# Leica Nova Series
## Technical Reference Manual

Version 2.1
**English**

- when it has to be **right**

# Introduction

**Purchase**

Congratulations on the purchase of a Leica SmartWorx Viva instrument.

☞ To use the product in a permitted manner, please refer to the detailed safety directions in the CS10/CS15 User Manual, the GS10/GS15 User Manual, the GS25 User Manual, the TS11 User Manual, the TS15 User Manual, the Leica TS12 Robotic User Manual and the Leica MS50/TS50/TM50 User Manual.

**Symbols**

The symbols used in this manual have the following meanings:

| Type | Description |
|---|---|
| ☞ | Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner. |

**Trademarks**

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
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**Validity of this manual**

- This manual applies to SmartWorx Viva. For the Lite version of SmartWorx Viva, some functionality described in this manual is not available.
- This manual applies to the Leica Viva Series. Differences between GPS and TPS are marked and described.

**Available documentation**

| Name | Description/Format | | |
|---|---|---|---|
| CS10/CS15 User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| GS10/GS15 User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| TS11 User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| GS25User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| TS15 User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| TS12 Robotic User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |
| TS12 Lite User Manual | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. | - | ✓ |

| Name | Description/Format | | |
|---|---|---|---|
| Viva Series Technical Reference Manual | Overall comprehensive guide to the product and application functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists. | - | ✓ |

**Refer to the following resources for all Leica Viva Series documentation/software:**

- the SmartWorx Viva USB documentation card
- https://myworld.leica-geosystems.com

# 1 Configurable Keys

## 1.1 Hot Keys

☞ Hot keys are found on the TS and on the CS15 model only. The CS10 model does not have any hotkeys.

**Description**

Two levels of hot keys exist:
- The first level is the keys **F7**, **F8**, ..., **F12** and **F13**, the user definable Smartkey.
- The second level is the combination of Fn and **F7**, **F8**, ..., **F12**.

**Functionality**

Hot keys provide a shortcut for quickly and directly carrying out functions or starting applications assigned to the keys. The assignment of functions and applications to hot keys is user configurable.

**Use**

- The first level is accessed by pressing **F7**, **F8**, ..., **F12** or **F13**, the user definable Smartkey, directly.
- The second level is accessed by pressing Fn first followed by **F7**, **F8**, ... **F12**.
- Hot keys can be pressed at any time. It is possible that a function or application assigned to a hot key cannot be executed in certain situations.

**Define hot key step-by-step**

This step-by-step description shows how to assign the **Coding & linework settings** screen to the **F7** key and to the first line of the **My GPS Favourites** or **My TPS Favourites** menu.

| Step | Description |
|---|---|
| 1. | Select **Main Menu: User\Work settings\Hot keys & favourites**. |
| 2. | **Hot Keys & Favourites**<br>For hot keys/Fn hot keys select **F7: User - Coding & linework settings**.<br>For favourites select **1: User - Coding & linework settings**. |
| 3. | **OK** |
| 4. | **OK** |
| 5. | Press **F7** to access **Coding & linework settings**.<br>OR<br>GPS Press the favourites key and 1 to access **Coding & linework settings**.<br>TPS Press Fn, the favourites key and 1 to access **Coding & linework settings**. |

**User definable Smartkey**

The user definable Smartkey is located next to the right hand fine drives. It enables fast and comfortable recording of measurements. Being equipped with a soft touch key located in the instruments turning axis allows highest precision measurements. All functions and application programs that can be assigned to the hot keys can be assign to the user definable Smartkey including **<None>**.

## 1.2 Favourites Key

**Description**

GPS

- Fn opens the **My GPS Favourites** menu.
- The key alone opens the **Leica GPS Favourites** menu.

TPS

- Fn opens the **My TPS Favourites** menu.
- The key alone opens **Leica TPS Favourites**.

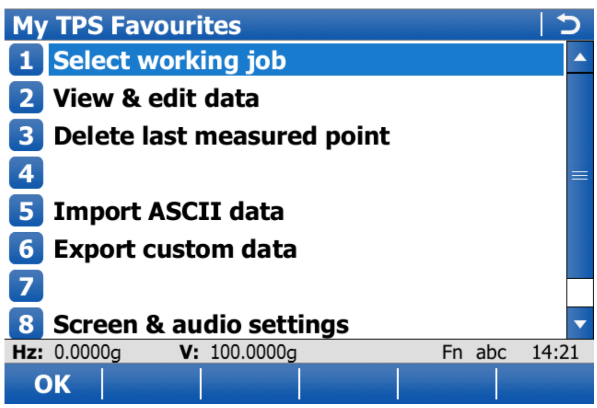
The following chapter is about the **My GPS Favourites** and **My TPS Favourites** menus only. Refer to **Leica TPS Favourites** for more information about **Leica TPS Favourites**.

**Functionality of the favourites menu**

The **My GPS Favourites** and **My TPS Favourites** menus can be configured to contain the most used functions or applications. The favourites menu cannot be accessed while in a configuration screen.
Selecting an option in the menu carries out the function or starts the application assigned to the option.

**My favourites menu**

The following screen is an example of what a **My GPS Favourites** or **My TPS Favourites** menu can look like. The softkeys and their order is fixed. The functions and applications which are assigned to the individual places in the menu can differ depending on the configuration.




| Key | Description |
|---|---|
| **OK** | To execute the selected function. |
| Fn **Quit** | To exit the screen. |

**Define favourites menu step-by-step**

Defining the favourites menu is the same process as for defining the hot keys. Refer to "1.1 Hot Keys".

# 2 TPS Settings TPS

## 2.1 Leica TPS Favourites

**Description**

Frequently used settings can be accessed and changed quickly. The change is applied immediately. The workflow is not interrupted.
This screen displays the possible settings to change to.

☞ Changes made on this screen are stored in the active working style.

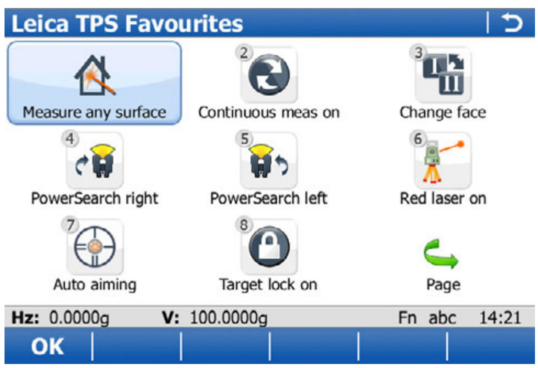
**Access**

Tap the target aiming icon or select .

**Leica TPS Favourites**

The appearance of the screen changes, depending on whether the instrument is equipped with motorisation, ATR, reflectorless EDM or PowerSearch.
To change to the displayed setting do one of the following:

- Tap on the icon on the touch screen.
- Highlight a field and press .
- Highlight a field and press OK.
- Highlight a field and press **OK**.
- Press the number next to the function.




| Key | Description |
|---|---|
| **OK** | To apply the selected setting, or to access the selected function. |
| Fn **Quit** | To exit the screen. |

#### Description of options

| Icon | Description |
|---|---|
| **Measure any surface** | To measure to any surface (reflectorless). Automatically sets **Target aiming**: **Manual**. |
| **Measure to prism** | To measure to prisms. |
| **Continuous meas on** | To set the measure mode to continuous. |
| **Continuous meas off** | To set the measure mode to the previous non-continuous mode. |
| **Change face** | To change the face of the telescope. |
| **PowerSearch right** | Prisms are searched for with PowerSearch in the PS window when this icon is used.<br>☞ If this icon is selected and reflectorless measurements is still set, then this setting is changed to measurements to prisms. |
| **PowerSearch left** | To start **PowerSearch right** in anti-clockwise direction. |
| **Red laser on** | To turn the red laser of the reflectorless EDM on. |
| **Red laser off** | To turn the red laser of the reflectorless EDM off. |
| **Auto aiming** | To set **Target aiming**: **Automatic**. |
| **Manual aiming** | To set **Target aiming**: **Manual**. |
| **Target lock on** | To set **Target aiming**: **Lock**. |
| **Target lock off** | To set **Target aiming** to the previous non-lock setting. |
| **Joystick** | To turn the instrument using the arrow keys. Refer to **Joystick**. |
| **Turn to Hz/V** | To turn the instrument to a specific entered position. Refer to **Turn Instrument to Hz/V**. |
| **Check point** | To check a point or the instrument orientation. Refer to **Check Point**. |
| **Compass** | To turn the instrument using compass readings. Refer to **Orientation With Compass**. |
| **Bluetooth connection** | To define Bluetooth connections. |
| **Camera** | To begin the camera function of the CS field controller. Refer to "2.6 Using the Digital Camera". |
| **Panoramic image** | To generate a panoramic image. Refer to "34.3.5 Panoramic Imaging".<br>☞ Panoramic images can only be generated with motorized instruments with overview camera. |
| **Sketch pad** | To create a sketch on a virtual piece of paper. Refer to "34.5.2 Field Sketching". |
| **Start Active Assist** | To connect to the Active Assist service. |
| **End Active Assist** | To disconnect from the Active Assist service. |

## 2.2 Check Point

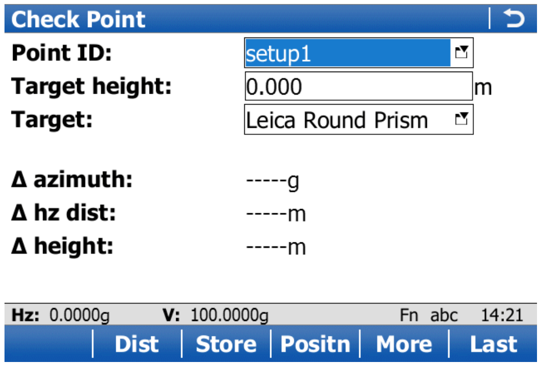
**Description**

This screen is used to check if a measured point is identical to a point already stored in the job, or if the instrument's orientation to a backsight point is still correct.

**Access**

In **Leica TPS Favourites** click **Check point**.

**Check Point**




| Key | Description |
|---|---|
| **Dist** | To measure a distance. |
| **Store** | To store the point and return to **Main Menu**. |
| **Positn** | To position to the selected point.<br>For **Target aiming**: **Automatic** the instrument does an ATR search.<br>For **Target aiming**: **Lock** the instrument tries to lock on to a prism. |
| **More** | To display additional information. |
| **Last** | To recall the point ID of the last checked point. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list | Point ID to be checked.<br>If a stored point was checked, the point ID for that point is remembered and recalled when **Last** is pressed. |
| **Target height** | Editable field | The last used prism height is suggested. An individual prism height can be typed in. |
| **Target** | Selectable list | Target names as configured in the **Targets** screen. |
| **Δ azimuth** | Display only | Difference between calculated azimuth and current orientation. |
| **Δ hz dist** | Display only | Difference between calculated and current distance. |
| **Δ height** | Display only | Difference between calculated and current height. |
| **Current azimuth** | Display only | Current orientation. |
| **Horiz distance** | Display only | Current distance between station and backsight point. |
| **Height difference** | Display only | Current height difference between station and backsight point. |
| **Calc'd azimuth** | Display only | Calculated azimuth between station and backsight point. |
| **Calc'd hz dist** | Display only | Calculated horizontal distance between station and backsight point. |
| **Calc'd Δheight** | Display only | Calculated height difference between station and backsight point. |

## 2.3 Joystick

**Description**

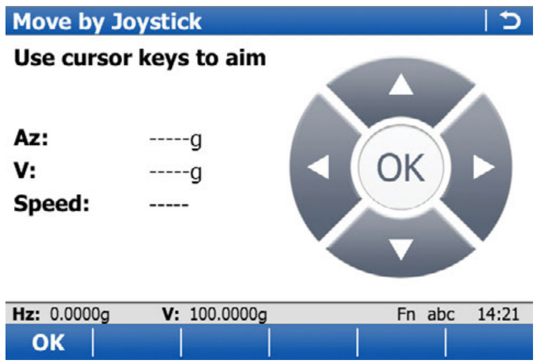
The instrument can be turned using the keyboard arrow keys on the instrument or field controller, or the arrow keys displayed on the touch screen.
When this screen is accessed, the EGL is turned on automatically. When leaving the screen, the EGL is turned off.

**Access**

In **Leica TPS Favourites** click **Joystick**.

**Move by Joystick**

Use the arrow keys to start the telescope movement.
Press an arrow key again to speed up the movement. Press any of the other arrow keys while the instrument turns to stop the movement.
Press **OK** to stop the instrument movement.




| Key | Description |
|---|---|
| **OK** | To return to **Main Menu**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Speed** | **-----**, **Very slow**, **Slow**, **Medium** and **Fast** | Displays the rotating speed of the instrument. Press the same arrow key to change the speed. |

## 2.4 Turn Instrument to Hz/V

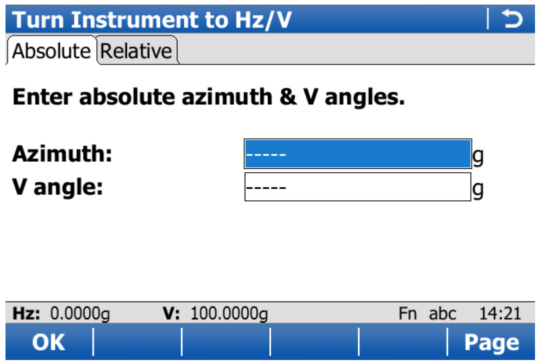
**Description**

This screen is used when the instrument is remote controlled and the telescope is to be turned to a certain direction.

**Access**

In **Leica TPS Favourites** click **Turn to Hz/V**.

**Turn Instrument to Hz/V, Absolute page**




| Key | Description |
|---|---|
| **OK** | To return to **Main Menu**. The instrument turns to the prism. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Azimuth** | Editable field | Oriented horizontal direction for the instrument to turn to. |
| **Angle right** | Editable field | Displays the horizontal angle difference between the backsight point and the current telescope position. |
| **V angle** | Editable field | Vertical direction for the instrument to turn to. |

**Next step**

**Page** changes to the **Relative** page.

**Turn Instrument to Hz/V, Relative page**

The values are added to the current telescope position to calculate the new direction for the telescope to turn to.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **ΔHz** | Editable field | Angular difference for the horizontal angle to turn to. |
| **ΔV** | Editable field | Angular difference for the vertical angle to turn to. |

**Next step**

Press **OK**. The instrument turns to the prism.

For **Target aiming: Automatic** an ATR measurement is performed. If no prism was found, the instrument turns to the position typed in.

For **Target aiming: Lock** the instrument locks on the prism and the LOCK icon is displayed. If no prism was found, the instrument turns to the position typed in.

## 2.5 Orientation With Compass

**Description**

Using a conventional magnetic compass while remotely controlling the instrument, it is possible to determine the direction towards which the instrument should turn to perform a target search to locate the prism.

**Access**

In **Leica TPS Favourites** press **Compass**.

☞ The instrument must be connected to a radio to be remote controlled with the field controller.

**Orientation with compass step-by-step**

| Step | Description |
|---|---|
| 1. | Set up the instrument. |
| 2. | Start the Survey application. |
| 3. | Turn the telescope until **Hz: 0.0000**. |
| 4. | Look through the telescope with **Hz: 0.0000** to select an object which is easily recognisable. |
| 5. | Standing at the instrument, point the compass to the selected object. Turn the rotating dial until the "N" lines up with the north end of the compass needle.<br>☞ The compass dial must not be turned once the "N" is lined up with the north end of the compass needle. |
| 6. | Go to the prism. From the prism aim the "N" of the compass towards the instrument. Read the horizontal angle as pointed to by the north end of the compass needle. |
| 7. | In **Leica TPS Favourites** click on the **Compass** icon. |
| 8. | **Orientation With Compass**<br>**Compass reading**: The horizontal angle read from the compass while aiming to the instrument.<br>**V angle**: If the compass works as a clinometer, those values can also be used.<br>☞ The horizontal and vertical angle reads from the compass are always displayed in degree regardless of the system settings. |
| 9. | **OK** to return to the survey screen. The instrument turns to the prism.<br>For **Target aiming: Automatic** an ATR measurement is performed. If no prism was found, the instrument turns to the position typed in.<br>For **Target aiming: Lock** the instrument locks on the prism and the LOCK icon is displayed. If no prism was found, the instrument turns to the position typed in. |

## 2.6 Using the Digital Camera

**Taking a picture step-by-step**

| Step | Description |
|---|---|
| 1. | Aim the camera to the desired target. |
| 2. | Check the view at the display. |
| 3. | Press **OK** or click **Capture** to take the picture.<br>☞ **Capture** changes to **Save**. |
| 4. | Press **OK** again or click **Save** to open the **Save As** dialog. |
| 5. | Click **Discard** to reject the picture. |

# 3 GNSS Settings

## 3.1 Leica GPS Favourites

**Description**

Frequently used settings can be accessed and changed quickly. The change is applied immediately. The workflow is not interrupted.
This screen displays the possible settings to change to.

☞ Changes made on this screen are stored in the active working style.

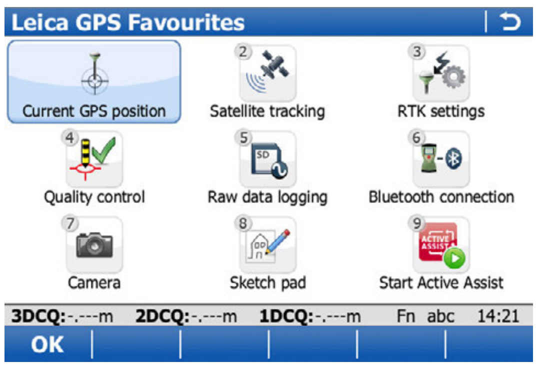
**Access**

Tap the position status icon or select .

**Leica GPS Favourites**

The appearance of the screen changes, depending on the RTK settings defined.
To change to the displayed setting do one of the following:

- Tap on the icon on the touch screen.
- Highlight a field and press .
- Highlight a field and press .
- Highlight a field and press **OK**.
- Press the number next to the function.




| Key | Description |
|---|---|
| **OK** | To apply the selected setting, or to access the selected function. Once leaving a screen, the system returns to the screen from where this screen was accessed.. |
| Fn **Quit** | To exit the screen. |

#### Description of options

| Icon | Description |
|---|---|
| **Current GPS position** | To open the status screen **Current GPS Position**. Refer to "22.5 Current GPS position". |
| **Satellite tracking** | To open the status screen **Satellite Tracking**. Refer to "22.3 Satellite tracking". |
| **RTK data link status** | Available when RTK is configured. Opens the status screen **RTK Data Link Status** or **RTK Data Link Status (RTK1)**/**RTK Data Link Status (RTK2)**. Refer to "22.4 RTK data link status". |
| **RTK settings** | To open the configuration screen **RTK Rover Settings** or **RTK base settings (RTK1)**/**RTK base settings (RTK2)**. Refer to "19.7 RTK Rover" and "19.8 Base RTK 1 / Base RTK 2". |
| **Load RTK profile** | To load an existing profile via the **RTK Rover Wizard**. Refer to "13.1 RTK rover wizard". |
| **Radio ch. / dial-up** | To open the configuration screen **Radio Configuration**. Refer to "20.3 Radios for GPS Real-Time". |
| **Start RTK stream**<br>**Stop RTK stream** | To start streaming RTK data.<br>To stop streaming RTK data. |
| **Quality control** | To open the configuration screen **Quality Control**. Refer to "13.4 Quality control". |
| **Raw data logging** | To open the status screen **Raw Data Logging Status**. Refer to "22.6 Raw data logging". |
| **Bluetooth connection** | To define Bluetooth connections. |
| **Camera** | To begin the camera function of the CS field controller. Refer to "2.6 Using the Digital Camera". |
| **Sketch pad** | To create a sketch on a virtual piece of paper. Refer to "34.5.2 Field Sketching". |
| **Start Active Assist**<br>**End Active Assist** | To connect to the Active Assist service.<br>To disconnect from the Active Assist service. |

# 4 Main Menu

## 4.1 Main Menu Functions

**Main Menu**


| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| **Map** | To open **Tap Map**. Refer to "39 Tap Map". |
| Fn **Mode** | To switch between GPS and TPS mode. |
| Fn **Exit** | To close Leica SmartWorx Viva software. |

| Icon | Description |
|---|---|
|  | Software maintenance is close to due date or has expired. The reminder message has previously been confirmed with **OK**. The icon will disappear when licence keys are entered manually or uploaded from a file. Refer to "30.3 Load licence keys". |

**Description of the main menu functions**

| Main menu function | Description | Refer to chapter |
|---|---|---|
| **Go to Work!** | To select and start an application. | "4.2 Go to Work!" |
| **Jobs & Data** | To manage jobs and data, as well as import and export. Available in SmartWorx when operating an RTK rover or a TPS. | "4.3 Jobs & Data" |
| **Instrument** | To access settings regarding GPS and instrument connections as well as status information. | "4.4 Instrument" |
| **User** | To make settings regarding the software and the display as well as other useful tools. Available in SmartWorx when operating an RTK rover or a TPS. | "4.5 User" |

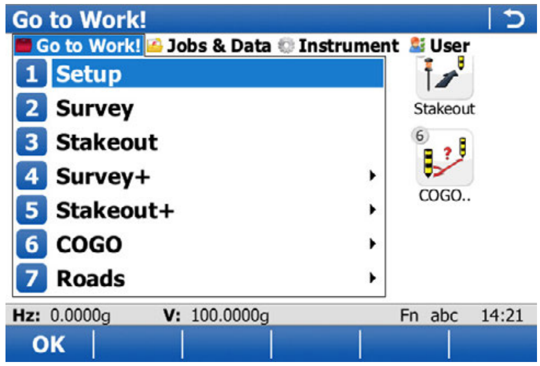
## 4.2 Go to Work!

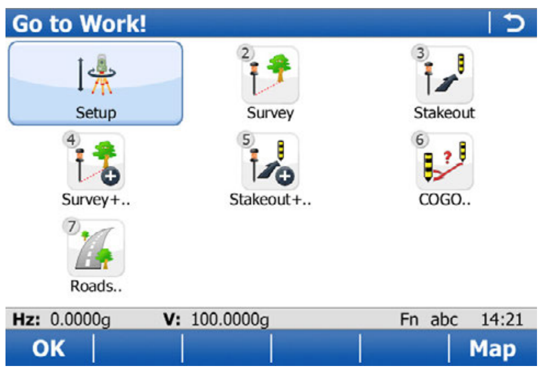
**Description**

The **Go to Work!** menu contains all loaded applications. Selecting an option in the menu starts the application. Configurations and measurements that can be performed depend on the application.

☞ The menu can be displayed as drop-down menu or as icon menu. To change between both options go to **User\System Settings\SmartWorx options**. Change to the **General** page and check or uncheck **Use drop down menus in the main menu**.

**Go to Work!**




| Key | Description |
|---|---|
| **OK** | To start the highlighted application or to open a submenu. |

**Next step**

Refer to **Applications - General** for information on the applications.

## 4.3 Jobs & Data

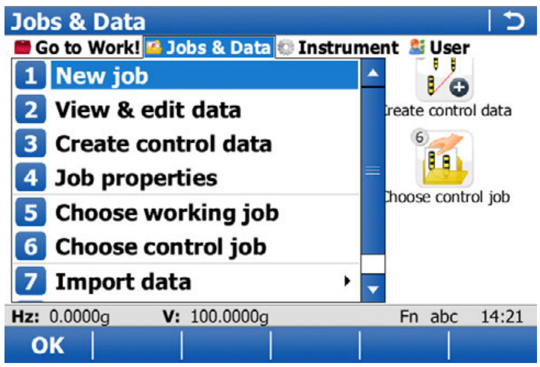
**Description**

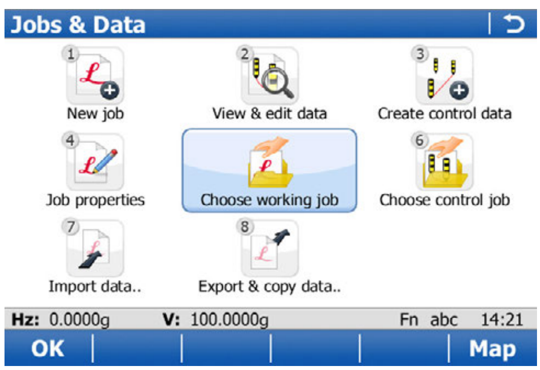
**Jobs & Data** is available in SmartWorx when operating an RTK rover or a TPS. It is used to:

- Create a new job.
- Select a job.
- View job properties.
- View and edit data.
- Import data.
- Export and copy data.

☞ The menu can be displayed as drop-down menu or as icon menu. To change between both options go to **User\System Settings\SmartWorx options**. Change to the **General** page and check or uncheck **Use drop down menus in the main menu**.

**Jobs & Data**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |

**Next step**

| | |
|---|---|
| **New job** | Refer to chapter 5.2. |
| **View & edit data** | Refer to chapter 6. |
| **Create control data** | Refer to chapter 9. |
| **Job properties** | Refer to chapter 5.3. |
| **Choose working job** | Refer to chapter 5.4. |
| **Choose control job** | Refer to chapter 5.4. |
| **Import data** | Refer to chapter 10. |
| **Export & copy data** | Refer to chapter 11. |

## 4.4 Instrument

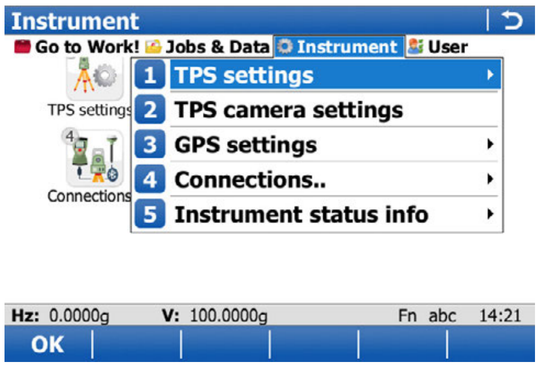
**Description**

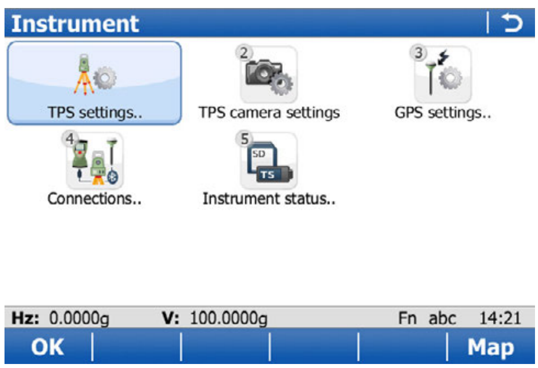
**Instrument** is used to:

- Configure parameters related to the instrument.
- Configure parameters related to the interfaces.
- Check status information.

The menu can be displayed as drop-down menu or as icon menu. To change between both options go to **User\System Settings\SmartWorx options**. Change to the **General** page and check or uncheck **Use drop down menus in the main menu**.

**Instrument**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |

**Next step**

| | |
|---|---|
| **GPS settings** | Refer to chapter 13. |
| **TPS settings** | Avialable for TPS. Refer to chapter 13. |
| **Base settings** | Available in SmartWorx when operating an RTK base. Refer to chapter 22. |
| **Connections..** | |
| • **GPS connection wizard** | Refer to chapter 13.1. |
| • **TPS connection wizard** | Avialable for TPS. Refer to chapter 13. |
| • **All other connections** | Refer to chapter 19. |
| **Base connections** | Available in SmartWorx when operating an RTK base. Refer to chapter 22. |
| **Instrument status info** | Available in SmartWorx when operating an RTK rover or a TPS. Refer to chapter 22. |
| **Base status info** | Available in SmartWorx when operating an RTK base. Refer to chapter 22. |
| **TPS camera settings** | Refer to "34.2 Instrument - TPS camera settings". |

## 4.5 User

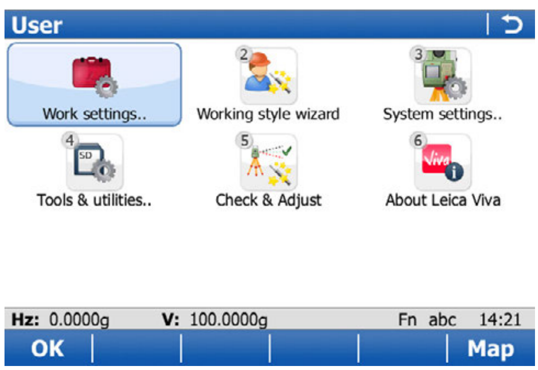
**Description**

**User** is available in SmartWorx when operating an RTK rover or a TPS. It is used:

- To configure user favourite settings for the survey and the instrument.
- For functionality which is not directly related to surveying data, such as loading firmware or licence keys, format data storage devices and viewing ASCII files.

The menu can be displayed as drop-down menu or as icon menu. To change between both options go to **User\System Settings\SmartWorx options**. Change to the **General** page and check or uncheck **Use drop down menus in the main menu**.

**User**


| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |

**Next step**

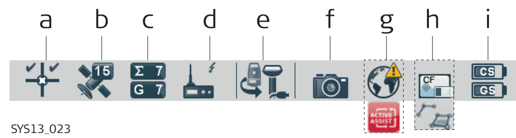
| | |
|---|---|
| **Work settings** | Refer to chapter 25. |
| **Working style wizard** | Refer to chapter 28. |
| **System settings** | Refer to chapter 29. |
| **Tools & other utilities** | Refer to chapter 30. |

**Description**

The screen icons display the status information of the instrument.

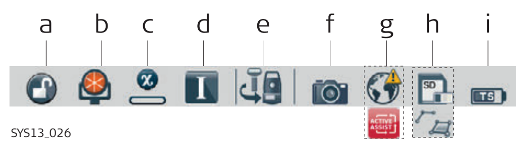
☞ The icons provide information related to basic instrument functions. The icons that appear depend upon which instrument is used and the current instrument configuration.

**Icon bar - GNSS Mode**



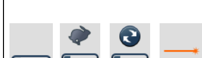

a) GNSS position status
b) Number of visible satellites
c) Number of satellites contributing to position solution
d) Real-time device and real-time status
e) Current active instrument
f) Camera
g) Internet online status (CS field controller), Active Assist service or Leica Exchange service
h) Memory storage (SD card/CompactFlash card/USB stick/internal memory) or Line/area/auto points
i) Battery level (field controller/instrument)

**Icon bar - TPS Mode**




a) Automatic aiming
b) Prism
c) Measure mode
d) Instrument face I&II/Compensator level
e) Current active instrument
f) Camera
g) Internet online status (TPS instrument), Active Assist service or Leica Exchange service
h) Memory storage (SD card/USB stick/internal memory) or Line/area/auto points
i) Battery level (field controller/instrument)

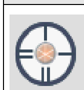
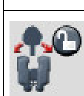
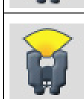
**TPS specific icons**

| Icon | Description |
|---|---|
| Automatic aiming  | Displays the current automatic aiming or PowerSearch settings. |
| Prism  | Displays the selected prism. |
| Measure mode  | Displays the selected measurement mode. The red laser icon will display when the red laser is active. |
| Compensator level and Instrument face I or II  | Displays the compensator is off or out of range icons, or the instrument face I or II icon. |

## GNSS specific icons

| Icon | Description |
|---|---|
| Position status  | Displays the status of the current position. As soon as this icon becomes visible the instrument is in a stage where practical operation can commence. |
| Number of visible satellites  | Displays the number of theoretically visible satellites above the configured cut-off angle according to the current almanac. |
| Contributing satellites  | Displays the number of satellites that are contributing to the currently computed position solution.<br>☞ The number of contributing satellites can differ from the number of visible satellites. This difference can be because satellites cannot be viewed, or because the observations to these satellites are considered too noisy to be used. |
| Real-time device  | Displays the real-time device configured to be used. |
| Real-time status  | Displays the status of the real-time device configured to be used. |

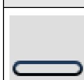
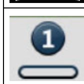
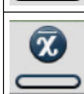
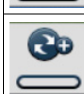
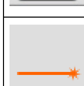
## Automatic aiming

| Icon | Description |
|---|---|
|  | The instrument is in Auto Aiming mode using ATR. |
|  | The instrument is in manual aiming mode |
|  | The instrument is in target lock mode, however not following a prism at current. Lock Status: Unlocked. |
|  | The instrument is in target lock mode, following a prism at current. Lock Status: Locked. |
|  | The **Visibility** setting in **Measure & Target Settings** is set to **Rain & fog**. This setting ensures better performance under unfavourable visibility conditions. |
|  | The **Visibility** setting in **Measure & Target Settings** is set to **Sun & reflections**. This setting ensures better performance under sunny conditions with reflexions. |
|  | The instrument is in prediction or locking on the fly is activated. The instrument will lock towards a prism coming into the field of view and follow this prism. |
|  | The prediction time has elapsed. The instrument beeps and the EGL is blinking.The instrument will lock towards a prism coming into the field of view and follow this prism. |
|  | Searching for the prism using **Auto aiming**. |
|  | Searching for the prism using **PowerSearch**. |

## Prism

| Icon | Description |
|---|---|
|  | Leica circular prism |
|  | Leica 360° prism |
|  | Leica mini prism |
|  | Leica mini 0 |
|  | Leica mini 360° |
|  | Leica Machine Automation power prism MPR122 |
|  | Leica reflective tape or HDS target. |
|  | Reflectorless |
|  | User defined prism |

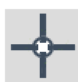
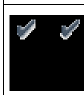
## Measure mode

| Icon | Description |
|---|---|
|  | No active distance measurement |
|  | Distance measurement active |
|  | Measure mode **Single** |
|  | Measure mode **Single (fast)** |
|  | Measure mode **Continuous** |
|  | Measure mode **Averaging** |
|  | Measure mode **Continuous+** |
|  | Measure mode **Long range (>4km)** |
|  | Measure mode **Long range avg** |
|  | Red laser is turned on |

**Compensator level and instrument face I or II**

| Icon | Description |
|---|---|
|  | Compensator is turned off. |
|  | Compensator is turned on, but is out of range. |
|   | The current face of the instrument is shown, if the compensator and the Hz-correction are turned on. |

**Position status**

| Icon | Description |
|---|---|
|  | Navigation position available |
|  | Code solution available |
|  | Fixed position available |
|  | xRTK fixed position available |
|  | Precise mode |
|  | The ticks indicate that an ambiguity check is being made. |

**Number of visible satellites**

| Icon | Description |
|---|---|
|   | The number of visible satellites. |

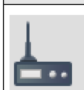
**Contributing satellites**

| Icon | | Description |
|---|---|---|
| **When a position status icon is displayed then** | | |
| Σ 9<br>G 8 | | the number of satellites currently used for the position computation are shown. |
| **If no position is currently available then** | | |
| L1 9<br>L2 9 | L5 9 | • the L1, L2 and L5 values (GPS only) show how many satellites are being tracked. OR |
| Σ 9<br>G 8<br><br>Σ 9<br>E 1 | Σ 9<br>R 1<br><br>Σ 9<br>B 1 | • the sum and G (GPS), R (GLONASS), E (Galileo) or B (BeiDou) values show how many satellites are being tracked. |

☞ The number of contributing satellites can differ from the number of visible satellites. This may be either because satellites cannot be viewed or the observations to these satellites are considered to be too noisy to be used in the position solution.

☞ The number of contributing GLONASS satellites could be zero if five or more GPS satellites are used for the position computation. The processing algorithm automatically selects the best possible set of satellite combinations for the position computation. A position computation with R = 0 is certainly within the specified reliability.

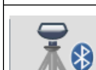
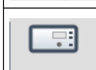
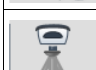
**Receive RTK corrections using**

| Icon | | Description |
|---|---|---|
|  | | Radio |
|  | | Digital cellular phone/modem |
|  | | SBAS/WAAS/EGNOS/MSAS/GAGAN/SmartLink |
|  | | CGR10/CGR15 |
|  | | NTRIP |
|  | | RS232 |
|  |  | Indicates a connection error. |

## Real-time status

| Icon | Description |
|---|---|
|  | An arrow pointing down indicates a real-time rover configuration. The arrow flashes when real-time messages are received. |
|  | An arrow pointing up indicates a real-time base configuration. The arrow flashes when real-time messages are sent. |
|  | Sending/receiving data |
|  | Raw data logging active |
|  | Synchronization active |

## Current active instrument

| Icon | Description |
|---|---|
|  | TS instrument |
|  | TS with cable |
|  | GS rover instrument |
|  | GS rover with cable |
|  | TS and GS rover connected via cable. The instrument in the foreground is used first. |
|  | TS and GS rover connected via Bluetooth. The instrument in the foreground is used first. |
|  | GS base with active Bluetooth connection |
|  | CS with GS05 used |
|  | TS and CS used |
|  | GS25 used |
|  | GS25 with cable connection |
|  | GS base and GS25 connected via cable |
|  | GS12 rover instrument |
|  | GS12 rover connected via cable |
|  | GS12 base |
|  | Caution. Connection between CS and GS via Bluetooth is not established. |

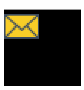
**Camera**

| Icon | Description |
|---|---|
|  | To capture an image with the camera |
|  | Image capture in progress |

**Internet online status**

| Icon | Description |
|---|---|
|  | Instrument is online in the Internet. |
|  | Internet not connected. |

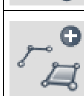
**Leica Exchange service**

| Icon | Description |
|---|---|
|  | Logged into Leica Exchange. |
|  | Data upload in progress. |
|  | Data download in progress. |
|  | Exchanging new data. |
|  | Data transfer problem. |

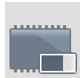
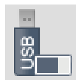
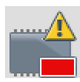
**Active Assist service**

| Icon | Description |
|---|---|
|   | Active Assist is active. Leica technical support can gain remote access to the instrument. |

**Data management**

| Icon | Description |
|---|---|
|  | To access data management where lines/areas can be opened/closed. |
|  | At least one line is open. |
|  | At least one area is open. |
|  | At least one line and one area are open. |

**Memory storage**

| Icon | Description |
|---|---|
|  | Internal memory. Sufficient memory space available. |
|   | CompactFlash card is inserted and can be removed. Sufficient memory space available. |
|   | Secure Digital Memory card is inserted and can be removed. Sufficient memory space available. |
|   | USB stick is inserted and can be removed. Sufficient memory space available. |
|   | The memory device is inserted and cannot be removed. It is strongly recommended not to remove the memory device to avoid loss of data. |
|        | Memory device full |

**Battery**

| Icon | Description |
|---|---|
|   | A CS internal battery is inserted and in use. Sufficient power available. |
|   | A GS internal battery is inserted and in use. Sufficient power available. |
|   | A TS internal battery is inserted and in use. Sufficient power available. |
|   | Power level is getting low. |
|   | Power level is getting low. |
|  | Battery empty. Instrument turns off immediately. |

# 5 Jobs & Data - Jobs

## 5.1 Overview

**Description**

Jobs

- structure surveying projects.
- contain all points, lines, areas and codes that are measured/recorded and stored.
- can be downloaded to LGO for post-processing or for data transfer to a further program.
- can be uploaded from LGO, for example, for (real-time) stakeout operations.
- can be stored on the data storage device or, if fitted, the internal memory.

**Type of jobs**

- Data jobs. Explained in this chapter.
- DTM files. Refer to "54.6 Staking Out a DTM or Points & DTM".
- Road alignment files.

**Default job**

A job called **Default** is available on the instrument after: formatting the memory device, inserting a previously formatted data storage device or deleting all jobs from **Job properties**.

**Working job**

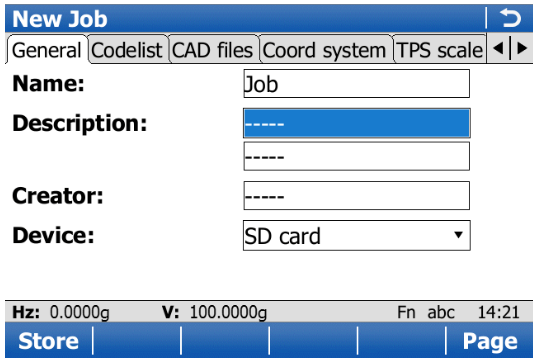
The working job is the one data is stored to. One job is always considered the working job. After formatting the memory device, the job **Default** is used until a user-defined job is created and selected.
When a job becomes the working job, then the sort and filter settings of this job are saved in the SystemRAM. If the data storage device is formatted then these last used sort and filter settings are used for the job **Default**.

## 5.2 Creating a New Job

**Access**

Select **Main Menu: Jobs & Data\New job.**

**New Job, General**




| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new job. The name can be up to 16 characters long and include spaces. Input required. |
| **Description** | Editable field | Two lines for a detailed description of the job, for example, work to be performed or the classes contained in the job. Input optional. |
| **Creator** | Editable field | The person's name who is creating the job. Input optional. |
| **Device** | Selectable list | The device on which the new job will be stored. Depending on the instrument options, this may be a display only field. |
| **Use with System1200** | Check box | When this box is checked, the job can be used on System 1200 instruments. The setting of this check box is remembered until changed manually. |

**Next step**

**Page** changes to the **Codelist** page.

**New Job, Codelist page**

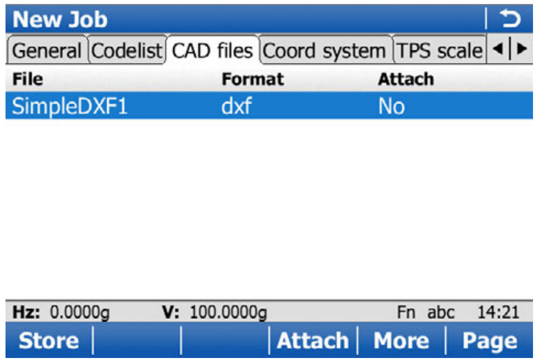
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Codelist** | Selectable list | Choosing a codelist copies the codes to the job. |

**Next step**

**Page** changes to the **CAD files** page.

**New Job, CAD files page**




| Key | Description |
|---|---|
| **Store** | To store the settings. Selected and attached CAD files will be available in the job as background maps. |
| **Unit** | To change between the options in the **Unit** column. Available when the **Unit** column is visible after using the **More** key.<br>The default value for the units depends on the selection in **Regional Settings**, **Distance** page. If the regional settings units are inches or miles, then the default cad file units are feet. If the regional settings are kilometer, then the default settings for cad files are meters. |
| **Attach** | To attach a CAD file from the \DATA folder of any data storage device. The new job and the CAD file need not be on the same data storage device. The setting in the **Use** column will be updated. CAD heights are supported. |
| **More** | To display information about the format, size, source and units. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Description |
|---|---|
| **File** | The name of the CAD files available in the \DATA directory of any data storage device. |
| **Format** | The format of the CAD file: dxf, shp or Leica for CAD files that are already attached to other jobs and converted to Leica format. |
| **Size (MB)** | The size of the CAD file in megabytes. |
| **Source** | The memory device where the CAD file is stored. |
| **Unit** | The units used for the CAD file. |
| **Use** | If set to **Yes**, the file is attached to the job when **Store** is pressed. |

### Next step

**Page** changes to the **Coord system** page.

**New Job, Coord system page**

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Coord system** | Selectable list | Choosing a coordinate system attaches it to the job. If it is not known which coordinate system to use, select **Coord system**: **WGS 1984**. |
| All other fields on this screen are display only fields. They depend on the transformation type of the selected coordinate system. | | |

#### Next step

GPS **Page** changes to the **Averaging** page.

TPS **Page** changes to the **TPS scale** page.

**New Job, Averaging page**

In order to check measurements, the same point can be measured more than once. If activated, an average or an absolute difference is calculated.

#### Description of fields

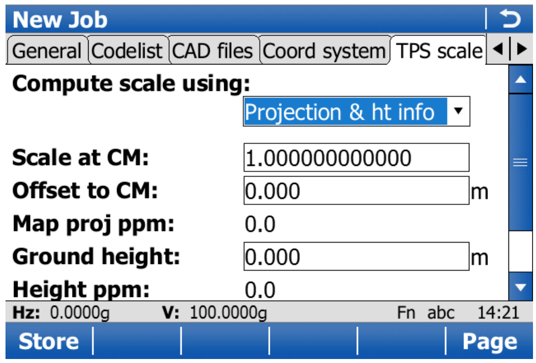
| Field | Option | Description |
|---|---|---|
| **Mode** | | Defines the averaging principles for multiple measured points. The selection determines the availability of the subsequent fields for setting the acceptable averaging limits or absolute differences. |
| | **Average** | Computes the average for the position and the height. Points exceeding the defined limits are marked with **!** in **Edit Point:**, **Mean** page. |
| | **Absolute differences** | Computes the absolute differences between two points selected from a list of measured points which are all stored with the same point ID. |
| | **Off** | Averaging is turned off. No other fields are available. |
| **Method** | | The method used for computing the average. Available for **Mode**: **Average**. |
| | **Weighted** | Calculates a weighted average |
| | **No weighting** | Calculates an arithmetic average. |
| **Points to use** | Selectable list | The type of points which will be taken into account for averaging or absolute differences. Available for **Mode**: **Average** and **Mode**: **Absolute differences**. |
| **Limit in position** and **Limit in height** | Editable field | The acceptable difference for the position and height components. Available for **Mode**: **Average**. |
| From **Easting** to **Cartesian Z** | Editable fields | The acceptable absolute differences for each coordinate component. Available for **Mode**: **Absolute differences**. |

#### Next step

**Store** creates a new job.

**New Job,**
**TPS scale page** TPS

The geometric distance correction (geometric ppm) is derived from the map projection distortion (map projection ppm), the height above reference datum correction (height ppm) and an individual correction (individual ppm).
The calculation of the map projection ppm follows the formula for the Transversal Mercator Projection. The individual factors are: the scale factor of the line of projection central meridian, Gauss-Krüger = 1.0, UTM = 0.9996, etc. and the offset from the line of projection.
The calculation of the height ppm is derived from the height of the instrument station above the reference datum. Normally this is the height above mean sea level MSL.




| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **SF/ppm** | To change between entering the scale factor or the ppm. Only available for **Compute scale using:SF/GeoPPM**. |
| **ppm=0** | To set **Geometric ppm: 0.0**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Compute scale using** | **Projection & ht info** | To enter all values for determining the geometric ppm. |
| | **SF/GeoPPM** | To enter only the scale factor or the geometric ppm value. |
| | **Stn & coord system** | To automatically calculate the ppm/scale factor from the coordinate system and station position. |
| **Scale at CM** | Editable field | The scale at the central meridian.<br>Available for **Compute scale using: Projection & ht info**. |
| **Offset to CM** | Editable field | The offset to the central meridian.<br>Available for **Compute scale using: Projection & ht info**. |
| **Map proj ppm** | Display only | The map projection ppm value. If this value cannot be calculated, then **-----** is displayed and is also ignored in the calculation of the geometric ppm value.<br>Available for **Compute scale using: Projection & ht info** and **Compute scale using: Stn & coord system**. |
| **Ground height** | Editable field | The height of the instrument station above the reference datum.<br>Available for **Compute scale using: Projection & ht info**. |
| **Height ppm** | Display only | The height ppm value calculated from the height coordinates of the current station stored in the internal memory. If this value cannot be calculated, then **-----** is displayed and is also ignored in the calculation of the geometric ppm value.<br>Available for **Compute scale using: Projection & ht info** and **Compute scale using: Stn & coord system**. |
| **User entered ppm** | Editable field | The individual ppm value.<br>Available for **Compute scale using: Projection & ht info** and **Compute scale using: SF/GeoPPM**. |
| **Geometric ppm** | Display only | For **Projection & ht info**:<br>**Geometric ppm** =<br>**Map proj ppm** + **User entered ppm** + **height ppm value calculated fromGround height**.<br>For **Stn & coord system**:<br>**Geometric ppm** =<br>**Map proj ppm** + **Height ppm**. |
| **User entered scale factor** | Editable field | The user entered scale factor.<br>**Compute scale using: SF/GeoPPM**. |

### Additional calculation method for the geometric ppm value

The geometric ppm value can also be calculated by a resection calculation. The scale factor from the resection is used for **User entered ppm**.

Individual ppm=(s-1)*106.s=1+ppm*10$^{-6}$. The **Geometric ppm** value is calculated with the following:

- **Scale at CM: 1**,
- **Offset to CM: 0**,
- **Map proj ppm: 0** and
- **Ground height: 0**.

### Automatic calculation of the geometric ppm value

When **Compute scale using: Stn & coord system**:

- the ppm values for Map Proj ppm, Height ppm and Geometric ppm are automatically calculated. The coordinates of the current instrument station stored in the internal memory are used, which are based on the currently active coordinate system.
- each time an application is accessed, the geometric ppm value is automatically calculated. The coordinates of the current instrument station stored in the internal memory are used (these coordinates may have been updated), which are based on the currently active coordinate system (this coordinate system may have changed). This way, the user is always working with the correct geometric ppm value.
- when the **<None>** coordinate system is chosen, then the geometric ppm value cannot be automatically calculated. A message will appear, allowing the user to either manually enter the ppm values or accept ppm values of 0.

### Next step

**Page** changes to the **Averaging** page.

## 5.3 Job Properties and Editing a Job

**Description**

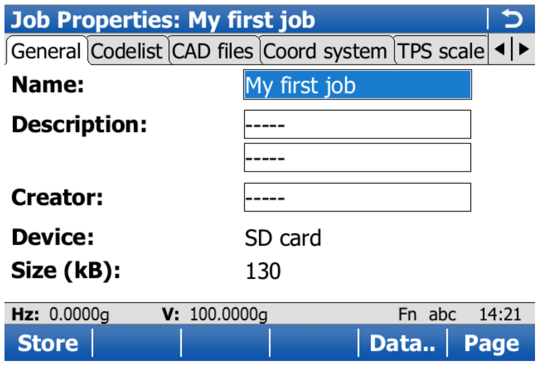
In the **Job Properties:**, the settings for a job can be viewed and changed.

**Access**

Select **Main Menu: Jobs & Data\Job properties.**

**Job Properties:, General page**

The fields on this page are identical with the fields in **New Job**, **General**. Refer to "5.2 Creating a New Job".

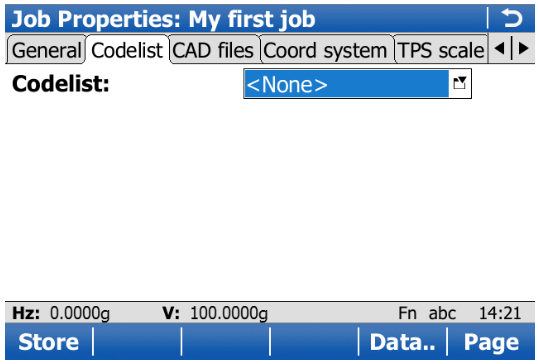



| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **Data..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply. |
| **Page** | To change to another page on this screen. |
| Fn **Log..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Page** changes to the **Codelist** page.

**Job Properties:, Codelist page**




| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **Import** | To add additional codes from a new codelist to the job. The name of this codelist is copied to the job. |
| **Codes..** | To view codes currently stored in the job. Refer to "5.5 Managing Job Codes". |
| **Data..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply. |
| **Page** | To change to another page on this screen. |
| Fn **Log..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list. |
| Fn **Export** | To copy codes from the job to an existing or new codelist. |
| Fn **Quit** | To exit the screen. |

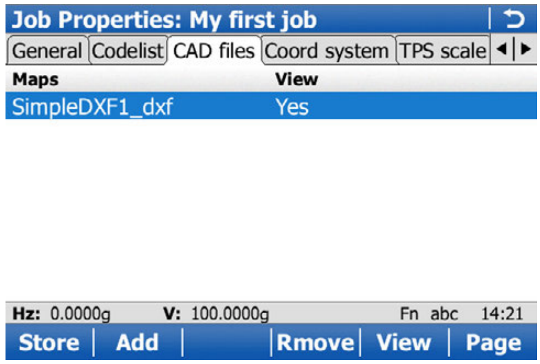
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Codelist** | **<None>** | No codes are stored in the job.<br>This default setting can be changed. Choosing a codelist copies the codes to the job. |
| | Display only | Codes are stored in the job.<br>If codes had been copied from a codelist in the internal memory, the name of the codelist is displayed. If codes have been typed in, then the name of the working job is displayed. |

### Next step

**Page** changes to the **CAD files** page.

**Job Properties:, CAD files page**




| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **Add** | To select a CAD file to be added to the job properties. The screen that opens is very similar to **New Job**, **CAD files** page. Refer to "5.2 Creating a New Job" for a description of the screen.<br>Only the files that are currently not attached to the job are displayed in the **CAD Files** screen. The files listed are all dxf, shp files and mpl files from the \Data directory on a data storage device or in the internal memory. If an mpl file is selected, then this file, including all related files, is copied to the appropriate job folder. |
| **Rmove** | To delete the highlighted Map file from the job.<br>☞ If deleted accidentally, the file must be attached again. |
| **View** | To change the setting in the **View** column. |
| **Page** | To change to another page on this screen. |
| Fn **Layrs..** | To change to the CAD layers screen. On this screen, it is possible to make layers from the CAD file visible or invisible for MapView. |
| Fn **Log..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list. |
| Fn **Quit** | To exit the screen. |

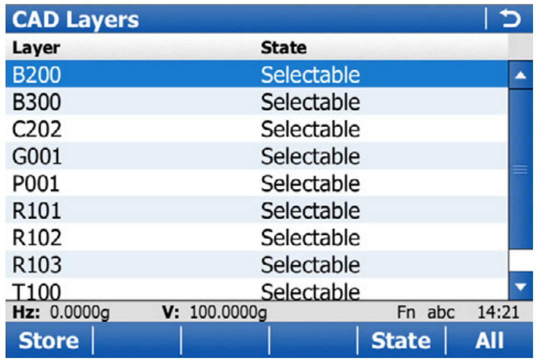
**Description of columns**

| Column | Description |
|---|---|
| **Maps** | The name of the CAD files that can be used.<br>The files displayed are the converted Leica Map files (*.mpl) within the job. The original file extension is added to the file name with an underscore, for example example_dxf. |
| **View** | If set to **Yes**, the map is visible as background maps in MapView. |

**Next step**

| IF you want to change to | THEN |
|---|---|
| another page | **Page** changes to the **Coord system** page and the **Averaging** page and for TPS also to the **TPS scale** page. The functionality on all pages is identical with the creation of a new job. Refer to "5.2 Creating a New Job"<br>If the coordinate system of the working job is edited, and **Use auto coordinate system** has been selected in the **RTK Rover Wizard**, a message will display requesting confirmation to deactivate auto coordinate system. |
| the **CAD Layers** page | press Fn **Layrs...** Refer to "CAD Layers". |

## CAD Layers




| Key | Description |
|---|---|
| **Store** | To store the settings. |
| **State** | To change between the options in the **State** column of the highlighted layer.<br>☞ Shapefiles are not displayed on this screen. Shape files are only displayed in **Job Properties:**, **CAD files** page. |
| **All** | To make all layers have the same state as the currently highlighted layer. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Description |
|---|---|
| **Layer** | The name of the layer.<br>For dxf files, all layers are listed, no matter if the layer is filled or empty. |
| **State** | The state of the layer:<br>• **Hidden**<br>These layers are not shown on the **Map** page and their positions are not used when zooming to extents. Nothing in these layers can be selected.<br>• **Visible**<br>These layers are shown on the **Map** page and their positions are used when zooming to extents. Nothing in these layers can be selected. Empty dxf layers can be set to visible.<br>• **Selectable**<br>These layers are shown on the **Map** page and their positions are used when zooming to extents. Objects on these layers are available to be selected. |

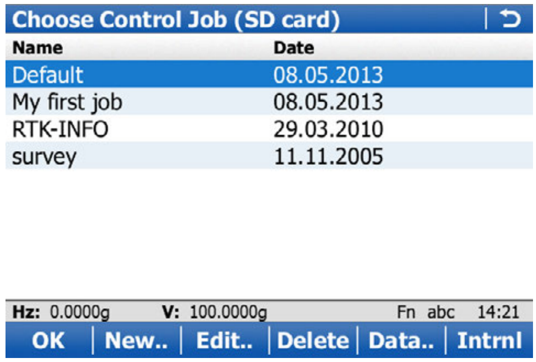
## 5.4 Choosing a Job

**Access**

- For a working job, where measured points are stored to, select **Main Menu: Jobs & Data\Choose working job.**
- For a control job with control points, select **Main Menu: Jobs & Data\Choose control job.**

**Choose working job**

Listed are all data jobs stored on the data storage device or in the internal memory depending on the current device.




| Key | Description |
|---|---|
| **OK** | To select the highlighted job and to return to the screen from where this screen was accessed. |
| **New..** | To create a job. Refer to "5.2 Creating a New Job". |
| **Edit..** | To edit the highlighted job. Refer to "5.3 Job Properties and Editing a Job". |
| **Delete** | To delete the highlighted job, including all map files from attached CAD files. |
| **Data..** | To view, edit and delete points, lines, areas, images and scans stored with the job. Points, lines, areas, images and scans are shown on separate pages. Selected sort and filter settings apply. |
| **CF card**, **SD card** or **Intrnl** | To change between viewing jobs stored on another data storage device or internal memory. |

# 5.5 Managing Job Codes

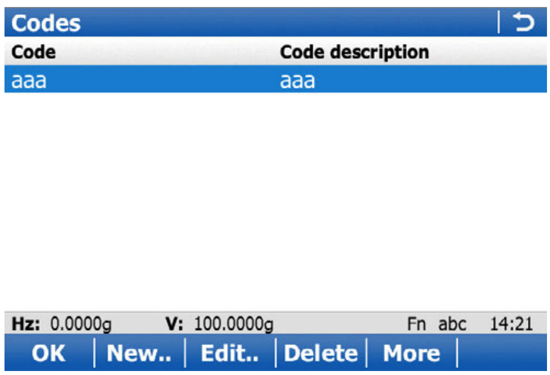
**Description**

Available for jobs which have a codelist attached. To view, edit, group and sort all codes currently stored in the job. The functionality of this screen is mainly the same as for **Main Menu: Jobs & Data\New job, Codelist**. For simplicity, the functionality which is different for **Main Menu: Jobs & Data\Job properties, Codelist** is explained here. Refer to "7.4 Managing Codes" for information on **Main Menu: Jobs & Data\New job, Codelist**.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\Job properties.**<br>OR<br>Select **Main Menu: Jobs & Data\Choose working job** or **Choose control job**. **Edit..** to access **Job Properties:**. |
| 2. | **Page** until the **Codelist** page is active. |
| 3. | **Codes..** to access **Job Codes**. |

**Job Codes**

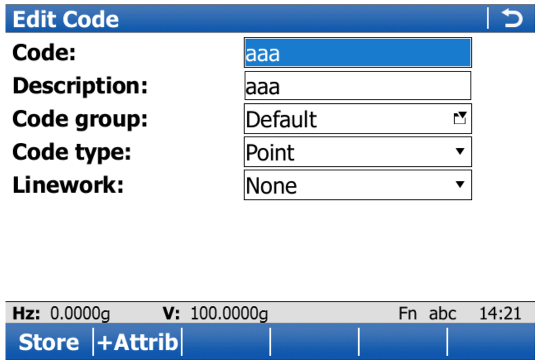



| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **New..** | To create a new code. Refer to "7.4.2 Creating/Editing a Code". |
| **Info** | To edit the highlighted code. Accesses **Edit Code** where new attributes can be added to a code and line styles can be changed. |
| **More** | To display information about the code group, the code type, the code description and the quick codes if available. |
| Fn **Group** | To access **Code Groups**. To view, create, activate and deactivate code groups. Refer to "7.5 Managing Code Groups". |
| Fn **Sort** | To access **Sort Codes**. To sort codes by code name, code description, quick code or last used. |
| Fn **Quit** | To exit the screen. |

### Next step

| IF | THEN |
|---|---|
| the job codes do not need to be changed | **OK** closes the screen. |
| a new job code is to be created | **New..**. Refer to "7.4.2 Creating/Editing a Code". |
| an existing job code is to be edited | highlight the job code and **Info**. |

## Edit Code




| Key | Description |
|---|---|
| **Store** | To store the code including any newly created attributes. |
| **+Attrib** | To add a new attribute to a code. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. |
| Fn **Quit** | To exit the screen. |

The behaviour of this screen varies with the type of code to be edited. The differences are explained in the table.

| Type of code | Description |
|---|---|
| **Point codes** and **Free codes** | New attributes can be added with **+Attrib**. |
| **Line codes** and **Area codes** | • New attributes can be added with **+Attrib**.<br>• The line style can be changed. This new line style is stored to the code. It can be decided whether to update the line style of all previously stored lines/areas with this code in this job. |

# 6 Jobs & Data - Data

## 6.1 Overview

**Description**

Data management is the administration of data stored in the working job, including
- viewing data and related information.
- editing data.
- creating new data.
- deleting existing data.
- filtering existing data.

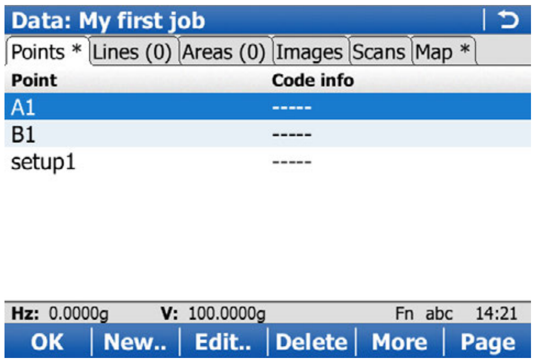
## 6.2 Accessing Data Management

**Access**

Select **Main Menu: Jobs & Data\View & edit data.**

☞ The objects listed on the pages belong to the working job. The objects listed and their order depend on the active sort and filter settings. An active filter for a page is indicated by * to the right of the name of the page. Refer to "6.6 Point Sorting and Filters" for information about sort and filter settings.

**Data:, Points page**



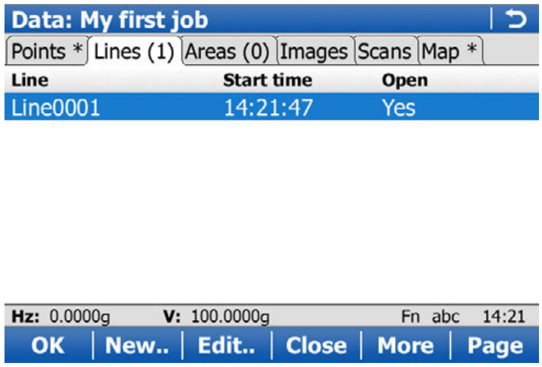

| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **New..** | To create a point. |
| **Edit..** | To edit the highlighted point. |
| **Delete** | To delete the highlighted point. |
| **More** | To display information about the codes and code information if stored with any point, the 3D coordinate quality, the class, Easting, Northing and Elevation, the time and the date of when the point was stored, and the flag for Linework.<br>☞ The order in which the Easting and Northing columns are shown depends on the **Grid format** configured to be used in **Regional Settings**, **Coords** page.<br>☞ The Easting, Northing and Elevation values are shown in the unit configured in **Regional Settings**, **Distance** page. |
| **Page** | To change to another page on this screen. |
| Fn **Log..** | To view points, lines, areas and free codes stored with the job sorted by time. Refer to "6.5 Data Log". |
| Fn **Filter..** | To define sort and filter settings. Refer to "6.6 Point Sorting and Filters". |
| Fn **Quit** | To exit the screen. |

**Next step**

**Page** changes to the **Lines** and **Areas** page.

**Data:, Lines and Areas page**

The explanations given for the softkeys are valid for both pages.
The number in brackets next to the name of the page indicate the number of open lines/areas. Example: Lines (2)/Areas (2) means that two lines/areas are open.




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **New..** | To create a line/area. After storing the new line/area, all existing lines and areas which are open are closed. Refer to "6.3.1 Creating a New Point". |
| **Edit..** | To edit the highlighted line/area. |
| **Close** and **Open** | To change between the options in the **Open** column of the high-lighted line/area. Only available for the current working job. |
| **More** | To display information about the codes if stored with any line/area, the start time, the end time of when the last point was added to the line/area, the length of the line, the perimeter and the area of the area. |
| **Page** | To change to another page on this screen. |
| Fn **Delete** | To delete the highlighted line/area. |
| Fn **Filter..** | To define sort and filter settings. Refer to "6.6 Point Sorting and Filters". |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Line** or **Area** | The listed lines/areas already stored in the working job. |
| **Open** | The status of a line/area.<br>• **Yes**<br>The line/area is open. Measured points are assigned to the line/area.<br>• **No**<br>The line/area is closed. Measured points are not assigned to the line/area.<br>**Close** and **Open** change between the options. |

**Next step**

| IF the line/area | THEN |
|---|---|
| which was last used is to be opened | press a hot key configured to reopen last used line/area. This hot key can be used at any time. Refer to "1.1 Hot Keys" for information on hot keys. |
| is to be viewed | **Page** until the **Map** page is active. |

☞ For information on camera and images refer to "34.4 Image Management".

**Data:, Scans page**

| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **View** | To open **Scan Viewer** for scans that show **Yes** in the **Display** column. **Scan Viewer** is a perspective display of the 3D-point clouds. To cancel the loading of the selected scan(s) pressing ESC. |
| **Display** | To change the setting in the **Display** column for the highlighted scan. |
| **More** | To display information about the date, the time, the status, the number of surface points and the number of boundary points. |
| **Page** | To change to another page on this screen. |
| Fn **Delete** | To delete the highlighted scan. |
| Fn **All** or Fn None | To change the setting in the **Display** column for all scans at once. |
| Fn **Quit** | To exit the screen. |

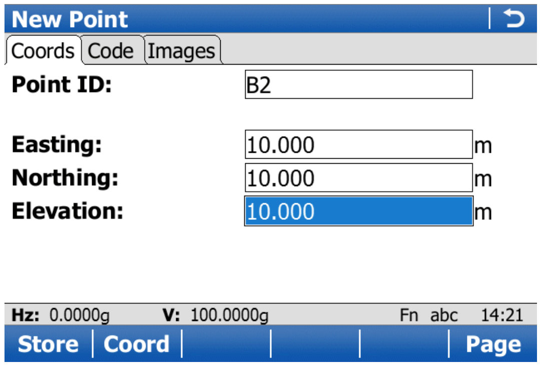
# 6.3 Point Management

## 6.3.1 Creating a New Point

**Access**

In **Data:**, **Points** page, press **New...**

**New Point, Coords page**




| Key | Description |
|---|---|
| **Store** | To store the new point entered and all associated information. |
| **Coord** | To view other coordinate properties. |
| **North** or **South** | Available for local geodetic or WGS 1984 geodetic coordinates when **Local latitude** or **WGS84 latitude** is highlighted. Changes between North and South latitude. |
| **East** or **West** | Available for local geodetic or WGS 1984 geodetic coordinates when **Local longitude** or **WGS84 longitude** is highlighted. Changes between East and West longitude. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** or Fn Elev | Available for local coordinates. Changes between the ellipsoidal and the orthometric height. |
| Fn **IndivID** or Fn **Run** | For an individual name independent of the ID template or to change back to the next ID from the configured ID template. |
| Fn **Quit** | To exit the screen. |

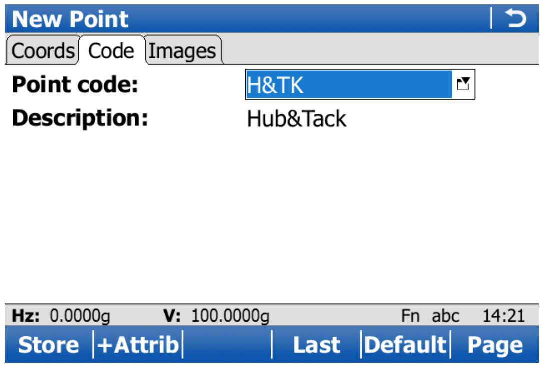
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The name of the new point. The configured point ID template is used. The ID can be changed in the following ways:<br>• To start a new sequence of point IDs, type over the point ID.<br>• For an individual name independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| Coordinate fields | Editable field | Negative geodetic coordinates are interpreted as being of the opposite hemisphere or other side of the central meridian. For example, entering -25 °N will be stored as 25 °S, entering -33 °E will be stored as 33 °W. |

**Next step**
**Page** changes to the **Code** page.

**New Point, Code page**

The settings for **Code & attributes** in **Main Menu: User\Work settings\Coding & linework** determine the availability of the subsequent fields and softkeys.




| Key | Description |
|---|---|
| **Store** | To store the new point entered and all associated information. |
| **+Attrib** | To create additional attributes for this point code. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. |
| **Last** | To recall the last used attribute values which were stored with this point code. |
| **Default** | To recall the default attribute values for the selected code. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point code** | Selectable list | When the check box **Use a list box to view codes** is checked in **Coding & Linework Settings**:<br>The codes from the job codelist are used.<br>All point codes of the job codelist can be selected. The description of the code is shown as a display only field. The attributes are shown as display only, editable fields or selectable lists depending on their definition. |
| | Editable field | When the check box **Use a list box to view codes** is not checked in **Coding & Linework Settings**:<br>Codes for points can be typed in but not selected from a codelist.<br>A check is performed to see if a point code of this name already exists in the job. If so, an information message is displayed. If **Suggested attributes**: **Last used** in **Coding & Linework Settings**, the according attributes are also shown. |
| **Attribute** | Editable field | When the check box **Use a list box to view codes** is checked: Up to 20 attribute values are available.<br>When the check box **Use a list box to view codes** is not checked: Up to eight attribute values are available. |

**Next step**

**Store** stores the new point entered and all associated information.

The properties stored with the point are:

- Class: **Ctrl**
- Sub class: **Fixed (Pos & Ht)**
- Source: **User entered**
- Instrument source: GPS

---

☞ It may happen that a point with the same point ID exists in the job. If the codes and/or attribute values of the new and the existing point do not match, a screen opens where they can be corrected.

---

## 6.3.2 Editing a Point

**Access**

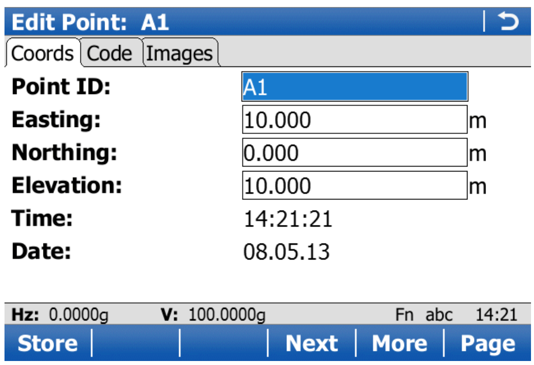
In **Data:**, **Points** page highlight a point to be edited. Press **Edit..**.

**Edit Point:, Coords page**

The visible pages on this screen depend on the properties of the point being edited.

It is possible to edit the point ID and for points of **Class: Ctrl** and **Class: Est** also the coordinates. Other point-related data is shown in display only fields.

- Changing the point ID of a point, applies this new point ID to all other points with the same original name, regardless of their class.
- Points of **Class: Ref** cannot be renamed.
- Changing coordinates of a point which has been previously used in other applications, for example COGO, or hidden point measurements does not update the application results.
- An edited point retains the creation value for **Time**.




| Key | Description |
|---|---|
| **Store** | To store the changes. |
| **Coord** | To view other coordinate properties. |
| **Prev** | To display the previous point in the list of points displayed in **Data:**, **Points** page. Available unless the beginning of the list is reached. |
| **Next** | To display the next point in the list of points displayed in **Data:**, **Points** page. Available unless the end of the list is reached. |
| **More** | To display information about class, sub class, 3D coordinate quality, time and date of when point was stored, instrument source, source and the flag for Linework if available. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** or Fn Elev | Available for local coordinates. Changes between the ellipsoidal and the orthometric height. Changing the height type does not edit the point. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Page** changes to the next page.

**Edit Point:, Obs page**

Available when the edited point is **Class: Meas**.

**For GPS points**

The name of the real-time base station from where the GPS/GNSS point was measured, the name of antenna used to measure the point and the baseline values, are shown in display only/observations fields.

**For TPS points**

It is possible to edit the reflector height. The name of the station from where the point was measured is shown in a display only field.

☞ Changing the reflector height recalculates the point height.

The distance variables **ΔHz**, **ΔV**, **Δ slope dist** are shown in a display only field, whenever a measurement has been taken in both faces.

**More** displays the horizontal angle or the azimuth from the point to the instrument.

**Next step**

**Page** changes to the next page.

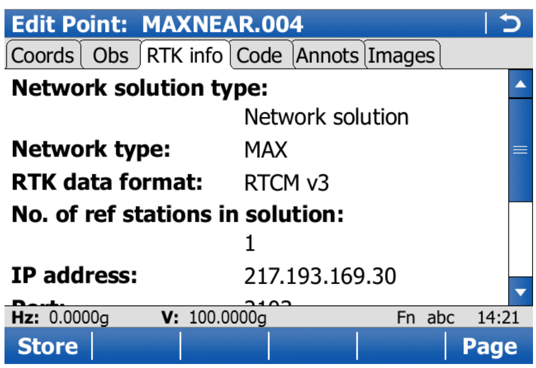
---

**Edit Point:, RTK info page**

Available for GNSS points which were recorded in real-time mode, however not for average or mean points.

All fields are display only fields and cannot be edited.

The information is obtained from **System settings** and data coming across with the real-time information and the Ntrip connection.



#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Network solution type** | **Single baseline** | Displayed when **Use RTK network** is not checked in **RTK Rover Settings**, **RTK network** page. |
| | **Network solution** | Displayed when **Use RTK network** is checked in **RTK Rover Settings**, **RTK network** page. |
| **Network type** | **FKP**, **VRS**, **MAX**, **i-MAX** | The type of reference network selected in **RTK Rover Settings**. Refer to "RTK Rover Settings, RTK network page". |
| | **Nearest** | If **Network type: Nearest** is selected in **RTK Rover Settings**, a singlebase solution is calculated and the number of base stations equals 1. |
| **RTK data format** | Display only | Refer to "RTK Rover Settings, General page". |
| **No. of ref stations in solution** | Display only | • For single-baseline solutions, this number is always 1.<br>• For VRS and i-MAX, this number is always 1 since it is not possible to derive the number of base stations contributing to the VRS or i-MAX corrections from the data format.<br>• For network solutions, this information is derived from the content of the data format. Only **RTCM v3** and **Leica 4G** are able to provide this number. |
| **Mountpoint** | Display only | The name of the correction data stream that was selected from the source table received in the **TCP/IP port**. Available for network RTK with Ntrip.<br>The information is available for all Ntrip connections independent from the **Network type** used. The information is derived from the **Connection Settings**, either manually defined or selected from the **NTRIP Source Table**. |
| **Point measured inside network** | Display only | Available for network RTK with Ntrip and MAX and data format **RTCM v3** or **Leica 4G**. |
| **User ID** | Display only | Available for single baseline RTK, network RTK with/without Ntrip. |

#### Next step

**Page** changes to the next page.

**Edit Point:, Code page**

Available when the edited point is **Class: Meas**.

The point code and code information can be edited. All point codes in the job can be selected.
The description of the code is shown as a display only field.
The attributes are shown as display only, editable fields or selectable lists depending on their definition.
The attribute values shown depend on the setting in **Coding & Linework Settings**. **Suggested attributes**: **Last used** shows the last used attribute values which are stored for this point code in the active codelist. **Suggested attributes**: **Default values** shows the default attribute values for this point code if existing.

☞ It may happen that a point with the same point ID exists in the job. If the codes and/or attribute values of the new and the existing point do not match, a screen opens where they can be corrected.

**Next step**
**Page** changes to the next page.

---

**Edit Point:, Annots page**

Available when the edited point is **Class: Nav** or **Class: Meas** and no offset point.

The comments to be stored with the point can be edited.

**Next step**
**Page** changes to the next page.

---

**Edit Point:, Mean page**

Available when the edited point is **Class: Avge**.

Refer to "6.3.3 Mean Page" for a detailed description.

---

## 6.3.3 Mean Page

**Description**

In order to check measurements, the same point can be measured more than once.

These measured points are assigned the class **Meas**. The various measured coordinate triplets for one point can be recorded using the same point ID. If the averaging mode is activated, an average is calculated when more than one measured coordinate triplet is available for the same point ID.

The averaged point is given the class **Avge**. It is checked if the deviations of each single point are within the limits configured in **Job Properties:, Averaging** page.

After averaging, the **Mean** page becomes available in **Edit Point:** and accessible from the Survey application. Available functionality on the **Mean** page depends on the selected averaging mode.

**Averaging**

**Defining the averaging mode and configuring the limits**

The averaging mode and the limits are configured in **Job Properties:, Averaging** page. Refer to "5.3 Job Properties and Editing a Job".

**Description of averaging modes**

| Averaging mode | Description |
|---|---|
| **Average** | When more than one measured coordinate triplet is recorded for the same point, the average for the position and the height is computed. Depending on the selected averaging method, the average will be computed weighted or arithmetic (no weighting). The class **Avge** is assigned to the averaged point.<br>The horizontal and height distances from the measured points to the average are computed and displayed on the **Mean** page.<br>A check is performed that the differences in position and height, between the **averaged point** and the point being stored, do not exceed the defined limits. |
| **Absolute differences** | What is described for **Average** also applies for **Absolute differences**. Additionally, the **absolute difference** between two points selected from a list of measured points with the same point ID, is checked to be within the defined limits. |
| **Off** | Averaging functionality is turned off. With more than one measured coordinate triplet recorded for the same point, no average for the position and the height is computed. |

**Averaging with position only or height only points**

Position only points, height only points and points with full coordinate triplets are handled in the averaging.

**Access step-by-step**

The **Mean** page can be accessed if

**Mode: Average** or **Mode: Absolute differences** is configured in **Job Properties:, Averaging** page.

AND

more than one measured coordinate triplet is recorded for the same point using the same point ID.

### Access within data management

| Step | Description |
|---|---|
| 1. | In **Data:**, **Points** page highlight a point to be edited. |
| 2. | **Edit..** to access **Edit Point:**, **Mean** page. |

### Access within Survey

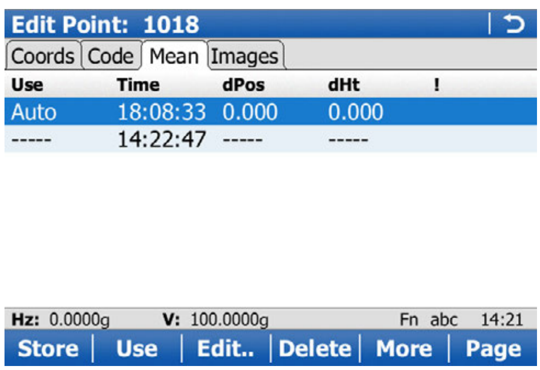
From within the Survey application, the **Mean** page is accessible when the RTK Rover interface is active.

In **Survey**, **Points** page, press Fn **Avg** or Fn **Abs** to access **Edit Point:**, **Mean** page.

---

**Edit Point:, Mean page**

All measured coordinate triplets recorded using the same point ID are shown.




| Key | Description |
|---|---|
| **Store** | To store the changes. |
| **Use** | To change between the options in the **Use** column for the highlighted coordinate triplet. To include or exclude this triplet in or from the calculation of the average. |
| **Edit..** | To view and edit the highlighted measured coordinate triplet. It is possible to edit the point ID and the antenna height without impact on all other classes of the point with the same original name. The coordinates are updated. A change in codes must be an overall change for the average point.<br>Example: One of the measured coordinate triplets has a wrong point ID and should not be included in the average. By editing the point ID, the point is renamed and no longer contributes to the average. |
| **Delete** | To delete the highlighted coordinate triplet. The average is recomputed. |
| **More** | To change between time and date of when the point was stored and the 3D coordinate quality. |
| **Page** | To change to another page on this screen. |
| Fn **Diffs** | Available for **Mode**: **Absolute differences** and **Yes** is set in the **Use** column for exactly two measurements. To display the absolute coordinate differences when a local coordinate system is active. Differences exceeding the defined limit are indicated by **!**. |

#### Description of columns

| Column | Description |
|---|---|
| **Use** | The use of a measured coordinate triplet in the averaging.<br>• **Auto**<br>The coordinate triplet is included in the averaging computation if within the averaging limit defined in **Job Properties::Averaging** page.<br>• **Yes**<br>The coordinate triplet is always included in the averaging computation even if it would fall outside the averaging limit defined in **Job Properties::Averaging** page.<br>• **No**<br>The coordinate triplet is never included in the averaging computation.<br>• **-----**<br>The coordinate triplet cannot be included in the averaging computation. Automatically set by the system.<br>**Use** changes between the options. |
| **Time** | The time the measured coordinate triplet was stored. |
| **Date** | The date the measured coordinate triplet was stored. The format is as defined in **Regional Settings**, **Time** page. |
| **dPos** | The horizontal distance from the measured coordinate triplet to the average. **dPos** : **-----** indicates unavailable information, for example for a height only point. |
| **dHt** | The height distance from the measured coordinate triplet to the average. **dHt: -----** indicates unavailable information, for example for a position only point. |
| **!** | Available for measured coordinate triplets with **Auto** or **Yes** in the **Use** column if **Mode: Average**. Indicates an exceeding of the limits. |

#### Next step

**Store** stores the changes.

# 6.4 Line/Area Management

## 6.4.1 Overview

**Description**

A line/area consists of points and can be created/edited in **Data:**, **Lines** and **Areas** page. The individual points are measured within any application. All points can be used except auxiliary points. Points can be simultaneously assigned to one or more lines and/or areas.

A line/area can have

- a style for display in MapView.
- a code independent of the point code of the points comprising the line/area.

☞ Points are assigned to a line/area when the line/area is open. Refer to "6.2 Accessing Data Management" for information on how to open a line/area.

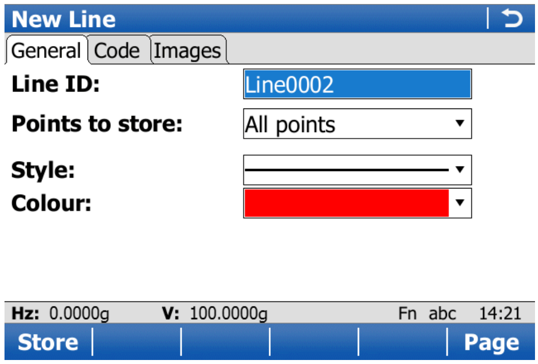
## 6.4.2 Creating a New Line/Area

☞ The functionality of all screens and fields are similar for the creation of both lines and areas. The descriptions for lines can be applied for areas.

**Access**

In **Data:**, **Lines** page, press **New...**.

**New Line, General page**




| Key | Description |
|---|---|
| **Store** | To store the new line entered and all associated information. |
| **Page** | To change to another page on this screen. |
| Fn **IndivID** or Fn **Run** | For an individual name independent of the ID template or to change back to the next ID from the configured ID template. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line ID** | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways:<br>• To start a new sequence of line IDs, type over the line ID.<br>• For an individual name independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Points to store** | Selectable list | The type of points which are used to form the line during a survey. |
| **Style** | Selectable list | The line style in which lines/areas are represented in MapView and LGO. For **Line code: <None>** on the **Code** page a line style can be selected from a selectable list. Otherwise the line style as defined for the selected line code is shown. |
| **Colour** | Selectable list | A colour in which the line will be displayed. |

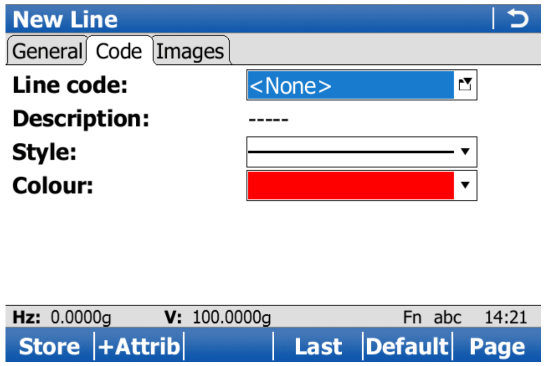
**Next step**

**Page** changes to the **Code** page.

**New Line, Code page**

The settings for **Code & attributes** in **Main Menu: User\Work settings\Coding & linework** determine the availability of the subsequent fields and softkeys.

☞ The value for **Start time** with which the line is stored is the time when **Store** was pressed. The same value is assigned to the value for **End time** until a point is added to the line.




| Key | Description |
|---|---|
| **Store** | To store the new line entered and all associated information. Any existing lines and areas which are open are closed. |
| **+Attrib** | To create additional attributes for this line code. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. |
| **Last** | To recall the last used attribute values which were stored with this line code. |
| **Default** | To recall the default attribute values for the selected code. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line code** | | The line code to be stored with the point. |
| | Selectable list | When the check box **Use a list box to view codes** is checked in **Coding & Linework Settings**:<br>All line codes of the job codelist can be selected.<br>The description of the code is shown as a display only field.<br>The line style is shown as defined for the selected line code. It is the style in which lines/areas are represented in MapView and LGO. For **Line code: <None>**, it can be changed.<br>The attributes are shown as display only, editable fields or selectable lists depending on their definition. |
| | Editable field | When the check box **Use a list box to view codes** is not checked in **Coding & Linework Settings**:<br>Codes for lines can be typed in but not selected from a codelist.<br>A check is performed to see if a line code of this name already exists in the job. If so, the line style and colour are copied from the existing code and shown as display only. If **Suggested attributes**: **Last used** in **Coding & Linework Settings**, the according attributes are also shown. |
| **Attribute** | Editable field | When the check box **Use a list box to view codes** is checked: up to 20 attribute values are available.<br>When the check box **Use a list box to view codes** is not checked: up to eight attribute values are available. |

### Next step

**Store** stores the new line entered and all associated information.

### Creating lines/areas most efficiently

| IF the task is to create | THEN |
|---|---|
| multiple lines/areas with subsequent line/area IDs | use the hot key/favourites menu function **Linework - Create new line (quick)**/**Linework - Create new area (quick)**. Pressing the hot key or selecting the function from the **My GPS Favourites** menu creates and immediately stores the new line/area. For the line/area ID, the line/area ID template as defined in **ID Templates** is used. The code and attributes are taken over from the last created line/area. |
| lines/areas with certain codes | use quick coding. The job codelist must contain quick codes for lines/areas. By typing the quick code a new line/area is created and immediately stored with that line/area code and attributes. For the line/area ID, the line/area ID template as defined in **ID Templates** is used. |

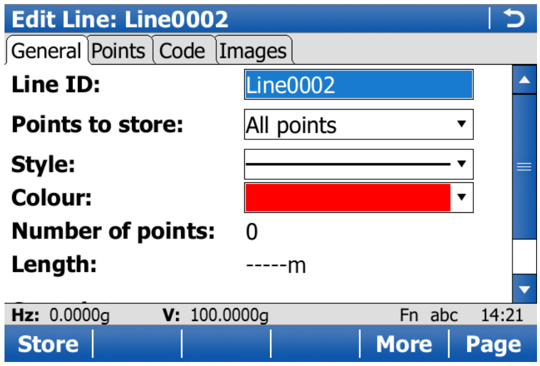
## 6.4.3 Editing a Line/Area

☞ The functionality of all screens and fields are similar for the creation of both lines and areas. The descriptions for lines can be applied for areas.

**Access**

In **Data:**, **Lines** page, press **Edit..**.

**Edit Line, General page**




| Key | Description |
|---|---|
| **Store** | To store the changes. |
| **More** | To display **End time** and **End date**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

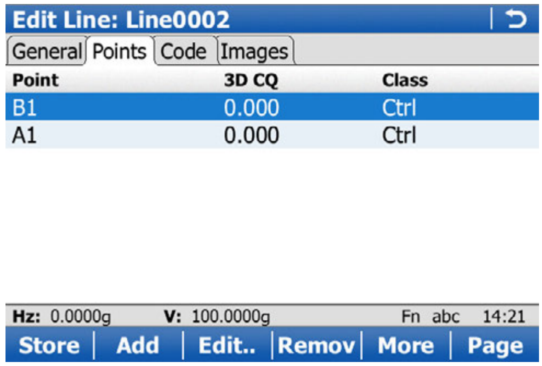
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line ID** | Editable field | The name of the line can be edited. ☞ A line cannot be renamed to an already existing line ID. |
| **Points to store** | Selectable list | The type of points which are used to form the line during a survey can be edited. |
| **Style** | Editable field | The line style in which lines/areas are represented in MapView and LGO. |
| **Colour** | Editable field | A colour in which the line will be displayed. |
| **Number of points** | Display only | The number of points contained within the line. |
| **Length** | Display only | The sum of the distances between the points in the sequential order in which they are stored for the line. This length can be a horizontal grid distance or a geodetic distance on the WGS 1984 ellipsoid. |
| **Start date** and **Start time** | Display only | The time/date when the line was created. ☞ An edited line retains the creation value for **Start time**. |
| **End date** and **End time** | Display only | The time/date when the last point was added to the line. This can be different to the time the point was created. The values do not change after deleting the last added point or after editing unless an additional point is added to the line. |

**Next step**
**Page** changes to the **Points** page.

**Edit Line, Points page**

All points belonging to the line are listed. The point that was added last to the line is at the top of the list.




| Key | Description |
|---|---|
| **Store** | To store the changes. |
| **Add** | To add an existing point from the working job to the line. A new point is added above the point which was highlighted when the key was pressed. The value for **End time** on the **General** page changes when a point was added to the line. |
| **Edit..** | To edit the highlighted point. |
| **Remov** | To remove the highlighted point from the line. The point itself is not deleted. |
| **More** | To display information about the point codes if stored with the line, the time and the date of when the line was stored, the 3D coordinate quality, the class and the flag for Linework. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Page** changes to the **Code** page.

**Edit Line, Code page**

The line code can be edited. All line codes can be selected. For **Line code:None**, the line style can be changed.

The description of the code is shown as a display only field.

The attributes are shown as display only, editable fields or selectable lists depending on their definition.

**Next step**

**Store** stores the changes.

## 6.5 Data Log

**Description**

A list of all objects and free codes in the working job is displayed in order of time.

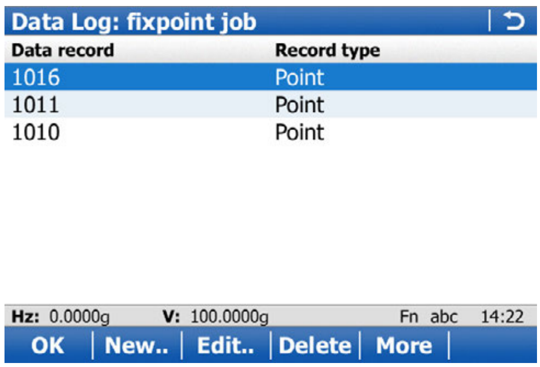
**Access step-by-step**

**Access within data management**
In **Data:**, **Points** page, press Fn **Log..** to access **Data Log**.

**Access within job management**
In **Job Properties:**, **General** page, press Fn **Log..** to access **Data Log**.

**Data Log**

In the column **Data record**, all points, lines and areas as well as free codes stored within the working job are displayed. They are always sorted by time with the most recent record at the top. For lines and areas, the value for **Start time** is relevant.




| Key | Description |
|---|---|
| **OK** | To close the screen. |
| **New..** | To insert a free code below/before the currently highlighted object or record. The functionality of inserting a free code is identical to the functionality of entering a free code during a survey. |
| **Edit..** | To edit the highlighted object or free code. The functionality of editing a free code is identical to the functionality of entering a free code during a survey. Refer to "26.3 Free Coding". |
| **Delete** | To delete the highlighted object or free code. |
| **More** | To display information about the type of data recorded, the time and the date of when it was stored or for lines and areas when they were created and the codes if stored with any object. |
| Fn **Quit** | To exit the screen. |

**Next step**
**OK** returns to the screen from where **Data Log** was accessed.

# 6.6 Point Sorting and Filters

## 6.6.1 Sorting and Filters for Points, Lines and Areas

**Description**

The sort settings define the order of the objects in the working job. The filter settings define the objects to be viewed.

Three types of filters are available:

| | |
|---|---|
| Point filter: | An active point filter shows selected points in **Data:**, **Points** page. |
| Line filter: | An active line filter shows selected lines in **Data:**, **Lines** page. |
| Area filter: | An active area filter shows selected areas in **Data:**, **Areas** page. |

For information on camera and images refer to "34.4 Image Management".

The sort and filter settings are stored in the job. They are remembered after turning off the instrument.
When a job becomes active, then the sort and filter settings of this job are saved in the internal memory. If the data storage device is formatted then these last used sort and filter settings are used for the job **Default**.
When a new job is created, the sort and filter settings from what was the working job are copied to the new job.

Changing the working job influences the sort and filter settings for the objects. The settings are changed to those of the selected job.

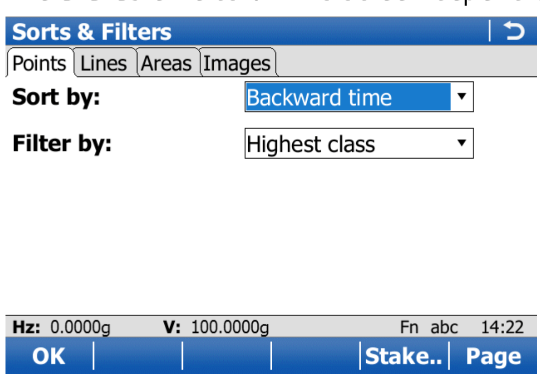
An active filter for an object is indicated in **Data:** by ***** located on the right side of the page name.

**Access**

In **Data:** on the **Points**, **Lines** or **Areas** page, press Fn **Filter..** to access **Sorts & Filters**.

**Sorts & Filters, Points page**

The available fields on this screen depend on the selected setting for **Filter by**.




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. The selected sort and filter settings are applied. |
| **Codes..** | Available for **Filter by: Point code**. To define the code filters. Refer to "6.6.2 Point, Line and Area Code Filter". |
| **Stake..** | To filter points for the Stakeout application. Refer to "6.6.3 Stakeout Filter". |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

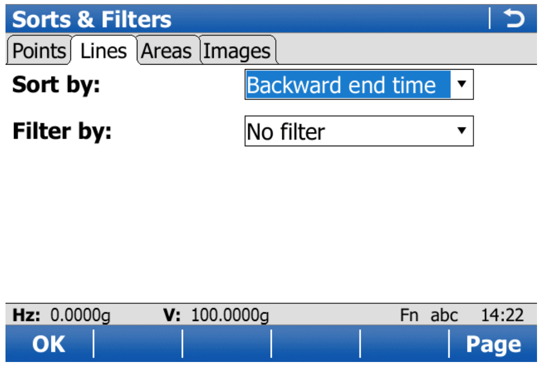
| Field | Option | Description |
|---|---|---|
| **Sort by** | **Ascending point ID**, **Descending point ID**, **Forward time** or **Backward time** | Always available. The method points are sorted by. |
| **Filter by** | | Always available. The method the points are filtered by. |
| | **No filter** | Shows all points. |
| | **Highest class** | Shows points of highest class. |
| | **Range of point IDs** | Shows points with point IDs between the entered start and end ID. The points are left aligned and sorted by the first digit. |
| | **Pt ID wildcard** | Shows points with point IDs matching the wildcard. |
| | **Time** | Shows points which were recorded within a defined time window. |
| | **Class** | Shows points of the selected class. |
| | **Instrument** | Shows points originating from the selected instrument or software program type. |
| | **Coordinate type** | Shows points of the selected type of coordinates. |
| | **Point code** | Shows points with selected codes attached. |
| | **Box around point** | Shows points within the defined radius from a particular point. The radius is the horizontal distance. |
| | **Individual line** | Shows points forming a selected line. This can be useful, for example, during stakeout. |
| | **Individual area** | Shows points forming a selected area. This can be useful, for example, during stakeout. |
| **Start ID** | Editable field | Available for **Filter by: Range of point IDs**. The first point to be displayed. |
| **End ID** | Editable field | Available for **Filter by: Range of point IDs**. The last point to be displayed. |
| **Wildcard** | Editable field | Available for **Filter by: Pt ID wildcard**. * and ? are supported. * indicates an undefined number of unknown characters. ? indicates a single unknown character. |
| **Start date** | Editable field | Available for **Filter by: Time**. The date of the first point to be displayed. |
| **Start time** | Editable field | Available for **Filter by: Time**. The time of the first point to be displayed. |
| **End date** | Editable field | Available for **Filter by: Time**. The date of the last point to be displayed. |
| **End time** | Editable field | Available for **Filter by: Time**. The time of the last point to be displayed. |

| Field | Option | Description |
|---|---|---|
| **Control (Ctrl)**, **Adjusted (Adj)**, **Reference (Ref)**, **Average (Avge)**, **Measured (Meas)**, **Navigated (Nav)**, **Estimated (Est)**, **None** | **Show** or **Hide** | Available for **Filter by: Class**. Defined classes are shown or hidden. |
| **View** | | Available for **Filter by: Class**. |
| | **Highest triplet** | The coordinate triplets of the highest class are shown. |
| | **All triplets** | All classes for one coordinate triplet are shown. |
| **Instrument** | **All**, **TPS**, **GPS**, **LEICA Geo Office**, **Level**, **Controller**, **Third party SW** or **Unknown** | Available for **Filter by: Instrument**. Points originating from this instrument type are shown. |
| **Type** | **WGS84 only** or **Local only** | Available for **Filter by: Coordinate type**. Points from the chosen coordinate type are shown. |
| **Point ID** | Selectable list | Available for **Filter by: Box around point**. The point to which the radius is applied. Opening the selectable list opens **Data:**. Refer to "6.2 Accessing Data Management". |
| **Radius** | Editable field | Available for **Filter by: Box around point**. The radius of the circle within which the points are shown. |
| **Line ID** | Selectable list | Available for **Filter by: Individual line**. Opening the selectable list opens **Data:**. Refer to "6.2 Accessing Data Management". |
| **Area ID** | Selectable list | Available for **Filter by: Individual area**. Opening the selectable list opens **Data:**. Refer to "6.2 Accessing Data Management". |

**Next step**

**Page** changes to the **Lines** page.

**Sorts & Filters, Lines and Areas page**




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. The selected sort and filter settings are applied. |
| **Codes..** | Available for **Filter by: Code / code group**. To select the line codes to be used. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Sort by** | **Ascending line ID**, **Descending line ID**, **Forward start time**, **Backward start time**, **Forward end time**, **Backward end time** | Always available. The method the lines are sorted by. |
| **Filter by** | | Always available. The method by which the lines are filtered. |
| | **No filter** | Shows all lines. |
| | **Code / code group** | Shows lines with selected codes attached. |

### Next step

**OK** closes the screen.

## 6.6.2 Point, Line and Area Code Filter

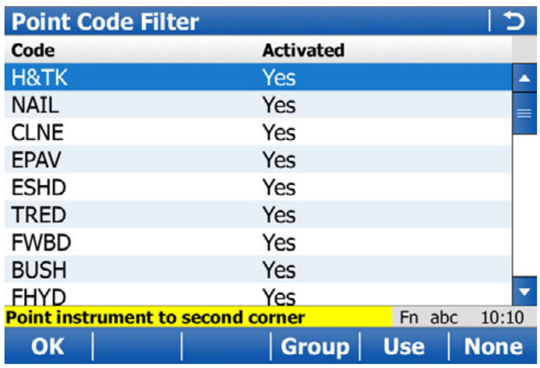
☞ For each object, a code filter exists. The point, line and area code filters are independent from each other. The functionality is identical. For simplicity, the point code filter is explained.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Sorts & Filters** select **Filter by: Point code**. |
| 2. | **Codes..** to access **Point Code Filter**. |

**Point Code Filter**

This screen shows the point codes from the working job and codes currently used as filter. Point codes are sorted according to the settings in **Sort Codes**.




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **Group** | To activate and deactivate code groups. Accesses **Code Groups**. Any code group that has been previously deactivated are displayed as deactivated here. Codes belonging to a deactivated code group are not displayed in **Point Code Filter**. |
| **Use** | To activate and deactivate the filter for the highlighted code. |
| **None** or **All** | To deactivate or activate all point codes. |
| Fn **Sort** | To define the order of the codes. Accesses **Sort Codes**. |
| Fn **Quit** | To exit the screen. |

## 6.6.3 Stakeout Filter

**Description**

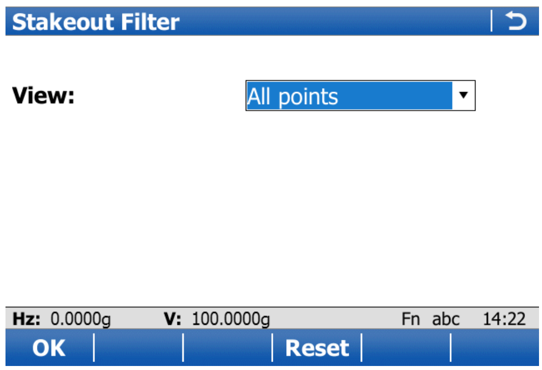
The settings on this screen define a filter for the Stakeout application. The Stakeout filter can be applied to show points which are already staked or points that are still to be staked.

The stakeout filter acts in addition to any other filter set in **Sorts & Filters**. For example, points still to be staked out with a particular code can be filtered.

**Access**

In **Sorts & Filters**, **Points** page, press **Stake..** to access **Stakeout Filter**.

**Stakeout Filter**




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **Reset** | To reset the staked flag for all points of the currently working job. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **View** | **All points** | Shows all points. |
| | **Points to stake** | Shows points not yet staked out. |
| | **Staked points** | Shows points which are already staked out. |

## 6.7 Scan Viewer

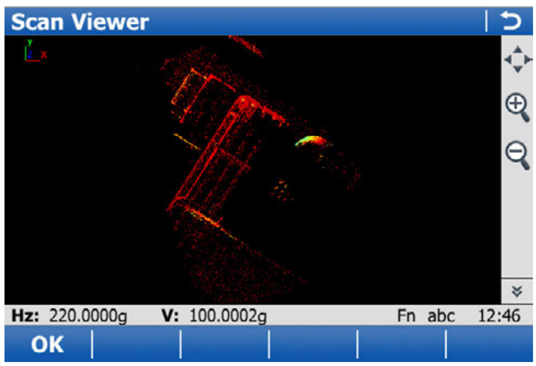
**Description**

The Scan Viewer is available on MS50.
The Scan Viewer is a point cloud viewer. One or more scans can be viewed.
The Scan Viewer respectively the **Scans** tab in the data management is available as soon as a scan in available in the data job.
Scan Viewer provides a perspective display of the 3D point clouds which allows for a better overall understanding of the measured data.
The displayed data can be navigated in.

**Access**

| Step | Description |
|---|---|
| 1. | In **Data:**, **Scans** page, highlight one scan and press **Display** to set **Yes** in the **Display** column.<br>☞ To set **Yes** in the **Display** column for all scans. press Fn **All**. |
| 2. | Press **View**. |

**Scan Viewer**



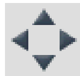
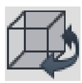

| Key | Description |
|---|---|
| **OK** | To return to **Data:**, **Scans** page. |
| Fn **Config..** | To configure Scan Viewer. Refer to "Scan View Settings". |
| Fn **Quit** | To exit the screen. |

**Scan View Settings**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Background colour** | Selectable list | A colour in which the background will be displayed. |
| **Point cloud colour** | **Intensity** | The point cloud is colored according to the intensity value of the received EDM signal. |
| | **Single colour** | A point cloud gets a single colour. If several scans are available, each point cloud gets a different colour. A colour table is defined in the background, from which the colours are picked for each point cloud. |
| | **RGB** | The point cloud is coloured according to the RGB (red, green, blue) values from the panoramic image. If a panoramic image has been taken when defining a scan, the RGB values are available. |

**Toolbar icons**

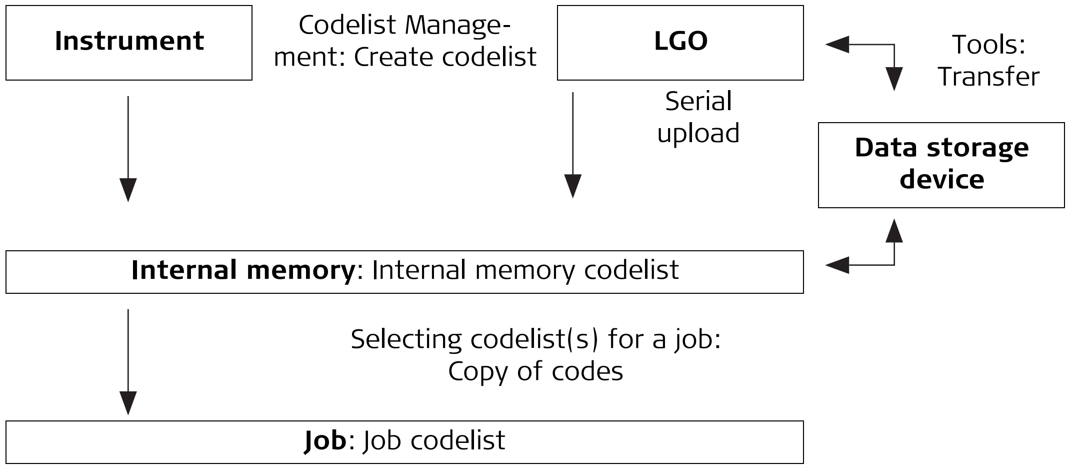
| Icon | Description |
|---|---|
|  | To scroll the Scan Viewer toolbar. |
|  | The fit icon fits all displayable data using the largest possible scale. |
|  | To zoom into the map.<br>☞ Pressing ESC stops the zooming process. |
|  | To zoom out of the map.<br>☞ Pressing ESC stops the zooming process. |
|  | To zoom into the point cloud in real-time by tapping the screen and moving the stylus up. To zoom out move the stylus down the screen. |
|  | To rotate the point cloud in 3D. The rotation point is the closest point of the scan to the centre of the 3D viewer. |
|  | To toggle between pre-defined perspective views zoomed fit: top view, front view and side view. |
|  | To change the pixel size of a single scan point displayed in the viewer. |

# 7 Codelists

## 7.1 Overview

☞ It is recommended to create a codelist in LGO. A codelist can be transferred from LGO to the internal memory of the instrument using the data storage device.

**Steps from creating to using a codelist**




The creating, editing and managing of codelists is explained in this chapter. In order to use a codelist on the instrument, it must be transferred from the data storage device to the internal memory.

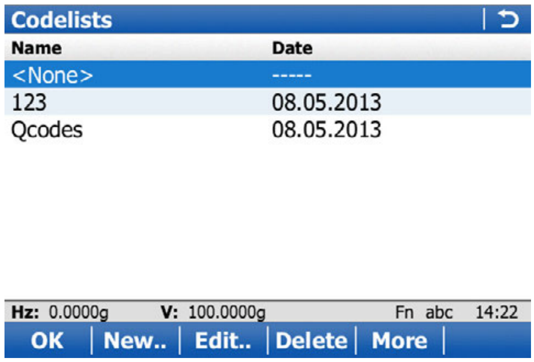
## 7.2 Accessing Codelist Management

**Access**

| Step | Description |
|---|---|
| 1. | Go to **Job Properties:**, **Codelist** page when creating a new job or editing an existing working or control job. |
| 2. | Open the selectable list for **Codelist**. |

**Codelists**

Listed are all codelists stored in the internal memory.



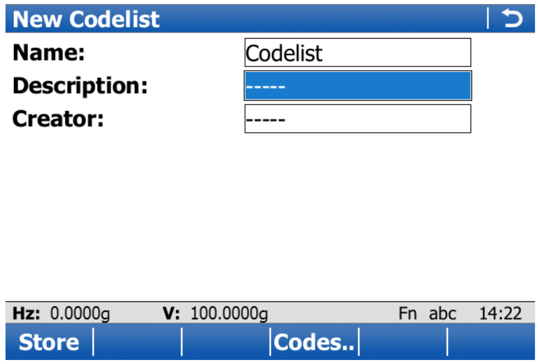

| Key | Description |
|---|---|
| **OK** | To return to the screen from where this screen was accessed. The codes from the highlighted codelist are copied to the working job. |
| **New..** | To create a codelist. Refer to "7.3 Creating/Editing a Codelist". |
| **Edit..** | To edit the highlighted codelist. Refer to "7.3 Creating/Editing a Codelist". |
| **Delete** | To delete the highlighted codelist. |
| **More** | To display information about the creator and the date of when the codelist was created. |
| Fn **Quit** | To exit the screen. |

# 7.3 Creating/Editing a Codelist

**Access**

In **Codelists** press **New..** or **Edit..**.

**New Codelist or Edit Codelist**




| Key | Description |
|---|---|
| **Store** | To store the codelist. |
| **Codes..** | To access **Codes** where codes can be created, edited or deleted and code groups can be accessed. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the codelist. The name can be up to 16 characters long and include spaces. Input required. |
| **Description** | Editable field | A detailed description of the codelist. This description can be, for example, work to be performed. Input optional. |
| **Creator** | Editable field | The person's name who is creating the codelist. Input optional. |

# 7.4 Managing Codes

## 7.4.1 Accessing Codes

**Description**

Managing codes includes
- creating new codes
- viewing codes with their related information
- editing codes
- deleting existing codes.

**Access step-by-step**

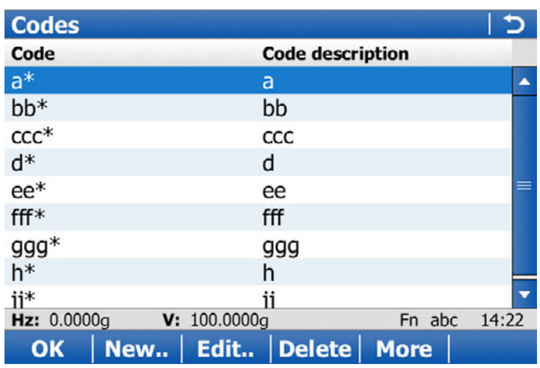
| Step | Description |
|---|---|
| 1. | In **Codelists**, highlight the codelist of the codes which are to be managed. |
| 2. | **Edit..** to access **Edit Codelist**. |
| 3. | **Codes..** to access **Codes**. |

**Codes**

Codes from currently active code groups are shown.

The listed codes belong to
the codelist selected from the internal memory when this screen was accessed through **New job\Codelist**
OR
to the job codelist when this screen was accessed through **Job properties\Codelist**.

The * indicates codes which have attributes attached.




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **New..** | To create a new code. Refer to "7.4.2 Creating/Editing a Code". |
| **Edit..** | To edit the highlighted code. Refer to "7.4.2 Creating/Editing a Code". |
| **Delete** | To delete the highlighted code. |
| **More** | To display information about the code description, the quick codes if available, the code groups and the code type. |
| Fn **Group** | To view, create, delete, activate and deactivate code groups. Refer to "7.5 Managing Code Groups". |
| Fn **Sort** | To sort codes by code name, code description, quick code or the last use. |

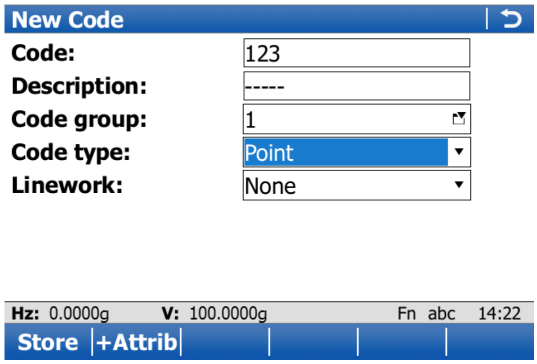
## 7.4.2 Creating/Editing a Code

The values for code groups, codes and attributes are case sensitive. For example, the code group Tree is not the same as the code group TREE.

Attribute names that have already been typed in cannot be edited in a job codelist.

A new code can also be created within an application. In this case, the new code is added to the job codelist.

**New Code or Edit Code**




| Key | Description |
|---|---|
| **Store** | To add the new code and any associated attributes to the codelist in the internal memory. |
| **+Attrib** | To add a new editable field for an attribute of attribute type normal and of value type text. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and the attribute value to be used as the default attribute value can be typed in. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Code** | Editable field | A unique name for the new code. The name can be up to 16 characters long and include spaces. Input required. |
| **Description** | Editable field | A detailed description of the code. This description can be, for example, the full designation if **Code** is an abbreviation. Input optional. |
| **Code group** | Selectable list | The code group to which the code is to be assigned. |
| **Code type** | Selectable list | Defines the use of the code. It can be used as thematical code for points, lines or areas or as a free code. |
| | | Makes a code unique. A code can have the same value with different types within the same codelist. For example a code OAK can be of type **Point**, **Line**, **Area** and/or **Free**. |
| **Linework** | Selectable list | Only available for **Code type: Point**. To allow a new line or new area to be opened whenever the point code is newly selected. This functionality is also available when creating codelists with LGO Codelist Management. |
| | **None** | Select this option to disable the functionality. All other code settings on the instrument are not affected when this option is set. |
| | **Begin line** | When a point code is newly selected, a new line is opened and the point being stored is added to the line. When the same point code remains selected, a new line is not opened. The point being stored is added to the current line. |
| | **Begin area** | The behaviour for opening a new area is the same as the behaviour for opening a new line. |
| **Style** | Selectable list | Available for **Code type: Line** and **Code type:** Area. The style in which lines/areas are represented in MapView and LGO. |
| **Attribute** | Editable field | Up to twenty attributes can be created. |
| | | ☞ Attributes of attribute type mandatory or fixed and of value type real or integer must be created in LGO. |

## 7.5 Managing Code Groups

**Access**

In **Codes**, press Fn **Group**.

**Code Groups**

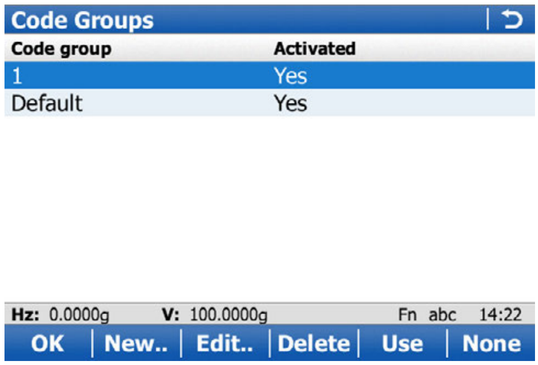
The listed code groups belong to

- the codelist selected from the internal memory when this screen was accessed through **New job\Codelist**

OR

- to the job codelist when this screen was accessed through **Job properties\Codelist**.

Codes from currently active code groups are shown.




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **New..** | To create a new code group. In **New Code Group** type in a unique name for **Name**. **Store** stores the new code group typed in and returns to **Code Groups**. |
| **Edit..** | Available for codelists in the internal memory. To edit the highlighted code group. In **Edit Code Group** type in the changes for **Name**. **Store** stores the changes and returns to **Code Groups**. |
| **Use** | To activate and deactivate the highlighted code group. Codes belonging to a deactivated code group are not displayed in **Codes**. |
| **None** or **All** | To deactivate or activate all code groups. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Code group** | The name of the code group. |
| **Activated** | Use code group or not. The codes belonging to a deactivated code group cannot be selected from the selectable list for code selection. **Use** changes between the options. |

# 8 Coordinate Systems

## 8.1 Overview

**Description**

A coordinate system
- consists of up to five elements.
- allows the conversion from WGS 1984 geodetic or cartesian coordinates to, local cartesian, geodetic or grid coordinates and back.
- can be attached to jobs.
- can be manually defined.
- can be computed in the field.
- can be directly received from a reference network. Refer to "19.7.1 Configuration of a Rover Real-Time Connection".
- can be downloaded to LGO.
- can be uploaded from LGO.

**Using coordinate systems on TPS**

Coordinate systems are used on TPS instruments to combine GPS data with TPS data.

☞ TPS An attached coordinate system is not used to reduce any measured distance on a TPS instrument.

☞ All GPS surveyed points are always stored as WGS 1984 geodetic coordinates regardless of the coordinate system being used. Using a different coordinate system converts the coordinates displayed on the screen, but does **not** convert and restore the coordinate values in the database DBX.

☞ TPS Points surveyed with a TPS instrument are always stored in local GRID coordinates regardless of the coordinate system being used.

☞ One coordinate system can be attached to a job at one time. This coordinate system remains attached to the job unless it is changed.

**Default coordinate systems**

The default coordinate system is **WGS 1984**. It cannot be deleted. It is not possible to create a coordinate system called **WGS 1984**.
Additional default coordinate systems may be available for certain countries.

**Active coordinate system**

The active coordinate system is the one attached to the working job. One coordinate system is always considered as the active coordinate system.

**Automatic coordinate system (RTCM transformation parameters)**

When **Use auto coordinate system** is checked in the **RTK Rover Wizard**, the coordinate system is directly received from the reference network via RTCM correction data. Refer to "19.7.1 Configuration of a Rover Real-Time Connection".

**Coordinate systems when transferring jobs between GPS and TPS**

When transferring a job from GPS to TPS, or vice versa, the coordinate system stays attached to the job. It then appears like any other coordinate system on the instrument.

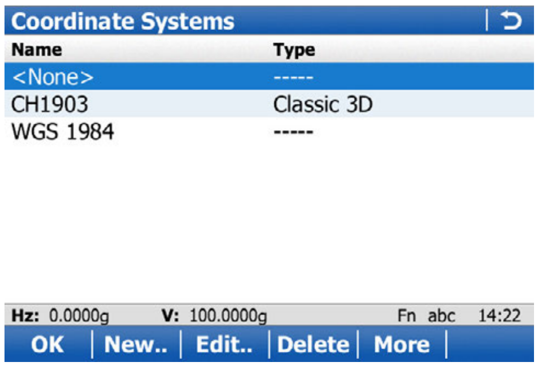
## 8.2 Accessing Coordinate System Management

### Access

| Step | Description |
|---|---|
| 1. | Go to **Job Properties:**, **Coord system** page when creating a new job or editing an existing working or control job. |
| 2. | Open the selectable list for **Coord system**. |

### Coordinate Systems

Listed are all coordinate systems stored in the database DBX. Any unavailable information is shown as **-----**.




| Key | Description |
|---|---|
| **OK** | To select the highlighted coordinate system and to return to the previous screen. With a data storage device inserted, the selected coordinate system will be attached to the working job. |
| **New..** | To create a coordinate system manually. Refer to "8.3 Coordinate Systems - Creating and Editing". |
| **Edit..** | To edit the highlighted coordinate system. Refer to "8.3 Coordinate Systems - Creating and Editing". |
| **Delete** | To delete the highlighted coordinate system. Deletion is not possible if the highlighted coordinate system is active and its source is RTCM. |
| **More** | To display information about the type of transformation used, the type of heights computed, the number of control points used for the determination and the date of when the coordinate system was created. |
| Fn **Set-D** | Available unless a default coordinate system is highlighted. To turn the highlighted coordinate system into a user defined default coordinate system stored in the instrument. |
| Fn **Default** | To recall the deleted default coordinate systems. |
| Fn **Quit** | To exit the screen. |

## 8.3 Coordinate Systems - Creating and Editing

☞ Coordinate systems can be defined by manual creation or determined by calculation.
In this chapter, the manual creation of coordinate systems is explained. Refer to "42 Determine Coordinate System" for information on the determination by calculation.

☞ Coordinate systems with a Classic 3D transformation can be defined by manual creation.

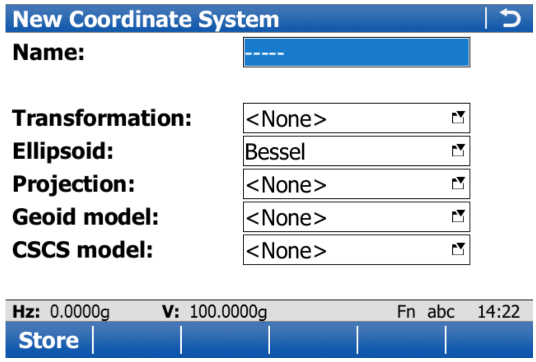
☞ The type of transformation of the selected coordinate system determines which elements of a coordinate system can be edited. The name of the coordinate system, the method of residual distribution and the geoid model in use are always editable.

☞ For coordinate systems with source RTCM, only the geoid model in use can be changed.
However, if no projection is received with the automatic coordinate system, then the projection can also be defined.

**Access**

In **Coordinate Systems**, highlight a coordinate system. A copy of this coordinate system is taken for further configurations. Press **New..** or **Edit..**.

## New Coordinate System or Edit Coordinate System




| Key | Description |
|---|---|
| **Store** | To store the coordinate system. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new coordinate system. The name can be up to 16 characters long and include spaces. |
| **Residuals** | | Available for transformations with control points. Manually entered transformations do not have control points. The method by which residuals are distributed throughout the transformation area. The transformation results become more realistic and any strain is dispersed in the transformation. |
| | **1/distance**, 1/distance$^2$, **1/distance$^{3/2}$** | Distribute the residuals of the control points according to the distance between each control point and the newly transformed point. |
| | **Multiquadratic** | Distributes the residuals using a multiquadratic interpolation approach. |
| **Transformation** | Selectable list | The type of transformation. |
| **Pre Transform** | Selectable list | Available when editing a coordinate system and for Twostep transformations. The name of a preliminary 3D transformation, which, together with the selected projection, is used to obtain preliminary grid coordinates for a final 2D transformation. |
| **Ellipsoid** | Selectable list | Available unless projection **Type: Customised**. The local coordinates are based on this ellipsoid. |
| **Projection** | Selectable list | The map projection. |
| **Geoid model** | Selectable list | The geoid model. |
| **CSCS model** | Selectable list | The Country Specific Coordinate System model. |

# 8.4 Transformations

## 8.4.1 Accessing Transformation Management

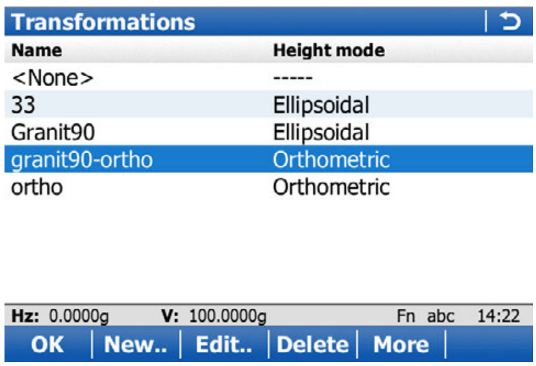
**Transformations** cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system (RTCM transformation parameters)".

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Coordinate Systems**, highlight a coordinate system. |
| 2. | Press **New..** or **Edit..**. |
| 3. | Highlight **Transformation**. |
| 4. | ENTER to access **Transformations**. |

**Transformations**

Listed are all Classic 3D transformations stored in the database DBX. Any unavailable information is shown as **-----**.




| Key | Description |
|---|---|
| **OK** | To select the highlighted transformation and to return to the previous screen. |
| **New..** | To create a new transformation. Refer to "8.4.2 Creating/Editing a Transformation". |
| **Edit..** | To edit the highlighted transformation. Refer to "8.4.2 Creating/Editing a Transformation". |
| **Delete** | To delete the highlighted transformation. |
| **More** | To display information about the type of heights computed and the number of control points used for the determination of the transformation. |
| Fn **Set-D** | To turn the highlighted transformation into a user-defined default transformation stored in the instrument. |
| Fn **Quit** | To exit the screen. |

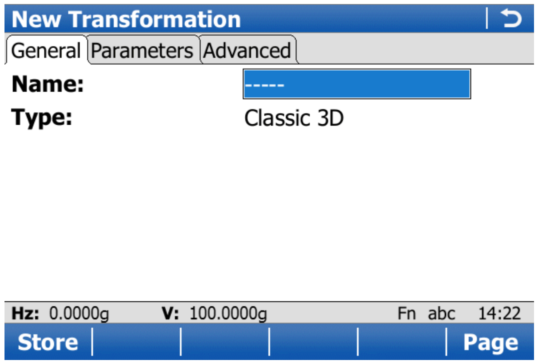
## 8.4.2 Creating/Editing a Transformation

Classic 3D transformations can be created.

**Access**

In **Transformations**, highlight a transformation. A copy of this transformation is taken for further configurations. Press **New..** or **Edit..**.

**New Transformation or Edit Transformation, General page**




| Key | Description |
|---|---|
| **Store** | To store the transformation. |
| **Clear** | To set the editable fields to 0. Available on the **Parameters** and the **Advanced** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new transformation. The name can be up to 16 characters long and include spaces. |
| **Type** | Display only | No other transformations than Classic 3D can be created. |

**Next step**

**Page** changes to the **Parameters** page.

**New Transformation or Edit Transformation, Parameters page**

Enter the known values of the transformation parameters.

**Next step**

**Page** changes to the **Advanced** page.

---

**New Transformation or Edit Transformation, Advanced page**

Select at least a height mode and a transformation model.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Height mode** | Selectable list | The type of heights to be computed. |
| **Model** | Selectable list | The transformation model to be used. For **Model:Molodensky-Badakus**, additional editable fields are available. |

**Next step**

**Store** stores the transformation.

---

## 8.5 Ellipsoids

### 8.5.1 Accessing Ellipsoid Management

☞ **Ellipsoids** cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system (RTCM transformation parameters)".

**Access step-by-step**

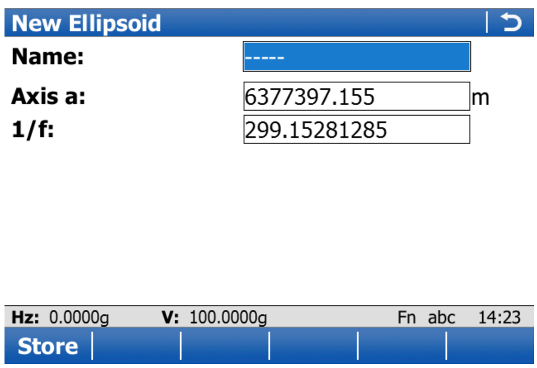
| Step | Description |
|---|---|
| 1. | In **Coordinate Systems**, highlight a coordinate system. |
| 2. | Press **New..** or **Edit..**. |
| 3. | Highlight **Ellipsoid**. |
| 4. | ENTER to access **Ellipsoids**. |

### 8.5.2 Creating/Editing an Ellipsoid

**Access**

In **Ellipsoids**, highlight an ellipsoid. A copy of this ellipsoid is taken for further configurations. Press **New..** or **Edit..**.

**New Ellipsoid or Edit Ellipsoid**




| Key | Description |
|---|---|
| **Store** | To store the ellipsoid. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new ellipsoid. A name is mandatory, can be up to 16 characters long and include spaces. |
| **Axis a** | Editable field | The semi-major axis a. |
| **1/f** | Editable field | The reciprocal value of flattening f. |

## 8.6 Projections

### 8.6.1 Accessing Projection Management

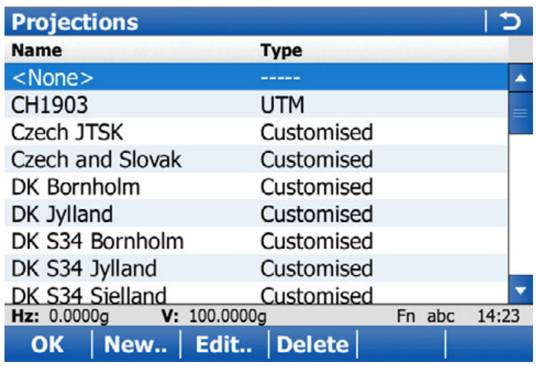
**Projections** cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system (RTCM transformation parameters)".

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Coordinate Systems**, highlight a coordinate system. |
| 2. | Press **New..** or **Edit..**. |
| 3. | Highlight **Projection**. |
| 4. | ENTER to access **Projections**. |

**Projections**

Listed are all projections stored in the database DBX. Any unavailable information is shown as **-----**.




| Key | Description |
|---|---|
| **OK** | To select the highlighted projection and to return to the previous screen. |
| **New..** | To create a new projection. Refer to "8.6.2 Creating/Editing a Projection". |
| **Edit..** | To edit the highlighted projection. Refer to "8.6.2 Creating/Editing a Projection". |
| **Delete** | To delete the highlighted projection. |
| Fn **Set-D** | Available unless a default projection is highlighted. To turn the highlighted projection into a user-defined default projection stored in the instrument. |
| Fn **Default** | To recall the deleted default projections. |
| Fn **Quit** | To exit the screen. |

#### Description of columns

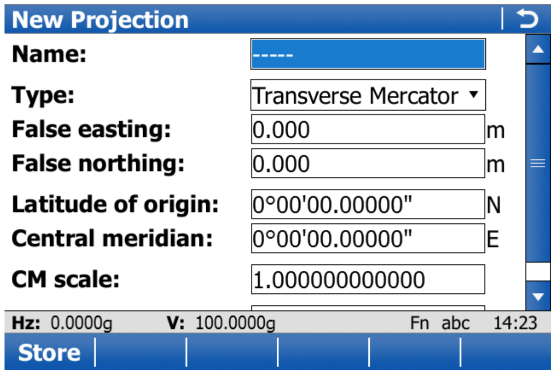
| Column | Option | Description |
|---|---|---|
| **Type** | | The projection type. Refer to standard surveying literature for details on projections. |
| | **Customised** | Customised projection. Certain fixed projections which cannot be defined by any of the following options. |
| | **Transverse Mercator** | Transverse Mercator. Conformal projection onto a cylinder with its axis lying on the equatorial plane. The cylinder is tangential to a meridian. |
| | **UTM** | Universal Transverse Mercator. Transverse Mercator Projection with fixed zone-defining constants. The central meridian is selected automatically according to the selected zone number. |
| | **Oblique Mercator** | Oblique Mercator. Oblique Mercator Conformal projection onto a cylinder. The cylinder is tangent to any circle other than the equator or a meridian. |
| | **Mercator** | Mercator. Conformal projection onto a cylinder with its axis lying on a meridian plane. The cylinder is tangent to the sphere along the equator. |
| | **Lambert 1 parallel** | Lambert 1 Parallel. Conformal projection onto a cone, with its axis coinciding with the z-axis of the ellipsoid. |
| | **Lambert 2 parallel** | Lambert 2 Parallel. Conformal projection onto a cone, with its axis coinciding with the z-axis of the ellipsoid. The cone is secant to the sphere. |
| | **Cassini** | Soldner-Cassini. Projection onto a cylinder. It is not an equal area or conformal. The scale is true along the central meridian and along lines perpendicular to central meridian. |
| | **Polar stereo** | Polar Stereographic. Conformal azimuthal projection onto a plane. The point of projection is on the surface of the ellipsoid diametrically opposite of the origin which is the centre of the projection. |
| | **Double stereo** | Double Stereographic. Conformal azimuthal projection onto a plane. The point of projection is on the surface of the sphere diametrically opposite of the centre of the projection. |
| | **RSO** | Rectified Skewed Orthomorphic. This is a special type of Oblique Mercator projection. |

## 8.6.2 Creating/Editing a Projection

**Access**

In **Projections**, highlight a projection. A copy of this projection is taken for further configurations. Press **New..** or **Edit..**.

**New Projection or Edit Projection**




| Key | Description |
|---|---|
| **Store** | To store the projection. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new projection. A name is mandatory, can be up to 16 characters long and include spaces. |
| **Type** | Selectable list | The projection type. The setting for determines the availability of the subsequent fields for the parameters of the projection. Refer to "8.6.1 Accessing Projection Management" for a description of the projection types. |

# 8.7 Geoid Models

## 8.7.1 Overview

**Use in the field**

For use on the instrument in the field, geoid field files are created from the geoid model.

**Create geoid models on the instrument**

Geoid models can be created on the instrument in one of three ways:

1. The geoid field file is stored on a data storage device and can be used when the data storage device is inserted in the instrument. It is recommended for large geoid field files. This method is explained in this chapter.
2. The geoid field file is stored in the internal memory of the instrument. It is recommended for large geoid field files. This method is also explained in this chapter.
3. The geoid field file is transferred to the internal memory and can be used at any time. Refer to "30.1 Transfer user objects"for information on how to transfer geoid field files to the internal memory on the instrument.

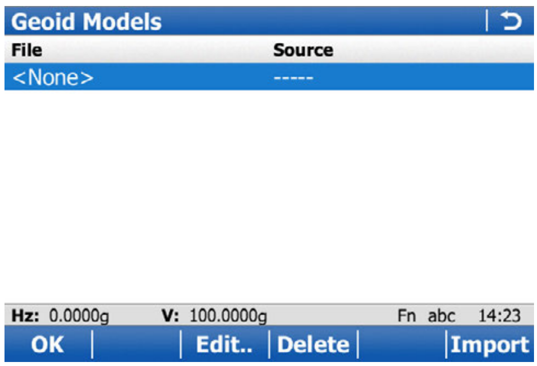
## 8.7.2 Accessing Geoid Model Management

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Coordinate Systems**, highlight a coordinate system. |
| 2. | Press **New..** or **Edit..**. |
| 3. | Highlight **Geoid model**. |
| 4. | ENTER to access **Geoid Models**. |

**Geoid Models**

Listed are all geoid models stored in the database DBX. Any unavailable information is shown as **-----**. For example, **-----** would be shown if the geoid field file associated to the geoid model is not available on the data storage device / internal memory.




| Key | Description |
|---|---|
| **OK** | To select the highlighted geoid model and to return to the previous screen. |
| **CF card** | To create a new geoid model. The \DATA\GPS\GEOID directory on the data storage device is automatically scanned for geoid field files. Refer to "8.7.3 Creating a New Geoid Model from the Data Storage Device / Internal Memory". |
| **Edit..** | To view the highlighted geoid model. None of the fields can be edited. The geoid field file from which the geoid model was created must be stored in the internal memory or in the \DATA\GPS\GEOID directory on the data storage device. |
| **Delete** | To delete the highlighted geoid model. The geoid field file which was associated with this geoid model is then also deleted. |
| Fn **Quit** | To exit the screen. |

### 8.7.3 Creating a New Geoid Model from the Data Storage Device / Internal Memory

**Requirement**

At least one geoid field file with the extension *.gem is in the \DATA\GPS\GEOID directory on the data storage device / internal memory.

**Create geoid model step-by-step**

| Step | Description |
|---|---|
| 1. | Listed in **Geoid Models** are all geoid models stored in the internal memory.<br>OR<br>Press **CF card** to scan the \DATA\GPS\GEOID directory on the data storage device. |
| 2. | For each geoid field file on the data storage device or in the internal memory, one geoid model is automatically created. The names given to the geoid models are those names which were entered in LGO.<br>☞ Existing geoid models are automatically overwritten by new models with the same name. |
| 3. | The creation of a geoid model is finished. |

## 8.8 CSCS Models

**Use in the field**

For use on the instrument in the field, CSCS field files are created from the CSCS model.

☞ The creation of CSCS models on the instrument and the functionality of all screens and fields are similar to those for geoid models. Refer to " Requirement".

The directory on the data storage device / internal memory for CSCS field files with the extension *.csc is \DATA\GPS\CSCS.

☞ All changes made effect the control job.

**Access**

Select **Main Menu: Jobs & Data\Create control data.**

☞ **Data..** displays the Data in the control job.

**Create new point**

This screen is similar to the **New Point** screen. Refer to "New Point, Coords page".

| Key | Description |
|---|---|
| **Next** | To store the point and to remain in the screen. The point ID increments according to point ID template. |

**Methods for creating lines, arcs and polylines**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | | Select one of the following options to create a line/arc/polyline. |
| | **2 points** and **Line - 2 points** | For lines/polylines. Uses two known points to define the reference line. |
| | **Pt, brng, dist, grade** and **Line - Pt, brng, dist, grad** | For lines/polylines. Defines the reference line using a known point, a distance, an azimuth and the gradient of the line. A new point is created at the end of the line. |
| | **Pt, brng, dist, Δht** and **Line - Pt, brng, dist, Δht** | For lines/polylines. The same as **Pt, brng, dist, grade**/**Line - Pt, brng, dist, grad** but uses the difference in height instead of the gradient. A new point is created at the end of the line. |
| | **3 points** and **Arc - 3 points** | For arcs/polylines. Defines the reference arc using three known points. |
| | **2 points/radius** and **Arc - 2 points/radius** | For arcs/polylines. Defines the reference arc with two known points and a known radius. |

**Create new line/arc**

For all point fields, the MapView interactive display can be used to select the desired point.

| Key | Description |
|---|---|
| **Store** | To store the line/arc to the control job. |
| **Next** | To store the line/arc and to remain in the screen. The line ID increments according to line ID template. |
| **Survy..** | To manually measure a point. Available when a point field is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual line ID different to the defined ID template and the running line ID according to the ID template. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line ID** | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways:<br>• To start a new sequence of line IDs, type over the line ID.<br>• For an individual name independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Azimuth** | Editable field | The azimuth of the line from the start point. |
| **Δ height** | Editable field | The difference in height from the start point to the end point of the line. |
| **End point** | Selectable list | The last point forming the line. |
| **Grade** | Editable field | The gradient of the line from the start point to the end point of the line. |
| **Horiz distance** | Editable field | The horizontal grid distance from the start point to the end point of the line. |
| **Line length** | Display only | For lines: The horizontal grid distance between the two points of the line. If the distance cannot be calculated, **-----** is displayed.<br>For arcs. The horizontal grid distance along the arc between the points. If the distance cannot be calculated, **-----** is displayed. |
| **Radius** | Editable field | The radius of the arc. |
| **Second point** | Selectable list | The medium point forming the arc. |
| **Start point** | Selectable list | The first point forming the line. |
| **Point ID** | Editable field | The end point of the defined line. Available for creating a line with **Method:Pt, brng, dist, Δht**. |

#### Next step

**Page** changes to the **Code** page. Refer to "New Line, Code page".

#### Create new polyline - Segment by segment

| Step | Description |
|---|---|
| 1. | In **Create New Polyline** select **Segment by segment**. |
| 2. | Select the method to use for the first segment. Refer to "Methods for creating lines, arcs and polylines" for a description of methods. |
| 3. | Type in the values for the first segment. Refer to "Create new line/arc" for a description of the input fields. |
| 4. | **Next** to store the segment. |
| 5. | Repeat step 2. to 4. until all segments are entered. |
| 6. | **Finish** to store the polyline. |

## Create new polyline - Enter point IDs

In **Create New Polyline** select **Enter point IDs**.

| Key | Description |
|---|---|
| **Store** | To store the line to the control job. |
| **Page** | To change to another page on this screen. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual line ID different to the defined ID template and the running line ID according to the ID template. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line ID** | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways:<br>• To start a new sequence of line IDs, type over the line ID.<br>• For an individual name independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Points in line** | Editable field | Enter a list of points from the control job and characters to define the line. |
| | . | Entering a dot between the points adds point-by-point to the polyline.<br>Example: Entering 1.3.5 creates a polyline with the points 1, 3 and 5 in that order. |
| | - | Entering a minus between the points adds all points between the two points to the polyline, according to the point ID ordering.<br>Example: Entering 1-5 creates a polyline with all points between 1 and 5.<br>☞ This can only be used with numeric point IDs. |
| | ( ) | Entering ( ) creates an arc between the points which are outside ( ) through the point which is inside ( ).<br>Example: Entering 1(3)5 creates a 3-point arc from 1 to 5 through 3 as the arc mid point. |
| **Line length** | Display only | The calculated 2D line length according to the selected points. Units according to distance in regional settings.<br>☞ The line length is shown in the unit configured in **Regional Settings**, **Distance** page. |

#### Create offset line & pts

| Key | Description |
|---|---|
| **OK** | To store the line/points to the control job. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line ID** | Selectable list | To select a line. Open the selectable list to access the **Line Selection** screen showing all selectable lines from the control job. |
| **Offset** | Editable field | Perpendicular offset of the line. Left is negative. RIght is positive. |
| **Objects to create** | **Line** | To create lines only. |
| | **Points** | To create points only. |
| | **Line & points** | To create lines and points. |
| **Line ID** | Editable field | The name of the new line. The configured ID template for lines is used. Type over the line ID to change it. |
| **Starting point ID** | Editable field | The point ID of the line start point. The configured ID template for points is used. |

#### Extend existing polyline

| Step | Description |
|---|---|
| 1. | In **Line to extend** select the line to extend. |
| 2. | **OK**. |
| 3. | Continue as if creating a new polyline. Refer to "Create new polyline - Segment by segment". |

# 10 Jobs & Data - Import data

## 10.1 Overview

**Description**

The data to import must be stored on the data storage device or in the internal memory.

Data can be imported to a job
- on the data storage device.
- on the internal memory.

**Import formats**

| Format | Characteristic | Description |
|---|---|---|
| **ASCII** | Import variables | Point ID, grid coordinates, thematical codes. No free codes, no attributes. |
| | Format definition | Free format. Use and order of variables and delimiter can be defined during import. |
| | Units | As currently configured on the instrument |
| | Height | Orthometric or ellipsoidal |
| | **Specialities** | |
| | Local heights but no coordinates in file | Points are imported without coordinates but with local height and code if available. |
| | Coordinates but no heights in file | Points are imported without height but with coordinates and code if available. |
| | No coordinates or heights in file | No import |
| | No point IDs in file | No import |
| **GSI8**<br>**GSI16** | Import variables | Point ID (WI 11), local coordinates (WI 81, WI 82, WI 83), thematical codes (WI 71). No free codes, no attributes. Example for GSI8:<br>110014+00001448 81..01+00001363 82..01-00007748 83..01-00000000 71....+000sheep |
| | Format definition | Fixed format. Easting and Northing can be switched during import. |
| | Units | As defined in the GSI file |
| | Heights | Orthometric or ellipsoidal |
| | **Specialities** | |
| | Local heights but no coordinates in file | Points are imported without coordinates but with local height and code if available. |
| | Coordinates but no heights in file | Points are imported without height but with coordinates and code if available. |
| | No coordinates or heights in file | No import |
| | No point IDs in file | No import |
| **DXF** | Import variables | Block, point, line, arc, polyline. Local coordinates. No free codes, no attributes. |
| | Format definition | Fixed format (X/Y/Z). |
| | Units | Not predefined. |

| Format | Characteristic | Description |
|---|---|---|
| | Heights | Z value imported as orthometric. |
| | **Specialities** | |
| | No coordinates or heights in file | No import |
| **MxGenio** | - | - |
| **LandXML** | - | - |
| **Terramodel** | - | - |
| **Carlson** | - | - |
| **Japan XML** | - | - |
| **DTM data** | Format definition | DXF file containing DTM data |
| **XML data** | Import variables | Definable:<br>points, lines, coordinate system, codes, global codelist, aligments, DTM |

**Checks**

Points are always imported with the class **Ctrl** and a coordinate quality of **-----**. Refer to "Appendix J Glossary".

While importing points to a job, checks are performed against point ID, class and coding of points already existing in the job.

# 10.2 Importing ASCII/GSI Data

**Requirements**

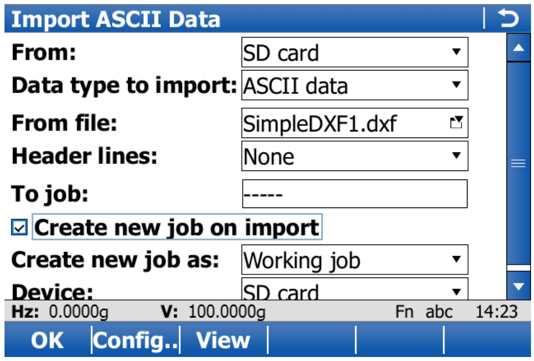
At least one ASCII file with any file extension, is stored in the \DATA or \GSI directory of the data storage device.

☞ Do not remove the data storage device while importing the data.

**Access**

Select **Main Menu: Jobs & Data\Import data\Import ASCII data**.

**Import ASCII Data**




| Key | Description |
|---|---|
| **OK** | To import the data. |
| **Config..** | To define the format of the data to be imported. |
| **View** | To view the file from which data will be imported. |
| Fn **Hts..** | To define how heights and the Easting are imported. |
| Fn **Quit** | To exit the screen. |

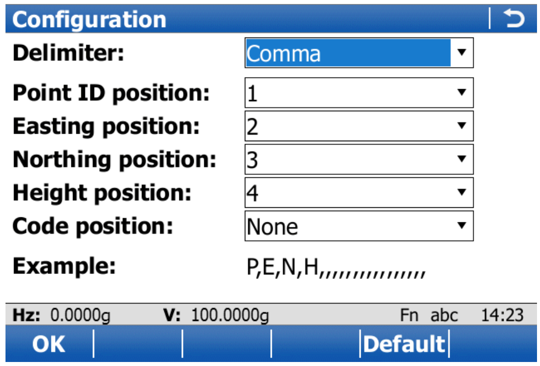
#### Description of fields

| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | Defines from which storage device the data are imported. |
| **Data type to import** | Selectable list | Defines if ASCII or GSI data are imported. |
| **From file** | Selectable list | For **Data type to import: ASCII data**: All files in the \DATA directory on the data storage device can be selected.<br>For **Data type to import: GSI data**: All files with extension *.gsi in the \GSI directory on the data storage device can be selected. |
| **Header lines** | Selectable list | This option allows up to ten header lines which can exist in an ASCII file to be skipped. Select the number of header lines. |
| **To job** | Selectable list | Available when **Create new job on import** is not checked. Choosing a job as destination for import makes this job the working job. |
| | Editable field | Available when **Create new job on import** is checked. The name of the new job. |
| **Create new job on import** | Check box | When this box is checked and the file from which the data should be imported is selected the **To job** field displayes a suggested jobname. The suggested jobname is the name of the file without the extension. |
| **Create new job as** | Selectable list | The new job can wither be a working job or a control job. |
| **Device** | Selectable list | The device on which the new job will be stored. |

#### Next step

**Config..** accesses, depending on selection for **Data type to import**, either **Configuration** or **Configuration (GSI)**.

## Configuration




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Default** | To recall the default import settings. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Delimiter** | Selectable list | The separator between the import variables. |
| **Point ID position**, **Easting position**, **Northing position**, **Height position** and **Code position** | **None** (not for **Point ID position**) and from **1** to **20** | Select the positions of the particular variables. An example is shown at the bottom of the screen. |
| **Multiple spaces between data** | | Available for **Delimiter: Space**. |
| | **Yes** | For space delimited data having multiple spaces between the variables. |
| | **No** | For space delimited data having one space between the variables. |
| **Number of lines/pt** | Selectable list | Available for **Delimiter: Line feed**. The number of lines used to describe each point. |

### Next step

| Step | Description |
|---|---|
| 1. | **OK** leads back to **Import ASCII Data**. |
| 2. | Fn **Hts..** to access **Define Ht Type & Easting Import**. |

### Configuration (GSI)

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Switch WI81/WI82** | **Yes** or **No** | All WI 81 data, normally Easting, is imported as Northing and all WI 82 data, normally Northing, is imported as Easting. This coordinate switch is necessary for "left handed" coordinate systems. |
| **Definition of feet** | Selectable list | The type of feet used in the GSI file. |

#### Next step

| Step | Description |
|---|---|
| 1. | **OK** leads back to **Import ASCII Data**. |
| 2. | Fn **Hts..** to access **Define Ht Type & Easting Import**. |

### Define Ht Type & Easting Import

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Import as** | Selectable list | The height type for the imported data. |
| **Easting** | Selectable list | The Easting can be imported as written in the ASCII file or it can be multiplied by -1. This change is required by some coordinate systems. |

**OK** leads back to **Import ASCII Data**.

## 10.3 Importing Data in LandXML Format

**Requirements**

At least one file in LandXML format with the file extension *.xml has to be stored in the \DATA directory of the data storage device.

☞ The file can contain points, lines, areas, alignments (Road/Rail/Tunnel jobs) and DTM's/PLA's.

**Access**

Select **Main Menu: Jobs & Data\Import data\Import XML data**.

**Import XML Data**

| Key | Description |
|---|---|
| **OK** | To import the data. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | Defines from which storage device the data are imported. |
| **From file** | Selectable list | All files with extension *.xml in the \DATA directory on the data storage device can be selected. |
| **Import points, lines, areas, coord systems & point codes** | Check box | When this box is checked, points, lines and areas are imported and a job can be selected. |
| **Import alignments** | Check box | When this box is checked, alignments are imported and a job can be selected. |
| **Import DTM** | Check box | When this box is checked, DTM's are imported and a new DTM job is created which can be selected. |

**Next step**

**OK** start the import.

## 10.4 Importing Alignment Data

**Requirements**

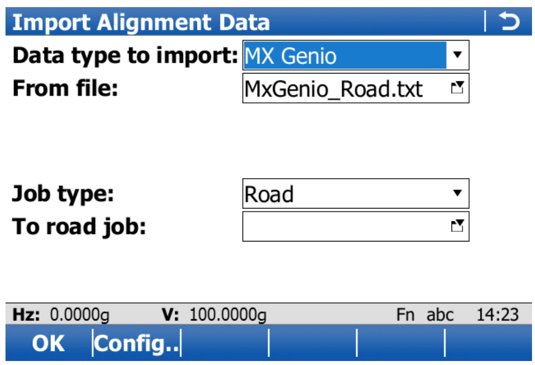
The requirements depend on the file type:

- For MxGenio: At least one file in MxGenio format with the file extension *.txt is stored in the \DATA directory of the data storage device.
- For LandXML and Terramodel: At least one file in LandXML format with the file extension *.xml is stored in the \DATA directory of the data storage device.
- For DXF: At least one file in DXF format with the file extension *.dxf is stored in the \DATA directory of the data storage device.
- For Carlson: At least one file in Carlson format with the file extension *.cl is stored in the \DATA directory of the data storage device.

**Access**

Select **Main Menu: Jobs & Data\Import data\Import alignment data**.

**Import Alignment Data**



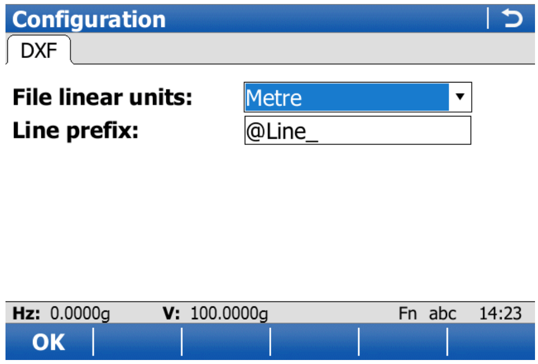

| Key | Description |
|---|---|
| **OK** | To import the data. |
| **Config..** | To define the format of the data to be imported. Available for **Data type to import: MX Genio**, **Data type to import: DXF** and **Data type to import: Carlson**. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Data type to import** | Selectable list | Defines if MX Genio, LandXML, DXF, Terramodel or Carlson data are imported. |
| **From file** | Selectable list | For **Data type to import: MX Genio**: All files with the extension *.txt in the \DATA directory on the data storage device can be selected.<br>For **Data type to import: LandXML**: All files with the extension *.xml in the \DATA directory on the data storage device can be selected.<br>☞ For cross section-based LandXML data, vertex connection definitions are mandatory.<br>For **Data type to import: DXF**: All files with extension *.dxf in the \DATA directory on the data storage device can be selected.<br>For **Data type to import: Terramodel**: A Terramodel *.xml file in the \DATA directory on the data storage device can be selected. The file must contain the centreline.<br>For **Data type to import: Carlson**: All Carlson centreline files with the extension *.cl in the \DATA directory on the data storage device can be selected. |
| **Section file** | Selectable list | For **Data type to import: Terramodel**: All ASCII cross-section files with the extension *.txt in the \DATA directory on the data storage device can be selected.<br>For **Data type to import: Carlson**: All Carlson cross-section files with the extension *.sct in the \DATA directory on the data storage device can be selected. |
| **Job type** | **Road** and **Rail** | The type of job the data are converted to. |
| **To road job** or **To rail job** | Selectable list | When importing data, a new/empty rail or road job must be created for the data to be stored in. |

**Configuration**

This screen is available for **Data type to import: MX Genio**, **Data type to import: DXF** and **Data type to import: Carlson**.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **File linear units** | Selectable list | The units used in the file to import. |
| **Line prefix** | Editable field | Available for **Data type to import: DXF**. The prefix to be used. ☞ **Line prefix** can not be defined for Carlson data. |

### Next step

| Step | Description |
|---|---|
| 1. | **OK** leads back to **Import Alignment Data**. |
| 2. | **OK** opens, depending on the selections made, a screen for the line, layer or track selection. |

**Import MX Genio Data, for Road jobs**

| Key | Description |
|---|---|
| **OK** | To start the import. |
| **Centre** | To set the highlighted line as centreline. |
| **Use** | To set **Yes** or **No** in the **Use** column for excluding/including the highlighted line from/to import. |
| Fn **Quit** | To exit the application. |

☞ Line selection is also possible on the **Map** page.

| IF | THEN |
|---|---|
| a single line is to be selected | tap on the line. |
| multiple lines are to be selected | click the icon, drag the stylus on the screen in a diagonal line to make a rectangular area. |
| the context menu is to be activated | hold down the supplied stylus anywhere on the map for 0.5 second. Refer to "38.6 Context Menu".<br>☞ To deselect all objects for import, select **Clear selected object**. |

**Description of columns**

| Column | Description |
|---|---|
| **Line name** | Displays the name of all the lines in the layer. |
| **CL** | Shows **CL** for the line selected as centreline. |
| **Use** | For **Yes**: The selected line is used for the import.<br>For **No**: The selected line is not used for the import. |

**Next step**
**OK** start the import.

**Define Track Design, MxGenio for Rail jobs**

For MxGenio, only single track Rail jobs can be created.

| Key | Description |
|---|---|
| **OK** | To start the import. |
| **Ch CL** | To select/deselect the highlighted line as external chainage centreline. The selection is optional. |
| **T. CL** | To select/deselect the highlighted line as track centreline. The selection is mandatory. |
| **Rail L** | To select/deselect the highlighted line as left rail. The selection is optional. |
| **Rail R** | To select/deselect the highlighted line as right rail. The selection is optional. |
| Fn **Quit** | To exit the application. |

☞ Line selection/deselection is also possible on the **Map** page.

| IF | THEN |
|---|---|
| a single line is to be selected/deselected | tap on the line. |
| the context menu is to be activated | hold down the supplied stylus anywhere on the map for 0.5 second. Refer to "38.6 Context Menu". |

**Description of columns**

| Column | Description |
|---|---|
| **Line name** | Displays the name of all the lines. |
| **Use as** | Displays a line selected as external chainage centreline, track centreline, left rail or right rail. |

**Next step**
**OK** start the import.

### Select Layers to Import, for DXF Road/Rail data, LandXML Road/Raildata, Terramodel Road data and Carlson Roaddata

| Key | Description |
|---|---|
| **OK** | To start the import. |
| **Edit..** | • For Road: To define the centerline and to turn lines on and off for the highlighted layer.<br>• For Rail: To define the external chainage centreline (optional), to define the track centerline (mandatory), to define the left rail (optional) and to define the right rail (optional).<br>By default, the longest stringline is set as the centreline.<br>For DXF and LandXML data (Road and Rail), line selection, per layer, is also possible in **Edit Layer**, **Map** page.<br>• To select a single line, tap on the line.<br>• For Road: To select multiple lines, click the icon, drag the stylus on the screen in a diagonal line to make a rectangular area.<br>• To activate the context menu, hold down the supplied stylus anywhere on the map for 0.5 second. Refer to "38.6 Context Menu". |
| **Use** | To set **Yes** or **No** in the **Use** column for excluding/including the high-lighted line from/to import. |
| Fn **Quit** | To exit the application. |

**Description of columns**

| Column | Description |
|---|---|
| **Layer name** | Displays the name of all layers available for importing. |
| **Use** | For **Yes**: The selected layer is used for the import.<br>For **No**: The selected layer is not used for the import. |

**Next step**

**OK** start the import.

## 10.5 Importing DXF Data

**Requirements**

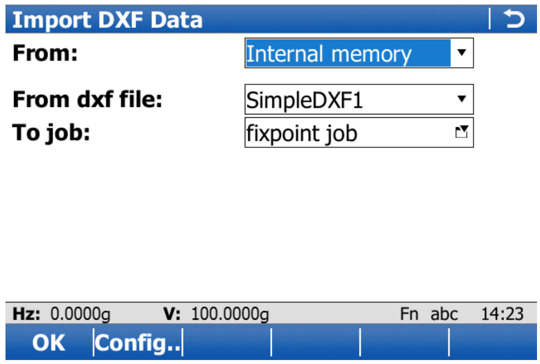
At least one file in DXF format with the file extension *.dxf has to be stored in the \DATA directory of the data storage device.

☞ Do not remove the data storage device while importing the data.

**Access**

Select **Main Menu: Jobs & Data\Import data\Import DXF data**.

**Import DXF Data**




| Key | Description |
|---|---|
| **OK** | To import the data. |
| **Config..** | To define the format of the data to be imported. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | Defines from which storage device the data are imported. |
| **From file** | Selectable list | All files with extension *.dxf in the \DATA directory on the data storage device can be selected. |
| **To job** | Selectable list | Choosing a job as destination for import makes this job the working job. |

**Next step**

**Config..** accesses **DXF Import**.

**DXF Import**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Block prefix** | Editable field | Optional prefix to imported blocks. |
| **Point prefix** | Editable field | Optional prefix to imported points. |
| **Line prefix** | Editable field | Optional prefix to imported lines. |
| **File units** | Selectable list | Choosing the unit for the DXF data to be imported. |
| **Create points at the vertices of lines** | Check box | Option if points will be created at vertices of the imported line/arc/polyline elements. |
| **Convert white elements** | Check box | Option if white coloured elements will be converted to black coloured elements. |
| **Height to exclude** | Selectable list | Height values inside the DXF file are considered invalid and will not be converted. |
| **Apply height to 2D CAD data on import** | Check box | When this box is checked, a height can be defined which is then applied to all imported 2D CAD points. |
| **Height to apply** | Editable field | Available when **Apply height to 2D CAD data on import** is checked. The height to apply to 2D CAD points. |

### Next step

**OK** leads back to **Import DXF Data**.

## 10.6 Importing DTM Data

**Requirements**

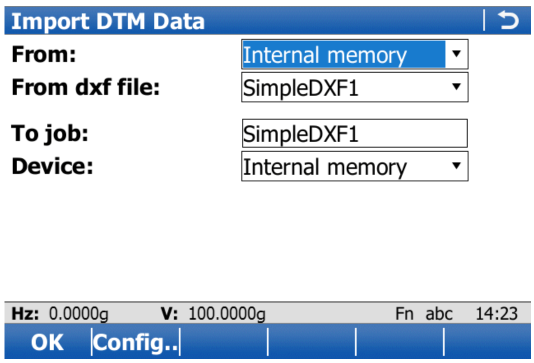
- At least one file in DXF format with the file extension *.dxf has to be stored in the \DATA directory of the data storage device.
- The DXF file must contain a 3D face layer.

☞ Do not remove the data storage device while importing the data.

**Access**

Select **Main Menu: Jobs & Data\Import data\Import DTM data**.

**Import DTM data**




| Key | Description |
|---|---|
| **OK** | To import the data. |
| **Config..** | To define the linear units of the data to be imported. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | Defines from which storage device the data are imported. |
| **From dxf file** | Selectable list | All files with extension *.dxf in the \DATA directory on the data storage device can be selected. |
| **To job** | Selectable list | Choosing a job as destination for import makes this job the DTM job. |
| **Device** | Selectable list | Defines to which storage device the data are imported. |

**Next step**

**Config..** accesses **Configuration**.

**Configuration**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **File linear units** | Selectable list | Choosing the unit for the DXF data to be imported. |

**Next step**

**OK** leads back to **Import DXF Data**.

# 11 Jobs & Data - Export & copy data

## 11.1 Overview

**Description**

Data can be exported
- to a file on the data storage device.
- to a file on the internal memory.

**Export format**

| Format | Characteristic | Description |
|---|---|---|
| **ASCII** | Export variables | Point ID, grid coordinates, thematical codes, code description, up to four attributes and linework. No free codes. |
| | Format definition | Free format. Use and order of variables and delimiter can be defined during export. |
| | Units | As currently configured on the instrument |
| | Height | Orthometric or ellipsoidal |
| **Custom** | Export variables | Refer to the online help of LGO. |
| | Format definition | Composed individually as format file using LGO. Refer to the online help of LGO for information on creating format files. |
| | Units | Defined within the format file. |
| | Coordinate conversion | All coordinate types are supported. |
| | Height | All height types are supported. If the desired height cannot be computed, the default value for the missing variable is output. |
| | **Specialities:** | |
| | Points in file outside of CSCS model | If the variable is missing, the default value is output. |
| | Points in file outside of geoid model | If the variable is missing, or a geoid separation is available, the default value is output. |
| **DXF** | Coordinate conversion | All points are converted to local grid position using the coordinate system. |
| | Height | Orthometric height and ellipsoidal height are supported. |
| | **Specialities:** | |
| | Points in file outside of CSCS model | Points outside of CSCS model are not exported. |
| | Points in file outside of geoid model | The ellipsoidal height is exported. |
| **LandXML** | Coordinate conversion | All points are converted to local grid position using the coordinate system. |
| | Height | Orthometric height and ellipsoidal height are supported. |
| | **Specialities:** | |
| | Points in file outside of CSCS model | LocalGrid position of the points outside of CSCS model is not exported. |

| Format | Characteristic | Description |
|---|---|---|
| | Points in file outside of geoid model | The ellipsoidal height is exported. |
| **FBK/RAW5/ RAW** | Coordinate conversion | All points are converted to local grid position using the coordinate system. |
| | Height | If a geoid model exists, then orthometric height is supported, otherwise ellipsoidal height is exported. |
| | Units | Metre, US Ft or Int Feet, Gons, Dec Deg, DMS |

## 11.2 Exporting Data from a Job to an ASCII Format

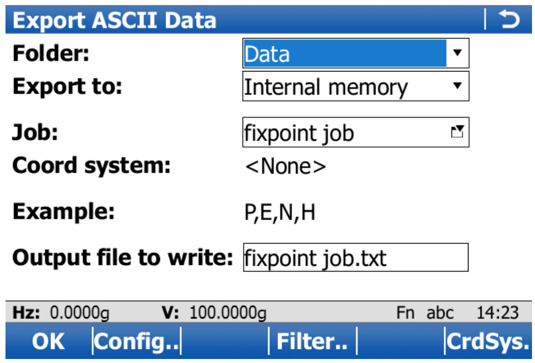
**Description**

The settings on this screen define the data that is converted and exported and what format is used.
Data is exported from the selected job. Currently active view, filter and sort settings are applied.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export ASCII data.**

**Export ASCII Data**




| Key | Description |
|---|---|
| **OK** | To select the highlighted format file. |
| **Config..** | To define the format of the data to be exported. |
| **Filter..** | To define the order in which points, lines and areas are exported as well as which points are exported. |
| **CrdSys.** | To update the coordinate system in which the coordinates are exported. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Export to** | Selectable list | Defines where the exported data are saved to. For **Export to: Internal memory** the data is always exported to the \DATA directory. |
| **Folder** | Selectable list | The data can be exported to the \DATA or the root directory or to the folder where the selected job is located. |
| **Job** | Selectable list | To select the job to export. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **Output file to write** | Editable field | The name of the file to which the data will be exported. |

**Next step**

**Config..** accesses **Configuration**.

**Configuration**

| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Default** | To recall the default import settings. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Delimiter** | Selectable list | The separator between the import variables. |
| **1st position** to **8th position** | **None**, **Point ID**, **Easting**, Northing, **Elevation**, **Code**, **Code information**, **Code & code info**, **Description**, Attribute 1 to **Attribute 4** and **Linework** | Select the variable of the particular positions. An example is shown on the **Export ASCII Data** screen. |

## 11.3 Exporting Data from a Job to a Custom Format

**Description**

The settings on this screen define the data that is converted and exported and what format is used.
Data is exported from the selected job. Currently active view, filter and sort settings are applied.

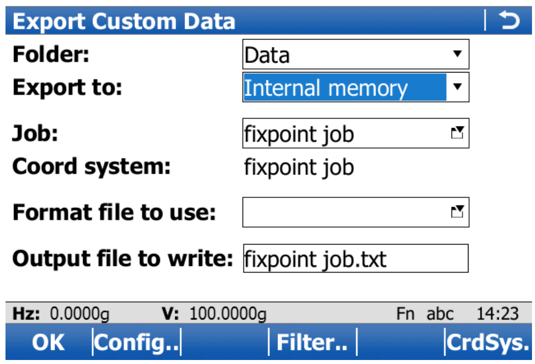
**Requirements**

At least one format file was created using LGO and transferred to the internal memory.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export custom data.**

**Export Custom Data**




| Key | Description |
|---|---|
| **OK** | To select the highlighted format file. |
| **Config..** | To configure the default extension to be used. |
| **Filter..** | To define the order in which points, lines and areas are exported as well as which points are exported. |
| **CrdSys.** | To update the coordinate system in which the coordinates are exported. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Export to** | Selectable list | Defines where the exported data are saved to.<br>For **Export to: Internal memory** the data is always exported to the \DATA directory. |
| **Folder** | Selectable list | Available for **Export to: CF card**, **Export to: SD card** and **Export to: USB**. The data can be exported to the \DATA, the \GSI or the root directory or to the folder where the selected job is located. Data must be stored to the \GSI directory to be read in a TPS instrument. |
| **Job** | Selectable list | To select the job to export. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **Format file to use** | Selectable list | The format files currently available in the internal memory. |
| **Output file to write** | Editable field | The name of the file to which the data will be exported. |

## 11.4 Exporting Data in DXF Format

**General**

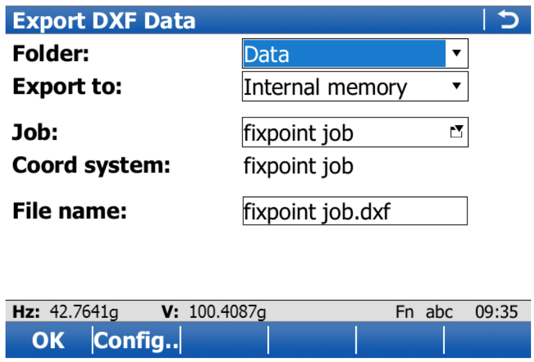
Data can be exported to a DXF file in a data storage device or the internal memory.

☞ Do not remove the data storage device while exporting the data.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export DXF Data.**

**Export DXF data**




| Key | Description |
|---|---|
| **OK** | To accept the settings. |
| **Config..** | To define what is exported. |
| Fn **Quit** | To exit the screen. |

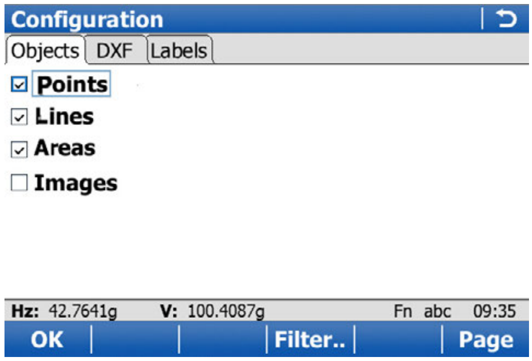
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Folder** | Selectable list | Defines if the data is exported to the \DATA directory or to the folder where the selected job is located. |
| **Export to** | Selectable list | Available for **Folder: Data**. Defines which data storage device the data is exported to. |
| | Display only | Available for **Folder: Same as job**. Displays the data storage device of the selected **Job**. |
| **Job** | Selectable list | To select the job to export. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **File name** | Editable field | The name of the file to which the data will be exported. |

**Next step**

**Config..** goes to **Configuration**, **Export** page.

**Configuration, Export page**




| Key | Description |
|---|---|
| **OK** | To export the data. |
| **Filter..** | To define the order in which points, lines and areas are exported as well as which points are exported. Refer to "6.6.1 Sorting and Filters for Points, Lines and Areas". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Points** | Check box | When this box is checked, points are exported. |
| **Lines** | Check box | When this box is checked, lines are exported. |
| **Areas** | Check box | When this box is checked, areas are exported. |
| **Images** | Check box | When this box is checked, images are exported. |

**Next step**
**Page** changes to the **DXF** page.

For information on camera and images refer to "34.6 Exporting Images".

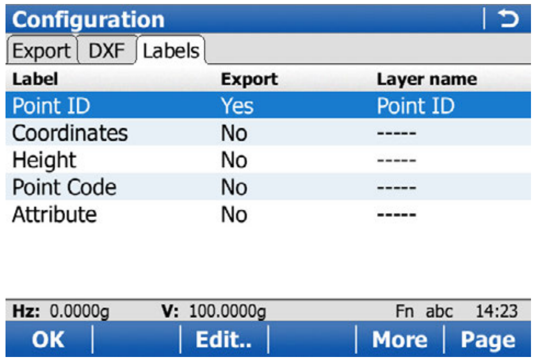
**Configuration, DXF page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Export lines & areas** | Selectable list | Defines if lines and areas are exported as Line or Polyline entities. |
| **Symbol size** | Editable field | Defines the size used for creation of the LGO symbols. |
| **Dimensions** | Selectable list | Defines if the data is exported as 2D or 3D. |
| **Export to DXF layer** | Selectable list | Defines the DXF layer. |
| **Export LGO symbols** | Check box | When this box is checked, the relevant symbols for LGO are also exported. |

**Next step**
**Page** changes to the **Labels** page.

**Configuration, Labels page**




| Key | Description |
|---|---|
| **OK** | To accept the settings. |
| **Edit..** | To define if the label is exported, its colour, the number of decimal places to use and what layer or block it is exported to. |
| **More** | To display information about the layer name, the colour and the decimals. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Label** | The name of the label. |
| **Export** | Shows if the label is exported or not. |
| **Layer name** | The name of the layer that is exported which can be:<br>• Name of a user-defined layer<br>If the label is exported to a user-defined layer.<br>• **Same layer as point**<br>If the label is exported to the same layer as the point symbol.<br>• **Block with point**<br>If the label is exported to a block with the point symbol.<br>• **-----**<br>The label is not exported. |
| **Colour** | The colour of the label. |
| **Decimals** | The number of decimals used. |

**Next step**
**Edit..** access **Labels**.

**Labels**

### Description of fields

| Field | Option | Description |
|---|---|---|
| First field on screen | Check box | When this box is checked, the chosen label types are exported.<br>☞ All other fields on the screen are active and can be edited. |
| **Colour** | Selectable list | Defines the colour for the label. |
| **Decimals** | From **0** to **4** | Available for the labels **Coordinates** and **Height**. Defines the number of decimal places for the label. |
| **Export to** | **User defined** | The label is exported to a user defined layer. |
| | **Same layer as point** | The label is exported to the layer which the point symbols are exported to. |
| | **Block with point** | The label is exported to a block with the point symbol and all other labels which are also set to be exported to **Block with point**. Only one block is created for a point and there can be one or more labels in this block. |
| **Layer name** | Selectable list | Available for **Layer name: User defined** is checked. The name of the layer. |
| **Export code descriptions** | Check box | Available when **Point Code** is highlighted in **Configuration**, **Labels** page. Defines if the code descriptions are exported with the point code. |
| **Export attribute names** | Check box | Available when **Attribute** is highlighted in **Configuration**, **Labels** page. Defines if the attribute names are exported with the attribute values. |

**Next step**
**OK** returns to **Configuration**.

## 11.5 Exporting Data in XML Format

**General**

Data can be exported to an XML file in the
- \DATA directory or
- same directory as the job is in

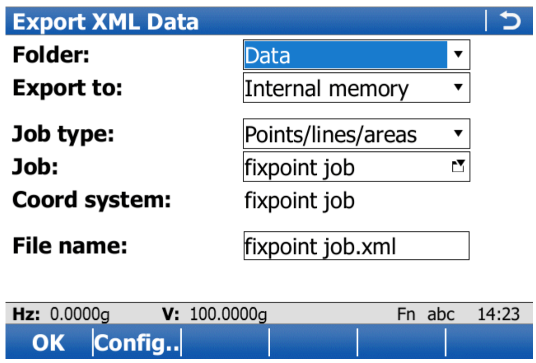
on the
- data storage device or
- internal memory.

Do not remove the data storage device while exporting the data.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export XML Data.**

**Export XML Data**




| Key | Description |
|---|---|
| **OK** | To export the data. |
| **Config..** | To define what is exported. |
| Fn **Quit** | To exit the screen. |

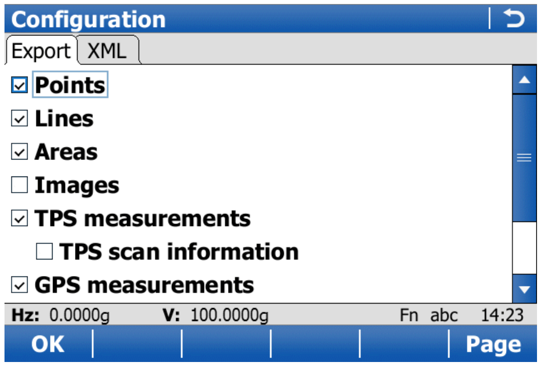
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Export to** | Selectable list | Defines where the exported data are saved to. |
| **Folder** | Selectable list | The data can be exported to the \DATA directory or to the folder where the selected job is located. |
| **Job type** | **Points/lines/areas**, **Road**, **Rail** or **Tunnel** | The type of job to be exported. To use this option, select **LandXML version: 1.2** and check **Use Hexagon XML extension** in **Configuration**, **XML** page. |
| **Job** | Selectable list | To select the job to export. The selectable list depends on the setting for **Job type**. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **File name** | Editable field | The name of the file to which the data will be exported. |

**Next step**

**Config..** accesses **Configuration**, **Export** page.

**Configuration, Export page**




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Points** | Check box | When this box is checked, points are exported. |
| **Lines** | Check box | When this box is checked, lines are exported. |
| **Areas** | Check box | When this box is checked, areas are exported. |
| **Images** | Check box | When this box is checked, all onboard, TPS and panoramic images are exported. |
| **TPS measure-ments** | Check box | When this box is checked, TPS observations are exported. |
| **GPS measure-ments** | Check box | When this box is checked, GPS observations are exported. |
| **Codes** | Check box | When this box is checked, point codes, line codes and area codes are exported. |
| **Free codes** | Check box | When this box is checked, the free code, free code description, free code group and the free code attributes, are all exported to the LandXML file associated to each exported point.<br>Free code export works also when **Use Hexagon XML extension** is checked on the **XML** page. |
| **Application results** | Check box | When this box is checked, all application results such as stakeout and reference line are exported. They are only exported when **Use Hexagon XML extension** is checked on the **XML** page. |

**Next step**

**Page** changes to the **XML** page.

☞ For information on camera and images refer to "34.6 Exporting Images".

**Configuration, XML page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Dimensions** | Selectable list | Defines the dimension of the exported entities. |
| **LandXML version** | Selectable list | Defines the LandXML version of the file exported file. |
| **Use Hexagon XML exten-sion** | Check box | Available for **LandXML version**: **1.2**. When this box is checked, a job type can be selected for the export in the **Export XML Data** screen. |

## 11.6 Exporting Data using Stylesheets

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export with Stylesheet.**

**Export Data Using Stylesheet**

| Key | Description |
|---|---|
| **OK** | To export the data. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Folder** | Selectable list | The data can be exported to the \DATA directory or to the folder where the selected job is located. |
| **Export to** | Selectable list | Defines where the exported data is saved to. |
| **Job type** | **Points/lines/areas**, **Road**, **Rail** or **Tunnel** | The type of job to be exported. |
| **Job** | Selectable list | To select the job to export. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **Stylesheet to use** | Selectable list | The stylesheets currently available in the \CONVERT folder on the internal memory of the CS: My Device\Leica GeoSystems\SmartWorx Viva\Convert. |
| **Description:** | Display only | A detailed description of the stylesheet. This information is entered by the user in a variable within the stylesheet. |
| **File name** | Editable field | The name of the file to which the data will be exported. The file extension is defined by the user in a variable inside the stylesheet. Default is "txt" if the extension has not been defined. |

## 11.7 Exporting Data in FBK/RW5/RAW Format

**General**

Data can be exported to an AutoDesk FBK, TDS RAW, TDS RW5, Carlson RW5 or MicroSurvey RW5 file. The newly created file is stored in the \DATA directory of the data storage device or the internal memory.

The formatted FBK files can be imported directly into Autodesk products.

The created RW5 and RAW files can be processed with various survey office packages.

Although the export operation converts any job to an FBK/RW5/RAW file, the figure creation is based on existing lines and areas present in the job.

**Point codes**

Each point collected should have a point code.

| IF you are creating | THEN |
|---|---|
| Autodesk FBK file | Point codes are used to match the Description Keys in Autodesk LDT and Civil 3D to each position located. |
| TDS RW5 file | Point codes are used to generate raw linework in TDS Foresight. |
| MicroSurvey RW5 file | Point codes are used to match the Description Keys in MicroSurvey CAD to each position located. |

**Line/Area ID**

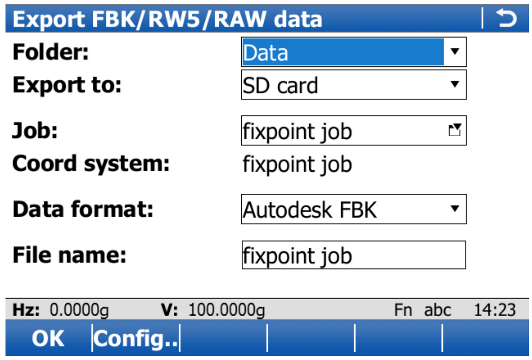
| IF you are creating | THEN |
|---|---|
| Autodesk FBK file | The figure ID follows the user selection as defined in the configuration menu. |
| TDS RW5 file | The line and area IDs are not used when importing data into TDS Foresight. |
| MicroSurvey RW5 file | The line and area IDs are not used when importing data into MicroSurvey CAD 2005. |

☞ Do not remove the data storage device while exporting the data.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Export FBK/RW5/RAW data.**

## Export FBK/RW5/RAW data




| Key | Description |
|---|---|
| **OK** | To export the data. |
| **Config..** | To configure some format-specific options. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Export to** | Selectable list | Defines where the exported data are saved to. |
| **Folder** | Display only | The data can be exported to the \DATA directory or to the folder where the export job is located. |
| **Job** | Selectable list | To select the job to export. |
| **Coord system** | Display only | The coordinate system currently attached to the selected job. |
| **Data format** | **Autodesk FBK**, **TDS RW5**, **TDS RAW**, **Carlson RW5** or **Micro-Survey RW5** | Ensure that this field is set properly. |
| **File name** | Editable field | Default is the name of the selected **Job**. It can be changed.<br>☞ The extension designation (.FBK, .RW5 or .RAW) is added automatically. |

### Next step

**Config..** to access the configuration screen.

**Configuration for FBK, General page**

### Description of fields

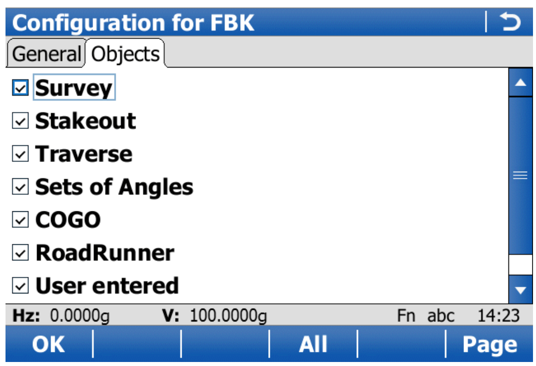
| Field | Option | Description |
|---|---|---|
| **Use numerical pt ID** | Check box | Available unless **Data format: TDS RW5**. |
| **Pt ID offset** | Editable field | The point IDs are offset by this value. |
| **Use angle right** | Check box | Define if angle right values are exported. |
| **Figure ID** | Selectable list | Available for **Data format: Autodesk FBK**. For all other formats, the figure ID is set to point code only automatically. |

### Next step

**Page** changes to the **Objects** page.

---

**Configuration for FBK, Objects page**




| Key | Description |
|---|---|
| **OK** | To return to **Export FBK/RW5/RAW data**. |
| **All** | To check all boxes at once. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| All fields | Check box | To include points from an application, check a box. |

### Next step

**OK** returns to **Export FBK/RW5/RAW data**.

---

## 11.8 Copy Data Between Jobs

**Description**

This chapter explains the process of copying data from one job to another.

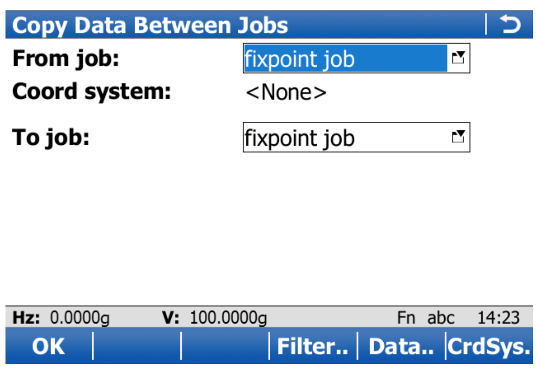
Important features:

- Points are copied as defined by the point filter settings.
- Points selected for copying can be viewed in a points listing. The point sort settings define the order of the points in the listing. The point filter settings define the points to be viewed in the listing.
- Only points are copied - observation data is not copied.
- When points are copied from one job to another:
  - the point codes and attached attributes are also copied.
  - the **Class** is retained.
  - the **Sub class** is retained.
  - the **Source** is changed to **Copied Point**.
  - the point coordinate quality is retained.
  - the **Instrument Flag** is retained.
  - the **Date** and **Time** is retained.

**Access**

Select **Main Menu: Jobs & Data\Export & copy data\Copy data between jobs.**

**Copy Data Between Jobs**




| Key | Description |
|---|---|
| **OK** | To copy a selection of points. |
| **Filter..** | To define the point sort and/or point filter settings of points from the job. Refer to "6.6.1 Sorting and Filters for Points, Lines and Areas". |
| **Data..** | To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply. Refer to "6 Jobs & Data - Data". |
| **CrdSys.** | To select a different coordinate system. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From job** | Selectable list | Describes where the points are to be copied from. |
| **Coord system** | Display only | The coordinate system which is currently attached to the job. |
| **To job** | Selectable list | Describes where the points are to be copied to. |

# 12 Instrument - TPS settings TPS

## 12.1 Measure mode & target

### 12.1.1 Measure & Target Settings

**Description**

The settings on this screen define the active EDM **E**lectronic **D**istance **M**easurement and ATR **A**utomatic **T**arget **R**ecognition settings.

☞ Available options depend on the purchased model, for example with or without ATR.

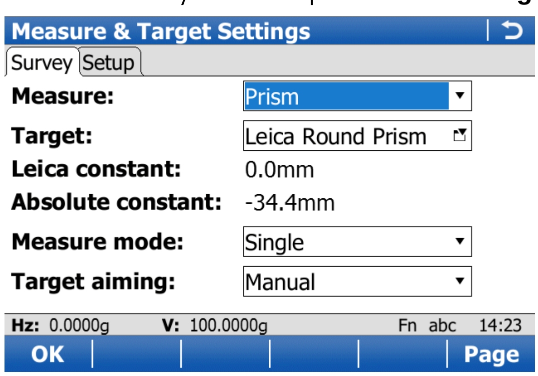
**Access**

Select **Main Menu: Instrument\TPS settings\Measure mode & target**.

**Measure & Target Settings**

**Description**

- This screen has two pages - the **Survey** page and the **Setup** page.
- The **Survey** page and **Setup** page contain identical fields.
- The settings made in the **Survey** page are used by all applications and all measurements taken outside of the **Setup** application.
- The settings made in the **Survey** page are only used inside the Setup application.
- Any changes made to the **Measure & Target Settings**, for example via icons or hotkeys, while the Setup application is active, only affect the Setup **Measure & Target Settings**.
- Any changes made to the **Measure & Target Settings**, for example via icons or hotkeys, while the Setup application is not active, only affect the Survey **Measure & Target Settings**.
- When entering the Setup application, the Setup **Measure & Target Settings** are active.
- When leaving the Setup application, the Survey **Measure & Target Settings** are active.
- Both Survey and Setup **Measure & Target Settings** are part of the working styles.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Test** | To access the **Measurement Signal Test** screen. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Measure** | **Prism** | All fields are set to the last used options.<br>The infrared EDM exists for all instrument types and allows to measure the distance to a prism or a tape. For **Target aiming: Automatic** or **Target aiming: Lock** this option is automatically set. |
| | **Any surface** | To measure without reflector. |
| **Measure mode** | **Single** | Available for **Measure: Prism**. When a single measurement with high precision is required. |
| | **Single (fast)** | Available only for **Measure: Prism**. When a single measurement is required but the time to survey must be minimised. The highest accuracy is of less importance.<br>Use this mode for example when performing, "typical" topographical surveys. |
| | **Continuous** | When continuous distance measurements are required.<br>Use this mode for example when continually checking the positions of a moving prism pole. |
| | **Continuous+** | Available for **Measure: Prism**. This is the measurement mode for the interpolation of angle measurements in prism LOCK continuous mode.<br>In difference to normal continuous mode, where angle measurements are only assigned to certain distance measurements, **Continuous+** will perform a linear interpolation between the previous and following angle measurement, based upon the timestamp of the EDM measurement. Using this interpolation procedure, a higher accuracy for all dynamic applications, for example machine guidance, is possible.<br>Use this mode for example with machine control applications. |
| | **Averaging** | Repeats measurements in standard measuring mode. The average distance of **No. of distances** and the standard deviation for the averaged distance are calculated.<br>Use this mode for example when performing cadastral survey where rigid guidelines must be followed. |
| | **Long range (>4km)** | Available only for **Measure: Prism**. When long distances ( > 4 km) to prisms are needed.<br>Use this mode for example for triangulation measurements. |
| | **Long range avg** | Available for **Measure: Prism**. Whenever long distances ( > 4 km) to prisms are needed but in addition, average values and standard deviations for multiple precise distance measurements are required. |

| Field | Option | Description |
|---|---|---|
| | | Use this mode for example when performing triangulation measurements within a cadastral survey where rigid guidelines must be followed. |
| | **Precise** | Available for **Measure: Prism** on TS50/TM50. Fine measuring mode for highest precision measurements with prisms. |
| **No. of distances** | | Available if **Measure mode**: **Averaging** or **Measure mode**: **Long range avg**. Input field for the maximum number of distances to be averaged from 2 to 999 distances. |
| **Target** | Selectable list | Target names as configured in the **Targets** screen. |
| **Leica constant** | Display only | The additive constant as stored for the selected prism in the SmartWorx Viva software. |
| **Absolute constant** | Display only | The true additive constant. |
| **Target aiming** | **Manual** | Measurements are done without any automation. ATR search and/or ATR measurement are not performed. |
| | **Automatic** | Positioning to static prisms. The ATR sensor is used for measurements to static prisms. If needed an ATR measurement or ATR search is performed after pressing **Meas** or **Dist**. |
| | **Lock** | Unavailable for SmartStation/TS12 Lite. The instrument locks onto and follows the moving prism. The ATR sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on **Measure** single or continuous measurements are performed pressing **Meas** or **Dist**. |
| **Visibility** | **Good** | If weather conditions are normal, then select this mode. |
| | **Rain & fog** | To increase the instrument measuring ability during suboptimal weather conditions. This mode is automatically deactivated when the instrument is turned off. |
| | **Rain & fog always** | As for **Rain & fog**, however this mode stays active when the instrument is turned off. |
| | **Sun & reflections** | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This mode has a considerabel influence on the range (restriction 100 - 150 m). This mode is automatically deactivated when the instrument is turned off. |
| | **Sun & rflctns always** | As for **Sun & reflections**, however this mode stays active when the instrument is turned off. |
| **Allow lock in on the fly** | Check box | Available for **Target aiming**: **Lock**. For robotic instruments and the remote operation with CS10/CS15. |

| Field | Option | Description |
|---|---|---|
| | | When this box is checked, the instrument locks to a prism as soon as it enters the ATR field of view when previously locked to a prism and target lock was lost.<br>☞ A power search helps to lock to shaking prisms.<br>Works on all prisms and tape targets. |
| **High dynamics at short range** | Check box | Available for **Target aiming**: **Lock**. For robotic instruments and the remote operation with TS15.<br>When this box is checked, the performance improves for distances less than 20 m to the instrument. The instrument reacts faster to changes in prism speed and direction. |
| **Use precise target aiming** | Check box | Available for the 0.5" instruments of TS50/TM50. When this check box is checked, ATR measurements with higher accuracy are performed. |

## 12.1.2 Targets

**Description**

Each prism type has an absolute constant.
Leica Geosystems prisms are predefined as defaults and can be selected. Additional prisms can be defined.

**Default targets**

Following default prisms are always available on the instrument:

| Product Name | Name in list | Type | Leica constant | Absolute constant |
|---|---|---|---|---|
| GRZ4, GRZ122 | **Leica 360° Prism** | Prism | +23.1 mm | -11.3 mm |
| GMP111-0 | **Leica Mini 0** | Prism | 0.0 mm | -34.4 mm |
| GRZ101 | **Leica Mini 360°** | Prism | +30.0 mm | -4.4 mm |
| GMP101, GMP111 | **Leica Mini Prism** | Prism | +17.5 mm | -16.9 mm |
| GZM29, GZM30, GZM31, CPR105 | **Leica Reflectve Tape** | Tape | +34.4 mm | 0.0 mm |
| GPR1, GPR111, GPR113, GPR121, GPH1P | **Leica Round Prism** | Prism | 0.0 mm | -34.4 mm |
| - | **Reflectorless** | RL | +34.4 mm | 0.0 mm |
| MPR122 ☞ For Machine Control purposes only! | **Leica HDS Target** | Prism | +28.1 mm | -6.3 mm |

**Access**

Open the selectable list for **Target** in **Measure & Target Settings**.

**Targets**

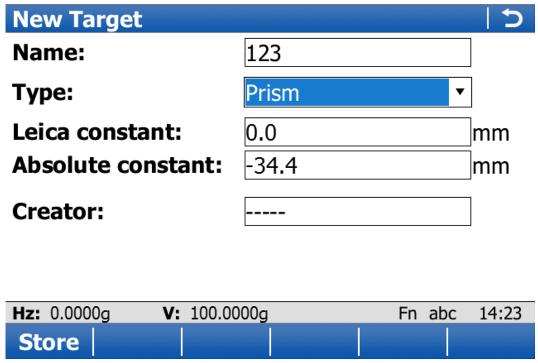

| Key | Description |
|---|---|
| **OK** | To select the highlighted target and to return to the previous screen. |
| **New..** | To define a new target. Refer to "12.1.3 Creating/Editing a Target". |
| **Edit..** | To edit the highlighted target. It is not possible to edit default targets. Refer to "12.1.3 Creating/Editing a Target". |
| **Delete** | To delete the highlighted target. It is not possible to delete default targets. |
| **More** | To display information about the additive constant, the target type and the creator of the target. |
| Fn **Default** | To recall previously deleted default targets and to reset default targets to the default settings. User-defined targets are not affected. |
| Fn **Quit** | To exit the screen. |

## 12.1.3 Creating/Editing a Target

**Access**

In **Targets**, highlight a target. All constants are copied from this target. Press **New..** or **Edit..**.

**New Target**




| Key | Description |
|---|---|
| **Store** | To store the target. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A significant name for the new target. |
| **Type** | **Prism**, **Tape** or **Undefined** | The type of target to be defined. |
| **Leica constant** | Editable field | The additive constant as stored for the selected prism in the SmartWorx Viva software. ☞ An additive constant of 0.0 mm has been defined for the Leica Geosystems standard targets GPR1, GPR111, etc. All entered or selected additive constant values are differences to this 0.0 mm based Leica Geosystems TPS prism system. |
| **Absolute constant** | Editable field | The true additive constant. The additive constant is always in mm. ☞ The additive constants of non-Leica Geosystems prisms are often given in the true zero prism system. Use the following formula to convert the additive constant to the Leica Geosystems TPS prism system. This Leica constant must be entered into the Leica instrument. Formula: True zero constant - 34.4 mm = Leica constant. It is highly recommended to check the additive constant for non-Leica Geosystems prisms on a baseline with an appropriate procedure. |
| **Creator** | Editable field | A name of the creator or other comments can be entered. |

# 12.2 Prism search settings

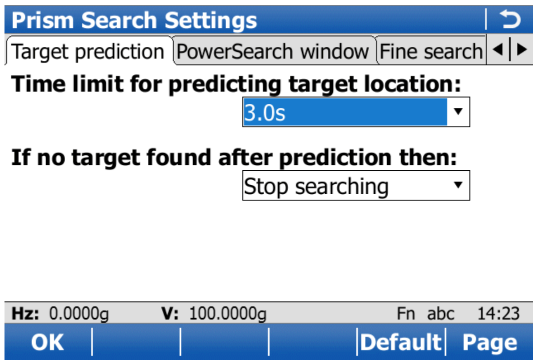
**Description**

The settings on this screen define
- the size of search windows for prisms to be searched in. The prisms can be searched with PowerSearch in the **PowerSearch window** or with ATR in the **Fine search window**.
- the behaviour of automatic prism search after the target is lost in lock mode.

**Access**

Select **Main Menu: Instrument\TPS settings\Prism search settings**.

**Prism Search Settings, Target prediction page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Default** | To recall the default settings. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

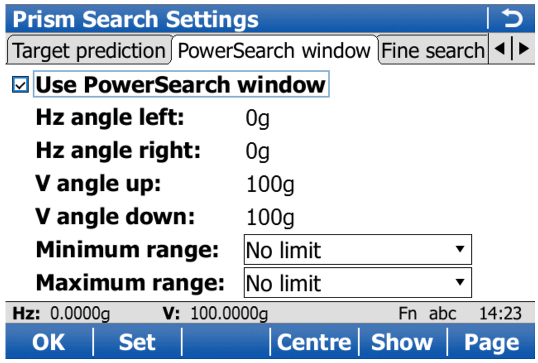
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Time limit for predicting target location** | From **1 s** to **5 s** | If the target is lost when **Target aiming: Lock** the path of the prism is predicted for the selected number of seconds. |
| **If no target found after prediction then** | **Stop searching** | Perform no search after prediction. |
| | **Start fine search** | Perform search after prediction with ATR in a dynamic **Fine search window**. |
| | **Start Power-Search** | Perform search after prediction with Power-Search. Activate PowerSearch on the **Power-Search window** page. |
| | **Turn to last msd pt** | If the target is lost when **Target aiming: Lock**, then the instrument turns back to the last stored point. The field of view is disabled while the instrument is repositioning. |

**Next step**

**Page** changes to the **PowerSearch window** page.

## Prism Search Settings, PowerSearch window page




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **New..** | To define new PowerSearch window. |
| **Centre** | To centre the PowerSearch window to the current position of the telescope. |
| **Show** | To position the telescope to corners of PowerSearch window. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

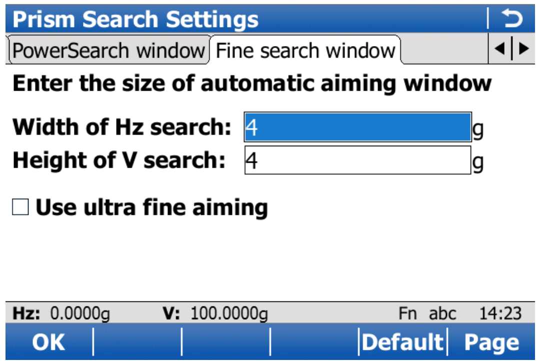
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use PowerSearch window** | Check box | If checked, PowerSearch searches in the defined window. |
| **Hz angle left**, **Hz angle right**, **V angle up** and **V angle down** | Display only | The left, right, upper and lower boundaries of the PowerSearch window. |
| **Minimum range** | **No limit** and from **25 m** to **175 m** | Minimum distance of the search range for the PS window to be defined. |
| **Maximum range** | From **25 m** to **175 m** and **No limit** | Maximum distance of the search range for the PS window to be defined. |

### Next step

**Page** changes to the **Fine search window** page.

**Prism Search Settings, Fine search window page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Default** | To recall the default settings. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Width of Hz search** | Editable field | Horizontal extent of window. |
| **Height of V search** | Editable field | Vertical extent of window. |
| **Use ultra fine aiming** | Check box | Reduces the field of view of the ATR. The setting is only applied for **Target aiming**: **Automatic** in **Measure & Target Settings**. |

### Next step

**Page** changes to another page on this screen.

# 12.3 Atmospheric corrections

**Description**

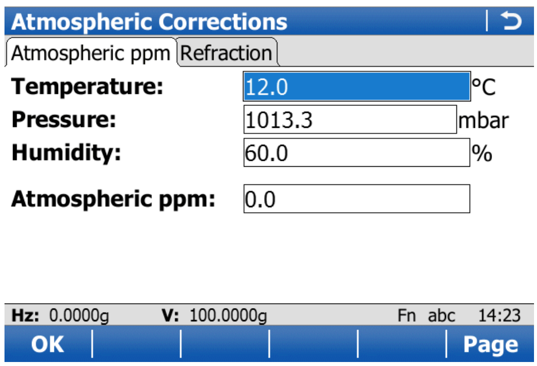
The settings on this screen define the atmospheric ppm and the refraction.
For standard applications, the distance is corrected due to atmospheric influences. The geometrical correction and the projection distortions are set to 0.00. Heights are reduced with the standard refraction coefficient.
Refer to the TS11 User Manual, the TS15 User Manual, the Leica TS12 Lite User Manual and the MS50/TS50/TM50 User Manual for information on calculations.

**Access**

Select **Main Menu: Instrument\TPS settings\Atmospheric corrections**.

**Atmospheric Corrections, Atmospheric ppm page**

The atmospheric distance corrections are derived from the dry air temperature, air pressure or elevation above mean sea level MSL, and the relative air humidity or wet bulb temperature.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **P<>E** | To change **Pressure** to **Elev above MSL** and back. |
| Fn **%<>T'** | To change **Humidity** to **Temp wet-bulb** and back. |
| Fn **ppm=0** | To set **Atmospheric ppm: 0.0**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

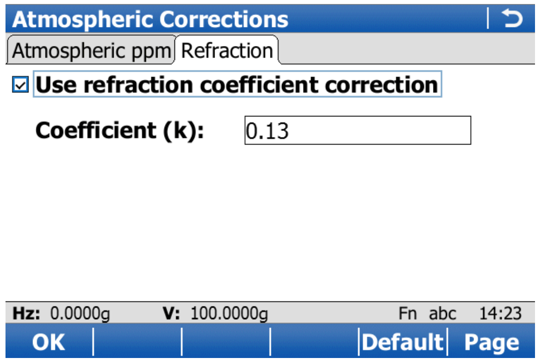
| Field | Option | Description |
|---|---|---|
| **Temperature** | Editable field | Sets the temperature. |
| **Pressure** or **Elev above MSL** | Editable field | Sets the atmospheric pressure or the elevation above mean sea level dependent on selection. |
| **Humidity** or **Temp wet-bulb** | Editable field | Sets the relative air humidity or the wet bulb temperature dependent on selection. |
| **Atmospheric ppm** | Editable field or display only | The atmospheric ppm is either set or calculated from the values in the previous fields. |

**Next step**

**Page** changes to the **Refraction** page.

**Atmospheric Corrections, Refraction page**

The refraction correction is taken into account during the calculation of the height difference.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Default** | To recall the default settings. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use refraction coefficient correction** | Check box | If checked, refraction correction is applied to measurements. |
| **Coefficient (k)** | Editable field | Refraction coefficient to be used for calculation. |

### Next step

**Page** changes to another page.

## 12.4 Level bubble & compensator

**Description**

If raw data is to be displayed and recorded, the compensator and the horizontal correction can be deactivated.

☞ The graphical level bubble is displayed correctly for the situation when the first screen is aligned with two foot screws.

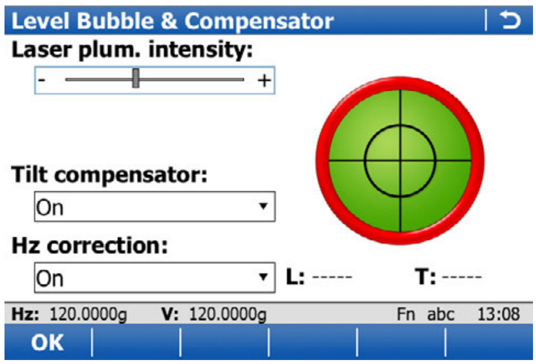
**Access**

Select **Main Menu: Instrument\TPS settings\Level bubble & compensator**.

OR

Tap / .

**Level Bubble & Compensator**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**.<br>For a TS remote controlled by a CS: To return to **Remote Control**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Intensity** | Scroll bar | To adjust the intensity of the laser plummet. |
| **Tilt compensator** | **On** | Vertical angles are relative to plumb line. The horizontal angle is corrected for the transversal tilt errors if **Hz correction**: **On**. |
| | **Off** | Vertical angles are relative to vertical/standing axis. |
| | **Always off** | The mode stays always deactivated. |
| **Hz correction** | **On** | The horizontal angles are corrected for the line of sight, tilting axis and if **Tilt compensator**: **On** transversal tilt errors. |
| | **Off** | Horizontal angles are not corrected. |
| | **Always off** | The mode stays always deactivated. |

**Description**

**Quality control**

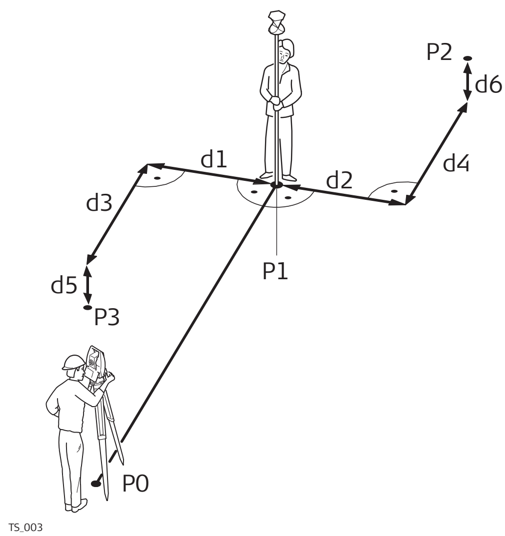
The instrument can be configured to monitor sequentially stored measurements and to notify the user if the coordinates lie within a defined range of each other.

If configured, the X,Y coordinates of a point being stored can be compared to the coordinates of the last previously stored point. If the difference is less than the defined position tolerance then a warning is shown. It can now be decided whether to store the point or not.

If configured, backsight target points and resection target points which were measured during the setup procedure are then also checked in this manner.

**Offsets**

The offset values are applied to measured points. The Offset function allows offset points to be determined, for instance when the reflector cannot be set up directly on a point. Transverse, longitudinal and/or elevation offsets can be defined from the reflector position to the offset point. All of the displayed and recorded measurement data is in relation to the offset point.

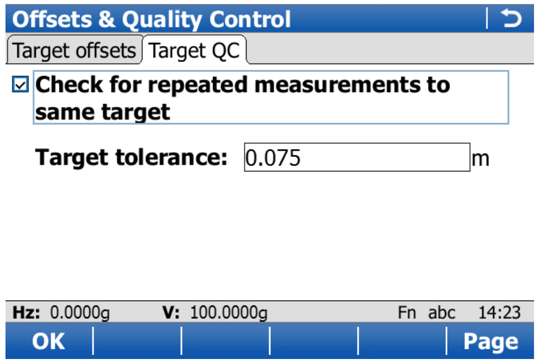



P0 Station
P1 Current position
P2 Offset point
P3 Offset point
d1 Offset cross left
d2 Offset cross right
d3 Offset length towards instrument
d4 Offset length away from instrument
d5 Offset height down
d6 Offset height up

**Access**

Select **Main Menu: Instrument\TPS settings\Offsets & Quality Control**.

**Offsets & Quality Control, Target QC page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

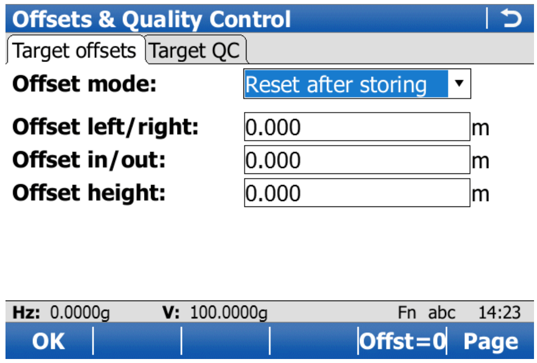
| Field | Option | Description |
|---|---|---|
| **Check for repeated measurements to same target** | Check box | If checked, target checking is activated. |
| **Target tolerance** | Editable field | The position tolerance. The units are defined by **User\System settings\Regional settings**. |

### Next step

**Page** changes to the **Target offsets** page.

If configured in a survey screen page, the offset values appear also in the survey screen page in Survey.

**Offsets & Quality Control, Target offsets page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Offst=0** | To set all offsets to 0.000. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Offset mode** | **Reset after storing** | The offset values are reset to 0.000 after a point is measured with **Store** or **Meas**. |
| | **Permanent** | The offset values are applied to every measured point until reset or changed. |
| **Offset left/right** | Editable field | Sets cross offset of target point, perpendicular to the line of sight. |
| **Offset in/out** | Editable field | Sets length offset of target point, in the direction of the line of sight. |
| **Offset height** | Editable field | Sets height offset of target point. |

### Next step

**Page** changes to another page.

## 12.6 Lights / Lights & accessories TS

**Description**

The settings on this screen allow the lights on the instrument to be configured.
For motorised instruments (TS15, TS12 Lite), the horizontal/vertical boundaries of a search window can be defined.

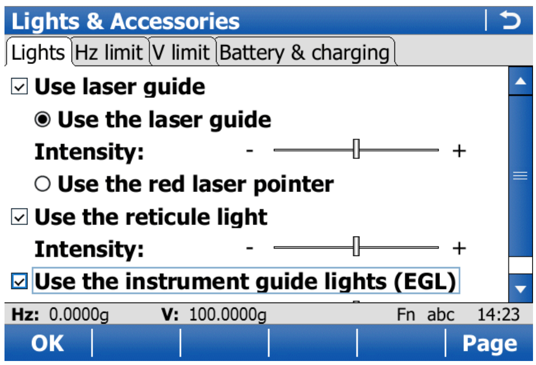
**Access**

For manual TPS instruments:
Select **Main Menu: Instrument\TPS settings\Lights**.

For motorised TPS instruments:
Select **Main Menu: Instrument\TPS settings\Lights & accessories**.

**Lights & Accessories, Lights page**

This screen is available for motorised instruments.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use laser guide** | Check box | When this box is checked, either the GUS74 or the red laser guide can be activated. |
| **Use the laser guide** | Check box | Available if the instrument has a GUS74. If checked, the GUS74 is turned on. |
| **Intensity** | From 0 % to 100 % | To adjust the GUS74 intensity using the left and right arrow keys. |
| **Use the red laser pointer** | Check box | If checked, the red laser of the reflectorless EDM is turned on. |
| **Use the reticule light** | Check box | If checked, the reticule illumination is turned on. |
| **Intensity** | From 0 % to 100 % | To adjust the reticule illumination intensity using the left and right arrow keys. |
| **Use the instrument guide lights (EGL)** | Check box | If checked, the Emitting Guide Light (EGL) is turned on. This field is only available if EGL is fitted. |
| **Intensity** | From 0 % to 100 % | To adjust the EGL/Laser Guide intensity using the left and right arrow keys. |

**Next step**
**Page** changes to the **Hz limit** page.

**Lights & Accessories, Hz limit page**

This screen is available for motorised instruments.

| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **New..** | To define new search window. Follow the instructions on the screen. |
| **Show** | To position the telescope to corners of the search window. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Limit Hz movement of instrument** | Check box | When this box is checked, horizontal boundaries for the search window can be defined. |
| **Hz begin** and **Hz end** | Editable field | The boundaries of the search window as horizontal angles where the search begins/ends. |

### Next step

**Page** changes to the **V limit** page.

**Lights & Accessories, V limit page**

This screen is available for motorised instruments.

| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **New..** | To define new search window. Follow the instructions on the screen. |
| **Show** | To position the telescope to corners of the search window. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Limit V movement of instrument** | Check box | When this box is checked, vertical boundaries for the search window can be defined. |
| **Limit movement for** | Selectable list | Limits can be set for eyepiece and/or lens. |
| **V begin** and **V end** | Editable field | The boundaries of the search window as vertical angles where the search begins/ends. For eyepiece and lens. |

**Lights & Accessories, Battery & charging page**

This screen is available for MS50/TS50/TM50 on the CS when is connected to a MS50/TS50/TM50.

| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Main power source** | | Determines the power source to be used when internal and external battery are attached at the same time. |
| | **Internal battery** | Select this setting if an internal battery and an external power source are attached but the internal battery must be used first. |
| | **External power** | Select this setting if:<br>• an interal battery is attached but an external battery will be attached later. Then the external power source will used as power source.<br>• an external power source and an internal battery is attached but the external power source must be used. |
| **Charge the internal battery when external power is connected** | Check box | The internal battery is charged from the external power source, if attached. |

# 13 Instrument - GPS settings GPS

## 13.1 RTK rover wizard

### 13.1.1 Overview

**Description**

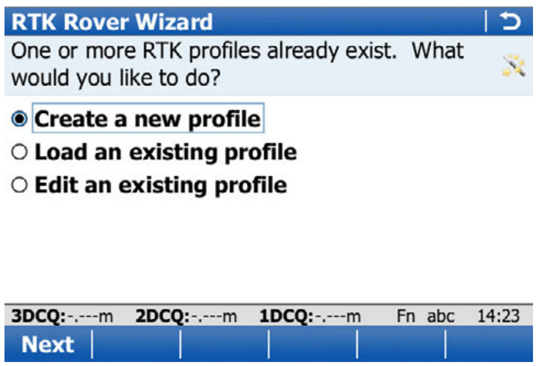
Using this wizard, the settings for a real-time rover behaviour are defined at one glance. These settings are stored in an RTK profile.

**Access**

Select **Main Menu: Instrument\GPS settings\RTK rover wizard**.

If RTK profiles exist, the wizard starts with the screen shown in this section. Otherwise, the wizard starts the process of creating a new RTK profile. In this case refer to "13.1.2 Creating a New RTK Profile".

**RTK rover wizard**




| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| Fn **Quit** | To exit the wizard. |

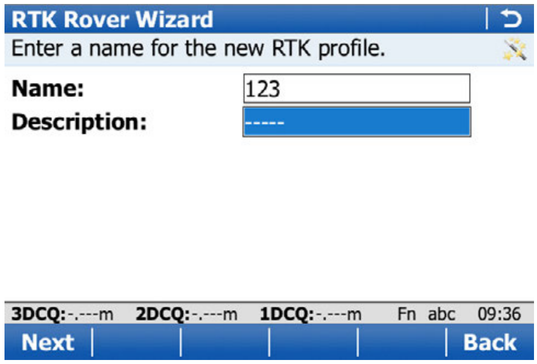
**Next step**

| IF you want to | THEN |
|---|---|
| create a new set of settings | select **Create a new profile**, press **Next** and continue with "13.1.2 Creating a New RTK Profile". |
| select a different set of settings | select **Load an existing profile**, press **Next** and continue with "13.1.3 Loading an Existing RTK Profile". |
| edit an existing set of settings | select **Edit an existing profile**, press **Next** and continue with "13.1.4 Editing an Existing RTK Profile". |

## 13.1.2 Creating a New RTK Profile

**RTK rover wizard, Enter a name for the new RTK profile.**

Type in the name and a description for the new set of settings.




| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

## 13.1.3 Loading an Existing RTK Profile

**RTK rover wizard, Choose an RTK profile.**

Select an existing RTK profile from the selectable list. Listed are profiles that match the instrument in use.


| Key | Description |
|---|---|
| **Finish** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Delete** | Pressing this key deletes the RTK profile currently shown in the selectable list. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

## 13.1.4 Editing an Existing RTK Profile

**RTK rover wizard, Choose an RTK profile.**

Select the RTK profile to be edited from the selectable list. Listed are profiles that match the instrument in use.


| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Delete** | Pressing this key deletes the RTK profile currently shown in the selectable list. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create a copy** | Check box | Creates a copy before the editing process starts. |

## 13.2 Satellite tracking GPS

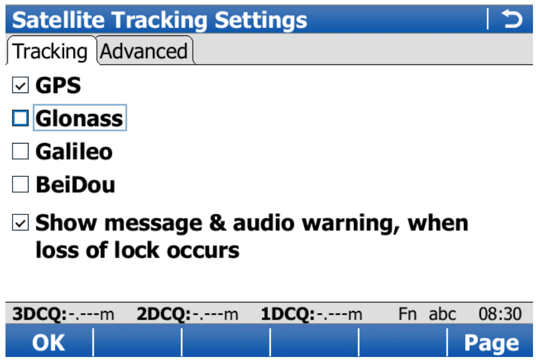
**Description**

The settings on this screen define which satellite system, satellites and satellite signals are used by the instrument.

**Access**

Select **Main Menu: Instrument\GPS settings\Satellite tracking**.

**Satellite Tracking Settings, Tracking page**




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

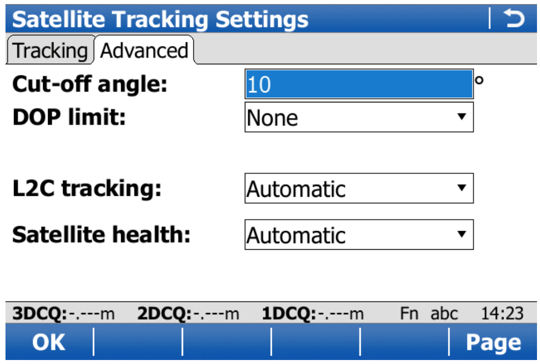
- Any of the GNSS can only be disabled, if at least one other GNSS in enabled.
- At least one GNSS must be enabled.
- **GPS** can never be disabled:
  - On the base station.
  - On the GS14
  - On the GS05/GS06

| Field | Option | Description |
|---|---|---|
| **GPS** | Check box | Defines if the GPS L1, L2 and L5 signals are accepted by the instrument when tracking satellites. For L5, a licence is required. |
| **Glonass** | Check box | Defines if GLONASS L1 and L2 signals are accepted by the instrument when tracking satellites. |
| **Galileo** | Check box | Defines if Galileo E1, E5a, E5b and Alt-BOC signals are accepted by the instrument when tracking satellites. |
| **BeiDou** | Check box | Defines if BeiDou B1 and B2 signals are accepted by the instrument when tracking satellites. |
| **Show message & audio warning, when loss of lock occurs** | Check box | Activates an acoustic warning signal and a message given by the instrument when satellites are lost. |

**Next step**

**Page** changes to the **Advanced** page.

**Satellite Tracking Settings, Advanced page**




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| **Hlth..** | Available for **Satellite health: User defined**. To configure the satellites used in the survey. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

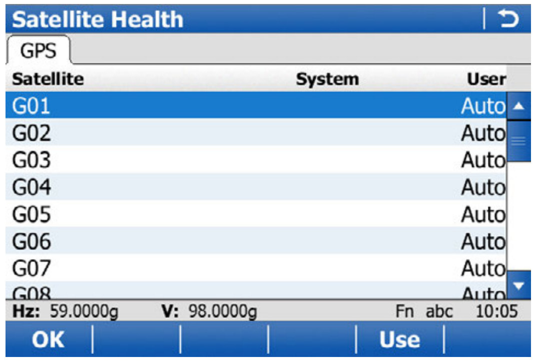
| Field | Option | Description |
|---|---|---|
| **Cut-off angle** | Editable field | Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. Recommended settings:<br>• For real-time: 10°.<br>• For purely post-processing applications: 15°. |
| **DOP limit** | **None**, **GDOP**, **HDOP**, **PDOP** or **VDOP** | If activated, the limit defined in **Limiting value** is checked. GPS positions are unavailable when the limit is exceeded. |
| **Limiting value** | Editable field | The maximum acceptable DOP value.<br>Available unless **DOP limit: None**. |
| **L2C tracking** | **Automatic** | L2 signals which are flagged as unhealthy are not recorded or used for real-time computations. This setting is selected automatically when **GPS** is checked on the **Tracking** page. |
| | **Always track** | L2C signals are always tracked. |
| **Satellite health** | | Sets the satellite tracking behaviour.<br><br>This setting is remembered when the instrument is turned off. It is stored as part of the configuration set. |
| | **Automatic** | Incoming satellite signals are monitored by the instrument. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations. |
| | **User defined** | Satellites must manually be included/excluded from data recording and real-time computations with **Hlth..**. |

**Next step**

**Hlth..** changes to **Satellite Health**.

**Satellite Health**

The screen contains a page for each GNSS system the receiver is configured to track. The explanations given for the softkeys are valid for all pages.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Use** | To change between the options in the column **User**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Option | Description |
|---|---|---|
| **Satellite** | **01** to **50** | The Pseudo Random Noise number (GPS, 1 to 32),), the Slot ID (GLONASS, 1 to 24) or the **S**pace **V**ehicle number (Galileo, 1 to 50, and BeiDou, 1 to 37) of the satellites.<br>There is a prefix G for GPS satellites, a prefix R for GLONASS satellites, a prefix E for Galileo satellites and a prefix C for BeiDou satellites. |
| **System** | **OK**, **N/A** or **Unhealthy** | Information on the satellite health taken from the almanac. **N/A** stands for not available. |
| **User** | **Bad** | Excludes satellite from tracking. |
| | **OK** | Includes satellite in tracking. |
| | **Auto** | Automatic satellite tracking when satellite is healthy. |

### Next steps

| Step | Description |
|---|---|
| 1. | **Page** changes to the **Glonass** page, to the **Galileo** page and to the **BeiDou** page, where GLONASS satellites, Galileo and BeiDou satellites used in the survey can be configured. |
| 2. | **OK** returns to **Satellite Tracking**. |
| 3. | **OK** returns to **Main Menu**. |

### 13.3.1 Rover Antenna Heights

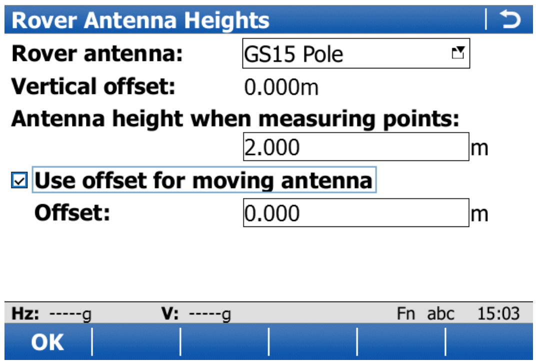
**Access**

Select **Main Menu: Instrument\GPS settings\Antenna heights.**

**Rover Antenna Heights**

This screen consists of two pages:

- If a GS10/GS15/GS08plus/GS14 is selected, then no pages are available.
- If a GS05/GS06 is selected, then two page tabs are available - **Internal** and **External**. The internal settings are used when an external (connected by cable) antenna is NOT used. The external settings are used when an external (connected by cable) antenna is used.




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| Fn **Quit** | To exit the screen. |

**Description of fields for the External page**

| Field | Option | Description |
|---|---|---|
| **Rover antenna** | Selectable list | Leica Geosystems antennas are predefined as default and can be selected from the list. Default antennas contain an elevation-dependent correction model. New antenna correction models can be set up and transferred to the instrument using LGO. Open the list to define or edit additional antennas.<br>Refer to "14 Antenna Heights". |
| **Vertical offset** | Display only | The vertical antenna offset for the selected antenna. |
| **Antenna height when measuring points** | Editable field | Sets the default antenna height for the current working style. This height is then also the default antenna height during the use of applications. The antenna height can still be changed during a survey. The initial value depends on the selected antenna.<br>Unavailable for SmartStation. The height is added in the Setup and GPS Survey application. |
| **Use offset for moving antenna** | Check box | When unchecked, the moving antenna height is considered the same as the default antenna height. |
| **Offset** | Editable field | When the check box **Use offset for moving antenna** is checked: Sets the default antenna height for auto points and for the moving part of a track when logging raw observations. |

## 13.3.2 Antennas

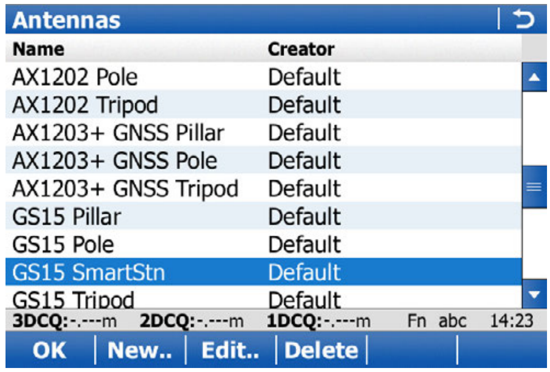
**Description**

Listed are antennas in the instrument's internal memory.

**Access**

Open the selectable list for **Rover antenna** in **Rover Antenna Heights**.

**Antennas**



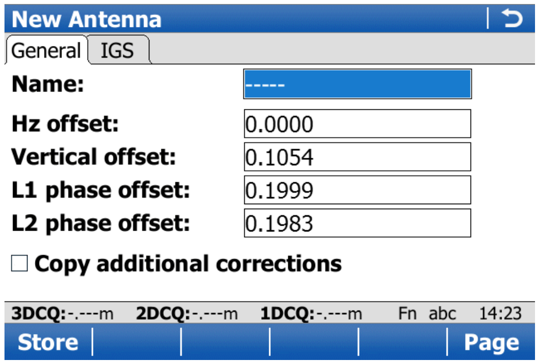

| Key | Description |
|---|---|
| **OK** | To select the highlighted antenna and to return to the previous screen. |
| **New..** | To define a new antenna. Refer to "13.3.3 Creating/Editing an Antenna". |
| **Edit..** | To edit the highlighted antenna. It is not possible to edit default antennas. Refer to "13.3.3 Creating/Editing an Antenna". |
| **Delete** | To delete the highlighted antenna. It is not possible to delete default antennas. |
| Fn **Default** | To recall previously deleted default antennas and to reset default antennas to the default settings. User-defined antennas are not affected. |
| Fn **Quit** | To exit the screen. |

## 13.3.3 Creating/Editing an Antenna

**Access**

In **Antennas**, highlight an antenna. All offsets are copied from this antenna. Press **New..** or **Edit..**.

**New Antenna or Edit Antenna, General page**




| Key | Description |
|---|---|
| **Store** | To store the antenna. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new antenna. |
| **Hz offset** | Editable field | Horizontal offset of measurement reference point. |
| **Vertical offset** | Editable field | Vertical offset of measurement reference point. |
| **L1 phase offset** | Editable field | Offset of L1 phase centre. |
| **L2 phase offset** | Editable field | Offset of L2 phase centre. |
| **Copy additional corrections** | Check box | Allows additional corrections to be copied from the antenna which was highlighted before this screen was accessed. |

**Next step**
**Page** changes to the **IGS** page.

**New Antenna or Edit Antenna, IGS page**

The combination of values typed in here provides a unique standardised ID for the antenna being used.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **IGS name** | Editable field | The International GPS/GNSS Service name of the antenna. |
| **Serial number** | Editable field | The serial number of the antenna. |
| **Setup number** | Editable field | The setup number of the antenna. Identifies the version number of the current calibration. |

**Next step**
**Store** stores the new antenna.

## 13.4 Quality control

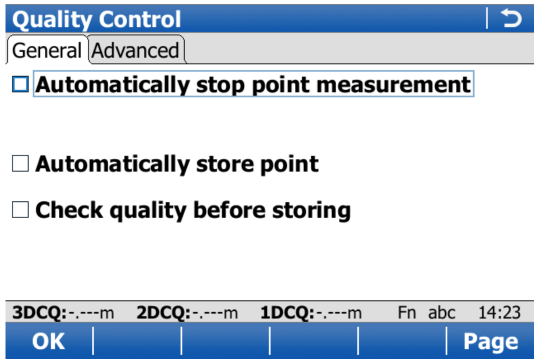
**Description**

The settings on this screen define the limits for coordinate quality accepted for point occupations.

**Access**

Select **Main Menu: Instrument\GPS settings\Quality control**.

**Quality Control, General page**

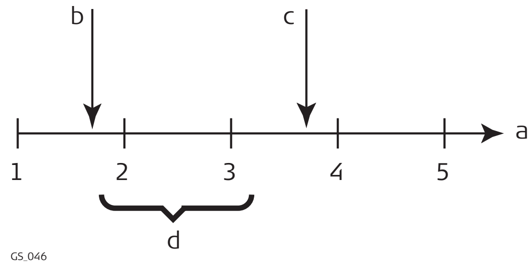



| Key | Description |
|---|---|
| **OK** | To accept changes. |
| **Param..** | To configure the time interval after which a point occupation can be stopped automatically. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

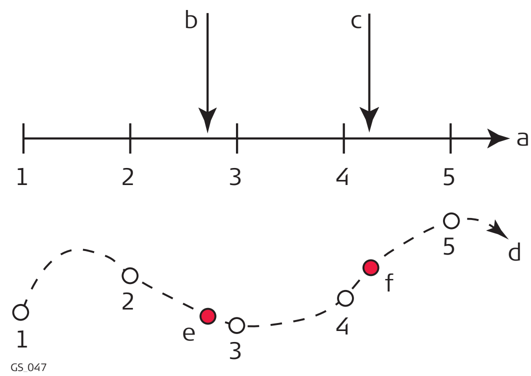
| Field | Option | Description |
|---|---|---|
| **Automatically stop point measurement** | Check box | Activates a selectable list for the stop criteria.<br>Stops the measurements automatically when the parameter defined for **Stop criteria** reaches 100 %. |
| **Stop criteria** | | Defines the method used for **Automatically stop point measurement**. The setting determines the computation and value to be shown in the survey screen mask and in the status screen. Parameters for the selected method are defined with **Param..**. |
| | **Accuracy** or **Positions** | Available when working with real-time device. Records observations between pressing **Meas** and **Stop**. Recommended for normal real-time applications. Refer to the diagram below. |
| | **Instantaneous** | Records the time tag when **Meas** is pressed. A coordinate is interpolated between the positions at the neighbouring two epochs to filter out effects of slight movement. Recommended when measuring positions of objects while the antenna is moving very fast.<br>Example: Measuring the position of lampposts by driving in a car along the road and pressing **Meas** when the car is next to the lamppost. Refer to the diagram below. |
| | **Stop & go indicator** | Available when raw data logging is configured.<br>The occupation time is based on a user defined baseline length, the number of satellites and the GDOP. |
| | **Time**, **Observations** or **Number of satellites** | Available when working without real-time device and when raw data are recorded for post-processing. |
| **Automatically store point** | Check box | Stores points automatically after stopping the point occupation. If **Automatically stop point measurement** and **Automatically store point** are checked, then points are recorded by pressing one button. |
| **Check quality before storing** | Check box | If activated, the limit defined in **Tolerance** is checked before storing a point. A warning signal is given when the limit is exceeded. |
| **Check** | **Position only**, **Height only** or **Position & height** | The type of coordinate quality to be checked before storing a point. |
| **Tolerance** | Editable field | The maximum acceptable coordinate quality. |

#### Stop criteria: Accuracy or Positions




a) Time in epochs
b) **Meas** pressed
c) **Stop** pressed
d) Post-processed coordinates computed by averaging resulting positions of epochs 2 and 3

#### Stop criteria: Immediately




a) Time in epochs
b) **Meas** pressed and point coordinates interpolated based on epochs 2 and 3
c) **Meas** pressed and point coordinates interpolated based on epochs 4 and 5
d) Plan view
e) **Meas** pressed and point coordinates interpolated based on epochs 2 and 3
f) **Meas** pressed and point coordinates interpolated based on epochs 4 and 5

#### Next step

| IF parameters for Stop criteria | THEN |
|---|---|
| are not to be configured | **Page** changes to the **Advanced** page. |
| are to be configured | **Param..** changes to **Parameters for Auto Stop** or **Real-Time Stop Criteria**. |

### Quality Control, Advanced page

#### Description of fields

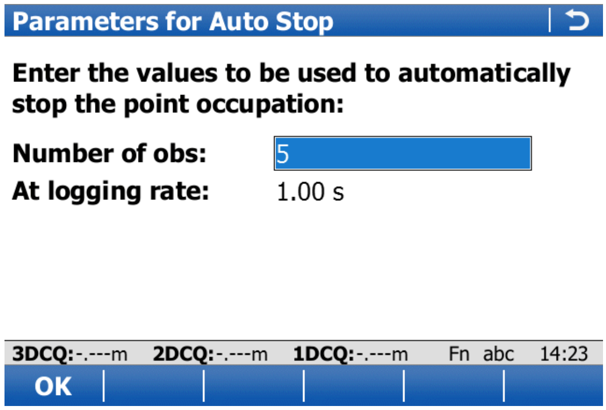
| Field | Option | Description |
|---|---|---|
| **Automatically start measuring point on entering survey** | **No** | Starts point occupation when pressing **Meas**. |
| | **Yes** | Starts point occupation automatically when entering the survey screen. All subsequent points must be occupied by pressing **Meas**. |
| | **Timed** | Starts point occupation automatically at a certain time. |

#### Next step

**OK** closes the screen.

**Parameters for Auto Stop**

The parameters shown on this screen depend on the setting for **Stop criteria**.




| Key | Description |
|---|---|
| **OK** | To accept changes. |

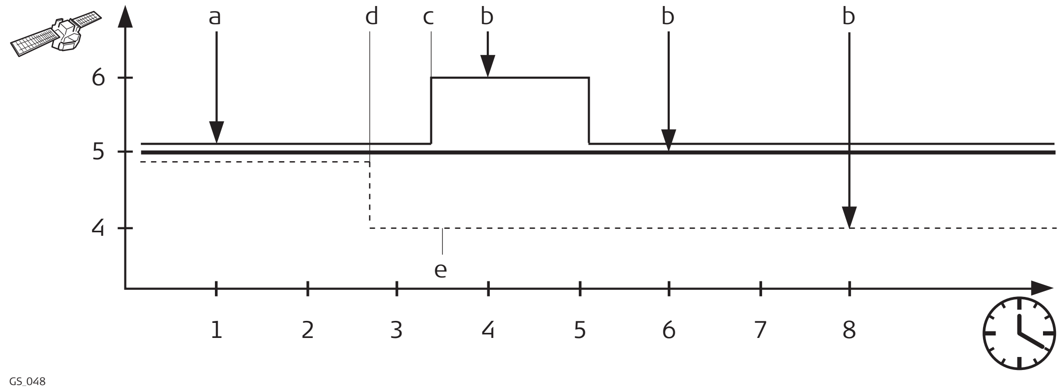
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Time at point** | Editable fields | Sets the required observation time for each point. Counting time starts when **Meas** is pressed. The instrument stops measuring when the set length of time is reached. |
| **Number of obs** | Editable fields | Sets the required number of observations that are to be recorded at each point. Counting observations starts when **Meas** is pressed. The instrument stops measuring when the set number of observations is reached. |
| **At logging rate** | Display only | Displays the rate at which static raw observations are logged as configured. |
| **8+ satellites for**, **7 satellites for**, **6 satellites for**, **5 satellites for** and **4 satellites for** | Editable field | Sets the required observation time depending on the number of satellites available. Counting time starts when **Meas** is pressed. The instrument stops measuring when the set length of time for a certain number of satellites is reached. Should the number of available satellites change during observation, the observations already recorded will be taken into account. |
| **Baseline length** | Selectable list | Used for the calculation of the occupation time for **Stop criteria: Stop & go**. |
| **Extend occupation time by factor of** | From **1.0** to **5.0** | The factor extends the point occupation time recommended by SmartWorx Viva. It directly influences the occupation time shown in **Time at point** on the **Survey** screen. |

**Next step**

| Step | Description |
|---|---|
| 1. | **OK** closes the screen. |
| 2. | **OK** returns to the screen from where **Parameters for Auto Stop** was accessed. |

**Observation time depending on the number of satellites available**

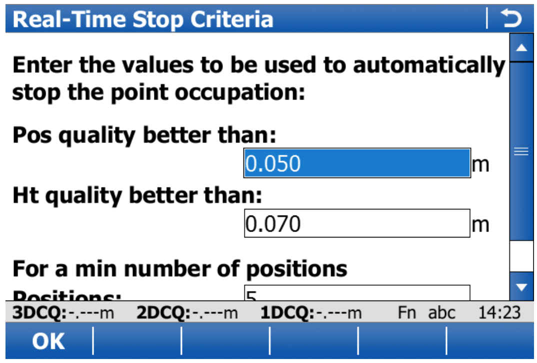



a) **Meas** is pressed. Counting time starts.
b) Observation is stopped.
c) 40 % for six satellites.
d) 30 % for five satellites.
e) 30 % for four satellites.

Thin line represents **6 satellites for: 3 min**.
Bold line represents **5 satellites for: 5 min**.
Dashed line represents **4 satellites for: 7 min**.

**Real-Time Stop Criteria**

The parameters shown on this screen depend on the setting for **Stop criteria**.




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Pos quality better than** and **Ht quality better than** | Editable field | Sets the maximum position and height qualities for each point occupation. Calculating the qualities starts when **Meas** is pressed. The instrument stops measuring when the position and height qualities are both less than the configured values. |
| **Positions** | Editable field | Raw data is logged for a minimum number of positions even when the **Pos quality better than** and **Ht quality better than** is already less than the specified maximum. |
| **Position update** | Display only | Displays the value for **GPS position update rate** as configured in **Screen & Audio Settings**, **Screen** page. |
| **No. of positions** | Editable field | Sets the number the positions which must be observed before the instrument stops measuring. Counting the number of positions starts when **Meas** is pressed. |

### Next step

**OK** closes the screen.

## 13.5 Raw data logging

### Description

Logged raw observations are used for
- static and kinematic operations. With these operations, raw data is always post-processed in the office. Raw data must therefore be logged on both base and rover instruments.
- real-time operations
  - to check the work in the office by post-processing.

  OR
  - to fill in gaps when a real-time position could not be calculated in the field, for example, due to problems with the real-time data reception from the reference station or the RTK network provider

Observations must be logged on all instruments which will be used for post-processing.

The settings on this screen define the logging of raw observations.

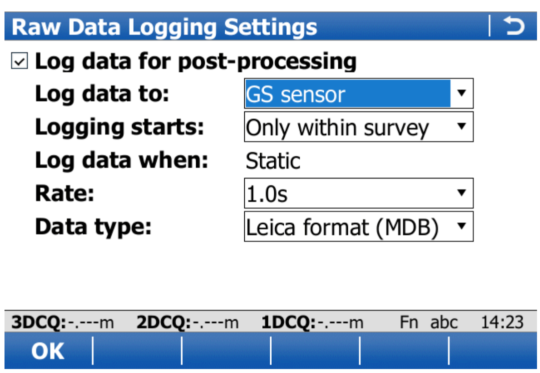
### Access

- The licence for raw data logging is required to log GNSS raw data on the GS, CS or TS instrument.
- The licence for RINEX logging is required to log RINEX data on the GS or CS. RINEX data cannot be logged on the TS11/TS15/TS12 Lite.

The licence key can only be loaded from an SD card using the Webserver or myWorld@Leica Geosystems.

Select **Main Menu: Instrument\GPS settings\Raw data logging**.

### Raw data logging settings




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Log data for post-processing** | Check box | Activates raw data logging. |
| **Log data to** | **Controller** or **GS sensor** | For GS10/GS14/GS15/GS25, data can either be logged to the field controller or to the GS. |
| | **Controller** | For GS05/GS06/GS08plus/GS12 data can only be logged to the field controller. |
| | **TS instrument** or **GS sensor** | For SmartStation, data can either be logged to the TS11/TS15 or to the GS14/GS15. |
| **Logging starts** | Selectable list | Available for GS10/GS14/GS15/GS25 with **Log data to: GS sensor**. Data logging can start as soon as the instrument is turned on or only while in the Survey application.<br>For GS05/GS06/GS08plus/GS12 data can only be logged with the Survey application. |
| **Log data when** | **Static** | Raw observation logging during static intervals when occupying a point. The instrument has to be stationary. For SmartStation, this is the only option available. |
| | **Static & kinematic** | Raw observation logging during static and moving intervals. For post-processed kinematic rover operations. Unavailable for SmartStation. |
| | **Kinematic** | Raw observation logging during moving intervals. For post-processed kinematic antenna operations. Unavailable for SmartStation. |
| **Rate** | From **0.05s** to **300.0s** | Rate at which raw observations are logged.<br>For GS05/GS06/GS08plus/GS12 logging rates of **0.2s** and slower are supported.<br>Recommendations:<br>• The maximum logging rate using Bluetooth on the field controller is 0.2 s.<br>• For static operations with long baselines and over long time **Rate: 15.0s** or **Rate: 30.0s**.<br>• For base stations for post-processed and real-time kinematic rovers, **Rate** at the base should be the same rate as at the rover.<br>• For initialisation while static and occupying distinct points in kinematic chains **Rate** between **0.1s** and **2.0s**. |
| **Data type** | Selectable list | Unavailable for SmartStation.<br>Available for **Log data to: GS sensor**. Data can be logged in the Leica proprietary MDB format or in RINEX.<br>For GS05/GS06/GS08plus/GS12, this field is available for **Log data when: Static**. |

# 14 Antenna Heights GPS

## 14.1 Overview

**Description**

The height of the GNSS antenna above a point consists of three components:
- the vertical or slope height reading,
- the vertical offset,
- the vertical phase centre variations.

For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre variations into account.

**Vertical or slope height**

Only vertical antenna heights measured to the **M**echanical **R**eference **P**lane are accepted.

**Measurements required**

This table is an overview of required measurements depending on antennas, setup and accessories. All former Leica antenna types are supported.

| IF the antenna is | AND the accessories are | AND the setup is | THEN the measurements required are |
|---|---|---|---|
| Leica antenna, for example GS15 | standard Leica | tripod or tripod short | vertical height from height hook |
| Leica antenna, for example GS15 | standard Leica | pole | none.<br>Value is 2.00 m<br>(as indicated on the pole) |
| Leica antenna, for example GS15 | standard Leica | pillar | vertical height to the MRP. |
| Leica antenna, for example GS15 | non-Leica | any | • vertical height to the MRP.<br>• possibly vertical offset. |
| non-Leica antenna | standard Leica<br>OR<br>non-Leica | any | • vertical height to the MRP.<br>• possibly vertical offset.<br>• phase centre variations.<br>• horizontal offset if a slope height reading. |

**Vertical phase centre variations**

For Leica antennas: Are handled automatically in the standard antenna records.

For non-Leica antennas: Can be stored in a newly created antenna record.
OR
Antenna records including azimuth and elevation-dependent corrections must be created using LGO or imported using the ANTEX format.

The antenna calibrations to determine the phase centre variations of all Leica antennas were executed by Geo++® GmbH.

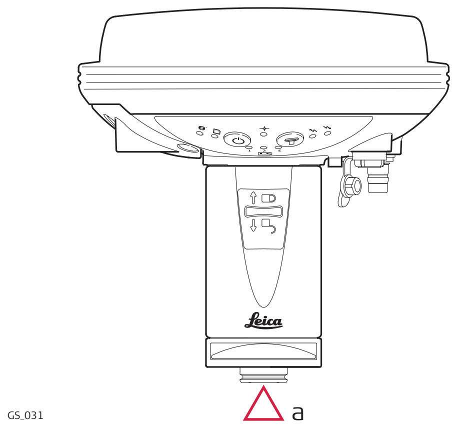
## 14.2 Mechanical Reference Planes, MRP

**General**

The **M**echanical **R**eference **P**lane

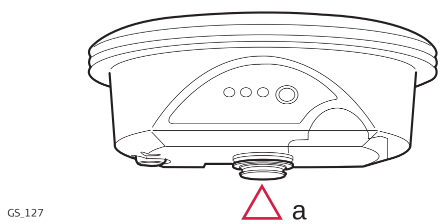
- is where the antenna heights are measured to.
- is where the phase centre variations refer to.
- varies for different antennas.

**GS15**



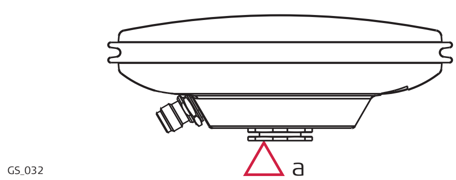

a) The mechanical reference plane is the underside of the threaded metal insert.

**GS08plus/GS12/ GS14**




a) The mechanical reference plane is the underside of the thread.

**AS05/AS10**




a) The mechanical reference plane is the underside of the threaded metal insert.

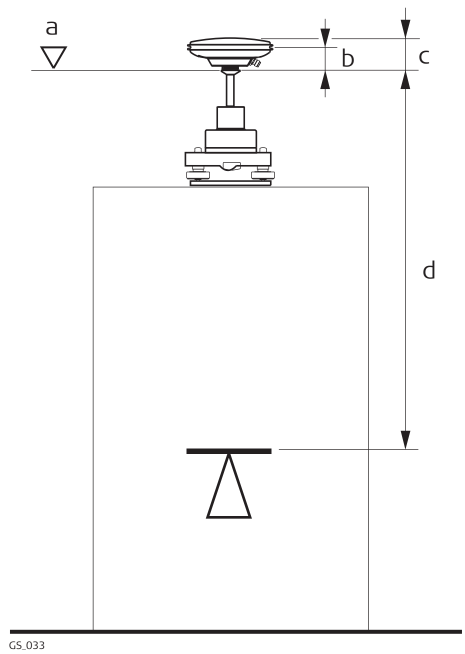
## 14.3 Determining Antenna Heights

### 14.3.1 Pillar Setup

☞

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.

**Pillar setup**




a) Mechanical reference plane
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical height reading

Vertical offset = 0

**Vertical height reading**

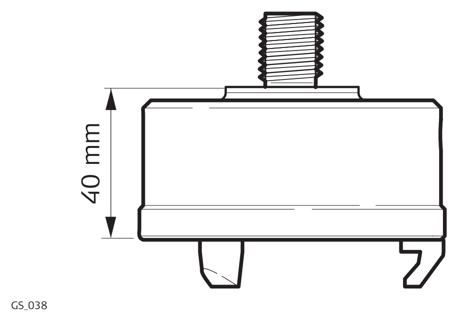
The vertical height reading is the height difference between the pillar benchmark and the mechanical reference plane of the antenna. Normally, it is determined indirectly by levelling.

**Determine the antenna height step-by-step**

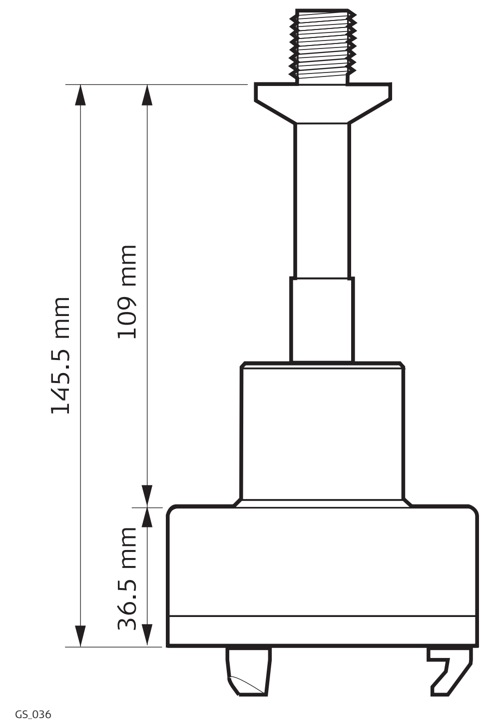
Sometimes, it is difficult to measure to the MRP directly.

| Step | Description |
|---|---|
| 1. | Determine the height difference between the pillar benchmark and a surface on the carrier. |
| 2. | Look up the height difference between this surface on the carrier and where the MRP of the antenna sits on the carrier. |
| 3. | Add the values determined in step 1. and 2., to get the **vertical height reading**. |
| 4. | For Leica standard antennas plus accessories, the **vertical offset** is 0.00 m. |

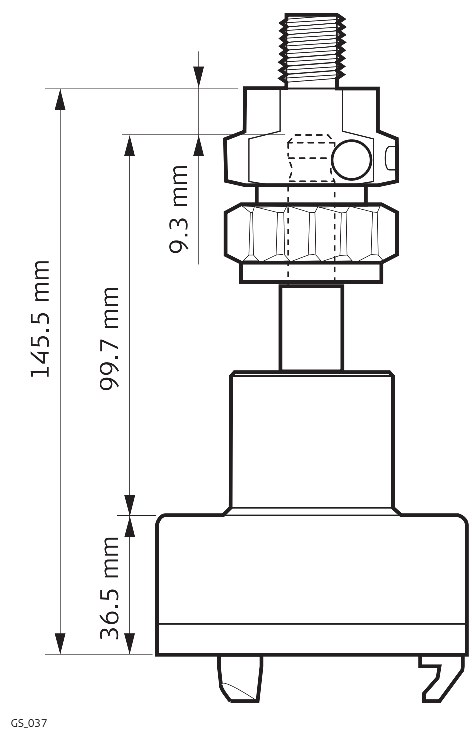
**Carrier and adapter dimensions**




GRT247 carrier, preferred for GS15 - **Tripod Short** setup




GRT146 carrier - **Tripod** setup




GRT144 carrier with GAD31 screw-to-stub adapter - **Tripod** setup

**Next step**

- At the beginning of a survey, enter the vertical height reading into the instrument.
- The vertical offset of 0.00 m is stored in the antenna setup record for a pillar setup and will automatically be taken into account.
- Refer to **Overview** for the vertical phase centre variations.

☞ For carriers other than those carriers shown in the diagram above, the dimensions must be determined.

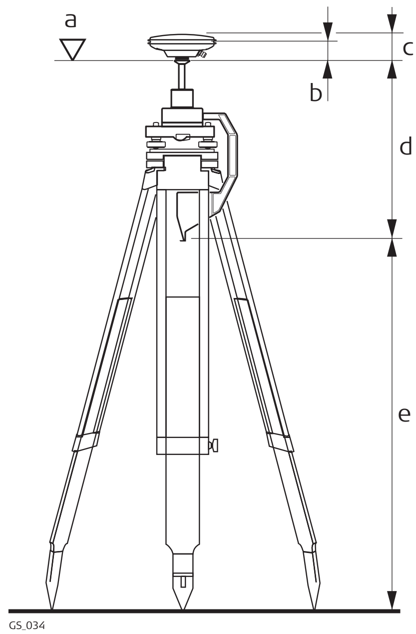
☞ Except for Leica standard antennas plus accessories, the vertical offset must be measured. This value must be entered in the antenna setup record.

## 14.3.2 Tripod Setup

☞

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.

**Tripod setup**




a) Mechanical reference plane
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical offset
e) Vertical height reading

**Vertical height reading**

The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. It is determined using the height hook.

**Determine the antenna height step-by-step**

| Step | Description |
|---|---|
| 1. | Determine the **vertical height reading** using the height hook. |
| 2. | For Leica standard antennas plus accessories, the **vertical offset** is 0.36 m for a **Tripod** setup and 0.2545 m for a **Tripod Short** setup. |

**Next step**

- Determine the antenna type.
- At the beginning of a survey, enter the vertical height reading into the instrument.
- The vertical offset is stored in the antenna setup record for all tripod setups and will automatically be taken into account. It does not need to be entered.
- Refer to **Overview** for the vertical phase centre variations.

☞ For other than the carriers shown in the diagram above, the dimensions must be determined, the vertical offset must be adapted and entered into a new antenna record.

☞ For other height measurement devices than the height hook, the dimensions must be determined and the vertical offset must be adapted.

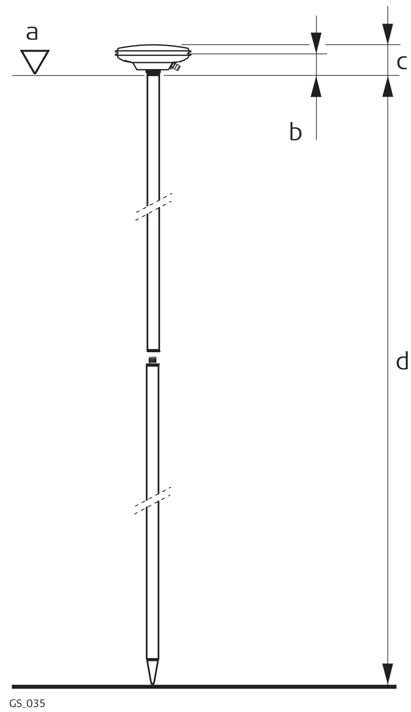
☞ For other than Leica standard antennas, the vertical offset must be measured. It must be entered in the antenna setup record.

## 14.3.3 Pole Setup

☞

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.

**Pole setup**




a) Mechanical reference plane
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical height reading, 2.00 m for the fully extended Leica telescopic pole.

Vertical offset = 0

**Vertical height reading**

The vertical height reading is the height difference between the bottom end and the top end of the pole. Usually, this height difference is a fixed value.

**Next step**

- At the beginning of a survey, enter the vertical height reading into the instrument. A standard rover configuration with a standard antenna setup record for a pole setup uses the value of 2.00 m already as default.
- The vertical offset of 0.00 m is stored in the antenna setup record for a pole setup and will automatically be taken into account. It does not need to be entered.
- Refer to **Overview** for the vertical phase centre variations.

☞

For other than the Leica standard poles, the dimensions must be determined.

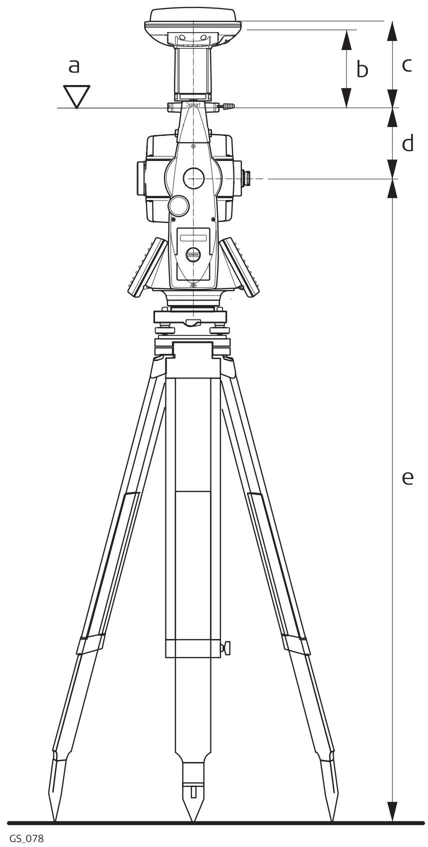
☞

For other than Leica standard antennas, the vertical offset must be measured. It must be entered in the antenna setup record.

☞

- For a SmartStation setup, select the SmartStation antenna in use. This configuration depends on both the used GS and the used TS instrument. The configuration will ensure the correct vertical offset is applied to the antenna heights.
- For a SmartStation setup, the antenna height value in the GPS survey screen must equal the value for **Instrument height**. **Instrument height** is seen in the preceding **Set Station Point**.
- Leica standard accessories are used.

**SmartStation setup**




a) Mechanical reference plane
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical offset
e) Instrument height reading

# 15 Connections.. - GPS connection wizard GPS

## 15.1 Starting the GPS Connection Wizard

**Description**

This chapter explains how the field controller can be connected with a GNSS antenna using a wizard.

**Access**

Select **Main Menu: Instrument\Connections..\GPS connection wizard**.

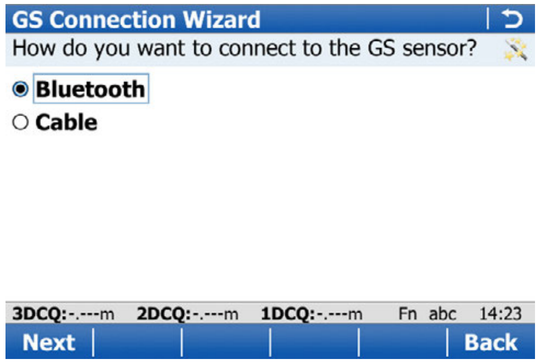
**GS Connection Wizard - Step 1**


| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

| IF connecting a | THEN |
|---|---|
| GS10/GS15/GS08plus/GS12/GS25 | refer to "15.2 Connection to GS10/GS15/GS08plus/GS12/GS25". |
| GS05/GS06 | follow the instruction on the screen. |

**GS Connection Wizard - Step 2**




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Next** changes to the next screen.

| IF | THEN |
|---|---|
| connected via cable | follow the instructions on the screen. |
| connected via Bluetooth | the screen shown depends on whether a Bluetooth GPS connection has previously been configured or not. |

**GS Connection Wizard - Step 3**

This screen is displayed if a Bluetooth connection has previously been configured.


| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Search** | To search for a different GPS instrument. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

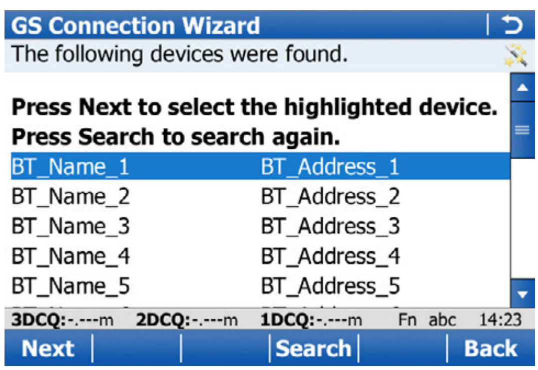
**Next step**

Follow the instructions on the screen.

---

**GS Connection Wizard - Step 3**

This screen is displayed if a NO Bluetooth connection has previously been configured. Move the focus using the arrow keys or the stylus to select a Bluetooth device.




| Key | Description |
|---|---|
| **Next** | To connect to the selected device and continue to the next screen. |
| **Search** | To search for a different total station. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

Follow the instructions on the screen.

---

# 16 Connections.. - TPS connection wizard TPS

## 16.1 Starting the TPS Connection Wizard

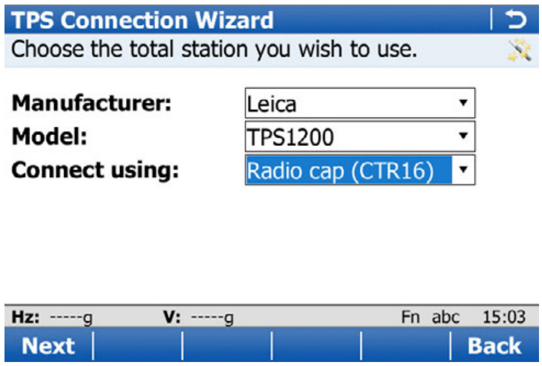
**Description**

This chapter explains how the field controller can be connected with a total station using a wizard.

**Access**

Select **Main Menu: Instrument\Connections..\TPS connection wizard**.

**TPS Connection Wizard - Step 1**




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Manufacturer** | Selectable list | The brand of the instrument. |
| **Model** | Selectable list | The instrument model.<br>☞ The Leica models TC1000 and TC1100 are not supported. |
| **Connect using** | **Cable**, **Bluetooth** or **Internal radio** | How the instrument is connected. The options available depend on the selection for **Model**. |
| | **Radio cap (CTR16/17)** | The CTR16 can be only used on the CS15. To connect a CS15 to a TS with RH16 or TCPS29 attached.<br>☞ Offline configuration is possible if a Bluetooth address is known. |

**Next step**

**Next** changes to the next screen.

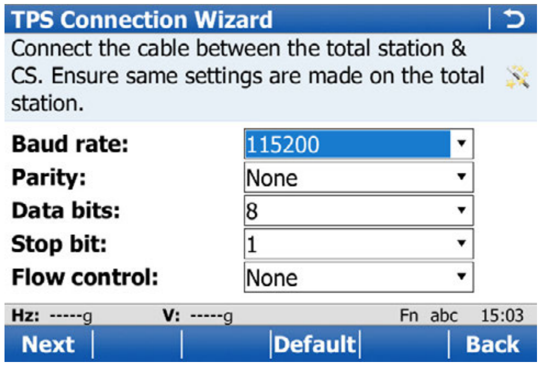
| IF | THEN |
|---|---|
| connected via cable | refer to **Connection Using Cable**. |
| connected via Bluetooth | refer to **Connection Using Bluetooth**. |
| connected via internal radio | refer to **Connection Using Internal Radio**. |
| connected via CTR16 | refer to "16.3 Connection Using Bluetooth". |

## 16.2 Connection Using Cable

**Description**

The connection settings must be specified.

**TPS Connection Wizard - Step 2**




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Default** | To return the fields back to their default values. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Baud rate** | From **1200** to **115200** | Frequency of data transfer from instrument to device in bits per second. |
| **Parity** | **None**, **Even** or **Odd** | Error checksum at the end of a block of digital data. |
| **Data bits** | **6**, **7** or **8** | Number of bits in a block of digital data. |
| **Stop bit** | **1** or **2** | Number of bits at the end of a block of digital data. |
| **Flow control** | **None** or **RTS/CTS** | Activates hardware handshake.<br>When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data. |

**Next step**

**Next** and follow the instructions on the screen.

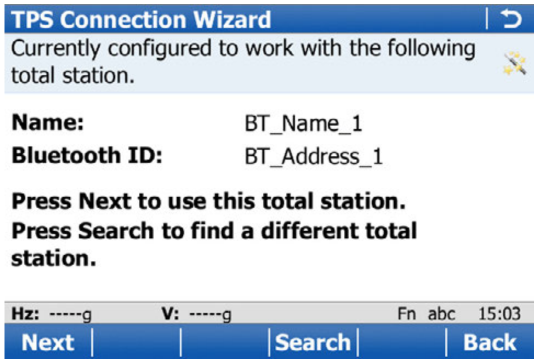
## 16.3 Connection Using Bluetooth

**Description**

The screen shown depends on whether a last used Bluetooth ID is available for the chosen instrument model.

**TPS Connection Wizard - Step 2**

This screen is displayed if the chosen instrument model has a previously used Bluetooth ID already stored.
For a CTR16 connection, the last total station which was connected via RH16 or TCPS29 and CTR16 is displayed.



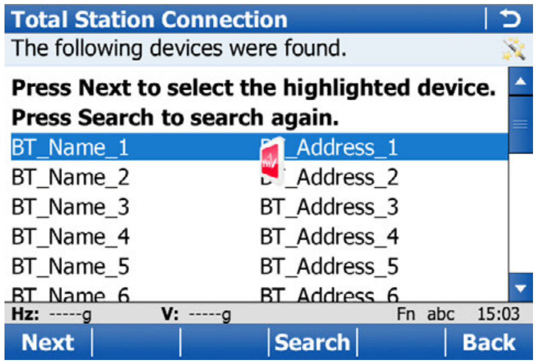

| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Search** | To search for a different total station.<br>For a CTR16 connection also: To check if the radio used for the connection was changed. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

Follow the instructions on the screen.

**Total Station Connection - Step 2**

This screen is displayed if the chosen instrument model has NO previous used Bluetooth ID already stored.
Move the focus using the arrow keys or the stylus to select a Bluetooth device.




| Key | Description |
|---|---|
| **Next** | To connect to the selected device and continue to the next screen. |
| **Search** | To search for a different total station. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**
Follow the instructions on the screen.

**TPS Connection Wizard - Step 2**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Link number** | Editable field | The assigned channel number. |
| **Set as** | **Remote** or **Base** | ☞ The radio modules inside the field controller and the TPS instrument must be set to opposite settings. It is recommended to set the field controller to **Remote** and TPS instrument to **Base**. |

**Next step**
**Next** and follow the instructions on the screen.

## 16.5 Connection To Leica Legacy and Third Party Total Stations

Once you begin working with the CS always work on the controller! Do not touch the total station software, excluding turning the laser pointer, laser plummet or guide lights on/off for some models.

Refer to "35.7 Connection to Other Total Stations" for supported functions.

**Settings required**

Before using any Leica Legacy or third party total station, please ensure that the following values are set **on the** TPS:

| Instrument | Settings |
|---|---|
| Leica Legacy total station | 1. Total station ppm/scale:<br>• Atmospheric ppm = 0<br>• Geometric ppm = 0 or scale factor = 1<br>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.<br>2. Communication settings:<br>• The communication settings on the TPS must match the default parameters for that particular instrument type as seen on the CS.<br>• For TPS1000, TPS2000 and TPS1100 instruments:<br>  • set the communication mode to GSI<br>  • ensure the TPS is in the measurement screen when trying to connect. |
| Third party total station - Topcon | 1. Total station ppm/scale:<br>• Atmospheric ppm = 0<br>• Geometric ppm = 0 or scale factor = 1<br>• Prism constant = 0 (non-motorised instruments only)<br>• The vertical angle on the total station must be set to zenith for all Topcon instruments.<br>• The angular unit on both the total station and controller must match<br>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.<br>2. Communication settings:<br>• The communication settings on the TPS must match the default parameters for that particular instrument type as seen on the CS.<br>• On motorised Topcon total stations, for example GTS800 and above, set the communication values through **Prog\Ext. Link\Setting\RS232**.<br>• For non-motorised instruments ensure that the total station is in the survey measurement screen when trying to connect.<br>3. External Link mode<br>• To connect to motorised Topcon total stations, for example GTS800 and above, set the external link mode through **Prog\Ext. Link\Execute**. |

<table>
<tr><th>Instrument</th><th>Settings</th></tr>
<tr><td></td><td>4. Required cable:<ul><li>TDS DB9 Data Cable (148 SCGTSSOKTOP – Topcon/Sokkia)</li></ul></td></tr>
<tr><td>Third party total station - Sokkia</td><td>1. Total station ppm/scale:<ul><li>Atmospheric ppm = 0</li><li>Geometric ppm = 0 or scale factor = 1</li><li>Prism constant = 0</li><li>The vertical angle display setting must be the same on the CS and the total station</li></ul>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.<br>2. Units:<ul><li>For a Set 030R/220/010 instrument, the angle unit at the total station must be set to degrees, minutes, seconds. The angle setting at the CS does not matter.</li></ul>3. Communication settings:<ul><li>The communication settings on the TPS must match the default parameters for that particular instrument type as seen on the CS.</li><li>For all Sokkia instruments ensure the TPS is in the measurement screen when trying to connect.</li><li>On motorised Sokkia total stations, set additional total station communication values: Comms mode: RS232C, Checksum: No and Controller: 2 Way + Remote</li><li>For the Sokkia SRX set Tilt correction: No to have an uninterrupted connection. On the total station go to Settings\Obs. Condition\Tilt crn: No.</li></ul>4. Required cable:<ul><li>TDS DB9 Data Cable (148 SCGTSSOKTOP – Topcon/Sokkia)</li></ul></td></tr>
<tr><td>Third party total station - Nikon</td><td>1. Total station ppm/scale:<ul><li>Atmospheric ppm = 0</li><li>Geometric ppm = 0 or scale factor = 1</li><li>Prism constant = 0</li><li>The angular unit on both the total station and controller must match</li></ul>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.<br>2. Communication settings:<ul><li>The communication settings on the TPS must match the default parameters for that particular instrument type as seen on the CS.</li><li>For all Nikon instruments ensure the TPS is in the measurement screen when trying to connect.</li></ul>3. Required cable:<ul><li>TDS DB9 Data Cable (148 CNTG Nikon)</li></ul></td></tr>
</table>

# 17 Connections.. - CS connection wizard TS

## 17.1 Starting the CS Connection Wizard

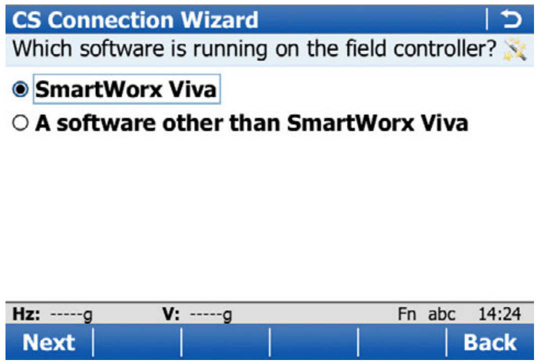
**Description**

This chapter explains how to configure a total station for remote controlled from the CS.

**Access**

Select **Main Menu: Instrument\Connections..\CS connection wizard**.

**CS Connection Wizard,**
**Which software is running on the field controller?**

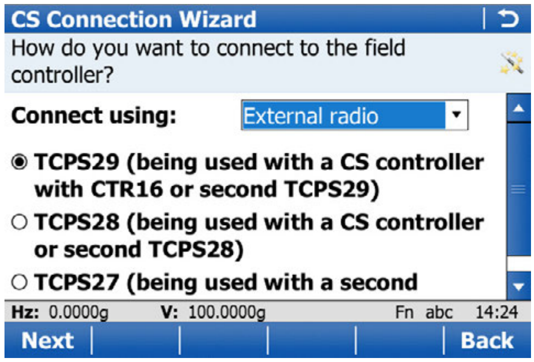



| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

**Next step**

Independent of the selection made, **Next** changes to a screen where the connection type must be selected.

**CS Connection Wizard,**
**How do you want to connect to the field controller?**




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Connect using** | | How the instrument is connected. |
| | **Radio handle**, **Bluetooth** or **External radio** | When **External radio** is selected, choose the type of **External radio** in use. |
| | **Cable** | For TS11/TS15: Serial cable connection.<br>For MS50/TS50/TM50: USB cable connection. Select **Cable** for a USB cable connection. Use the cables GEV234 (Lemo - USB), GEV237 (Lemo - Lemo) or GEV261 (combined RS232/USB cable). |
| | **Cable RS232** | Available on MS50/TS50/TM50 to configure serial connection. |
| | **WLAN** | Available when **A software other than SmartWorx Viva** is checked in the previous screen. Requires configurations in WinCE. |

### Next step

**Next** changes to the next screen.

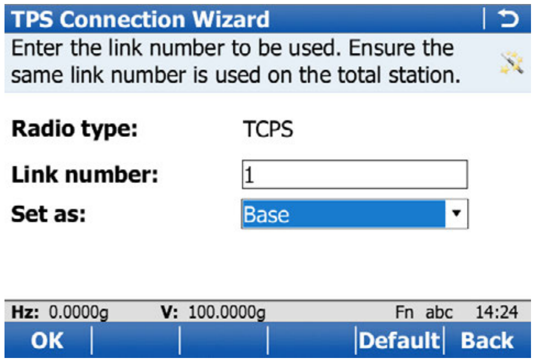
| IF | THEN |
|---|---|
| connected via Radio-Handle | **Next** changes to the next screen.<br><br>The RadioHandle is detected automatically, if it is plugged onto the TS. The name of the RadioHandle is then displayed.<br>If the RadioHandle is not plugged onto the TS, then select the RadioHandle which will be used. Press **Next**.<br>☞ The RH16 can only be connected to a CS15 equipped with a CTR16. |
| connected via TCPS27/TCPS28 | Select the TCPS connected and press **Next**. Refer to "17.2 Connection Using TCPS". |
| connected via TCPS29 | Select the TCPS connected. Further configurations are not required. |
| connected via cable | refer to "17.3 Connection Using Cable". |
| a MS50/TS50/TM50 is connected via cable and SmartWorx Viva is running on the field controller | the systems sets all the parameters to be able to connect to a CS via USB interface from port 1. |
| a MS50/TS50/TM50 is connected via cable and a software other than SmartWorx Viva is running on the field controller | • for a serial connection refer to "17.3 Connection Using Cable".<br>• for a USB connection, the systems sets all the parameters to be able to connect to a CS via USB interface from port 1. |
| connected via Bluetooth | **Next** changes to the next screen.<br>The Bluetooth connection is established automatically.<br>Press **Finish**. |
| connected via WLAN | enabled and configure WLAN within WinCE.<br>**Next** changes to the next screen.<br>Press **Finish**. |

## 17.2 Connection Using TCPS

**TPS Radio Communication**

☞ This screen is valid for TCPS27 and TCPS28.

The channel on which the TCPS broadcasts can be changed. Changing channels changes the frequency at which the TCPS operates. This may be necessary to enable multiple pairs of TCPS to work simultaneously in the same area without interferring with each other.




| Key | Description |
|---|---|
| **OK** | To confirm the settings and to continue to the next screen. |
| **Default** | To return the fields back to their default values. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Radio type** | Display only | The type of protocol. |
| **Link number** | Editable field | The assigned channel number. |
| **Set as** | **Remote** or **Base** | The TCPS inside the field controller and the TS11/TS15 must be set to opposite settings. It is recommended to set the field controller to **Remote** and TS11/TS15 to **Base**. |

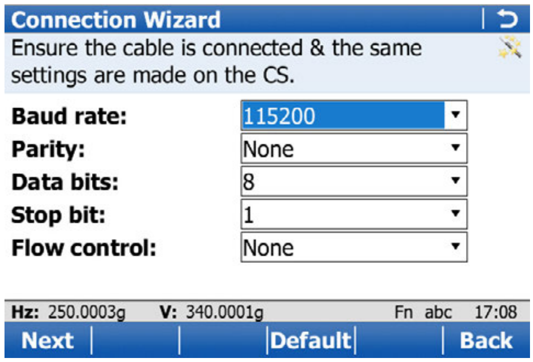
**Next step**

**OK** and follow the instructions on the screen.

## 17.3 Connection Using Cable

**CS Connection Wizard - Connect the cable between the total station & CS. Ensure same settings are made on the CS.**

Valid for TS11/TS15.




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Default** | To return the fields back to their default values. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Baud rate** | From **1200** to **115200** | Frequency of data transfer from instrument to device in bits per second. |
| **Parity** | **None**, **Even** or **Odd** | Error checksum at the end of a block of digital data. |
| **Data bits** | **6**, **7** or **8** | Number of bits in a block of digital data. |
| **Stop bit** | **1** or **2** | Number of bits at the end of a block of digital data. |
| **Flow control** | **None** or **RTS/CTS** | Activates hardware handshake.<br>When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data. |

### Next step

**Next** and follow the instructions on the screen.

# 18 Connections.. - Internet wizard

**Description**

This chapter explains how the field controller can be connected to the Internet using a wizard and without using RTK.

**Access**

Select **Main Menu: Instrument\Connections..\Internet wizard**.

The screen displayed varies.

| IF | AND | THEN |
|---|---|---|
| the **Internet wizard** is started for the first time | a CS is used | the Internet device can be connected to the<br>• CS 3.5G modem port<br>• Bluetooth mobile phone |
| | a TS11/TS15/TS12 Lite/MS50/TS50/TM50 is used | the Internet device can be connected to a Bluetooth phone of type<br>• GSM/GPRS/UMTS device<br>• CDMA device |
| the Internet connection is configured | not connected | • the Internet connection can be edited.<br>• the connection can be started. |
| the Internet connection is configured | connected | • the Internet connection can be edited.<br>• the connection can be stopped. |

**Next step**
Make a selection, press **Next** and follow the instructions on the screen.

# 19 Connections.. - All other connections

## 19.1 Accessing Configuration Connections

**Description**

The instrument has various connections which can be configured to be used with different ports and devices. The configuration varies depending on the individual application.

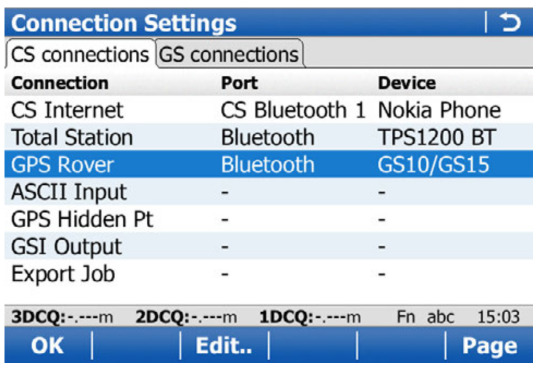
**Access**

For RTK rover, TPS, TS11/TS15 and MS50/TS50/TM50:
- Select **Main Menu: Instrument\Connections..\All other connections**.

For RTK base:
- Select **Main Menu: Base connections\Connections..\All other connections**.

**Connection Settings**

The screen gives an overview of all connections with the currently assigned port and device.
For an RTK rover, this screen consists of the **CS connections** and the **GS connections** or **TS connections** page.
For a GS05/GS06/GS08plus/GS12, this screen consists of only one page.




| Key | Description |
|---|---|
| **OK** | To return to the screen from where this screen was accessed. |
| **Edit..** | To configure the parameters related to the highlighted connection. Refer to the sections on each individual connection in this chapter. |
| **Cntrl..** | Available for certain devices connected to certain connections. To configure additional parameters related to the highlighted device.<br>For MS50/TS50/TM50: Available when the **GeoCom** connection is set to **Cable** (USB) and **WLAN**. To show the IP and the port for third party connections. |
| Fn **Conect** and Fn **Disco** | Available for a real-time connection configured to use an Internet connection. To connect/disconnect from the GPS reference data. |

# 19.2 CS Internet / GS Internet / TS Internet

## 19.2.1 SmartWorx

**Description**

The Internet connection

- allows accessing the Internet using the field controller (CS internal GSM) or the instrument plus a GPRS device.
- can be used together with the real-time connection to receive real-time data from, for example, an Ntrip Caster via Internet communication.

Refer to "37 NTRIP via Internet" for information about Ntrip.

The settings on this screen define the port and parameters required for accessing the Internet.

**Access**

For RTK rover:

- In **Connection Settings**, **CS connections** page, highlight **CS Internet**. **Edit..**.
- In **Connection Settings**, **GS connections** page, highlight **GS Internet**. **Edit..**.

For RTK base:

- In **Base Connection Settings**, select **GS Internet**. **Edit..**.

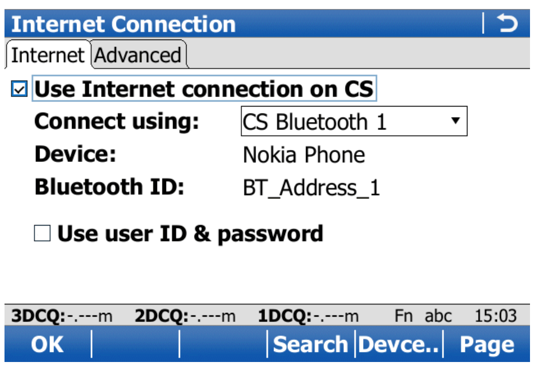
For TPS:

- In **Connection Settings**, highlight **CS Internet**. **Edit..**.

For TS11/TS15/TS12 Lite:

- In **Connection Settings**, highlight **TS Internet**. **Edit..**.

**Internet Connection, Internet page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Search** | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if **CS Bluetooth 1** or **CS Bluetooth 2** are selected. |
| **Devce..** | To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". Available if **Use Internet connection on CS**/**Use Internet connection on GS**/**Use Internet connection on TS** is checked. |
| **Page** | To change to another page on this screen. Available if **Use Internet connection on CS**/**Use Internet connection on GS**/**Use Internet connection on TS** is checked. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use Internet connection on CS**, **Use Internet connection on GS** or **Use Internet connection on TS** | Check box | Activates the Internet connection. |
| **Connect using** | | The ports available for connection to the Internet. |
| | **CS modem** | The internal GSM modem of the field controller. |
| | **CS RS232 port** | The RS232 port on the field controller. |
| | **CS Bluetooth 1** and **CS Bluetooth 2** | The Bluetooth ports on the field controller which will be used for the connection functionality. |
| | **CS modem** | |
| | **GS Port 1** | For GS10: The physical port P1 on the box.<br>For GS15: The red LEMO port. |
| | **GS Port 2** | For GS10: The physical port P2 on the box.<br>For GS15: The black LEMO port. |
| | **GS Port 3** | For GS10: The physical port P3 on the box.<br>For GS15: The port for the slot devices. |
| | **TS Bluetooth 1** and **TS Bluetooth 2** | The Bluetooth ports on the TS11/TS15/TS12 Lite which will be used for the connection functionality. |
| **Device** | Display only | The name of the selected device. |
| **Connect to internet using** | **GPRS** | Access the Internet using a **G**eneral **P**acket **R**adio **S**ervice connection. |
| | **Dial-up** | Access the Internet using the facilities of the public switched telephone network. |
| **Use user ID & password for Internet connection** | Check box | If checked, a user ID and a password can be typed in. |
| **User ID** | Editable field | Some providers ask for a user ID to allow connecting to the Internet via GPRS. Contact your provider if a user ID must be used.<br>It is possible to show/hide the User ID. |
| **Password** | Editable field | Some providers ask for a password to allow connecting to the Internet via GPRS. Contact your provider if a password is required. |

#### Next step

**Page** changes to the **Advanced** page.

**Internet Connection, Advanced page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use static IP address** | Check box | In order to get access to the Internet, an IP address is required. This IP address identifies the instrument in the Internet. This option should only be checked if a static IP address is available for the instrument.<br>The IP address to get access to the Internet is provided by the network provider permanently. Each time the instrument wants to access the Internet via the device the same IP address identifies the instrument. This behaviour is important if the instrument is used as a TCP/IP server. |
| **IP address** | Editable field | Available if **Use static IP address** is checked. To set the IP address. |
| **Use DynDNS** | Check box | To configure a dynamic DNS service. This setting provides access to the RTK data stream of a GS base server while it is using a dynamic IP address. The setting allows TCP/IP clients to use an Internet domain name to address a GS with a dynamic IP address.<br>Use case: A GS is set up in base mode with an Internet connection using GPRS. The GS has a different IP address every time the Internet connection is established or after running for a certain time. The GS checks every 12 min if its IP address has changed. If so, the GS updates the DynDNS settings.<br>Refer to **DynDNS** for more information about DynDNS. |
| **Service provider** | Selectable list | Available when **Use DynDNS** is checked. Select the DNS service to use.<br>☞ Register at the selected DynDNS service to receive a user name and password and to create a host name. |
| **Host name** | Editable field | Available when **Use DynDNS** is checked. Type in the host name that you created at the DynDNS service where you registered.<br>☞ Leica Viva rovers can resolve host names. Using DynDNS is an easy way to provide RTK data from a receiver without having to know the current IP address. |
| **User name** | Editable field | Available when **Use DynDNS** is checked. Type in the user name provided by the DynDNS service where you registered. |
| **Password** | Editable field | Available when **Use DynDNS** is checked. Type in the password provided by the DynDNS service where you registered. |

**Next step**

**OK** returns to the screen from where **Internet Connection** was accessed.

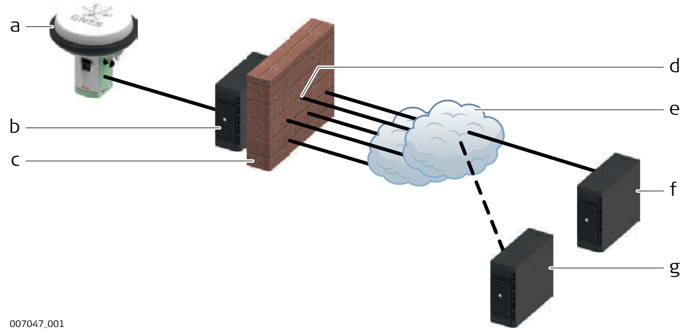
## 19.2.2 DynDNS

**Usage with dynamic IP address**

**Goal**

To access a GS with a dynamic IP address using a host name.

**Basic concept of dynamic DNS (DynDNS)**




a) GS with mobile Internet device
b) ISP with DNS server
c) Firewall
d) Port 8245 or 80
e) Internet
f) checkip.dyndns.org
g) dyndns.com

- When using a mobile Internet connection, be aware of two types of restrictions:
  1) The first restriction is on the outgoing ports. When the GS is trying to access checkip.dyndns.org it uses port 8245. For using two-dns.de, an alternative to DynDNS.com, port 80 is needed additionally. It is important that ports 8245 and possibly 80 are open for outgoing connections, depending on which service you use.
  2) The second restriction is for incoming connections. If you managed to connect to DynDNS.com and associate your IP address with your hostname, you could theoretically connect to it using the hostname. In practise, you can run into the problem of ports not being open.
- Most likely your ISP has closed the standard ports - port 80 for web interface access or port 21 for FTP access.

  In order to access the Internet with a mobile device/SIM card, you need an **A**ccess **P**oint **N**ame, a user name and a password and a list of open incoming ports.

  Imagine this APN like a subnet for your phone that your ISP can configure, for example what external networks, services, open ports are available. Usually when you use mobile devices/SIM cards from the same ISP, the APN is the same for all these devices.

  The open ports you can use when providing RTK data from your GS are defined by this APN profile. This means besides the APN, user name and password, you must also ask your ISP for a list of open ports. These open ports can then be configured on the GS for the **Base RTK 1** and **Base RTK 2** interface. All other ports on the GS cannot be configured/changed.

☞ Ask for a list of open ports for the APN you want to use before configuring your DynDNS setup.

### Configuring mobile Internet and DynDNS step-by-step

| Step | Description |
|---|---|
| 1. | Contact your Internet service provider and ask for the APN profile for your mobile device/SIM card. You will receive a document listing all open ports for your APN. |
| 2. | Register at the DynDNS service of your choice.<br>Create:<br>• A user name and password for your DynDNS account.<br>• A host name for the GS. |
| 3. | Select **Base Menu\Instrument\Base connections\All other connections**. |
| 4. | Highlight **GS Internet** and press **Edit..**. |
| 5. | On the **Internet** page, check **Use Internet connection on GS**.<br>Select the mobile device to use. |
| 6. | On the **Advanced** page, check **Use DynDNS**.<br>Select the **Service provider**.<br>Enter **Host name**, **User name** and **Password**. |
| 7. | To see the details about your mobile Internet connection:<br>Select **Base Menu\Instrument\Base status info\Connection status**. Highlight **GS Internet**. Press **Intfce**.<br>The last updated IP address is displayed. |
| 8. | Select **Base Menu\Instrument\Base connections\All other connections**. |
| 9. | Highlight **Base RTK 1** and press **Edit..**. |
| 10. | Configure the transmission of RTK correction data and press **OK**. |
| 11. | Press **Cntrl..**. |
| 12. | Configure **User type**: **Server to use**. Make sure the TCP/IP port is set to a port listed as open in your APN profile.<br>Configure, how many clients can connect to this port simultaneously to allow up to ten rovers to connect to a base RTK port. |
| 13. | You can now receive RTK correction data from your base using the host name and the configured RTK port. |

### Troubleshooting

- Go to **Base Menu\Instrument\Base status info\Connection status**. Highlight **GS Internet**. Press **Intfce**. Check that DynDNS status is shown as on. Check that the currently registered IP address is correct.
- Everything is fine, but you do not get data from the port that you configured for your data stream? Use the DynDNS tool http://www.dyndns.com/support/tools/openport.html and enter the IP address of your GS . You can find the IP address as described above. Enter the port you are trying to connect to. The tool will tell you if this port is open. If not, please change your data stream configuration to a different port.

## 19.3 GPS Rover / Base Sensor GPS

**Description**

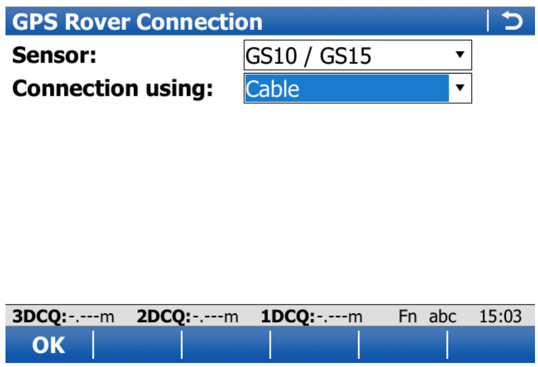
To connect the field controller to the sensor (antenna) either on the base or on the rover side.

**Access**

For RTK rover:
- In **Connection Settings**, **CS connections** page, highlight **GPS Rover**. **Edit..**.
- Select **Instrument\Connections..\GPS connection wizard**.

For RTK base:
- In **Base Connection Settings**, select **Base Sensor**. **Edit..**.
- Select **Instrument\Base connections\Connect to base sensor**.

**GPS Rover Connection / Connect to Base Sensor**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed.<br>When changing the sensor type, SmartWorx Viva must be shutdown and re-started before the sensor can be used. |
| **Search** | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available for GS10/GS15/GS08plus/GS12/GS14/GS25 with **Connection using: Bluetooth**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Sensor** | Selectable list | Select the attached model. |
| **Connect using** | **Cable** or **Bluetooth** | How the instrument is connected. The options available depend on the selection for **Sensor**. The availability of the other fields depends on the selection made here. |
| **Last used rover** | Display only | For GS10/GS15/GS08plus/GS12/GS14/GS25: Available for RTK rover.<br>The name of the selected Bluetooth device. |
| **Last used base** | Display only | For GS10/GS15/GS08plus/GS12/GS14/GS25: Available for RTK base.<br>The name of the selected Bluetooth device. |
| **Bluetooth ID** | Display only | For GS10/GS15/GS08plus/GS12/GS14/GS25: The ID of the selected Bluetooth device. |

## 19.4 ASCII Input

### 19.4.1 Configuration of an ASCII Input Connection

**Description**

The ASCII Input connection receives ASCII messages from third-party devices such as depth sounders, barometers, digital cameras, pipe detectors, Geiger counters, etc. The ASCII messages are stored as annotations together with the next manually measured point and/or auto point.

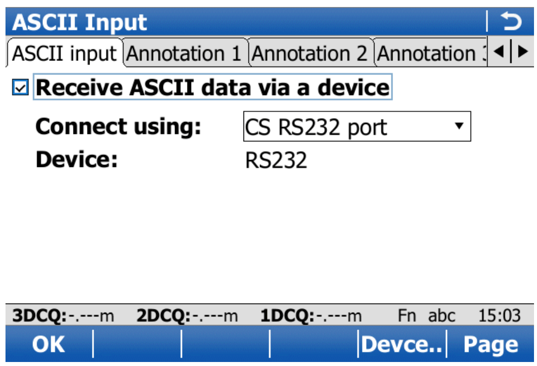
The settings on this screen define the port and the device to be used and the type of ASCII messages to be written to individual annotations.

**Access**

For RTK rover:
- In **Connection Settings**, **CS connections** page, highlight **ASCII Input**. **Edit..**.

For TPS:
- In **Connection Settings**, highlight **ASCII Input**. **Edit..**.

**ASCII Input, ASCII input page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Devce..** | Available when **Receive ASCII data via a device** is checked. To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| **Page** | To change to another page on this screen. |
| Fn **Cmnd..** | To configure a message to be sent through the configured port to the device. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Receive ASCII data via a device** | Check box | Activates the ASCII input connection. |
| **Connect using** | **CS Bluetooth 1** and **CS Bluetooth 2** | The Bluetooth ports on the field controller, will be used for the connection functionality. |
| | **CS RS232 port** | The RS232 port on the field controller. |
| **Device** | Display only | The name of the device selected for ASCII input. |

**Next step**

**Page** changes to the **Annotation 1**/**Annotation 2**/**Annotation 3**/**Annotation 4** page.

**ASCII Input, Annotation 1/Annotation 2/Annotation 3/Annotation 4 page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Store ASCII data to this annotation** | Check box | If checked, ASCII messages are recorded with the selected annotation. |
| **Message desc** | Editable field | The description for the ASCII message being received. This description is then displayed in other screens, for example in the status screen. |
| **Message ID** | Display only | The message ID to identify a particular ASCII message coming from the device. The message is then saved to the annotation. The following characters can be used as filter:<br>^ To accept strings starting with the subsequent characters. For example, ^1 accepts 12 but not 21.<br>$ To accept strings ending with the preceding characters. For example, 1$ accepts 21 but not 12.<br>. To accept any character except newline.<br>[ ] To accept a set of characters. For example, [0-9] accepts all numbers.<br>Any characters to accept strings that include the characters at any position. For example 1 accepts 1234, 4321 or 2134 but not 2345. |
| **Prefix '@<Desc>@' when writing** | Check box | Stores the description in **Message desc** as prefix to the ASCII message. This prefix helps to more easily identify the annotations registered with a point. |

### Next step

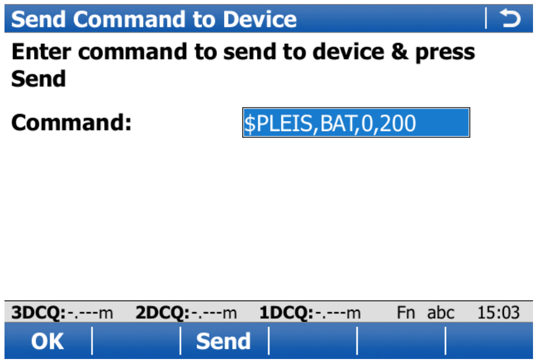
**Page** changes to another page on this screen.

## 19.4.2 Configuration of a Command to the Device

**Access**

For RTK rover:
- In **ASCII Input**, **ASCII input** page, Fn **Cmnd..**.

**Send Command to Device**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Send** | To send the command to the device. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Command** | Editable field | A message to be sent to the device through the configured port when the survey or stakeout application is accessed. This functionality, for example, allows the device to be started remotely. The last used command that was entered is remembered as part of the active working style. |

## 19.5 GPS Hidden Pt GPS

**Description**

Hidden point measurement devices are used for measuring to points which cannot be directly measured with GPS, for example house corners or trees. The measurements made with a hidden point measurement device are directly transferred to the instrument for the calculation of the coordinates of the hidden point. They can also be entered manually.

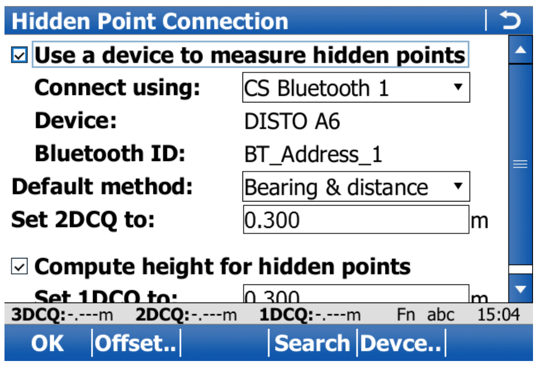
The settings on this screen define the port, the device and estimated qualities to be used for the hidden point connection.

**Access**

For RTK rover:

- In **Connection Settings**, **CS connections** page, highlight **GPS Hidden Pt**. **Edit..**.

**Hidden Point Measurement**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Offset..** | To configure the height and external angle offsets. |
| **Search** | Available when a Bluetooth port and device is selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| **Devce..** | To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

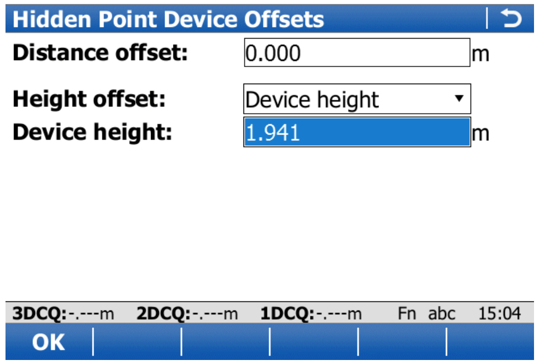
| Field | Option | Description |
|---|---|---|
| **Use a device to measure hidden points** | Check box | To compute a hidden point with height. Activates the hidden point connection. If not checked, the measured values must be entered manually. |
| **Connect using** | **CS Bluetooth 1** and **CS Bluetooth 2** | The Bluetooth ports on the field controller which will be used for the connection functionality. |
| | **CS RS232 port** | The RS232 port on the field controller. |
| **Device** | Display only | The name of the selected hidden point device. |
| **Bluetooth ID** | Display only | Available if **CS Bluetooth 1** or **CS Bluetooth 2** are selected. The Bluetooth ID of the hidden point device. |

| Field | Option | Description |
|---|---|---|
| **Default method** | | The method which is suggested first when starting the Survey Hidden Points application. |
| | **Bearing & distance** | The distance and bearing from the known point to the hidden point are to be determined. An auxiliary point helps compute the bearing which might not be known. The auxiliary point can be measured in the direction from the known point to the hidden point. |
| | **Using 2 bearings** | The bearings from the known points to the hidden point are to be determined. Auxiliary points help compute the bearings which might not be known. Auxiliary points can be measured in the direction from the known points to the hidden point. |
| | **Using 2 distances** | The distances from the known points to the hidden points are to be determined. The location of the hidden point relative to the line between the two known points is to be defined. |
| | **Chainage & offset** | The chainage from one known point along the line between the two known points must be determined. The offset of the hidden point to the line between the two known points must be determined. |
| | **Back brng & distance** | The distance and the bearing from the hidden point to the known point are to be determined. An auxiliary point helps compute the bearing which might not be known. An auxiliary point can be measured in the direction from the hidden point to the known point. |
| **Set 2DCQ to** | Editable field | The estimated value for the position quality assigned to all hidden points. This value must be estimated because hidden point measurement devices do not output position qualities. |
| **Compute height for hidden points** | Check box | Select to compute a hidden point with height. |
| **Set 1DCQ to** | Editable field | Available when **Compute height for hidden points** is checked. The estimated value for the height quality assigned to all hidden points. |

#### Next step

| IF height and external angle/distance offsets | THEN |
|---|---|
| are not to be configured | **OK** closes the screen and returns to the screen from where **Hidden Point Measurement** was accessed. |
| are to be configured | **Offset..**. |

### Hidden Point Device Offsets




| Key | Description |
|---|---|
| **OK** | To accept changes and to return to **Hidden Point Measurement**. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

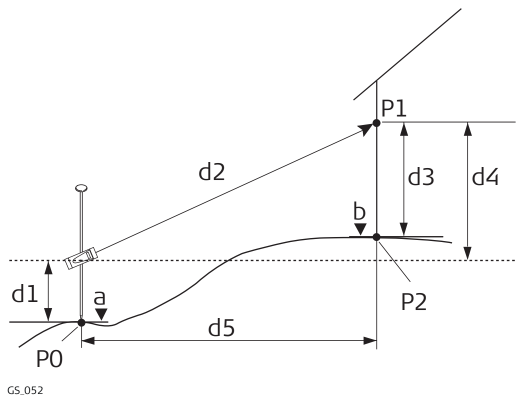
| Field | Option | Description |
|---|---|---|
| **Distance offset** | Editable field | The offset is automatically added to the measured distance. |
| **Height offset** | | Available when **Compute height for hidden points** is checked in **Hidden Point Measurement**. |
| | **None** | No height offsets are used. The result is the delta height between the centre of the device and the aimed point. |
| | **Device height** | When measuring hidden points, the height of the hidden point measurement device can be typed in. This option should be used when the hidden point can be directly measured using the hidden point device. |
| | **Device & target ht** | When measuring hidden points, the height of the hidden point measurement device as well as the target height can be typed in. This option should be used when the hidden point cannot be directly measured with a hidden point device, but a target point can be used to calculate the position. |
| **Device height** | Editable field | The height of the hidden point measurement device. This height is the distance from the ground to the centre of the device. |
| **Target height** | Editable field | The distance from the hidden point to the aimed point. |
| **Angle offset** | | Sets the default method for entering an angle offset. EAO is an offset angle between the North of the device being used and WGS 1984 geodetic North. EAOs are applied when measuring hidden points using a device capable of measuring azimuths. |
| | **None** | No EAO value is applied to the azimuth measurement received from the hidden point measurement device. |
| | **Permanent** | Applies a default value for the offset angle. The value is changeable. |

| Field | Option | Description |
|---|---|---|
| | **New for each point** | Offset angle values must be entered for each new hidden point. |
| **Offset** | Editable field | Available for **Angle offset: Permanent**.<br>The default value for the offset angle. |

### Next step

| Step | Description |
|---|---|
| 1. | **OK** returns to **Hidden Point Measurement**. |
| 2. | **OK** returns to the screen from where **Hidden Point Measurement** was accessed. |

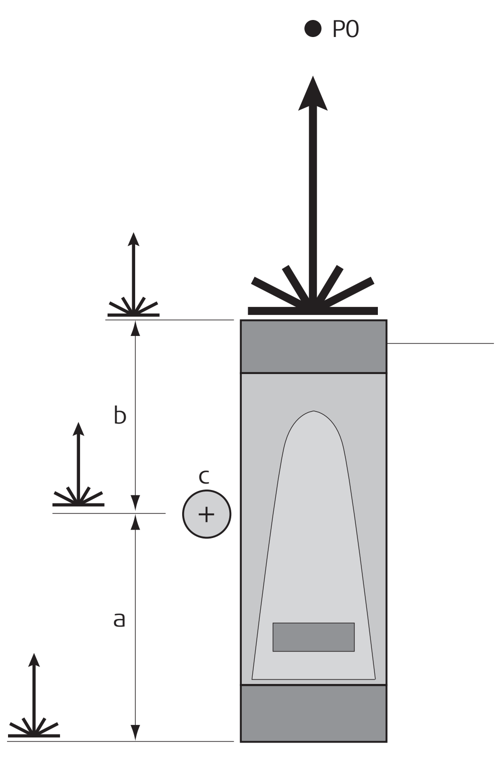
## Diagram




P0 Known point
P1 Target point
P2 Hidden point
a Height of P0
b Height of P2 = a + d1 + d4 - d3
d1 Device height: height of hidden point measurement device above P0
d2 Slope distance
d3 Device height: height of P1 above P2
d4 Height difference between hidden point measurement device and P1
d5 Horizontal distance

## Distance offsets at hidden point measurement devices

A Leica DISTO is shown as an example




a) Negative **Distance offset**
b) Positive **Distance offset**
c) Pole
d) DISTO
P0 Hidden point

## 19.6 Export Job

**Description**

The Export Job connection allows data from a job to be exported from the instrument to another instrument.

The settings on this screen define the port and the device to which the data will be exported.

**Access**

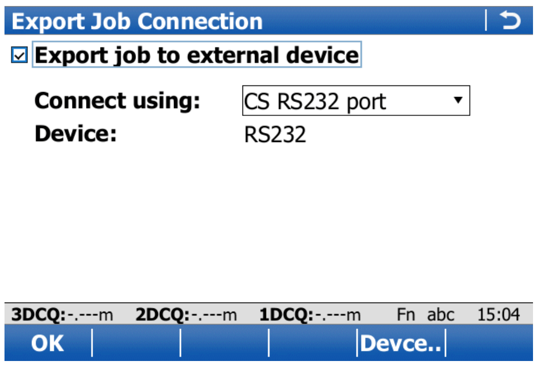
For RTK rover:

- In **Connection Settings**, **CS connections** page, highlight **Export Job**. **Edit..**.

For TPS and TS11/TS15/TS12 Lite:

- In **Connection Settings** highlight **Export Job**. **Edit..**.

**Export Job Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Search** | Available when **CS Bluetooth 1** or **CS Bluetooth 2** are selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| **Devce..** | To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Export job to external device** | Check box | Activates the connection. |
| **Connect using** | **CS Bluetooth 1** / **CS Bluetooth 2** or **TS Bluetooth 1** / **TS Bluetooth 2** | The Bluetooth ports on the field controller or the TS11/TS15/TS12 Lite which will be used for the connection functionality. |
| | **CS RS232 port** or **Cable** | The RS232 port on the field controller or the TS11/TS15/TS12 Lite. |
| | **Radio handle** | Hotshoe connection for RadioHandle. This port is located on top of Communication side cover. |
| **Device** | Display only | The device currently assigned to the selected port within the active working style. The device which is selected determines the availability of the next fields. |
| **Job Number** | Selectable list | Available if the **Device** is a Leica instrument. Select a job number to assign to the job. |
| **Name** | Editable field | Available if the **Device** is a Leica instrument. The name of the job. |

## 19.7 RTK Rover GPS

### 19.7.1 Configuration of a Rover Real-Time Connection

**Description**

The real-time connection allows real-time related parameters to be configured. These parameters include defining the real-time messages and the base to be used.

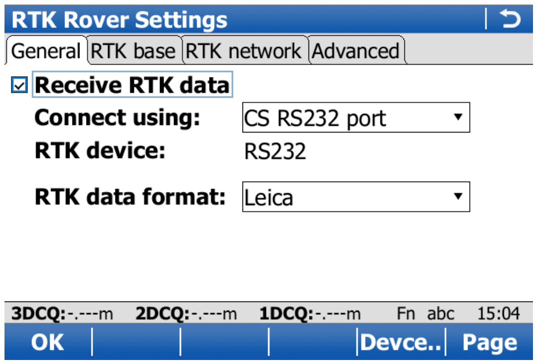
**Access**

For RTK rover:

- In **Connection Settings**, **GS connections** page, highlight **RTK Rover**. **Edit..**.

**RTK Rover Settings, General page**

The available fields and keys on this screen depend on the selected settings.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Search** | Available when connecting via Bluetooth. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| **Devce..** | To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices".<br>For **Connect using**: **CS modem**, a special screen opens to edit the CS modem settings. Refer to "21.3 Creating/Editing a Device". |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Receive RTK data** | Check box | If checked, the rover real-time connection is activated. |
| **Connect using** | **CS modem** | The internal GSM modem of the field controller. |
| | **CS RS232 port** | The RS232 port on the field controller. Unavailable for GS08plus/GS12. |
| | **CS Bluetooth 1** and **CS Bluetooth 2** | The Bluetooth ports on the field controller which will be used for the connection functionality. |
| | **CS Internet 1**, **CS Internet 2** and **CS Internet 3** | The Internet ports on the field controller. If these ports are not assigned to a specific connection, then these ports are additional remote ports. |
| | **GS Port 1** | For GS10: The physical port P1 on the box.<br>For GS14/GS15: The red LEMO port.<br>For GS25: The physical LEMO port P1 on the box. |

| Field | Option | Description |
|---|---|---|
| | **GS Port 2** | For GS10: The physical port P2 on the box.<br>For GS15: The black LEMO port.<br>For GS25: The physical LEMO port P2 on the box. |
| | **GS Port 3** | For GS10: The physical port P3 on the box.<br>For GS15/GS25: The slot for a device. |
| | **GS Port 4** | For GS25: The physical LEMO port P4 on the box. |
| | **GS Internet 1**, **GS Internet 2** and **GS Internet 3** | The Internet ports on the GS10/GS14/GS15/GS25. If these ports are not assigned to a specific connection, then these ports are additional remote ports. |
| | **TS Bluetooth 1** and **TS Bluetooth 2** | The Bluetooth ports on the TPS which will be used for the connection functionality. |
| | **TS Internet 1**, **TS Internet 2** and **TS Internet 3** | The Internet ports on the TPS. If these ports are not assigned to a specific connection, then these ports are additional remote ports. |
| | **CS CGR radio** | The CGR10/CGR15 that can be attached to the CS. |
| **RTK device** | Display only | The device currently assigned to the selected port within the active working style. The device which is selected determines the availability of the next fields. |
| **RTK data format** | | ☞ If a mountpoint was selected from a downloaded source table during the use of the RTK connection wizard, then the RTK format which is used with the NTRIP mountpoint is displayed. |
| | **Leica** | The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. This format is recommended when working exclusively with Leica instruments. |
| | **Leica 4G** | The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/Alt-BOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. |
| | **CMR/CMR+** | CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. |
| | **RTCM 18,19 v2** | Message according to RTCM version 2.x. Uncorrected carrier phase and pseudorange. Message 3 is also generated. Use for real-time operations where the ambiguities will be resolved at the rover. Accuracy at the rover: 1 - 5 cm rms after a successful ambiguity resolution. |
| | **RTCM v3** | Use RTCM when rover units from a different manufacturer are to be used.<br>Use to decode the standard **RTCM v3** and the **RTCM v3 (MSM)** messages from the base.<br>Message according to RTCM version 3. A new standard format for transmission of **G**lobal **N**avigation **S**atellite **S**ystem correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. |

| Field | Option | Description |
|---|---|---|
| | | **Message types for real-time GNSS operation:**<br>• 1001: L1-only GPS real-time observables<br>• 1002: Extended L1-only GPS real-time observables<br>• 1003: L1 & L2 GPS real-time observables<br>• 1004: Extended L1 & L2 GPS real-time observables<br>• 1005: Stationary real-time base station **A**ntenna **R**eference **P**oint<br>• 1006: Stationary real-time base station ARP with antenna height<br>• 1007: Antenna descriptor<br>• 1008: Antenna descriptor and serial number<br>• 1009: L1-only GLONASS real-time observables<br>• 1010: Extended L1-only GLONASS real-time observables<br>• 1011: L1 & L2 GLONASS real-time observables<br>• 1012: Extended L1 & L2 GLONASS real-time observables<br>**Network RTK Messages according to Master-Auxiliary Concept:**<br>• 1014: Network Auxiliary Station Data message.<br>This message contains details of the base stations in the network. For example, the master station and its coordinates, and the coordinate differences between the master and its auxiliaries.<br>• 1015: Ionospheric Correction Differences message<br>• 1016: Geometric Correction Differences message<br>• 1021: Helmert / Abridged Molodensky transformation<br>• 1022: Molodensky-Badekas transformation<br>• 1023: Transformation Residual Message, ellipsoidal grid representation; CSCS/position & geoid/height residuals are supported<br>• 1024: Transformation Residual Message, plane grid representation; CSCS/position & geoid/height residuals are supported<br>• 1025: Projection types except LCC2SP, OM<br>• 1026: Projection type Lambert Conic Conformal (LCC2SP)<br>• 1027: Projection type Oblique Mercator (OM)<br>• 1029: Unicode Text String message<br>• 1032: Physical Reference Station Position message<br>• 1033: Receiver and Antenna Descriptor message |

| Field | Option | Description |
|---|---|---|
| | | • 1037: GLONASS Ionospheric Correction Differences message (phase).<br>• 1038: GLONASS Geometric Correction Differences message (phase).<br>• 1039: GLONASS Combined Geometric and Ionospheric Correction Differences message (phase).<br>• 1068: GLONASS Ionospheric Correction Differences message (code).<br>• 1069: GLONASS Geometric Correction Differences message (code).<br>• 1070: GLONASS Combined Geometric and Ionospheric Correction Differences message (code).<br>Pseudorange and phase range values for L1 and L2. Depending on the type of instrument, the data for L1-only or for L1 and L2 are sent out.<br>**Message types for universal real-time GNSS operation, decoding from RTCM v3 (MSM):**<br>The receiver can decode **RTCM v3 (MSM)**.<br>• 1071: Compact GPS pseudo ranges (MSM1)<br>• 1072: Compact GPS phase ranges (MSM2)<br>• 1073: Compact GPS pseudo ranges and phase ranges (MSM3)<br>• 1074: Full GPS pseudo ranges and phase ranges plus **C**arrier-to-**N**oise **R**atio (MSM4)<br>• 1075: Full GPS pseudo ranges, phase range, phase range rate and CNR (MSM5)<br>• 1076: Full GPS pseudo ranges and phase ranges plus CNR, high resolution (MSM6)<br>• 1077: Full GPS pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)<br>• 1081: Compact GLONASS pseudo ranges (MSM1)<br>• 1082: Compact GLONASS phase ranges (MSM2)<br>• 1083: Compact GLONASS pseudo ranges and phase ranges (MSM3)<br>• 1084: Full GLONASS pseudo ranges and phase ranges plus CNR (MSM4)<br>• 1085: Full GLONASS pseudo ranges, phase ranges, phase range rates and CNR (MSM5)<br>• 1086: Full GLONASS pseudo ranges and phase ranges plus CNR, high resolution (MSM6)<br>• 1087: Full GLONASS pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)<br>• 1091: Compact Galileo pseudo ranges (MSM1)<br>• 1092: Compact Galileo phase ranges (MSM2) |

| Field | Option | Description |
|---|---|---|
| | | • 1093: Compact Galileo pseudo ranges and phase ranges (MSM3)<br>• 1094: Full Galileo pseudo ranges and phase ranges plus CNR (MSM4)<br>• 1095: Full Galileo pseudo ranges, phase ranges, phase range rates and CNR (MSM5)<br>• 1096: Full Galileo pseudo ranges and phase ranges plus CNR, high resolution (MSM6)<br>• 1097: Full Galileo pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)<br>• 1121: Compact BeiDou pseudo ranges (MSM1)<br>• 1122: Compact BeiDou phase ranges (MSM2)<br>• 1123: Compact BeiDou pseudo ranges and phase ranges (MSM3)<br>• 1124: Full BeiDou pseudo ranges and phase ranges plus CNR (MSM4)<br>• 1125: Full BeiDou pseudo ranges, phase ranges, phase range rates and CNR (MSM5)<br>• 1126: Full BeiDou pseudo ranges and phase ranges plus CNR, high resolution (MSM6)<br>• 1127: Full BeiDou pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)<br>**Accuracy at the rover:**<br>• For L1-only: 0.25 - 1 m rms.<br>• For L1 and L2: 1 - 5 cm rms after a successful ambiguity resolution. |
| | **RTCM 1,2 v2** | Message according to RTCM version 2.x. Differential and delta differential GPS corrections. Message 3 is also generated. Use for DGPS applications. Accuracy at the rover: 0.25 - 1 m rms. |
| | **RTCM 9,2 v2** | Message according to RTCM version 2.x. GPS partial correction set and delta differential GPS corrections. Message 3 is also generated. Use for DGPS applications with a slow data channel in the presence of interference. Accuracy at the rover: 0.25 - 1 m rms. |
| | **RTCM 20,21 v2** | Message according to RTCM version 2.x. Real-time carrier phase corrections and high accuracy pseudorange corrections. Message 3 is also generated. Use for real-time operations. Accuracy at the rover: 1 - 5 cm rms after a successful ambiguity resolution. |
| | **RTCM 1,2,18,19 v2** | Available for RTK base. Message according to RTCM version 2.x. Combination of **RTCM 1,2 v2** and **RTCM 18,19 v2**. |
| | **RTCM 1,2,20,21 v2** | Available for RTK base. Message according to RTCM version 2.x. Combination of **RTCM 1,2 v2** and **RTCM 20,21 v2**. |

| Field | Option | Description |
|---|---|---|
| | The availability of the following options, depends on the selection made for **SBAS tracking** on the **Advanced** page. | |
| | **Automatic SBAS** | SBAS satellites will be tracked and the SBAS service used will be automatically selected. |
| | **WAAS** | **W**ide **A**rea **A**ugmentation **S**ystem satellites will be tracked. |
| | **WAAS (test)** | To track **W**ide **A**rea **A**ugmentation **S**ystem satellites while the system is still in test mode. |
| | **EGNOS** | **E**uropean **G**eostationary **N**avigation **O**verlay **S**ystem satellites will be tracked. |
| | **EGNOS (test)** | To track **E**uropean **G**eostationary **N**avigation **O**verlay **S**ystem satellites while the system is still in test mode. |
| | **MSAS** | **M**TSAT **S**atellite-based **A**ugmentation **S**ystem where MTSAT stands for **M**ulti-functional **T**ransport **SAT**ellite |
| | **GAGAN** | **G**PS **A**ided **G**eo **A**ugmentation **N**avigation satellites will be tracked. |
| **RTCM version** | **1.x, 2.1, 2.2** or **2.3** | Available when the selected **RTK data format** is an RTCM version 2 format. The same version must be used at the reference and the rover. |
| **Bits per byte** | **6** or **8** | Defines the number of bits/byte in the RTCM message being received. |
| **Use auto coordinate system** | Check box | Available for **RTK data format**: **RTCM v3**. To set an RTCM coordinate system received by a reference network as active coordinate system. |
| **Receive RTK network information** | Check box | Available for **RTK data format**: **RTCM v3**. Activates an info message (RTCM message 1029). |
| **Behaviour** | Selectable list | Available for **RTK data format**: **RTCM v3**. |
| | **Log only** | The info message will only be logged to a text file. |
| | **Show only** | The info message will only be shown by the instrument. |
| | **Show & log** | The info message will be shown by the instrument and logged to a text file. |

**Next step**

**Page** changes to the **RTK base** page.

**RTK Rover Settings, RTK base page**

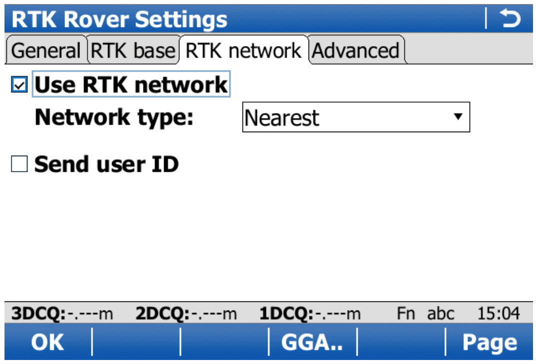
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Sensor at base** | Selectable list | The instrument type used at the base. If the real-time data format contains information of the instrument type, certain corrections based on this information are applied in order to provide correct results. The real-time data formats **Leica**, **Leica 4G**, **CMR/CMR+** and **RTCM v3** contain this information. These corrections are important when third party instruments are used as reference. |
| **Antenna at base** | Selectable list | The antenna used at the base. If the real-time data format contains information of the antenna, certain corrections based on this information are applied in order to provide correct results. The real-time data formats **Leica**, **Leica 4G**, **CMR/CMR+** and **RTCM v3** contain this information.<br>☞ If the reference data is corrected by absolute antenna calibration values and a Leica standard antenna is being used on the rover, select **ADVNULLANTENNA** as base antenna. |
| **RTK base is sending unique ID** | Check box | If checked, an ID can be typed in. |
| **RTK base ID** | Editable field | The special ID of the base station from which real-time data is to be received. The allowed minimum and maximum values vary. |
| | From **0** to **31** | For **RTK data format**: **Leica** and **RTK data format**: **CMR/CMR+**. |
| | From **0** to **1023** | For **RTCM version: 2.x**. |
| | From **0** to **4095** | For **RTK data format**: **Leica 4G** and **RTK data format**: **RTCM v3**. |

### Next step

**Page** changes to the **RTK network** page.

## RTK Rover Settings, RTK network page




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| Fn **GGA..** | To activate the sending of a GGA message for RTK network applications. Refer to "19.7.3 Configuration of GGA Message Sending for Reference Network Applications". |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use RTK network** | Check box | If checked, an RTK network can be used. |
| **Network type** | | Defines the type of reference network to be used. Refer to SmartNet documentation for more detailed descriptions. |
| | **Nearest** | The rover sends its position via NMEA GGA message to SmartNet. From this position, SmartNet determines the reference in a reference network that is closest to the rover. The corrections from that reference are sent to the rover. Supported for all real-time data formats.<br>If this option is selected, an NMEA GGA message must be activated using Fn **GGA..**. |
| | **i-MAX** | **i**ndividualised **M**aster-**A**u**X**iliary corrections. The rover sends its position via NMEA GGA message to SmartNet where the Master-Auxiliary corrections are calculated. The corrections are also individualised by SmartNet, which means it determines the best suitable corrections for that rover.<br>If this option is selected, an NMEA GGA message can be activated using Fn **GGA..**. |
| | **MAX** | **M**aster-**A**u**X**iliary corrections<br>The rover typically does not send its position to SmartNet. SmartNet calculates and sends Master-Auxiliary corrections to the rover.<br>The rover individualises the corrections for its position, which means it determines the best suitable corrections. The corrections are sent in **RTCM v3** with message types 1015/1016.<br>If this option is selected, an NMEA GGA message can be activated using Fn **GGA..**. |
| | **VRS** | **V**irtual **R**eference **S**tation. If this option is selected, an NMEA GGA message must be activated using Fn GGA... Refer to "19.7.3 Configuration of GGA Message Sending for Reference Network Applications". |
| | **FKP** | Area correction parameters. Derived from German: **F**lächen**K**orrektur **P**arameter |
| **Send user ID** | Check box | Activates the sending of a Leica proprietary NMEA message defining the user. |
| **User ID 1** and **User ID 2** | Editable field | The specific user IDs to be sent as part of the Leica proprietary NMEA message. By default the serial number of the instrument is displayed. |

### Next step

**Page** changes to the **Advanced** page.

**RTK Rover Settings, Advanced page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use prediction** | Check box | To activate and deactivate the prediction of real-time observations between the data rate of the base. Available unless **RTK data format: RTCM 1,2 v2** or **RTK data format: RTCM 9,2 v2**. |
| **Use height filter** | Check box | To activate and deactivate the height filter for height smoothing. |
| **Compute xRTK positions** | Check box | To activate or deactivate a slightly less accurate RTK position type, typically 5 - 10 cm, automatically providing more availability for phase fixed positions with a reliability of 99%. Recommended when working in heavy canopy environments.<br>☞ For NMEA messages, positions measured with the xRTK mode are flagged as fixed. |
| **Use SmartLink** | Check box | Availability:<br>• For GS10/GS15 or GS25<br>• For all RTK formats<br>• Independently from the xRTK configuration and SBAS settings<br>To activate and deactivate using Terrastar corrections to bridge RTK corrections outages for long periods of time, for example 10 minutes. Terrastar is a GNSS augmentation service working with geostationary broadcast satellites.<br>Use **SmartLink** to work for longer without the consistent usage of the RTK infrastructure.<br>☞ GPS L5, Galileo E5a/E5b/Alt-BOC and BeiDou B2 satellite signals are unavailable in **SmartLink** mode.<br>☞ The configurations in **Satellite Tracking Settings** are not changed.<br>☞ The **SmartLink** functionality is licenced. |
| **Glonass mode** | **Automatic** | The instrument decides automatically if GLONASS observations are fixed or not. Available for GLONASS instruments.<br>For GS05/GS06, the option **Automatic** is always used. |
| | **Glonass fix** | The GLONASS observations are fixed in an RTK solution. |
| | **Glonass float** | The GLONASS observations are not fixed in an RTK solution. |
| **SBAS tracking** | | Allows a **S**pace-**B**ased **A**ugmentation **S**ystem to be configured to provide additional corrections in conjunction with GPS signals. Also commonly referred to as **S**atellite-**B**ased **A**ugmentation **S**ystem, SBAS provides corrected time and distance measurements calculated by a network of ground relay stations and geostatic satellites. An SBAS can correct for problems such as atmospheric delays, poor satellite geometry and incorrect satellite positioning. |

| Field | Option | Description |
|---|---|---|
| | **Automatic SBAS** | SBAS satellites will be tracked and the SBAS service used will be automatically selected. |
| | **WAAS** | **W**ide **A**rea **A**ugmentation **S**ystem satellites will be tracked. |
| | **WAAS (test)** | To track **W**ide **A**rea **A**ugmentation **S**ystem satellites while the system is still in test mode. |
| | **EGNOS** | **E**uropean **G**eostationary **N**avigation **O**verlay **S**ystem satellites will be tracked. |
| | **EGNOS (test)** | To track **E**uropean **G**eostationary **N**avigation **O**verlay **S**ystem satellites while the system is still in test mode. |
| | **MSAS** | **M**TSAT **S**atellite-based **A**ugmentation **S**ystem where MTSAT stands for **M**ulti-functional **T**ransport **SAT**ellite |
| | **GAGAN** | **G**PS **A**ided **G**eo **A**ugmentation **N**avigation satellites will be tracked. |

**Next step**

**Page** changes to another page on this screen.

## Prediction

The following provides additional information on the prediction of real-time positions between the data rate of the base.

**Access**

In **RTK Rover Settings**, **Advanced** page.

**Description**

Prediction is the interpolation of real-time corrections between those corrections regularly transmitted by a reference at a defined data rate.

**Advantages in using prediction**

- Computation of real-time positions on the rover is independent from the transmission rate of the data from the base station.
- Positions computed with prediction have a reduced latency of around 20 ms.

**Recommended settings for using prediction**

The slower the data rate the more important it is to activate prediction.

**Height smoothing**

The following provides additional information on the height filter for height smoothing.

**Access**

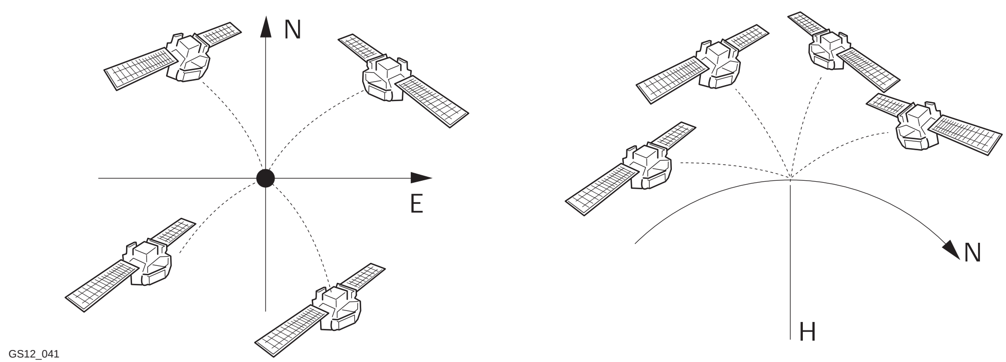
In **RTK Rover Settings**, **Advanced** page.

**Description**

Height smoothing is a filter applied to all heights measured in the WGS 1984 or a local coordinate system or output via NMEA. The filter defaults are best suited for high dynamic variations in height up to 1 m/s as carried out by graders.

**Height Smoothing with high dynamic GPS operations**

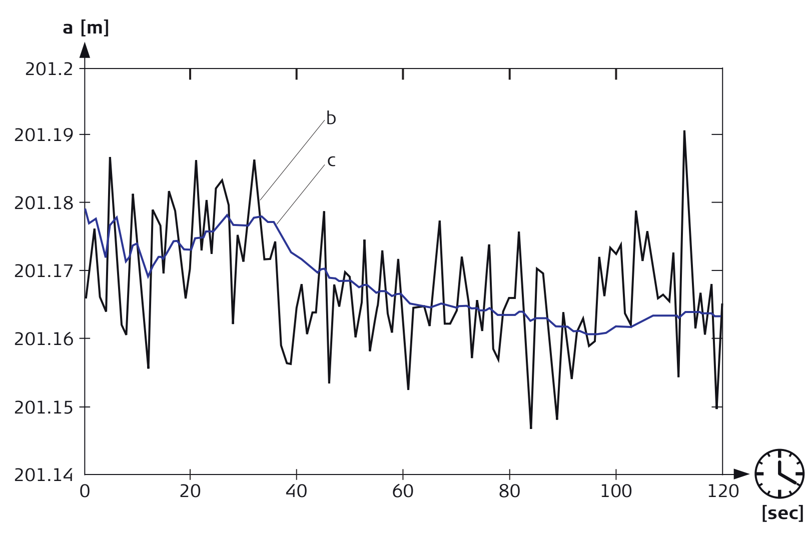
All GPS computed positions are almost twice as accurate in plan than in height. For the position determination, satellites can appear in all four quadrants. For the height determination, satellites can appear in two quadrants. Having fewer quadrants, weakens the height position compared to the plan position.




Position determination with satellites appearing in all four quadrants.

Height determination with satellites appearing in two quadrants.

In high dynamic GPS operations, this fact results in height variations of a few centimetres as shown in the blue curve in the following diagram. Some GPS monitoring applications require a stabilised height. By applying the filter, the height variations are smoothed and most of the noise in the height component is eliminated.




a) Height
b) Height variations
c) Smoothed height

## 19.7.2 Configuration with Digital Cellular Phone and Radio

**Description**

An ideal real-time setup is to combine a radio and a digital cellular phone to get the best of both technologies. The radio can be used where the radio signals can be received, the advantage being that the radio data transmission is free. If the radio channel is broken, when the rover goes out of range or due to an obstruction, change to the digital cellular phone to complete the survey. This switch allows maximum productivity and minimal costs with real-time GPS.

**Field procedure step-by-step**

| Step | Description |
|---|---|
| 1. | Set up a base. |
| 2. | On the base, attach a digital cellular phone to one port and a radio to another port. |
| 3. | Configure both connections on the base. |
| 4. | Start the base. Real-time data is transmitted on two ports simultaneously - using different devices. |
| 5. | Set up a rover. |
| 6. | On the rover, attach a digital cellular phone to one port and a radio to another port. |
| 7. | Use two working styles to configure both connections on the rover. |
| 8. | Start the rover using either the digital cellular phone connection or the radio connection. |
| 9. | On the rover, change the working style in use in order to change between using digital cellular phone and radio. There is no need to return to the base. |

## 19.7.3 Configuration of GGA Message Sending for Reference Network Applications

**Description**

Most reference networks require an approximate position of the rover. For reference network applications, a rover dials into the reference network and submits its approximate position in form of an NMEA GGA message.

By default, the instrument sends GGA messages with updated current positions automatically when a reference network is selected.

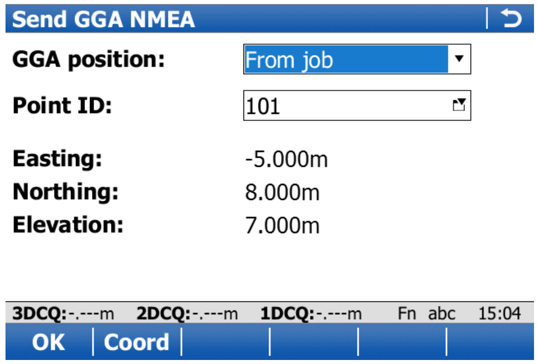
Surveying regulations in some countries require that one certain position can be selected. This position is then sent to the reference network as GGA message through the real-time connection every five seconds.

Refer to "F.3 GGA - Global Positioning System Fix Data" for information on GGA message format.

**Access step-by-step**

In **RTK Rover Settings**, **RTK network** page, press Fn **GGA..**.

## Send GGA NMEA




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Coord** | Available for **GGA position: From job** and **GGA position**: **LAST/HERE Posn**. To view other coordinate types. Local coordinates are available when a local coordinate system is active. |
| **Last** | Available for **GGA position: LAST/HERE Posn**. To use the same coordinates in the GGA message as when the instrument was last used in a reference network application. This functionality is possible when position coordinates from a previous reference network application are still stored in the internal memory. |
| **Here** | Available for **GGA position: LAST/HERE Posn**. To use the coordinates of the current navigation position in the GGA message. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **GGA position** | **Automatic** | The current rover position is sent to the reference network. The position is updated and sent every five seconds. |
| | **From job** | A point from the working job can be selected in **Point ID**. The position of this point is sent to the reference network every five seconds. |
| | **LAST/HERE Posn** | The position last used in a reference network application or the current navigation position can be selected using **Last** or **Here**. The selected position is sent every five seconds. |
| | **None** | No GGA message is sent to the reference network. |
| **Point ID** | Selectable list | Available for **GGA position: From job**. The coordinates of this point are sent out in the GGA message. |

# 19.8 Base RTK 1 / Base RTK 2 GPS

## 19.8.1 Configuration of a Reference Real-Time Connection

☞ Unavailable for GS05/GS06.

**Description**

The real-time connection allows real-time related parameters to be configured. These parameters include defining the real-time messages, data rates and time slicing. Up to two real-time connections can be configured on the instrument.

**Access**

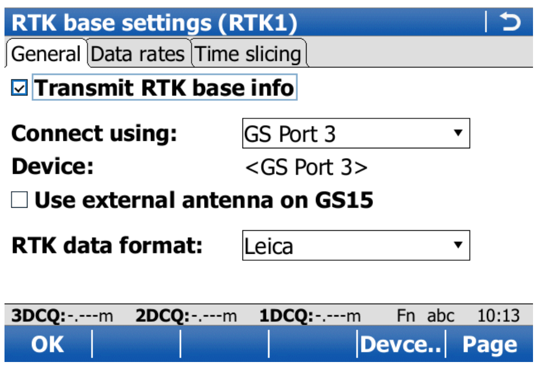
For RTK base:

- In **Base Connection Settings** highlight **Base RTK 1**. **Edit..**.

☞ Two real-time devices can be attached to two different ports, for example a radio and a digital cellular phone. On the reference, the two devices can operate simultaneously. Highlight **Base RTK 2** and press **Edit..** to configure a second real-time connection.

**RTK base settings (RTK1)/RTK base settings (RTK2), General page**

The available fields and pages on this screen depend on the selected settings.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Devce..** | Available for **Connect using: GS Port 1**/**GS Port 2**/**GS Port 3**/**GS radio**/**GS modem**. To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Transmit RTK base info** | Check box | Activates the base real-time connection. |
| **Connect using** | **GS Port 1** | For GS10: The physical port P1 on the box.<br>For GS14/GS15: The red LEMO port.<br>For GS08plus/GS12: Fixed to this setting. Streaming of RTK data throught the CS is not allowed.<br>For GS25: The physical LEMO port P1 on the box. |
| | **GS Port 2** | For GS10: The physical port P2 on the box.<br>For GS15: The black LEMO port.<br>For GS25: The physical LEMO port P2 on the box. |
| | **GS Port 3** | For GS10: The physical port P3 on the box.<br>For GS15/GS25: The slot for a device. |
| | **GS Port 4** | For GS25: The physical LEMO port P4 on the box. |
| | **GS Internet 1**, **GS Internet 2** and **GS Internet 3** | The internet ports on the GS10/GS14/GS15/GS25. If these ports are not assigned to a specific connection, then these ports are additional remote ports. |
| | **GS radio** | Available for GS14. |
| | **GS modem** | Available for GS14. |
| **Device** | Display only | The device currently assigned to the selected port within the active working style. |
| **RTK data format** | **Leica**, **Leica 4G**, **CMR/CMR+**, RTCM v3, **RTCM 18,19 v2**, **RTCM 1,2 v2**, **RTCM 9,2 v2**, **RTCM 20,21 v2**, **RTCM 1,2,18,19 v2** | Refer to "19.7.1 Configuration of a Rover Real-Time Connection" for information about these real-time data formats.<br>☞ For GS08plus/GS12, the setting is fixed to **RTCM v3**. |
| | **RTCM v3 (MSM)** | Refer to "19.7.1 Configuration of a Rover Real-Time Connection" for information about this real-time data format.<br>**RTCM v3 (MSM)** generates GNSS receiver observables in a universal manner to meet the coming reality when more GNSS and their signals will become available.<br>Encodes the raw observations of all tracked GNSS signals and delivers them as RTK corrections.<br>**RTCM v3 (MSM)** and **RTCM v3** are treated separately. |
| **RTCM version** | **1.x, 2.1, 2.2** or **2.3** | Available when the selected **RTK data format** is an RTCM version 2 format. The same version must be used at the reference and the rover. |
| **Use external antenna on GS15** | Check box | Available for **Connect using: GS Port 3**. Allows external radio / GSM antenna on the GS15 to be used for slot devices. |

### Next step

**Page** changes to the **Data rates** page.

**RTK base settings (RTK1)/RTK base settings (RTK2), Data rates page**

☞ This page is unavailable for GS08plus/GS12.

### Description

For all real-time data formats, parts of the message can be output at different rates. The settings on this screen define the output rates for the various parts of the selected real-time data format. The available fields on this screen depend on the selected setting for **RTK data format** in **RTK base settings (RTK1)**/**RTK base settings (RTK2)**.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **RTK data format** | Display only | The selected data format. |
| **Data** | From **0.1s** to **60.0s** | Rates for the transmission of raw observations. The default settings are suitable for standard applications. They can be changed for special applications. A check is performed for permissible combinations. |
| **Message type** | | The message type of **RTCM v3** and **Leica 4G**. |
| | **Compact** | Suitable for standard applications.<br>For **RTK data format**: **RTCM v3 (MSM)**, encoding according to MSM3. Refer to "RTK Rover Settings, General page". |
| | **Extended** | For **RTK data format**: **RTCM v3 (MSM)**, encoding according to MSM5. Refer to "RTK Rover Settings, General page". |
| **Coords** | From **10s** to **120s** | Rate for the transmission of reference coordinates. |
| **Info** | From **10s** to **120s** | Rate for the transmission of base station information such as point ID. |
| | **Off** | Available for **RTCM v3 (MSM)**. No receiver and antenna descriptors information message is sent out. Default for **Message type**: **Compact**. |
| **End of message** | **Nothing** or **CR** | To add a **C**arriage **R**eturn at the end of the real-time message. |
| **Messages to be streamed (local coords will be computed using coordinate system on the GS sensor)** | Selectable list | Available for **RTCM version: 2.3**. The messages sent within the coordinate message. |
| **RTK base ID** | Editable field | An identification for a base station. It is converted into a compact format and sent out with real-time data in all real-time data formats. It is different from the point ID of the base station. |

| Field | Option | Description |
|---|---|---|
| | | An ID of the base station is required if working with several base stations in time slicing mode on the same frequency. In this case, the ID of the base station from which data is to be accepted must be typed in at the rover. |
| | | The allowed minimum and maximum values vary. |
| | From **0** to **31** | For **Leica** and **CMR/CMR+**. |
| | From **0** to **1023** | For any RTCM version 2 format. |
| | From **0** to **4095** | For **Leica 4G**, **RTCM v3** and **RTCM v3 (MSM)**. |

**Next step**

**Page** changes to the **Time slicing** page.

### RTK base settings (RTK1)/RTK base settings (RTK2), Time slicing page

☞ This page is unavailable for GS08plus/GS12.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use time slicing** | Check box | The possibility to send delayed real-time messages. This functionality is required when real-time messages from different base stations are sent on the same radio channel. Time slicing works for all device types. |
| **Total base stations being used** | **2**, **3** or **4** | The number of base stations in use from where real-time messages are sent. |
| **Time slot for this base** | **2**, **3** or **4** The contents of the selectable list depend on the settings for **Total base stations being used**. | The time slot represents the actual time delay. The number of possible time slots is the number of base stations in use. The time delay equals 1 s divided by the total number of base stations. If two base stations are used, the time delay is 0.50 s. Therefore, the time slots are at 0.00 s and at 0.50 s. With three base stations, the time delay is 0.33 s. The time slots are at 0.00 s, 0.33 s and 0.66 s. |

**Next step**

**Page** changes to another page on this screen.

## 19.9 NMEA 1 / NMEA 2 GPS

☞ Unavailable for GS05/GS06/GS08plus/GS12.

☞ For GS05/GS06/GS08plus/GS12, streaming of GGA messages is supported for RTK network operations.

**Description**

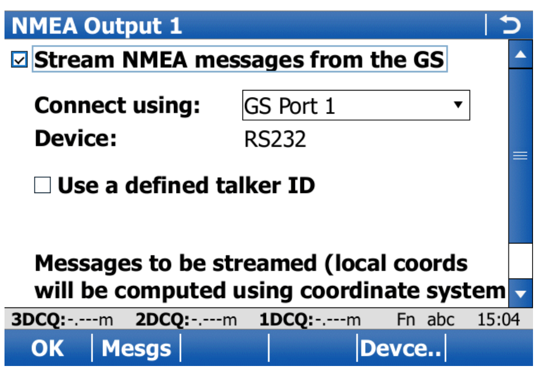
**N**ational **M**arine **E**lectronics **A**ssociation has developed a message standard related to the marine electronics industry. NMEA messages have been accepted as the standard for sharing specific data information between companies since the late 1970s. Refer to "Appendix F NMEA Message Formats" for a comprehensive description of each NMEA message.

The settings on this screen define the port, the device and the type of NMEA message to be used for the NMEA Out connection.
Up to two NMEA Out connections can be configured. Each NMEA Out connection can output different messages at different rates with different talker IDs. The output of NMEA messages on both ports is simultaneous.
The screens for the configuration of both NMEA connections are identical except for the title - **NMEA Output 1** and **NMEA Output 2**. For simplicity, the title **NMEA Output 1** is used in the following.

**Access**

For RTK rover:
- In **Connection Settings**, **GS connections** page, highlight **NMEA 1** or **NMEA 2**. **Edit...**

**NMEA Output 1**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Mesgs** | To configure what NMEA messages are output, the rates and the output timing method. Refer to paragraph "NMEA Messages". |
| **Devce..** | To create, select, edit or delete a device. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Stream NMEA messages from the GS** | Check box | Activates the output of NMEA. |
| **Stream NMEA messages from the GS** | Check box | Activates the output of NMEA. |
| **Connect using** | **GS Port 1** | For GS10: The physical port P1 on the box.<br>For GS15: The red LEMO port. |
| | **GS Port 2** | For GS10: The physical port P2 on the box.<br>For GS15: The black LEMO port. |
| | **GS Port 3** | For GS10: The physical port P3 on the box.<br>For GS15: The slot for a device. |
| | **GS BT** | The Bluetooth port on the GS10/GS15. |
| **Device** | Display only | Usually, **RS232** is used to transfer NMEA messages. |
| **NMEA Version** | **4.0 (extended)** | Backwards compatible to NMEA in SmartWorx Viva version 5.0 plus BeiDou support. |
| | **4.1 (compact)** | More compact message output than in Smart-Worx Viva version 5.0 plus BeiDou support |
| **Use a defined talker ID** | Check box | When this box is checked, a user-defined talker ID can be typed in. Otherwise, the standard NMEA Talker ID is used:<br>GN = **G**lobal **N**avigation **S**atellite **S**ystem<br>= GPS with GLONASS/Galileo/BeiDou in any combination<br>GP = GPS only<br>GL = GLONASS<br>GA = Galileo<br>BD = BeiDou |
| **Talker ID** | Editable field | Available when **Use a defined talker ID** is checked. Appears at the beginning of each NMEA message. |
| **Messages to be streamed (local coords will be computed using coordi-nate system on the GS sensor)** | Display only | The NMEA messages currently selected for output. |

### Overview of NMEA messages sent depending on SmartWorx Viva versions and settings

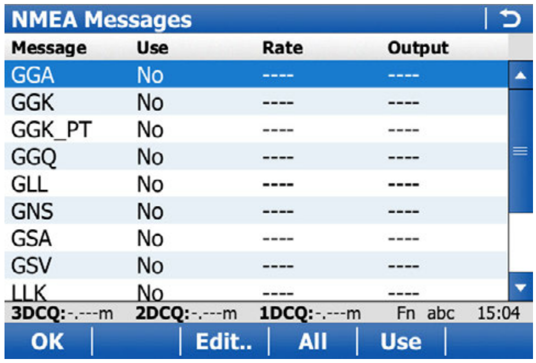
| Message | SmartWorx Viva v5.00 | | SmartWorx Viva v5.50 | | | |
|---|---|---|---|---|---|---|
| | GPS | GNSS | GPS | GNSS | GPS | GNSS |
| | | | NMEA v4.0 | | NMEA v4.1 | |
| GGA | $GPGGA | $GNGGA<br>$GPGGA<br>$GLGGA | $GPGGA | $GNGGA | $GPGGA | $GNGGA |
| GGK | $GPGGK | $GNGGK | $GPGGK | $GNGGK | $GPGGK | $GNGGK |
| GGK_PT | $PTNL,GGK | $PTNL,GGK | $PTNL,GGK | $PTNL,GGK | $PTNL,GGK | $PTNL,GGK |
| GGQ | $GPGGQ | $GNGGQ<br>$GPGGQ<br>$GLGGQ | $GPGGQ | $GNGGQ<br>$GPGGQ<br>$GLGGQ<br>$GAGGQ<br>$BDGGQ | $GPGGQ | $GNGGQ |
| GLL | $GPGLL | $GNGLL | $GPGLL | $GNGLL | $GPGLL | $GNGLL |
| GNS | $GPGNS | $GNGNS | $GPGNS | $GNGNS | $GPGNS | $GNGNS |
| GSA | $GPGSA | $GNGSA | $GNGSA | $GPGSA | $GPGSA | $GNGSA |
| GSV | $GPGSV | $GPGSV<br>$GLGSV | $GPGSV | $GPGSV<br>$GLGSV<br>$GAGSV<br>$BDGSV | $GPGSV | $GPGSV<br>$GLGSV<br>$GAGSV<br>$BDGSV |
| LLK | $GPLLK | $GNLLK<br>$GPLLK<br>$GLLLK | $GPLLK | $GNLLK<br>$GPLLK<br>$GLLLK<br>$GALLK<br>$BDLLK | $GPLLK | $GNLLK |
| LLQ | $GPLLQ | $GNLLQ<br>$GPLLQ<br>$GLLLQ | $GPLLQ | $GNLLQ<br>$GPLLQ<br>$GLLLQ<br>$GALLQ<br>$BDLLQ | $GPLLQ | $GNLLQ |
| RMC | $GNRMC | $GNRMC | $GNRMC | $GNRMC | $GNRMC | $GNRMC |
| VTG | $GPVTG | $GNVTG | $GPVTG | $GNVTG | $GPVTG | $GNVTG |
| ZDA | $GPZDA | $GPZDA | $GPZDA | $GPZDA | $GPZDA | $GPZDA |

### Next step

| IF NMEA messages | THEN |
|---|---|
| are not configured | **OK** closes the screen. |
| are to be configured | **Mesgs**. |

**NMEA Messages**

This screen shows the messages that can be output, which messages are currently output, the output rates and the output timing method.

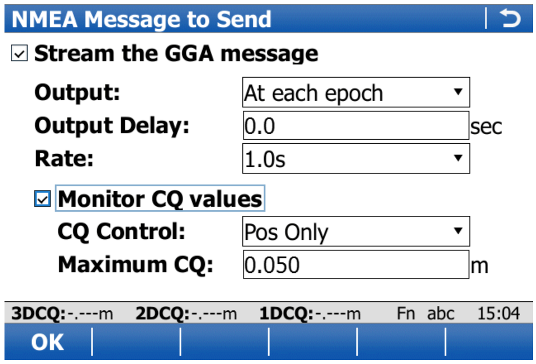



| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Edit..** | To configure how the currently highlighted message is output. Refer to paragraph "NMEA Message to Send". |
| **All** and **None** | To activate and deactivate the output for all messages. |
| **Use** | To activate and deactivate the output for the highlighted message. |
| Fn **Quit** | To exit the screen. |

**Next step**

| IF an NMEA message | THEN |
|---|---|
| is not to be configured | **OK** closes the screen. |
| is to be configured | highlight the message and **Edit..**. |

**NMEA Message to Send**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Stream the NMEA message** | Check box | When this box is checked, the selected NMEA message is output. |
| **Output** | **Immediately** | The NMEA message is created as soon as the information is available. It is sent out in the time interval as defined in **Rate**. |
| | **On point stored** | The NMEA message is sent on point storage. |
| | | If the time interval defined in **Rate** is shorter than the epochs of the screen update, then the internal computation of positions is changed to allow the specified rate of NMEA positions. The screen update remains unchanged. |
| **Point Type** | | Available for **Output: On point stored**. Defines the type of points for which the NMEA message is sent. |
| | **All points** | The NMEA message is sent when any type of point is stored. |
| | **Occupied pts only** | The NMEA message is sent when a manually measured point is stored. |
| | **Auto pts only** | The NMEA message is sent when auto points are stored. |
| **Rate** | From **0.05s** to **3600.0s** | Available unless **Output: On point stored**. Defines the time intervals at which the NMEA messages are created.<br>For GS05/GS06 logging rates > 5 Hz are supported. |
| **Monitor CQ values** | Check box | When this box is checked the CQ control can be defined. |

| Field | Option | Description |
|---|---|---|
| **CQ Control** | **Position only**, **Height only** or **Position & height** | Available when **Monitor CQ values** is checked. Activates a control over the coordinate quality. If the coordinate quality of the position and/or height component exceeds the limit as defined in **Maximum CQ**, then NMEA messages are not output. |
| **Maximum CQ** | Editable field | Available when **Monitor CQ values** is checked. The limit for the coordinate quality up to which NMEA messages are output. |

**Next step**

| Step | Description |
|---|---|
| 1. | **OK** returns to **NMEA Messages**. |
| 2. | **OK** returns to the screen from where **NMEA Messages** was accessed. |

## 19.10 Remote (OWI) GPS

☞ Unavailable for GS05/GS06/GS08plus/GS12.

**Description**

The remote connection allows:

- the instrument to be controlled using a device other than the field controller, for example a computer. **O**utside **W**orld **I**nterface or Leica Binary 2 commands can be used to control the instrument through the remote port. Documentation for OWI and LB2 is available on request from the Leica Geosystems representative.
- a message log to be requested from a remote client via an OWI message. A message log contains a history of warning messages and message lines.
- the downloading of data directly from the instrument's memory device to LGO through a serial port on the computer. The CS does not need to be removed from the instrument.

The settings on this screen define the port and the device to be used for the remote control.

☞ A port configured as a remote port can be used to output event input, meteo or tilt notification messages.

☞ The OWI commands listed here are protected by a licence key. Refer to "30.3 Load licence keys" for information on how to type in the licence key. The corresponding LB2 commands are also protected. If these OWI commands have been activated by a licence key, it is indicated in **About Leica Viva**.

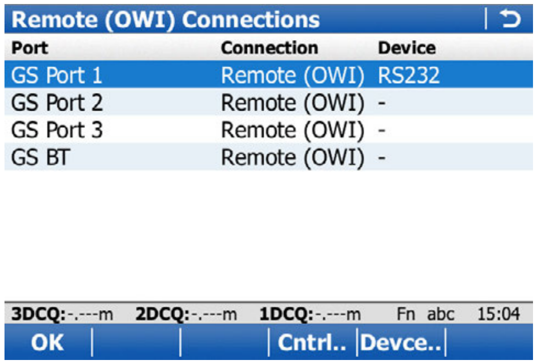
- AHT
- ANT
- CNF
- DCF
- DCT
- DPM
- GGA
- GGK
- GGK(PT)
- GGQ
- GLL
- GNS
- LLK
- LLQ
- NET
- POB
- POE
- POQ
- POS
- RMC
- RTK
- TPV
- USR

**Access**

For RTK rover:

- In **Connection Settings**, **GS connections** page, highlight **Remote (OWI)**. **Edit...**.

**Remote (OWI) Connections**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Cntrl..** | To configure additional parameters. |
| **Devce..** | Available unless an internet connection is used. To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| **Use** | Available unless a connection is **NMEA 1**, **NMEA 2** or **Remote (OWI)**. To use the highlighted connection by **Remote (OWI)**. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Port** | The physical port on the instrument which will be used for the connection functionality. |
| **Connection** | The connection configured for the ports. Any port which is not configured is automatically assigned the remote connection. |
| **Device** | The hardware connected to the chosen port. |

## 19.11 PPS Output GPS

The PPS output is an optional interface requiring a special port.

**Description**

PPS stands for **P**ulse **P**er **S**econd. It is a pulse that is output at a specified interval time. This can be used to activate another device. Additionally, a notification message can be output through the GS25 ports P1, P2, P3, P4 or BT when a PPS output occurs. For example, in aerial photography, an aerial camera can be configured to take a photo each time it receives a pulse from the instrument.

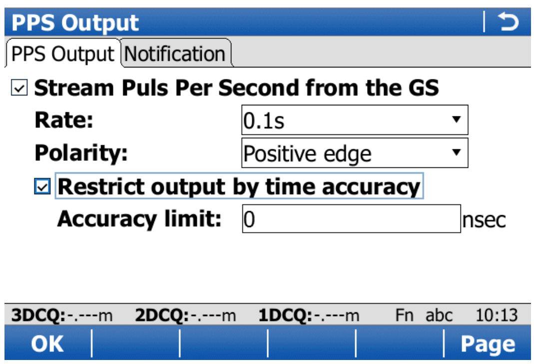
The settings on this screen define the output port and parameters for the PPS option. This screen is available if the instrument is fitted with a PPS output port.

This option is only available on GS25.

**Access**

For RTK rover:
- In **Connection Settings**, **GS connections** page, highlight **PPS Output**. **Edit..**.

**PPS Output, PPS Output page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Stream Pulse Per Second from the GS** | Check box | When this box is checked, the output of PPS is activated and relevant settings can be configured. |
| **Rate** | From **1.0s** to **20.0s** | The rate at which pulses are output. |
| **Polarity** | **Negative edge** and **Positive edge** | Measure the time from the negative edge or the positive edge of the pulse. |

**Next step**

**Page** changes to the **Notification** page.

**PPS Output, Notification page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Send notification on each PPS output** | Check box | When this box is checked, the output of a notification message with each PPS output is activated. Refer to "Appendix I PPS Output Notify Message Format" for information on the message format. |
| **Connect using** | **GS Port 1**, **GS Port 2** or **GS Port 3** | The ports on the GS25 used for the connection. |
| | **GS BT** | The Bluetooth ports on the GS25 used for the connection. |
| **Device** | Display only | The hardware connected to the chosen port. |
| **Notification** | Selectable list | The message can be in ASCII or in binary format. |

### Next step

**Page** changes to another page on this screen.

## 19.12 Event Input 1/Event Input 2 GPS

☞ The event input is an optional interface requiring a special port.

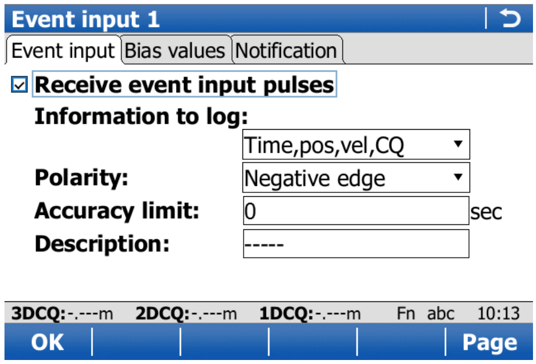
**Description**

The event input interface allows pulses which are sent from devices connected to the instrument to be recorded. These records can later be superimposed on the processed kinematic data and the positions where the events took place can be interpolated in LGO. Events logged during real-time operations can also be exported to an ASCII file using an appropriate format file. Additionally, a notification message can be output through the GS25 ports P1, P2, P3, P4 or BT providing information about when the event occurred. A port configured as a remote port can be used to output the notification message.
For example, in aerial photography, an aerial camera can be connected through the event input port. When the shutter opens, the position at which the event occurred is recorded.

The settings on this screen define the input port and parameters for the event input option. This screen is available if the instrument is fitted with a event input port.

☞ This option is only available on GS25.

**Event input 1/Event input 2, Event input page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Receive event input pulses** | Check box | When this box is checked, the detection and logging of events being sent to the event ports is activated and relevant settings can be configured. |
| **Information to log** | **Time,pos,vel,CQ**, Time,pos,vel, **Time,pos** or **Time** | Time, position, velocity and coordinate quality can be recorded in various combinations. |
| **Polarity** | **Negative edge** or **Positive edge** | The polarity according to the device in use. |
| **Accuracy limit** | Editable field | If two or more events take place during the time defined in s, the first event is recorded. Enter 0 to accept all events. The shortest recording time is 0.05 s. |
| **Description** | Editable field | Records up to four lines of data with the event record. Use the description to differentiate between the two event records if two event input ports are used at the same time. |

### Next step

**Page** changes to the **Bias values** page.

**Event input 1/Event input 2, Bias values page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **External bias** | Editable field | Sets a calibration value in ns according to the external event device and cable being used. |
| **Enter user defined internal bias** | Check box | When this box is checked, personal calibration values for the particular instrument can be configured.<br>When this box is not checked, default calibration values for the particular instrument are used. |
| **Internal bias** | Editable field | Available when **Enter user defined internal bias** is checked. Sets the particular calibration value in ns for the instrument. |

### Next step

**Page** changes to the **Notification** page.

**Event input 1/Event input 2, Notification page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Send notification on each Event Input** | Check box | When this box is checked, the output of a notification message with each event input is activated. Refer to "Appendix H Event Input Notify Message Format" for information on the message format. |
| **Connect using** | **GS Port 1**, **GS Port 2** or **GS Port 3** | The ports on the GS25 which are used for the connection. |
| | **GS BT** | The Bluetooth ports on the GS25 used for the connection. |
| **Device** | Display only | The hardware connected to the chosen port. |
| **Notification** | Selectable list | The message can be in ASCII or in binary format. |

### Next step

**Page** changes to another page on this screen.

## 19.13 Total Station TPS

**Description**

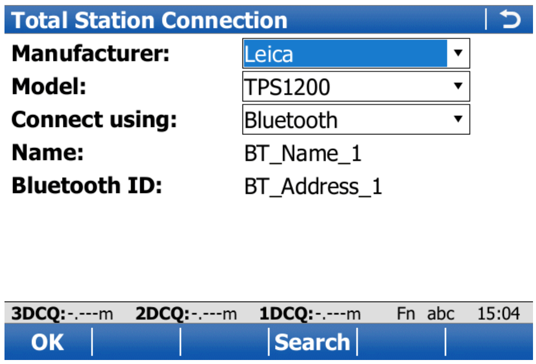
The settings on this screen define the communication of the field controller with Leica total stations and third-party instruments.

**Access**

For TPS:

- In **Connection Settings** highlight **Total Station**. **Edit..**.

**Total Station Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Search** | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if **Connect using: Bluetooth** is selected. |
| **Cntrl..** | Available for certain devices connected to certain connections. To configure additional parameters, for example changing the radio channel. |
| **Default** | To return the fields back to their default values. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Manufacturer** | Selectable list | The brand of the instrument. |
| **Model** | Selectable list | The instrument model. |
| **Connect using** | **Cable**, **Bluetooth**, **Internal radio**, **External radio** | How the instrument is connected. The options available depend on the selection for **Model**. The availability of the other fields depends on the selection made here. |
| | **Radio cap (CTR16/17)** | To configure a connection between a CS15 with CTR16 and a TS with RH16. |
| **Baud rate** | From **1200** to **115200** | Frequency of data transfer from instrument to device in bits per second. |
| **Parity** | **None**, **Even** or **Odd** | Error checksum at the end of a block of digital data. |
| **Data bits** | **6**, **7** or **8** | Number of bits in a block of digital data. |
| **Stop bit** | **1** or **2** | Number of bits at the end of a block of digital data. |
| **Flow control** | **None** or **RTS/CTS** | Activates hardware handshake.<br>When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data. |
| **Bluetooth ID** and **Name** | Display only | The last connected total station using CTR16.<br>If no information of a last total station is available, then **----** is displayed. |

## 19.14 GSI Output TPS TS

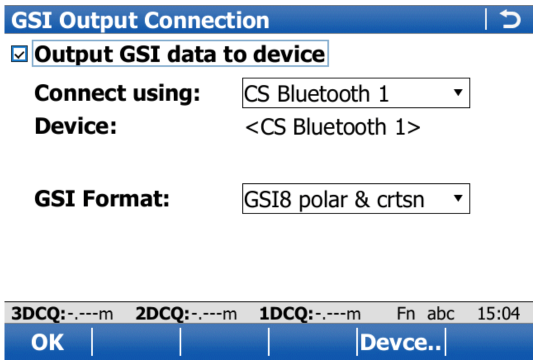
**Description**

Each time a measured point is stored to the working job, GSI data is streamed through the configured port of the field controller.

**Access**

In **Connection Settings** highlight **GSI Output**. **Edit...**

**GSI Output Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Search** | Available when **CS Bluetooth 1** or **CS Bluetooth 2** are selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| **Devce..** | To create, select, edit or delete a device. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Output GSI data to device** | Check box | Activates the connection. |
| **Connect using** | **CS RS232 port** | The RS232 port on the field controller. |
| | **CS Bluetooth 1** and **CS Bluetooth 2** | The Bluetooth ports on the field controller which will be used. |
| | **TS Bluetooth 1** and **TS Bluetooth 2** | The Bluetooth ports on the TS11/TS15/TS12 Lite which can be used. |
| | **Cable** | The RS232 port on the TS11/TS15/TS12 Lite. |
| | **Radio handle** | Hotshoe connection for RadioHandle. This port is located on top of Communication side cover. |
| **Device** | Display only | The device currently assigned to the selected port. |
| **GSI Format** | **GSI8 polar & crtsn** | GSI Polar and Cartesian (8 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM, E, N, Elev.) |
| | **GSI16 polar** | GSI Polar (16 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM, reflector height) |
| | **GSI16 cartesian** | GSI Cartesian (16 data characters)<br>(E, N, Elev, Reflector Height) |
| | **Pt,N,E,Ht,Date** | Coordinate data<br>(Northing BEFORE Easting) |
| | **Pt,E,N,Ht,Date** | Coordinate data<br>(Easting BEFORE Northing) |
| | **Pseudo NMEA GGA** | Based on NMEA (**N**ational **M**arine **E**lectronics **A**ssociation), which is a standard for interfacing marine electronic devices. |
| | **GSI8 polar** | GSI Polar (8 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM) |
| | **GSI16 polar 2** | GSI Polar (16 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM) |
| **Use RS232 GSI protocol** | Check box | A protocol defines if the system expects a handshake or no handshake.<br>If checked, a handshake is required.<br>A data block is sent out from the instrument and a receipt confirmation is expected. This handshake requires that GeoCom Mode is activated. |

**Output format - GSI Format**

GSI data is transmitted in blocks. Every block consists of several data words, refer to the examples in the following table. Every data word begins with a two character Word Index, the WI code, specifying the data type within this block. Each GSI8 word has in total 16 characters, consisting of 7 information characters followed by 8 data characters and finally the blank character ASCII code 32. The GSI16 block is like the GSI8 block, but begins with * and the data word contains 16 characters for large values such as UTM coordinates, alphanumeric codes, attributes or point IDs.

Example 1 shows a GSI8 block sequence with the words for point ID (11), Easting coordinate (81) and Northing coordinate (82). Example 2 shows a GSI16 block sequence with the words for point ID (11), horizontal (21) and vertical angle (22).

| Type | GSI8 Polar&Cart | GSI16 Polar | GSI16 Cartesian |
|---|---|---|---|
| WI 11 | Point ID | Point ID | Point ID |
| WI 21 | Hz | Hz | - |
| WI 22 | V | V | - |
| WI 31 | SlopeDist | SlopeDist | - |
| WI 51 | PPM Total/mm | PPM Total/mm | - |
| WI 81 | East | - | East |
| WI 82 | North | - | North |
| WI 83 | Elev. | - | Elev. |
| WI 87 | Refl. Ht | - | Refl. Ht |

**Example 1: GSI8**

Each word has 16 characters of which 8 characters are used for the data block.

| Word 1 | Word 2 | Word 3 |
|---|---|---|
| 110001+0000A110 | 81..00+00005387 | 82..00-00000992 |
| 110002+0000A111 | 81..00+00007586 | 82..00-00003031 |
| 110003+0000A112 | 81..00+00007536 | 82..00-00003080 |
| 110004+0000A113 | 81..00+00003839 | 82..00-00003080 |
| 110005+0000A114 | 81..00+00001241 | 82..00-00001344 |

**Example 2: GSI16**

Each word has 24 characters of which 16 characters are used for the data block.

| Word 1 | Word 2 | Word 3 |
|---|---|---|
| *110001+000000000PNC005<br>5 | 21.002+00000000133846<br>50 | 22.002+00000000053715<br>00 |
| *110002+000000000PNC005<br>6 | 21.002+00000000128025<br>30 | 22.002+00000000052550<br>00 |
| *110003+000000000PNC005<br>7 | 21.002+00000000112223<br>60 | 22.002+00000000054338<br>00 |
| *110004+000000000PNC005<br>8 | 21.002+00000000105735<br>50 | 22.002+00000000058176<br>00 |
| *110005+000000000PNC005<br>9 | 21.002+00000000099836<br>10 | 22.002+00000000051714<br>00 |

**GSI Word information**

| Pos. | Name | Description of values | Applicable for |
|---|---|---|---|
| 1-2 | Word Index (WI) | | |
| 3 | No significance | .: No information. | WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87 |
| 4 | Automatic index information | .: No information.<br>0: **Tilt compensator: Off**<br>3: **Tilt compensator: On** | WI 21, WI 22 |
| 5 | Input mode | .: No information.<br>0: Measured values transferred from instrument<br>1: Manual input from keyboard<br>2: Measured value, **Hz correction: On**.<br>3: Measured value, **Hz correction: Off**.<br>4: Result calculated from functions | WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87 |
| 6 | Units | .: No information.<br>0: **Distance: Metre (m)**, last digit 1 / 1000 m<br>1: **Distance: US ft (ft)** last digit 1 / 1000 ft<br>2: **Angle: 400 gon**<br>3: **Angle: 360° dec**<br>4: **Angle: 360°'"**<br>5: **Angle: 6400 mil**<br>6: **Distance: Metre (m)**, last digit 1 / 10000 m<br>7: **Distance: US ft (ft)** last digit 1 / 10000 ft | WI 21, WI 22, WI 31, WI 81, WI 82, WI 83, WI 87 |
| 7 | Sign | +: Positive value<br>-: Negative value | WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87 |
| 8-15<br>8-23 | Data | Data includes a sequence of 8 (16) numerical or alphanumerical characters.<br>☞ Certain data blocks are allowed to carry more than one value for example ppm/mm. This data is automatically transferred with the according sign before each single value. | WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87 |
| 16<br>24 | Separating character | : Blank | WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87 |

**Output format - Pt,N,E,Ht,Date**

**Format**

Point ID, Northing, Easting, Elevation, Date, Time <CR/LF>

**Description of fields**

The format settings are defined in **Regional Settings**.

| Field | Description |
|---|---|
| Point ID | Text describing the point identification |
| Northing | The Northing coordinate. |
| Easting | The Easting coordinate. |
| Elevation | The height coordinate. |
| Date | The measurement/origination date. |
| Time | The measurement/origination time. |
| <CR/LF> | **C**arriage **R**eturn **L**ine **F**eed |

**Example**

2004,4997.635,6010.784,393.173,09/10/2001,16:34:12.2
2005,4997.647,6010.765,393.167,09/10/2001,16:34:12.4
2006,4997.657,6010.755,393.165,09/10/2001,16:34:12.7

**Output format - Pt,E,N,Ht,Date**

**Format**

This output format is identical to the Pt,N,E,Ht,Date format except the order of the Easting and Northing variables are reversed.

**Output format - Pseudo NMEA GGA**

### Description

This output format is based on NMEA (**N**ational **M**arine **E**lectronics **A**ssociation), which is a standard for interfacing marine electronic devices.

### Format

$GPGGA,Time,Northing,N,Easting,E,1,05,1.0,Elevation,M,0.0,M,0.0,0001*99 <CR/LF>

### Description of Fields

| Field | Description |
|---|---|
| $GPGGA | Sentence identification (header including talker identification). A Talker ID appears at the beginning of the header of each NMEA message. |
| Time | UTC time of position (hhmmss.ss) |
| Northing | The Northing coordinate (always output with 2 decimal places) |
| N | Fixed text (N) |
| Easting | The Easting coordinate (always output with 2 decimal places) |
| E | Fixed text (E) |
| GPS Quality Indicator | Fixed number (1=no real-time position, navigation fix) |
| Number of satellites | Number of satellites in use (00 to 12) |
| HDOP | Fixed number (1.0) |
| Elevation | The height coordinate (always output with 2 decimal places) |
| Elevation units | Elevation units (F or M). The format settings are defined in **Regional Settings**. |
| Height Geoid | Fixed number (0.0) |
| Height units | Fixed text (M) |
| Time since last DGPS update | Fixed number (0.0) |
| DGPS Base station ID | Fixed number (0.0001) |
| Checksum | Fixed number (*99) |
| <CR/LF> | **C**arriage **R**eturn **L**ine **F**eed |

### Example

$GPGGA,171933.97,7290747.02,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,M,0.0,0001*99
$GPGGA,171934.20,7290747.02,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,M,0.0,0001*99
$GPGGA,171934.45,7290747.03,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,M,0.0,0001*99

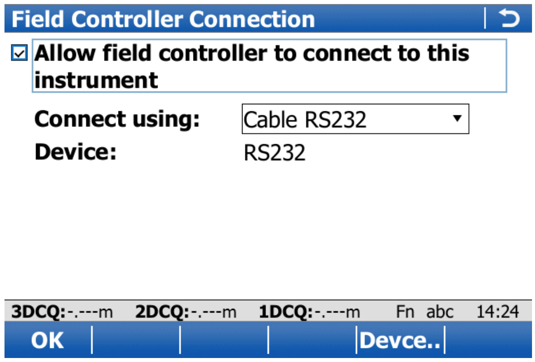
☞ Fields are always separated by a comma. A comma is never placed before the Checksum field. When information for a field is not available, the position in the data string is empty.

## 19.15 Field Controller Connection [TS]

**Description**

The Remote connection allows the TS11/TS15/TS12 Lite/MS50/TS50/TM50 instrument to be steered remotely from a field controller where SmartWorx Viva is running.
The settings on this screen define the port and the device used for the remote connection.

**Field Controller Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Devce..** | Available unless **Connect using**: **Cable** is selected on TS50. To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Allow field controller to connect to this instrument** | Check box | When this box is checked, the remote connection is activated. |
| **Connect using** | **Cable** | For TS11/TS15/TS12 Lite: The RS232 port. For MS50/TS50/TM50: The cable USB port. |
| | **Radio handle** | Hotshoe connection for RadioHandle. This port is located on top of Communication side cover. |
| | **Bluetooth** | The Bluetooth port on the TS11/TS15/TS12 Lite which is used. |
| | **Cable RS232** | The RS232 port on the MS50/TS50/TM50. |
| **Device** | Display only | The device currently assigned to the selected port. |

**Next step**

When the connection is established, most keys are locked. Available are:

- **Meas**, **Dist** and **Store**.
- **Dist** and **Store** have the same functionality as on the CS or as on the TS11/TS15/TS12 Lite/MS50/TS50/TM50 when it is independently controlled.
- **Level** goes to **Level Bubble & Compensator**. Check the level bubble, laser plummet internsity, tilt compensator and horizontal correction.

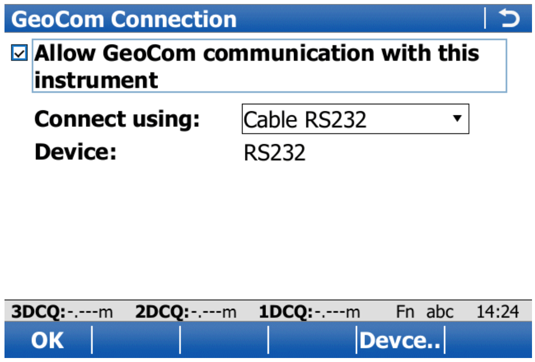
## 19.16 GeoCom Connection TS

**Description**

The GeoCOM Mode permits communication of the TS11/TS15/MS50/TS50/TM50 with a 3rd party device.

☞ TS12 Lite can not communicate with a 3rd party device.

**GeoCom Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Devce..** | Available unless **Connect using**: **Cable** is selected on TS50. To create, select, edit or delete a device. Refer to "21.2 Accessing Devices / GPRS Internet Devices". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Allow GeoCom communication with this instrument** | Check box | When this box is checked, the GeoCOM mode is activated. |
| **Connect using** | **Cable** | For TS11/TS15/TS12 Lite: The RS232 port.<br>For MS50/TS50/TM50: The cable USB port. |
| | **Radio handle** | Hotshoe connection for RadioHandle. This port is located on top of Communication side cover. |
| | **TS Bluetooth 1** and **TS Bluetooth 2** | The Bluetooth ports on the TS11/TS15 which can be used. |
| | **Cable RS232** | The RS232 port on the MS50/TS50/TM50. |
| | **WLAN** | The WLAN port on the MS50/TS50/TM50. |
| **Device** | Display only | The device currently assigned to the selected port. |

# 20 Connections.. - All other connections, Cntrl.. Key

## 20.1 Digital Cellular Phones

### 20.1.1 Overview

**Description**

For digital cellular phones, information such as
- the base stations that can be contacted
- the phone numbers of the base stations and
- the type of protocol to be used

can be defined.

Changing the base station to be dialled is of interest in two cases.

| | |
|---|---|
| Case 1: | Two real-time base stations, each equipped with a digital cellular phone, are set up at two locations belonging to different network providers.<br>When leaving the area of one base, the station can be changed and the other base can be called. |
| Case 2: | Set up as in case 1.<br>Two separate fixes from each base for each point can be obtained, providing redundancy for future least squares adjustment operations. |

**Technologies**

| | |
|---|---|
| CDMA | Code Division Multiple Access is a high speed data transmission for effective and flexible use of available resources such as bandwidth. Users of a cellular phone network occupy the same frequency band. The signal is especially coded for each user. |
| GSM | **G**lobal **S**ystem for **M**obile Communications is a more efficient version of CDMA technology that uses smaller time slots but faster data transfer rates. It is the world's most commonly used digital network. |

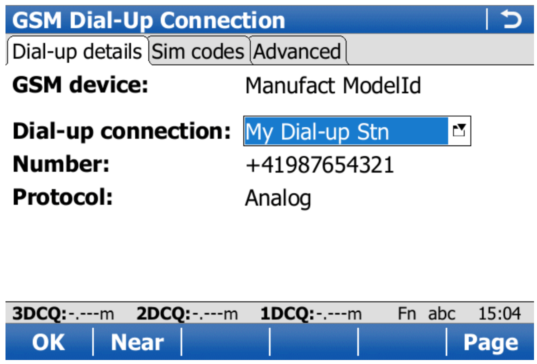
## 20.1.2 Configuring a GSM Connection

**Access**

For RTK rover and TPS:
- In **Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Cntrl..**.

For RTK base:
- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Cntrl..**.

**GSM Dial-Up Connection, Dial-up details page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Near** | To find the nearest base station with a digital cellular phone of GSM technology. Available when base stations to dial are already created in **Dial-up Connection List**. Coordinates of these stations must be known. |
| **Page** | To change to another page on this screen. Available if the Internet connection is activated. |
| Fn **Cmnd..** | To send AT commands to the digital cellular phone. |
| Fn **Clear** | Available on the **Sim codes** page. To set the additional editable fields to 0. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **GSM device** | Display only | Available for RTK rover and TPS. The type of digital cellular phone highlighted when this screen was accessed. |
| **Dial-up connection** | Selectable list | Available for RTK rover and TPS. The digital cellular phone base station to be dialled. Opening the selectable list accesses **Dial-up Connection List** where new base stations can be created and existing base stations can be selected or edited. Refer to "20.7 Configuring the Stations to Dial". |
| **Number** | Display only | Available for RTK rover and TPS. The number of the digital cellular phone at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |
| **Protocol** | Display only | Available for RTK rover and TPS. The configured protocol of the digital cellular phone at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |
| **APN** | Editable field | Available for RTK base with Internet capable devices.<br>The **A**ccess **P**oint **N**ame of a server from the network provider, which allows access to data services. Contact your provider to get the correct APN. |

#### Next step

**Page** changes to the **Sim codes** page.

---

### GSM Dial-Up Connection, Sim codes page

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **PIN code** | Editable field | To enter the **P**ersonal **I**dentification **N**umber of the SIM card. |
| **PUK code** | Editable field | If the PIN is locked for any reason, for example the wrong PIN was entered, input the **P**ersonal **U**nbloc**K**ing code for access to the PIN. |

#### Next step

**Page** changes to the **Advanced** page.

---

**GSM Dial-Up Connection, Advanced page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Network data rate** | | The network baud rate. |
| | Selectable list | For digital cellular phones of GSM technology that do not support autobauding choose the baud rate from the selectable list. |
| | **Autobauding** | Select this option for an automatic search of the network baud rate. |
| **Use transparent mode** | Check box | Define if the digital cellular phone uses Radio channel Protocol. Check for digital cellular phones that do use transparent mode. Uncheck for digital cellular phones that use RLP. Check with the network provider if the digital cellular phone uses transparent mode or not. |
| **Manually select cellphone network** | Check box | Available for digital cellular phone devices unless they are in data mode. When this box is checked, the currently selected network provider is displayed and the **Search** key is available.<br>Press **Search** for a list of all available networks and to select a specific network. |

### Next step

**Page** changes to another page on this screen.

## 20.1.3 Configuring a CDMA Connection

**Access**

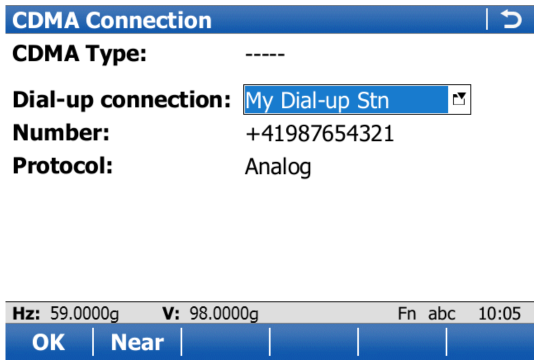
For RTK rover and TPS:

- In **Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Cntrl..**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Cntrl..**

**CDMA Connection**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Near** | To find the nearest base station with a digital cellular phone of CDMA technology. Available when base stations to dial are already created in **Dial-up Connection List**. Coordinates of these stations must be known. |
| Fn **Info** | To provide information about the CDMA device being used, such as the manufacturer, the model and the electronic serial number. |
| Fn **Reg** | To register the settings of the CDMA digital cellular phone over the air. For US and Canada only. Available when the registration process must be done manually. |
| Fn **Cmnd..** | To send AT commands to the digital cellular phone. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **CDMA Type** | Display only | The type of digital cellular phone highlighted when this screen was accessed. |
| **Dial-up connection** | Selectable list | The digital cellular phone base station to be dialled. Opening the selectable list accesses **Dial-up Connection List** where new base stations can be created and existing base stations can be selected or edited. Refer to "20.7 Configuring the Stations to Dial". |
| **Number** | Display only | The number of the digital cellular phone at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |
| **Protocol** | Display only | The configured protocol of the digital cellular phone at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |

**Next step**

Fn **Info** changes to **CDMA Information**.

## CDMA Information

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Manufact** | Display only | The manufacturer of the CDMA device being used. |
| **Model** | Display only | The model of the CDMA device being used. |
| **ESN No.** | Display only | **E**lectronic **S**erial **N**umber<br>For registration purposes, send the electronic serial number to the network provider in order to receive the service programming code and the mobile directory number. These numbers must be typed in **CDMA Registration**. |

### Next step

| Step | Description |
|---|---|
| 1. | Press **Print** to print all information to a file CDMA Info.log in the \DATA directory on the data storage device. |
| 2. | Press **OK** to return to **CDMA Connection**. |
| 3. | For US and Canada only: Press **Reg** to access **CDMA Registration**. |

## CDMA Registration

The settings allow the CDMA digital cellular phone to be registered over the air.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **MSL/SPC** | Display only | The **S**ervice **P**rogram **C**ode provided by the network provider. |
| **MDN** | Display only | The **M**obile **D**irectory **N**umber provided by the network provider |
| **MSID/MIN** | Display only | **M**obile **S**tation **Id**entity Number and **M**obile **I**dentification**N**umber. Another 10-digit number to identify the mobile phone. Sometimes identical with the MDN. |

### Next step

**OK** to return to **CDMA Connection**.

## 20.2 Modems

**Description**

For modems, information such as
- the base stations that can be contacted and
- the phone numbers of the base stations

can be controlled.

Changing the base station to be dialled is of interest in two cases.

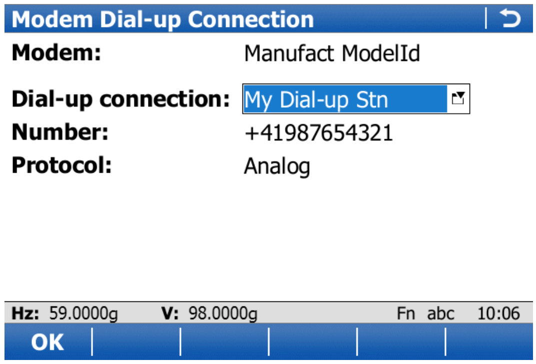
| | |
|---|---|
| Case 1: | Two real-time base stations, each equipped with a digital cellular phone, are set up at two locations belonging to different network providers.<br>When leaving the area of one base, the station can be changed and the other base can be called. |
| Case 2: | Set up as in case 1.<br>Two separate fixes from each base for each point can be obtained, providing redundancy for future least squares adjustment operations. |

**Access**

For RTK rover and TPS:
- In **Connection Settings**, highlight a connection which has a modem attached. **Cntrl..**.

For RTK base:
- In **Base Connection Settings**, highlight a connection which has a modem attached. **Cntrl..**.

## Modem Dial-up Connection




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Near** | To find the nearest base station with a modem. Available when base stations to dial are already created in **Dial-up Connection List**. Coordinates of these stations must be known. |
| Fn **Cmnd..** | To send AT commands to the modem. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Modem** | Display only | The type of modem highlighted when this screen was accessed. |
| **Dial-up connection** | Selectable list | The modem base station to be dialled. Opening the selectable list accesses **Dial-up Connection List** where new base stations can be created and existing base stations can be selected or edited. Refer to "20.7 Configuring the Stations to Dial". |
| **Number** | Display only | The number of the modem at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |
| **Protocol** | Display only | The configured protocol of the modem at the selected **Dial-up connection** as configured in **Dial-up Connection List**. |

## 20.3 Radios for GPS Real-Time

**Description**

For radios the channels on which the radio broadcasts can be changed. Changing channels changes the frequency at which the radio operates. Not all radios support channel changing.

Changing radio channels is of interest in three cases.

| | |
|---|---|
| Case 1: | Two real-time base stations are set up at two locations, each broadcasting on a different channel.<br>If the signal from one base station is jammed, the channel can be changed and the other base can be used. |
| Case 2: | Set up as in case 1.<br>Two separate fixes for each point can be obtained, providing redundancy for future least squares adjustment operations. |
| Case 3: | One real-time base and one real-time rover are being used.<br>If the signal is blocked due to radio interference, the channel at the base and the rover can be changed in order to work on a different frequency. |

**Requirements for channel changing**

| | |
|---|---|
| Pacific Crest radios: | • channel changing must be activated by a Pacific Crest dealer.<br>• A special licence might be required. |
| Satelline radios: | The radio must be in programming mode. This mode can be set by a Satelline dealer. |

☞ Channel changing may contravene radio broadcasting regulations in certain countries. Before operating with radios, check the regulations in force in the working area.

☞ The number of channels available and the frequency spacing between channels depends on the radio used.

For some Satel radios the configuration can be done within SmartWorx Viva.

☞ If channel changing is to be used, when configuring the base real-time connection, set **RTK base ID** in **RTK base settings (RTK1)**/**RTK base settings (RTK2), Data rates** page to a different ID for each base site. By doing so, the rover can recognise if the incoming real-time data after channel changing is being received from a different base station or if the original base station is using a new frequency. In the first case, the ambiguities are recomputed.

**Access**

For RTK rover and TPS:

- In **Connection Settings**, highlight a connection which has a radio attached. **Cntrl..**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a radio attached. **Cntrl..**.

**Radio Configuration**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Scan** | To provide information such as the station ID, latency and the data format of incoming signals from base stations broadcasting on the same radio channel. This information can be used to select appropriate base stations to dial. |
| Fn **Config..** | Available for connected Satel radios. Both hardware and firmware version must support channel configuration within SmartWorx Viva.<br>To add new, edit and delete channels from the radio's internal channel list. Editable are: the channel name/number, the frequency, the spacing and, on the base, the output power.<br>Refer to "Channel Configuration" for more information on the channel configuration.<br>To restrict the channel configuration, select **Main Menu: User\System settings\Admin settings**..<br>☞ On the base, the channel configuration is password protected. Contact your Leica local representative for information about the password. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Radio type** | Display only | The type of radio highlighted when this screen was accessed. |
| **Channel** | Editable field | The radio channel. The channel used must be within minimum and maximum allowed input values. The minimum and maximum allowed input values for a radio depend on the number of channels supported by the radio and the spacing between the channels. |
| **Actual frequency** | Display only | Available for **Radio type: Satelline 3AS**. Displays the actual frequency of the radio. |
| **Use different protocol** | Check box | Available when a Satelline radio is selected as **Radio type**.<br>When this box is checked, the Satelline radio can transmit data to and receive data from a Pacific Crest radio. The radio is configured accordingly online. The radio need not be connected to a PC and no configuration software is needed.<br>When this box is not checked and **OK** is pressed the device switches to the standard Satel 3AS/3ASd mode. |
| **Modulation type** | **Pac Crest 4FSK**, **Pac Crest GMSK**, **Pac Crest FST**, **TrimTalk(P) GMSK** and **TrimTalk(T) GMSK** | Defines the settings for Pacific Crest compatibility as shown in the next table. The available modulation types depend on the used radio hardware and firmware. |

### Settings depending on protocol

| Protocol | Baud rate 12.5 kHz | Baud rate 25 kHz | Modulation | Use Forward Error Correction |
|---|---|---|---|---|
| Satelline 3AS | 9600 | 19200 | 4FSK | ON |
| PCC-4FSK | 9600 | 19200 | 4FSK | ON |
| PCC-GMSK | 4800 | 9600[1]/NA[2] | GMSK | ON |
| TrimTalk450s (P) | 4800 | 9600[1]/NA[2] | GMSK | ON |
| TrimTalk450s (T) | 4800 | 9600[1]/NA[2] | GMSK | ON |
| PCC-FST | 9600 | 19200 | 4FSK | ON |

[1] For countries without narrow banding regulations

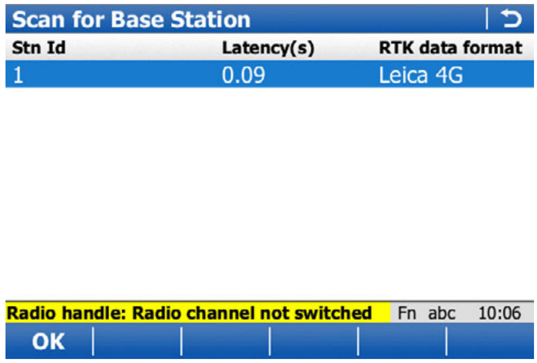
[2] For countries with narrow banding regulations, for example the USA

**Next step**

**Scan** to access **Scan for Base Station**.

**Scan for Base Station**

This screen provides information about the base stations, with specific types of devices attached, for example a radio, from which real-time corrections are being received. This information can also be useful for finding out if anyone else in the area is using a particular radio channel.




| Key | Description |
|---|---|
| **OK** | To select the highlighted base station and to continue with the subsequent screen. |
| **Chnl-1** and **Chnl+1** | Available for scanning base stations with radios attached. To switch the radio to one channel lower/higher than the current channel. The base stations displayed change to those broadcasting on the new channel. |

**Description of columns**

| Column | Description |
|---|---|
| **Station ID** | Station ID of available base stations from which a signal is being received.<br>For radios, the base station radios transmitting on the same channel will be listed. |
| **Latency(s)** | Time delay, in seconds and configured on the base, from when the base collects the data to when the data is transmitted. |
| **RTK data format** | Format of the data from the base station. Refer to "19.8.1 Configuration of a Reference Real-Time Connection" for more information about data formats. |

**Channel Configuration**

Minimum Satel firmware version required:

| Satel Radio Model | Firmware Version |
|---|---|
| M3-TR3 | 2.0.4.2 or higher |
| M3-R3 | 1.0.9.xx or higher |
| M3-TR1 | 3.62.3 or higher |

The information displayed is queried from the Satel radio. The current status is displayed. The information is not stored in SmartWorx Viva.

| Key | Description |
|---|---|
| **Store** | To apply and send the new configuration to the Satel radio and to return to the screen from where this screen was accessed. |
| **New..** | To create a new channel.<br>☞ Changes are only applied and send to the Satel radio when pressing **Store**. |
| **Edit..** | To edit the highlighted channel.<br>☞ Changes are only applied and send to the Satel radio when pressing **Store**. |
| **Delete** | To delete the highlighted channel.<br>☞ Changes are only applied and send to the Satel radio when pressing **Store**. |
| **More** | To change between **Spacing (kHz)** and **Rx Freq. (MHz)** on a rover respectively **Tx Freq. (MHz)** and also **Tx Power(mW)** on a base. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Channel** | Name/number to the channel. Any integer number between -32767 and 32767 is allowed. |
| **Rx Freq. (MHz)** | Available on the rover.<br>Receive frequency assigned to the channel in MHz. |
| **Tx Freq. (MHz)** | Available on the base.<br>Transmit frequency assigned to the channel in MHz. |
| **Spacing (kHz)** | Channel spacing assigned to the channel in kHz. |
| **Tx Power(mW)** | Available on the base.<br>Output power assigned to the channel in mW |

## 20.4 Radios for Remote Control

**Description**

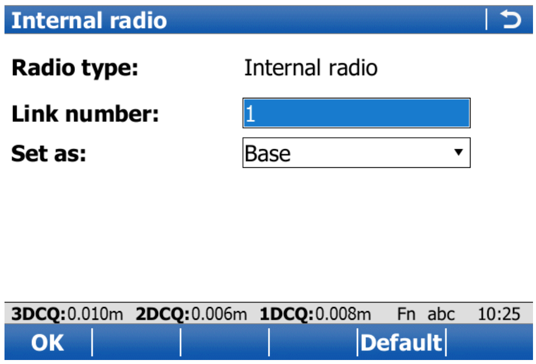
For radios the channels on which the radio broadcasts can be changed. Changing channels changes the frequency at which the radio operates. This change in frequency can be necessary to enable multiple pairs of radios to work simultaneously in the same area without interfering with each other.

**Access**

For TPS:

- In **Connection Settings**, highlight a connection which has an internal radio, a TCPS or a GFU attached. **Cntrl..**.

**TPS Radio Communication**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Default** | To change to the default radio settings. |
| Fn **Save** | To save the radio settings. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Radio type** | Display only | The type of radio device selected for the connection. |
| **Link number** | Editable field | The assigned channel number. The channel number for the field controller and the radio must be the same. The communication settings for the field controller and the radio must also be same. |
| **Set as** | **Remote** or **Base** | The radio modules inside the field controller and the radio must be set to opposite settings. It is recommended to set the field controller to **Remote** and the radio to **Base**. |

## 20.5 RS232

| | |
|---|---|
| **Description** | RS232 is a standard serial communication method that is able to transfer data without the need for predefined time slots. |
| **Access** | For RTK rover and TPS:<br>• In **Connection Settings**, highlight a connection which has an RS232 device attached. **Cntrl..**.<br>For RTK base:<br>• In **Base Connection Settings**, highlight a connection which has an RS232 device attached. **Cntrl..**. |
| **RS232 Connection** | Displayed is the type of device highlighted when this screen was accessed. |

## 20.6 Internet

**Description**

**Internet**

The Internet connection allows connection to the Internet to receive real-time data. A GPRS / Internet device must be attached to the instrument.

**Requirements**

**For Internet**

- Check **Use Internet connection on GS** in **Internet Connection**.
- An Internet port must be selected in **RTK base settings (RTK1)**/**RTK base settings (RTK2)** or **RTK Rover Settings**.

**Access**

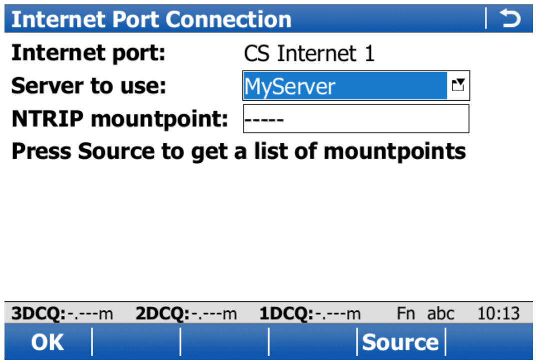
For RTK rover:

- In **Connection Settings**, highlight a connection which has an Internet device attached. **Cntrl..**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has an Internet device attached. **Cntrl..**.

## Internet Port Connection




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Internet port** | Display only | The name of the Internet port attached to the connection that was highlighted when this page was accessed. |
| **User type** | | How the instrument will operate in the Internet. |
| | **Client** | Available on the base. Must be selected when connecting to a server, for example Ntrip caster or TCP/IP server. |
| | **Server** | Available on the base. Must be selected to allow connections from TCP/IP clients, for example GNSS rovers. |
| **IP address** | Display only | Available for **User type**: **Server**. Current IP address of the GS instrument. |
| **TCP/IP port** | Editable field | The port number to which the TCP/IP clients connect for receiving the RTK data stream. |
| **Allow simultaneous connections** | **1** to **10** | Available on the base for **User type**: **Server**. Select the number of clients which are allowed to connect to the port. |
| **Server to use** | Selectable list | Available on the rover, also on the base for **User type**: **Client**. The server to be accessed in the Internet. Opening the selectable list accesses **Server to Connect** where new servers can be created and existing servers can be selected or edited. |
| **NTRIP mountpoint** | Editable field | Mountpoints are the Ntrip servers sending out real-time data. |

### Next step

Select **Source** to access **NTRIP Source Table**.
Highlight a mountpoint about which more information is required. This information helps to configure the instrument to use the selected mountpoint as a base. Press **Info** to access **Mountpoint**.

**Mountpoint, General page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Identifier** | Display only | The name of the selected Mountpoint. |
| **Format** | Display only | The real-time data format sent out by the Mountpoint. |
| **Format details** | Display only | Details about **Format**, for example the RTCM message types including update rates in seconds displayed in brackets. |
| **Authentic** | | The type of password protection required for the authorisation to the Ntrip server. |
| | **None** | If no password is required. |
| | **Basic** | If the password does not require encryption. |
| | **Digest** | If the password must be encrypted. |
| **NMEA** | Display only | Indicates if the Mountpoint must receive GGA NMEA data from the rover in order to compute VRS information. |
| **Charges** | Display only | Indicates if charges are currently made for the connection. |
| **Carrier** | Display only | The type of carrier message sent out. |
| **System** | Display only | The type of satellite system supported by the Mountpoint. |

**Next step**

**Page** changes to the **Location** page.

**Mountpoint, Location page**

Detailed information about the location of the Mountpoint is displayed.

**Next step**

**Page** changes to the **Miscell** page.

**Mountpoint, Miscell page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Generator** | Display only | The hard- or software generating the data stream. |
| **Compress** | Display only | The name of the compression / encryption algorithm. |
| **Bitrate** | Display only | The data speed in bits per second. |
| **Info** | Display only | Miscellaneous information if available. |

**Next step**

**OK** to return to the previous screen.

## 20.7 Configuring the Stations to Dial GPS

### 20.7.1 Accessing Dial-up Connection List

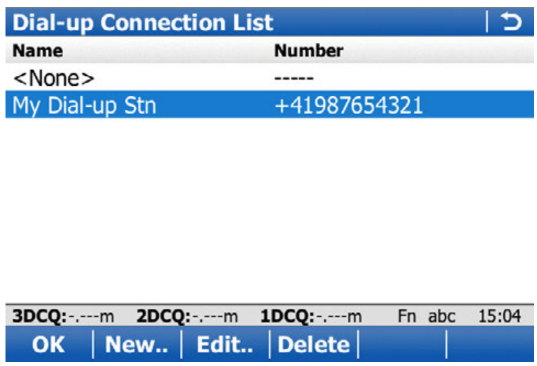
**Description**

**Dial-up Connection List** allows new stations to be created, provides a list of base stations that can be dialled and allows existing stations to be edited.
For digital cellular phones of any technology and for modems, the phone numbers of the device at the base station must be known. For a base station to be dialled, a name, the phone number and, if available, the coordinates can be configured.
The configuration is possible for rover and base digital cellular phones and modems.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Connection Settings**, highlight a connection which has a digital cellular phone of any technology or modem attached. |
| 2. | **Cntrl..**. |
| 3. | Open the selectable list for **Dial-up connection**. |

**Dial-up Connection List**




| Key | Description |
|---|---|
| **OK** | To select the highlighted station and to return to the screen from where this screen was accessed. |
| **New..** | To create a new station. Refer to "20.7.2 Creating / Editing a Station to Dial". |
| **Edit..** | To edit a station. Refer to "20.7.2 Creating / Editing a Station to Dial". |
| **Delete** | To delete the highlighted station. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

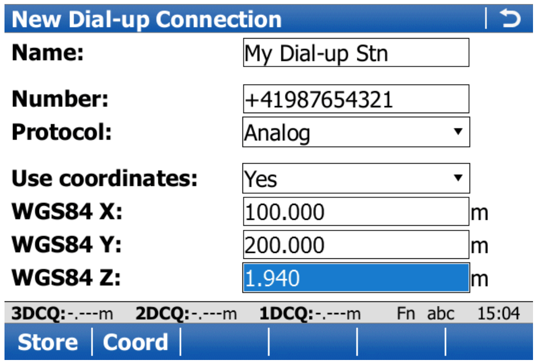
| Column | Description |
|---|---|
| **Name** | Name of all available base stations. |
| **Number** | Phone number of the station to dial. |

## 20.7.2 Creating / Editing a Station to Dial

**Access**

In **Dial-up Connection List** press **New..** or **Edit..**.

**New Dial-up Connection**




| Key | Description |
|---|---|
| **Store** | To return to the screen from where this screen was accessed. |
| **Coord** | To view other coordinate types. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new base station to be dialled. The name can be up to 16 characters long and include spaces. Input optional. |
| **Number** | Editable field | The number of the base station to dial. If the survey is to be undertaken across country borders it is necessary to input the phone number using standard international dialling codes. For example, +41123456789. Otherwise it can be input as a standard digital cellular phone number. |
| **Protocol** | | Available for digital cellular phones of GSM technology. The configured protocol of the digital cellular phone of GSM technology. |
| | **Analog** | For conventional phone networks. |
| | **ISDN v.110** or **ISDN v.120** | For GSM networks. |
| **Use coordinates** | Selectable list | Select **Yes** to type in the approximate coordinates of the base station. |

## 20.8 Configuring the Server to Connect GPS

### 20.8.1 Accessing Server to Connect

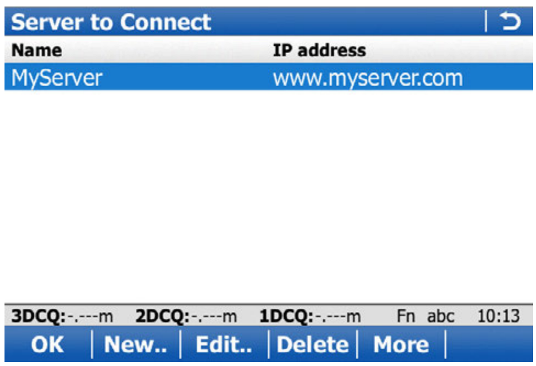
**Description**

**Server to Connect** allows new servers to be created, provides a list of servers that can be accessed in the Internet and allows existing servers to be edited.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Connection Settings**, highlight a connection which has an Internet connection attached. |
| 2. | **Cntrl..** |
| 3. | Open the selectable list for **Server name**. |

**Server to Connect**




| Key | Description |
|---|---|
| **OK** | To select the highlighted server and to return to the screen from where this screen was accessed. |
| **New..** | To create a new server. Refer to "20.8.2 Creating / Editing a Server". |
| **Edit..** | To edit a server. Refer to "20.8.2 Creating / Editing a Server". |
| **Delete** | To delete the highlighted server. |
| **More** | To change between the IP Address and the TCP/IP Port of the server. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

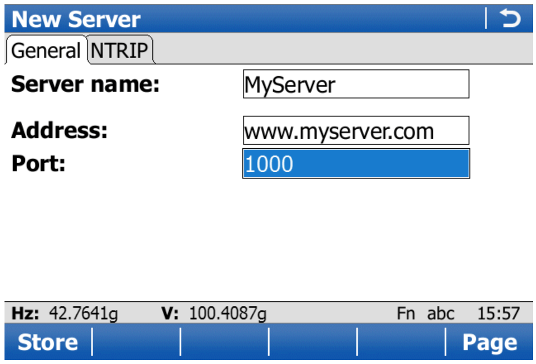
| Column | Description |
|---|---|
| **Name** | Name of all available servers. |
| **IP address** | IP addresses of all available servers. |
| **TCP/IP port** | TCP/IP Port numbers of all available servers. |

## 20.8.2 Creating / Editing a Server

**Access**

In **Server to Connect** press **New..** or **Edit..**.

**New Server, General page**




| Key | Description |
|---|---|
| **Store** | To return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the new server to be accessed. The name can be up to 16 characters long and include spaces. |
| **Address** | Editable field | Type in the host name or the IP address of the server to be accessed in the Internet. |
| **Port** | Editable field | The port of the Internet server through which the data is provided. Each server has several ports for various services. |

**Next step**

**Page** changes to the **NTRIP** page.

**New Server, NTRIP page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use NTRIP with this server** | Check box | Check to activate Ntrip. |
| **User ID** | Editable field | A user ID is required to receive data from to the Ntrip Caster. Contact the Ntrip administrator for information. |
| **Password** | Editable field | A password is required to receive data from the Ntrip Caster. Contact the Ntrip administrator for information. |

**Next step**

**Store** to store the settings.

# 21 Configuration of Devices

## 21.1 Devices

### 21.1.1 Overview

**Description**

Before using any device, it is necessary to configure the interface with which it will be used. Refer to "19.1 Accessing Configuration Connections" for information on how to configure the interfaces.

Some devices can be used with different interfaces for different applications. For example:

- GPS A radio can be used to receive real-time base data but a second radio could also be used to output simultaneous NMEA messages.
- TPS A radio can be used for remote control with a TPS but also to send GeoCOM commands from a computer to a TPS.

## 21.1.2 Digital Cellular Phones

**Description**

Digital cellular phones comprise of the technologies CDMA and GSM.

**Typical uses**

- To transmit real-time data.
- To receive real-time data.
- To download raw observations from a remote location.
- To steer an instrument.

**Example use**

| Step | Description |
|---|---|
| 1. | Base and rover must both be equipped with a digital cellular phone. |
| 2. | Ensure that the digital cellular phone at the base is on. |
| 3. | The rover digital cellular phone contacts the selected base of which the phone number was pre-defined. Refer to "21.3 Creating/Editing a Device". |
| 4. | One rover can dial in to the base digital cellular phone at a time. |
| 5. | As soon as the base digital cellular phone is contacted, real-time data is sent to the rover digital cellular phone that has called. |
| ☞ | Several digital cellular phone numbers can be pre-defined on the rover. Dialling a different number dials that particular base station. |

**Requirements for using digital cellular phones**

Always required:

- AT command language must be supported by the digital cellular phone.
- Working area must be covered by a digital cellular phone network.
- The network operator must support data transmission.

Sometimes required:

- SIM card. This SIM card is the same as is normally used in mobile phones. The SIM card must be enabled to transmit data. Contact the service provider to enable the SIM card.
- **P**ersonal **I**dentification **N**umber
- Registration

**Supported digital cellular phones**

Some digital cellular phones are predefined.
Other digital cellular phones can be used. Their settings must be defined by creating a new digital cellular phone configuration. Refer to "21.3 Creating/Editing a Device". These digital cellular phones must be connected with a cable or Bluetooth. Refer to "Appendix E Cables" for information on cables. Please contact the local selling unit or dealer for further information.

**Advantages**

- Unlimited range of the data channel between base and rover.
- Free of jamming from other users.
- Cheaper in price in the initial costs of buying.

**Disadvantages**

Fees are charged for the time that the digital cellular phone network is being used.

☞ Base and rover can both be equipped with a digital cellular phone and a radio. On the base, they operate simultaneously. On the rover, use the radio when within radio range of the base and the digital cellular phone when radio reception is not possible.

## 21.1.3 Modems

**Typical uses**

- To transmit NMEA messages.
- To download raw observations from a remote location.
- To transmit real-time data.

**Example of use**

| Step | Description |
|---|---|
| 1. | The base is equipped with a modem. |
| 2. | The rover is equipped with a digital cellular phone. |
| 3. | Ensure that the modem is switched on. |
| 4. | The rover digital cellular phone contacts the selected base of which the phone number was pre-defined. Refer to "21.3 Creating/Editing a Device". |
| 5. | One rover can dial in to the base modem at a time. |
| 6. | As soon as the base modem is contacted, it sends its data to the rover digital cellular phone that has called. |
| ☞ | Several modem numbers can be pre-defined on the rover. Dialling a different number changes the base station. |

**Requirements for using modem**

AT command language must be supported by the modem.

**Supported modems**

Some modems are predefined. Modems must be connected with a cable.
Other modems can be used. Their settings must be defined by creating a new modem configuration. Refer to "21.3 Creating/Editing a Device".

## 21.1.4 Radios for Real-Time GPS

**Typical uses**

- To transmit real-time data.
- To receive real-time data.
- To steer an instrument.

**Example of use**

| Step | Description |
|---|---|
| 1. | Base and rover must both be equipped with radios using the same frequency range and the same data format. |
| 2. | The base radio continuously sends out real-time data until the instrument is turned off, the configuration is changed or the radio is detached. |
| 3. | The rover radio continuously receives real-time data until the instrument is turned off, the configuration is changed or the radio is detached. |
| 4. | Several rovers can receive data from the same base at the same time. |
| ☞ | Several base radios can transmit real-time data simultaneously using different radio channels. Changing to a different radio channel on the rover changes the base from which real-time data is received. |

**Supported radios**

Some radios are predefined.
Other radios can be used. Their settings must be defined by creating a new radio configuration. Refer to "21.3 Creating/Editing a Device". These radios must be connected with a cable.

☞ Base and rover can both be equipped with a digital cellular phone and a radio. On the base, they operate simultaneously. On the rover, use the radio when within radio range of the base and the digital cellular phone when radio reception is not possible.

## 21.1.5 Radios for Remote Control TPS

**Typical uses**

- To remote control the TPS.
- To transmit data between a TPS and computer.

**Supported radios**

- The default radios used with TPS for remote control are the internal radio CTR16, the RadioHandle and the external radios TCPS. The TPS has to be set to the correct communication mode to send and receive data and commands via the radio.
- A Communication side cover must be fitted to the TPS when operating with the RadioHandle.

**User defined radios**

Other radios than the default radios can be used. Their settings must be defined by creating a new radio configuration. Refer to "21.3 Creating/Editing a Device". These radios must be connected with a cable. Refer to "Appendix E Cables" for information on cables.

## 21.1.6 RS232

**Standard RS232**

Standard RS232 is supported by default. The settings are:

| | | | |
|---|---|---|---|
| Baud rate: | 115200 | Stop bits: | 1 |
| Parity: | None | Flow control: | None |
| Data bits: | 8 | | |

## 21.1.7 USB

**USB**

USB is supported on the MS50/TS50/TM50. The USB interface on port 1 can be used to:

- connected to the CS via the USB interface.
- configure **GeoCom Connection** (cable). USB and serial interface are possible.
- configure **GSI Output Connection** (cable). USB and serial interface are possible.
- configure **Export Job Connection** (cable). USB and serial interface are possible.

If cable is selected (serial – RS232), then the USB interface is also available. If USB is selected, the serial interface is also available but with the default respectively previously set parameters.

☞ The IP address of the RNDIS interface of the MS50/TS50/TM50 cannot be changed within SmartWorx Viva. Use Windows CE to change the IP address, for example when connecting two instruments via USB to the same PC.

## 21.1.8 Hidden Point Measurement Devices

**Typical uses**

To measure

- distances (reflectorless distance measurements using laser technology)
- angles
- azimuths

to points which are not directly accessible with GPS, for example house corners or trees. If the device is connected to the instrument, the measurements taken with hidden point measurement devices are directly transferred. If the device is not connected, measurement can be typed in manually to calculate the coordinates of a hidden point.

**Example of use**

| Step | Description |
|---|---|
| 1. | An instrument must be a rover with or without real-time configuration. |
| 2. | A hidden point measurement device is connected to the instrument via cable or Bluetooth. |
| 3. | Hidden point measurements are configured and activated. |
| 4. | Distances, angles and azimuths are measured to the hidden point with the hidden point measurement device. |
| 5. | The measurements are directly transferred to the instrument and displayed in the appropriate fields. |
| ☞ | Hidden point measurement devices can be connected in addition to any of the other devices. They can be active at the same time. Changing of ports is not required. |

**Supported hidden point measurement devices**

Some devices are predefined.
Hidden point measurement devices of the same type but with different settings must be defined by creating a new hidden point measurement device. Refer to "21.3 Creating/Editing a Device".

## 21.1.9 GPRS / Internet Devices

**Description**

GPRS is a telecommunication standard for transmitting data packages using the **I**nternet **P**rotocol.
When using GPRS technology, charges are made based on the amount of transferred data and not, as per normal digital cellular phones, for the connection time.

**Typical uses**

To access the Internet with an instrument in order to receive real-time data from the Internet.

**Example use**

| Step | Description |
|---|---|
| ☞ | The following is an example use for receiving data from the Internet. |
| 1 | Rover must be equipped with a GPRS / Internet device. |
| 2 | The GPRS / Internet device accesses the Internet where the rover connects for example to Ntrip. |
| 3 | The rover receives real-time corrections via the Internet. |

**Requirements for using GPRS / Internet devices**

- AT command language must be supported by the digital cellular phone.
- **A**ccess **P**oint **N**ame of a server from the network provider. The APN can be thought of as the home page of a provider supporting GPRS data transfer.
- SIM card. This SIM card is the same as is normally used in mobile phones. The SIM card must be enabled to transmit data. Contact the service provider to enable the SIM card.
- **P**ersonal **I**dentification **N**umber
- Registration

**Supported GPRS / Internet devices**

Some GPRS/Internet devices are predefined. Other GPRS capable devices can be used as long as they use AT commands. Their settings must be defined by creating a new device configuration. Refer to "21.3 Creating/Editing a Device". Please contact the local selling unit or dealer for further information.

**Advantages**

- Unlimited range of the data channel between base and rover.
- Free of jamming from other users.
- Fees are charged for the amount of data being transferred.

## 21.2 Accessing Devices / GPRS Internet Devices

**Description**

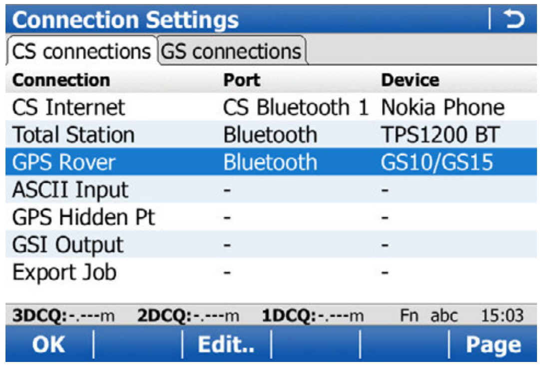
Allows devices to be created, edited, selected and deleted.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | For RTK rover and TPS:<br>• Select **Main Menu:Instrument\Connections..\All other connections**.<br>For RTK base:<br>• Select **Main Menu:Base connections\Connections..\All other connections**. |
| 2. | Highlight the appropriate interface based on the type of device to be configured. For example, highlight **RTK Rover** when a radio is to be configured. |
| 3. | **Edit..**. |
| 4. | Activate the interface by checking the check box. |
| 5. | **Devce..** to access **Devices**. |

**Devices**

This screen may consist of several pages and provides different devices for selection depending on which interface the screen was accessed from. The functionality described here is always the same.




| Key | Description |
|---|---|
| **OK** | To select the highlighted device and return to the screen from where this screen was accessed. |
| **New..** | To create a new device. Refer to "21.3 Creating/Editing a Device". |
| **Edit..** | To edit the highlighted device. Refer to "21.3 Creating/Editing a Device". |
| **Delete** | To delete the highlighted device. |
| **More** | To display information about the type of device and the creator of the device. |
| **Page** | To change to another page on this screen. |
| Fn **All** or Fn Filter.. | Available for Internet and Bluetooth devices. To list all devices or to hide devices which are not Internet or Bluetooth capable. |
| Fn **Default** | To recall previously deleted default devices and to reset default devices to the default settings. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Name** | Names of available devices. |
| **Type** | Type of device defined when creating the device. |
| **Creator** | The creator of the device. The creator can be either Default if the device is a default, or User if the device has been created. If a Default device is edited by using **Edit..** then its creator is still displayed as Default. |

# 21.3 Creating/Editing a Device

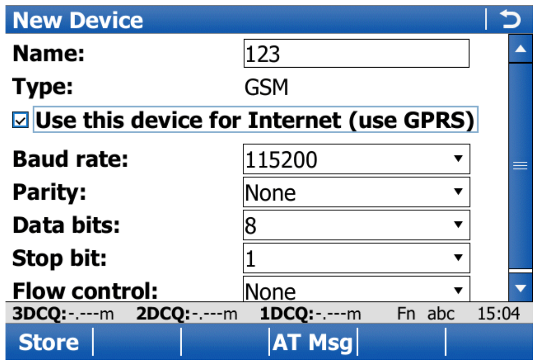
**Description**

Allows a new device to be configured or an existing device to be edited.

**Access**

In **Devices**, highlight a device of the same type as the device to be created, from the list. Press **New..** or **Edit...**

**New Device or Edit Device**




| Key | Description |
|---|---|
| **Store** | To store the new device and to return to the screen from where this screen was accessed. |
| **AT Msg** | Available for digital cellular phones and modems. To configure communication commands. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | Name of new device. |
| **Type** | Display only | Same device type as was highlighted when **New..** or **Edit..** was used. |
| **Use UMTS network if available** | Check box | In case of using GSM only modems together with modems, which are UMTS capable, this option must be disabled. |
| **Baud rate** | From **1200** to **230400** | Frequency of data transfer from instrument to device in bits per second. Unavailable for CS modem. |
| **Parity** | **None**, **Even** or **Odd** | Error checksum at the end of a block of digital data. Unavailable for CS modem. |
| **Data bits** | **6**, **7** or **8** | Number of bits in a block of digital data. Unavailable for CS modem. |
| **Stop bit** | **1** or **2** | Number of bits at the end of a block of digital data. Unavailable for CS modem. |
| **Flow control** | **None** or **Flow control** | Activates hardware handshake.<br>When the instrument/device is ready for data, it asserts the **R**eady **T**o **S**end line indicating it is ready to receive data. This line is read by the sender at the **C**lear **T**o **S**end input, indicating it is clear to send the data. Unavailable for CS modem. |

**Next step**

| IF the device is a | THEN |
|---|---|
| radio or device other than digital cellular phone or modem | **Store** to close the screen and to return to the screen from where this screen was accessed. |
| digital cellular phone or modem | **AT Msg**. |

**AT Msg**

The AT commands configure the devices. Please refer to the manual of device for information about which AT commands must be entered or contact the supplier.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Initialisation 1** | Editable field | Initialisation sequence to initialise digital cellular phone/modem.<br>When the device is used, between **Initialisation 1** and **Initialisation 2**, a check for the PIN is performed. |
| **(continued)** | Editable field | Allows the **Initialisation 1**, **Initialisation 2** or the **Connect** string to continue onto a new line. |
| **Initialisation 2** | Editable field | Initialisation sequence to initialise digital cellular phone/modem. |
| **Dial** | Editable field | Dialling string used to dial the phone number of the real-time base. |
| **Hang-up** | Editable field | Hangup sequence used to end the network connection. |
| **Escape** | Editable field | Escape sequence used to switch to the command mode before using the hangup sequence. |
| **Connect** | Editable field | Dialling string used to dial into the Internet. |

**Next step**
**Store** returns to **New Device** or **Edit Device**.

# 22 Instrument - Instrument status info

## 22.1 Status Functions

☞ The Status functions for the GPS RTK base menu, the GPS rover menu and for TPS are similar. The functions are described in the same chapters, differences are outlined.

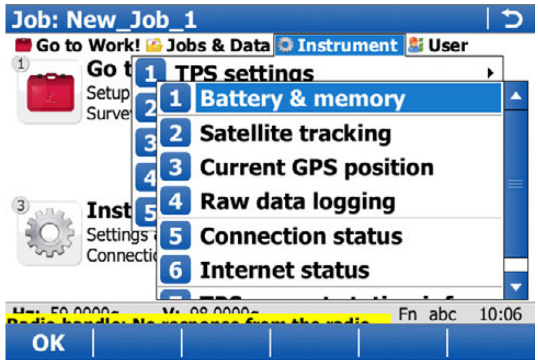
**Description**

The STATUS functions help using the instrument by showing the state of many instrument functions. All fields are display only fields. Unavailable information is indicated by **-----**.

**Access**

- For RTK base:
  Select **Main Menu: Instrument\Base status info**.
- For RTK rover and TPS:
  Select **Main Menu: Instrument\Instrument status info**.

## Status Menu




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |

## Description of the Status functions

| STATUS function | Description | Refer to chapter |
|---|---|---|
| **Battery & memory** | Information related to usage and status of battery and memory. | "22.2 Battery & memory" |
| **Satellite tracking** | • Information related to the satellites ordered by the elevation angle.<br>• A skyplot shows satellite information in a graphical way.<br>• Another page shows the date of the used almanacs, and, as shown on the skyplot, the number of satellites tracked and the number of satellites available above the cut-off elevation mask. | "22.3 Satellite tracking" |
| **RTK data link status** | Information related to real-time data, for example the data link and the device used to transfer real-time data. | "22.4 RTK data link status" |
| **Current GPS position** | Information related to the current antenna position and the speed of the antenna. | "22.5 Current GPS position" |
| **Raw data logging** | Information related to logging of raw observations. | "22.6 Raw data logging" |
| **Connection status** | • Information related to the configuration and use of interfaces, ports and devices.<br>• Information related to the incoming data from active devices. | "22.7 Connection status" |
| TPS **TPS current station info** | Information related to the current station set on the instrument. | "22.9 TPS current station info" |

## 22.2 Battery & memory

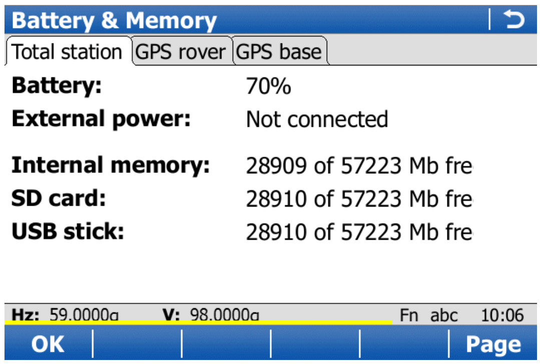
**Access**

Besides the standard access from the **Instrument status info**/**Base status info** menu, access is also possible by tapping the battery icon.

**Battery & Memory**

This description is valid for all pages of the screen. For the **GPS base** page, the information that is displayed depends on the real-time message.

| | |
|---|---|
| Leica/Leica 4G: | Transfers precise values for all fields. |
| RTCM: | Transfer of any of the information not part of the message. |
| CMR/CMR+: | Transfers general status information such as O.K. and Low. |




| Key | Description |
|---|---|
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Description |
|---|---|
| **Battery**, Battery 1 or **Battery 2** | The percentage of remaining power capacity for the battery is displayed numerically. If no information for a field is available, for example no battery is inserted, then 0% is displayed.<br>☞ On the MS50/TS50, if the battery gets charged **(charging)** is stated behind the percentage of the battery power level.<br>☞ When the battery is getting low on the TS, a warning message is displayed on the CS. |
| **External power** | Shows if an external power supply is connected. |
| **Internal memory**, **CF card**, **SD card** or **USB stick** | The total/free memory for data storage on the data storage device. If no information for a field is available, for example no data storage device is inserted, then **-----** is displayed. |

## 22.3 Satellite tracking GPS

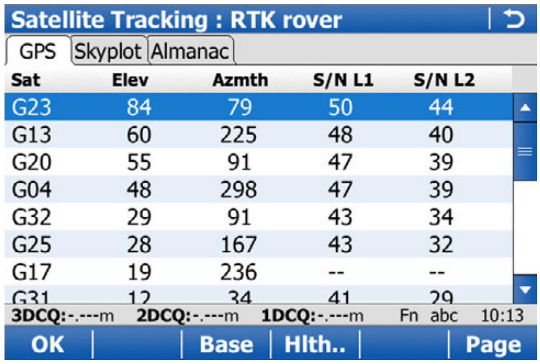
**Description**

This screen shows information related to the satellites ordered by the elevation angle.

**Access**

Besides the standard access from the **Instrument status info**/**Base status info** menu, access is also possible by tapping the number of visible satellites icon.

**Satellite Tracking: RTK rover, GPS/Glonass/Galileo /BeiDou/Augment. page**




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Base** / **Rover** | To change between the SNR values of rover and base. |
| **Hlth..** | To view the numbers of satellites categorised in good, bad and unavailable. |
| **Page** | To change to another page on this screen. The **Galileo** page is unavailable with GS08plus. |
| **More** | To display information about the SNR values for satellites. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

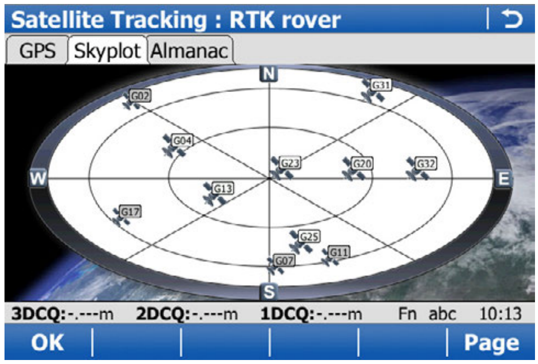
| Column | Description |
|---|---|
| **Sat** | The Pseudo Random Noise number (GPS), the Slot number (GLONASS), the **S**pace **V**ehicle number (Galileo, BeiDou) or the name (Terrastar) of the satellites. |
| **Elev** | The elevation angle in degrees. The arrows indicate if the satellite is rising or falling. |
| **Azmth** | The azimuth of the satellite. |
| **S/N L1**, **S/N L2** and **S/N L5** | The SNR on L1, L2 and L5 for GPS, on L1 and L2 for GLONASS, on E1, E5a, E5b and Alt-Boc for Galileo and on B1 and B2 for BeiDou. If the signal is currently not being used in the position calculations, the number is shown in brackets.<br>For GS05/GS06, **S/N L2** is unavailable. |

**Next step**

**Page** changes to another page on this screen.

**Satellite Tracking: RTK rover, Skyplot page**

Satellites below the **Cut-off angle** configured in **Satellite Tracking** are marked grey. The part of the skyplot between the 0° elevation and the cut-off angle is marked grey.




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **GPS ?** / **GPS ?** | To hide or show the GPS satellites (shown by the prefix G). |
| **GLO ?** / **GLO ?** | To hide or show the GLONASS satellites (shown by the prefix R). Available when Glonass is activated in **Satellite Tracking**. |
| **GAL ?** / **GAL ?** | To hide or show the Galileo satellites (shown by the prefix E). Available when **Galileo** is activated in **Satellite Tracking**. |
| **BDS ?** / **BDS ?** | To hide or show the BeiDou satellites (shown by the prefix C). Available when **BeiDou** is activated in **Satellite Tracking**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of symbols

| Symbol | Description |
|---|---|
|   | Satellites above the **Cut-off angle** configured in **Satellite Tracking**. |
|   | Satellites below the **Cut-off angle** configured in **Satellite Tracking**. |

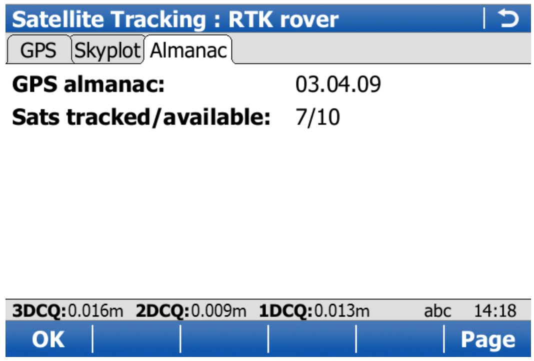
### Next step

**Page** changes to the **Almanac** page.

**Satellite Tracking: RTK rover, Almanac page**

The almanac page shows

- the date of the used almanacs, for each GNSS constellation configured
- as shown on the skyplot, the number of satellites tracked and the number of satellites available above the cut-off elevation mask.




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Page** | To change to another page on this screen. |

**Next step**

**OK** exits **Satellite Tracking**.

**Satellite Tracking, RTK rover page**

The information about the satellites at the base shown on this page is identical with the information shown for the rover.

**Next step**

**OK** exits **Satellite Tracking**.

## 22.4 RTK data link status GPS

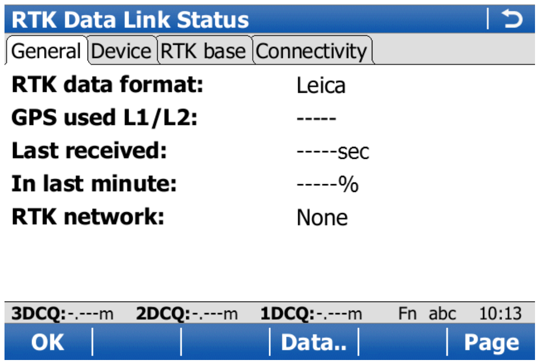
**Description**

This screen shows information related to real-time data, for example the data link and the device used to transfer real-time data.

**Access**

Standard access from the **Instrument status info**/**Base status info** menu.

**RTK Data Link Status, General page**




| Key | Description |
|---|---|
| **OK** | To exit the screen. |
| **Data..** | To view the data being received. Depending on the **RTK data format**, the shown data differ. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

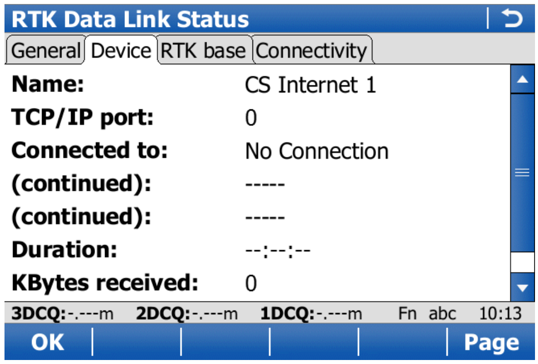
| Field | Description |
|---|---|
| **RTK data format** | The received real-time data format message type. |
| **GPS used L1/L2** | The number of satellites on L1, L2 and L5 (when **GPS L5** is activated in **Satellite Tracking**) being used in the current position solution. |
| **GLO used L1/L2** | Available if **Glonass** is activated in **Satellite Tracking**. The number of satellites on L1 and L2 being used in the current position solution. |
| **GAL used E1/E5a** | Available if **Galileo** is activated in **Satellite Tracking**. The number of satellites on E1 and E5a being used in the current position solution. |
| **GAL used E5b/ABOC** | Available if **Galileo** is activated in **Satellite Tracking**. The number of satellites on E5b and Alt-BOC being used in the current position solution. |
| **BDS used B1/B2** | Available if **BeiDou** is activated in **Satellite Tracking**. The number of satellites on B1 and B2 being used in the current position solution. |
| **Last data sent** | Available for an RTK base. Seconds since the last message from the base was sent. |
| **Last received** | Available for an RTK rover. Seconds since the last message from the base was received. |
| **In last minute** | Available for an RTK rover. The percentage of real-time data received from the base compared with the data received from the antenna within the last minute. This percentage indicates how well the data link is working. |
| **RTK network** | Available for an RTK rover. The type of base network in use. |
| **Stream NMEA messages from the GS** | Available for an RTK rover in a base network. NMEA positions must be send to a network. The type of NMEA message sent to the base network. If more than one message is sent at a time, then all types are shown separated by comma. |

#### Next step

**Page** changes to the **Device** page.

**RTK Data Link Status, Device page**

The content of this page differs for each type of device in use.




| Key | Description |
|---|---|
| **OK** | To exit the screen. |
| **Page** | To change to another page on this screen. |

### Description of fields

### For all devices available

| Field | Description |
|---|---|
| **Name** | The name of the device. |

### For RS232

| Field | Description |
|---|---|
| **Type** | The type of device. |
| **Port** | The port to which the device is connected. |
| **Bluetooth** | Available if device is connected via Bluetooth. Indicates the state of the connection. |

### For digital cellular phones and modems

| Field | Description |
|---|---|
| **Type** | The type of device. |
| **Port** | The port to which the device is connected. |
| **Firmware** | The software version of the attached digital cellular phone. |
| **Operator** | The name of the network operator in which the digital cellular phone is operating. |
| **Network type** | The type of reference network selected in **RTK Rover Settings**. Refer to "RTK Rover Settings, RTK network page". |
| **Status** | The current mode of the digital cellular phone. The options are Unknown, Detection and Registered. |
| **Bluetooth** | Available if device is connected via Bluetooth. Indicates the state of the connection. Unavailable for CS modem. |
| **Signal** | Indication of received signal strength of the digital cellular phone network. |

#### For radios

The available fields depend on the radio type.

| Field | Description |
|---|---|
| **Port** | The port to which the device is connected. |
| **Type** | The type of device. |
| **Channel** | The radio channel. |
| **Actual frequency** | The current set frequency of the radio. |
| **Frequency** | The defined central frequency of the radio. |
| **Firmware** | The software version of the attached radio. |
| **Signal** | Indication of strength of received radio signal. |

#### For Internet on the rover

| Field | Description |
|---|---|
| **TCP/IP port** | TCP/IP port number in use. |
| **Connected to** | IP address of the connected client. |
| **Duration** | The time length since when the instrument is connected to the Internet. |
| **KBytes received** | The amount of data received from the Internet in kilobyte. |
| **KBytes sent** | The amount of data sent to the Internet in kilobyte. |

#### For Internet on the base

| Field | Description |
|---|---|
| **TCP/IP port** | TCP/IP port number in use. |
| **Clients connected** | The number of connected clients and the number of allowed client connections as configured in **Internet Port Connection**. |

#### Next step

**Page** changes to the **RTK base** page.

**RTK Data Link Status, RTK base page**

As shown below, the name of the page changes depending on the type of base being used.

| Name of page | Description |
|---|---|
| **RTK base** page | Base is a real base station. |
| **Base (Nearest)** page | Base is the closest to the rover determined by for example SmartNet. |
| **Base (i-MAX)** page | Base information is individualised Master-Auxiliary corrections determined and sent by for example SmartNet. |
| **Base (MAX)** page | Base information is Master-Auxiliary corrections determined and sent by for example SmartNet. |
| **Base (VRS)** page | Base is a virtual base station. |
| **Base (FKP)** page | Base information is area correction parameters. |

### Description of fields

| Field | Description |
|---|---|
| **RTK base ID** | An identification for a base station. The ID can be converted into a compact format to be sent out with real-time data in all real-time data formats. It is different from the point ID of the base station. |
| **Antenna height** | • For **RTK data format: Leica**, **RTK data format: Leica 4G**, **RTK data format: RTCM v3** or **RTK data format: RTCM 9,2 v2/RTCM 1,2 v2** with **RTCM version: 2.3**:<br>The antenna height at the base from the marker to the MRP.<br>• For **RTK data format: CMR/CMR+** and **RTK data format: RTCM 18,19 v2** or **RTK data format: RTCM 18,19 v2** with **RTCM version: 2.2**:<br>The antenna height at the base from the marker to the phase centre.<br>• For all other **RTK data format**:<br>**-----** is displayed because the data format does not include information about the antenna height. |
| **Coords of** | The coordinates for the base station which are transferred depend on the active real-time data format.<br>• For real-time messages which include antenna height and antenna type: **Marker**. |
| | • For real-time messages which do not include antenna information: **Phase Centre** of L1. |
| **Number of aux ref** | The number of active auxiliary base stations from which data is received. |
| **Antenna at base** | The antenna used at the base. |
| **Sensor type at base** | The instrument type used at the base. |

### Next step

| IF | THEN |
|---|---|
| other coordinate types are to be viewed | **Coord**. Local coordinates are available when a local coordinate system is active. |
| another page is to be accessed | **Page**. |
| this screen is to be quit | **OK** exits the screen. |

**RTK Data Link Status, Connectivity page**

This screen shows the status real-time connectivity as dynamic troubleshooting screen. It shows the success of each of the steps in the connectivity to receive real-time corrections. If one step fails, the check box is unchecked.

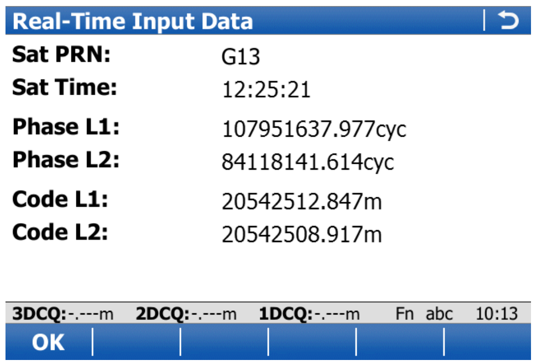
As each step is successfully completed, the check box will be checked.

**Real-Time Input Data**

The following provides additional information on the satellite data received via real-time message. Information of those satellites is displayed, which are used on both base and rover.

### Access

**Data..** on **RTK Data Link Status**, **General** page.




| Key | Description |
| --- | --- |
| **OK** | To return to **RTK Data Link Status**. |

#### Description of fields

The data being received from the satellites and the layout of the screen depend on the active real-time data format.

| Field | Description |
|---|---|
| **Sat PRN** | The PRN number (GPS), the Slot number (GLONASS) or the Space Vehicle number (Galileo, BeiDou) of the satellites shown with the prefix G (GPS), R (GLONASS), E (Galileo) or C (BeiDou). |
| **Sat Time** | The GPS time of the satellite. |
| **Phase L1**, **Phase L2**, **Phase L5** | The number of phase cycles from the antenna to the GPS satellite on L1, L2 and L5. |
| **Phase L1**, **Phase L2** | The number of phase cycles from the antenna to the GLONASS satellite on L1 and L2. |
| **E1/E5a/E5b/ALTB** | The number of phase cycles from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC. |
| **Phase B1**, **Phase B2** | The number of phase cycles from the antenna to the BeiDou satellite on B1 and B2. |
| **Msg 18 L1**, **Msg 18 L2** | The uncorrected carrier phases for L1 and L2. |
| **Msg 20 L1**, **Msg 20 L2** | The carrier phase corrections for L1 and L2. |
| **Code L1**, **Code L2**, **Code L5** | The pseudorange from the antenna to the GPS satellite for L1, L2 and L5. |
| **Code L1**, **Code L2** | The pseudorange from the antenna to the GLONASS satellite on L1 and L2. |
| **E1/E5a/E5b/ALTB** | The pseudorange from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC. |
| **Code B1**, **Code B2** | The pseudorange from the antenna to the BeiDou satellite on B1 and B2. |
| **Msg 19 L1**, **Msg 19 L2** | The uncorrected pseudoranges for L1 and L2. |
| **Msg 21 L1**, **Msg 21 L2** | The pseudorange corrections for L1 and L2. |
| **PRC** | Pseudorange corrections. |
| **RRC** | Rate of change of the corrections. |
| **IODE** | **I**ssue **O**f **D**ata **E**phemeris. The identification number of the ephemeris for a satellite. |

## 22.5 Current GPS position GPS

**Description**

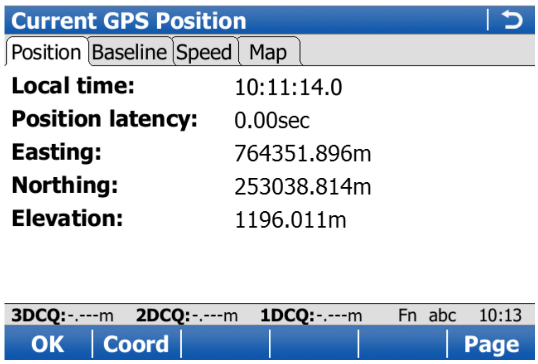
This screen shows information related to the current antenna position and the speed of the antenna. For real-time rover configurations, the baseline vector is also shown. MapView shows the current position in a graphical format.

**Access**

Besides the standard access from the **Instrument status info**/**Base status info** menu, access is also possible by:

- Tapping the position Status icon.

**Current GPS Position, Position page**




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Coord** | To see other coordinate types. Local coordinates are available when a local coordinate system is active. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To determine how often positions are computed and the screen display is updated. |
| Fn **Elev** | To see height as elevation. Available when local grid coordinates are displayed. |
| Fn **Ell Ht** | To see height as ellipsoidal height. Available when local grid coordinates are displayed. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Description |
|---|---|
| **Position latency** | The latency of the computed position. Latency is mostly due to time required for data transfer and computation of position. Depends on the use of the prediction mode. |
| **Position quality** and **Height quality** | Available for phase fixed and code only solutions. The 2D coordinate and height quality of the computed position. |
| **HDOP** and **VDOP** | Available for navigated solutions. |

#### Next step

| IF | THEN |
|---|---|
| the instrument is a real-time rover | **Page** changes to the **Baseline** page. |
| the instrument is not configured for real-time | **Page** changes to the **Speed** page. |
| the instrument is a real-time base | **OK** exits **Current GPS Position**. |

### Current GPS Position, Baseline page

Information on the baseline vector is displayed.

#### Next step

**Page** changes to the **Speed** page.

### Current GPS Position, Speed page

#### Description of fields

| Field | Description |
|---|---|
| **Horizontal speed** | The speed over ground in the horizontal direction. |
| **On bearing** | Available for local coordinate systems.<br>The bearing for the horizontal direction related to the North direction of the active coordinate system. |
| **Vertical speed** | The vertical component of the current velocity. |

#### Next step

**OK** exits **Current GPS Position**.

## 22.6 Raw data logging GPS

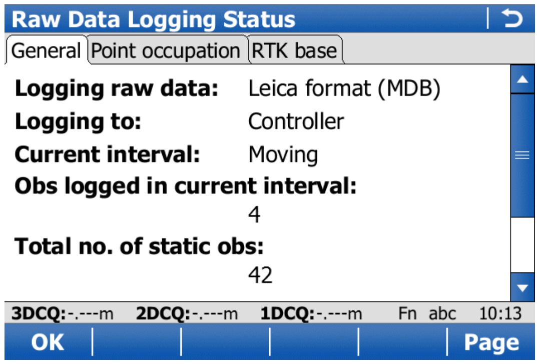
**Description**

This screen shows information related to logging of raw observations.

**Access**

Standard access from the **Instrument status info/Base status info** menu.

**Raw Data Logging Status, General page**




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Description |
|---|---|
| **Data format** | Shows if raw data is saved and if so in which format. |
| **Logging to** | Shows where the data is saved. |
| **Current interval** | The type of current interval. |
| **Obs logged in current interval** | The number of observations logged in current interval. |
| **Total no. of static obs** | The number of static epochs recorded in the current job. |
| **Total no. of moving obs** | The number of moving epochs recorded in the current job. |

**Next step**

**Page** changes to the **Point occupation** page.

**Raw Data Logging Status, Point occupation page**

**Description of fields**

| Field | Description |
|---|---|
| **Current status** | Shows if the instrument is moving or not. |
| **GDOP** | Current GDOP. |
| **Logging rate** | Rate at which raw observations are being recorded. |
| **No. of moving obs** | The number of logged moving raw observations. Reset as soon a new moving interval starts. |
| **Logging data from more than 5 sats since** | The time for how long five or more satellites are tracked on L1 and L2 without interruption. If less than five satellites were tracked, the counter is reset. The counter is not reset after **Meas**, **Stop** or **Store**. |
| **Measurement completed** | The percentage of collected data required for successful processing. It is a conservative estimate based on a 10 - 15 km baseline. The criteria used to display this value depend on the settings for **Automatically stop point measurement**, **Stop criteria** and **Enter the values to be used to automatically stop the point occupation:** in **Main Menu:** Instrument**GPS settings\Quality control**. |
| **Time to go** | The estimated time in hours, minutes and seconds until the configured criteria for **Stop criteria** or **Enter the values to be used to automatically stop the point occupation:** is reached. The criteria used to display this value depend on the settings for **Automatically stop point measurement**, **Stop criteria** and **Enter the values to be used to automatically stop the point occupation:** in **Main Menu: Instrument\GPS settings\Quality control**. |

**Next step**

**Page** changes to the **RTK base** page.

**Raw Data Logging Status, RTK base page**

As shown below, the name of the page changes depending on the type of base used.

| Name of page | Description |
|---|---|
| **RTK base** page | Base is a real base station. |
| **Base (Nearest)** page | Base is the closest to the rover determined by for example SmartNet. |
| **Base (i-MAX)** page | Base information is individualised Master-Auxiliary corrections determined and sent by for example SmartNet. |
| **Base (MAX)** page | Base information is Master-Auxiliary corrections determined and sent by for example SmartNet. |
| **Base (VRS)** page | Base is a virtual base station. |
| **Base (FKP)** page | Base information is area correction parameters. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Logging static obs** | A time in sec | The logging rate at the base. This information is shown if the real-time message format supports this information and raw observations are being logged at the base. |
| | **-----** | Raw observations are not being logged, or status information is not supported by RTK format. |

**Next step**

**OK** exits **Raw Data Logging Status**.

## 22.7 Connection status

### 22.7.1 Connection Status

**Description**

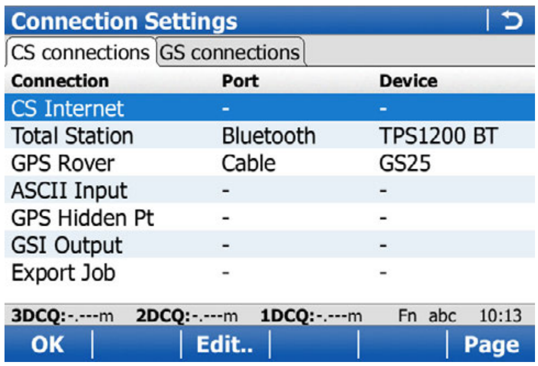
This screen gives an overview of all interfaces with the port and the devices currently assigned.

**Access**

Standard access from the **Instrument status info**/**Base status info** menu.

**Connection Status**

This screen consists of two pages, one for the field controller interfaces and one for the GS interfaces. For a GS05/GS06/GS08plus/GS12, the **GS connections** page is not shown.




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Intfce** | Available for configured interfaces being highlighted. To view information related to real-time data or the internet connection. |
| **Devce..** | To view the status of the attached device. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### 22.7.2 Internet

**Description**

This screen shows
- if the instrument is online on the Internet.
- for how long the instrument is online.
- the technology of data transfer.
- the amount of data received or sent since the instrument is online.

**Access**

This screen is accessible for a configured and activated Internet interface.

- On the **Connection Status**, **CS connections** page, highlight **CS Internet**.**Intfce**.
- On the **Connection Status**, **GS connections** page, highlight **GS Internet**. **Intfce**.

## 22.7.3 ASCII Input GPS

**Description**

This screen shows the
- incoming ASCII data which is stored as an annotation.
- description of the incoming ASCII data for each annotation field.

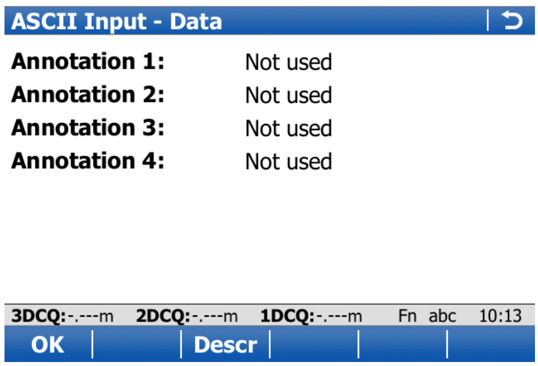
**Not used** is shown for annotation fields which are not configured to receive incoming ASCII data.

**Access**

This screen is accessible for a configured and activated ASCII Input interface.

On the **Connection Status**, **CS connections** page, highlight **ASCII Input.Intfce**.

**ASCII Input - Data**




| Key | Description |
|---|---|
| **OK** | To exit the screen. |
| **Data..** and **Descr** | To change between the given description for the incoming ASCII data or the last received ASCII data. |

## 22.7.4 RTK Data Link Status GPS

**Description**

For information about this screen, refer to "22.4 RTK data link status".

**Access**

This screen is accessible for a configured RTK rover interface.

On the **Connection Status**, **GS connections** page, highlight **RTK Rover.Intfce**.

## 22.7.5 Remote (OWI) GPS

**Description**

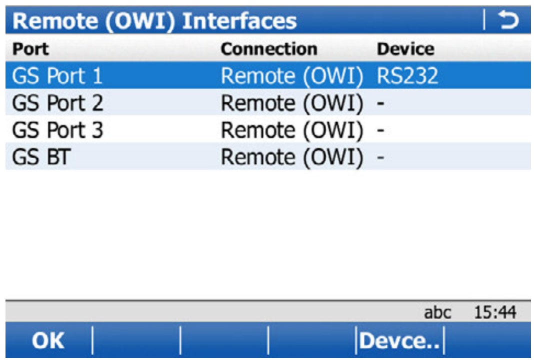
This screen shows all available ports and the interfaces and devices configured to these ports.

**Access**

This screen is accessible for a configured and activated remote interface.

On the **Connection Status**, **GS connections** page, highlight **Remote (OWI) Connections**.

**Remote (OWI)**




| Key | Description |
|---|---|
| **OK** | To exit the screen. |
| **Devce..** | Available for some devices. To view status information about the devices. |

**Description of fields**

| Column | Description |
|---|---|
| **Port** | The physical port on the instrument which is being used for the interface functionality. |
| **Connection** | The interface configured for the ports. |
| **Device** | The hardware connected to the chosen port. |

**Next step**
**OK** exits the screen.

## 22.7.6 Event Input 1/Event Input 2 GPS

**Description**

This screen shows the incoming data from the event input interface.

**Access**

This screen is accessible for a configured and activated event input interface.

On the **Connection Status**, **GS connections** page, highlight **Event Input 1** or **Event Input 2**.

**Event input 1/Event input 2**

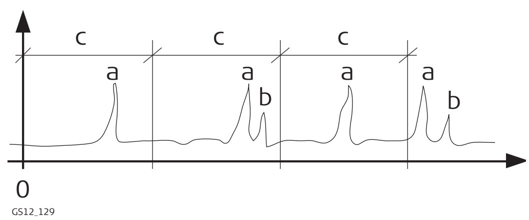
**Description of fields**

| Field | Description |
|---|---|
| **Time** | The local time of when the last event was available. |

**Next step**

**OK** exits the screen.

**Diagram**




a) Event
b) Event pulse
c) Accuracy limit

## 22.8 Internet connection status

**Description**

The status of the device used for the Internet connection is displayed as well as the status of the Internet connection itself.

**Access**

Besides the standard access from the **Instrument status info** menu, access is also possible by tapping the Internet icon.

**Internet Connection Status**

**On rover and base**

| Field | Option | Description |
|---|---|---|
| **Online** | Display only | Shows if the instrument is connected to the Internet. |
| **Duration** | Display only | The time length since when the instrument is connected to the Internet. |
| **KBytes received** | Display only | The amount of data received from the Internet in kilobyte. |
| **KBytes sent** | Display only | The amount of data sent to the Internet in kilo-byte. |

**On the base additionally**

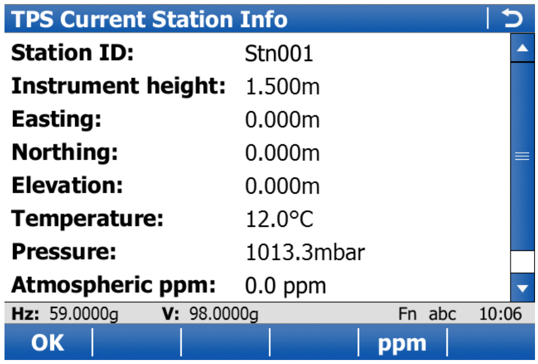
| Field | Option | Description |
|---|---|---|
| **DynDNS status** | | Available on base. |
| | **Error** | DynDNS is active but the IP address could not be updated at the DynDNS service. |
| | **Active** | DynDNS is active and has updated the IP address. |
| | **Off** | DynDNS is inactive. |
| **Last update** | Display only | Available on base. The time and the date of when the IP address was last updated at the DynDNS service by the GS. |
| **Current regis-tered IP** | Display only | Available on base. The last IP address that has been updated for the GS. |

## 22.9 TPS current station info TPS

**Access**

Standard access from the **Instrument status info** menu.

**TPS Current Station Info**




| Key | Description |
|---|---|
| **OK** | To exit the screen. |
| **Coord** | To display other coordinate types. |
| **ppm**/**SF** | To switch between displaying the station scale factor and the station ppm. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Description |
|---|---|
| **Station ID** | Station ID of the current station setup. |
| **Instrument height** | Instrument height of the current station setup. |
| **Easting** | Easting value of the instrument position. |
| **Northing** | Northing value of the instrument position. |
| **Local ellipsoid ht** or **Elevation** | For a selected coordinate system, ellipsoidal height and elevation can be displayed. |
| **Temperature** | Temperature set on the instrument. |
| **Pressure** | Pressure set on the instrument. |
| **Atmospheric ppm** | Atmospheric ppm set on the instrument. |
| **Station ppm** | Ppm of the current station set up. |
| **Station scale** | Scale factor of the current station set up. |

# 23 Instrument - Base settings GPS

## 23.1 Satellite tracking GPS

**Description**

The settings on this screen define which satellite system, satellites and satellite signals are used by the instrument.

☞ Unavailable for GS05/GS06.

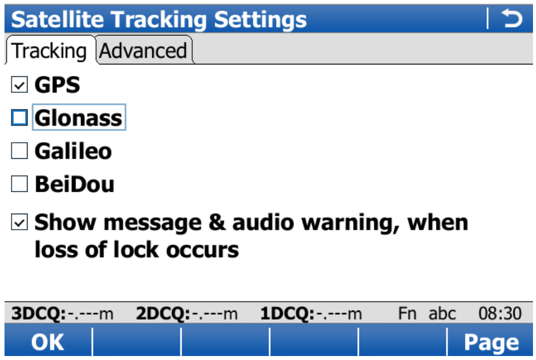
☞ This screen contains the same settings as the RTK Rover **Satellite Tracking Settings** screen. Changes made to the settings here in RTK Base mode, will be reflected in the RTK Rover mode and vice versa.

**Access**

For RTK base:

Select **Main Menu: Instrument\Base settings\Satellite tracking**.

## Satellite Tracking Settings, Tracking page




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

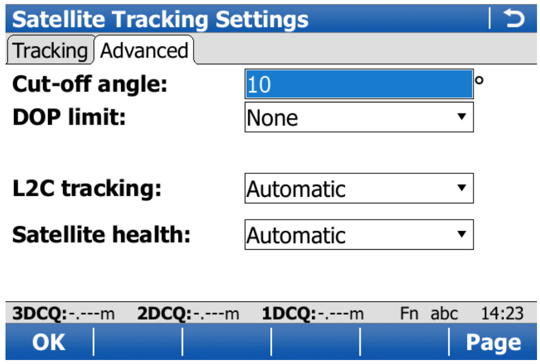
- Any of the GNSS can only be disabled, if at least one other GNSS in enabled.
- At least one GNSS must be enabled.
- **GPS** can never be disabled:
  - On the base station.
  - On the GS14
  - On the GS05/GS06

| Field | Option | Description |
|---|---|---|
| **GPS** | Check box | Defines if the GPS L1, L2 and L5 signals are accepted by the instrument when tracking satellites. For L5, a licence is required. |
| **Glonass** | Check box | Defines if GLONASS L1 and L2 signals are accepted by the instrument when tracking satellites. |
| **Galileo** | Check box | Defines if Galileo E1, E5a, E5b and Alt-BOC signals are accepted by the instrument when tracking satellites. |
| **BeiDou** | Check box | Defines if BeiDou B1 and B2 signals are accepted by the instrument when tracking satellites. |
| **Show message & audio warning, when loss of lock occurs** | Check box | Activates an acoustic warning signal and a message given by the instrument when satellites are lost. |

### Next step

**Page** changes to the **Advanced** page.

**Satellite Tracking Settings, Advanced page**




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| **Hlth..** | Available for **Satellite health: User defined**. To configure the satellites used in the survey. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

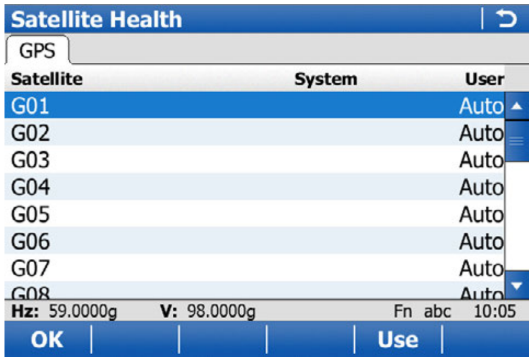
| Field | Option | Description |
|---|---|---|
| **Cut-off angle** | Editable field | Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. Recommended settings:<br>• For real-time: 10°.<br>• For purely post-processing applications: 15°. |
| **DOP limit** | **None**, **GDOP**, **HDOP**, **PDOP** or **VDOP** | If activated, the limit defined in **Limiting value** is checked. GPS positions are unavailable when the limit is exceeded. |
| **Limiting value** | Editable field | The maximum acceptable DOP value.<br>Available unless **DOP limit: None**. |
| **L2C tracking** | **Automatic** | L2 signals which are flagged as unhealthy are not recorded or used for real-time computations. This setting is selected automatically when **GPS** is checked on the **Tracking** page. |
| | **Always track** | L2C signals are always tracked. |
| **Satellite health** | | Sets the satellite tracking behaviour.<br><br>This setting is remembered when the instrument is turned off. It is stored as part of the configuration set. |
| | **Automatic** | Incoming satellite signals are monitored by the instrument. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations. |
| | **User defined** | Satellites must manually be included/excluded from data recording and real-time computations with **Hlth..**. |

**Next step**

**Hlth..** changes to **Satellite Health**.

**Satellite Health**

The screen contains a page for each GNSS system the receiver is configured to track. The explanations given for the softkeys are valid for all pages.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Use** | To change between the options in the column **User**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Option | Description |
|---|---|---|
| **Satellite** | **01** to **50** | The Pseudo Random Noise number (GPS, 1 to 32),), the Slot ID (GLONASS, 1 to 24) or the **S**pace **V**ehicle number (Galileo, 1 to 50, and BeiDou, 1 to 37) of the satellites.<br>There is a prefix G for GPS satellites, a prefix R for GLONASS satellites, a prefix E for Galileo satellites and a prefix C for BeiDou satellites. |
| **System** | **OK**, **N/A** or **Unhealthy** | Information on the satellite health taken from the almanac. **N/A** stands for not available. |
| **User** | **Bad** | Excludes satellite from tracking. |
| | **OK** | Includes satellite in tracking. |
| | **Auto** | Automatic satellite tracking when satellite is healthy. |

### Next steps

| Step | Description |
|---|---|
| 1. | **Page** changes to the **Glonass** page, to the **Galileo** page and to the **BeiDou** page, where GLONASS satellites, Galileo and BeiDou satellites used in the survey can be configured. |
| 2. | **OK** returns to **Satellite Tracking**. |
| 3. | **OK** returns to **Main Menu**. |

## 23.2 Base raw data logging

☞ Unavailable for GS05/GS06.

**Description**

Logged raw observations are used for

- static and kinematic operations. With these operations, raw data is always post-processed in the office. Raw data must therefore be logged on both base and rover instruments.
- real-time operations

  to check the work in the office by post-processing.

  OR

  to fill in gaps when a real-time position could not be calculated in the field, for example, due to problems with the real-time data reception from the reference station or the RTK network provider

Observations must be logged on all instruments which will be used for post-processing.

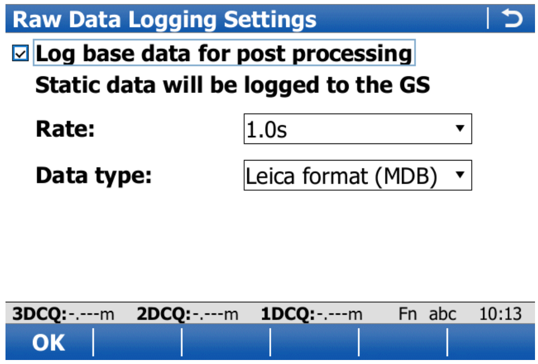
The settings on this screen define the logging of raw observations.

**Access**

For RTK base:

Select **Main Menu: Instrument\Base settings\Base raw data logging**.

## Raw Data Logging Settings




| Key | Description |
|---|---|
| **OK** | To accept changes. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Log base data for post processing** | Check box | Activates raw data logging. |
| **Rate** | From **0.05s** to **300.0s** | Rate at which raw observations are logged.<br><br>Recommendations:<br>• For static operations with long baselines and over long time **Rate: 15.0s** or **Rate: 30.0s**.<br>• For base stations for post-processed and real-time kinematic rovers, **Rate** at the base should be the same rate as at the rover. |
| **Data type** | Selectable list | Data can be logged in the Leica proprietary MDB format or in RINEX. |

# 24 Instrument - TPS camera settings TS CS

☞ For information on camera and images refer to "34 Camera & Imaging".

# 25 User - Work settings

## 25.1 ID templates

### 25.1.1 Accessing ID Template Configuration

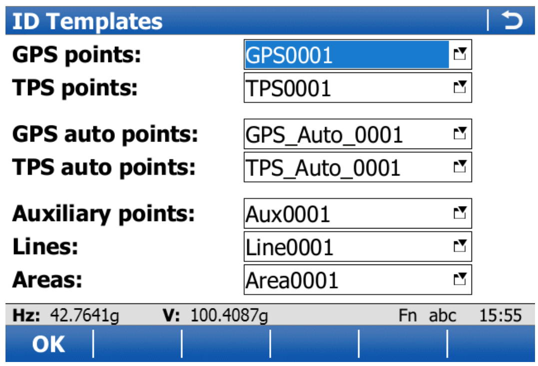
**Description**

ID templates are predefined templates for point, line or area numbers. ID templates save having to type in the ID for each object. They are useful when many points are collected quickly, for example in post-processed and real-time kinematic operations.
The ID templates that are selected to be used suggest IDs for **Point ID**, **Line ID** and **Area ID** when points, lines and areas are to be surveyed.

**Access**

Select **Main Menu: User\Work settings\ID templates**.

**ID Templates**



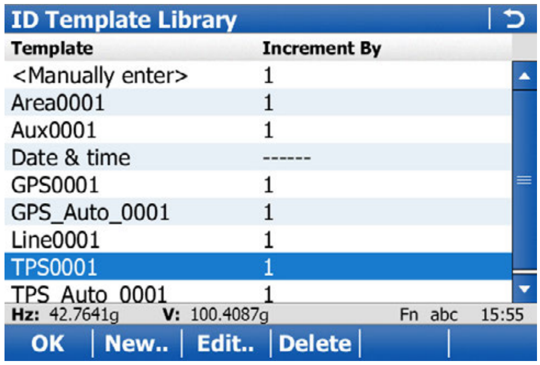

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. The currently active working style is automatically updated, to include the selected ID template. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **GPS points** GPS | Selectable list | Sets the ID templates for manually occupied GPS points. |
| **GPS auto points** GPS | Selectable list | Sets the ID templates for GPS auto points. These points are automatically recorded at a specific rate. |
| **TPS points** TPS | Selectable list | Sets the ID templates for manually occupied TPS points. |
| **TPS auto points** TPS | Selectable list | Sets the ID templates for TPS auto points. These points are automatically recorded at a specific rate. |
| **Auxiliary points** | Selectable list | Sets the ID templates for auxiliary points. These points are used when trying to find a stakeout point. |
| **Lines** | Selectable list | Sets the ID templates for lines. |
| **Areas** | Selectable list | Sets the ID templates for areas. |

**Next step**
ENTER to open a selectable list and to access **ID Template Library**.

## ID Template Library




| Key | Description |
|---|---|
| **OK** | To select the highlighted template. |
| **New..** | To create a new ID template. |
| **Edit..** | To edit the highlighted ID template. |
| **Delete** | To delete the highlighted ID template. It does not matter if the ID template is being used in a working style. The ID template will be rebuilt when that working style becomes active. |
| Fn **Default** | To recall deleted default ID templates. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Description |
|---|---|
| **Template** | The name of the ID template and the format of the ID object. |
| **Increment** | The amount by which the point ID is incremented. |

### Default ID templates

Some ID templates are implemented by default.

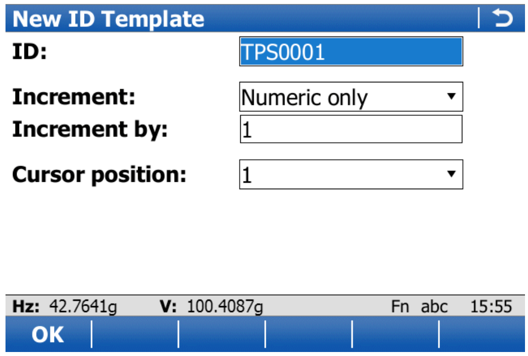
| Default ID template | Description |
|---|---|
| **<Manually enter>** | The last point ID during a survey will be displayed. This ID is automatically incremented if it contains numerical characters. If this ID is overwritten, the auto increment starts from the new ID. The automatic incrementation can be turned off when editing this ID template. |
| **Area0001** | Suggested as ID for areas in default working styles. This ID is automatically incremented. |
| **Aux0001** | Suggested as ID for auxiliary points in default working styles. These points are used when trying to find a stakeout point. This ID is automatically incremented. |
| **GPS0001** | Suggested as ID for GPS measured points in default working styles. This ID is automatically incremented. |
| **GPS_Auto_0001** | Suggested as ID for GPS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented. |
| **Line0001** | Suggested as ID for lines in default working styles. This ID is automatically incremented. |
| **TPS0001** | Suggested as ID for TPS measured points in default working styles. This ID is automatically incremented. |
| **TPS_Auto_0001** | Suggested as ID for TPS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented. |
| **Date & time** | The current local time and date is the ID. |

## 25.1.2 Creating/Editing an ID Template

**Access**

In **ID Template Library**, highlight an ID template. A copy of this ID template is taken for further configurations. **New...**

**New ID Template/Edit ID Template**




| Key | Description |
|---|---|
| **OK** | To store the new ID template into the ID template library. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **ID** | Editable field | The name of the ID template and the format of the ID object. Any characters including spaces are allowed. Leading spaces are not accepted. |
| **Increment** | Selectable list | IDs are incremented numerically or alphanumerically. |
| **Increment by** | Editable field | The amount by which the point ID is incremented. |
| **Cursor position** | Selectable list | The character position at which the cursor is placed when ENTER is pressed in **Point ID**, **Line ID** or **Area ID** when surveying points. **Last Character** means that the cursor is placed immediately to the right of the last character. |

**Examples for incrementation**

**For Increment: Numeric only**

The rightmost numeric part is incremented within the point ID.

| ID | Increment by | Next point ID | Notes |
|---|---|---|---|
| Point994 | 5 | Point999<br>Point1004<br>... | - |
| 994point | 5 | 999point<br>1004point<br>... | - |
| 123point123 | -10 | 123point113 | Numbers on the right are incremented. Negative increments allowed. |
| Point11 | -6 | Point5<br>Point-1<br>Point-7<br>Point-13<br>... | - |
| Abcdefghijklmn94 | 5 | Abcdefghijklmno99<br>Point ID increment fail | Incrementation fails if next increment will result in more than 16 characters. |
| Abcdefghijklmno9 | -5 | Abcdefghijklmnop4<br>Point ID increment fail | Negative incrementing fails if next increment requires negative sign and will result in more than 16 characters. |

**For Increment: Alphanumeric**

The rightmost character within the point ID is incremented regardless of whether that character is numeric or alphanumeric.

| ID | Increment by | Next point ID | Notes |
|---|---|---|---|
| Point994 | 5 | Point999<br>Point99E<br>Point99J<br>... | - |
| 994point | 5 | 994poiny<br>Point ID increment fail | Lower case alpha characters increment until z is reached. Then a new point ID must be entered. |
| Abcdef | -5 | Abcdea<br>AbcdeV<br>...<br>AbcdeB<br>Point ID increment fail | Lower case alpha characters decrement from lower to upper case until A is reached. Then a new point ID must be entered. |
| ABCDEB | 5 | ABCDEG<br>ABCDEL<br>...<br>Abcdez<br>Point ID increment fail | Upper case alpha characters increment from upper to lower case until z is reached. Then a new point ID must be entered. |

## 25.2 Coding & linework

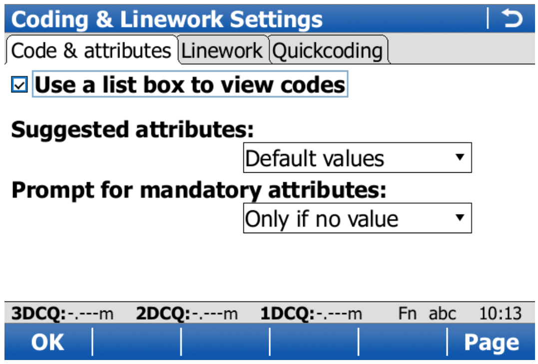
**Description**

The settings on this screen define the method of coding. Refer to "26 Coding" for a complete description of coding.

**Access**

Select **Main Menu: User\Work settings\Coding & linework**.

**Coding & linework settings, Code & attributes page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use a list box to view codes** | Check box | If checked, codes stored within the job codelist can be selected from a selectable list to code points, lines and areas. Otherwise, each code must be entered manually. |
| **Suggested attributes** | | Determines the attribute values displayed under certain circumstances. This setting is applicable to both the storing and displaying of attribute values. |
| | **Default values** | When available, the default attribute values, as stored in the job, are displayed and stored. |
| | **Last used** | When available, the last used attribute values as stored in the job are displayed and stored. |
| **Prompt for mandatory attributes** | **Always prompt** | A screen to enter mandatory attributes will always appear when codes being stored have one or more attributes of attribute type mandatory. Attributes of attribute type mandatory or fixed can only be created in LGO. |
| | **Only if no value** | A screen to enter mandatory attributes will only appear when codes being stored have one or more attributes of attribute type mandatory, without an attribute value. Attributes of attribute type mandatory must always be created in LGO. |
| | **Code change only** | A screen to type in mandatory attributes will only appear when a new code with a mandatory attribute was selected. |

**Next step**

**Page** changes to the **Linework** page.

**Coding & linework settings, Linework page**

The flags for Linework are defined on this screen. A flag

- is stored as a property of a point.
- can be exported with a format file.
- is different to a code.

The flags defined on this screen are linked to the options available for **Linework** in a survey screen page of an application. The selection for **Linework** in a survey screen page determines the flag stored with a point. The availability of **Linework** in a survey screen page is configured in **My Survey Screen Settings**. Refer to "27 Linework" for information on Linework.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Automatically create lines & areas when coding** | Check box | If checked, lines and areas can be automatically created and opened using codes. |
| **Use a stringing attribute** | Check box | Available if **Automatically create lines & areas when coding** is checked.<br>If checked, surveyed points that have the same code and attribute value for the **Stringing attribute** are strung together on one line. |
| **Attribute** | Selectable list | Available if **Use a stringing attribute** is checked.<br>The attribute value used to determine which surveyed points are strung together on one line. |
| **Begin line** | Editable field | Opens a new line when the next point is stored. Any lines which are currently open are closed. The point can be stored with a point code. |
| **3pt curve** | Editable field | Stores the linework flag for a curve through the next three measured points and continues a line/area. |
| **Re-open last line** | Editable field | Opens the last used line again. |
| **End line** | Editable field | Closes all open lines. |
| **Cont line/area** | Editable field | Indicates a line/area is open. |
| **Start spline** | Editable field | Stores the linework flag for beginning a spline and continues any open line/area. |
| **End spline** | Editable field | Stores the linework flag to stop a spline. |
| **Cont spline** | Editable field | Indicates a line/area is open with spline line type. |
| **Begin area** | Editable field | Opens a new area when the next point is stored. Any areas which are currently open are closed. The point can be stored with a point code. |
| **Re-open last area** | Editable field | Opens the last used area again. |
| **Close area** | Editable field | Closes all open areas. |

### Next step

**Page** changes to the **Quickcoding** page.

**Coding & linework settings, Quickcoding page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Quickcoding** | **Never** | Prevents the use of quick coding completely. |
| | **On** | Allows the use of quick coding and activates it. |
| | **Off** | Allows the use of quick coding, but keeps it deactivated. |
| **Digits to use** | **1**, **2** or **3** | Sets the mostly used number of digits for the quick code. Quick codes with fewer digits can still be used. While typing a quick code during a survey, using ENTER after typing one or two digits of the quick code indicates the end of the input. |
| **Store free code** | **After pt is stored** or **Before pt is stored** | Determines if a free code measured with a quick code is stored before or after the point. |

### Next step

**Page** changes to another page on this screen.

## 25.3 My Survey Screen

**Description**

Display settings define the parameters shown on a page on the survey screen.

Four survey screen pages are definable.

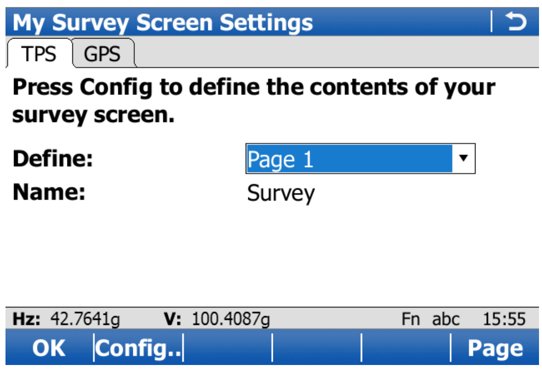
**Page 1**: Always shown on the survey screen.
**Page 2**: Can be shown or hidden on the survey screen.
**Page 3**: Can be shown or hidden on the survey screen.
**Page 4**: Never shown on the survey screen. Reserved for applications.

The settings on this screen define the layout of the four survey screen pages.

**Access**

Select **Main Menu: User\Work settings\My Survey Screen**.

**My Survey Screen Settings, TPS and GPS page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Config..** | To configure the selected survey screen page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

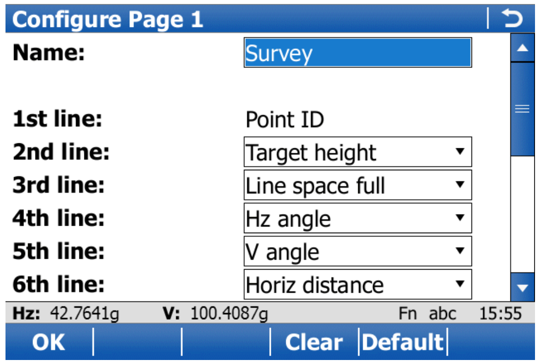
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Define** | **Page 1, 2, 3** or **4** | Selected survey screen page. |
| **Show within survey** | Check box | Indicates if the survey screen page is shown or hidden as a page in **Survey**. |

**Next step**

Highlight the survey screen page and **Config..** to access **Configure Page**.

## Configure Page




| Key | Description |
|---|---|
| **OK** | To accept changes and to return to previous screen. |
| **Clear** | To set all fields to **Line space full**. |
| **Default** | To recall the default settings. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | The name of the page is shown as page name in **Survey**. |
| **Show in the Survey application** | Check box | Shows or hides the page as a page in **Survey**. |
| **1st line** | Display only | Fixed to **Point ID**. |
| **2nd line** to **16th line** | | For each line, one of the following options can be selected. |
| | **Angle right** TPS | Displays the horizontal angle difference between the backsight point and the current telescope position. |
| | **% completed** GPS | Display only field for the percentage of the time for which the point has been occupied based on the setting for **Stop criteria** in screen **Quality Control**. Appears in the page during the point occupation if **Quality Control** is checked. |
| | **Annotation 1** to **Annotation 4** | Editable field for comments to be stored with the point. |
| | **Antenna height** GPS | Input field for antenna height for static observations. |
| | **Attrib (free) 01** to **Attrib (free) 20** | Display only field for attributes for free codes. |
| | **Attrib 01** to **Attrib 20** | Editable field for attributes for codes. |
| | **Target aiming** TPS | Unavailable for SmartStation. Select automation type. |
| | **Avg max #distances** TPS | Input field for maximum number of distance measurements in the averaging EDM mode. |
| | **Azimuth** TPS | Display only field for the azimuth. |

| Field | Option | Description |
|---|---|---|
| | **Backsight pt ID** TPS | Display only field for the point ID of the backsight point. |
| | **Code** | Editable field for codes. |
| | **Code (free)** | Editable field for free codes. |
| | **Code desc (free)** | Display only field for the description of free codes. |
| | **Code information** | Editable field for additional information relating to the code, such as instructions to the CAD package to start a line and string number and curve information. |
| | **Description** | Display only field for the description of codes. |
| | **Easting** TPS | Display only field for Easting coordinate of measured point. |
| | **GDOP** GPS | Display only field for the current GDOP of the computed position. |
| | **HDOP** GPS | Display only field for the current HDOP of the computed position. |
| | **Elevation** TPS | Display only field for the height coordinate of the measured point. |
| | **Height difference** TPS | Display only field for the height difference between station and reflector. |
| | **Horiz distance** TPS | Display only field for horizontal distance. |
| | **Humidity** GPS | Editable field for relative humidity to be stored with point. |
| | **Hz angle** TPS | Display only field for the horizontal angle. |
| | **Instrument height** TPS | Display only field for the instrument height. |
| | **Line space full** | Insert full line space. |
| | **Line space half** | Insert half line space. |
| | **Linework** | Selectable list with option for flagging a line/area. |
| | **Local ellipsoid ht** GPS | Display only field for the elevation of the current GNSS position. |
| | **Measure mode** TPS | Select EDM measurement mode. |
| | **Measure** TPS | Select EDM type. |
| | **Moving antenna ht** GPS | Input field for antenna height for moving observations. |
| | **Msd PP obs** GPS | Display only field for the number of static observations recorded over the period of point occupation. Appears in the page when recording of static observations is configured. |
| | **Northing** TPS | Display only field for Northing coordinate of measured point. |
| | **Number of dists** TPS | Display only field for number of averaged distances measured with EDM mode averaging. |

| Field | Option | Description |
|---|---|---|
| | **Offset left/right** TPS | Input field for horizontal distance offset for measured point, perpendicular to the line of sight. |
| | **Offset height** TPS | Input field for height offset for measured point. |
| | **Offset in/out** TPS | Input field for horizontal distance offset, in the direction of line of sight. |
| | **Offset mode** TPS | Select offset mode. |
| | **PDOP** GPS | Display only field for the current PDOP of the computed position. |
| | **PPM atmos** TPS | Display only field for atmospheric ppm. |
| | **PPM geometric** TPS | Display only field for geometric ppm value. |
| | **PPM total** TPS | Display only field for the total ppm value. |
| | **Point ID** | Editable field for the point ID. |
| | **Pressure** GPS | Editable field for atmospheric pressure. |
| | **Prism constant** TPS | Display only field for additive constant of currently selected reflector. |
| | **Quality 1D** GPS | Display only field for the current height coordinate quality of computed position. |
| | **Quality 2D** GPS | Display only field for the current 2D coordinate quality of computed position. |
| | **Quality 3D** GPS | Display only field for the current 3D coordinate quality of computed position. |
| | **RTK positions** GPS | Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover configurations. |
| | **SD (last recorded)** TPS | Display only field for the last recorded distance. |
| | **Slope distance** TPS | Display only field for measured slope distance. |
| | **Station ID** TPS | Display only field for current station ID. |
| | **Station easting** TPS | Display only field for current station Easting coordinates. |
| | **Station height** TPS | Display only field for current station height coordinates. |
| | **Station northing** TPS | Display only field for current station Northing coordinates. |
| | **Std deviation** TPS | Display only field of standard deviation in millimetres of averaged distances. |
| | **Target** TPS | Select a prism. |
| | **Target height** TPS | Input field for prism height. |
| | **Temp dry** GPS | Editable field for dry temperature to be stored with point. |

| Field | Option | Description |
|---|---|---|
| | **Temp wet** GPS | Editable field for wet temperature to be stored with point. |
| | **Time at point** GPS | Display only field for the time from when the point is occupied until point occupation is stopped. Appears in the page during the point occupation. |
| | **Type** | Display only field for the type of code, for example point code, line code or area code. |
| | **V angle** TPS | Display only field for vertical angle. |
| | **V angle display** TPS | Select vertical angle display. |
| | **VDOP** GPS | Display only field for the current VDOP of the computed position. |
| | **WGS84 ellipsoid ht** GPS | Display only field for the current GNSS position. |
| | **WGS84 latitude** GPS | Display only field for the current GNSS position. |
| | **WGS84 longitude** GPS | Display only field for the current GNSS position. |

## 25.4 Hot keys & favourites

**Description**

The settings on this screen assign functions, screens or applications to each of the first and second level of hot keys, including the user definable Smartkey **F13**, and the favourites key.

**Access**

Select **Main Menu: User\Work settings\Hot keys & favourites**.

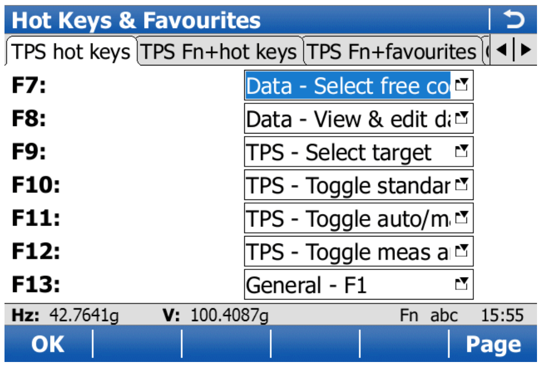
OR

Hold a hot key down for two seconds. This action is also possible after pressing Fn.

**Hot Keys & Favourites, GPS Hot Keys/TPS Hot Keys page**

To configure the first level of hot keys.

This page is only available for CS15 models. CS10 models do not have hot keys.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **F7** to **F12** | Selectable list | All functions, screens or applications which can be assigned to the particular key. |
| **F13** | Selectable list | Available for MS50/TS50/TM50. All functions, screens or application programs which can be assigned to the user definable Smartkey. |

**Next step**

**Page** changes to the **GPS Fn+hot keys/TPS Fn+hot keys** page.

**Hot Keys & Favourites, GPS Fn+hot keys/TPS Fn+hot keys page**

To configure the second level of hot keys.

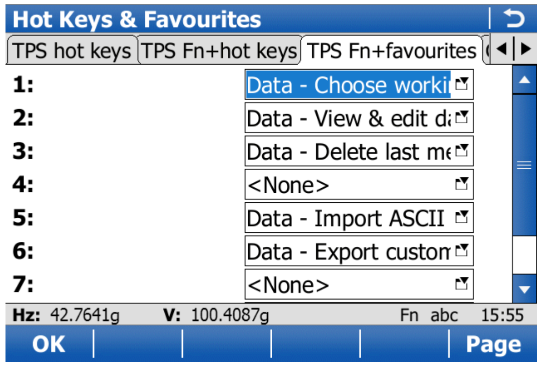
This page is only available for CS15 models. CS10 models do not have hot keys.

The functionality on this page is identical to the one on the **GPS Hot Keys/TPS Hot Keys** page.

**Next step**

**Page** changes to the **GPS Fn+favourites/TPS Fn+favourites** page.

**Hot Keys & Favourites, GPS Fn+favourites/TPS Fn+favourites page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **1** to **9** | Selectable list | All functions, screens or applications which can be assigned to the individual lines in the user-defined menu. |

### Next step

**Page** changes to the first page on this screen.

## 25.5 Prompt before storing

| | |
|---|---|
| **Access** | Select **Main Menu: User\Work settings\Prompt before storing**. |
| **Prompt Before Storing, GPS and TPS page** | Check a box if you want to be asked for input/selection when storing a point with **Store**. |
| **Enter the Following** | This screen is displayed when prompting is configured in **Prompt Before Storing** and when storing a point with **Store**.<br>☞ Only the fields relating to the ticked check boxes in **Prompt Before Storing** are shown. |

# 26 Coding

## 26.1 Overview

**Description**

A code is a description which can be stored by itself or with a point, line, or area. SmartWorx Viva coding is flexible with what types of codes can be stored and also how they are entered. Thematical and/or free codes can be stored to the system by;

- selecting codes from a codelist,
- entering a quick code combination,
- directly typing in the code, or
- selecting the code from a SmartCodes screen.

Quick coding and SmartCodes are both quick ways for a code to be selected, a point to be measured, and both code and point to be stored.

For coding, points, lines and areas have the same behaviour. In this chapter, the word object is used as a generic term for points, lines and areas.

**Coding methods**

| Coding method | Characteristic | Description |
|---|---|---|
| **Thematical** | Use | To store a description together with an object inside an application or in **Main Menu: Jobs & Data\ View & edit data**. |
| | Selection of the codes | • For thematical coding with codelist:<br>On a configured survey screen page, codes are selected from the job codelist in a selectable list. It is also possible to add thematical codes from the codelist to a SmartCodes screen for quick selection, or to select thematical codes using the quick coding method. The job codelist must contain thematical codes.<br>• For thematical coding without codelist:<br>On a configured survey screen page, codes are manually typed in. |
| | Recording of the codes | Together with the objects. |
| **Free** | Use | To store a description independent of an object at any time. A free code can be used to store a description related to an object, or additional descriptions such as the job name or temperature. |
| | Selection of the codes | • For free coding using a codelist:<br>Pressing the configured hot key opens a selectable list with the free codes of the job codelist. It is also possible to select free codes using the quick coding method. The job codelist must contain free codes.<br>• For free coding with direct input:<br>Pressing the configured hot key opens a screen for alphanumeric input. |

| Coding method | Characteristic | Description |
|---|---|---|
| | Recording of the codes | Stored as time-related information. A time stamp is stored with each free code. Free codes selected using quick coding can be configured to be stored before or after the object. |
| **Quick** | Use | Quick coding is the storing of an object plus a thematical or free code using a minimum number of keystrokes. |
| | Selection of the codes | Shortcuts must be assigned to codes in the job codelist. **Quickcoding: On** must be set in **Coding & linework settings**, **Quickcoding** page. Typing the shortcut searches for the assigned code. Point measurement begins. |
| | Recording of the codes | • For thematical codes:<br>Together with the objects. With **Automatically stop point measurement** and **Automatically store point** both checked in **Quality control**, the points and codes are immediately stored.<br>• For free codes:<br>Stored as time-related information before or after the points. A time stamp is stored with each free code. |
| | ☞ | Quick codes must be created in LGO. |
| | ☞ | Characters that can be assigned to quick codes are:<br>• 0 to 9<br>• A to Z<br>• a to z |

**Configure coding**

Refer to "25.2 Coding & linework" for information on configuring coding.

# 26.2 Thematical Coding

## 26.2.1 Thematical Coding with Codelist

**Requirements**

- The job codelist contains thematical codes for points, lines and/or areas.
- **Use a list box to view codes** is checked in **Coding & Linework Settings**.
- A survey screen page with an editable field for codes must be configured.

**Access**

Open the selectable list for **Code** in a survey screen page of an application.

OR

Open the selectable list for a **Code**/**Point code** in **New Point**, **Code** page. The procedure is similar for lines and areas.

OR

Open the selectable list for **Point code** in **Edit Point:**, **Code** page. The procedure is similar for lines and areas.

OR

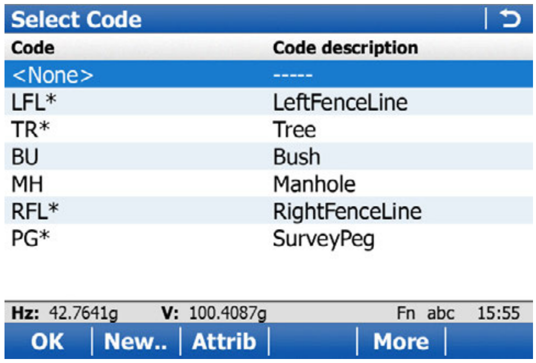
Open the selectable list for **Code (auto)** in **Survey**, **Auto** page, if configured.

**Select Code**

**Select Code** is shown as an example.
Depending on the setting for **Automatically create lines & areas when coding** in **Coding & Linework Settings**, **Linework** page, either;

- all point, line and area codes are available for selection, or
- only those point codes from the job codelist, which belong to an active code group, are available for selection.

Codes marked with * have attributes attached.




| Key | Description |
|---|---|
| **OK** | To accept changes and to return to the screen from where this screen was accessed. |
| **New..** | To create a new code. |
| **Attrib** | Available unless creating/editing a point/line/area. To type in attribute values for the selected code and/or add new attributes for the selected code. |
| **Last** | Available if a code has been previously used in the working job. To select from a list of last used codes. The codes are sorted by time with the most recently used code at the top of the list. |
| **More** | To display information about the code description, the code group, the code type and the quick code if codes with quick codes exist in the job. |
| Fn **Group** | To view, create, delete, activate and deactivate code groups. Refer to "7.5 Managing Code Groups". |
| Fn **Sort** | To sort codes by code name, code description, quick code, in the order they were added to the codelist, or the last used. |
| Fn **Quit** | To exit the screen. |

**Next step**

Highlight the desired code.

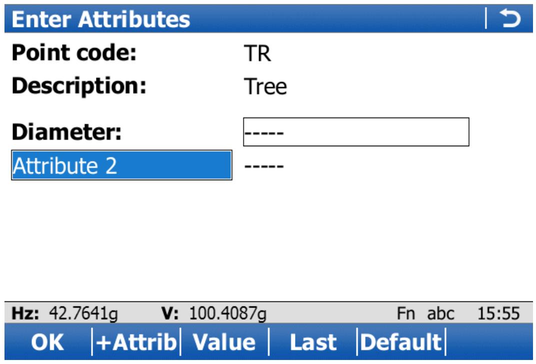
- If a point code is selected then any open line/area is closed. The measured point is stored with the selected code independently of any line/area.
- If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The measured point is assigned to that line. The line stays open until it is closed manually or another line code is selected.
- If an area code is selected then the behaviour is as for lines.

**Attrib** to access **Enter Attributes**.

**Enter Attributes**

If configured for the selected code, editable fields for attribute values are available. Any preconfigured attribute rules, for example, integer numbers only, a set range, or a selectable list, control what values can be entered. Type in the attribute values. Attribute values for attributes of type

- normal can be edited.
- fixed cannot be edited.




| Key | Description |
|---|---|
| **OK** | To return to the screen from where this screen was accessed. |
| **+Attrib** | To add a new attribute of type normal and of value type text. Up to twenty attributes can be added. Attributes of type mandatory or fixed and of value type real or integer must be created in LGO. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and the attribute value to be used as the default attribute value can be typed in. |
| **Last** | To recall the last used attribute values for the selected code. |
| **Default** | To recall the default attribute values for the selected code. |
| Fn **Quit** | To exit the screen. |

**Next step**

Press **OK**. The code and any associated attribute values are stored when the point is stored. If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should they not be identical, a screen opens where the code or attribute mismatch can be corrected.

## 26.2.2 Thematical Coding without Codelist

**Requirements**

- **Use a list box to view codes** is NOT checked in **Coding & Linework Settings**.
- A survey screen page with an editable field for codes must be configured.
- A survey screen page with a selectable list for code types must be configured.

**Access**

A thematical code is typed in the field
**Code** in a survey screen page of an application.
OR
**Code**/**Point code** in **New Point**, **Code** page. The procedure is similar for lines and areas.
OR
**Point code** in **Edit Point:**, **Code** page. The procedure is similar for lines and areas.
OR
in the field **Code (auto)** in **Survey**, **Auto** page, if configured.

**Survey, Code page**

Type in a code and attribute values. Up to eight attributes can be added. This setting is configured in the survey screen page.

- If a point code is selected then any open line/area is closed. The measured point is stored with the selected code independently of any line/area.
- If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The measured point is assigned to that line. The line stays open until it is closed manually or another line code is selected.
- If an area code is selected then the behaviour is as for lines.

**Next step**
Press **Meas**.

## 26.3 Free Coding

### 26.3.1 Free Coding Using a Codelist

**Requirements**

- The job codelist contains free codes.
- A hot key is configured to access the screen **Enter Free Code & Attributes** or the favourites menu is configured to display the option **Select free code from list**.

**Access**

Press a hot key configured to access the screen **Enter Free Code & Attributes**. Refer to "1.1 Hot Keys" for information on hot keys.

OR

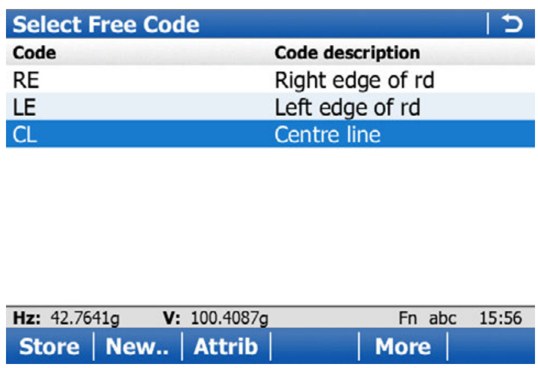
For GPS mode, press and select **Select free code from list** to access the screen **Select Free Code**.

For TPS mode, press Fn and select **Select free code from list** to access the screen **Select Free Code**.

Refer to "1.2 Favourites Key" for information on the key.

**Select Free Code**

All free codes from the job codelist which belong to an active code group, are available for selection. Free codes marked with * have attributes attached.




| Key | Description |
|---|---|
| **Store** | To store the free code and any associated attribute values and to return to the screen from where this screen was accessed. |
| **New..** | To create a new code. |
| **Attrib** | To type in attribute values and/or add new attributes for the selected free code. Refer to "26.2.1 Thematical Coding with Codelist". |
| **Last** | Available if a free code has been previously used in the working job. To select from a list of last used free codes. The free codes are sorted by time with the most recently used code at the top of the list. |
| **More** | To display information about the code description, the code group and the quick code if codes with quick codes exist in the job. |
| Fn **Group** | To view, create, delete, activate and deactivate code groups. Refer to "7.5 Managing Code Groups". |
| Fn **Sort** | To sort codes by code name, code description, quick code or the last used. |
| Fn **Quit** | To exit the screen. |

## 26.3.2 Free Coding with Direct Input

**Requirements**

A hot key is configured to access the screen **Enter Free Code & Attributes** or the favourites menu is configured to display the option **Enter free code**.

**Access**

Press a hot key configured to access the screen **Enter Free Code & Attributes**. Refer to "1.1 Hot Keys" for information on hot keys.

OR

For GPS mode, press and select **Enter free code** to access the screen **Enter Free Code & Attributes**.

For TPS mode, press Fn and select **Enter free code** to access the screen **Enter Free Code & Attributes**.

Refer to "1.2 Favourites Key" for information on the key.

**Enter Free Code & Attributes**

Type in a code and attribute values. As soon as a free code is typed in, a codelist is created within the job. Up to eight attributes can be added. Refer to "26.3.1 Free Coding Using a Codelist" for a description of keys.

**Next step**

Press **Store**.

## 26.4 Quick Coding

**Requirements**

- The job codelist contains quick codes for points, lines and/or areas.
- According to the user requirements, set **Store free code: Before pt is stored** or **Store free code: After pt is stored** in **Coding & Linework Settings**, **Quickcoding**.

**Activate quick coding**

The current setting for **Quickcoding** in the **Quickcoding** page determines how quick coding is activated. Quick coding can be activated at any time.

- For **Quickcoding: On**, Quick coding is active and can be used.
- For **Quickcoding: Off**, use a hot key, the favourites menu or tap the quick coding icon.
- For **Quickcoding: Never**, change the setting manually.

**Performing Quick coding**

A screen must be active where points can be measured.
Type in the one, two or three digits of the quick code. The current setting for **Digits to use** in **Coding & Linework Settings**, **Quickcoding** page determines by how many keystrokes quick coding is executed.
Press ENTER to execute quick coding after less than the configured keystrokes. This action is possible after one keystroke for **Digits to use: 2** and one or two keystrokes for **Digits to use: 3**.
Press ESC to clear digits from the entry.
Only mandatory attribute values can be entered. For non-mandatory attributes, either the default or the last used attribute values are stored, depending on the setting for **Suggested attributes** in **Coding & Linework Settings**, **Code & attributes** page.

For point codes:

- The point code assigned to the quick code is searched for in the job codelist and point measurement begins.
- The point code and any associated attribute values are stored with the point.
- If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should they not be identical, a screen opens where the code or attribute mismatch can be corrected.

For free codes:

- The free code assigned to the quick code is searched for in the job codelist and point measurement begins.
- The free code, associated attribute values and time related information are stored. The setting for **Store free code** in **Coding & Linework Settings**, **Quickcoding** page determines if the free code is stored before or after the point.

For line/area codes:

- The line/area code assigned to the quick code is searched for in the job codelist.
- A new line/area is created and immediately stored with that line/area code and attributes. For the line/area ID, the line/area ID template as defined in **ID Templates** is used.

## 26.5 SmartCodes

### 26.5.1 Overview

**Description**

SmartCodes is a quick way for a code to be selected and a point to be measured. All existing coding, linework, and point measurement functionality is retained.

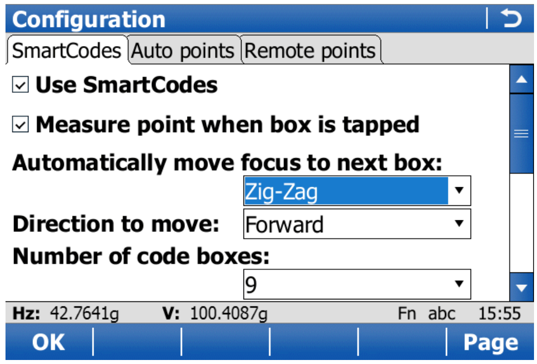
## 26.5.2 Configuring SmartCodes

**Access**

In **Survey** press Fn **Config..** to access **Configuration**.

**Configuration Smart-Codes page**

The settings on this page activate the using of SmartCodes and define the method. All settings in this screen are stored within the currently active working style.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use Smart-Codes** | Check box | If checked, using of SmartCodes is activated. ☞ All other fields on the screen are active and can be edited. |
| **Measure point when box is tapped** | Check box | If checked, when one of the code boxes is tapped in **Survey**, **SmartCodes** page, then the code is selected and the point is measured. |
| **Automatically move focus to next box** | | Method by which subsequent code box is selected after a point is stored. |
| | **Not used** | Nine code boxes are shown in the **Survey**, **Smart-Codes** page, but no automatic movement of the focus takes place. |
| | **Zig-Zag** | Each new code rotation through the block is started at the same end where the previous code rotation finished. |
| | **Same direction** | Each new code rotation through the block is started at the same end where the previous code rotation started. |
| | ☞ | Refer to "60 Survey Cross Section" for an explanation of **Zig-Zag** and **Same direction**. |
| **Direction to move** | | Available for **Automatically move focus to next box: Zig-Zag** and **Automatically move focus to next box: Same direction**. The way of using the code boxes. This setting controls the order in which the code boxes will be rotated through automatically. |
| | **Forward** | The code boxes are used in the same way as defined in **Survey**, **SmartCodes** page. |
| | **Backward** | The code boxes are used in the reverse way as defined in **Survey**, **SmartCodes** page. |
| **Number of code boxes** | From **1** to **9** | Available for **Automatically move focus to next box: Zig-Zag** and **Automatically move focus to next box: Same direction**. Number of code boxes shown in **Survey**, **SmartCodes** page. |
| **Show at bottom of screen** | | Information shown in line 8 of **Survey**, **Smart-Codes** page. |
| | **Not used** | No survey screen page element is shown. |
| | **Point ID** | The identifier for manually measured points. The configured point ID template is used. |
| | **3D CQ** | The current 3D coordinate quality of the computed position. |
| | **2D CQ** | The current 2D coordinate quality of the computed position. |
| | **1D CQ** | The current height coordinate quality of the computed position. |
| | **Linework** | The linework flag to be stored with the point. The options available depend on whether a line/area is currently open. |

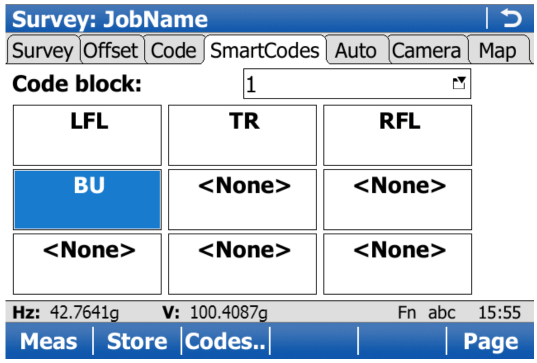
| Field | Option | Description |
|---|---|---|
| | **Antenna height** GPS | The height of the antenna that is being used. Changing the antenna height here does not update the default antenna height as defined in the active working style. |
| | **Target height** TPS | The height of the reflector that is being used. Changing the reflector height here does not update the default reflector height as defined in the active configuration set. |
| | **Hz** TPS | The current horizontal angle of the measured point. |
| | **V** TPS | The current vertical angle of the measured point. |
| | **Horiz distance** TPS | The current horizontal distance of the measured point. |
| | **Slope distance** TPS | The current slope distance of the measured point. |
| | **Height difference** TPS | The current height difference between the station and the measured point. |
| **Automatically create lines & areas when coding** | Check box | If checked, lines and areas can be automatically created and opened using codes. |
| **Use a stringing attribute** | Check box | Available if **Automatically create lines & areas when coding** is checked.<br>If checked, surveyed points that have the same code and attribute value for the **Stringing attribute** are strung together on one line. |
| **Stringing attribute** | Selectable list | Available if **Use a stringing attribute** is checked.<br>The attribute value used to determine which surveyed points are strung together on one line. |
| **Show code description instead of code** | Check box | If checked, the code descripton is shown in the code boxes instead of the code. |

## 26.5.3 Code Block

**Requirements**

- **Use SmartCodes** ticked in **Configuration**, **SmartCodes** page.

**Survey, SmartCodes page**




| Key | Description |
|---|---|
| **Meas** | To start recording positions. |
| **Codes..** | To select a code to be assigned to the highlighted code block. Available when a code box is highlighted. |
| **Page** | To change to another page on this screen. |

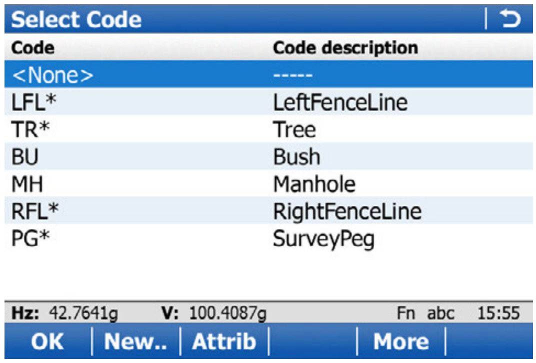
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Code block** | Selectable list | The code block to be used. |
| Code box | - | A measured point is stored with the code assigned to the highlighted code box.<br>When **Stringing attribute** is configured in **Stringing attribute**, **SmartCodes** page, an attribute value can be typed in below the code name of the highlighted code box. The attribute value can also be modified using the softkeys **+** and **-**.<br>For **Measure point when box is tapped** being checked in **Stringing attribute**, **SmartCodes** page, tapping the code box with the supplied stylus automatically starts measuring the point. Selecting the code box by using the arrow keys will not start measuring the point.<br>Lines/areas are automatically opened and closed using SmartCodes, as configured. |
| **Linework** | Selectable list | Available for **Show at bottom of screen**: **Linework**. Select the linework flag to be stored with the point. Then move the focus on the line/area code box. |

**Next step**

Highlight a code block and press **Codes..** to access **Select Code**.

### Select Code




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **New..** | To create a new code. |
| **Attrib** | To type in attribute values for the selected code and/or add new attributes for the selected code. |
| **Last** | Available if a code has been previously used in the working job. To select from a list of last used codes. The codes are sorted by time with the most recently used code at the top of the list. |
| **More** | To display information about the code description, the code group, the code type and the quick code if codes with quick codes exist in the job. |
| Fn **Group** | To view, create, delete, activate and deactivate code groups. Refer to "7.5 Managing Code Groups". |
| Fn **Sort** | To sort codes by code name, code description, quick code, in the order they were added to the codelist, or the last used. |
| Fn **Quit** | To exit the screen. |

### Copying a code block to a new job step-by-step

| Step | Description |
|---|---|
| ☞ | Code blocks are stored in the job. |
| 1. | Select **Main Menu: Jobs & Data\ Job properties**.<br>OR<br>Select **Main Menu: Jobs & Data\Choose working job** or **Choose control job**. **Edit..** to access **Job Properties:**. |
| ☞ | **Codelist**: If codes had been copied from the internal memory codelist, the name of the codelist is displayed. If codes have been typed in, then the name of the job is displayed. |
| 2. | Fn **Export** to copy codes and code blocks from the job to an existing or new codelist. |
| ☞ | Copying code blocks to an existing codelist overwrites the code blocks of the existing codelist. |
| 3. | **OK** and **Store** to save the current job and return to **Main Menu**. |
| 4. | Create a new job and assign the related codelist to the job. |
| ☞ | SmartCodes from the codelist are now available within the new job. |

# 26.6 Code and Attribute Mismatch

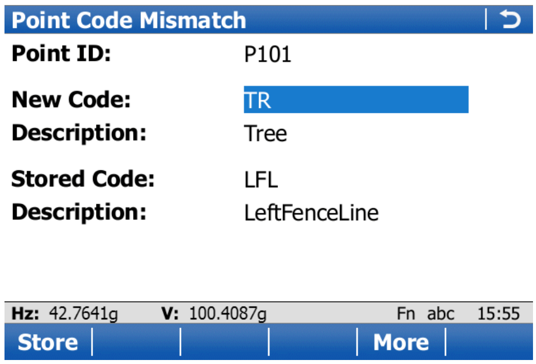
## 26.6.1 Code Mismatch

**Description**

When storing a point with a code, it can happen that a point with the same point ID already exists in the job. If the codes of the new and the existing point do not match, a screen opens where the code can be corrected. One point cannot have different codes.

**Point Code Mismatch**

This screen opens automatically if the codes of the new and the existing point do not match. Highlight the code to be stored with the new point.




| Key | Description |
|---|---|
| **Store** | To store the highlighted code and any associated attributes with the point being stored and to continue with the application or data management. |
| **More** | To display information about the code description, the code group and any attributes associated with the highlighted code. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **New Code** | Display only | The code for the point. |
| **Stored Code** | Display only | The code as stored for the existing point in the job. |

## 26.6.2 Attribute Mismatch

**Description**

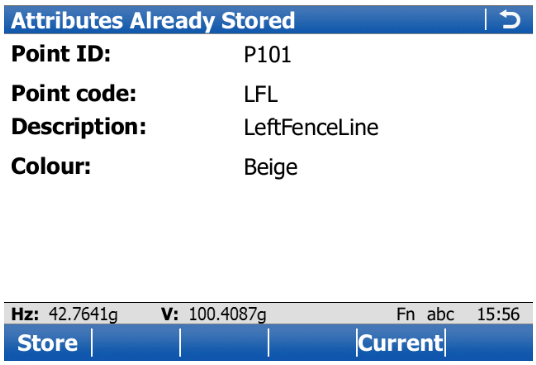
If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should the attributes not be identical, a screen opens where the attribute mismatch can be corrected. One point cannot have different attribute information.

☞ The name of the screen changes with pressing **Current** or **Stored**:

| | |
|---|---|
| Pressing **Current**: | **Attributes Being Stored** |
| Pressing **Stored**: | **Attributes Already Stored** |

**Attributes Already Stored/Attributes Being Stored**

This screen opens automatically if the attribute names and/or values of the new and the existing point do not match.




| Key | Description |
|---|---|
| **Store** | To store the selected attributes with the new/created point and to continue with the application or data management. |
| **Current** or **Stored** | To change between viewing the attribute names and values of the new/created point and those values stored for the existing point in the job. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point code** | Display only | • For **Attributes Already Stored**: The code of the existing point in the job.<br>• For **Attributes Being Stored**: The code of the new point. |
| Attributes | Display only | • For **Attributes Already Stored**: The attributes as stored for the existing point in the job.<br>• For **Attributes Being Stored**: The attributes of the new point. |

## 26.7 Code Information

**Description**

Code information is additional information with up to 40 alphanumeric characters. Code information relates to the code, such as instructions to the CAD package to start a line and string number and curve information.

Code information can be used independently of a code being selected. Code information is stored when the measured point is stored.

**Activating an editable field for code information**

The editable field for code information can be selected to be used in any survey screen mask for GPS and TPS.

To configure a survey screen mask select **Main Menu: User\Work settings\My Survey Screen**. Press **Config..** and select **Code information** for one of the fields.

**Using the code information editable field within applications**

If the use of the **Code information** field is configured to be used in a survey screen mask, then the editable field is shown on that survey screen mask in any application. At any time, text can be typed into the field. This text is remembered and remains displayed after the point is stored.

To recall entered text use the keys **Prev** and **Next** when the **Code information** is highlighted.

**Viewing and editing code information**

To view/edit code information, go to:

- **Data:**, **Points** page. Use **More** until the code information is visible.
- **Edit Point:**, **Code** page.

**Exporting code information**

To export code information select:

- **Main Menu: Jobs & Data\Export & copy data\Export ASCII data.** Press **Config..** to activate the export of code information.
- **Main Menu: Jobs & Data\Export & copy data\Export custom data.** Configure a format file to export code information for entered points/lines/areas, points/lines/areas measured by GPS/TPS, GPS baselines or TPS measurements.

# 27 Linework

## 27.1 Overview

**Description**

Working with lines can be automated. Two ways of working are available. They are listed in this table. The two ways of working can be mixed.

| Linework by | Description |
|---|---|
| **Linework listbox** | The **Auto** page in **Survey** and any survey screen page, can be configured to show a field **Linework** with a selectable list. Any application can be configured to display a survey screen page and therefore have access to this **Linework** field.<br>The selection from the selectable list determines<br>• the action taken for a line/area, for example opening or closing a line.<br>• the linework flag stored with a point.<br>The linework flags<br>• are configured in **Coding & Linework Settings**, **Linework** page.<br>• can be exported with a format file. |
| **Coding** | Point, line or area codes can be selected in many applications.<br>Selecting a point, line or area code closes any open line/area and opens a new line/area.<br>Refer to "26 Coding" for more information. |

☞ The linework flag can be used without thematical coding by using the linework field in the Survey screen page configuration.
The code can be linked to linework if it is configured as a point code to start a line/area, or it is a line or area code.
Quick coding can be used as described in "26.4 Quick Coding".

## 27.2 Performing Linework using the Linework Field

☞ The Survey application is used here to explain Linework.

**Requirements**

- A survey screen page with a selectable list for Linework must be configured.
- The linework flags must be defined in **Coding & Linework Settings**, **Linework** page.
- GPS The rover menu must be used.

**Access**

Select **Main Menu: Go to Work!\Survey**.

**Linework using the linework field step-by-step**

| Step | Description |
|---|---|
| 1. | Go to the point to be measured. |
| 2. | Select the linework flag to be stored with the point. |
| 3. | Measure the point. |
| ☞ | Depending on the option selected for **Linework**, a line/area is opened, closed or reopened. |
| 4. | Repeat steps 1. to 5. until all points for the linework are measured. |
| 5. | Fn **Quit** to exit the Survey application. |
| 6. | Use a format file to export the points including the linework flags. |

**Description**

Linework and coding can be combined.
This combination can be useful, because coding, assigning linework flags and opening/closing lines/areas can all be done with one point observation.

Combining Linework and coding can only be configured if thematical point codes or if thematical point, line and area codes are available for selection. Thematical coding can be done with or without codelists.

☞ Linework and coding can also be combined using SmartCodes. Refer to "26.5 SmartCodes".

**Configuration options**

The configuration for the types of codes available and the configuration for coding with/without a codelist both have an influence on the following:

- The required configuration of a survey screen page.
- The behaviour of the fields configured for the survey screen page.
- The behaviour of the software.

The possible configurations and their influence on the coding related fields are shown in this table:

| **Configuration selected in the Coding & Linework Settings screen** | **Behaviour of the coding related fields depending on the configuration selected.** | | |
|---|---|---|---|
| | **Code** | **Code type** | **Linework** |
| **Use a list box to view codes** ☑<br>**Automatically create lines & areas when coding** ☑ | Selectable list | Display only | Selectable list |
| **Use a list box to view codes** ☑<br>**Automatically create lines & areas when coding** ☐ | Selectable list | Display only | Selectable list |
| **Use a list box to view codes** ☐<br>**Automatically create lines & areas when coding** ☑ | Editable field | Selectable list | Selectable list |
| **Use a list box to view codes** ☐<br>**Automatically create lines & areas when coding** ☐ | Editable field | Display only | Selectable list |

**Requirements**

- A survey screen page must be configured with
  - a field for **Code**.
  - a selectable list for **Linework**.
  - a selectable list for **Code type** when using point, line and area codes without a codelist (**Use a list box to view codes** is unchecked).

    This field is not required if only point codes are used, or when working with a codelist (**Use a list box to view codes** is checked).

- Configure in **Coding & Linework Settings**, **Code & attributes** page
  - **Automatically create lines & areas when coding** checked or not checked.
  - **Use a list box to view codes** checked or not checked.
- In **Coding & Linework Settings**, **Linework** page, define the linework flags.

- GPS The rover menu must be used.

---

The Survey application is used here to explain the combination of Linework and Coding.

---

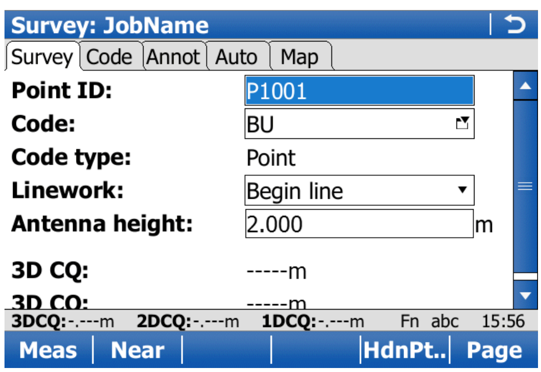
**Access**

Select **Main Menu: Go to Work!\Survey**.

---

**Survey, Survey page**

This example is what a survey screen page configured for Linework and coding looks like.
The most important keys are explained.




| Key | Description |
|---|---|
| **Meas** GPS | To start recording positions. The key changes to **Stop**. |
| **Stop** GPS | To end recording of positions when enough data is collected. The key changes to **Store**. |
| **Store** GPS | To store the point information. The key changes to **Meas**. |
| **Meas** TPS | To measure and store distances and angles. |
| **Stop** TPS | Available if **Measure mode: Continuous** and **Dist** was pressed. Stops the distance measurements. The key changes back to **Meas**. |
| **Dist** TPS | To measure and display distances. Available unless **Measure mode: Continuous** and/or **Log auto points** checked, after the tracking or logging is started. |
| **Store** TPS | To record data. If **Measure mode: Continuous** and/or **Log auto points** checked, records measured point and continues tracking. |

**Linework and Coding step-by-step**

| Step | Field | Description for thematical coding | |
|---|---|---|---|
| | | **Use a list box to view codes checked** | **Use a list box to view codes not checked** |
| 1. | **Code** | Select a code from the selectable list. Depending on the configuration only point codes, or also line and area codes are available for selection. | Type in a code. |
| ☞ | | **<None>** to store a point without code or to perform Linework without coding. | **-----** to store a point without code or to perform Linework without coding. |
| 2. | **Code type** | **Point** is displayed. This field is a display only field. It cannot be changed. | |
| 3. | **Linework** | Select an option for the linework flag to be stored with the point. Refer to "27.2 Performing Linework using the Linework Field" for a description of the options. | |
| ☞ | | Select **-----** to store a point without linework flag or to perform coding without Linework. | |
| 4. | - | GPS Press **Meas**, **Stop** and **Store**.<br>TPS Press **Meas**. | |
| ☞ | -<br>-<br>- | • The point is stored with the selected code.<br>• The point is stored with the selected linework flag.<br>• The choice of linework flags available for **Linework** is updated. | |

# 28 User - Working style wizard

## 28.1 Overview

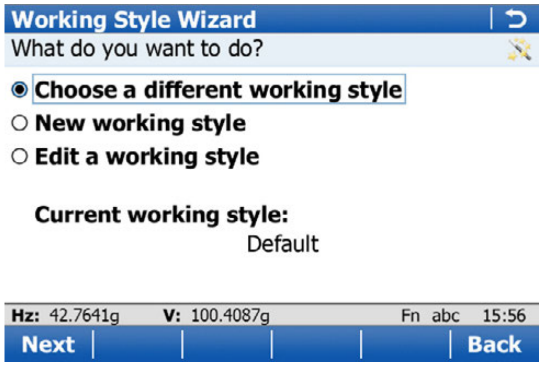
| | |
|---|---|
| **Description** | The software has many configurable parameters and functions which can be set by the user to suit their preferred method of working. These preferred settings can be saved as a Working Style.<br>Using the wizard, all the settings can be defined at once. Alternatively, all screens of this wizard can also be accessed individually. |
| **Default working style** | A default working style exists on the instrument. It uses standard settings for most applications. The default working style can be edited or deleted. It is always possible to restore the default working style by formatting the internal memory. |
| **User defined working styles** | New working styles can be created. The working style wizard assists in editing working styles. |
| **Edit outside the working style wizard** | Parameters and functions can be edited without going through the working style wizard. |

## 28.2 Accessing the Working Style Wizard

**Access**

Select **Main Menu: User\Working style wizard**.

**Working Style Wizard**




| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

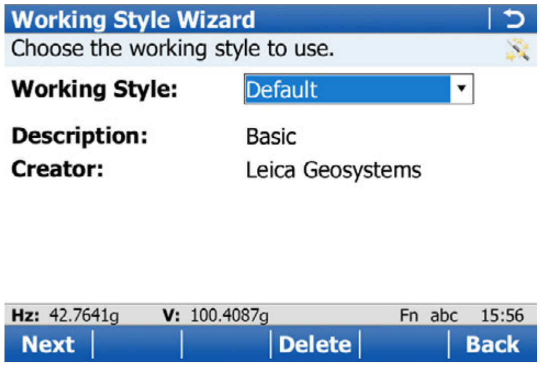
**Next step**

| IF you want to | THEN |
|---|---|
| select a different set of settings | select **Choose a different working style**, press **Next** and continue with "28.3 Choosing a Different Working Style". |
| create a new set of settings | select **New working style**, press **Next** and continue with "28.4 Creating a New Working Style". |
| edit an existing set of settings | select **Edit a working style**, press **Next** and continue with "28.5 Editing a Working Style". |

## 28.3 Choosing a Different Working Style

**Working Style Wizard, Choose the working style to use.**

Select an existing working style from the selectable list.

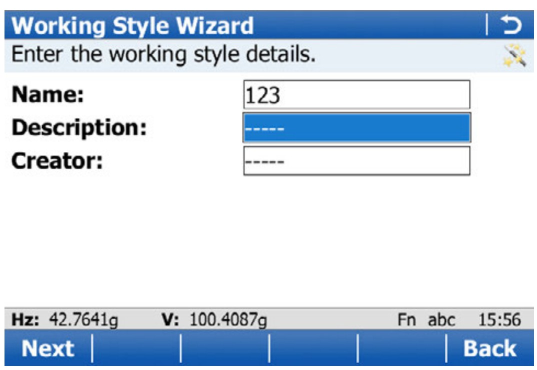



| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Delete** | To delete the highlighted working style. |
| **Back** | To return to the previous screen. |

## 28.4 Creating a New Working Style

**Working Style Wizard, Enter the working style details.**

Type in the name and a description for the new working style.

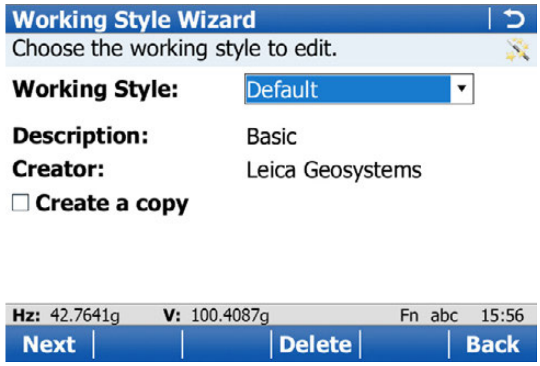



| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

# 28.5 Editing a Working Style

**Working Style Wizard, Choose the working style to edit.**

Select the working style to be edited from the selectable list.




| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Delete** | To delete the working style currently shown in the selectable list immediately. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create a copy** | Check box | Creates a copy of the working style before the editing process starts. |

# 29 User - System settings

## 29.1 Regional settings

**Description**

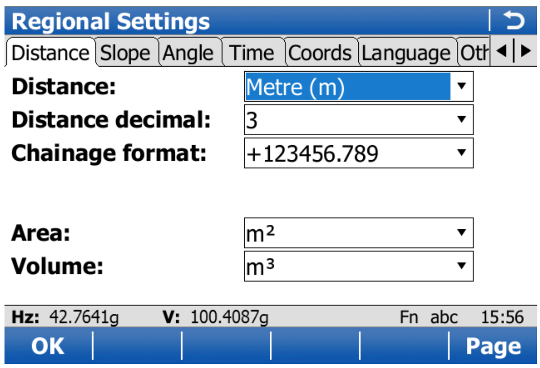
The settings on this screen define

- the units for all types of measurement data displayed.
- information related to some types of measurement data.
- the order in which coordinates are displayed.
- the instrument identification number.
- the languages available on the instrument.

**Access**

Select **Main Menu: User\System settings\Regional settings**.

**Regional Settings, Distance page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

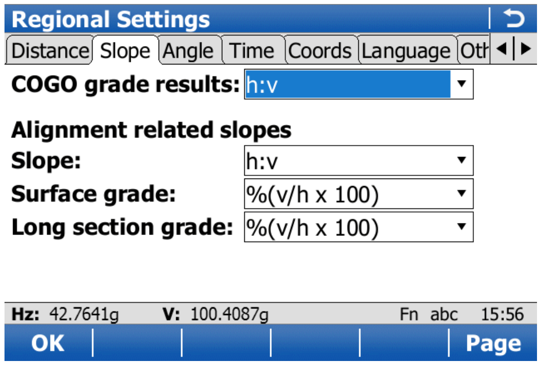
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Distance** | | The units shown for all distance and coordinate related fields. |
| | **Metre (m)** | Metres [m] |
| | **International ft (fi)** | International feet [fi], storage in US feet |
| | **Intl ft/inch (fi)** | International feet [fi], inches and 1/8 inches (0' 00 0/8 fi), storage in US feet |
| | **US ft (ft)** | US feet [ft] |
| | **US ft/inch (ft)** | US feet, inches and 1/8 inches (0' 00 0/8 fi) [ft] |
| | **US mile (mi)** | US miles [mi] |
| | **Kilometre (km)** | Kilometres [km] |
| **Distance decimal** | From **0** to **4** | The number of decimal places shown for all distance and coordinate related fields. This setting is for data display and does not apply to data export or storage. The available options depend on the selected **Distance**. |
| **Chainage format** | | Selects display format for all chainage information fields. |
| | **+123456.789** | Default chainage display form. |
| | **+123+456.789** | Separator between hundreds and thousands. |
| | **+1234+56.789** | Separators between tens and hundreds. |
| | **+123.4+56.789** | Separator between tens and hundreds with additional decimal point. |
| | **PegN°+10.000** | In this format, a peg distance is used to calculate a peg number and determine what additional value is shown next to it.<br>For example, at chainage of 100 m and a peg distance of 20 m, the peg number equals 5 (100/20 = 5).<br>Chainage 100 m = 5 + 0.000<br>Chainage 110 m = 5 + 10.000<br>Chainage -100 m = -5 - 0.000<br>Chainage -90 m = -4 - 10.000 |
| **Area** | **m²**, **Intl acres (Ai)**, **US acres (A)**, **Hectares (ha)**, **fi²** or **ft²** | The units shown for all area-related fields. |
| **Volume** | **m³**, **fi³**, **ft³** or **yd³** | The units shown for all volume-related fields. |

#### Next step

**Page** changes to the **Slope** page.

**Regional Settings, Slope page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

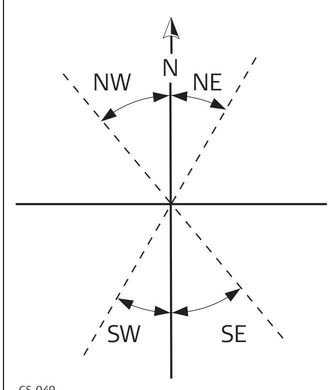
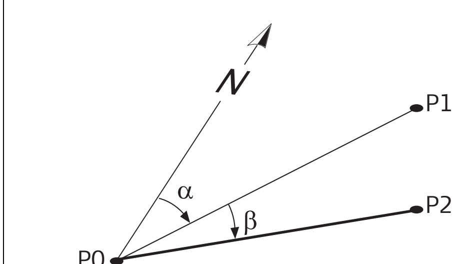
| Field | Option | Description |
|---|---|---|
| All fields | | The input and output format for grades. |
| | **h:v** | Horizontal by vertical distance. |
| | **v:h** | Vertical by horizontal distance. |
| | **%(v/h x 100)** | Percentage of vertical by horizontal distance. |
| | **Elevation angle** | Elevation angle. |

### Next step

**Page** changes to the **Angle** page.

**Regional Settings, Angle page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Angle** | **400 gon**, **360°'"**, **360° dec** or **6400 mil** | The units shown for all angular and coordinate related fields. |
| **Angle decimal** | | The number of decimal places shown for all angular and coordinate related fields. This setting is for data display and does not apply to data export or storage. |
| | From **1** to **4** | Available for **Angle: 6400 mil**. |
| | From **2** to **4** | Available for **Angle: 400 gon** and **Angle: 360° dec**. |
| | **5** | Available for MS50/TS50/TM50 and **Angle: 400 gon** or **Angle: 360° dec**. Unavailable for remote configuration. |
| | **0.1"**, **1"**, **5"**, **10"** or **60"** | Available for **Angle: 360°'"**. |
| **Hz angle display** | **North azimuth**, **South azimuth**,**North anti-clockwise** | Sets the reference direction as well as the direction from where and how azimuths are computed.<br>The azimuth fields in other screens are called **Azimuth**. |
| | **Bearing** | The azimuth fields in screens are called **Bearing**. NE, SW, SE and NW indicate the quadrant of the bearing.<br><br> |
| | **Angle right** | Displays the horizontal angle difference between the backsight point and the current telescope position.<br>The azimuth fields in screens are called **Angle right**.<br><br> |

| Field | Option | Description |
|---|---|---|
| | | P0 Instrument station<br>P1 Backsight point<br>P2 Point in direction of current telescope position<br>α Azimuth<br>β Angle right |
| **GPS direction ref** | **True** or **Magnetic** | Sets the North direction. |
| **Declination** | Editable field | Available for **GPS direction ref**: **Magnetic**.<br>The value for the magnetic declination. It is considered when computing or using any azimuth values. |
| **V angle display** TPS | **Zenith angle** | V = 0 in zenith. |
| | **Elevation angle** | V = 0 horizontal elevation angle. Vertical angles are positive above the horizon and negative below it. |
| | **Elevation angle %** | V = 0 horizontal. Vertical angles are expressed in % and are positive above the horizon and negative below it. |
| **Hold V angle after a Dist measurement** TPS | Check box | If checked, the vertical angle is fixed after a distance measurement with **Dist**, whereas the horizontal angle is continuously updated with the telescope movement.<br>If not checked, the vertical angle is continuously updated with the telescope movement.<br>☞ The active prism height is applied in the calculation of remote point elevations. The prism height must be set to zero to display and record the elevation of the targeted remote point. |

**Next step**

**Page** changes to the **Time** page.

**Regional Settings, Time page**

The time zone is read from WinCE.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Time format** | **24 hour** or **12 hour (am/pm)** | How the time is shown in all time-related fields. |
| **Current time** | Display only | Shows an example of the selected time format. |
| **Date format** | **Day.month.year**, Month/day/year or **Year/month/day** | How the date is shown in all date-related fields. |
| **Current date** | Display only | Shows an example of the selected date format. |

**Next step**

**Page** changes to the **Coords** page.

**Regional Settings, Coords page**

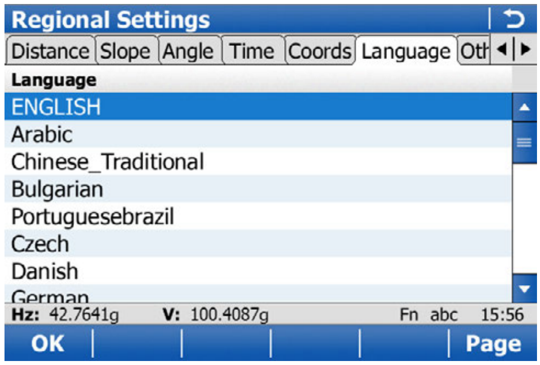
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Grid format** | **Easting, northing** or **Northing, easting** | The order in which grid coordinates are shown in all screens. The order in survey screen pages depends on the user settings. |
| **Geodetic format** | **Latitude, longitude** or **Longitude, latitude** | The order in which geodetic coordinates are shown in all screens. The order in survey screen pages depends on the user settings. |
| **Switch Easting for CAD files** and **Switch Northing for CAD files** | Check box | When these boxes are checked, then the signs of the Easting and Northing coordinates of CAD files are changed so that the CAD file in MapView is mirrored. The setting applies to all applications, including Roads.<br>☞ The signs of the Easting/Northing coordinate only change for the display purposes. The signs are not changed in the database.<br>☞ When importing/exporting dxf data, the signs of the data are switched according to the setting. |

### Next step

**Page** changes to the **Language** page.

## Regional Settings, Language page




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Delete** | To delete the highlighted language. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Language** | The languages available on the instrument. Three languages can be stored on the instrument at one time - English and two others. English cannot be deleted.<br>The selected language is used for the system software. If a language is not available for the system software, the English language is used instead.<br>Applications are available in the languages that were loaded on the instrument when the application was installed. |

**Next step**
**Page** changes to the **Others** page.

## Regional Settings, Others page

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Temperature** | **Celsius (°C)** or **Fahrenheit (°F)** | The units shown for all temperature-related fields. |
| **Pressure** | **mbar**, **mmHg**, **Inch Hg (inHg)**, **hPa** or **psi** | The units shown for all pressure-related fields. PSI = pounds per square inch. |
| **Velocity unit** | **Km/h (kmh)**, **Mph (mph)** or **Knots (kn)** | The units shown for all velocity-related fields. |

**Next step**
**Page** changes to the **Device ID** page.

## Regional Settings, Device ID page

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Device ID** | Editable field | This number is used for the generation of the file names. Using format files, the instrument ID can be exported together with data from the instrument. By doing so, it can be identified which instrument was used for certain measurements. Sets a four-digit number as instrument identification number. By default the last four numbers of the serial number are used. |

### Next step

**Page** changes to another page on this screen.

## 29.2 SmartWorx options

**Description**

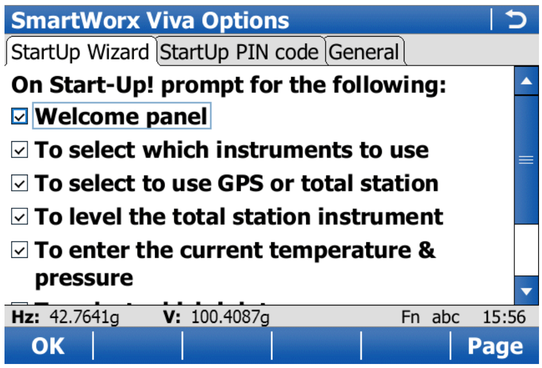
The settings on this screen define the behaviour of the instrument for a general start up.

**Access**

Select **Main Menu: User\System settings\SmartWorx options**.

**Welcome to SmartWorx Viva!**

If a check box is checked, the corresponding screen is shown during start up.
If all check boxes are unchecked, then, after turning on the instrument, the **Main Menu** is accessed immediately.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| Fn **Quit** | To exit the screen. |

**Welcome to SmartWorx Viva!, StartUp PIN code page**

If **Use PIN**: **Yes**, then, after turning on the instrument, a PIN code must be entered.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use PIN** | **Yes** | PIN protection is activated and a PIN code must be entered at startup. |
| | **No** | PIN protection is not activated and no PIN code is required at startup. |
| **New PIN** | Editable field | Available if **Use PIN**: **Yes**<br>The new PIN code that will be required at startup. PIN codes must be numerical only and 4 to 6 digits in length. |

**Next step**
**Page** changes to the **General** page.

**Welcome to SmartWorx Viva!, General page**

If the check box for **Use drop down menus in the main menu** is checked, then menus will appear as drop down menus.
If the check box for **Use drop down menus in the main menu** is unchecked, then menus will appear as graphical menus.

**Next step**
**OK** to the save the changes and return to the **Main Menu**.

## 29.3 Screen & audio

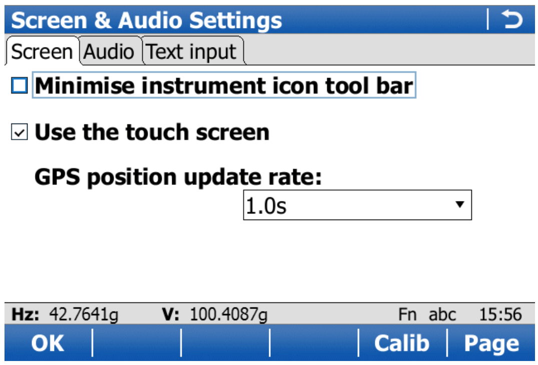
**Description**

The settings on this screen allow the screen appearance to be configured, turn the notification beeps on and off and define the behaviour of the keys. The settings are stored on the field controller itself. If the field controller is exchanged, the settings stored on the new field controller apply.

**Access**

Select **Main Menu: User\System settings\Screen & audio**.

**Screen & Audio Settings, Screen page**




| Key | Description |
| --- | --- |
| **OK** | To accept changes and return to **Main Menu**. |
| **Calib** | To calibrate the touch screen. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
| --- | --- | --- |
| **Minimise instrument icon tool bar** | Check box | If checked, the icon tool bar on the top of the screen is minimised to one small icon on the top left. Tap this icon to make the full icon tool bar visible again. |
| **Use the touch screen** | Check box | If checked, the touch screen is turned on. |
| **GPS position update rate** | **0.2s**, **0.5s**, or **1.0s** | The screen update rate for the GPS positions. |

**Next step**

**Page** changes to the **Audio** page.

**Screen & Audio Settings, Audio page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Message sounds** | **Sounds only** | A sound alert will be given when an information message appears. |
| | **Sounds & voice** | A sound and voice alert will be given when an information message appears. |
| **Use Hz sector beeps with total stations** | Check box | If checked, the horizontal sector beep is turned on. The instrument beeps when within 5 gon/4°30' of the defined sector, has a long and consistent beep within 0.5 gon/27' and no beep within 0.005 gon/16''. |
| **Hz sector angle** | Editable field | Editable field for the sector angle for which a beep will sound. |

### Next step

**Page** changes to the **Text input** page.

**Screen & Audio Settings, Text input page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Data input method** | **Function keys**, **Mobile phone style** or **Pop-up keyboard** | Alphanumeric input can either be through function or numeric keys.<br>For the CS10 model, alphanumeric input can also be through an on-screen pop-up keyboard to be used with the stylus. |
| **Default characters** | Selectable list | Sets the set of extra characters available through **Alpha** or **F1**-**F6** whenever an entry is made.<br>The choices available depend on the character sets loaded on the instrument and the language configured to be used. |

### Next step

**Page** changes to another page on this screen.

## 29.4 Admin settings

**Description**

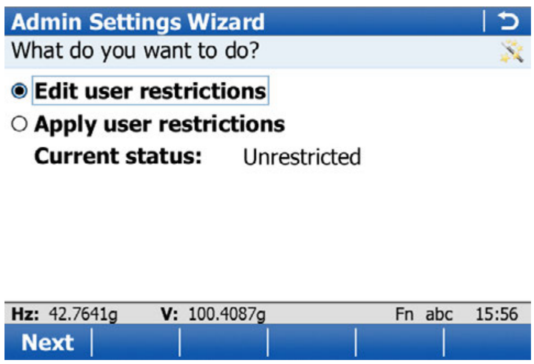
By the settings on this screen, access to certain areas of the system can be locked for other users, for example restricting them from creating a new working style.
To unlock the system, a correct password has to be entered. The number of attempts of password entries is not limited.

**Access**

Select **Main Menu: User\System settings\Admin settings**.

| IF the system is | THEN |
|---|---|
| locked | the password must be typed in. |
| not locked | restriction settings can be set and a password can be defined. Refer to "Admin Settings Wizard, What do you want to do?". |

**Admin Settings Wizard,**
**What do you want to do?**




| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| Fn **Quit** | To exit the wizard. |

**Next step**

| IF you want to | THEN |
|---|---|
| lock settings | select **Edit user restrictions**, press **Next** and continue with "Admin Settings Wizard, Enter new admin password.". |
| edit lock settings | select **Edit user restrictions**, press **Next** and follow the instructions on the screen. Then continue with "Admin Settings Wizard, Select the settings to be available.". |

**Admin Settings Wizard,**
**Enter new admin password.**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Password** | Editable field | Type in the password. |

**Next step**
**Page** saves the password and changes the state of the system to **Restricted**.

**Admin Settings Wizard, Select the settings to be available.**

| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Edit..** | To open the screen corresponding to the highlighted field. Shows the screen that will be hidden or displayed. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

**Admin Settings Wizard, Do you want to apply user restrictions?**

| Key | Description |
|---|---|
| **Next** | When **Yes, apply user restrictions now** is checked and this key is pressed, a password can be typed in.<br>When **No, just finish the wizard** is checked, this key returns to the **Main Menu**. |
| **Back** | To return to the previous screen. |

# 30 User - Tools & other utilities

## 30.1 Transfer user objects

**Description**

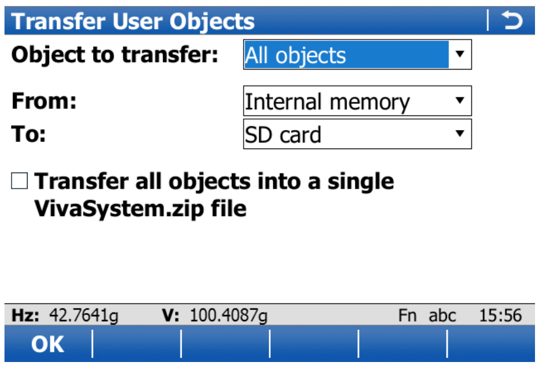
This chapter describes the basic procedure for
- transferring objects between the data storage device and the internal memory.
- sending a job from the CS10/CS15 to the TS11/TS15/TS12 Lite and vice versa. Since the TS menu cannot be used when it is connected to the CS, the commands for sending the jobs from and to the TS must be operated from the CS only.

Refer to "Appendix C Directory Structure of the Memory Device" for information about file types and locations of files on the data storage device.

**Access**

Select **Main Menu: User\Tools & other utilities\Transfer user objects**.

**Transfer User Objects**




| Key | Description |
|---|---|
| **OK** | To transfer an object and return to the screen from where this screen was accessed.<br>For transfer between TS and CS, the job is transferred through Bluetooth, radio or cable.<br>For transfer between TS and CS with jobs larger than 1 MB:<br>• The transfer time is estimated and displayed. Press **Yes** to start the transfer or **No** to cancel.<br>• A progress bar indicates the progress of the transfer. |
| Fn **Quit** | To exit the screen. |

### Description of fields

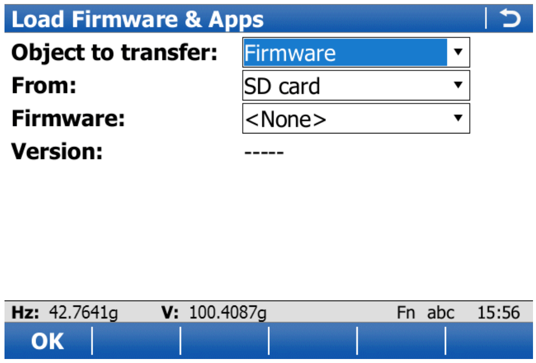
| Field | Option | Description |
|---|---|---|
| **Object to transfer** | Selectable list | Listed are the objects that can be transferred. The available fields on the screen depend on the option selected. |
| **From** | | Data storage device to transfer object from. |
| | **CF card** | Transfer from CS CompactFlash card. |
| | **SD card** | Transfer from CS Secure Digital Memory card. |
| | **USB** | Transfer from CS USB. |
| | **Internal memory** | Transfer from the field controller. |
| | **TS Internal memory** | Transfer from TS internal memory. |
| | **TS SD card** | Transfer from TS Secure Digital Memory card. |
| **To** | Selectable list | Data storage device to transfer object to. Data storage device not selected in **From**. |
| **Job** | Selectable list | To select the job to be transferred between memory devices or to/from TS. |
| **Admin settings** | Selectable list | To transfer the **Admin settings** defined. |
| **Antenna** | Selectable list | To select the antenna records to be transferred. |
| **Codelist** | Selectable list | To select the codelist to be transferred. |
| **Working Style** | Selectable list | To select the configuration set to be transferred. |
| **Coordinate system** | Selectable list | To select the coordinate system to be transferred. |
| **CSCS field file** | Selectable list | To select the Country Specific Coordinate System to be transferred. |
| **File** | Display only | The dial-up list, the RTK Rover Wizard list, the server list to be transferred as a binary file.<br>To select the custom templates stored on the data storage device in CONFIG\SKETCH_TEMPLATES. |
| **Format file** | Selectable list | To select the format files to be transferred. |
| **Geoid field file** | Selectable list | To select the Geoid Field File to be transferred. |
| **Choose working job** | Selectable list | To select the job to be transferred. |
| **Rail job** | Selectable list | To select the Rail job to be transferred. Available when the Roads application is loaded. |
| **Road job** | Selectable list | To select the Road job to be transferred. Available when the Roads application is loaded. |
| **Tunnel job** | Selectable list | To select the Tunnel job to be transferred. Available when the Roads application is loaded. |
| **XSL Stylesheet** | Selectable list | To select the stylesheets to be transferred. |

| Field | Option | Description |
|---|---|---|
| **Import image** | Selectable list | To select the geo-referenced map background image to be transferred.<br>☞ When selecting a world file image, the *.jpg and *.jgw files must have the same file names.<br>☞ The converted image file has the same name as the original .jpg file. |
| **Transfer for use with System1200** | Check box | Available for jobs with **To**: **CF card**. When this box is checked, the job files are copied to the DBX folder, not to a subfolder. |
| **Transfer all objects of the selected type** | Check box | Available for some transfer object options. To transfer all objects. |
| **Transfer all objects into a single VivaSystem.zip file** | Check box | Available for **Object to transfer: All objects**. To zip all objects automatically during transfer.<br>☞ Custom templates for the sketch pad are included.<br>☞ *.jpg and *.jgw files from the \Data and from the \Data\Map_Images folder are excluded. *.archive files from the \Data\Map_Images folder are transferred. |
| **Transfer scans**, **Transfer images**, **Transfer surfaces**, **Transfer CAD files** and **Transfer XML files** | Check box | Available on CS when connected to TS. Available for **Object to transfer: Job**.<br>Select the objects to transfer between CS and TS. Reduce the selection to shorten the transfer time. |

**Access**

Select **Main Menu: User\Tools & other utilities\Load firmware & Apps**.

**Load firmware & Apps**




| Key | Description |
|---|---|
| **OK** | To upload an application, firmware or language and return to the screen from where this screen was accessed. |
| **Delete** | To delete an application or language. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Object to transfer** | **Apps** | Application uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the data storage device and use the extension *.a*. |
| | **Firmware** GPS | Firmware uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the active memory device and use the extension *.fw.<br>☞ The firmware file for SmartWorx Viva includes the firmware of the CS modem. However, the firmware of the CS modem can also be loaded separately by using the stand-alone loader tool loader.exe. Refer to the CS10/CS15 User Manual and follow the CS firmware update instructions. |
| | **Language** | Language uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the data storage device and use an extension that is individual to each language. |
| **From** | Selectable list | Upload from CompactFlash card or Secure Digital Memory card. |
| **App** | Selectable list | List of application files stored on the card. |
| **Firmware** | Selectable list | List of firmware files stored on the card. |
| **Language** | Selectable list | List of language files stored on the card. |
| **Version** | Display only | Version of the application/firmware/language file chosen. |

☞ In order to load the firmware to a GS05/GS06, the GS05/GS06 must be connected to the CS.

☞ It is not possible to have more than three language files stored on the instrument. English is always available as the default language and cannot be deleted.

☞ There is only one version of each application. The application will be installed in English and in any other language that is already loaded onto the instrument. If a new language is loaded after an application has been installed, the application will need to be reinstalled to become available in the new language.

## 30.3 Load licence keys

**Description**

A licence key can be used to activate applications and protected options and can be used to define the expiry date of the software maintenance. Refer to "32 User - About Leica Viva" to find out how to check the expiry date of the software maintenance.

A licence key file can be uploaded to the field controller. To upload a licence key file the file must be located on the \SYSTEM directory of the data storage device. Licence key files use the naming convention L_123456.key, where 123456 is the instrument serial number.

In order to upload the GS05/GS06 Glonass licence, the GS05/GS06 must be connected to the field controller.
To delete the GS05/GS06 Glonass licence from the GS05/GS06, upload the GS05/GS06 GPS licence.

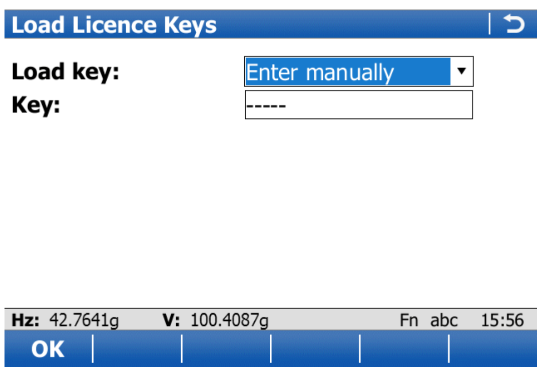
**Access**

Select **Main Menu: User\Tools & other utilities\Load licence keys**.

OR

Select an application not yet activated.

**Load Licence Keys**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu** or continue with the application. |
| Fn **Delete** | To delete all licence keys on the field controller. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Load key** | | The method used to input the licence key to activate the application or the protected options or the software maintenance. |
| | **Upload key from file** | The licence key file is uploaded from the data storage device. The licence key file must be stored in the \SYSTEM directory on the data storage device. |
| | **Enter manually** | Allows the licence key to be typed in manually. |
| **Key** | Editable field | Available for **Load key: Enter manually**. The licence key required to activate an application. Entry is not case sensitive. |

## 30.4 Ftp data transfer

**Description**

This functionality is to transfer jobs, codelists and other Viva Series related files on the data storage device with a standard and simple FTP server.

FTP protocol is used to transfer between Viva Series, which runs SmartWorx Viva and has an Internet device connected, and the FTP server. The zip/unzip functionality is included. Licence keys apply.

**Supported files**

The following list shows the supported file extensions that will automatically move to the corresponding directory after downloading.

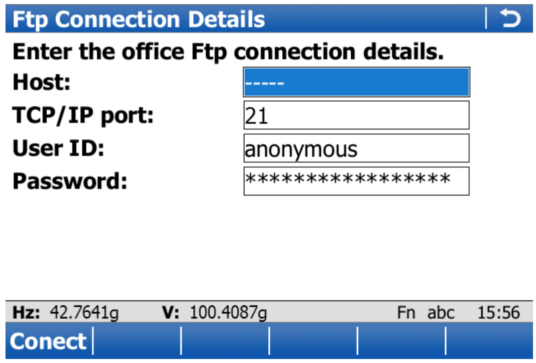
| Supported file | File extension | Directory |
|---|---|---|
| Almanac file | Almanac.sys | DATA/GPS |
| Antenna file from GPS | List.ant | GPS |
| Application files | *.a* | SYSTEM |
| ASCII files for import/export to/from job | *.txt | DATA |
| Coordinate system file from GPS | Trfset.dat | DBX |
| CSCS field files | *.csc | DATA/GPS/CSCS |
| DXF files for import/export to/from job | *.dxf | DATA |
| Firmware files | *.fw | SYSTEM |
| Format files | *.frt | CONVERT |
| Geoid field files | *.gem | DATA/GPS/GEOID |
| GSI files | *.gsi | GSI |
| GSM/Modem station list from GPS | *.fil | GPS |
| Language files | *.s* | SYSTEM |
| Licence file | *.key | SYSTEM |
| Report sheets created from applications | *.log | DATA |
| TPS working style files | *.xfg | CONFIG |
| System files | System.ram | SYSTEM |
| Custom ASCII file (SmartWorx Viva Export) | *.cst | DATA |
| Comma separated variables, text file format (ASCII) | *.csv | DATA |

☞ Configure and connect the Internet interface before using this function.

**Access**

Select **Main Menu: User\Tools & other utilities\Ftp data transfer**.

**Ftp Connection Details**




| Key | Description |
|---|---|
| **Conect** | To connect to the FTP server entered. |
| Fn **Quit** | To exit the screen. |

### Description of fields

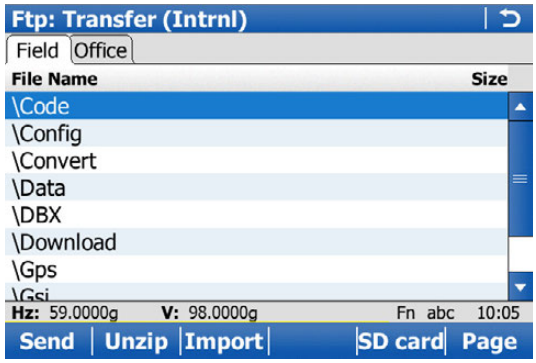
| Field | Option | Description |
|---|---|---|
| **Host** | Editable field | In order to get access to the Internet, a host name is required. This host name identifies the instrument in the Internet. |
| **TCP/IP port** | Editable field | Port to be used. Any number between 0 and 65535 is valid. |
| **User ID** | Editable field | The User ID allows connection to the ftp site. If no value is typed in, then the instrument logs into the FTP server anonymously. |
| **Password** | Editable field | The password to get access to the ftp site. |

### Next step

**Conect**. Once the connection to the FTP server is established, the **Ftp Data Transfer**, **Field** page is displayed.

**Ftp Data Transfer, Field page**

The files and folders on the selected memory device of the instrument are displayed including their size. To get into the folders, highlight the folder and ENTER.



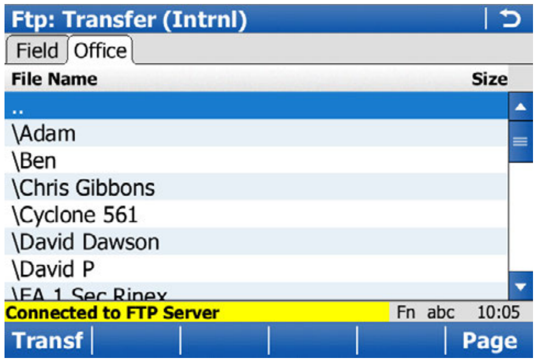

| Key | Description |
|---|---|
| **Send** | To copy the file or folder to its corresponding directory on the ftp server. Files or folders bigger than 100 KB are zipped before sending. |
| **Unzip** | To unzip a file in the download directory. Available if a zip file is highlighted. |
| **Import** | To move a file from the \Download folder to the appropriate directory folder based on its file extension type.<br>Available in the \Download folder when a file is highlighted. Unavailable for unrecognised files in the \Download folder. These files must stay in the \Download folder. |
| **CF card**, **SD card**, **USB** or **Intrnl** | To change between the data storage devices and the internal memory. |
| Fn **Quit** | To return to **Main Menu** and disconnect automatically from the FTP server. |

**Next step**

**Page** changes to the **Office** page.

**Ftp Data Transfer, Office page**

The files located on the FTP server are displayed.
Whenever switching to this page, if the connection to the server was disconnected, then a refresh action is done or it reconnects to the server.
The most important keys are explained.




| Key | Description |
|---|---|
| **Transf** | To download the highlighted file or folder list on the FTP server to the local download folder.<br>If recognised by the system, downloaded files are moved automatically to the corresponding directories. If not, they are stored in the download folder. Zipped files are unzipped before storing in the download folder. |
| **Page** | To change to another page on this screen. |
| Fn **Refrsh** | To refresh the FTP directory. |
| Fn **Quit** | To return to **Main Menu** and disconnect automatically from the FTP server. |

## 30.5 Format memory devices

**Description**

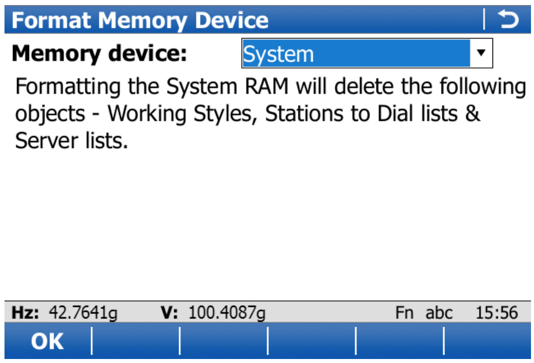
Allows the data storage device and the internal memory to be formatted. All data will be erased.

☞ If the internal memory is formatted, all system data such as almanac, user-defined configuration sets, user-defined antennas, codelists, geoid field files and CSCS field files will be lost.

**Access**

Select **Main Menu: User\Tools & other utilities\Format memory devices**.

**Format Memory Device**




| Key | Description |
|---|---|
| **OK** | To format a memory device and return to the screen from where this screen was accessed. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Memory device** | Selectable list | The type of memory to be formatted. |
| | **CF card** | Formatting the CF card will delete all data currently stored on the CF card. |
| | **Internal memory** | Formatting the Internal Memory will delete the following objects currently stored on the internal memory - Jobs, Admin Settings, Codelists, Coordinate Systems, Format Files, Geoid & CSCS field files, RTK Profiles, Sketch Templates & User Entered Antenna. |
| | **SD card** | Formatting the SD card will delete all data currently stored on the SD card. |
| | **USB stick** | Formatting the USB stick will delete all data currently stored on the USB stick. |
| | **Apps** | Formatting the Apps will delete all currently loaded apps. |
| | **System** | Formatting the System RAM will delete the following objects - Working Styles, Stations to Dial lists & Server lists. |

## 30.6 View contents of ASCII files

| | |
|---|---|
| **Description** | Allows ASCII files selected for **From file** in **Import ASCII Data** to be viewed in WordPad. |
| **Access** | Select **Main Menu: User\Tools & other utilities\View contents of ASCII files**. WordPad opens. |

# 30.7 Leica Exchange

## 30.7.1 Overview

**Availability**

Leica Exchange is available on your TS11/TS15/TS12 Lite/MS50/TS50/TM50 instrument or CS10/CS15 field controller.

**Description**

Leica Exchange is an online service that allows the data exchange between two users of the service. For example:

- The user in the field sends the daily measured data to the user in the office.
- The user in the field sends a codelist to a second user in the field.

**Requirements**

- Valid Leica Exchange subscription
- SmartWorx 4.0 or higher
- Leica Exchange licence key loaded on a field controller/instrument

AND / OR

- Leica Exchange entitlement ID loaded on a computer with Leica Exchange Office

**Creating User name and Password step-by-step**

| Step | Description |
|---|---|
| 1. | Order a Leica Exchange subscription. You will receive a subscription form. |
| 2. | Take the subscription ID in the subscription form and log in to your myWorld account (https://myworld.leica-geosystems.com). |
| 3. | Navigate to myTrustedServices. |
| 4. | On the **My Trusted Services** tab, select **Add Service** and type in the subscription ID. |
| 5. | The Leica Exchange Service is shown in the **My Trusted Services** tab. Once the Leica Exchange Service is registered, users can be assigned to the service on the **My Users** tab. |
| 6. | Click the **Add** button to define a new user and to assign services to the user.<br>For each user:<br>• Enter contact information<br>• Define a unique user name<br>• Assign a password<br>The user name and password are needed each time you access the Leica Exchange Service. The Leica Exchange Service can be accessed from SmartWorx in the field or using Leica Exchange Office PC software. |
| ☞ | After registering the subscription ID in your myWorld account, the subscription usage statistic is fully accessible. The total quota is shown and the consumed and remaining GB are displayed in total GB and GB/month. |

**Access**

Select **Main Menu: User\Tools & other utilities\Leica Exchange**.

If a user is currently logged in then the **Leica Exchange Main Menu** screen is accessed.If no user is currently logged in then the **Leica Exchange Login** screen is accessed.

**Leica Exchange Login**

User name and password must be typed in each time the **Leica Exchange** service is accessed.

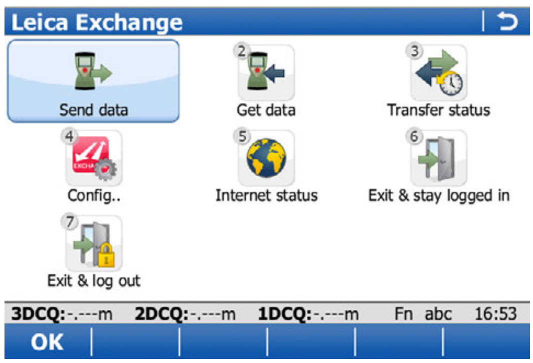
### Description of fields

| Field | Option | Description |
|---|---|---|
| **User name** | Editable field | The user ID created in MyWorld allows connection to the exchange server. |
| **Password** | Editable field | The password created in MyWorld to get access to the exchange server. |

### Next step

The first time you log into **Leica Exchange** you need to accept the license agreement. If a connection to the **Leica Exchange** server is active and if the user name and password are recognised, then **OK** accesses **Leica Exchange Main Menu**.

**Leica Exchange Main Menu**




| Key | Description |
|---|---|
| **OK** | To access the selected functionality. |
| Fn **Quit** | To exit the screen. |

### Description of options

| Icon | Description |
|---|---|
| **Send data..** | To select objects to be uploaded to the server from the CS or TS and to start the upload. Access **Leica Exchange Data Transfer**. |
| **Get data..** | To select objects to be downloaded from the server to the CS or TS and to start the download. Access **Select Data to Download**. Data sent to a user are stored in the users "inbox" for two weeks. |
| **Transfer status..** | To check the transfer status for the last 20 transfers since login. |
| **Config..** | To access the **Configuration** screen for **Leica Exchange**. |
| **Connection status..** | To see details about the connection. The **Internet Connection Status** opens. A checked box for **Connected to Leica Exchange** indicates an established connection to the Leica Exchange Server. |
| **Exit & stay logged in** | To remain logged in but return to the **Main Menu**. Any transfer in progress continues in the background. You can see from anywhere inside SmartWorx when new files are received. |
| **Exit & log out** | To unlog and to return to the **Main Menu**. Any transfer in progress is stopped. |

## 30.7.2 Configuring Leica Exchange

**Access**

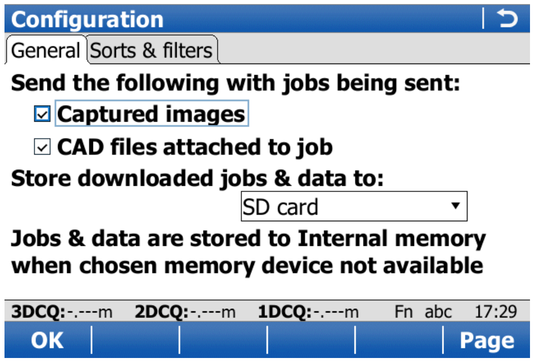
Select **Config..** in **Leica Exchange Main Menu**.

OR

Press Fn **Config..** in **Select Data to Send**, **Select People to Send Data** or **Leica Exchange Data Transfer**.

**Configuration, General page**

This screen consists of two pages. The explanations for the softkeys given here are valid for all pages.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Captured images** | Check box | When this box is checked, the jobs are sent with the Images folder. |
| **CAD files attached to job** | Check box | When this box is checked, the jobs are sent with the Map files folder. |
| **Store down-loaded jobs & data to** | Selectable list | The device on which the jobs and data are stored.<br><br>☞ Jobs and data are stored in the internal memory when the chosen memory device is not available. |

**Next step**

**Page** changes to the **Sorts & filters** page.

**Configuration, Sorts & filters page**

## Description of fields

| Field | Option | Description |
|---|---|---|
| **Sort objects by** | | The method points are sorted by. |
| | **Time** | Sorts objects on the instrument by the time they were created.<br>Sorts objects in the inbox by the time when they were uploaded to the server. |
| | **Size** | Sorts the objects by size in Kb. |
| | **File name** | Sorts the objects alphabetically by the object name. |
| | **Type** | Sorts the objects in alphabetical order of the object types. After applying the alphabetical order, the time is considered for the order of the files. |
| **Display following objects for sending:** | Check boxes | When a box is checked, the filter is active for that object type.<br>The filter is valid for objects sent from the instrument. Objects on the server are always visible. |

### Next step

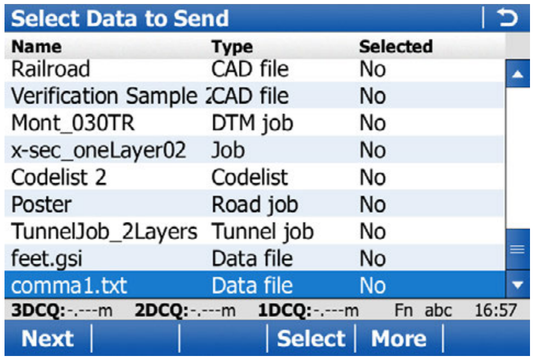
**OK** closes the screen.

## 30.7.3 Sending Data

**Access**

Select **Main Menu: User\Tools & other utilities\Leica Exchange\Send data...**

**Select Data to Send**




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. The Internet and server connection is checked. |
| **Select** | To set **Yes** or **No** in the **Selected** column for the highlighted object. |
| **More** | To change between type, size, modification date and source of the listed objects. |
| Fn **Config..** | To configure **Leica Exchange**. |
| Fn **All** or Fn None | To select or deselect all object for sending data. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Name** | The user-defined name of the objects. |
| **Type** | Supported are job, CAD files (dxf and shape files), data files, coordinate systems and codelists. |
| **Size** | The size of the selected object. |
| **Modified date** | The date when the object was last modified. |
| **Source** | The memory device where the object is stored. |
| **Selected** | For **Yes**: The selected object is used for sending data.<br>For **No**: The selected object is not used for sending data. |

**Next step**

Make a selection and press **Next**.

**Select People to Send Data**

| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. |
| **Select** | To set **Yes** or **No** in the **Selected** column for the highlighted name. |
| **Back** | To return to the previous screen. |
| Fn **Config..** | To configure **Leica Exchange**. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Name** | The name of the person data can be send to. The list is downloaded from MyWorld. Refer to "Creating User name and Password step-by-step" for information on how to define user names. |
| **Selected** | For **Yes**: Data is sent to the person. Multiple selection is possible.<br>For **No**: Data is not sent to the person. |

**Next step**

Make a selection and press **Next**. The transfer starts.

While the transfer is in progress,

- the status can be checked by pressing **Status**. Refer to "30.7.5 Data Transfer Status".
- other tasks can be done. Press **Finish** to exit the wizard.

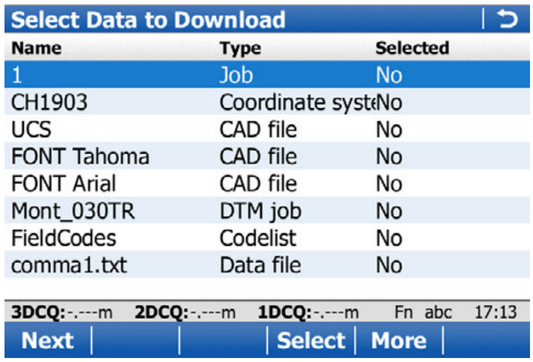
## 30.7.4 Getting Data

**Access**

Select **Main Menu: User\Tools & other utilities\Leica Exchange\Get data...**

**Select Data to Download**

The information shown is derived from the list of information retrieved from the server.




| Key | Description |
|---|---|
| **Next** | To confirm the settings and to continue to the next screen. The Internet and server connection is checked. |
| **Select** | To set **Yes** or **No** in the **Selected** column for the highlighted object. |
| **More** | To change between type, size, modification date and source of the listed objects. |
| Fn **Config..** | To configure **Leica Exchange**. |
| Fn **All** or Fn None | To select or deselect all object for sending data. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Name** | The user-defined name of the objects. |
| **Type** | Supported are job, CAD files (dxf and shape files), data files, coordinate systems and codelists.<br>Jobs downloaded from the server are stored in a subfolder of the DBX folder of the data storage device selected in **Store downloaded jobs & data to** in **Configuration**, **General** page.<br>All files with unknown format, for example CAD or data files, are stored in the \DATA folder of the selected data storage device.<br>Coordinate systems and codelists are stored to the internal memory of the CS or TS. From the internal memory, the codelist/coordinate system can be directly selected when creating/editing a job. |
| **Size** | The size of the selected object. |
| **Modified date** | The date when the object was last modified. |
| **Selected** | For **Yes**: The selected object is used for sending data.<br>For **No**: The selected object is not used for sending data. |

**Next step**

Make a selection and press **Next**. The transfer starts.
While the transfer is in progress,

- the status can be checked by pressing **Status**. Refer to "30.7.5 Data Transfer Status".
- other tasks can be done. Press **Finish** to exit the wizard.

## 30.7.5 Data Transfer Status

**Access**

Select **Transfer status..** in **Leica Exchange Main Menu**.

OR

Press **Status** in the wizard window while data is being send/received.

**Data Transfer Status**

The last 20 transfers since login are displayed.

| Key | Description |
|---|---|
| **OK** | To return to **Leica Exchange Main Menu**. |
| **Pause** | To pause all transers. |
| **Resume** | To restart all transfers. |
| **Accept** | Available when a row with status **Conflict** is highlighted. To choose between replacing or discarding the downloaded file. |
| **Remov** | Available for finished or cancelled transfers. To remove the transfer from the list. |
| **Cancel** | To cancel the highlighted transfer. |
| **More** | To change between user, size, date and expected time by when the transfer will be finished. |
| Fn **Config..** | To configure **Leica Exchange**. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

| Column | Description |
|---|---|
| **Type** | The type of file transferred. |
| **Name** | The name of the file transferred. |
| **Who** | The user the file is transferred to or from. |
| **Status** | **... down/up** - The downloading/uploading transfer is running is in progress.<br>**Sent** - The upload has been successfully finished.<br>**Downloaded** - The download has been successfully finished.<br>**Pending** - A transfer is in progress and the current transfer has not been started.<br>**Paused** - The transfer has been paused.<br>**Canceled** - The transfer has been cancelled.<br>**Conflict** - The transfer is finished, but there is another file with the same name in the designated folder. Press **Accept**.<br>**Interrup.** - The transfer has been interrupted due to internet connection loss or other events that result in interrupting the transfer. |

## 30.7.6 In the Office

**In the office**

| Step | Description |
|---|---|
| 1. | After activating the Entitlement ID, login to Leica Exchange Office with your user name and password. |
| 2. | Click on one of the icons to define the view in the right half of the window: **Inbox**, **Status**, **History**, **Contacts**. On the left side of the window, the data on the computer are displayed. Navigate to the folder you want to place received data or to where the data to be sent are stored. |
| 3. | To get files from the inbox, click **Inbox**, select the files and drag them into the left half of the window.<br>To send data, click **Contacts** and drag & drop the files from the left to the right. To send files to multiple users, select the users, drag & drop the files from the left to the right. |
| 4. | To see the status of current transfers, click **Status**.<br>To see all transfers done from both field and office and also the time when the objects were sent and received, click **History**. |

# 31 User - Check & Adjust TS

## 31.1 Overview

**Description**

Leica Geosystems instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

**Electronic adjustment**

The following instrument errors can be checked and adjusted electronically:

| | |
|---|---|
| l, t | Compensator longitudinal and transversal index errors |
| i | Vertical index error, related to the standing axis |
| c | Horizontal collimation error, also called line of sight error |
| a | Tilting axis error |
| ATR | ATR zero point error for Hz and V - option |
| Telescope camera | Telescope camera zero point error, relation between principal point of telescope camera and crosshair in telescope in Hz and V - option |

If the compensator and the horizontal corrections are activated in the instrument configuration, every angle measured in the daily work is corrected automatically . Check whether the tilt correction and the horizontal correction are turned on.

The results are displayed as errors but used with the opposite sign as corrections when applied to measurements.

**Mechanical adjustment**

The following instrument parts can be adjusted mechanically:

- Circular level on instrument and tribrach
- Optical plummet - option on tribrach
- Allen screws on tripod

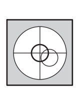
**Precise measurements**

To get precise measurements in the daily work, it is important:

- To check and adjust the instrument from time to time.
- To take high precision measurements during the check and adjust procedures.
- To measure targets in two faces. Some of the instrument errors are eliminated by averaging the angles from both faces.

During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned above, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20°C



Before determining the instrument errors, the instrument has to be levelled using the electronic level.

The tribrach, the tripod and the underground should be stable and secure from vibrations or other disturbances.

The instrument should be protected from direct sunlight to avoid thermal warming.
It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are early in the morning or with overcast sky.

---

Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment, but at least 15 min, should be taken into account.

---

Even after adjustment of the ATR, the crosshairs may not be positioned exactly on the centre of the prism after an ATR measurement has been completed. This outcome is a normal effect. To speed up the ATR measurement, the telescope is normally not positioned exactly on the centre of the prism. These small deviations/ATR offsets, are calculated individually for each measurement and corrected electronically. This means that the horizontal and vertical angles are corrected twice: first by the determined ATR errors for Hz and V, and then by the individual small deviations of the current aiming.

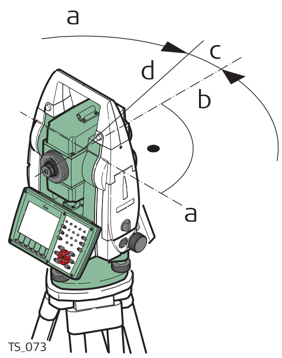
---

## 31.2 Details on Instrument Errors

**Definition**

Instrument errors occur, if the standing axis, the tilting axis and the line of sight are not precisely perpendicular to each other.

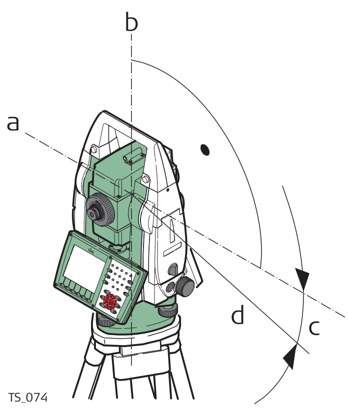
**Horizontal collimation error (c)**




a) Tilting axis
b) Line perpendicular to tilting axis
c) Horizontal collimation error (c), also called line of sight error
d) Line of sight

The Horizontal collimation error (c) is also called line of sight error. It is caused by the deviation between the optical line of sight, which means the direction in which the crosshairs points and the line perpendicular to the tilting axis. This error affects all horizontal readings and increases with steep sightings.

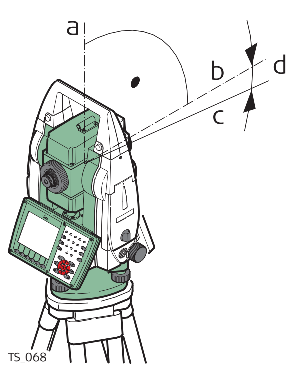
**Tilting axis error (a)**




a) Axis perpendicular to the vertical axis
b) Mechanical vertical axis of the instrument, also called standing axis
c) Tilting axis error
d) Tilting axis

The deviation between the mechanical tilting axis and the line perpendicular to the vertical axis causes the tilting axis error (a).
This error affects horizontal angles. The effect is zero in the horizon and increases with steep sights. To determine this error, it is necessary to point to a target located significantly below or above the horizontal plane. To avoid influences from the horizontal collimation error (c), this has to be determined prior to the tilting axis error.

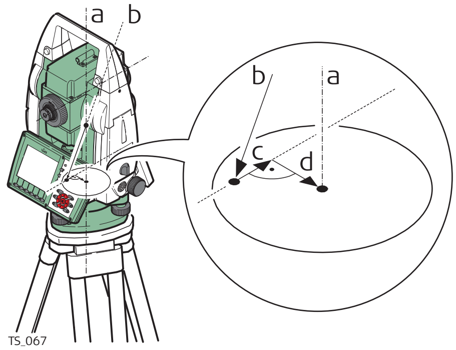
**Vertical index error (i)**




a) Mechanical vertical axis of the instrument, also called standing axis
b) Axis perpendicular to the vertical axis
c) V = 90° reading in a specific face
d) Vertical index error

A vertical index error (i) exists, if the 0° mark of the vertical circle reading does not coincide with the mechanical vertical axis of the instrument, also called standing axis. The V index error (i) is a constant error that affects all vertical angle readings.

**Compensator index errors (l, t)**




a) Mechanical vertical axis of the instrument, also called standing axis
b) Plumb line
c) Longitudinal component (l) of the compensator index error
d) Transversal component (t) of the compensator index error

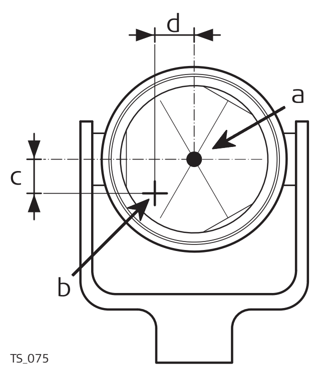
The compensator index errors (l, t) occur, if the vertical axis of the instrument and the plumb line are parallel but the zero points of the compensator and the circular level do not coincide. The calibration procedure electronically adjusts the zero point of the compensator.

A longitudinal component in direction of the telescope and a transversal component perpendicular to the telescope define the plane of the dual axis compensator of the instrument.

The longitudinal compensator index error (l) has a similar effect as the vertical index error and affects all vertical angle readings.

The transversal compensator index error (t) is similar to the tilting axis error. The effect of this error to the horizontal angle readings is 0 at the horizon and increases with steep sightings.

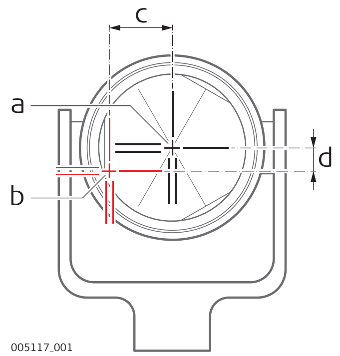
**Automatic aiming collimation errors**




a) Centre of prism
b) Crosshairs
c) V component of ATR collimation error
d) Hz component of ATR collimation error

The ATR collimation error is the angular divergence between the line of sight, which means the direction in which the crosshairs point, and the ATR CCD camera axis, which detects the centre of the prism. The horizontal and vertical components of the ATR calibration errors correct the horizontal and vertical angles to measure exactly to the centre of the prism.

**Telescope camera collimation error**




a) Physical crosshairs in the telescope
b) Digital crosshairs in the telescope camera view
c) Hz component of telescope camera collimation error
d) V component of telescope camera collimation error

The telescope camera collimation error is the angular divergence between the physical crosshairs in the telescope and digital crosshairs in the telescope camera view. The determined horizontal and vertical offset values are applied as constant offset to the recent calibration values.

A full telescope camera calibration takes other camera parameters into account, for example focus position, rotation, scale and lens distortion. The full calibration is performed after production and in service.

☞ Even after adjustment of the ATR, the crosshairs might not be positioned exactly on the centre of the prism after an ATR search. This is a normal effect. To speed up the ATR search, the telescope is not positioned exactly on the centre of the prism. The small rest deviations, the ATR offsets, are measured individually for each measurement and corrected electronically. This means that the horizontal and vertical angles are corrected twice: first by the determined ATR errors for horizontal and vertical and then by the individual small deviations of the current pointing, the ATR offsets.

**Summary of errors to be adjusted electronically**

| Instrument error | Effects Hz | Effects V | Elimination with two face measurement | Automatically corrected with proper adjustment |
|---|---|---|---|---|
| c - Line of sight error | ✓ | - | ✓ | ✓ |
| a - Tilting axis error | ✓ | - | ✓ | ✓ |
| l - Compensator index error | - | ✓ | ✓ | ✓ |
| t - Compensator index error | ✓ | - | ✓ | ✓ |
| i - Vertical index error | - | ✓ | ✓ | ✓ |
| ATR Collimation error | ✓ | ✓ | - | ✓ |
| Co-axial camera collimation error | ✓ | ✓ | ✓ | ✓ |

## 31.3 Accessing the Check & Adjust Wizard

**Access**

Select **Main Menu: User\Check & Adjust**.

**Check & Adjust Wizard, What do you want to do?**

| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| Fn **Quit** | To exit the wizard. |

**Next step**

| IF you want to | THEN |
|---|---|
| determine the instrument errors | select one of the three available check and adjust procedures and refer to the relevant subchapters. |
| view the current values | select **View the current values**. Refer to "31.7 Viewing the Current Values". |
| configure **Check & Adjust** | select **Configure Check & Adjust**. Refer to "31.8 Configuring Check & Adjust". |
| adjust the circular level | Refer to "31.9 Adjusting the Circular Level of the Instrument and Tribrach". |
| inspect the laser plummet | Refer to "31.11 Inspecting the Laser Plummet of the Instrument". |
| adjust the tripod | Refer to "31.12 Servicing the Tripod". |

## 31.4 Combined Adjustment (l, t, i, c, ATR and tele camera)

**Access**

In **Check & Adjust Wizard**, **What do you want to do?** select **Check & adjust the compensator, index error, line of sight error & automatic target aiming** or **Check & adjust the compensator, index error, line of sight error, automatic target aiming & telescope camera** for MS50/TS50/TM50 and press **Next**.

**Description**

The combined adjustment procedure determines the following instrument errors in one process:

| | |
|---|---|
| l, t | Compensator longitudinal and transversal index errors |
| i | Vertical index error, related to the standing axis |
| c | Horizontal collimation error, also called line of sight error |
| ATR Hz | ATR zero point error for horizontal angle - option |
| ATR V | ATR zero point error for vertical angle - option |
| Telescope camera Hz | Telescope camera zero point error for horizontal angle - option |
| Telescope camera V | Telescope camera zero point error for vertical angle - option |

☞

Before determining the instrument errors, the instrument has to be:
- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.

**Check & Adjust Wizard, Step 1**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

**Description of fields**

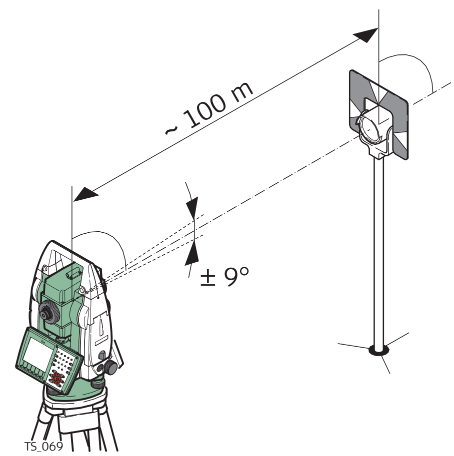
| Field | Option | Description |
|---|---|---|
| **Calibrate the automatic target aiming** | Check box | When this box is checked, the determination of the ATR horizontal and vertical adjustment values is included.<br>☞ Use a clean Leica standard prism as target. Do not use a 360° prism.<br>When this box is not checked, the determination of the ATR horizontal and vertical adjustment value is excluded. |
| **Calibrate the telescope camera** | Check box | When this box is checked, the determination of the telescope camera horizontal and vertical zero point adjustment values is included.<br>☞ In **Camera Settings**, **TS overview** page, **Use TS overview camera** must be checked.<br>☞ A prism is not required to run the procedure.<br>☞ Use a clean Leica standard prism as target. Do not use a 360° prism. |

Aim the telescope accurately at a target at a distance of about 100 m. The target must be positioned within ± 9°/± 10 gon of the horizontal plane

☞ The procedure can be started in face I or II.

☞ The fine pointing must be performed manually in both faces.

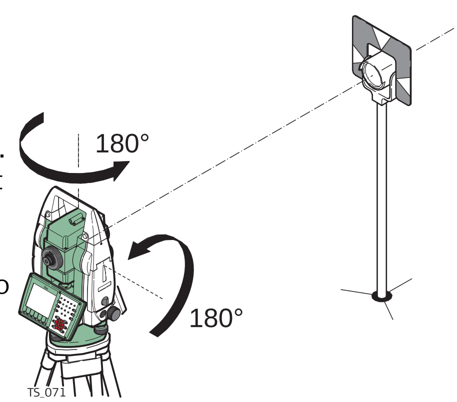
**Meas** to measure and to continue to the next screen.




For MS50/TS50/TM50:

If **Calibrate the telescope camera** has been checked, aim at the same target accurately with the telescope camera using the view finder and the digital crosshair on the display.
**Meas** to measure and to continue to the next screen.

Motorised instruments change automatically to the other face.




Non-motorised instruments guide to the other face using the **Telescope Positioning** screen.
**Meas** to measure the same target in the other face and to calculate the instrument errors.

☞ If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

**Check & Adjust Wizard, Step 2**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **No. of measurements** | Display only | Shows the number of runs. One run consists of a measurement in face I and II. |
| All other fields | Display only | The standard deviations of the determined adjustment errors are displayed. The standard deviations can be calculated from the second run onwards. |

**Check & Adjust Wizard, It is recommended to repeat the last calibration routine at least three times.**

Measure at least two more runs.

### Next step

| IF | THEN |
|---|---|
| more runs must be added | select **Add another calibration loop** and press **Next**. |
| no more runs must be added | select **Finish the calibration & store the results** and press **Next** to accept the measurements and to access the results screen. |

**Check & Adjust Wizard, Results**

| Key | Description |
|---|---|
| **Finish** | To accept and store the new determined instrument errors, where **Yes** is set in the **Use** column. If the report sheet recording has been enabled, then the results are written or appended to an existing report sheet. |
| **Redo** | To reject all results and to repeat the complete check and adjust procedure. |
| **Use** | To set **Yes** or **No** in the **Use** column for the highlighted set. |
| **More** | To view additional information about the current used old instrument errors. |

### Description of columns and fields

| Column | Option | Description |
|---|---|---|
| **New** | Display only | The new determined and averaged instrument errors. |
| **Use** | **Yes** | Stores the new adjustment error. |
| | **No** | Keeps the currently used error active on the instrument and rejects the new one. |
| **Old** | Display only | The old adjustment errors, which are currently valid on the instrument. |

## 31.5 Tilting Axis Adjustment (a)

**Access**

In **Check & Adjust Wizard**, **What do you want to do?** select **Check & adjust the tilting axis** and press **Next**.

**Description**

This adjustment procedure determines the following instrument error:

| | |
|---|---|
| a | Tilting axis error |

☞

Before determining the tilting axis error, the instrument has to be:
- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.
- The horizontal collimation error must be determined before.

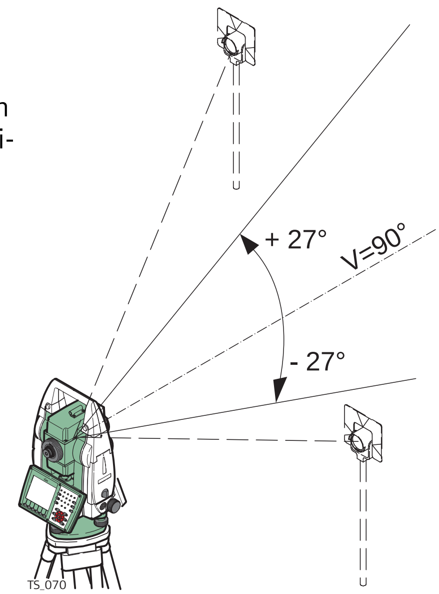
**Check & Adjust Wizard, Step 1**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

Aim the telescope accurately at a target at a distance of about 100 m. For distances less than 100 m, make sure to point to the target precisely. The target must be positioned within at least 27°/30 gon above or beneath the horizontal plane.

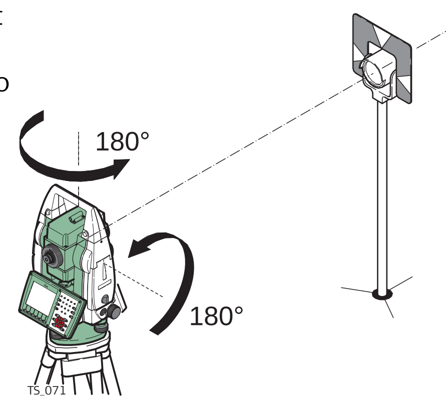
☞ The procedure can be started in face I or II.

☞ The fine pointing must be performed manually in both faces.




**Meas** to measure and to continue to the next screen.

Motorised instruments change automatically to the other face.




Non-motorised instruments guide to the other face using the **Telescope Positioning** screen.

**Meas** to measure the same target in the other face and to calculate the instrument errors.

☞ If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

**Check & Adjust Wizard, Step 2**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **No. of measurements** | Display only | The number of runs. One run consists of a measurement in face I and II. |
| **σ a T-axis** | Display only | The standard deviation of the determined tilting axis error. The standard deviation can be calculated from the second run onwards. |

**Check & Adjust Wizard, It is recommended to repeat the last calibration routine at least three times.**

Measure at least two more runs.

**Next step**

| IF | THEN |
|---|---|
| more runs must be added | select **Add another calibration loop** and press **Next**. |
| no more runs must be added | select **Finish the calibration & store the results** and press **Next** to accept the measurements and to access the results screen. |

**Check & Adjust Wizard, Results**

| Key | Description |
|---|---|
| **Finish** | To accept and record the new determined tilting axis error. If the report recording has been enabled, then the results are written to or appended to an existing report sheet. |
| **Redo** | To reject the result and to repeat the complete check and adjust procedure. |
| Fn **Quit** | To exit the wizard. |

**Description of columns and fields**

| Column | Option | Description |
|---|---|---|
| **New** | Display only | The new determined and averaged tilting axis error. |
| **Old** | Display only | The old instrument error, which is currently valid on the instrument. |

## 31.6 Compensator Adjustment (l, t)

**Access**

In **Check & Adjust Wizard**, **What do you want to do?** select **Check & adjust the compensator** and press **Next**.

**Description**

The compensator adjustment procedure determines the following instrument errors:

| | |
|---|---|
| l | Compensator longitudinal index error |
| t | Compensator transversal index error |

☞ Before determining the compensator index errors, the instrument has to be:

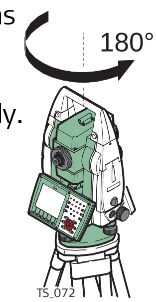
- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.

**Check & Adjust Wizard, 1st tilt measurement in any face.**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

**Meas** to measure the first face. No target has to be aimed at.

Motorised instruments change to the other face and release a measurement automatically.




Non-motorised instruments guide to the other face using the **Telescope Positioning** screen.

**Meas** to release the measurement in the other face.

☞ If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

**Check & Adjust Wizard, Step 2**

| Key | Description |
|---|---|
| **Next** | To measure the target. |
| Fn **Quit** | To exit the wizard. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **No. of measurements** | Display only | The number of runs. One run consists of a measurement in face I and II. |
| **σ l Comp** and **σ t Comp** | Display only | The standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards. |

**Check & Adjust Wizard, It is recommended to repeat the last calibration routine at least three times.**

Measure at least two more runs.

**Next step**

| IF | THEN |
|---|---|
| more runs must be added | select **Add another calibration loop** and press **Next**. |
| no more runs must be added | select **Finish the calibration & store the results** and press **Next** to accept the measurements and to access the results screen. |

**Check & Adjust Wizard, Results**

| Key | Description |
|---|---|
| **Finish** | To accept and record the new determined instrument errors. If the report sheet recording has been enabled, then the results are written and appended to an existing report sheet. |
| **Redo** | To reject all results and to repeat the complete check and adjust procedure. |
| Fn **Quit** | To exit the wizard. |

**Description of columns and fields**

| Column | Option | Description |
|---|---|---|
| **New** | Display only | The new determined and averaged instrument errors. |
| **Old** | Display only | The old instrument errors, which are currently valid on the instrument. |

## 31.7 Viewing the Current Values

**Access**

In **Check & Adjust Wizard**, **What do you want to do?** select **View the current values** and press **Next**.

**Check & Adjust Wizard**


| Key | Description |
|---|---|
| **OK** | To return to **Check & Adjust Wizard**, **What do you want to do?**. |
| **More** | To display information about the date of the determination, the standard deviation of the errors and the temperature during the determination. |
| Fn **Quit** | To exit the wizard. |

☞ The temperature of the environment around the instrument can differ from the temperature shown on the screen as it is the internal temperature of the instrument.

## 31.8 Configuring Check & Adjust

**Access**

In **Check & Adjust Wizard**, **What do you want to do?** select **Configure Check & Adjust** and press **Next**.

**Check & Adjust Wizard**

| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the wizard. |

**Description of options**

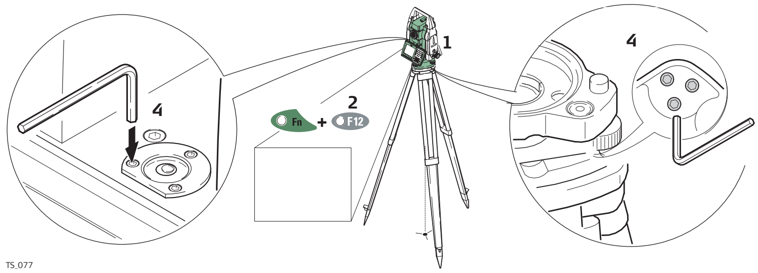
| Option | Description |
|---|---|
| **2 weeks**, **1 month**, **3 months**, **6 months** or **12 months** | If one or more adjustment values were determined longer ago than the time specified with this parameter, then a reminder message is displayed each time the instrument is turned on. This helps to redetermine the instrument errors on a regular basis. |
| **Never** | A reminder message to readjust the instrument is never displayed. This setting is not recommended. |

**Next step**

**Next** to change to the **Report sheet** screen.

## 31.9 Adjusting the Circular Level of the Instrument and Tribrach

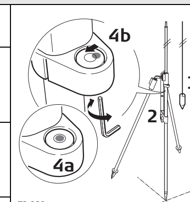
**Adjusting the circular level step-by-step**




| Step | Description |
|---|---|
| 1. | Place and secure the instrument into the tribrach and onto a tripod. |
| 2. | Using the tribrach footscrews, level the instrument with the electronic level. |
| 3. | Select **Instrument\TPS settings\Level bubble & compensator** to access the **Level Bubble & Compensator** screen. |
| 4. | Check the position of the circular level on the instrument and tribrach. |
| 5. | a) If both circular levels are centred, no adjustments are necessary |
| | b) If one or both circular levels are not centred, adjust as follows: |
| | **Instrument**: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. Turn the instrument by 200 gon (180°). Repeat the adjustment procedure if the circular level does not stay centred. |
| | **Tribrach**: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. |
| ☞ | After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose. |

## 31.10 Adjusting the Circular Level of the Prism Pole

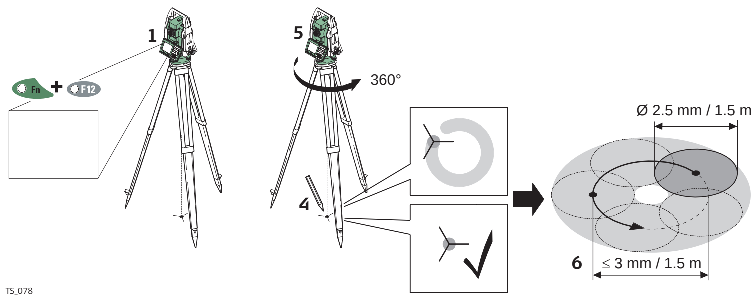
**Adjusting the circular level step-by-step**

| Step | Description | |
|---|---|---|
| 1. | Suspend a plumb line. |   |
| 2. | Use a pole bipod, to align the prism pole parallel to the plumb line. | |
| 3. | Check the position of the circular level on the prism pole. | |
| 4. | a) If the circular level is centred, no adjustment is necessary.<br>b) If the circular level is not centred, use an allen key to centre it with the adjustment screws. | |
| ☞ | After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose. | |

## 31.11 Inspecting the Laser Plummet of the Instrument

☞ The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, return the instrument to any Leica Geosystems authorised service workshop.

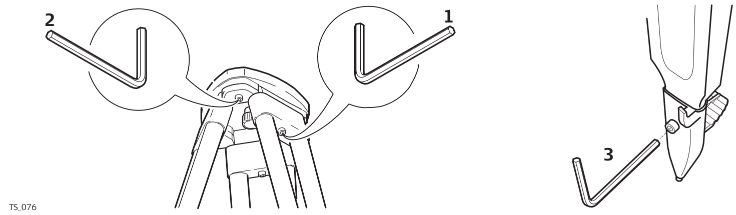
### Inspecting the laser plummet step-by-step




The following table explains the most common settings.

| Step | Description |
|---|---|
| 1. | Place and secure the instrument into the tribrach and onto a tripod. |
| 2. | Using the tribrach footscrews, level the instrument with the electronic level. |
| 3. | Select **Instrument\TPS settings\Level bubble & compensator** to access the **Level Bubble & Compensator** screen. |
| 4. | The laser plummet is switched on when the **Level Bubble & Compensator** screen is entered. Adjust the laser plummet intensity. Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, like a sheet of paper. |
| 5. | Mark the centre of the red dot on the ground. |
| 6. | Turn the instrument through 360° slowly, carefully observing the movement of the red laser dot. |
| ☞ | The maximum diameter of the circular movement described by the centre of the laser point must not exceed 3 mm at a distance of 1.5 m. |
| 7. | If the centre of the laser dot describes a perceptible circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems authorised service workshop. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m, it is about 2.5 mm. |

## Servicing the tripod step-by-step




The following table explains the most common settings.

| Step | Description |
|---|---|
| ☞ | The connections between metal and timber components must always be firm and tight. |
| 1. | Tighten the leg cap screws moderately, with the supplied allen key. |
| 2. | Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground. |
| 3. | Tighten the allen screws of the tripod legs. |

| | |
|---|---|
| **Access** | Select **Main Menu: User\About Leica Viva**. |
| **About Leica Viva, CS controller page** | The information relates to the field controller. This screen shows, depending on the controller type:<br>• The serial number,<br>• The equipment number,<br>• The firmware version of the boot software,<br>• The firmware version for the **E**lectric **F**ront **I**nterface,<br>• If a total station radio installed,<br>• If Wireless LAN is installed,<br>• If the internal GSM/CS modem is installed.<br><br>**Next step**<br>**Page** changes to the **Total station** page. |
| **About Leica Viva, Total station page** TPS | The information relates to the TPS instrument. This screen shows:<br>• The type of instrument,<br>• Additional instrument hardware options such as EDM or PowerSearch.<br><br>**Next step**<br>**Page** changes to the **GS sensor** page. |
| **About Leica Viva, GS sensor page** GPS | The information relates to the GPS instrument. This screen shows:<br>• The currently active system language,<br>• The serial number of the measurement engine,<br>• The availability of additional instrument hardware options,<br>• If the protected OWI commands and the ability to track GPS L5, GLONASS, Galileo and BeiDou have been activated by a licence key.<br>• The expiry date of the SmartLink option.<br><br>**Next step**<br>**Page** changes to the **SmartWorx Viva** page. |

**About Leica Viva, SmartWorx Viva page**

The information relates to the SmartWorx Viva instrument. This screen shows the applications installed on the instrument, and the following information.

**Description of fields**

| Field | Description |
|---|---|
| **WinCE version** | Firmware version for WinCE. |
| **SmartWorx Viva** | Firmware version for the onboard software. |
| **API version** | Firmware version for the application interface. |
| **CCP end** | Expiry date of the software maintenance.<br>When the the TPS or CS is switched on, a reminder message appears within one month of the due date of the software maintenance or when the software maintenance has expired.<br>The message appears only once!<br>is displayed on the **Main Menu** until the licence key has been updated.<br>Refer to "30.3 Load licence keys" for updating licence keys. |
| **mySecurity end** | If mySecurity is activated in myWorld: The date when the instrument must be connected to mySecurity in order to renew the security functionality.<br>If mySecurity is not activated in myWorld: **Not activated** is displayed. |
| **Load licence keys** | The information listed here indicates for which applications the licence keys are loaded. |

**Next step**

**Page** changes to another page on this screen.

# 33 mySecurity

**Description**

mySecurity is a cloud-based theft protection. A locking mechanism ensures that the instrument is disabled and can no longer be used. A Leica Geosystems service centre will inform local authorities if such an instrument turns up.

mySecurity is activated in myWorld.

**Adding/removing instruments to/from mySecurity**

| Step | Description |
|---|---|
| 1. | Go to myWorld@Leica Geosystems (**https://myworld.leica-geosys-tems.com**). |
| ☞ | You must add your instruments to **myProducts** first, before the instru-ments can be added to mySecurity. |
| 2. | Select **myTrustedServices**/**mySecurity**.<br>Available information for listed instruments:<br>• Activation date of the mySecurity service<br>• Renewal date of the mySecurity service<br>• Stolen status, in case of the instrument has been flagged as stolen |
| 3. | Click **Add** to add an instrument to mySecurity.<br>Select the instrument from the selectable list.<br>Click **OK**. |
| 4. | Select an instrument.<br>Click **Remove** to delete the instrument from mySecurity. |

**Activating the theft protection**

For an active theft protection, the instrument must be connected to myWorld within a defined time interval.
If the instrument is not connected within the defined interval, then the instrument is blocked and cannot be used. In this case, the instrument must be connected to myWorld again and the theft protection must be re-activated.

| Step | Description |
|---|---|
| 1. | Click the checkbox to select an instrument. |
| 2. | Click **Details**. |
| 3. | For **New mySecurity Renewal** set the start date of the theft protection.<br>Click **In 3 months**, **In 6 months** or **In 12 months** to define the connection interval. |
| 4. | Click **Set**. |
| 5. | Download and install the mySecurity Online Update program. |
| 6. | The program scans for the instrument connection port automatically.<br>In case automatic scanning fails, click **Scan** for a search of the port.<br><br>Select the connection settings.<br>Click **Defaults** for the pre-defined connection settings. |
| 7. | Click **Connect**.<br>After the activation, the end date of the theft protection is displayed in the mySecurity Online Update program and on the instrument. |
| 8. | Press **Close**. |
| 9. | Click the Refresh button to update the screen information. |
| 10. | Check the status, the activation date and the renewal date of the theft protection. |

**Status information on the instrument**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: User\About Leica Viva**. |
| 2. | Go to the **SmartWorx Viva** page. |
| 3. | **mySecurity end**:<br>Displays the date when the instrument must be connected to mySecurity. The date is transferred from myWorld to the instrument. |
| ☞ | Several days before the **mySecurity end**, a reminder message is displayed each time the instrument is turned on. |
| ☞ | When the **mySecurity end** has been exceeded, a message informs about the instrument lock. Go to myWorld to renew the theft protection. |
| ☞ | When the instrument is locked,<br>• all GeoCom commands for functionality are locked.<br>• all GeoCom commands for service are locked except the commands for firmware upgrade.<br>• a firmware downgrade via GeoCom is impossible. Versions lower than 5.50 and without mySecurity option cannot be loaded. |

**Report stolen instrument**

| Step | Description |
|---|---|
| 1. | Go to myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**). |
| 2. | Select **myTrustedServices**/**mySecurity**. |
| 3. | Click the checkbox to select an instrument. |
| 4. | Click **Details**. |
| 5. | In the **General** section, click **Report as Stolen**. |
| 6. | A warning comes up to confirm device as stolen.<br>Click **OK**. |
| 7. | The **Status** of the instrument changes to **Stolen!**.<br>A Leica Geosystems service centre will inform local authorities if such an instrument turns up. |

**Locate stolen instrument**

If a reported, stolen instrument attempts to connect to myWorld, then the IP address of the computer will be logged. The IP address is used to locate the instrument.

In myWorld/**myTrustedServices**/**mySecurity**, the **Status** of the instrument changes to **Located**.

Clicking **Show Location** shows:

- The date and time when the instrument was located
- The IP address of the computer
- A link to show the location on a map

# 34 Camera & Imaging

## 34.1 Overview

**Description**

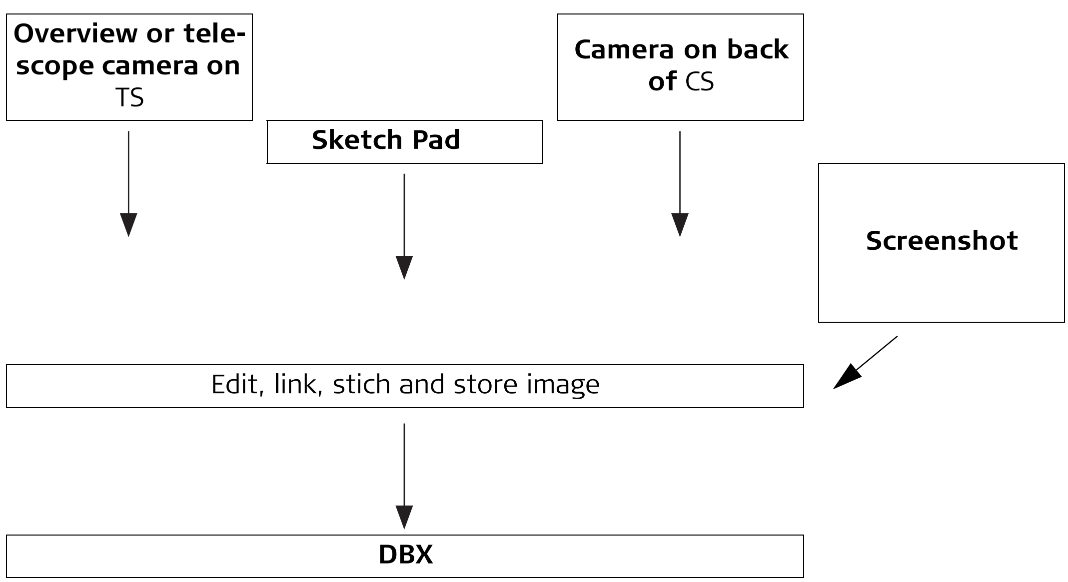
Instruments can be equipped with up to two cameras:

| Type | Available on |
|---|---|
| Overview camera | TS11 I, TS15 I, MS50, TM50 I, TS50 I, CS |
| Telescope camera | TM50 I, TS50 I, MS50 |

The camera & imaging functionality is an interactive feature embedded in SmartWorx Viva but used by some applications as well as data management. A licence key is required to store overview and telescope camera images.

- Camera applications:
  - Taking images of survey relevant objects for documentation purposes
  - Visual aiming using the view finder and the digital crosshair
- The images can be linked to points, lines and areas stored in the working job.
- Images can be captured in a defined sequence and combined to a panoramic image.
- Screenshots can be taken from the display as additional information.
- Images, screenshots and digital sketches can be edited and sketched on. This functionality is also available on instruments which do not have a camera or a imaging licence.
- Overview and telescope camera images can be transferred from the TPS to the CS.
- Images can be exported in DXF and LandXML format.
- The cameras can be switched.

Depending on where the camera & imaging functionality is accessed from, different functionality is available.



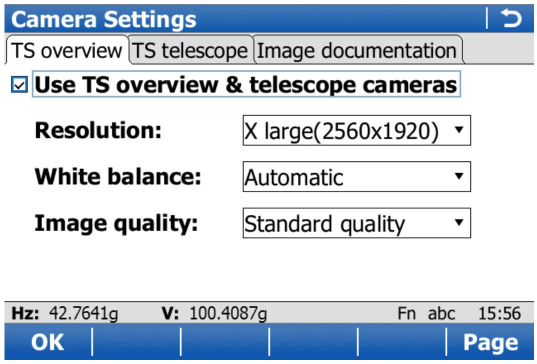
**Camera & imaging workflow on the TS**

| Step | Description |
|---|---|
| ☞ | The camera functionality on the TS must be licensed. |
| 1. | Select **Main Menu: Jobs & Data\New job**. Create a working job. Return to the **Main Menu**. |
| 2. | Select **Main Menu: Instrument\TPS camera settings**. On the **Check & Adjust Wizard**/**TS telescope** page, check **Use TS overview camera**/**Use TS overview & telescope cameras**. Return to the **Main Menu**. |
| 3. | Select **Main Menu: Go to Work!\Setup**. Define the station setup. Return to the **Main Menu**. |
| 4. | Select **Main Menu: Go to Work!\Survey**. Measure a point. |
| 5. | **Page** until the **Camera** page is active. **Cpture** to take an image on demand. |
| 6. | The image is only displayed, not stored yet. |
| 7. | To draw on the image, press the sketching icon on the toolbar. |
| 8. | To store the image, press **Store**. |
| 9. | Decide how to link the image:<br>• With the last measured point<br>• With any point, line or area<br>• No link at all<br>• Cancel |

**Access**

Select **Main Menu: Instrument\TPS camera settings**.

**Camera Settings, TS overview/TS telescope (for TS50) page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Use TS overview camera** | Check box | Available for TS11 I/TS15 I. The overview camera can be physically switched on and off.<br>When this box is checked, the camera is switched on. |
| **Use TS overview & telescope cameras** | Check box | Available for MS50/TS50 I/TM50 I. The overview AND the telescope camera can be physically switched on and off.<br>When this box is checked, the cameras are switched on. |
| **Resolution** | Selectable list | The resolution has a direct influence on the file size. When images are transferred between TS and CS, select **Medium** or **Small**. **Small** is recommended to save transfer time. |
| **White balance** | Selectable list | This setting defines the colour impression. If **Automatic** does not provide satisfying results, select **Indoor** or **Outdoor** depending on the surveying environment. |
| **Image quality** | | The grade of compression of the image. |
| | **Highest quality** | Low jpg compression, better image quality, larger file size |
| | **Standard quality** | Higher jpg compression, standard image quality, smaller file size |

**Next step**

**Page** to change to the **Image documentation** page.

**Camera Settings, Image documentation page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Capture overview image with every measurement**<br>For MS50/TS50 I/TM50:<br>**Capture overview image with every measurement**, **Capture telescope image with every measurement** | Check box | When this box is checked, an image is taken automatically with every measurement. The order of images taken is: 1. telescope camera, 2. overview camera.<br>When this box is not checked, pictures can be taken on demand. Use this option to save power. The active view finder defines the camera source when pressing **Cpture**.<br>In applications, use **Cpture** on the **Camera** page to take pictures.<br>Outside of applications, use the icon and then **Cpture**.<br>Images taken with the camera are always stored related to the active working job. The images are stored in a subfolder of the active working job. The images can be viewed in the Data Management. |
| **Link image with measurement** | Check box | Available when **Capture overview image with every measurement** is checked.<br>When this box is checked, the image taken with a measurement is automatically linked to the last measurement taken.<br>Several images can be linked with one point. One image can be linked to several measured points.<br>When this box is not checked, the image taken with a measurement is not automatically linked to a measurement. The image can be linked manually in data management. |
| **Store crosshair on image** | Check box | Available for TS11 I/TS15 I/MS50/TS50 I/TM50. When this box is checked, the crosshairs are stored on the picture. |
| **Store points, lines & areas on image** | Check box | When this box is checked, point, line and area information is stored on images taken with **Cpture**. The information stored on the image depends on the distance slider and the settings defined in **Camera View Settings** and **Sorts & Filters**. |
| **Keep original image** | Check box | When this box is checked, the image without points, lines and areas is saved additionally. |

## 34.3 Taking an Image

### 34.3.1 Overview

**Description**

- The camera can be used to take images of survey relevant objects.
- The images can be linked to points, lines and areas stored in the job.
- Screenshots can be taken from the display as additional information in support cases.

Standard functionality is provided by softkeys, keys and a toolbar.

The softkeys are available regardless of where the camera functionality was accessed from and always perform the same functions.

If **Display TS camera focussing toolbar** is checked in **Camera View Settings**, icons are available in a toolbar. One toolbar is located on the right side of the screen. A second toolbar on the left side of the screen is available when the telescope camera is active. Some of the functions performed by the icons can also be replicated using a softkey or key in the same mode as when the icon appears.

**Requirements**

- A TS11 I/TS15 I/MS50/TM50 I/TS50 I must be used.
- The camera configuration must be active. Refer to "34.2 Instrument - TPS camera settings".
- The documentation configuration must be set. Refer to "34.2 Instrument - TPS camera settings".

## 34.3.2 Outside of Applications

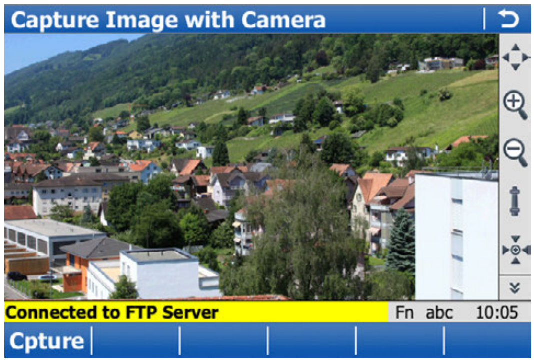
**Access**

Press a function key configured with the option **User - Use camera**.

OR

Click .

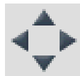
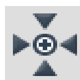
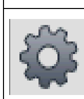
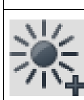
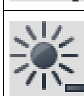
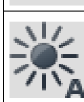
**Capture Image with Camera**




| Key | Description |
|---|---|
| **Cpture** | To take an image with the current pixel resolution. The image is then displayed but not stored on the memory device yet. |
| Fn **Config..** | To configure what is displayed on the **Camera** page. Refer to "Camera View Settings, General page". |
| Fn **Quit** | To exit the screen. |

**Overview of keys, softkeys and icons**

The softkeys described in this table are standard on all camera & imaging screens. For descriptions of mode-specific softkeys, see appropriate chapters.

| Icon | Key or Softkey | Description |
|---|---|---|
|  | - | To scroll the camera & imaging toolbar. |
|  | **1** | The fit icon displays, after zooming in/out, the complete image in VGA resolution. |
|  | **2** | To zoom into the image. |
|  | **3** | To zoom out of the image. |
|  | **5** | To zoom to the maximum in the current viewing direction. |
|  | - | To define a range by a minimum and a maximum distance. Three-dimensional points within the defined range are displayed.<br>☞ This functionality is only available on the **Camera** page within the Survey application.<br><br>Top slider<br>The maximum distance from the instrument, for example set to 400.<br>Bottom slider<br>The minimum distance from the instrument, for example set to 10.<br>Result<br>Points between 10 m and 400 m from the instrument are displayed on the image.<br>☞ To move the slider, tap on the slider, hold and drag it or use the up and down arrow keys. |
|  | Fn **Config..** | To access **Camera View Settings**. Refer to " Camera View Settings, General page". |
|  | - | To increase the brightness from the current value. |
|  | - | To decrease the brightness from the current value. |
|  | - | To return to automatic brightness of the image. |
|  | - | To configure the camera. Refer to "34.2 Instrument - TPS camera settings". |

| Icon | Key or Softkey | Description |
|---|---|---|
|  | - | To switch between overview and telescope camera. After turning the instrument on the overview camera is in use. The style of the cross-hairs changes with the camera in use.<br>☞ Or use the hot key/favourites menu function **TPS - Toggle overview/telescope camera**. |
|  | - | To switch continuous autofocus on and off. |
|  | - | Continuous autofocus is active. |
|  | **Focus** | To activate a single autofocus. Single autofocus deactives continuous autofocus. Same functionality as pressing the autofocus button on the side cover of the instrument.<br>☞ Or use the hot key/favourites menu function **TPS - Single auto focus**.<br>☞ While continuous autofocus is active, any manually measured distance updates the focus position. |
| - |  +  | Available on CS. To focus manually:<br>• Up and down arrow: To focus in big steps.<br>• Right and left arrow: To focus in small steps. |
| - | Pressing 2x autofocus button on side cover - short | To perform an automatic contrast based refocus. |
| - | Pressing autofocus button on side cover - long | To start continuous autofocus. |

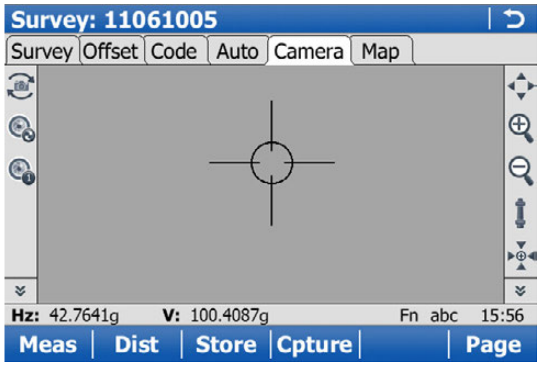
## 34.3.3 Within Applications

**Access**

In the Survey, Reference Plane and Setup application, go to the **Camera** page.

**In Survey**

A **Camera** page is displayed.
The style of the crosshairs changes with the camera in use.
Refer to "Overview of keys, softkeys and icons" for information on the toolbar.




| Key | Description |
|---|---|
| **Meas** | To measure and store distances and angles.<br>If configured, an image is taken automatically.<br>If configured, the image is linked to the point measurement automatically. |
| **Stop** | Available if **Measure mode: Continuous** and **Dist** was pressed. Stops the distance measurements. The key changes back to **Meas**. |
| **Dist** | To measure and display distances. |
| **Store** | To record data.<br>If **Measure mode: Continuous** and/or **Log auto points** is checked, measured points are recorded and tracking continues. If configured, an image is taken automatically.<br>☞ Depending on the configuration, crosshairs are stored on top of the image.<br>☞ For the overview camera: If a valid distance measurement is available, then the parallax is corrected and the crosshairs are overlaid on the image on their true position. |
| **Cpture** | To take an image with the current pixel resolution. The image is then displayed but not stored on the memory device yet. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure what is displayed on the **Camera** page. Refer to "Camera View Settings, General page". |
| Fn **2Store** | Available for **Measure mode**: **Single** and **Measure mode**: **Single (fast)**. **Target aiming**: **Manual** must be selected. To take an angle only measurement in Face I and Face II and automatically store an average of the two measurements. |
| Fn **2Face** | Available for **Measure mode**: **Single** and **Measure mode**: **Single (fast)**. To take an angle and distance measurement in Face I and Face II. The point stored is an average of the two measurements. When using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

**In Setup** TS

In the setup application, points can be linked with images. Depending on the configuration the images are linked either automatically or manually.
A **Camera** page is displayed. Depending on the screen, the available keys differ.
The style of the crosshairs changes with the camera in use.
Refer to "Overview of keys, softkeys and icons" for information on the toolbar.

**For Set Station Orientation and Measure Target**

| Key | Description |
|---|---|
| **Set** | For **Setup method: Set orientation**: To set the station and orientation and exit the Setup application.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically. |
| **Meas** | For **Setup method: Multiple backsights**: To measure and store the distances and angles made to the control points.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically.<br>For measurements in two faces, two images are linked with one point. |
| **Dist** | To measure and display distances. |
| **Store** | For **Setup method: Set orientation**: To store the measurement with or without a distance.<br>For **Setup method: Multiple backsights**: To record display values temporarily. The target measurements will not be stored to the current job until the station is set.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically.<br>For measurements in two faces, two images are linked with one point. |
| **Cpture** | To take an image with the current pixel resolution. The image is then displayed but not stored on the memory device yet.<br>For **Setup method: Multiple backsights**, **Setup method: Transfer height** and **Setup method: Resection**:<br>In case of multiple backsight setups, link the image with the next or the previous target. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure what is displayed on the **Camera** page. Refer to "Camera View Settings, General page". |
| Fn **Quit** | To exit the screen. |

#### For the Results screen

| Key | Description |
|---|---|
| **Cpture** | To take an image with the current pixel resolution. The image can then be linked to the calculated setup point. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure what is displayed on the **Camera** page. Refer to "Camera View Settings, General page". |
| Fn **Quit** | To exit the screen. |

### Camera View Settings, General page

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display TS camera zooming toolbar** / **Display TS camera focussing toolbar** | Check box | Determines if the toolbar of icons is displayed. Refer to "Overview of keys, softkeys and icons". |
| **Display crosshairs** | Check box | TS<br>If no distance is measured, then the coarse style crosshair is indicated which is approximately the field of view.<br>If a valid distance is measured and the parallax can be resolved, then the fine style crosshair is indicated as two intersecting lines on the true position. When the instrument turns about three gon in horizontal or vertical direction after measuring a distance, then the crosshair style changes back to the field of view variant.<br>In tracking mode, the crosshairs are always on the correct position and displayed as two intersecting lines.<br>When locked onto a prism, the crosshair style adapts with distance measurements. |
| **Crosshair colour** | Selectable list | Available if **Display crosshairs** is checked. Defines the colour of the crosshairs. |

#### Next step

**Page** to change to the **Points display** page.

**Camera View Settings, Points display page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display points** | Check box | When this box is checked, points from the working job with 3D local grid coordinates are displayed on the view finder. Use the display of points to check completeness and reliability of the survey.<br><br>Points are displayed with a visual 3D effect: Points further away from the instrument are displayed smaller than points closer to the instrument. |
| **Point ID**, **Point code**, **Height of point** or **Quality of point** | Check box | When this box is checked, the relevant information of a measured point is displayed next to the point symbol. |
| **Point symbol colour** | Selectable list | Available if **Display points** is checked. Defines the colour of the points. |
| **Number of points** | Selectable list | Available if **Display points** is checked. The maximum number of overlaid points. The last points stored in the DBX are displayed, regardless of the point class. If **20** is selected and a new point is measured, then the first point of the previous 20 is no longer displayed. |
| **Only display points measured from current station** | Check box | In addition to the selected number of points, the points displayed can be restricted further by showing only points measured from the current station. |

### Next step

**Page** changes to the **Lines / areas display** page.

**Camera View Settings, Lines / areas display page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display lines & area** | Check box | When this box is checked, lines/areas from the working job with 3D local grid coordinates are displayed on the view finder. Use the display of points to check completeness and reliability of the survey.<br>Points are displayed with a visual 3D effect: Points in further away from the instrument are displayed smaller than points closer to the instrument.<br>☞ Points are only displayed on the image. They are not saved with the image. |
| **Display line & area IDs** | Check box | When this box is checked, then the line/area IDs are displayed with the lines/areas. |
| **Use fixed colour for lines & areas** | Check box | When this box is checked, a colour for displaying lines/areas can be selected.<br>When this box is not checked, the lines/areas are displayed in the line/area code colour. |
| **Colour** | Selectable list | This colour is used for the lines/areas and for the text related to the line and area IDs. |
| **Number of lines / areas to show** | Selectable list | Available if **Display lines & area** is checked. The maximum number of overlaid lines/areas. The last lines/areas stored in the DBX are displayed. If **20** is selected and a new line/area is measured, then the first line/area of the previous 20 is no longer displayed.<br>☞ The selected number is the sum of lines and areas. For example, if **20** is selected, this can be 5 lines and 15 areas. |

### Next step

**Page** changes to another page on this screen.
For MS50: **Page** changes to the **ScanArea display** page.

**Camera View Settings, ScanArea display page**

Available for MS50.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Current scan definition colour** | Selectable list | This colour is used in **Scan Viewer** for the scan area currently defined. |

### Next step

**Page** changes to another page on this screen.

### 34.3.4 Screenshot

**Description**

Press a hot key configured to **User - Screenshot capture** or Fn and '**.**'. The screenshot is displayed and can be edited by sketching.

The screenshot can be linked with points manually. Sketching on the screenshot is possible.

The screenshot is stored as jpg with a predefined compression rate. The resolution is 640 x 480. Screenshots can be georeferenced by linking to a point. Screenshots cannot be orientated and calibrated.

## 34.3.5 Panoramic Imaging

**Description**

A panoramic image is a combination of single images. Panorama images show the area of what can be seen from the instrument station. Panorama images are used for documentation purposes and support the evaluation of the surveying data directly in the field or in the office. Panorama images can be imported into LGO.

Panoramic images can be generated independent of any application.

A panorama is organised with a panorama instance within the DBX. The single images are stored in the DBX\JOB\IMAGES folder of the data storage device. The single images are named Img_Pano_x_y_date_time.jpg where as

| Field | Description |
|---|---|
| x | Number of the row, starts with upper left corner |
| y | Number of columns, starts with upper left corner data |
| Date | Same as with normal images |
| Time | Same as with normal images |

☞ Panoramic images can only be generated with motorized instruments with overview camera (TS15 I/MS50/TM50 I/TS50 I).

**Access**

In **Leica TPS Favourites** click **Panoramic image**.
OR
Press a function key configured with the option **User - Capture panoramic image**.
OR
At the end of Setup, a panoramic image can be taken.

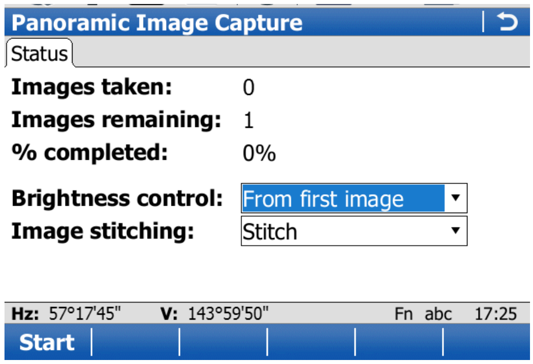
**Select Panoramic Image Type**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Image type** | **Rectangular area** | Area defined by upper left and lower right corner |
| | **Multi-row 360° image** | 360° with one or more rows above each other |
| | **Single row 360° image** | 360° in one row |
| | **Polygonal area** | Area defined by three or more corners in clockwise direction. |

**Next step**
**OK** and follow the instructions on the screen to define the area.
Once the panoramic image area is defined then the **Panoramic Image Capture** screen opens.

## Panoramic Image Capture




| Key | Description |
|---|---|
| **Start** | To start taking the panorama images. |
| **Stop** | To end taking the panorama images. |
| **Pause** | To pause taking the panorama images. |
| **Resume** | To continue taking panorama images after **Pause** has been pressed. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Images taken** | Display only | The number of captured images. |
| **Images remaining** | Display only | The number of images remaining to be taken. |
| **% completed** | Display only | In percent, the number of images taken against the total number of images which must be taken. |
| **Image file name** | Display only | The name of the file where the image is stored to. |
| **Brightness control** | | To control the brightness of each tile of the panorama image. |
| | **From first image** | The brightness is measured for first image of the panorama. The value is applied to all further tiles. Recommended for panorama images taken under normal conditions |
| | **From each image** | The brightness is measured for each image of the panorama. Recommended for panorama images with diverse brightness. |
| **Image stitching** | **Stitch** | A stitched panoramic image is created and stored. Possibilities: <br>• Colouring of any related scan <br>• Panoramic image is exported to any export <br>• Documentation onboard <br><br>Stitching combines multiple images with overlapping fields of view to one segmented panorama or high-resolution image. |
| | **Do not stitch** | The image is not stitched. No name of the panoramic image is added to the DBX. |

### Next step

The panorama and the images are stored in the images folder of the working job, either with or without link to the reference triplet of the current station.

An image belonging to a panorama image can be linked manually with another object without affecting the panorama image.

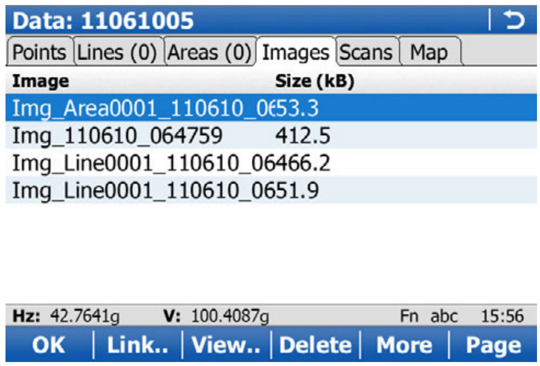
## 34.4 Image Management

☞ Image Management is available on instruments which have a camera or a camera license.

**Access**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\View & edit data.** |
| 2. | **Page** until the **Images** page is active. |

**Data:, Images page**




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. |
| **Link..** | To display a points list and to link the image to a point. |
| **View..** | To display an image. Refer to "Image Notes". |
| **Delete** | To delete the highlighted image and all its links. |
| **More** | To display information about the image size and the time and the date of when the image was stored. |
| **Page** | To change to another page on this screen. |
| Fn **Filter..** | To define sort and filter settings. Refer to " Sorts & Filters, Images page". |
| Fn **Quit** | To exit the screen. |

**Next step**

| IF | THEN |
|---|---|
| an image is to be viewed or edited | **Open**. Refer to "Image Notes". |
| sort and filter settings are to be defined | Fn **Filter..**. Refer to "Sorts & Filters, Images page". |

## Image Notes

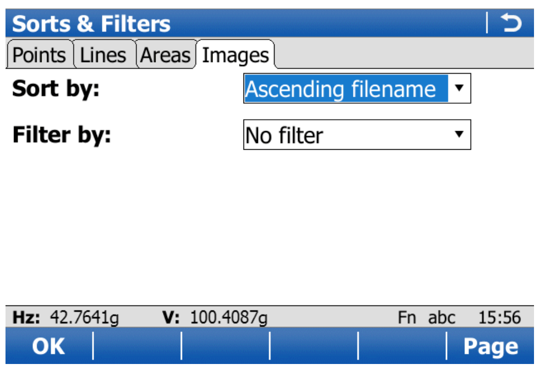
Use the arrow keys on the keypad to move the image on the screen.

| Key | Description |
|---|---|
| **Store** | To store the image with the added link or a sketch created.<br>If no sketch was created, then the image is not stored a second time to avoid a loss of quality. |
| **Prev** | To display the previous image in the list of images displayed in **Data:**, **Images** page. Available unless the beginning of the list is reached. |
| **Next** | To display the next image in the list of images displayed in **Data:**, **Images** page. Available unless the end of the list is reached. |
| Fn **Config..** | To activate or deactivate a toolbar with icons for sketching. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Store** returns to **Data:**, **Images** page.

## Sorts & Filters, Images page




| Key | Description |
|---|---|
| **OK** | To close the screen and return to the screen from where this screen was accessed. The selected sort and filter settings are applied. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Sort by** | **Ascending filename**, **Descending filename**, **Forward time** and **Backward time** | Always available. The method the images are sorted by. |
| **Filter by** | | Always available. The method by which the images are filtered. |
| | **No filter** | Shows all images. |
| | **Image source** | Shows photos taken with the camera or screenshots. Make the selection in the **Image source** field. |
| | **Camera type** | Shows images taken with the TS11/TS15 or CS camera. Make the selection in the **Camera type** field. |
| | **Linked / unlinked** | Shows linked or unlinked images. Make the selection in the **Image** field. |
| **Image source** | | Available for **Filter by**: **Image source**. |
| | **Camera** | Shows images taken with the camera on the TS11/TS15 or CS. |
| | **Screenshot** | Shows pictures taken from the instrument screen. |
| | **Field sketch** | Shows field sketches created. |
| **Camera type** | | Available for **Filter by**: **Camera type**. |
| | **Overview camera** | Shows images taken with the overview camera on the instrument. |
| | **CS camera** | Shows images taken with the camera on the CS. |
| | **Telescope camera** | Shows images taken with the telescope camera on the instrument. |
| **Image** | Selectable list | Available for **Filter by**: **Linked / unlinked**. Either linked or unlinked images are displayed. |

### Next step

**OK** returns to **Data:**, **Images** page.

## 34.5 Sketching

### 34.5.1 Sketching on Images

**Description**

A sketch can be overlaid on an image taken with a camera.

A sketch can be made on every jpg file stored in the DBX\JOB\IMAGES folder of the working job.

The sketch is stored together with the image in jpg format. The compression rate is specified in the **Camera Settings** screen. The image with the sketch is stored by pressing **Store**.

**Access step-by-step**

**In data management** (the image is already stored and possibly linked)

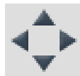
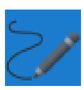
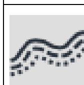
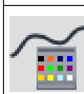
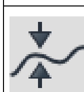
| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\View & edit data.** |
| 2. | **Page** until the **Images** page is active. |
| 3. | Press **View**. |
| 4. | In **Sketch Pad**, click the  icon in the toolbar. |

**For images**

| Step | Description |
|---|---|
| 1. | Click .<br>OR<br>Start the Survey or Setup application and go to the **Camera** page. |
| 2. | Press **Cpture**. The image is taken as with a digital camera. |

**For screenshots**(the image is already stored and possibly linked)
Press a hot key configured to **User - Screenshot capture**. The screenshot is displayed and can be edited by sketching.

**Overview of keys, softkeys and icons for sketching**

| Icon | Key or Softkey | Description |
|---|---|---|
|  | - | To scroll the camera & imaging toolbar. |
|  | **1** | The fit icon displays, after zooming in/out, the complete image in VGA resolution. |
|  | **2** | To zoom into the image.<br>☞ Pressing ESC stops the zooming process. |
|  | **3** | To zoom out of the image.<br>☞ Pressing ESC stops the zooming process. |
|  | - | The windowing icon zooms to a specified area window. An area window can be drawn by dragging the stylus on the screen in a diagonal line to make a rectangular area or by tapping twice on the screen to define diagonally opposite corners of a rectangular area. This action causes the screen to zoom to the selected area. |
|  | - | To activate sketching. The  icon is displayed. The image cannot be moved. |
|  | - | To quit sketching. The  icon is displayed. The image can be moved. |
|  | - | To change the line style. Tap the icon to open a window displaying line styles for selection. The selected line style is remembered. |
|  | - | To change the line colour. Tap the icon to open a window displaying line colours for selection. The selected line colour is remembered. |
|  | - | To change the line width. Tap the icon to open a window displaying line widths for selection. The selected line width is remembered. |
|  | - | To undo all changes since the last saving. |

## 34.5.2 Field Sketching

**Description**

The field sketch functionality is used to create a sketch on a virtual paper. Sketching is possible on predefined or on customer templates. Custom templates can, for example, include a company logo or check boxes for tasks that must be done.

The sketch is stored as image in jpg format. The jpg file is stored in the DBX\JOB\IMAGES folder of the data storage device.
The predefined templates are optimised for A4 printout. Customer templates can be optimised for any format.

A screenshot cannot be made from the field sketch.

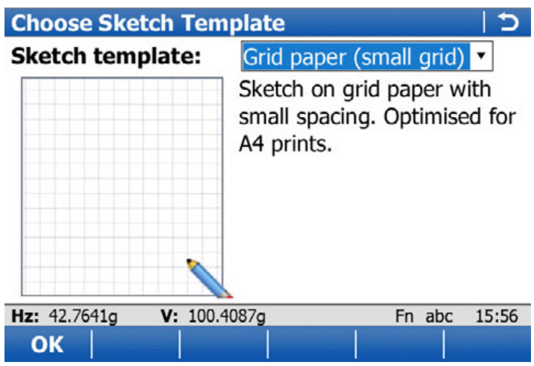
**Access**

In **Leica TPS Favourites** or **Leica GPS Favourites** click **Sketch pad**.

OR

Press a hot key configured to access the screen **Choose Sketch Template**. Refer to "25.4 Hot keys & favourites" for information on hot keys.

**Choose Sketch Template**




| Key | Description |
|---|---|
| **OK** | To create a copy of the selected sketch template and to start sketching. |
| Fn **Delete** | To delete the selected custom template. |
| Fn **Quit** | To exit the screen.2 |

**Description of fields**

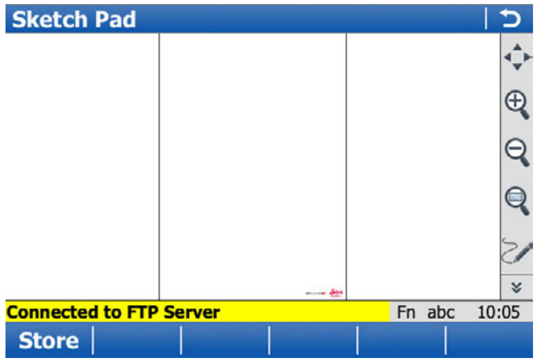
| Field | Option | Description |
|---|---|---|
| **Sketch template** | **Plain paper**, **Lined paper-narrow**, **Lined paper-wide**, **Grid paper (small grid)** or **Grid paper (large grid)** | The predefined sketch templates. |
| | Custom templates | The custom templates must be jpg files with a maximum of five megapixel. The templates are stored in the CONFIG\SKETCH_TEMPLATES folder of the data storage device. To make a custom template selectable in the list, transfer the template to the internal memory in **Main Menu:** User**Tools & other utilities\Transfer user objects**. Refer to "30.1 Transfer user objects". |

**Next step**

Select a template. **OK** to access **Sketch pad**.

**Sketch Pad**

Refer to "Overview of keys, softkeys and icons" for information on the toolbar.




| Key | Description |
|---|---|
| **Store** | To store and link the field sketch. |
| Fn **Quit** | To exit the screen. |

## 34.6 Exporting Images

**Exporting images in DXF format**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\Export & copy data\Export DXF Data.** |
| 2. | **Config..** goes to **Configuration**, **Export** page. |
| 3. | Checking **Images** activates the export of images linked with any point, line or area. |
| ☞ | If multiple images are linked with one point, one line or one area, then all images linked are exported. |
| ☞ | Images are exported according to the filter settings. Press **Filter..** to check the settings. |

**Exporting images in XML format**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\Export & copy data\Export XML Data.** |
| 2. | **Config..** accesses **Configuration**, **Export** page. |
| 3. | Checking **Images** activates the export of images linked with any point, line or area. |
| ☞ | Images are exported according to the filter settings. Press **Filter..** to check the settings. |

# 35 TPS Functions

## 35.1 EDM

**Description**

**E**lectronic **D**istance **M**easurement **EDM** is the function used for distance measurements.

There are different modes the instrument can work in. Refer to "12.1.1 Measure & Target Settings".

## 35.2 Prism Search Methods

### 35.2.1 Automatic aiming

**Description**

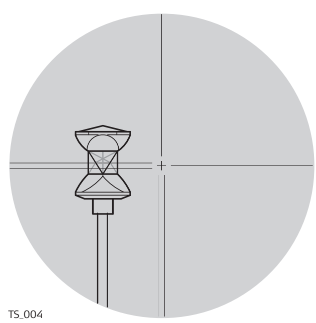
Automatic aiming is the function which recognises and measures the position of a prism using a CCD array. A laser beam is transmitted and the reflected beam is received by the built-in CCD array. The position of the reflected spot with respect to the centre of the CCD is computed. These automatic aiming offsets are used to correct the horizontal and vertical angles. The automatic aiming offsets are also used to control the motors which turn the instrument to centre the crosshairs to the prism. In order to minimise the time for measuring, the crosshairs are not moved to the exact centre of the prism. The automatic aiming offset can be up to 500 cc depending on selected **Measure mode**. The automatic aiming function measures the offsets between the crosshairs and prism centre and corrects the horizontal and vertical angles accordingly. Therefore the horizontal and vertical angles are measured to the prism-centre, even if the crosshairs are not aimed precisely at the centre of the prism.

Motorised instruments can be equipped with automatic aiming. For **Target aiming: Automatic** the instrument can find a static prism and measure a distance once **Meas** or **Dist** is pressed. The instrument does not follow a moving prism.

**Field of view**

The telescope field of view is the region seen when looking through the telescope. The automatic aiming field of view is the region seen by the automatic aiming. Both are identical on TPS instruments.

**Automatic aiming measurement**

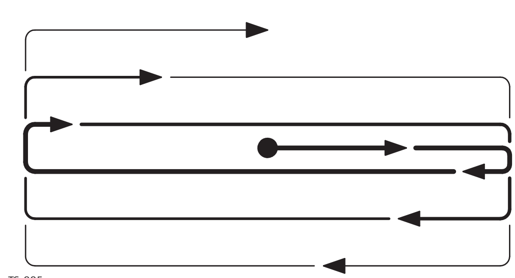



If the prism is in the field of view with **Target aiming: Automatic** the crosshairs are automatically positioned to the prism when, for example **Meas** or **Dist** is pressed. No automatic aiming search is started.

☞ The displayed values are always related to the centre of the prism after **Meas** or **Dist** is pressed. For **Meas**, these values are displayed only shortly after the key press.

The crosshairs of the telescope may not fully coincide with the centre of the prism when viewed through the telescope. The remaining automatic aiming offsets for the horizontal and vertical angles are measured by the automatic aiming function and applied to the measured and displayed angles.

**Automatic aiming search**




If the prism is not in the field of view when **Meas** or **Dist** is pressed, an automatic aiming search is started. For the automatic aiming search the automatic aiming window is scanned line by line starting at the current telescope position. If the

- prism was not found: **Retry** can be pressed to search for the prism in an increased area.
- prism was found: The automatic aiming measurement is performed to position the telescope to the centre of the prism.

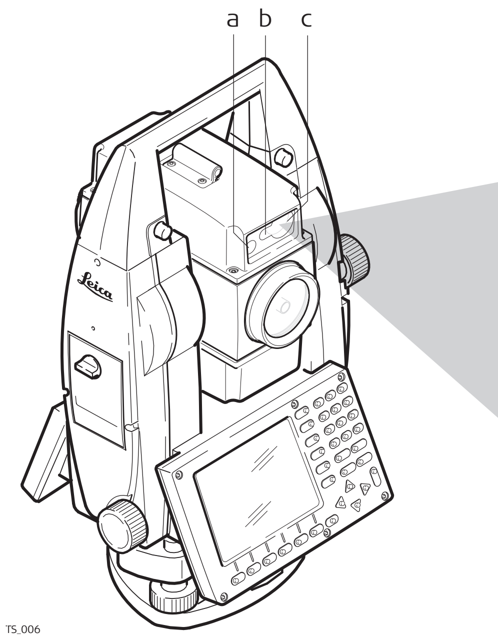
| | |
|---|---|
| **Automatic aiming window** | The automatic aiming window is a relative window based on the current telescope position. The horizontal and vertical extent can be defined. |
| **Fine search window** | If no target is found after the prediction time and **If no target found after prediction then: Start fine search** is set, then the prism is searched for with automatic aiming using a dynamic automatic aiming window. This window covers a horizontal region from the position of loss of lock to the current telescope position, and the same extent on the other side. The vertical dimension of the dynamic window is one third of the horizontal expansion. |
| **Targeting modes** | Refer to "12.1.1 Measure & Target Settings". |

## 35.2.2 PowerSearch

**Description**

The PowerSearch module allows an automatic prism detection within a short time period. The PowerSearch function can be started in the **Leica TPS Favourites** screen and configured in **TPS settings\Prism search settings**, **PowerSearch window**.

**Functionality**




The PowerSearch function consists of a transmitter (a) and a receiver (b). Both are installed in the telescope.

When PowerSearch is activated, the instrument starts to rotate around its standing axis. The transmitter emits a vertical laser swath. If the laser swath detects a prism, the rotation of the instrument is stopped. Afterwards an automatic aiming measurement in the vertical direction is performed.

a) EGL
b) Transmitter
c) Receiver

☞ If a PS window is defined and active, PowerSearch is executed within the defined limits.

**360° search**

If the search window is not defined and PowerSearch is started, the prism is searched for with PowerSearch in the 360° window. The default search with PowerSearch consists of a short swing in anti-clockwise direction followed by a complete 360° turn in clockwise direction. If a prism is detected the movement is stopped and an automatic aiming search is performed.

**PowerSearch window**

The PowerSearch window can be defined individually. It is specified by absolute angle values and does not change its position. The PowerSearch window can be set in the **Prism Search Settings, PowerSearch window** page by aiming at two opposite points of the PowerSearch window. When **Use PowerSearch window** is checked and a PowerSearch is started, a prism is searched for within the defined window.

**Dynamic PowerSearch window**

When **Use PowerSearch window** is not checked and the instrument has lost lock, after the prediction time, the prism is searched for in a dynamic PowerSearch window. This window covers a region at the position after prediction of horizontal 100 gon by vertical 40 gon.

**Direction of search**

The PowerSearch routine can be activated clockwise or anticlockwise by using hotkeys. This action will have no influence on the prism search settings.

## 35.3 Follow Moving Prisms - Lock

**Description**

Lock enables instruments equipped with automatic aiming to follow a moving prism. The automatic aiming sensor is active when Lock is active. When **Target lock on** is selected in **Leica TPS Favourites**, an automatic aiming search is executed. The instrument locks onto the prism and follows its movements. Automatic aiming offsets are continuously applied to the angle measurements. When the instrument loses lock to the prism, a PowerSearch or fine search (auto aiming search) can be executed depending on the prism search settings.
Lock is unavailable for SmartStation.

☞ If the speed of the prism is too fast, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

**Enable lock**

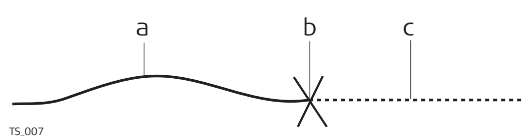
Selecting **Target lock on** in **Leica TPS Favourites**, will immediately activate an automatic aiming search to find the prism. Alternatively, as long as **Target aiming** is set to **Lock** in **Measure & Target Settings**, then pressing **Meas**, **Dist**, **PowerSearch right**, **OK** in **Check Point**, **Joystick**, **Turn to Hz/V** and **Orientation With Compass** will start a PowerSearch or automatic aiming search to find the prism. When the prism is found, the instrument locks onto the prism. The instrument follows the moving prism and the automatic aiming function remains active.

**Loss of lock**

When the instrument is locked onto a prism, lock may be lost if the movement of the prism is too fast for the instrument to follow or the prism is hidden behind an object. After lock is lost, the prediction, as set in **Prism Search Settings** is used to find the prism again.
The automatic aiming function is still active.

☞ Whenever the prism is moved in the field of view during the prediction and any other search periods, the instrument locks automatically to the prism.

**Prediction**




a) Moving prism locked onto by the instrument
b) Loss of lock
c) Prediction

As long as the prism is being tracked by the instrument a mathematical filter continuously calculates the average speed and direction of the prism. If the line of sight between instrument and prism is disturbed, the instrument keeps on moving using these calculated values. This behaviour is called prediction. The prediction time can be configured. During prediction, the LOCK icon is displayed and if the prism comes into the instruments field of view again the automatic aiming will lock to the prism.

**Prism search after prediction**

After prediction, the prism is searched for depending on the settings in **Prism Search Settings**.

- **If no target found after prediction then: Stop searching**. If the prism moved in the field of view, the prism is not searched for until **Meas**, **Dist**, **Target lock on** is pressed.
- **If no target found after prediction then: Start fine search**: prism is searched for in the dynamic automatic aiming window with automatic aiming.
- **If no target found after prediction then: Start PowerSearch** and **Use PowerSearch window** is checked: prism is searched for in the PS window with PowerSearch.
- **If no target found after prediction then: Start PowerSearch** and **Use PowerSearch window** is NOT checked: prism is searched for in the dynamic PowerSearch window.

**Relock**

Independent of the setting for **If no target found after prediction then** the instrument can relock to the prism. Refer to paragraph "Enable lock".

## 35.4 RCS

**Description**

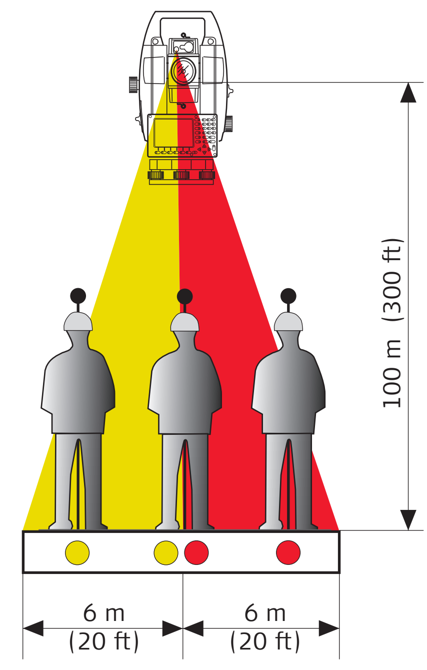
The instrument can be controlled by the field controller via radio. The automatic aiming function does not necessarily have to be active when working in RCS mode. The field controller is used to remote control the instrument. No data can be stored on the field controller. The screen and content displayed on the field controller are a copy of the remote controlled instrument.
The communication between the total station and the field controller is established via radio modems. One radio modem has to be connected to the total station serial port.

## 35.5 EGL

**Description**

The **E**mitting **G**uide **L**ight, EGL, consists of two differently coloured flashing lights in the telescope housing of the TPS. The EGL is used for guidance into the line of sight. If the left light is seen, the prism must be moved right and vice versa. If both flashing lights can be seen, the prism is in the line of sight of the instrument.

**Functionality**




The EGL can be used

- to help guide the prism into the telescope line of sight when the instrument is controlled remotely and **Target aiming: Lock**.
- to stake out points.

The instrument emits two differently coloured flashing cones of light. At a target distance of 100 m, the cones have a width of 6 m. Between the two cones of light, a sector with a width of 30 mm is created where both guide lights are visible simultaneously. In this position, the prism is in the line of sight of the instrument.

**Using the EGL step-by-step**

| Step | Description |
|---|---|
| 1. | Check **Use the instrument guide lights (EGL)** in the **Instrument Lights** screen.<br>OR<br>Set **Target aiming: Lock** and press **Compass** or **Turn to Hz/V** or **Joystick** on the **Leica TPS Favourites** screen. |
| 2. | Align instrument line of sight and prism, where both flashing EGL lights can be seen simultaneously. |
| 3. | **OK** to lock onto the prism. |
| 4. | If the instrument has locked onto the prism the EGL is turned off automatically. |
| ☞ | If the EGL was turned on in **Instrument Lights**, it has to be turned off by unchecking the check box. |

## 35.6 Illumination

**Description**

There are several different illumination types built into the instrument that all fulfil different functions. Some are to support measurements, for example the visible red laser pointer. Others, such as the screen illumination, are for more convenient work with the instrument. These different types of illumination are described in this chapter.

**Laser plummet**

The laser plummet allows setting up the instrument over a marked point. The laser beam is emitted from the bottom of the instrument, pointing to the ground. When the instrument is levelled and the laser beam points exactly at the ground point, the instrument is set up correctly.

The laser plummet can be turned on and off. It is turned on automatically when opening the **Instrument\TPS settings\Level bubble & compensator** screen and turned off when leaving the screen.

**Visible red laser pointer**

The visible red laser pointer is used to measure to any surface. The visible red laser pointer is arranged coaxially with the line of sight of the telescope and emitted through the objective. If the instrument is correctly adjusted, the visible red laser beam coincides with the line of sight.

☞ The direction of the beam should be inspected before precise distance measurements are executed. An excessive deviation of the laser beam from the line of sight can cause inaccurate results.

**GUS74 Laser Guide**

The GUS74 Laser Guide is an option for TPS instruments. It is built into a special telescope compartment and emits a visible red laser beam to visualise the line of sight over long ranges. The GUS74 Laser Guide is used for special applications such as tunnelling. Refer to GUS74 Laser Guide Manual for detailed information.

## 35.7 Connection to Other Total Stations

### 35.7.1 Leica Legacy Total Stations

**Supported functions**

| **Function** | **TPS300 TPS400 TPS700** | **TPS700A** | **TPS800** | **TPS1000 TPS1100** |
|---|---|---|---|---|
| Robotic control | - | - | - | - |
| Auto aiming | - | ✓ | - | ✓ |
| Level bubble | - | - | - | - |
| Auto aiming in setup | - | ✓[1] | - | ✓[1] |
| Compensator on/off | ✓ | ✓ | ✓ | ✓ |
| Laser plummet on/off | ✓ | ✓ | ✓ | - |
| Laser pointer on/off | ✓ | ✓ | ✓ | - |
| EGL on/off | ✓ | ✓ | ✓ | ✓ |
| Connection status | ✓ | ✓ | ✓ | ✓ |
| TPS battery status | - | - | - | - |
| Move between reflectorless & prism measurements | ✓ | ✓ | ✓ | ✓ |
| Measure mode continuous | ✓ | ✓ | ✓ | ✓ |
| Auto logged points | ✓ | ✓ | ✓ | ✓ |

✓ Supported
- Not supported
1 The auto aiming function when doing a setup only works if a distance is measured. The **Meas** or **Dist** key must be used. When using the **Store** key only, the auto aiming function in setup is unavailable.

☞ SmartPole and SmartStation are not supported with Leica Legacy instruments.

☞ Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

## 35.7.2 Topcon

**Supported functions**

| Function | GTS<br>GPT<br>GPT-L | GTS800<br>GTS820<br>GTS900 | GPT8000<br>GPT8200<br>GPT9000 |
|---|---|---|---|
| Robotic control | - | - | - |
| Auto aiming | - | - | - |
| Level bubble | - | - | - |
| Compensator on/off | - | - | - |
| Laser plummet on/off | - | - | - |
| Laser pointer on/off | - | - | - |
| EGL on/off | ✓ | ✓ | ✓ |
| Connection status | ✓ | ✓ | ✓ |
| TPS battery status | - | - | - |
| Move between reflectorless & prism measurements | ✓ | ✓ | ✓ |
| Measure mode continuous | - | - | - |
| Auto logged points | - | - | - |

✓ Supported
- Not supported

☞ Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

## 35.7.3 Sokkia

**Supported functions**

| Function | Set 030R/220/010 | Set 10/10K Series<br>Set 20/20K Series<br>Set 30R/30RK/130R | Set 110 Series<br>Set 110R<br>Set 120 Series | Set 110M Series | Set 230RM Series | Set 300/500/600<br>SRX Series | Set X Series<br>Set SCT6 |
|---|---|---|---|---|---|---|---|
| Robotic control | - | - | - | - | - | - | - |
| Auto aiming | - | - | - | - | - | - | - |
| Level bubble | - | - | - | - | - | - | - |
| Compensator on/off | - | - | - | - | - | - | - |
| Laser plummet on/off | - | - | - | - | - | - | - |
| Laser pointer on/off | - | - | - | - | - | - | ✓ |
| EGL on/off | - | - | - | ✓ | - | ✓ | - |
| Connection status | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| TPS battery status | - | - | - | - | - | - | - |
| Move between reflectorless & prism measurements | 1 | - | - | - | ✓ | ✓ | ✓ |
| Measure mode continuous | ✓ | ✓ | | | | ✓ | ✓ |
| Auto logged points | ✓ | ✓ | | | | ✓ | ✓ |
| Others | 2 | - | - | - | - | - | - |

✓ Supported
- Not supported
(grey) Not available
1 Set **Prism** or **Any surface** measure modes at the instrument. Set the correct prism constant at the controller.
2 Setup not available. Set horizontal angle at instrument.

☞ Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

## 35.7.4 Nikon

**Supported functions**

| Function | 800 Series | Nikon A Series | DTM300 Series | DTM330 Series NPL330 Series | DTM500 Series | Nivo C Nivo M |
|---|---|---|---|---|---|---|
| Robotic control | - | - | - | - | - | - |
| Auto aiming | - | - | - | - | - | - |
| Level bubble | - | - | - | - | - | - |
| Compensator on/off | - | - | - | - | - | ✓ |
| Laser plummet on/off | - | - | - | - | - | - |
| Laser pointer on/off | - | - | - | - | - | - |
| EGL on/off | - | - | - | - | ✓ | - |
| Connection status | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| TPS battery status | - | - | - | - | - | - |
| Move between reflectorless & prism measurements | - | - | - | ✓ | - | ✓ |
| Measure mode continuous | | ✓ | - | ✓ | ✓ | ✓ |
| Auto logged points | | | - | ✓ | ✓ | ✓ |
| Others | - | 1 | - | - | - | - |

✓ Supported
- Not supported
(grey) Not available
1 Setup not available. Set horizontal angle at instrument.

☞ Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

# 36 Calculator

## 36.1 Accessing the Calculator

**Description**

The calculator can be used to perform the following arithmetic operations such as

- addition, subtraction, multiplication and division
- statistics
- trigonometry, hyperbolic trigonometry and calculations with Pi
- polar, rectangular and angle conversions
- powers, logs, roots and exponential functions.

**Operating modes**

The calculator has two operating modes - RPN mode and Standard mode.
The arithmetic operations available are identical, the difference lies in the way information is entered, stored and displayed on the screen.

| Type | Description |
|---|---|
| RPN | **R**everse **P**olish **N**otation<br>This operating mode was developed as a way of writing mathematical expressions without using parenthesis and brackets. Many scientific calculators, for example Hewlett Packard calculators, are implemented with this operating mode. Values are entered and kept in a working stack. |
| Standard | This operating mode is based on the principles of conventional pocket calculators. There is no stacking of values. |

**Access**

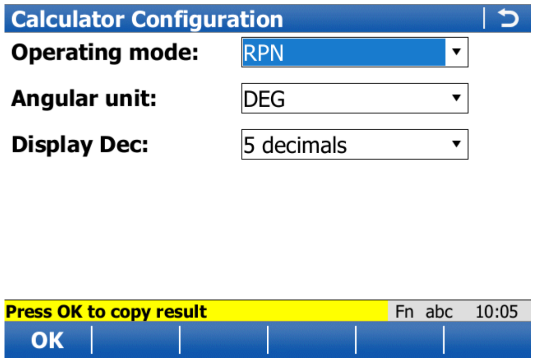
Press **Calc** in any screen when editing an editable field for numeric characters, such as **Azimuth** in **Traverse Input**.

## 36.2 Configuring the Calculator

**Access**

In **RPN Calculator** or **Standard Calculator** press Fn **Config..** to access **Calculator Configuration**.

**Calculator Configuration**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Operating mode** | **RPN** | The principle of, for example, Hewlett Packard calculators. |
| | **Standard** | The principle of conventional pocket calculators. |
| **Angular unit** | | The unit used for trigonometric functions in the calculator. The selection here is independent from the angle setting in **Regional Settings**, **Angle**. |
| | **DEG** | Degrees |
| | **RAD** | Radians |
| | **GRAD** | Gon |
| **Display Dec** | From **0** to **10 decimals** | The number of decimal places shown. |

### Next step

**OK** confirms the selections made and returns to the screen from where this screen was accessed.

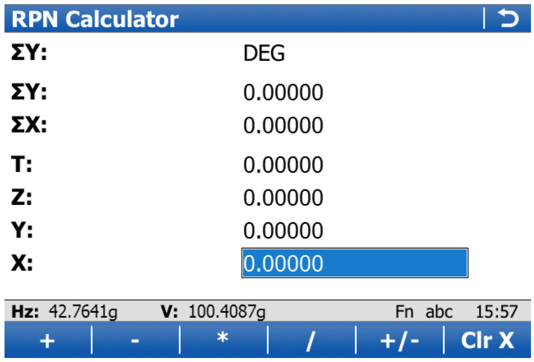
# 36.3 Using the Calculator

## 36.3.1 RPN Mode

**Requirements**

**Operating mode: RPN** in **Calculator Configuration**.

**RPN Calculator**




| Key | Description |
|---|---|
| **F1** - **F6** | The function keys are allocated seven times. Refer to **Description of Softkeys**. |
|  | Using the up and down keys the various allocations can be accessed. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| First field on the screen | Display only | The unit used for trigonometric functions in the calculator as configured in **Calculator Configuration**. |
| | **DEG** | Degrees |
| | **RAD** | Radians |
| | **GRAD** | Gon |
| **ΣY** | Display only | The result of the sum or difference of values in **Y** using **Σ+** and **Σ-**. |
| **ΣX** | Display only | The result of the sum or difference of values in **X** using **Σ+** and **Σ-**. |
| **T** | Display only | Third stack. After an operation, the value from **Z** is written here. |
| **Z** | Display only | Second stack. After an operation, the value from **Y** is written here. |
| **Y** | Display only | First stack. After an operation, the value from **X** is written here. |
| **X** | Editable field | The value for the next operation. |

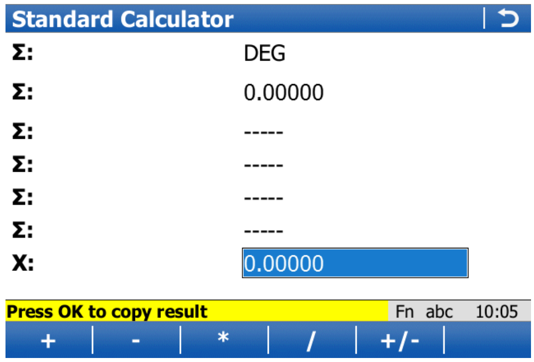
**Next step**
Fn **Quit** returns to **Main Menu**.

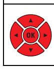
## 36.3.2 Standard Mode

**Requirements**

**Operating mode: Standard** in **Calculator Configuration**.

**Standard Calculator**




| Key | Description |
|---|---|
| **F1** - **F6** | The function keys are allocated seven times. Refer to **Description of Softkeys**. |
|  | Using the up and down keys the various allocations can be accessed. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| First field on the screen | Display only | The unit used for trigonometric functions in the calculator as configured in **Calculator Configuration**. |
| | **DEG** | Degrees |
| | **RAD** | Radians |
| | **GRAD** | Gon |
| **Σ** | Display only | The result of the sum or difference of values in the last field on the screen using **Σ+** and **Σ-**. |
| Third to sixth field on the screen | Display only | Previously entered value<br>OR<br>Latest operation including result.<br># indicates that the value is cut after the third decimal. |
| Last field on the screen | Editable field | The value for next operation or result from latest operation. |

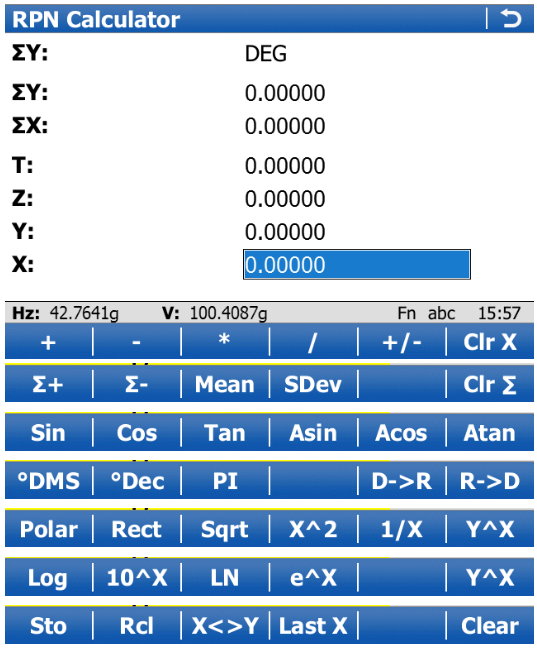
**Next step**

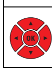
Fn **Quit** returns to **Main Menu**.

## 36.3.3 Description of Softkeys

**Overview of softkeys**

The softkeys shown and described are from **Operating mode: RPN**. Most of the softkeys are identical and their functionality is similar to the softkeys from **Operating mode: Standard**.




| Key | Description |
|---|---|
| **F1** - **F6** | The function keys are allocated seven times. |
|  | Using the up and down keys the various allocations can be accessed. |

**Description of softkeys**

**First level**


| Key | Description |
|---|---|
| **+** | To add **X** and **Y**. |
| **-** | To subtract **X** from **Y**. |
| ***** | To multiply **X** by **Y**. |
| **/** | To divide **Y** by **X**. |
| **+/-** | To change between positive and negative algebraic sign for **X**. |
| **Clr X** | To clear **X**. |

### Second level


| Key | Description |
|---|---|
| **Σ+** | To add **X** to **ΣX** and **Y** to **ΣY**. |
| **Σ-** | To subtract **X** from **ΣX** and **Y** from **ΣY**. |
| **Mean** | To calculate the mean **ΣX**. |
| **SDev** | To calculate the standard deviation for **ΣX**. |
| **Clr ∑** | To clear **ΣX** and **T**. |

### Third level


| Key | Description |
|---|---|
| **Sin** | To calculate sine of **X**. |
| **Cos** | To calculate cosine of **X**. |
| **Tan** | To calculate tangent of **X**. |
| **Asin** | To calculate arcsine of **X**. |
| **Acos** | To calculate arccosine of **X**. |
| **Atan** | To calculate arctangent of **X**. |

### Fourth level


| Key | Description |
|---|---|
| **°DMS** | To convert decimal degrees into dd.mm.ss. |
| **°Dec** | To convert dd.mm.ss into decimal degrees. |
| **PI** | To insert **X: 3.1415926536**. The number of decimals depends on the selection for **Display Dec** in **Calculator Configuration**. |
| **D->R** | To convert degrees into radians. |
| **R->D** | To convert radians into degrees. |

### Fifth level


| Key | Description |
|---|---|
| **Polar** | Conversion of rectangular coordinates into polar coordinates. The y coordinate must be visible in **Y** and the x coordinate in **X** when pressing this key. The angle is displayed in **Y** and the distance in **X**. |
| **Rect** | Conversion of polar coordinates into rectangular coordinates. The angle must be visible in **Y** and the distance in **X** when pressing this key. The y coordinate is displayed in **Y**, the x coordinate in **X**. |
| **Sqrt** | To calculate $\sqrt{\mathbf{X}}$. |
| **X^2** | To calculate $\mathbf{X}^2$. |
| **1/X** | To inverse **X:**. |
| **Y^X** | To calculate $\mathbf{Y}^{\mathbf{X}}$. |

### Sixth level


| Key | Description |
|---|---|
| **Log** | To calculate the $\log_{10}\mathbf{X}$. |
| **10^X** | To calculate $10^{\mathbf{X}}$. |
| **LN** | To calculate the $\log_e\mathbf{X}$. |
| **e^X** | To calculate $e^{\mathbf{X}}$. |
| **Y^X** | To calculate $\mathbf{Y}^{\mathbf{X}}$. |

### Seventh level


| Key | Description |
|---|---|
| **Sto** | To store **X** to the memory. Up to ten values can be stored. |
| **Rcl** | To recall a value for **X** from the memory. Up to ten values can be recalled. |
| **X<>Y** | To swap the values for **X** and **Y**. |
| **Last X** | To recall the last **X** before recent calculation. |
| **Clear** | To delete everything. |

Fn to access the second level of function keys


| Key | Description |
|---|---|
| Fn **Config..** | To configure the calculator. |
| Fn **Done** | To return to **Main Menu**. |
| Fn **Quit** | To exit the screen. |

# 37 NTRIP via Internet

## 37.1 Configuring Access to the Internet

It is recommended to configure an Ntrip connection via the **RTK Rover Wizard**. Select **Main Menu\Instrument\GPS settings\RTK rover wizard** and follow the on-screen instructions.
The remainder of this chapter describes each of the steps and screens when configuring without the use of the **RTK Rover Wizard**.

TPS One Internet interface is available - the **CS Internet**.

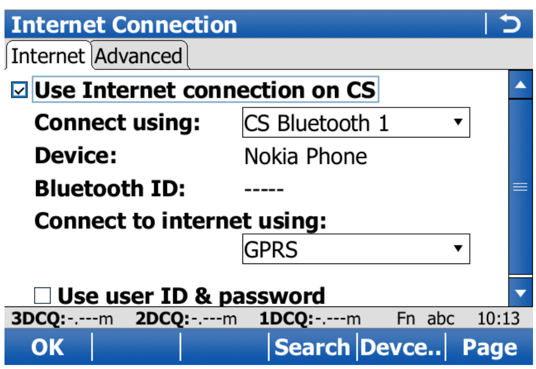
GPS Two Internet interfaces are available - the **CS Internet** and the **GS Internet**.
The **CS Internet** is used as an example. The explanations are also valid for the **GS Internet**.

To access the Internet with a GPS or TPS instrument, **G**eneral **P**acket **R**adio **S**ystem devices will normally be used. GPRS is a telecommunication standard for transmitting data packages using the Internet Protocol (IP).

**Select the internet interface**

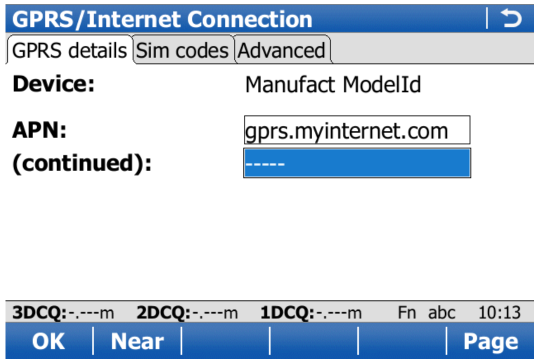
Select **Main Menu: Instrument\Connections..\All other connections**.
On the **CS connections** page highlight **CS Internet**.
Press **Edit...**

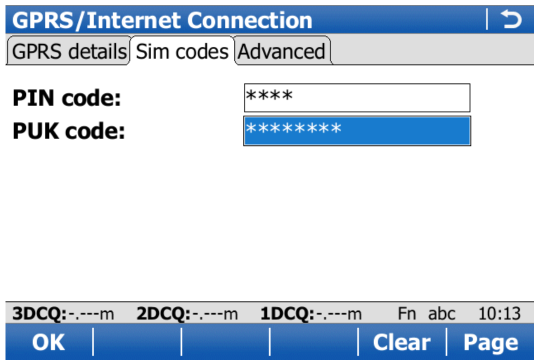
**Configure the Internet interface**




| Step | Description |
|---|---|
| 1. | Select a port (**Connect using**). |
| 2. | Select a device (**Devce..**). |
| 3. | If necessary enter **User ID** and **Password**. Some providers ask for a **User ID** and a **Password** to allow connecting to the Internet via GPRS. Contact your provider if a user ID and password needs to be used. |
| 4. | **OK** to return to **Connection Settings**. |
| 5. | In **Connection Settings** press **Cntrl...** Continue with the next paragraph. |

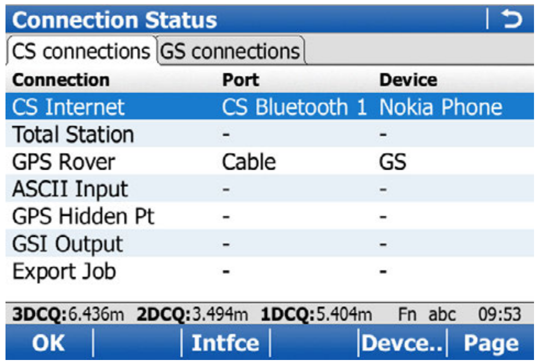
### Configure the GPRS/Internet Connection




| Step | Description |
|---|---|
| 1. | On the **GPRS details** page, type in the **APN** (**A**ccess **P**oint **N**ame of a server from the network provider). Contact your provider to get the correct APN. |
| 2. | On the **Sim codes** page, type in the **PIN code** for the Sim card.<br>If the PIN is locked for any reason, for example the wrong PIN was entered, input the **P**ersonal **U**nbloc**K**ing code for access to the PIN. |
| 3. | **OK** twice to return to the **Main Menu**.<br>The instrument is now online to the Internet. The Internet online status icon is displayed. But because GPRS is being used, no charges are yet made since no data transfer from the Internet has yet taken place. |

## Check the status of the Internet connection

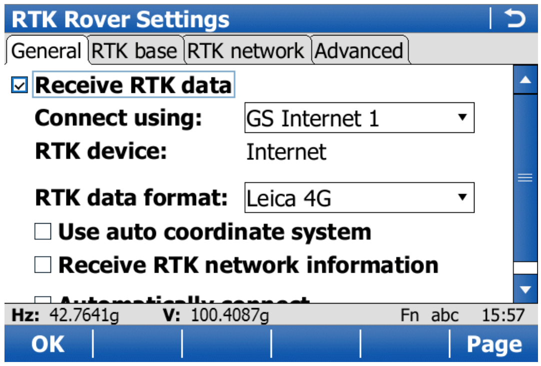


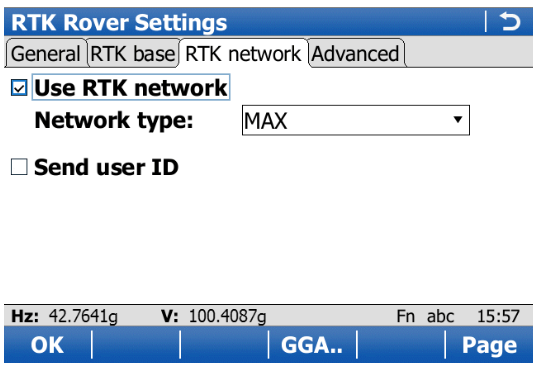

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Instrument\Instrument status info\Connection status**. |
| 2. | On the **CS connections** page highlight **CS Internet**. |
| 3. | Press **Intfce**. |
| 4. | Check the Internet online status. |
| 5. | **OK** twice to return to the **Main Menu**. |

## Select the internet interface

Select **Main Menu: Instrument\Connections..\All other connections**.
On the **GS connections** page highlight **RTK Rover**.
Press **Edit..**.

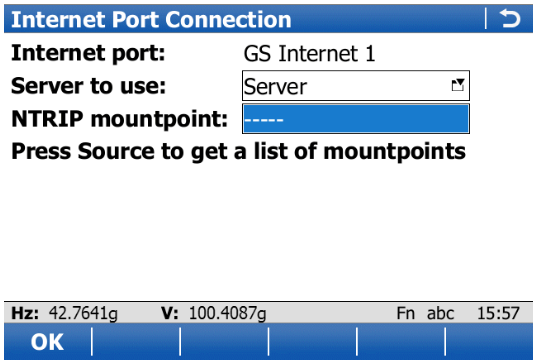
## Settings for the RTK rover

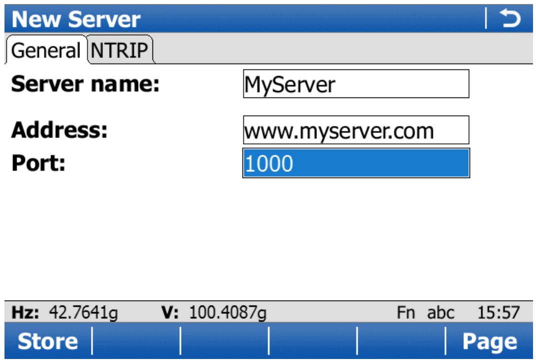


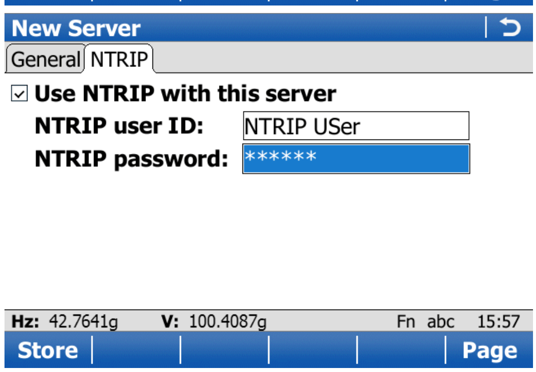




| Step | Description |
|---|---|
| 1. | On the **General** page, make sure that an Internet port is selected for **Connect using**. |
| 2. | On the **RTK network** page, enable **Use RTK network**. |
| 3. | Press **OK** to return to **Connection Settings**, **GS connections** page. |
| 4. | Press **Cntrl..** to access **Internet Port Connection**. Continue with the next paragraph. |

## Select the server to be accessed in the Internet

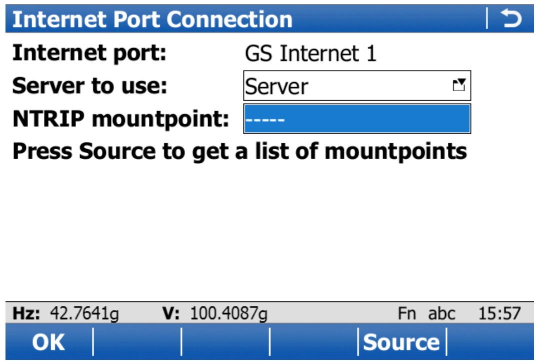


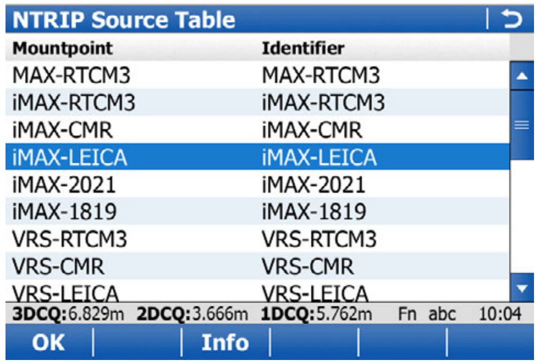




| Step | Description |
|---|---|
| 1. | The **Server to use**, must be Ntrip enabled. To create a new server click into the selectable list. |
| 2. | In **New Server**, **General** page, type in the address and the port of the server through which the data is provided. Each server has several ports for various services. |
| 3. | In **New Server**, **NTRIP** page, activate the use of Ntrip. |
| 4. | Type in the **NTRIP user ID** and the **NTRIP password**. A user ID and the password are required to receive data from the Ntrip Caster. Contact the Ntrip administrator for information. |
| 5. | **Store** followed by **OK** to return to **Internet Port Connection**. |

## Select the Ntrip mountpoint




| Step | Description |
|---|---|
| 1. | If the selected server is Ntrip enabled, Ntrip mountpoint is available. |
| 2. | Press **Source** to access **NTRIP Source Table**. |
| 3. | All mountpoints are listed. Mountpoints are the Ntrip servers sending out real-time data. This screen consists of two columns. The first column shows the abbreviations for the Mountpoints, the second the city where the Mount-point is located. |
| 4. | Highlight a mountpoint. |
| 5. | Press **OK** twice to return to **Connection Settings**, **GS connections** page. |
| 6. | Fn **Conect** and Fn **Disco** are now available in all applications to connect to and disconnect from the Ntrip server. |

# 38 MapView Interactive Display Feature

## 38.1 Overview

**Description**

MapView is an interactive display feature embedded in the firmware. MapView provides a graphical display of the survey elements which allows for a better overall understanding of how the data being used and measured relates to each other.

Depending on the application and where in the application MapView is accessed from, different functionality is available.

The displayed data in all modes of MapView can be shifted by using both the arrow keys and the touchscreen.

A geo-referenced background image can be displayed behind the map.

**Displayable data**

The data displayed in MapView is defined by the application through which it was accessed, filters set in **Sorts & Filters**, and the selections made in **Map View Settings**.

☞ The datum view is always considered as local.

☞ If negative coordinates are used in CAD files to suit projections with the origin in North-East and the axes going South and West, use the setting **Switch Easting for CAD files** and **Switch Northing for CAD files** in **Regional Settings**, **Coords** page to mirror the CAD file in MapView.

## 38.2 Accessing MapView

**Description**

The MapView interactive display feature is provided as a page within all applications and data management. It is accessed through the application itself. Depending on the application and from where in the application MapView is accessed, different MapView modes are available.

**Access step-by-step**

**Example for data management**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Jobs & Data\View & edit data**. |
| 2. | **Page** until the **Map** page is active. |

**Example for an application**

| Step | Description |
|---|---|
| 1. | Select **Main Menu: Go to Work!\COGO\Intersection**. |
| 2. | **COGO Intersection**<br>Choose a method and enter appropriate data. |
| 3. | **Calc** to access **Intersection Result**, **Results** page. |
| 4. | **Page** until the **Plot** page is active. |

## 38.3 Configuring MapView

**Description**

Allows options to be set which are used as default options within MapView. These settings are stored within the working style and apply to all Map and Plot pages, regardless of how MapView is accessed.

☞ Any changes made in **Map View Settings** affect the appearance of MapView in all applications, not just the active application.

**Access step-by-step**

Press Fn **Config..** on any **Map** or **Plot** page.

**Map View Settings, General page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Display map-view toolbar** | Check box | Determines if the toolbar of icons is displayed. Refer to "38.4.2 Keys, Softkeys and Toolbar". |
| **Show my path** | Check box | Displays the path of the rover as a dashed line. |
| **Centre to** TPS | **Target** | To centre the map on the target.<br>For **Measure mode: Single** and **Measure mode: Single (fast)**, the map will centre onto the last measured point.<br>For **Measure mode: Continuous** and **Measure mode: Long range (>4km)**, the map will centre onto the current reflector position. |
| | **TPS instrument** | To centre the map on the instrument. |
| **Rotate data in map by 180°** | Check box | To rotate the map by 180°. The north arrow is not rotated and still orientated towards the top of the screen. |

**Next step**

**Page** changes to the **Points** page.

**Map View Settings, Points page**

| Key | Description |
|---|---|
| **OK** | To confirm the selections and to return to the screen from where this screen was accessed. |
| **Symbol** | To view all point symbols and their descriptions. |
| **Page** | To change to another page on this screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display points** | Check box | Determines if points are displayed in MapView. |
| **Point ID** | Check box | Available if **Display points** is checked. Determines if the ID of a point is displayed. |
| **Point code** | Check box | Available if **Display points** is checked. Determines if the code of a point is displayed. |
| **Height of point** | Check box | Available if **Display points** is checked. Determines if the height of a point is displayed. |
| **Quality of point** | Check box | Available if **Display points** is checked. Determines if the coordinate quality of a point is displayed. |
| **Show pt info for a maximum of 200 pts** | Check box | If checked, point information is not shown when more than 200 points are displayed.<br>If not checked, the point information as configured is shown regardless of the number of points being displayed. |

### Displayable point information


a) **Point ID**
b) **Point code**
c) **Height of point**
d) **Quality of point**

### Next step

**Page** changes to the **Lines & areas** page.

## Map View Settings, Lines & areas page

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display lines** | Check box | Determines if lines are displayed in MapView. |
| **Line ID** | Check box | Available if **Display lines** is ticked. Determines if the ID of a line is displayed. |
| **Line code** | Check box | Available if **Display lines** is ticked. Determines if the code of a line is displayed. |
| **Display areas** | Check box | Determines if areas are displayed in MapView. |
| **Area ID** | Check box | Available if **Display areas** is ticked. Determines if the ID of an area is displayed. |
| **Area code** | Check box | Available if **Display areas** is ticked. Determines if the code of an area is displayed. |

### Displayable line/area information

A line is shown as example.


a) **Line ID**
b) **Line code**

### Next step

**Page** changes to the **DTM** page.

## Map View Settings, DTM page

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display DTM in map** | Check box | When this box is checked, DTM triangles are shown within the **Map** page of the Stakeout, Reference Line, Road or Rail application.<br>☞ The setting of for this check box is linked to the setting for the **Show DTM on map** check box in **Use heights from DTM** (**Roads**, Tools menu). |
| **Colour** | Selectable list | Defines the colour of the active DTM layer boundary. |

### Next step

**Page** changes to the **Alignments** page.

**Map View Settings, Alignments page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Display alignments** | Check box | Determines if alignments are displayed in MapView. |
| **Line ID** | Check box | Available if **Display alignments** is ticked. Determines if the ID of an alignment is displayed. |
| **Vertical exaggeration of profiles** | Editable field | The exaggeration factor of the map. The value can be between 0.1 and 50. ☞ This setting only has an effect in applications where cross-section views are displayed. |
| **Display all layers in cross-section view** | Check box | When this box is checked, all layers of an alignment are displayed in a cross section view. |

### Next step

**Page** changes to the **CAD import** page.

**Map View Settings, CAD import page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point prefix**, **Line prefix** or **Area prefix** | Editable field | The identifier with up to four characters is added in front of the ID of the imported CAD points, lines or areas. |
| **Create points at the vertices of lines** | Check box | Option if points will be created at vertices of the imported line/arc/polyline elements. |
| **Height to exclude** | Editable field | Height values inside the DXF file are considered invalid and will not be converted. |
| **Apply height to 2D CAD data on import** | Check box | When this box is checked, a height can be defined which is then applied to all imported 2D CAD points. |
| **Height to apply** | Editable field | Available when **Apply height to 2D CAD data on import** is checked. The height to apply to 2D CAD points. |

### Next step

**Page** changes to the **Map images** page.

**Map View Settings, Map images page**

| Key | Description |
|---|---|
| **OK** | To confirm the selections and to return to the screen from where this screen was accessed. |
| **Images** | To select the background image to be used. Opens **Map images**. |
| **Page** | To change to another page on this screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Display map image** | Check box | When this box is checked, a geo-referenced background image is displayed behind the map. ☞ At least one image file (*.jpg + *.jgw, *.archive) must have been transferred to the internal memory. |

**Next step**

**OK** confirms the selections and returns to the previous screen.

**Map images**

**Access**

Press **Images** in **Map View Settings**, **Map images** page.

| Key | Description |
|---|---|
| **OK** | To confirm the selections and to return to the screen from where this screen was accessed. |
| **None** or **All** | To deactivate or activate all background images. |
| **Delete** | To delete the highlighted background image. |
| **Use** | To activate and deactivate the highlighted background image. |
| Fn **Quit** | To exit the screen. |

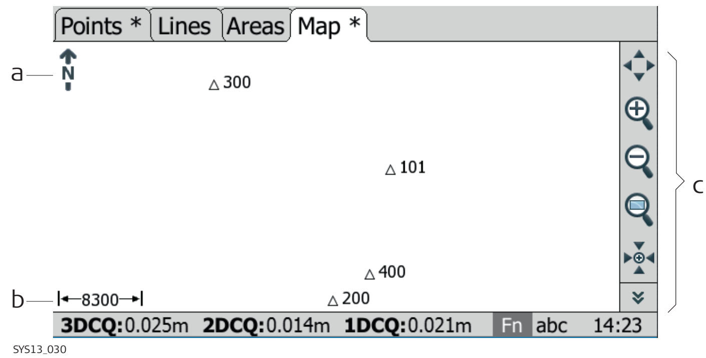
**Description of columns**

| Column | Description |
|---|---|
| **Image** | The name of the background image.<br>Hierarchy of listing = hierarchy in the map:<br>• Names alphabetically<br>• Numbers<br>The file that is on top of the list is shown on the top in the map. |
| **Size (kB)** | The size of the background image in kilobytes. |
| **View in map** | Use background image or not. **Use** changes between the options. |

## 38.4 MapView Components

### 38.4.1 Screen Area

**Standard screen**




a) North arrow
b) Scale bar
c) Toolbar

**Scale bar**

| Symbol | Description |
| --- | --- |
| \|←120→\| | Scale of the current screen. The minimum is 0.1 m. There is no maximum for the zoom but the scale cannot display values greater than 99000 m. In this case the value displayed will be >99000 m. |

**North arrow**

| Symbol | Description |
| --- | --- |
|  | North arrow. North is always orientated towards the top of the screen. |

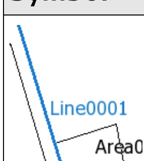
**Toolbar**

| Symbol | Description |
| --- | --- |
|  | Icon toolbar. Refer to "38.4.2 Keys, Softkeys and Toolbar" for more information about the functionality of the icons in the toolbar. |

**Point with focus**

| Symbol | Description |
| --- | --- |
| △101 | The point that has the focus. |

**Line/area with focus**

| Symbol | Description |
| --- | --- |
|  | The line/area that has the focus is bolder than other lines shown in blue for the full and in orange for Lite version of SmartWorx Viva. |

**Rover**

| Symbol | Description |
|---|---|
|   | Available in survey mode. Position of the rover. The rover path is shown as dotted line. |

**Prism**

| Symbol | Description |
|---|---|
|  | Measured position. The orientation of the instrument is shown as dotted line. |

**Instrument station**

| Symbol | Description |
|---|---|
|  | Position of the instrument station. |

## 38.4.2 Keys, Softkeys and Toolbar

**Description**

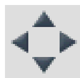
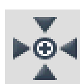
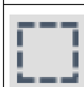
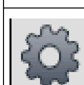
Standard functionality is provided by softkeys, keys and a toolbar within MapView.

The softkeys are available regardless of the mode in which MapView was accessed and always perform the same functions.

Icons are available in a toolbar. The toolbar is always located on the right side of the screen. Some of the functions performed by the icons can also be replicated using a softkey or key in the same mode as when the icon appears. The softkey/key equivalent of each icon, if one exists, are indicated in the following table.

**Overview of keys, softkeys and icons**

The softkeys described in this table are standard on all MapView screens. For descriptions of mode-specific softkeys, see appropriate chapters.

| Icon | Key or Softkey | Description |
|---|---|---|
|  | - | To scroll the MapView toolbar. |
|  | **1** or Fn **Refrsh** in some applications | The fit icon fits all displayable data, according to filters and the map configuration, into the screen area, using the largest possible scale. |
|  | **2** | To zoom into the map.<br>☞ Pressing ESC stops the zooming process. |
|  | **3** | To zoom out of the map.<br>☞ Pressing ESC stops the zooming process. |
|  | - | The windowing icon zooms to a specified area window. An area window can be drawn by dragging the stylus on the screen in a diagonal line to make a rectangular area or by tapping twice on the screen to define diagonally opposite corners of a rectangular area. This action causes the screen to zoom to the selected area. |
|  | **5** | To centre the selected point, the GPS rover, the TPS target or TPS instrument. |
|  | - | To select multiple objects. Points within the rectangular area are always selected. Depending on the application also lines, for example dbx lines, Road/Rail job lines or lines from background maps, and areas are selected.<br><br>Drag the stylus on the screen in a diagonal line to make a rectangular area.<br>• Drag from top left to bottom right to select all lines inside the rectangular window.<br>• Drag from bottom right to top left to select all lines crossing the rectangular window. |
|  | Fn **Config..** | To configure MapView. Refer to "38.3 Configuring MapView". |
|  | Fn **Layrs..** | To turn layers of background maps (CAD files) on and off. Refer to "5.2 Creating a New Job" for information on CAD files. |
|  | - | To import CAD files for background only maps. Refer to "5.2 Creating a New Job". |
|  | - | To switch the view. Available in some applications, for example Reference Plane, Road or Rail. |
| - | **0** | To make the MapView do a complete redraw. |
| - | Fn **Filter..** | To change the filter settings. Refer to "6.6 Point Sorting and Filters". |

## 38.4.3 Point Symbols

**Description**

When **Display points** is checked in **Map View Settings**, **Points** page, points are displayed, in all modes, according to their class. A list of the point types available, and their description, is available.

**Access**

Press **Symbol** in **Map View Settings**, **Points** page.

**Symbols**

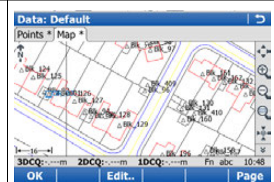
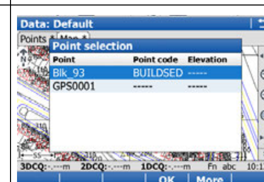
| Symbol | Description |
|---|---|
| △ | 3D control point is a point of class **CTRL** with full coordinate triplet. |
| △ | 2D control point is a position only point of class **CTRL**. |
| ⊛ | Adjusted point is a point of class **ADJ**. |
| ▽ | Base point is a point of class **REF**. |
| ◎ | Average point is a point of class **AVGE**. |
| ⊙ | Measured point is a point of class **MEAS**. |
| ☼ | Single Point Position uploaded from LGO. |
| ⊡ | Navigated point is a point of class **NAV**. |
| + | Estimated point is a point of class **EST**. |

☞ Points of class **None** or points of class **Ctrl**/**Meas** with a height only component cannot be displayed in MapView.

# 38.5 Selecting Points, Lines and Areas

**Selecting a point/line/area using the touch screen step-by-step**

The instructions for selecting a point using the softkeys can be applied for lines and areas.

| Step | Description | Display |
|---|---|---|
| 1. | Go to **Data:**, **Map** page. | |
| | If no point field is highlighted on the previous page when the **Map** page is accessed, then any point that is selected will be assigned to the first point field on the previous page, the second point to the second point field, etc.<br>If a point field is highlighted when the **Map** page is accessed then the point selected will be assigned to that field. | |
| 2. | Tap on the point to be selected. |  |
| | When there are multiple points within the same area and the precise selection is unclear, tapping on the point will access **Select Point**. | |
| 3. | Have multiple points been selected?<br>• If yes, continue with step 4.<br>• If no, continue with step 5. | |
| 4. | **Select Point**<br>**Point ID** The ID of the points within range of the point selection.<br>**Point code** The code of the points within range of the point selection.<br>Select the desired point. |  |
| | **More** to display information about the point code, the 3D coordinate quality and class, the time the point was stored and the date the point was stored. | |
| 5. | **OK** returns to **Data:**, **Map** page with the focus on the selected point. | |
| 6. | A square is centred on the selected point and the point parameter text is highlighted. | |

**Select a point/line/area without touch screen**

Without touch screen or when **Use the touch screen** is not checked in **Screen & Audio Settings**, **Screen** page, points, lines and areas can only be selected using the selectable lists.

## 38.6 Context Menu

**Access**

The context menu is available in Survey, COGO, Stakeout (points and DTM), Reference Line, Roads and Data Management.
On a **Map** page hold down the supplied stylus on an object for 0.5 second.

**Options in the context menu**

The options available in the context menu depend on the object and the application.

| Option | Available in | Description |
|---|---|---|
| **Import** | • Data Management<br>• COGO<br>• Reference Line<br>• Stakeout<br>• Survey<br>• Roads | Imports the selected CAD object into the DBX. The object is imported to the job the CAD is attached to.<br>The entities the object is imported with are displayed.<br><br>The import settings are configured in **Map View Settings**, **CAD import** page. Refer to "38.3 Configuring MapView". |
| **Information..** | • Data Management<br>• COGO<br>• Reference Line<br>• Stakeout<br>• Survey<br>• Roads | Displays the entities of the object. |
| **Manage layers..** | • Data Management<br>• COGO<br>• Reference Line<br>• Stakeout<br>• Survey<br>• Roads | Opens the **CAD Layers** screen and highlights the layer to which the object belongs. Refer to "CAD Layers". |
| **Stake point..** | • Stakeout | Imports the selected point to the control job and selects it for staking immediately. |
| **Stake vertices..** | • Stakeout | Available when **Create points at the vertices of lines** is checked in **Map View Settings**, **CAD import** page.<br>Imports the selected line/area, along with the new points being created at the vertices.<br>The vertices are imported in a sequential order following the direction of the line. The first point created is the point automatically selected to be staked. The next point to be staked is the next vertex along the line. |
| **Use as CL** | • Import Alignment Data | To select/deselect the highlighted line as external chainage centreline. |
| **Use as Track CL** | • Import Alignment Data | To select/deselect the highlighted line as track centreline. |
| **Use as left Rail/Use as right Rail** | • Import Alignment Data | To select/deselect the highlighted line as left/right rail. |
| **Clear selected object** | • Import Alignment Data | To remove the highlight from the highlighted line. |

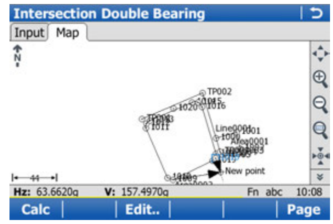
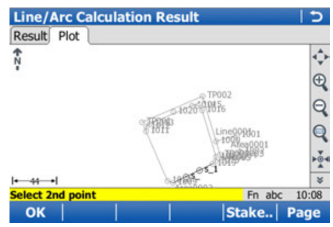
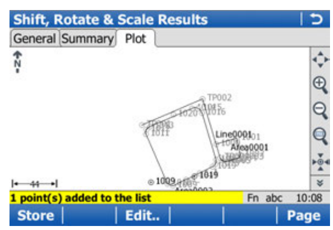
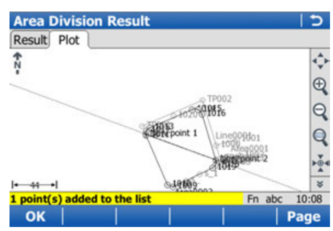
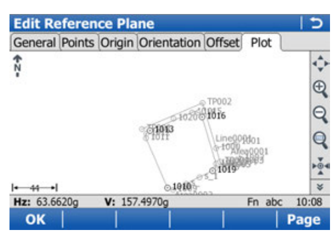
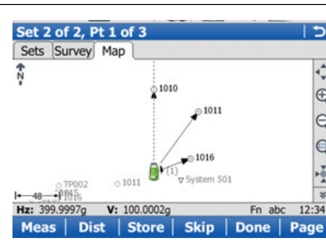
| Option | Available in | Description |
| --- | --- | --- |
| **Turn to point** | • TPS in survey mode. | To display the current direction as dashed line. A point on the **Map** page can then be tapped and the instrument turns to this direction.<br><br>If **Target aiming: Automatic** the instrument does an ATR search. If **Target aiming: Lock** the instrument tries to lock on to a prism. |
| **Turn to here** | • TPS in survey mode. | To display the current direction as dashed line. A location on the **Map** page can then be tapped and the instrument turns to this direction. |

## 38.7 Viewing Results

**Description**

MapView can be used to view the results of an application. Results are shown in black, all other information, that is displayable, is shown in grey.

**Example of results displayed in MapView**

| Application | Display | Description |
|---|---|---|
| COGO Intersection, Double bearing |  | Intersecting lines with known bearings from known points |
| COGO line calculation, Segmentation |  | Points defining the line and those points created on the line |
| COGO Shift, Rotate & Scale |  | Original points in grey, calculated COGO points in black |
| COGO Area Division |  | Points from the area and the area division are black, other points are grey |
| Reference Plane, Edit Reference Plane |  | A dashed rectangle indicates the face view of the plane. |
| Sets of Angles, Calculating Angles<br>TPS |  | Directions from station to sets of angle points |

| Application | Display | Description |
|---|---|---|
| Setup TPS |  | Directions to resection points. |

# 39 Tap Map

**Description**

Tap Map is an extended MapView regarding the context menus.
Tap Map can easily be accessed from the **Main Menu**.
The configuration and the toolbar of Tap Map are identical with those of MapView.

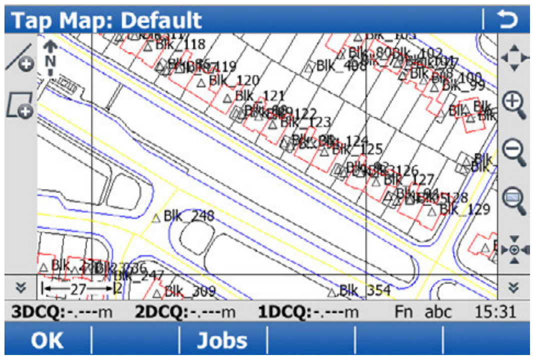
**Access**

In **Main Menu**, press **Map**.

**Tap Map**

Hold down the supplied stylus on an object for 0.5 second.

Refer to "38.4.1 Screen Area" for information on the screen area and the toolbar.




| Key | Description |
|---|---|
| **OK** | To return to the **Main Menu**. |
| **Jobs** | To define if data from the active working or control job, Road job or DTM job is shown. And, for Road and DTM jobs to define the layer of which data is displayed in the **Tap Map** screen. |
| Fn **Config..** | To configure Tap Map. Refer to "38.3 Configuring MapView". |
| Fn **Layrs..** | To turn layers of background maps (CAD files) on and off. Refer to "5.2 Creating a New Job" for information on CAD files and CAD background maps. |

**Options in the context menu**

The options available in the context menu depend on the object.

☞ Multi selection is only possible when lines are closed.

**Tap and hold on no object and no other object is currently selected**

| Option | Description |
|---|---|
| **Create point here** | To open the **New Point** screen. Refer to "New Point, Coords page". |
| **Turn to here** | TPS The instrument turns to the direction of the tapped point or pixel. The CAD element that was tapped is NOT imported.<br>If **Target aiming: Automatic** the instrument does an ATR search. If **Target aiming: Lock** the instrument tries to lock on to a prism. |

### Tap on a point

| Option | Description |
|---|---|
| **Turn to here** | TPS The instrument turns to the direction of the tapped point or pixel. The CAD element that was tapped is NOT imported.<br>If **Target aiming: Automatic** the instrument does an ATR search. If **Target aiming: Lock** the instrument tries to lock on to a prism. |
| **Bearing & dist from pt..** | To open the **Traverse Input** of **COGO**. The tapped point is displayed in the field **From**. Refer to "Traverse Input, Input page". |
| **Check point..** | TPS To open the **Check Point** screen. Refer to "Check Point". |
| **Stake point..** | Available when a DBX or CAD point was tapped. To open the **Stakeout** application. The tapped point is the point to be staked. Refer to "Stakeout, Stake page". |
| **Change to arc (mid pt)** | Not for CAD points. To create an arc in the line to which the point belongs. The arc is created running through the selected point and the point before and the point after. This functionality is only possible if the point:<br>• belongs to a line or area.<br>• is not the first or last point in the line or area.<br>• is not currently the middle point of an arc in that line. |
| **Remove arc** | Not for CAD points. To remove the arc of which the tapped point is the centre point. This functionality is only possible if the selected point belongs to a DBX line or area and is currently the middle point of an arc in that line. |
| **Edit point..** | To open the **Edit Point:** screen. Refer to"Edit Point:, Coords page". |
| **Import** | For CAD points. Imports the selected point into the DBX. The point is imported to the job the CAD is attached to. The entities the point is imported with are displayed. The import settings are configured in **Map View Settings**, **CAD import** page. Refer to "Map View Settings, CAD import page". |
| **Information..** | For CAD points. Displays the entities of the point. |
| **Manage layers..** | For CAD points. To open the **CAD Layers** screen. Refer to "CAD Layers". |
| **Delete point** | To delete the tapped point. |
| **Clear selected object** | To remove the highlight from all highlighted objects. |

#### Two points selected

| Option | Description |
|---|---|
| **Create line** | To create a line from the selected points. The points are added in the order in which they were tapped. |
| **Compute inverse..** | To open the **Inverse Point to Point** screen. Refer to "Inverse Point to Point/Inverse Point to Current Pos, Inverse page". |
| **Segment line..** | To open the **Define Line Segmentation** screen. Refer to "Create Line, Input page". |
| **Import** | For CAD points. Imports the selected point into the DBX. The point is imported to the job the CAD is attached to. The entities the point is imported with are displayed. The import settings are configured in **Map View Settings**, **CAD import** page. Refer to "Map View Settings, CAD import page". |
| **Delete point** | To delete the tapped point. |
| **Clear selected objects** | To remove the highlight from all highlighted objects. |

#### Three points selected

| Option | Description |
|---|---|
| **Create line** | For CAD points. To create a line from the selected points. The points are added in the order in which they were tapped. |
| **Create area** | For CAD points. To create an area from the selected points. The points are added in the order in which they were tapped. |
| **Clear selected objects** | To remove the highlight from all highlighted objects. |

**One line/area selected**

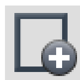
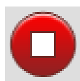
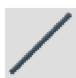
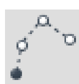
| Option | Description |
|---|---|
| **Use in Roads** | To stake/check a (local) line/(local) manual slope. |
| **Use in Reference Line** | To stake/measure a line (with slope), to stake a grid from the line or to select a stake/measure task. |
| **Open line**/**Open area** | To open the selected line/area. If a CAD line/area was selected, then the CAD line is first imported to the DBX. |
| **Edit line..**/**Edit area..** | To edit the line/area properties. Refer to "Edit Line, General page". |
| **Stake vertices..** | Available when **Create points at the vertices of lines** is checked in **Map View Settings**, **CAD import** page.<br>Imports the selected line/area, along with the new points being created at the vertices.<br>The vertices are imported in a sequential order following the direction of the line. The first point created is the point automatically selected to be staked. The next point to be staked is the next vertex along the line. |
| **Measure line**/**Stake line** | For CAD lines/areas. To measure/stake a line, segment, slope line or slope segment or to stake a grid. |
| **Import** | For CAD lines/areas. Imports the selected line/area into the DBX. The line/area is imported to the job the CAD is attached to. The entities the line/area is imported with are displayed. The import settings are configured in **Map View Settings**, **CAD import** page. Refer to "Map View Settings, CAD import page". |
| **Information..** | For CAD lines/areas. Displays the entities of the line/area. |
| **Manage layers..** | For CAD lines/areas. To open the **CAD Layers** screen. Refer to "CAD Layers". |
| **View line details..** | For Road lines. To view and edit the design data. Refer to "View & Edit Data". |
| **Delete line**/**Delete area** | To delete the line/area. |
| **Clear selected object** | To remove the highlight from all highlighted objects. |

**Several lines selected**

| Option | Description |
|---|---|
| **Delete objects** | To delete all highlighted objects. |
| **Clear selected object** | To remove the highlight from all highlighted objects. |

**Overview of icons in the drawing toolbar**

If **Display drawing toolbar** is checked in **Map View Settings**, **General** page, icons are available in the drawing toolbar. The drawing toolbar is always located on the left side of the screen.

| Icon | Description |
|---|---|
|  | To scroll the MapView toolbar. |
|  | To create a line. After storing the new line, all existing lines which are open are closed. If a line is open, then measured points are assigned to the line. |
|  | To create an area. After storing the new area, all existing areas which are open are closed. If an area is open, then measured points are assigned to the area. |
|  | Available if objects are closed. To open the highlighted object (lines/areas). |
|  | Available if objects are open. To close the highlighted object (lines/areas). |
|  | Available if a line/area is open. To create a straight line between the last point of a line to the new point being tapped or surveyed. |
|  | Available if a line/area is open. To create an arc from the next two points which are tapped or surveyed. This icon is unavailable if the currently open line or area contains no points. |
|  | Available if a line/area is open. To create an arc from the next three points which are tapped or surveyed. |

# 40 Applications - General

**Description**

Applications are software packages supporting specific tasks. Available for both GPS and TPS are:

- COGO..
- Determine coord system
- TPS hidden point for TPS
- Ref plane & grid scan
- Roads (Alignment Editor, Road stake, Road check, Rail stake, Rail stake, Tunnel stake for TPS, Tunnel check for TPS)
- Scanning for MS50 R2000
- Setup for TPS
- Sets of angles for TPS including monitoring
- Stakeout DTM
- Stakeout
- Stakeout DTM
- Measure to ref line / Stake to ref line
- Survey, including auto point and for GPS also hidden points
- Cross Section
- Traverse for TPS
- QuickVolume
- Volume calculations
- Customised applications
- Start base over known point for GPS
- Start base over last setup for GPS
- Start base over any point for GPS

For an explanation of the applications refer to the relevant chapters.

**Loadable and non-loadable applications**

| | |
|---|---|
| Loadable applications: | • Can be loaded onto the instrument.<br>• Can be deleted from the instrument. |
| Non-loadable application: | • Are always available on the instrument.<br>• Survey is a non-loadable application. To get an update for the application, the system software has to be reloaded. |

**Licence key**

Some loadable applications are protected. They are activated through a specific licence key, which can either be typed in **Main Menu: User\Tools & other utilities\Load licence keys** or the first time the application is started. Refer to "30.3 Load licence keys" for information on how to type in or upload a licence key.

**Customised applications**

Customised applications can be developed locally using the GeoC++ development environment. Information on the GeoC++ development environment is available on request from the Leica Geosystems representative.

**Access to the Go to Work! drop-down menu**

Select **Main Menu: Go to Work!**.

OR

Press .

☞ The screens for each COGO.. calculation method can be accessed directly by pressing a configured hot key or via the key. The currently active configuration set and job are used.

# 41 COGO

## 41.1 Overview

**Description**

COGO is an application to perform **co**ordinate **geo**metry calculations such as
- coordinates of points.
- bearings between points.
- distances between points.

The calculations can be made from
- existing point data in the job, known distances or known azimuths.
- manually measured points.
- entered coordinates.

In contrast to hidden point measurements within the Survey application, COGO is more of a calculation program than a measuring program.

☞ Changing coordinates of a point which has been previously used in COGO does not result in the point being recomputed.

**COGO calculation methods**

The COGO calculation methods are:
- Inverse
- Traverse
- Intersection
- Line and arc calculations
- Area division
- Shift, rotate & scale
- Angle
- Horizontal curve
- Triangle

**Distances and azimuths**

Type of distances: The choices are
- Ground
- Grid
- Ellipsoidal

Type of azimuths: The azimuths are grid azimuths relative to the local grid.

**Coding of COGO points**

- Thematical coding is available in the results screen after the COGO calculation. Thematical coding of COGO points is identical to coding manually measured points. Refer to "26 Coding" for information on coding.
- For the COGO calculation shift, rotate & scale, the codes from the original points are taken over for the calculated COGO points.

## 41.2 Accessing COGO

**Access**

Select **Main Menu**: **Go to Work!\COGO..** and select a COGO calculation method.

**COGO calculation methods**

**Description of the COGO calculation methods**

| COGO calculation methods | Description |
|---|---|
| **Inverse** | To calculate the direction, the distance and the 3D coordinate differences between two known points (or one known point and the current GPS position).<br>To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GPS position) and a user-defined line.<br>To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GPS position) and a user-defined arc.<br>For these calculations, only points with full coordinate triplets or position only points can be used. |
| **Traverse** | To calculate the position of new points using<br>• the azimuth/bearing and the distance from a known point. Offset optional.<br>• the angle and the distance from a known point. Offset optional.<br>For these calculations, only points with full coordinate triplets or position only points can be used. |
| **Intersection** | To calculate the position of an intersection point using<br>• bearings from two known points.<br>• a bearing and a distance from two known points.<br>• distances from two known points.<br>• four points.<br>• two TPS observation lines.<br>For these calculations, only points with full coordinate triplets or position only points can be used. |
| **Intersection** | To calculate;<br>• the centre point of an arc.<br>• an offset point from a distance along, and offset from, an arc.<br>• an offset point from a distance along, and offset from, a line.<br>• a base point on an arc of a known offset point.<br>• a base point on a line of a known offset point.<br>• new points along an arc by segmentation.<br>• new points along a line by segmentation. |
| **Area Division** | To divide an area by a<br>• defined line.<br>• percentage.<br>• defined area size. |

| COGO calculation methods | Description |
|---|---|
| **Shift, rotate & scale** | To calculate the coordinates of new points using shifts, rotation and scale.<br>The values for the shift, rotation and/or scale can either be entered manually or computed using selected matching points.<br>For these calculations, points with full coordinate triplets, position only points or height only points can be used. |
| **Angle** | To calculate the angles that are defined by three points. |
| **Horizontal curve** | To calculate the missing parameters of a curve by the input of the known parameters. |
| **Triangle calculator** | To define a triangle by entering the three sides of the triangle or by selecting three points. |

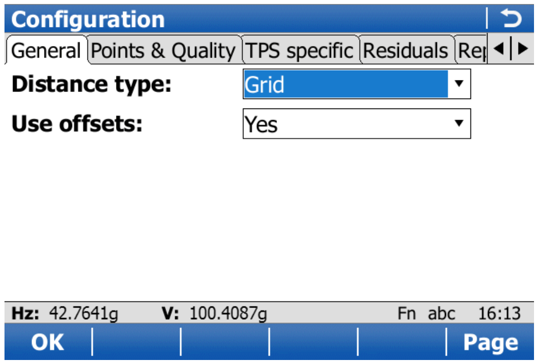
## 41.3 Configuring COGO

**Access**

Press Fn **Config..** in the Input screen of any COGO calculation method.

**Configuration, General page**

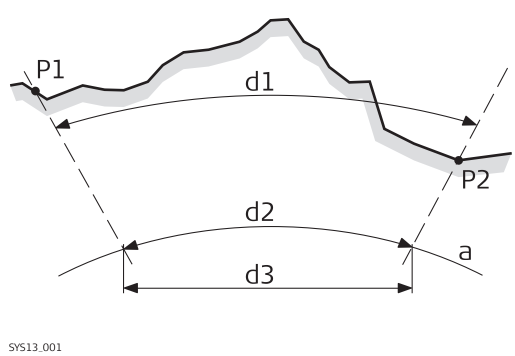
This screen consists of the **General** page, **Points & Quality** page, **TPS specific** page, **Residuals** page and the **Report sheet** page. The explanations given for the softkeys given are valid for all pages.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Distance type** | | The type of distances and offsets to be accepted as input or displayed in the fields, and used in the calculation. |
| | **Grid** | Distances are calculated as the trigonometric distance between the position of two points. The distance field is **Horiz distance**. |
| | **Ground** | Distances are horizontal distances between two points at the mean elevation parallel to the ellipsoid of the active coordinate system. The distance field is **Horiz dist (ground)**. |
| | **Ellipsoid** | Distances are reduced to the ellipsoid. They are calculated as the shortest distance between the two points on the ellipsoid. A scale factor is applied. The distance field is **Horiz dist (ell)**. ☞ In the attached coordinate system, a projection, an ellipsoid and a transformation have to be defined to calculate grid, ground and ellipsoid coordinates. |
| **Use offsets** | **Yes** or **No** | Activates the use of offsets in the COGO calculations. Editable fields for the offsets are available in the Input screen of any COGO calculation method. |
| **Restart calculation with last used values** | Check box | Available for **Intersection** and **Intersection**. When this box is checked, after storing a result, the **Input** page is displayed showing the previously used values. |




a Ellipsoid
**Known**
P1 First known point
P2 Second known point
**Unknown**
d1 Ground distance
d2 Ellipsoid distance
d3 Grid distance

#### Next step

**Page** changes to the **Points & Quality** page.

**Configuration, Points & Quality page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Store computed COGO points with class** | **Measured (Meas)** or **Control (Ctrl)** | Defines the point class of COGO calculated and stored points as **Measured (Meas)** or **Control (Ctrl)** triplets. |
| **Position quality for computed COGO point** | Editable field | The estimated value for the position quality assigned to all calculated COGO points which is used for the averaging calculation. |
| **Height quality for computed COGO point** | Editable field | The estimated value for the height quality assigned to all calculated heights which is used for the averaging calculation. |

**Next step**
**Page** changes to the **TPS specific** page.

**Configuration, TPS specific page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Measure in two faces** | | Defines if the instrument measures the second face automatically after storing the first. |
| | **Yes** | After storing a measurement with **Meas** or **Store** motorised instruments change face automatically, non-motorised instruments access **Telescope Positioning**. The measurements of face I and face II are averaged on the base of face I. The averaged value is stored. |
| | **No** | No automatic measurement in two faces. |
| **TPS observation Compute height** | | Defines the height being used within TPS observations. |
| | **Using average** | Using an average of the two observations. |
| | **Use upper height** | Using the upper height. |
| | **Use lower height** | Using the lower height. |

**Next step**
**Page** changes to the **Residuals** page.

**Configuration, Residuals page**

This page applies to **Shift, Rotate & Scale (Match Pts)**.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Easting** | Editable field | The limit above which Easting residuals will be flagged as possible outliers. |
| **Northing** | Editable field | The limit above which Northing residuals will be flagged as possible outliers. |
| **Elevation** | Editable field | The limit above which Height residuals will be flagged as possible outliers. |
| **Residual Distbtn** | | The method by which the residuals of the control points will be distributed throughout the transformation area. |
| | **None** | No distribution is made. Residuals remain with their associated points. |
| | **1/distance**, 1/distance² or **1/distance³/²** | Distributes the residuals according to the distance between each control point and the newly transformed point. |
| | **Multiquadratic** | Distributes the residuals using a multiquadratic interpolation approach. |

**Next step**

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

**Page** changes to the first page on this screen.

☞ **Azimuth** is used throughout this chapter. This term should also always be considered to mean **Bearing**.

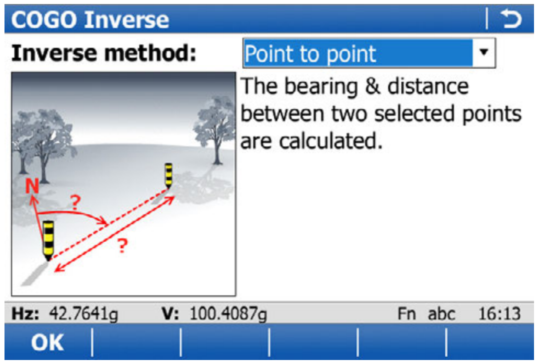
# 41.4 COGO Calculation - Inverse Method

## 41.4.1 Selecting the Inverse Method

**Access**

Select **Main Menu**: **Go to Work!\COGO..\Inverse**.

**COGO Inverse**



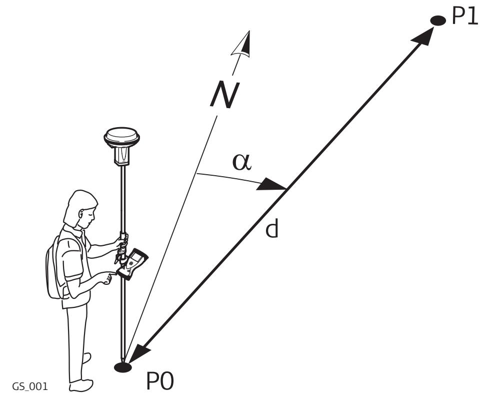

| Key | Description |
|---|---|
| **OK** | To select a method and to continue with the subsequent screen. |

**Description of the Inverse methods**

| Inverse methods | Description |
|---|---|
| **Point to point** | The direction, the distance and the coordinate differences between the two known points can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Elements that must be known are<br>• coordinates of two points.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered. |
| **Point to current pos** | The direction, distance and coordinate differences between the current rover position and a known point can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Elements that must be known are<br>• coordinates of one point.<br><br>The coordinates of the known point<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered. |

| Inverse methods | Description |
|---|---|
| **Current pos to line** | The direction, distance and coordinate differences between the current position and a given line can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Sufficient information must be known to define a line.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |
| **Point to line** | The direction, distance and coordinate differences between a known point and a given line can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Sufficient information to define a line and the coordinates of one point must be known.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |
| **Point to arc** | The direction, distance and coordinate differences between the current position and a given arc can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Sufficient information to define an arc and the coordinates of one point must be known.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |
| **Current pos to arc** | The direction, distance and coordinate differences between a known point and a given arc can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.<br><br>Sufficient information must be known to define an arc.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |

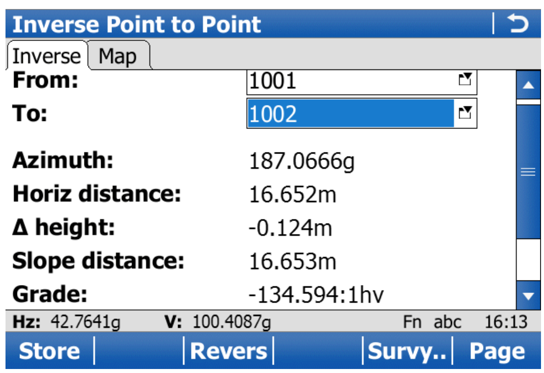
**Diagram**




**Known**
P0 First known point/current position
P1 Second known point
**Unknown**
α Direction from P0 to P1
d Horizontal distance between P0 and P1

**Inverse Point to Point/Inverse Point to Current Pos, Inverse page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.
**-----** is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Revers** | To swap the **From** and **To** points around. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **From** or **To** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Quit** | To exit COGO calculation. |

#### Description of fields

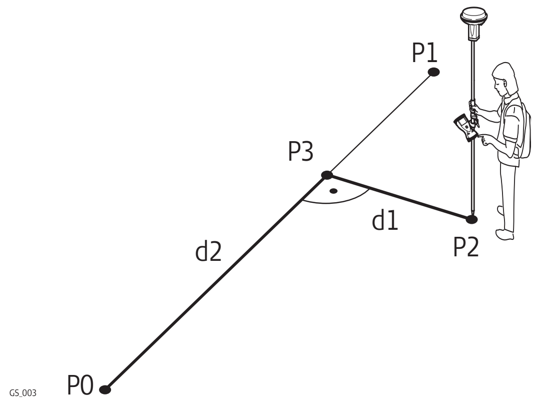
| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | The point ID of the first known point for the COGO calculation. |
| | **Current position** | Available for **Inverse method: Point to current pos**. |
| **To** | Selectable list | The point ID of the second known point for the COGO calculation. |
| | **Current position** | Available for **Inverse method: Point to current pos**. |
| **Azimuth** | Display only | The direction from the first to the second known point. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Display only | The horizontal distance between the two known points. |
| **Δ height** | Display only | The height difference between the two known points. |
| **Slope distance** | Display only | The slope distance between the two known points. |
| **Grade** | Display only | The grade between the two known points. |
| **Δ easting** | Display only | The difference in Easting between the two known points. |
| **Δ northing** | Display only | The difference in Northing between the two known points. |

#### Next step

**Page** changes to the **Map** page. The calculated distance between the two known points is indicated.

## 41.4.3 Point to Line and Current Position to Line

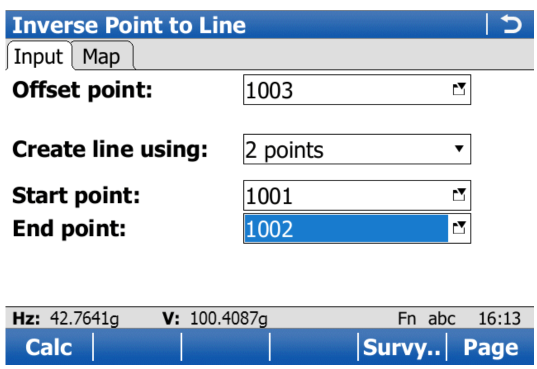
**Diagram**




**Known**
P0 Start point
P1 End point
P2 Offset point
**Unknown**
P3 Base point
d1 Offset distance
d2 ΔLine distance

**Inverse Point to Line/Inverse Current Pos to Line, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.
**-----** is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.




| Key | Description |
|---|---|
| **Calc** | To calculate COGO point. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available if **Azimuth** or **Horiz distance** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available if **Azimuth** or **Horiz distance** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available if **Start point**, **End point** or **Offset point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To mathematically modify the values. Available if **Azimuth** or **Horiz distance** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

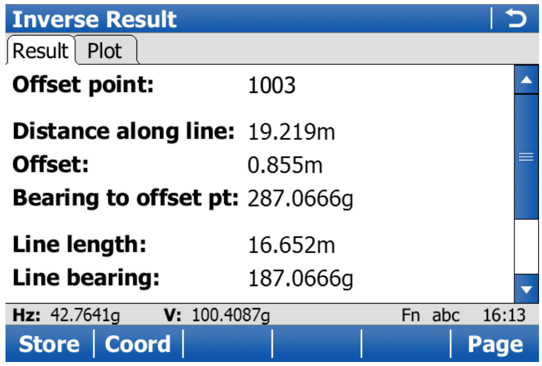
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Offset point** | Selectable list | Available for **Inverse method**: **Point to point**. The offset point. |
| | **Current position** | Available for **Inverse method: Current pos to line**. |
| **Create line using** | | The method by which the line will be defined. |
| | **2 points** | Uses two known points to define the line. |
| | **Pt, bearing & dist** | Defines the line using a known point, a distance and an azimuth of the line. |
| **Start point** | Selectable list | The start point of the line. |
| **End point** | Selectable list | Available for **Method**: **2 points**. The end point of the line. |
| **Azimuth** | Editable field | Available for **Method**: **Pt, bearing & dist**. The azimuth of the line. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | Available for **Method**: **Pt, bearing & dist**. The horizontal distance from the start point to the end point of the line. |

### Next step

**Calc** calculates and accesses **Inverse Result**.

**Inverse Result,
Result page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. |

### Description of fields

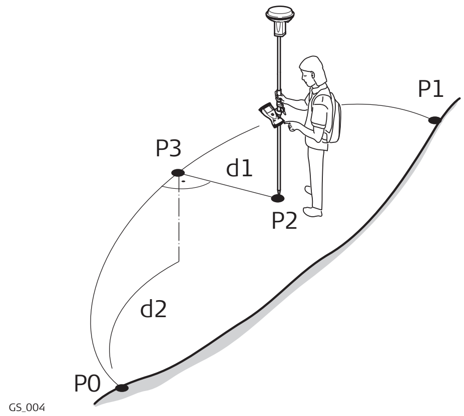
| Field | Option | Description |
|---|---|---|
| **Offset point** | Display only | Point ID of offset point or **Current position**. |
| **Distance along line** | Display only | Horizontal distance from start point to base point. |
| **Offset** | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| **Bearing to offset pt** | Display only | Bearing from base point to offset point. |
| **Line length** | Display only | Length of line from start point to end point. |
| **Line bearing** | Display only | Bearing of line from start point to end point. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Display only | The height of the calculated point. |

### Next step

**Page** changes to the **Plot** page.

## 41.4.4 Point to Arc and Current Position to Arc

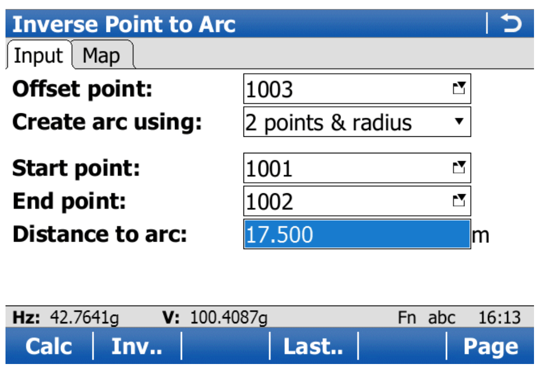
**Diagram**




**Known**
P0 Start point
P1 End point
P2 Offset point
**Unknown**
P3 Base point
d1 Offset-XX
d2 ΔArcDist-XX

**Inverse Point to Arc/Inverse Current Pos to Arc, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.
**-----** is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.




| Key | Description |
|---|---|
| **Calc** | To calculate COGO point. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available if **Radius**, **Arc length** or **Chord length** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available if **Radius**, **Arc length** or **Chord length** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available if **Start point**, **Second point**, **End point**, **Offset point** or **PI point** is high-lighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To mathematically modify the values. Available if **Radius**, **Arc length** or **Chord length** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

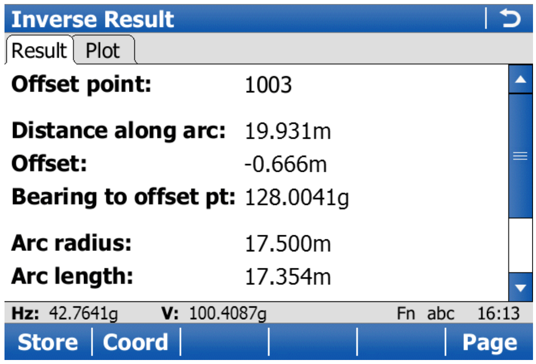
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Offset point** | Selectable list | Available for **Point to arc: Point to line**. The offset point. |
| | **Current position** | Available for **Inverse method: Current pos to arc**. |
| **Create arc using** | | The method by which the arc will be defined. |
| | **3 points** | Uses three known points to define the arc. |
| | **2 points & radius** | Defines the arc using two known points and a radius of the arc. |
| | **2 tngnts & radius** | Defines the arc using two tangents and a radius of the arc. |
| | **2 tngnts & arc lngth** | Defines the arc using two tangents and the length of the arc. |
| | **2 tngnts & crd lngth** | Defines the arc using two tangents and the chord of the arc. |
| **Start point** | Selectable list | The start point of the arc. Available for **Method**: **3 points** and **Method**: **2 points & radius**. |
| **Second point** | Selectable list | The second point of the arc. Available for **Method**: **3 points**. |
| **End point** | Selectable list | The end point of the arc. Available for **Method**: **3 points** and **Method**: **2 points & radius**. |
| **Point 1** | Selectable list | A point on the first tangent. Available for **Method**: **2 tngnts & radius**, **Method**: **2 tngnts & arc lngth** and **Method**: **2 tngnts & crd lngth**. |
| **PI point** | Selectable list | The point of intersection of the two tangents. Available for **Method**: **2 tngnts & radius**, **Method**: **2 tngnts & arc lngth** and **Method**: **2 tngnts & crd lngth**. |
| **Point 2** | Selectable list | A point on the second tangent. Available for **Method**: **2 tngnts & radius**, **Method**: **2 tngnts & arc lngth** and **Method**: **2 tngnts & crd lngth**. |
| **Radius** | Editable field | The radius of the arc. Available for **Method**: **2 points & radius** and **Method**: **2 tngnts & radius**. |
| **Arc length** | Editable field | The length of the arc. Available for **Method**: **2 tngnts & arc lngth**. |
| **Chord length** | Editable field | The length of the chord. Available for **Method**: **2 tngnts & crd lngth**. |

### Next step

**Calc** calculates the result and accesses **Inverse Result**.

**Inverse Result, Result page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Offset point** | Display only | Point ID of offset point for **Inverse method**: **Current pos to arc** or current position. |
| **Distance along arc** | Display only | Horizontal distance along the arc from start point to base point. |
| **Offset** | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| **Bearing to offset pt** | Display only | Bearing of offset point from base point to offset point. |
| **Arc radius** | Display only | Computed radius of arc. |
| **Arc length** | Display only | Computed length of arc. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Display only | The height of the calculated point. |

**Next step**

**Page** changes to the **Plot** page.

## 41.5 COGO Calculation - Traverse Method

**Description**

Elements that must be known are
- the coordinates of one point.
- the direction from the known point to the COGO point.
- the distance from the known point to the COGO point.
- offsets, if necessary and configured.

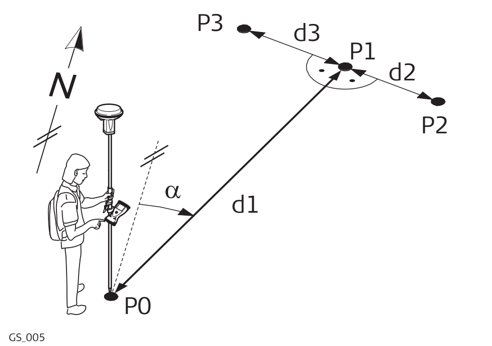
The coordinates of the known point
- can be taken from the working job.
- can be manually measured during the COGO calculation.
- can be entered.

The direction from the known point to the COGO point can be an azimuth or an angle.

Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.

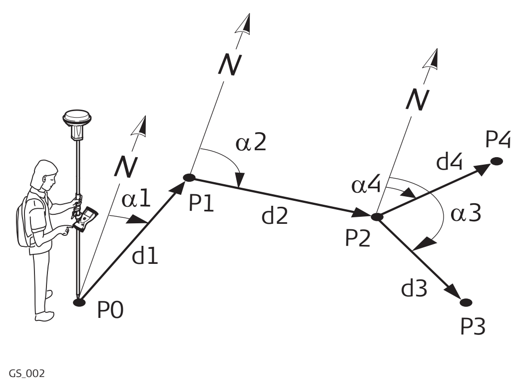
A COGO traverse calculation can be calculated for
- a single point.
- multiple points. Several single points are calculated in one sequence.
- sideshots.

| | |
|---|---|
| **Diagram** | **COGO traverse calculation with offset for a single point** |




**Known**
P0 Known point
α Direction from P0 to P1
d1 Distance between P0 and P1
d2 Positive offset to the right
d3 Negative offset to the left
**Unknown**
P1 COGO point without offset
P2 COGO point with positive offset
P3 COGO point with negative offset

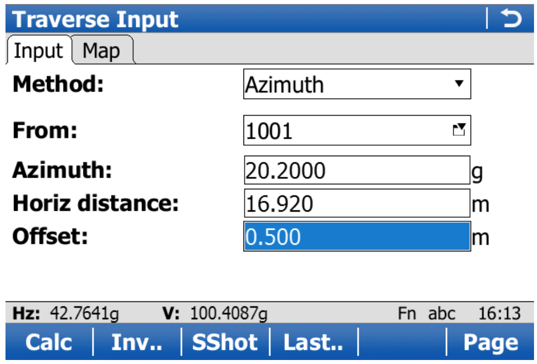
**COGO traverse calculation without offset for multiple points**




**Known**
P0 Known point
α1 Direction from P0 to P1
α2 Direction from P1 to P2
α3 Direction from P2 to P3
α4 Direction from P2 to P4
d1 Distance between P0 and P1
d2 Distance between P1 and P2
d3 Distance between P2 and P3
d4 Distance between P2 and P4
**Unknown**
P1 First COGO point
P2 Second COGO point
P3 Third COGO point - sideshot
P4 Fourth COGO point

**Traverse Input, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.




| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted. |
| **SShot** | To calculate the point as a sideshot. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **From** or **Backsight** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To add, subtract, multiply and divide values. Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

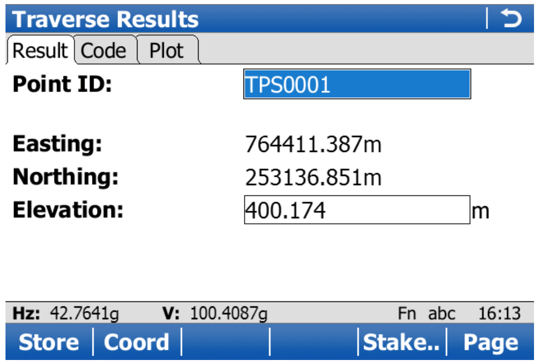
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | **Azimuth** | The direction from the known point to the COGO point is an azimuth. |
| | **Angle right** | The direction from the known point to the COGO point is an angle. |
| **From** | Selectable list | The point ID of the known point for the COGO calculation. |
| **Backsight** | Selectable list | The point ID of a point used as backsight. Available for **Angle right**. |
| **Angle right** | Editable field | The angle between **Backsight** and the new COGO point to be calculated from the point selected as **From**: A positive value is for clockwise angles. A negative value is for anticlockwise angles. Available for **Angle right**. |
| **Azimuth** | Editable field | The direction from the known point to the COGO point. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | The horizontal distance between the known point and the COGO point. |
| **Offset** | Editable field | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available for **Use offsets**: **Yes** in **Configuration**, **General** page. |

### Next step

**Calc** calculates the result and accesses **Traverse Results**.

## Traverse Results, Result page




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **IndivID** | For an individual point ID independent of the ID template. Fn **Run** changes back to the next ID from the configured ID template. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for the currently active instrument type in **ID Templates**. The point ID can be changed. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Editable field | The height of the known point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, an arrow points from the known point to the calculated COGO point.
**Store** stores the result.

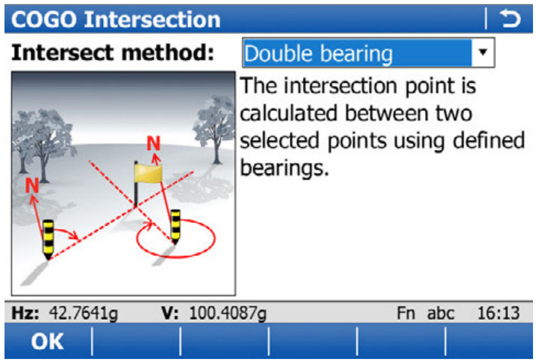
# 41.6 COGO Calculation - Intersection Method

## 41.6.1 Selecting the Intersection Method

**Access**

Select **Main Menu**: **Go to Work!\COGO..\Intersection**.

**COGO Intersection**



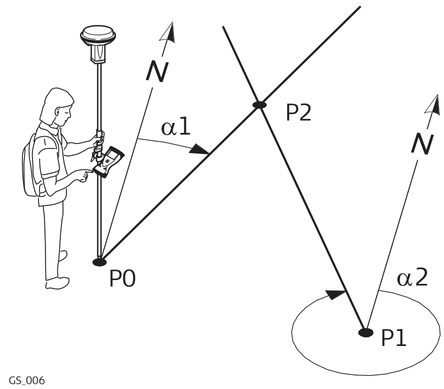

| Key | Description |
|---|---|
| **OK** | To select a method and to continue with the subsequent screen. |

#### Description of the Intersection methods

| Intersection methods | Description |
|---|---|
| **Double bearing** | Calculates the intersection point of two lines. A line is defined by a point and a direction.<br><br>Elements that must be known are<br>• the coordinates of two points.<br>• the direction from these known points to the COGO point.<br>• offsets if necessary and configured.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered.<br><br>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in. |
| **Double distance** | Calculates the intersection point of two circles. The circles are defined by the known point as the centre point and the distance from the known point to the COGO point as the radius.<br><br>Elements that must be known are<br>• the coordinates of two points.<br>• the distance from the known points to the COGO point.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered.<br><br>Points with full coordinate triplets and position only points can be used. |

| Intersection methods | Description |
|---|---|
| **Bearing & distance** | Calculates the intersection point of a line and a circle. The line is defined by a point and a direction. The circle is defined by the centre point and the radius.<br><br>Elements that must be known are<br>• the coordinates of points.<br>• the direction from one known point to the COGO point.<br>• the distance from the second known point to the COGO point.<br>• offsets if necessary and configured.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered.<br><br>Points with full coordinate triplets and position only points can be used. |
| **By points** | Calculates the intersection point of two lines. A line is defined by two points.<br><br>Elements that must be known are<br>• the coordinates of four points.<br>• offsets of the lines if necessary and configured.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be manually measured during the COGO calculation.<br>• can be entered.<br><br>Points with full coordinate triplets and position only points can be used. |
| **TPS observations** | Calculates the intersection point of two lines. A line is defined by a TPS station and a TPS measurement from this station.<br><br>Elements that must be known are<br>• the coordinates of two points.<br>• azimuths of the lines.<br><br>The coordinates of the known points<br>• must be taken from the working job.<br>• must be TPS station points.<br><br>The azimuths of the lines<br>• must be TPS measurements from the known points.<br><br>Points with full coordinate triplets and position only points can be used. |

**Diagram**




**Known**

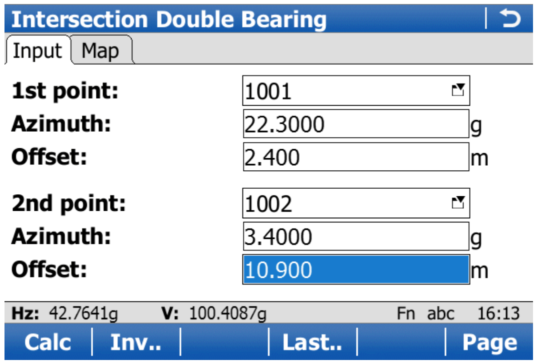
P0 First known point
P1 Second known point
α1 Direction from P0 to P2
α2 Direction from P1 to P2

**Unknown**

P2 COGO point

**Intersection Double Bearing, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.




| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Azimuth** or **Offset** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Azimuth** or **Offset** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To add, subtract, multiply and divide values. Available when **Azimuth** or **Offset** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

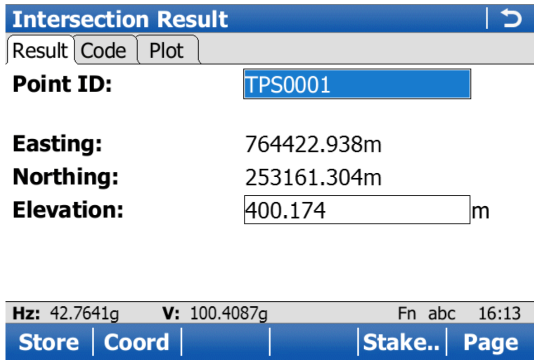
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **1st point** | Selectable list | The point ID of the first known point for the COGO calculation. |
| **2nd point** | Selectable list | The point ID of the second known point for the COGO calculation. |
| **Azimuth** | Editable field | The direction from the first known point to the COGO point. |
| **Offset** | Editable field | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available for **Use offsets**: **Yes** in **Configuration**, **General** page. |

**Next step**

**Calc** calculates the result and accesses **Intersection Result**.

**Intersection Result, Result page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **IndivID** | For an individual point ID independent of the ID template. Fn **Run** changes back to the next ID from the configured ID template. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

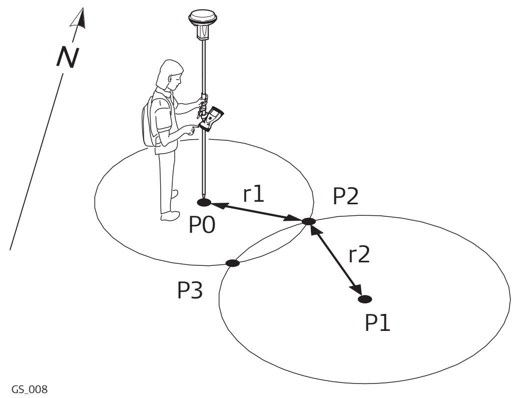
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **Auxiliary points** in **ID Templates**. The point ID can be changed. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, arrows point from the known points to the calculated COGO point.
**Store** stores the result.

**Diagram**




**Known**

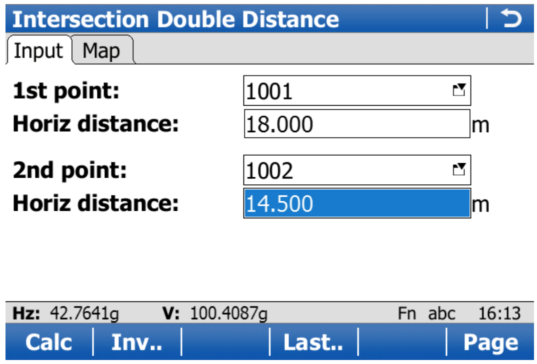
| | |
|---|---|
| P0 | First known point |
| P1 | Second known point |
| r1 | Radius, as defined by the distance from P0 to P2 |
| r2 | Radius, as defined by the distance from P1 to P2 |

**Unknown**

| | |
|---|---|
| P2 | First COGO point |
| P3 | Second COGO point |

**Intersection Double Distance, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.




| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Horiz distance** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Horiz distance** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To add, subtract, multiply and divide values. Available when **Horiz distance** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

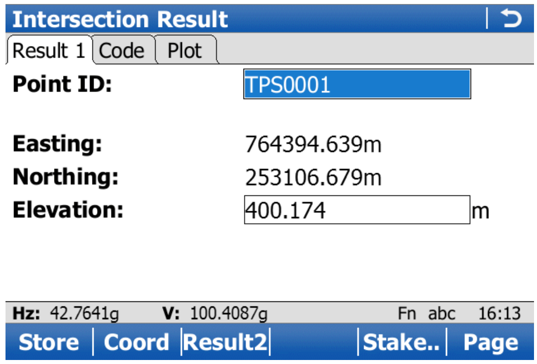
### Description of fields

| Field | Option | Description |
|---|---|---|
| **1st point** | Selectable list | The point ID of the first known point for the COGO calculation. |
| **2nd point** | Selectable list | The point ID of the second known point for the COGO calculation. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | The horizontal distance between the known points and the COGO point. |

### Next step

**Calc** calculates the result and accesses **Intersection Result**.

**Intersection Result, Result 1/Result 2 page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Result1** or **Result2** | To view the first and second result. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **IndivID** | For an individual point ID independent of the ID template. Fn **Run** changes back to the next ID from the configured ID template. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

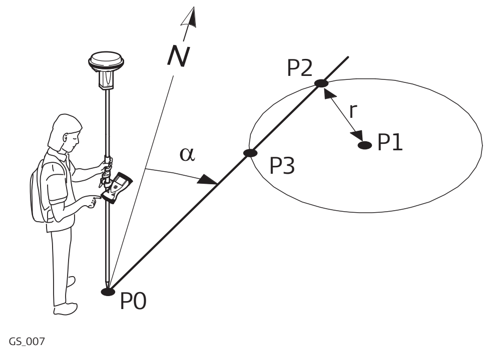
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **GPS** / **TPS** in **ID Templates**. The point ID can be changed. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, the calculated COGO points are shown.
**Store** stores the result.

**Diagram**




**Known**

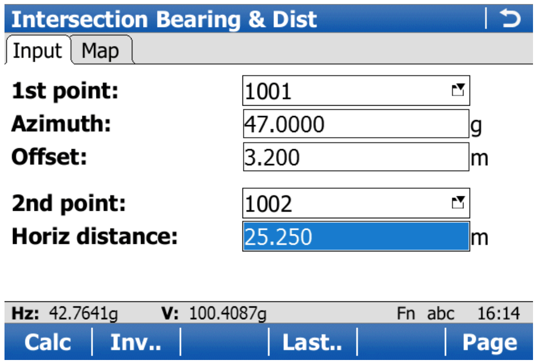
P0 First known point
P1 Second known point
α Direction from P0 to P2
r Radius, as defined by the distance from P1 to P2

**Unknown**

P2 First COGO point
P3 Second COGO point

**Intersection Bearing & Dist, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.



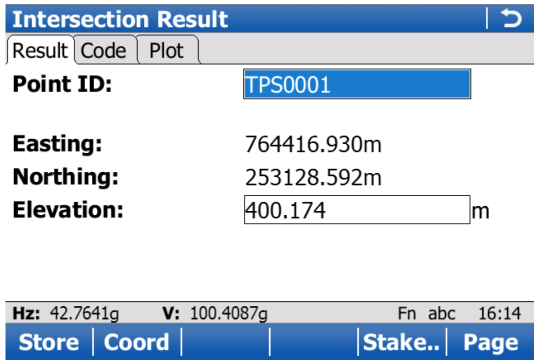

| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To add, subtract, multiply and divide values. Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **1st point** | Selectable list | The point ID of the first known point for the COGO calculation. |
| **2nd point** | Selectable list | The point ID of the second known point for the COGO calculation. |
| **Azimuth** | Editable field | The direction from the first known point to the COGO point. |
| **Offset** | Editable field | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available for **Use offsets**: **Yes** in **Configuration**, **General** page. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | The horizontal distance between the known point and the COGO point. |

**Next step**
**Calc** calculates the result and accesses **Intersection Result**.

**Intersection Result, Result 1 page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Result1** or **Result2** | To view the first and second result. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **IndivID** | For an individual point ID independent of the ID template. Fn **Run** changes back to the next ID from the configured ID template. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

### Description of fields

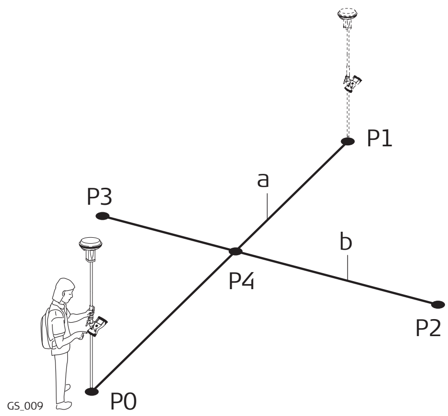
| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **GPS** / **TPS** in **ID Templates**. The point ID can be changed. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, an arrow points from the first known points to the calculated COGO point.
**Store** stores the result.

## 41.6.5 Intersection with By Points

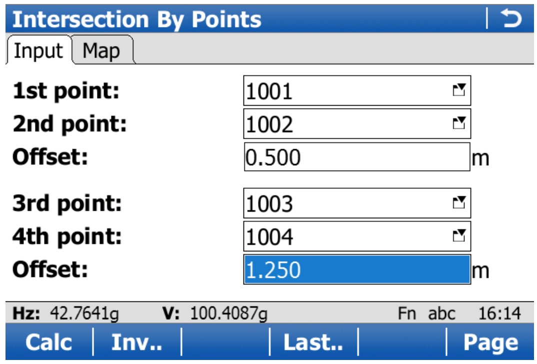
**Diagram**




**Known**
P0 First known point
P1 Second known point
P2 Third known point
P3 Fourth known point
a Line from P0 to P1
b Line from P2 to P3
**Unknown**
P4 COGO point

**Intersection By Points, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.




| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Offset** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Offset** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **1st point**, **2nd point**, **3rd point** or **4th point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To add, subtract, multiply and divide values. Available when **Offset** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

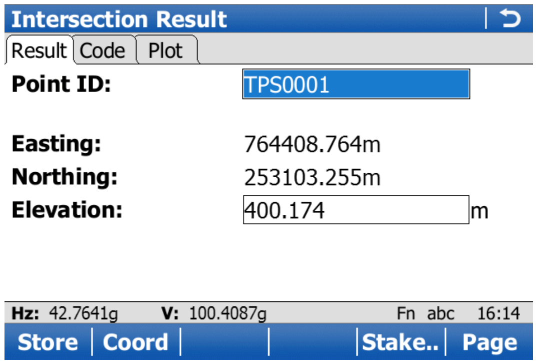
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **1st point** | Selectable list | The point ID of the known start point of the first line for the COGO calculation. |
| **2nd point** | Selectable list | The point ID of the known end point of the first line for the COGO calculation. |
| **3rd point** | Selectable list | The point ID of the known start point of the second line for the COGO calculation. |
| **4th point** | Selectable list | The point ID of the known end point of the second line for the COGO calculation. |
| **Offset** | Editable field | The offset of the line in the direction **1st point** to **2nd point** or **3rd point** to **4th point**. A positive offset is to the right, a negative offset is to the left. Available for **Use offsets**: **Yes** in **Configuration**, **General** page. |

**Next step**

**Calc** calculates the result and accesses **Intersection Result**.

**Intersection Result, Result page**




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| Fn **IndivID** | For an individual point ID independent of the ID template. Fn **Run** changes back to the next ID from the configured ID template. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

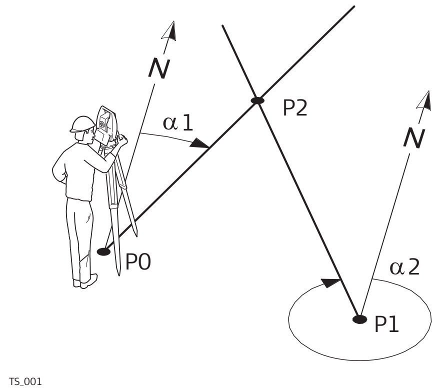
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **GPS** / **TPS** in **ID Templates**. The point ID can be changed. |
| **Easting** and **Northing** | Display only | The calculated coordinates. |
| **Elevation** | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, two solid lines are displayed.
**Store** stores the result.

**Diagram**

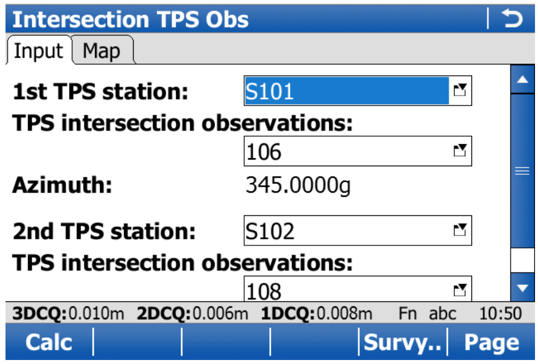



**Known**
P0 First known point (TPS station)
P1 Second known point (TPS station)
α1 Direction from P0 to P2
α2 Direction from P1 to P2
**Unknown**
P2 COGO point

**Intersection TPS Obs, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.




| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Survy..** | To manually measure a point for the COGO calculation. Available when **1st TPS station** or **2nd TPS station** is highlighted and the selected station is the active TPS setup. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **1st TPS station** | Selectable list | The point ID of the first TPS station which is the known start point of the first line for the COGO calculation. |
| **TPS intersection observations** | Selectable list | The point ID of the TPS measurement which is the known end point of the first line for the COGO calculation. |
| **Azimuth** | Display only | The azimuth related to the known end point of the first/second line for the COGO calculation. |
| **2nd TPS station** | Selectable list | The point ID of the second TPS station which is the known start point of the second line for the COGO calculation. |
| **TPS intersection observations** | Selectable list | The point ID of the TPS measurement which is the known end point of the second line for the COGO calculation. |

### Next step

**Calc** calculates the result and accesses **Intersection Result**.

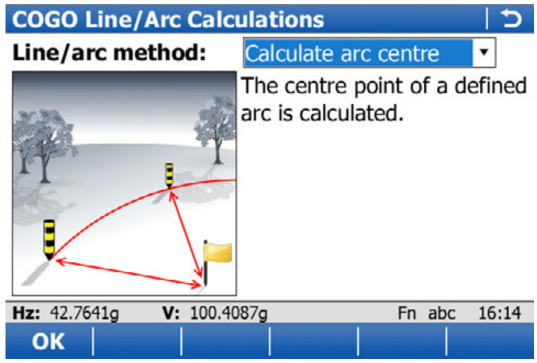
## 41.7 COGO Calculation - Line/Arc Calculations Method

### 41.7.1 Selecting the Line/Arc Method

**Access**

Select **Main Menu**: **Go to Work!\COGO..\COGO..**.

**COGO Line/Arc Calculations**




| Key | Description |
|---|---|
| **OK** | To select a method and to continue with the subsequent screen. |

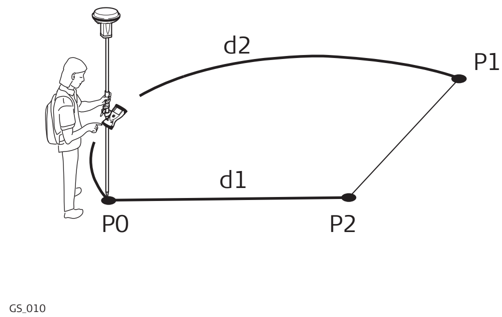
### Description of the Line/Arc methods

| Line/Arc Methods | Description |
|---|---|
| **Calculate arc centre** | Calculates the coordinates of the centre of the arc.<br><br>Elements that must be known are<br>• coordinates of three points<br>OR<br>• coordinates of two points<br>• radius to the two points<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |
| **Calculate arc offset pt** | Calculates the coordinates of a new point after input of arc and offset values in relation to an arc.<br><br>Elements that must be known are<br>• coordinates of three points.<br>• offsets.<br>OR<br>• coordinates of two points.<br>• radius to the two points.<br>• offsets.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |
| **Calculate line offset pt** | Calculates the coordinates of a new point after input of station and offset values in relation to a line.<br><br>Elements that must be known are<br>• coordinates of two points.<br>• offsets.<br>OR<br>• coordinates of one point.<br>• bearing and distance from one point.<br>• offsets.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered. |

<table>
<tr><th>Line/Arc Methods</th><th>Description</th></tr>
<tr><td>Calculate arc base pt</td><td>Calculates the coordinates of the base point, station and offset of a point in relation to an arc.<br><br>Elements that must be known are<br>• coordinates of three points<br>• coordinates of an offset point<br>OR<br>• coordinates of two points<br>• radius to the two points<br>• coordinates of an offset point<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered.</td></tr>
<tr><td>Calculate line base pt</td><td>Calculates the base point, station and offset of a point in relation to a line.<br><br>Elements that must be known are<br>• coordinates of two points and an offset point.<br>OR<br>• coordinates of one point and an offset point<br>• bearing and distance from one point<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered.</td></tr>
<tr><td>Segment an arc</td><td>This method is similar to Segment a line. See the following row.</td></tr>
<tr><td>Segment a line</td><td>Calculates the coordinates of new points on a line.<br><br>Elements that must be known are<br>• coordinates of the start and the end point of the line<br>OR<br>• a bearing and distance from a known point that define the line<br>AND EITHER<br>• the number of segments dividing the line<br>OR<br>• a segment length for the line.<br><br>The coordinates of the known points<br>• can be taken from the working job.<br>• can be measured during the COGO calculation.<br>• can be entered.</td></tr>
</table>

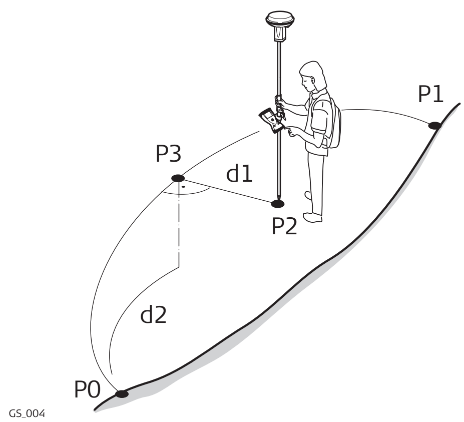
## 41.7.2 Arc Calculation

#### Diagram for arc centre




P0 **Start point**
P1 **End point**
P2 Arc centre
d1 **Arc radius**
d2 **Arc length**

#### Diagram for arc base point and offset point




P0 **Start point**
P1 **End point**
P2 **Offset point**
P3 Base point
d1 **Offset**
d2 **Distance along arc**

**Create Arc, Input page**

The softkeys are similar to line calculation. Refer to "41.7.3 Calculate Line Offset Point and Calculate Line Base Point" for information on softkeys.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create arc using** | | The method by which the arc will be defined. |
| | **3 points** | Uses three known points to define the arc. |
| | **2 points & radius** | Defines the arc using two known points and a radius of the arc. |
| | **2 tngnts & radius** | Defines the arc using two tangents and a radius of the arc. |
| | **2 tngnts & arc lngth** | Defines the arc using two tangents and the length of the arc. |
| | **2 tngnts & crd lngth** | Defines the arc using two tangents and the chord of the arc. |
| **Start point** | Selectable list | The start point of the arc. Available for **Line/arc method**: **3 points** and **Line/arc method**: **2 points & radius**. |
| **Second point** | Selectable list | The second point of the arc. Available for **Line/arc method**: **3 points**. |
| **End point** | Selectable list | The end point of the arc. Available for **Line/arc method**: **3 points** and **Line/arc method**: **2 points & radius**. |
| **Point 1** | Selectable list | A point on the first tangent. Available for **Line/arc method**: **2 tngnts & radius**, **Line/arc method**: **2 tngnts & arc lngth** and **Line/arc method**: **2 tngnts & crd lngth**. |
| **PI point** | Selectable list | The point of intersection of the two tangents. Available for **Line/arc method**: **2 tngnts & radius**, **Line/arc method**: **2 tngnts & arc lngth** and **Line/arc method**: **2 tngnts & crd lngth** |
| **Point 2** | Selectable list | A point on the second tangent. Available for **Line/arc method**: **2 tngnts & radius**, **Line/arc method**: **2 tngnts & arc lngth** and **Line/arc method**: **2 tngnts & crd lngth**. |
| **Radius** | Editable field | The radius of the arc. Available for **Line/arc method**: **2 points & radius** and **Line/arc method**: **2 tngnts & radius**. |
| **Arc length** | Editable field | The length of the arc. Available for **Line/arc method**: **2 tngnts & arc lngth**. |
| **Chord length** | Editable field | The length of the chord. Available for **Line/arc method**: **2 tngnts & crd lngth**. |

#### Next step

| IF | THEN |
|---|---|
| **Line/arc method**: **Calculate arc centre** | **Calc** accesses **Centre of Arc Result**. |
| **Line/arc method**: **Calculate arc offset pt** | **OK** accesses **Calculations Input**. |
| **Line/arc method**: **Calculate arc base pt** | **OK** accesses **Calculations Input**. |

### Calculations Input, Input page

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Distance along arc** | Editable field | Horizontal distance along the arc from start point to base point. Available for **Line/arc method**: **Calculate arc offset pt**. |
| **Offset**, **Offset (ground)** or **Offset (ell)** | Editable field | Offset from base point to offset point. Positive to the right and negative to the left of the arc. Available for **Line/arc method**: **Calculate arc offset pt**. |
| **Offset point** | Selectable list | Point ID of offset point. Available for **Line/arc method**: **Calculate arc base pt**. |

#### Next step

| IF | THEN |
|---|---|
| **Line/arc method**: **Calculate arc offset pt** | **Calc** accesses **Line/Arc Calculation Result**. |
| **Line/arc method**: **Calculate arc base pt** | **Calc** accesses **Line/Arc Calculation Result**. |

**Centre of Arc Result/Line/Arc Calculation Result, Result page**

The result screens for base point and offset point are similar.
Refer to paragraph " Line/Arc Calculation Result, Result page" for information on softkeys.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **GPS** / **TPS** in **ID Templates**. |
| **Elevation** or **Local ellipsoid ht** | Editable field | The height of the start point of the arc is suggested. A height value to be stored with the calculated point can be typed in. |
| **Arc radius** | Display only | Computed radius of arc. |
| **Arc length** | Display only | Computed length of arc. |
| **Bearing to offset pt** | Display only | Bearing of offset point from base point to offset point. Available for **Line/arc method**: **Calculate arc offset pt**. |
| **Offset point** | Display only | Point ID of offset point. Available for **Line/arc method**: **Calculate arc base pt**. |
| **Distance along arc**, **Distance along arc (grnd)** or **Distance along arc (ell)** | Display only | Horizontal distance along the arc from start point to base point. Available for **Line/arc method**: **Calculate arc offset pt**. |
| **Offset**, **Offset (ground)** or **Offset (ell)** | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for **Line/arc method**: **Calculate arc offset pt**. |

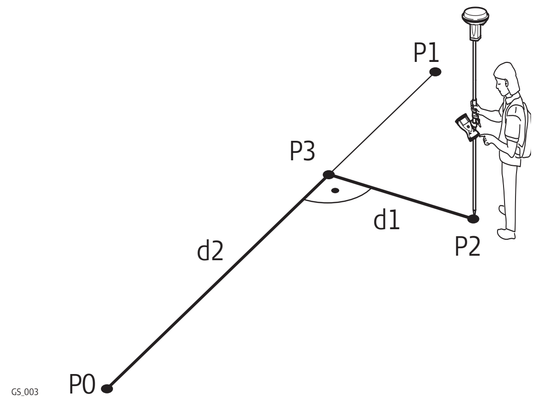
### Next step

On the **Code** page, type in a code if desired.
On the **Plot** page, the arc and the new point is shown.

**Store** stores the result

## 41.7.3 Calculate Line Offset Point and Calculate Line Base Point

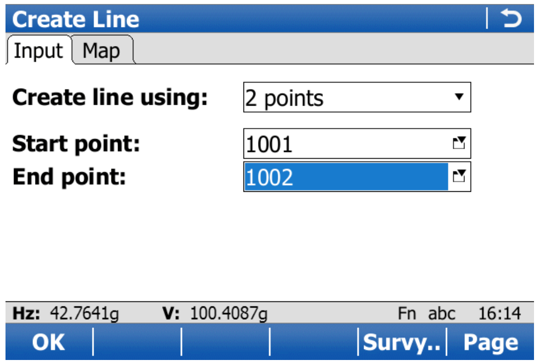
**Diagram**




P0 **Start point**
P1 **End point**
P2 **Offset point**
P3 Base point
d1 **Offset-XX:**
d2 **ΔLine-XX:**

☞ Line management is not available for COGO line calculations.

**Create Line, Input page**




| Key | Description |
|---|---|
| **OK** | To change to the second layer of editable fields. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available if **Azimuth** or **Horiz distance** is highlighted. |
| **Last..** | To select the values for the distance and the offset from previous COGO inverse calculations. Available if **Azimuth** or **Horiz distance** is highlighted. |
| **Survy..** | To measure a point manually for the COGO calculation. Available if **Start point** or **End point** is highlighted. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Modif..** | To mathematically modify the values. Available if, **Azimuth** or **Horiz distance** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line/arc method** | | The method by which the line will be defined. |
| | **2 points** | Uses two known points to define the line. |
| | **Pt, bearing & dist** | Defines the line using a known point, a distance and an azimuth of the line. |
| **Start point** | Selectable list | The start point of the line. |
| **End point** | Selectable list | The end point of the line. Available for **Line/arc method**: **2 points**. |
| **Azimuth** | Editable field | The azimuth of the line. Available for **Line/arc method**: **Pt, bearing & dist**. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | The horizontal distance from the start point to the end point of the line. Available for **Line/arc method**: **Pt, bearing & dist**. |

**Next step**

**OK** accesses **Calculations Input**.

**Calculations Input, Input page**

### Description of fields

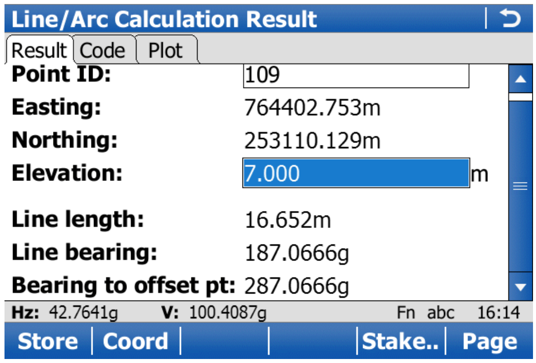
| Field | Option | Description |
|---|---|---|
| **Distance along line**, **Distance along line (ground)** or **Distance along line (ell)** | Editable field | Available for **Line/arc method**: **Calculate line offset pt**. Horizontal distance from start point to base point. |
| **Offset**, **Offset (ground)** or **Offset (ell)** | Editable field | Available for **Line/arc method**: **Calculate line offset pt**. Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| **Offset point** | Selectable list | Available for **Line/arc method**: **Calculate line base pt**. The offset point. |

### Next step

**Calc** accesses **Line/Arc Calculation Result**.

**Line/Arc Calculation Result, Result page**

The result screens for base point and offset point are similar. The explanations given for the softkeys are valid for the **Result** page.




| Key | Description |
|---|---|
| **Store** | To store the result. |
| **Coord** | To view other coordinate types. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the COGO point depending on the point ID template configured for **GPS** / **TPS** in **ID Templates**. |
| **Elevation** or **Local ellipsoid ht** | Editable field | The height of the start point of the line is suggested. A height value to be stored with the calculated point can be typed in. |
| **Offset point** | Display only | Point ID of offset point. Available for **Line/arc method**: **Calculate line base pt**. |
| **Distance along line**, **Distance along line (ground)** or **Distance along line (ell)** | Display only | Horizontal distance from start point to base point. Available for **Line/arc method**: **Calculate line base pt**. |
| **Offset**, **Offset (ground)** or **Offset (ell)** | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for **Line/arc method**: **Calculate line base pt**. |
| **Line length** | Display only | Length of line from start point to end point. |
| **Line bearing** | Display only | Bearing of line from start point to end point. |
| **Bearing to offset pt** | Display only | Bearing of offset point from base point to offset point. |

**Next step**

On the **Code** page, type in a code if desired.
On the **Plot** page, the line and the new point is shown.
**Store** stores the result.

## 41.7.4 Segment an Arc

**Exceptions to line calculation segmentation**

The arc segmentation and the functionality of all screens and fields are similar to those for line segmentation. Refer to "41.7.5 Segment a Line"

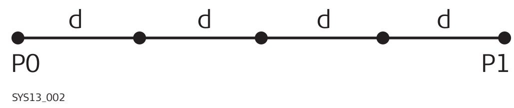
**New field and option in Define Arc Segmentation**

| Field | Option | Description |
|---|---|---|
| **Method** | **Delta angle** | To divide the arc by an angular value. |
| **Delta angle** | Editable field | The angular value by which new points will be defined on the arc. |

## 41.7.5 Segment a Line

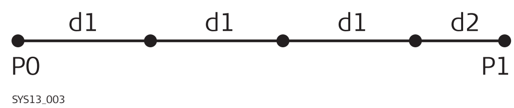
**Diagram**

Line divided by **Method**: **No. of segments**




P0 **Start point**
P1 **End point**
d Equally spaced segments result from dividing a line by a certain number of points.

Line divided by **Method Segment length**




P0 **Start point**
P1 **End point**
d1 **Segment length**
d2 Remaining segment

☞ For a description of the **Create Line**, **Input** page, refer to "41.7.3 Calculate Line Offset Point and Calculate Line Base Point".

**Define Line Segmentation**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | Selectable list | How the line is to be divided. Depending on the selection, the following fields are editable or display only fields. |
| **Line length** | Display only | Calculated line length between the selected **Start point** and **End point**. |
| **No. of segments** | Editable field or display only | For **Method**: **No. of segments** type in the number of segments for the line. For **Method**: **Segment length** this field indicates the calculated number of segments. This method can result in a remaining segment. |
| **Segment length** | Editable field or display only | For **Method**: **No. of segments** this field is the calculated length of each segment. For **Method**: **Segment length** type in the required segment length. |
| **Last segment** | Display only | Available for **Method**: **Segment length**. The length of the remaining segment. |
| **Starting pt ID** | Editable field | The point ID to be assigned to the first new point on the line. The selected point ID templates from **ID Templates** are not applied. |
| **Pt ID increment** | Editable field | Is incremented numerically for the second, third, etc. point on the line. |

**Next step**

**Calc** calculates the coordinates of the new points. The heights are computed along the line assuming a linear slope between **Start point** and **End point**.

On the **Plot** page, the known points defining the line and those points created on the line are shown.

# 41.8 COGO Calculation - Area Division

## 41.8.1 Selecting the Division Method

**Description**

The COGO calculation area division divides an area by a defined line, by percentage or by the size of a subarea.

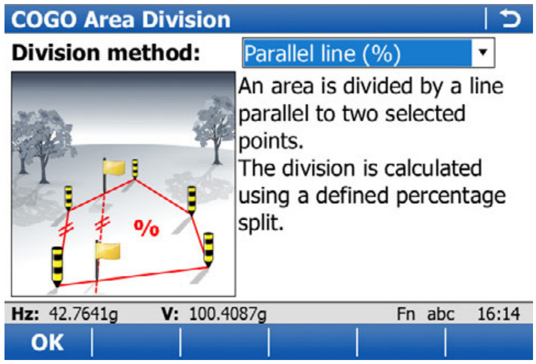
Elements that must be known for the calculation depend on the area division method. At least three points are required to form an area.

The coordinates of the known points
- can be taken from the working job.
- can be measured during the COGO calculation.
- can be entered.

**Access**

Select **Main Menu**: **Go to Work!\COGO..\Area division**.

## COGO Area Division




| Key | Description |
|---|---|
| **OK** | To select  a method and to continue with the subsequent screen. |

### Description of the Area Division methods

| Area Division method | Description |
|---|---|
| **Parallel line (%)** | The border will be parallel to a line defined by two points. The division is calculated using a defined percentage split. |
| **Parallel line (area)** | The border will be parallel to a line defined by two points. The division is calculated using a defined area size. |
| **Parallel line (line)** | The border will be parallel to a line defined by two points. The division is calculated by defining the position of the dividing line. |
| **Perpendic line (%)** | The border will be perpendicular to a line defined by two points. The division is calculated using a defined percentage split. |
| **Perpendic line (area)** | The border will be perpendicular to a line defined by two points. The division is calculated using a defined area size. |
| **Perpendic line (line)** | The border will be perpendicular to a line defined by two points. The division is calculated by defining the position of the dividing line. |
| **Swing line (%)** | The border will be a line rotated around a rotation point by an azimuth. The division is calculated using a defined percentage split. |
| **Swing line (area)** | The border will be a line rotated around a rotation point by an azimuth. The division is calculated using a defined area size. |

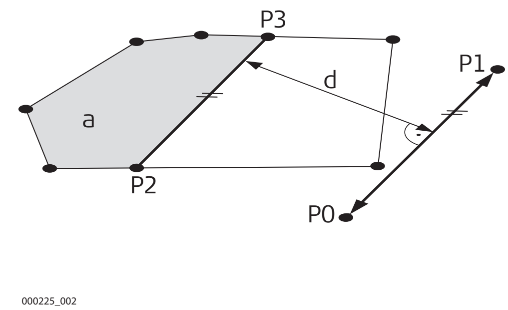
#### Elements required

| Divide by | Using | | Elements required |
|---|---|---|---|
| Line | Parallel line | Through a point | • Two points defining the line<br>• One point on the dividing line |
| | | By a distance | • Two points defining the line<br>• Distance |
| | Perpendicular line | Through a point | • Two points defining the line<br>• One point on the dividing line |
| | | By a distance | • Two points defining the line<br>• Distance |
| Percentage | Parallel line | - | • Percentage size of new area<br>• Two points defining the line |
| | Perpendicular line | - | • Percentage size of new area<br>• Two points defining the line |
| | Swing line | Rotation point | • Percentage size of new area<br>• Rotation point of the swing line |
| Area | Parallel line | - | • Size of new area<br>• Two points defining the line |
| | Perpendicular line | - | • Size of new area<br>• Two points defining the line |
| | Swing line | Rotation point | • Size of new area<br>• Rotation point of the swing line |

**Diagram**

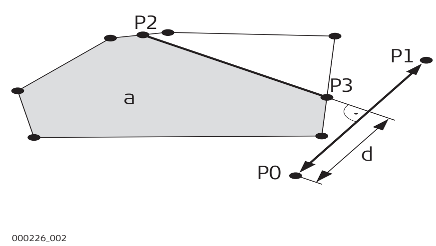
The diagrams show the area division methods. Some diagrams apply to several area division methods.

| Area division method | Using | Devide by | Shift by |
|---|---|---|---|
| 1. | **Parallel Line** | **Defined Line** | **Distance** |
| 2. | **Parallel Line** | **Percentage** | - |
| 3. | **Parallel Line** | **Area** | - |



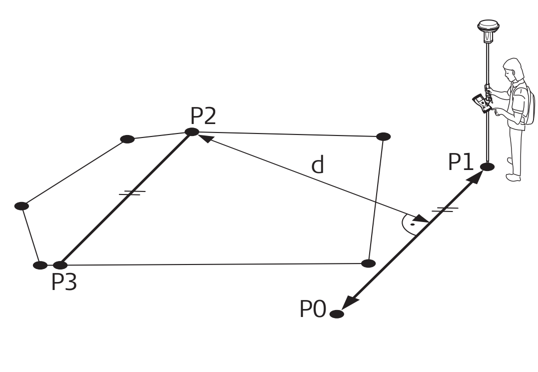

P0 **Point A** of defined line
P1 **Point B** of defined line
P2 First new COGO point
P3 Second new COGO point
d **Horiz distance**
a **Area left of line**

| Area division method | Using | Devide by | Shift by |
|---|---|---|---|
| 1. | **Perpendic Line** | **Defined Line** | **Distance** |
| 2. | **Perpendic Line** | **Percentage** | - |
| 3. | **Perpendic Line** | **Area** | - |



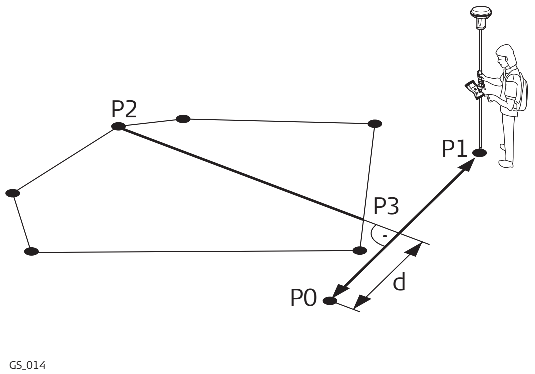

P0 **Point A** of defined line
P1 **Point B** of defined line
P2 First new COGO point
P3 Second new COGO point
d **Horiz distance**
a **Area left of line**

| Area division method | Using | Devide by | Shift by |
|---|---|---|---|
| 1. | **Parallel Line** | **Defined Line** | **Through Point** |



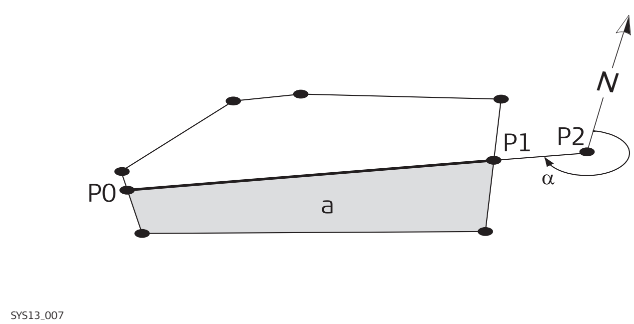

P0 **Point A** of defined line
P1 **Point B** of defined line
P2 **Through point**; in this case it is a known point of the existing border
P3 New COGO point
d **Horiz distance**

| Area division method | Using | Devide by | Shift by |
|---|---|---|---|
| 1. | **Perpendic Line** | **Defined Line** | **Through Point** |




P0 **Point A** of defined line
P1 **Point B** of defined line
P2 **Through point**; in this case it is a known point of the existing border
P3 New COGO point
d **Horiz distance**

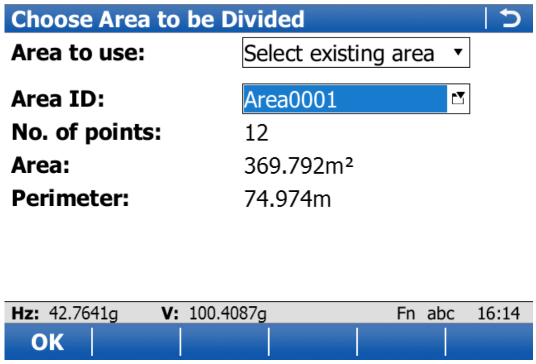
| Area division method | Using | Devide by | Shift by |
|---|---|---|---|
| 1. | **Swing Line** | **Percentage** | - |
| 2. | **Swing Line** | **Area** | - |




P0 First new COGO point
P1 Second new COGO point
P2 **Rotation point**
α **Azimuth**
a **Area left of line**

## 41.8.2 Choosing an Area to be Divided

**Choose Area to be Divided**




| Key | Description |
|---|---|
| **OK** | To accept the changes and access the subsequent screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Area to use** | | The setting determines the availability of the subsequent fields and screen. |
| | **Select existing area** | To use an area from the working job. The area can be edited and a new area can be created from points existing in the job. |
| | **Survey new area** | To survey points that do not exist in the job yet. The points will be added to a new area. |
| | **Create new with pts** | To create a new area by selecting points from the job. |
| **Area ID** | Selectable list | For **Area to use**: **Select existing area**. To select the area to be divided. |
| | Editable field | For **Area to use**: **Survey new area** and **Area to use**: **Create new with pts**. To enter a name for the new area. |
| **No. of points** | Display only | Number of points forming the area. |
| **Area** | Display only | The size of the selected area. |
| **Perimeter** | Display only | The perimeter of the area. |

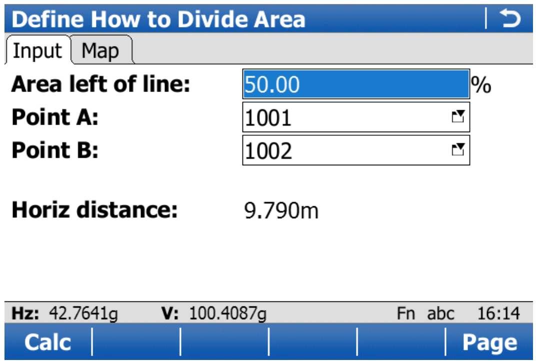
### Next step

| IF | THEN |
|---|---|
| **Area to use**: **Select existing area** | **OK** accesses **Define How to Divide Area**. Refer to "41.8.3 Dividing an Area". |
| **Area to use**: **Survey new area** | **OK** accesses **Survey Job name**. Refer to "57 Survey - General". |
| **Area to use**: **Create new with pts** | **OK** accesses **Edit Area**. Refer to "6.4.3 Editing a Line/Area". |

# 41.8.3 Dividing an Area

**Define How to Divide Area, Input page**

After each change of parameters on this screen, the values in the display only fields are recalculated and updated.




| Key | Description |
|---|---|
| **Calc** | To perform the area division and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **Inv..** | To calculate the value for the distance from two existing points. Available if **Horiz distance** is highlighted. |
| **Size** and **%** | To display the size and the percentage of the subarea. |
| **Last..** | To select the value for the distance from previous COGO inverse calculations. Available if **Horiz distance** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available if **Point A**, **Point B**, **Rotation point** or **Through point** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

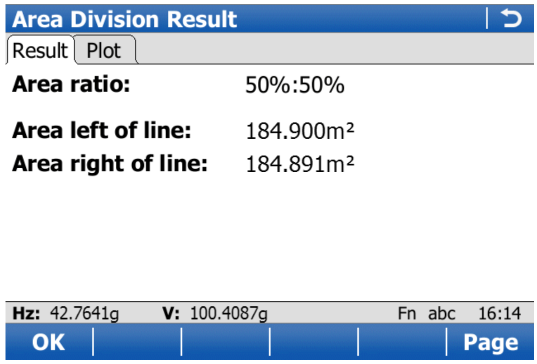
| Field | Option | Description |
|---|---|---|
| **Area left of line** | Editable field | For dividing by percentage or area. The size of the sub area must be typed either in % or in $m^2$.<br>When dividing the area using a parallel or perpendicular line, a reference line is defined by **Point A** and **Point B**. The direction of the new dividing line is always the same as the direction of the reference line. The direction of a perpendicular line is the same as the reference line rotated 90° anticlockwise. The sub area is always to the left of the new dividing line.<br>When dividing an area using a swing line, the direction of the new dividing line is defined by the **Rotation point** and the **Azimuth**. The sub area is always to the left of the new dividing line. |
| | Display only | For dividing by a line. The size of the sub area is calculated and displayed. |
| **Point A** | Selectable list | The first point of the line which is used as the reference for a new parallel or perpendicular border. |
| **Point B** | Selectable list | The second point of the line which is used as the reference for a new parallel or perpendicular border. |
| **Shift** | | Available for dividing by a line. |
| | **By distance** | The new border will run in a certain distance from the line defined by **Point A** and **Point B**. |
| | **Through point** | The new border will run through a point defined in **Through point**. |
| **Through point** | Selectable list | Available for **Shift**: **Through point**. The point through which the new border will run. |
| **Rotation point** | Selectable list | Available for using a swing line. The point around which the new border will rotate by **Azimuth**. |
| **Azimuth** | Display only | Available for using a swing line. The angle of the new border from **Rotation point** to the new COGO point. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Display only | The distance from the line defined by **Point A** and **Point B** to the new border. |

### Next step

**Calc** performs the area division and accesses **Area Division Result**.

## 41.8.4 Results of the Area Division

**Area Division Result, Result page**




| Key | Description |
|---|---|
| **OK** | To accept the calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Area ratio** | Display only | The ratio of the size of the two sub areas in percent. |
| **Area left of line** | Display only | The size of the first sub area in $m^2$. |
| **Area right of line** | Display only | The size of the second sub area in $m^2$. |

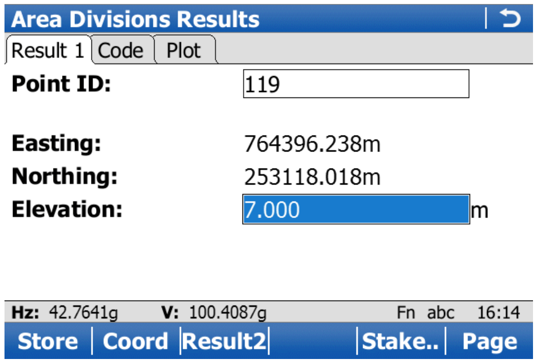
**Next step**

On the **Plot** page, the points defining the area and the calculated COGO points are shown in black.

**OK** accesses **Area Divisions Results**.

**Area Divisions Results, Result page**

The coordinates of the intersection points of the new border with the original area are displayed.




| Key | Description |
|---|---|
| **Store** | To store the two results and to return to **Choose Area to be Divided** once both points are stored. |
| **Coord** | To view other coordinate types. |
| **Result1** or **Result2** | To view the first and second result. |
| **Stake..** | To access the Stakeout application and stake out the calculated COGO point. |
| **Page** | To change to another page on this screen. |
| Fn **Ell Ht** and Fn **Elev** | To change between the ellipsoidal and the orthometric height. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit COGO calculation. |

**Next step**

On the **Code** page, type in a code if desired.

On the **Plot** page, The points defining the area and the points of the new border are shown in black.

**Store** stores the results.

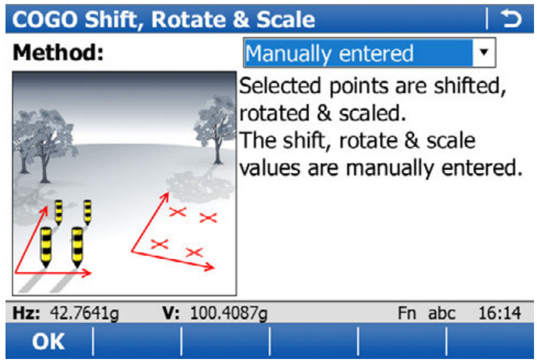
## 41.9 COGO Calculation - Shift, Rotate & Scale

### 41.9.1 Selecting the Shift, Rotate & Scale Method and the Points to be Moved

**Access**

Select **Main Menu**: **Go to Work!\COGO..\Shift, rotate & scale**.

**COGO Shift, Rotate & Scale**




| Key | Description |
|---|---|
| **OK** | To select a method and to continue with the subsequent screen. |

### Description of the Shift, Rotate & Scale methods

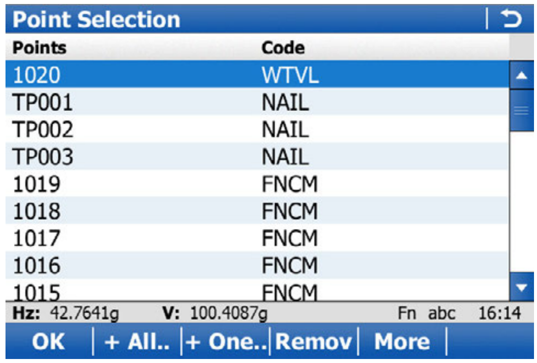
| Shift, Rotate & Scale methods | Description |
|---|---|
| **Manually entered** | Applies shifts and/or rotation and/or scale to one or several known points. The values for shifts and/or rotation and/or scale are typed in manually.<br><br>Elements that must be known are<br>• the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the working job.<br>• the shift values. They can be defined as: the direction of Easting, Northing and Height, or as an azimuth and a grid distance, or as shift from one point to another.<br>• the rotation value. It can be defined by a point as rotation centre plus a rotation or by an existing and new azimuth.<br>• the scale. It is only applied to the position, not to the height.<br><br>Points with full coordinate triplets, position only points and height only points can be used. |
| **Matching points** | Applies shifts and/or rotation and/or scale to one or several known points. The shifts and/or rotation and/or scale are calculated from selected points using a 2D Helmert transformation.<br><br>Elements that must be known are<br>• the coordinates of at least two matching points for the calculation of the shifts and/or rotation and/or scale.<br>• the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the working job.<br><br>Points with full coordinate triplets, position only points and height only points can be used.<br><br>The number of pairs of points matched determines whether the shift, rotation and scale values are computed. For only one point, only shifts are calculated, rotation and scale are not. |

### Next step

**OK** accesses **Point Selection** which is the same for **Method: Manually entered** and **Method: Matching points**.

**Point Selection**

Listed are points which have been selected for shifting, rotating and/or scaling.

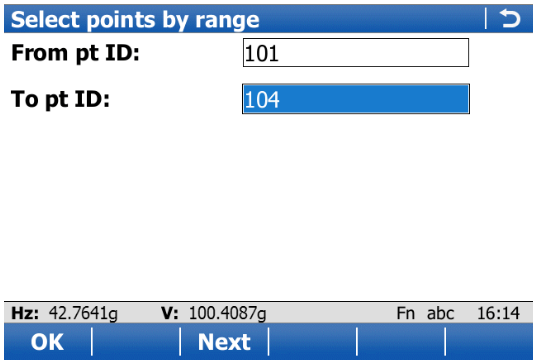



| Key | Description |
|---|---|
| **OK** | To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **+ All..** | To add all points from the working job to the list. Selected sort and filter settings apply. **OK** adds all displayed points to the list in **Point Selection** and returns to that screen. |
| **+ One..** | To add one point from the working job to the list. Selected sort and filter settings apply. **OK** adds the currently highlighted point to the list in **Point Selection** and returns to that screen. |
| **Remov** | To remove the highlighted point from the list. The point itself is not deleted. |
| **More** | To display information about the codes if stored with any point, the time and the date of when the point was stored and the 3D coordinate quality and the class. |
| Fn **Rem A** | To remove all points from the list. The points themselves are not deleted. |
| Fn **Range** | To define a range of points from the working job to be added to the list. |
| Fn **Quit** | To exit COGO calculation. |

### Next step

| IF | AND | THEN |
|---|---|---|
| all points are to be added | - | **+ All..**. |
| one point is to be added | - | **+ One..**. |
| a range of points is to be added | - | Fn **Range** accesses **Select points by range**. |
| all points are added | **Method:Manually entered** | **OK** accesses **Computed Parameters**. Refer to "41.9.2 Manually Entered". |
| | **Method:Matching points** | **OK** accesses **Match Common Points (%d)**. Refer to "41.9.3 Matching Points". |

**Select points by range**




| Key | Description |
|---|---|
| **OK** | To add the points within the selected range to the list in **Point Selection**. Returns to the screen from where this screen was accessed. |
| **Next** | To add the points within the selected range to the list in **Point Selection** without quitting this screen. Another range of point IDs can be selected. |

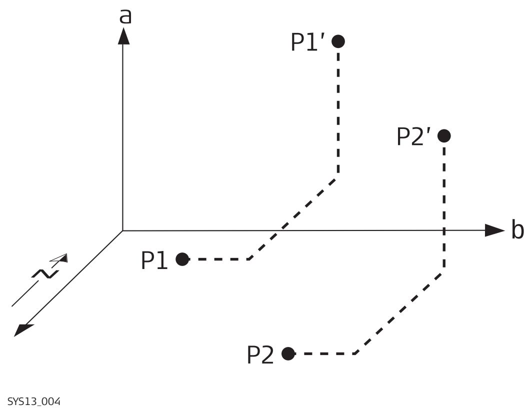
### Description of fields

| Field | Option | Description |
|---|---|---|
| **From pt ID** and **To pt ID** | Editable field | • Numeric point IDs in both fields: <br>Points with numeric point IDs falling within the range are selected. <br>Example: <br>**From pt ID: 1**, **To pt ID: 50** <br>Selected are point IDs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.... 49, 50 as well as 001, 01, 0000045, ... <br>Not selected are point IDs 100,200,300, ... <br>• Alphanumeric point IDs in both fields: <br>The left most character of both entries is used as the basis for the range. The standard ASCII numerical range is used. Points with alphanumeric point IDs falling within the range are selected. <br>Example: <br>**From pt ID: a9**, **To pt ID: c200** <br>Selected are point IDs a, b, c, aa, bb, cc, a1, b2, c3, c4, c5, a610, ... <br>Not selected are point IDs d100, e, 200, 300, tzz ... |

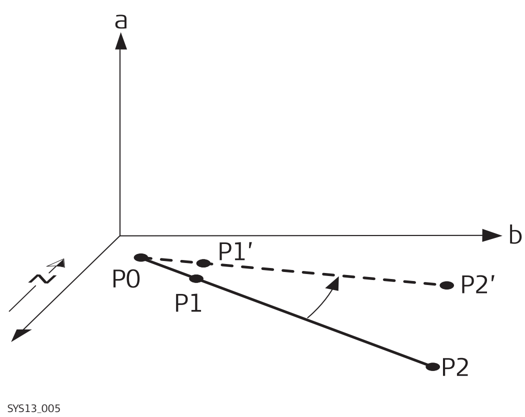
### Next step

Select a range of points.
**OK** returns to **Point Selection**.

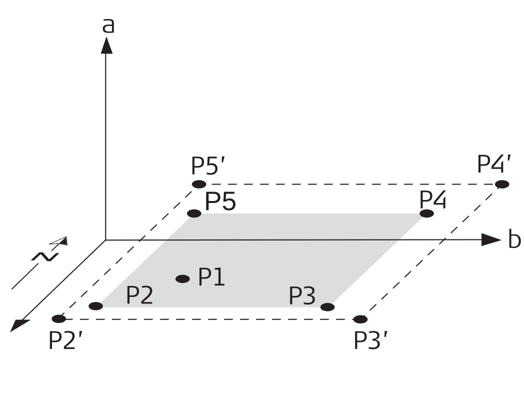
**Diagram**




**Shift**
a Height
b Easting
P1 Known point
P1' Shifted point
P2 Known point
P2' Shifted point



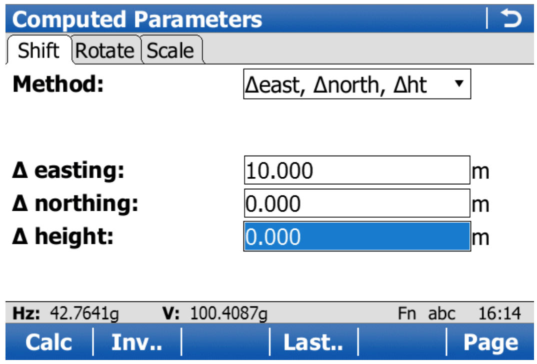

**Rotation**
a Height
b Easting
P0 **Rotation point**
P1 Known point
P1' Rotated point
P2 Known point
P2' Rotated point




**Scale**
a Height
b Easting
P1 **Rotation point**, can be held fixed, all other points are then scaled from here
P2 Known point
P2' Scaled point
P3 Known point
P3' Scaled point
P4 Known point
P4' Scaled point
P5 Known point
P5' Scaled point

## 41.9.2 Manually Entered

**Computed Parameters, Shift page**




| Key | Description |
|---|---|
| **Calc** | To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **Inv..** | To calculate the amount of shift in Easting, Northing and height from two existing points. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted. |
| **Last..** | To select the value for the shift from previous COGO inverse calculations. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. Available for **Method**: **Use 2 points** if **From** or **To** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the COGO application. Refer to "41.3 Configuring COGO". |
| Fn **Modif..** | To mathematically modify the values. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted. |
| Fn **Quit** | To exit COGO calculation. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | | The method by which the shift in Δ Easting, Δ Northing and Δ Height will be determined. |
| | **Δeast, Δnorth, Δht** | Defines the shift using coordinate differences. |
| | **Bearing, dist, height** | Defines the shift using an azimuth, a distance and a height difference. |
| | **Use 2 points** | Computes the shift from the coordinate differences between two known points. |
| **From** | Selectable list | Available for **Method**: **Use 2 points**. The point ID of the first known point for calculating the shift. |
| **To** | Selectable list | Available for **Method**: **Use 2 points**. The point ID of the second known point for calculating the shift. |
| **Azimuth** | Editable field | Available for **Method**: **Bearing, dist, height**. The azimuth defines the direction of the shift. |
| **Horiz distance**, **Horiz dist (ground)** or **Horiz dist (ell)** | Editable field | Available for **Method**: **Bearing, dist, height**. The amount of shift from the original point to the calculated COGO points. |
| **Δ easting** | Editable field or display only | The amount of shift in East direction. |
| **Δ northing** | Editable field or display only | The amount of shift in North direction. |
| **Δ height** | Editable field or display only | The amount of shift in height. |

#### Next step

**Page** accesses **Computed Parameters**, **Rotate** page.

**Computed Parameters, Rotate page**

The softkeys are the same as on the **Shift** page.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | | The method by which the rotation angle will be determined. |
| | **User entered** | The rotation can be manually typed in. |
| | **Computed** | The rotation will be calculated as **New azimuth** minus **Existing azimuth**. |
| **Rotation point** | Selectable list | The point around which all points will be rotated. |
| **Existing azimuth** | Editable field | Available for **Method**: **Computed**. A known direction before rotating. |
| **New azimuth** | Editable field | Available for **Method**: **Computed**. A known direction after rotating. |
| **Rotation** | Editable field or display only | The amount by which the points will be rotated. |

### Next step

**Page** accesses **Computed Parameters**, **Scale** page.

**Computed Parameters, Scale page**

The softkeys are the same as on the **Shift** page.

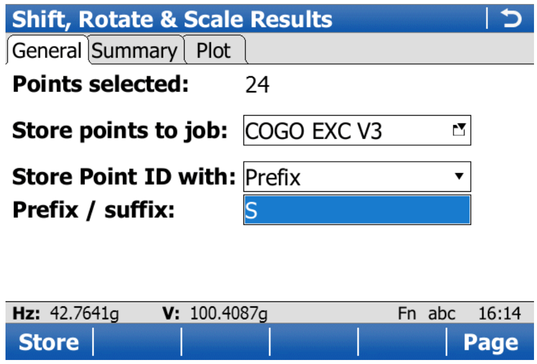
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | | The method by which the scale factor will be determined. |
| | **User entered** | The scale factor can be manually typed in. |
| | **Computed** | The scale factor will be calculated as **New distance** divided by **Existing distance**. |
| **Existing distance** | Editable field | Available for **Method**: **Computed**. A known distance before scaling. This value is used for calculating the scale factor. |
| **New distance** | Editable field | Available for **Method**: **Computed**. A known distance after scaling. This value is used for calculating the scale factor. |
| **Scale** | Editable field or display only | The scale factor used in the calculation. |
| **Scale from point** | **No** | Scaling is performed by multiplying the original coordinates of the points by **Scale**. |
| | **Yes** | **Scale** is applied to the coordinate difference of all points relative to **Rotation point** selected on the **Rotation** page. The coordinates of **Rotation point** will not change. |

### Next step

**Calc** performs the shift, rotation and scale calculation and accesses **Shift, Rotate & Scale Results**.

## Shift, Rotate & Scale Results, General page




| Key | Description |
|---|---|
| **Store** | To store the results and continue with the next screen. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Points selected** | Display only | The number of selected points having been shifted, rotated and/or scaled. |
| **Store points to job** | Selectable list | The calculated COGO points will be stored in this job. The original points are not copied to this job. |
| **Store Point ID with** | **Prefix** | Adds the setting for **Store Point ID with** in front of the original point IDs. |
| | **Suffix** | Adds the setting for **Store Point ID with** at the end of the original point IDs. |
| **Prefix / suffix** | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the calculated COGO points. |

### Next step

| IF | THEN |
|---|---|
| the used parameters are to be viewed | **Page** accesses **Shift, Rotate & Scale Results**, **Summary** page. |
| the calculated COGO points are to be viewed graphically | **Page** accesses **Shift, Rotate & Scale Results**, **Plot** page. Original points are displayed in grey, calculated COGO points are displayed in black. |
| the calculated COGO points are to be stored | **Store** accesses **Shift, Rotate & Scale Results**, **Result** page. Refer to paragraph "Shift, Rotate & Scale Results, Result page". |

**Shift, Rotate & Scale Results, Result page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **No. of new points** | Display only | Number of new points created. |
| **No. of skipped pts** | Display only | Number of points which were skipped either due to not being able to convert coordinates, or points with identical point IDs already in the **Store points to job**. |

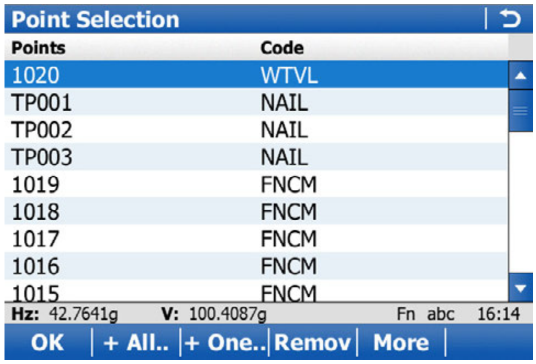
### Next step

**OK** returns to **COGO Shift, Rotate & Scale**.

## 41.9.3 Matching Points

**Point Selection**

Listed are points which have been selected for shifting, rotating and/or scaling.



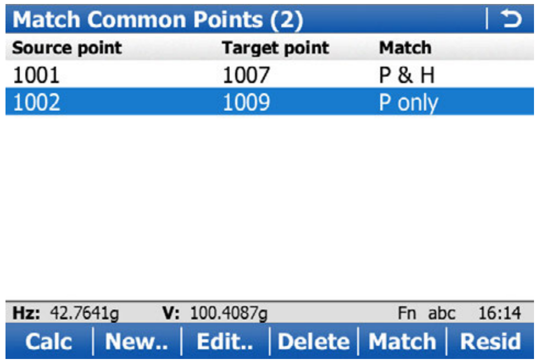

| Key | Description |
|---|---|
| **OK** | To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **+ All..** | To add all points from the working job to the list. Selected sort and filter settings apply. **OK** adds all displayed points to the list in **Point Selection** and returns to that screen. |
| **+ One..** | To add one point from the working job to the list. Selected sort and filter settings apply. **OK** adds the currently highlighted point to the list in **Point Selection** and returns to that screen. |
| **Remov** | To remove the highlighted point from the list. The point itself is not deleted. |
| **More** | To display information about the codes if stored with any point, the time and the date of when the point was stored and the 3D coordinate quality and the class. |
| Fn **Rem A** | To remove all points from the list. The points themselves are not deleted. |
| Fn **Range** | To define a range of points from the working job to be added to the list. |
| Fn **Quit** | To exit COGO calculation. |

**Next step**

| IF | AND | THEN |
|---|---|---|
| all points are to be added | - | **+ All..**. |
| one point is to be added | - | **+ One..**. |
| a range of points is to be added | - | Fn **Range** accesses **Select points by range**. |
| all points are added | **Method:Manually entered** | **OK** accesses **Computed Parameters**. Refer to "41.9.2 Manually Entered". |
| | **Method:Matching points** | **OK** accesses **Match Common Points (%d)**. Refer to "41.9.3 Matching Points". |

## Match Points

This screen provides a list of points chosen from the working job. The points are used for the determination of the 2D Helmert transformation. The number of points matched is indicated in the title, for example (2). Unless there is no pair of matching points in the list all softkeys are available.




| Key | Description |
|---|---|
| **Calc** | To confirm the selections, compute the transformation and continue with the subsequent screen. |
| **New..** | To match a new pair of points. This pair is added to the list. A new point can be manually measured. Refer to paragraph"Choose Matching Points or Edit Matching Points". |
| **Edit..** | To edit the highlighted pair of matched points. |
| **Delete** | To delete the highlighted pair of matched points from the list. |
| **Match** | To change the type of match for a highlighted pair of matched points. |
| **Resid** | To display a list of the matched points used in the transformation calculation and their associated residuals. Refer to paragraph "Fix Parameters". |
| Fn **Param** | To define the parameters to be fixed in the 2D transformation. |
| Fn **Quit** | To exit COGO calculation. |

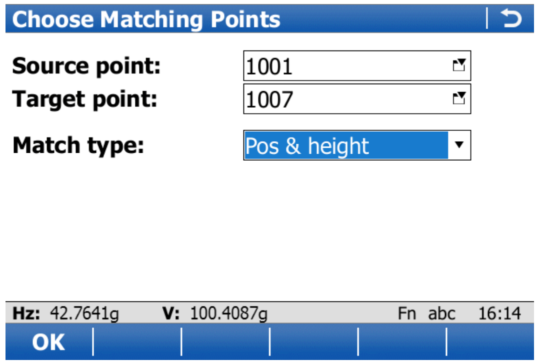
### Description of columns

| Column | Description |
|---|---|
| **Source point** | The point ID of the points of origin for the calculation of the shifts and/or rotation and/or scale. |
| **Target point** | The point ID of the target points for the calculation of the shifts and/or rotation and/or scale. |
| **Match** | The type of match to be made between the points. This information is used in the transformation calculation. **P**osition **&H**eight, **P**osition **only**, **H**eight **only** or **None**.<br>**None** removes matched common points from the transformation calculation but does not delete them from the list. This option can be used to help improve residuals. |

### Next step

| IF | THEN |
|---|---|
| the transformation is to be computed | **Calc**. The calculated shift, rotation and scale values are displayed in **Point Selection**. They cannot be edited. The remaining functionality of the calculation is similar to shift, rotate & scale (manual). Refer to "41.9 COGO Calculation - Shift, Rotate & Scale". |
| a pair of points is to be matched or edited | **New..** or **Info**. Refer to paragraph "Choose Matching Points or Edit Matching Points". |
| parameters for the transformation are to be fixed | Fn **Param**. Refer to paragraph "Fix Parameters". |

## Choose Matching Points or Edit Matching Points




| Key | Description |
|---|---|
| **OK** | To confirm the selections. |
| Fn **Quit** | To exit COGO calculation. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Source point** | Selectable list | A point of origin for the calculation of the shifts and/or rotation and/or scale. |
| **Target point** | Selectable list | A target point for the calculation of the shifts and/or rotation and/or scale. |
| **Match type** | | The type of match to be made between the points selected. |
| | **Pos & height** | Position and height |
| | **Pos only** | Position only |
| | **Height only** | Height only |
| | **None** | None |

## Fix Parameters

The settings on this screen define the parameters to be used in the transformation.

| IF the value for a field is | THEN the value for this parameter will be |
|---|---|
| **-----** | calculated. |
| any number | fixed to that value. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Δ easting** | Editable field | Shift in Easting direction. |
| **Δ northing** | Editable field | Shift in Northing direction. |
| **Δ height** | Editable field | Shift in Height direction. |
| **Rotation** | Editable field | Rotation around the vertical axis. |
| **Scale** | Editable field | Scale factor. |

**Next step**

| IF | AND | THEN |
|---|---|---|
| a field displays **-----** | the parameter must be fixed to a value | highlight the field. Enter the value of the parameter. **Fix**. |
| a field displays a value | the parameter must be calculated | highlight the field. **Adjst**. |
| all parameters are configured | - | **OK** to return to **Match Points**. |

## 41.10 COGO Calculation - Angle Method

**COGO Angle, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.

| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Survy..** | To manually measure a point for the COGO calculation. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

**Description of fields**

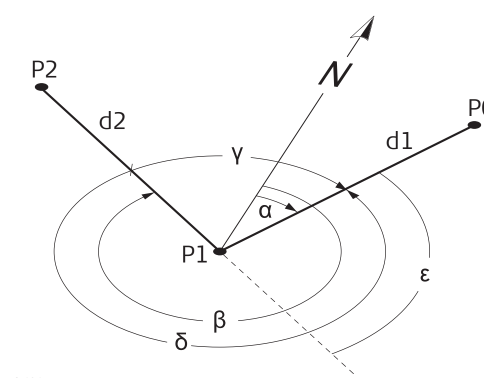
| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list | The backsight point. |
| **At point** | Selectable list | The point of intersection of the backsight and foresight direction. |
| **To point** | Selectable list | The foresight point. |

**Next step**
**Calc** calculates the result and accesses **COGO Angle**, **Results**.

**COGO Angle, Results page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the **Input** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

**Description of fields**




α **Azimuth at-from**
ß **Azimuth at-to**
γ **Deflection angle**
δ **Angle right**
ε **Angle left**
P0 **Point ID**
P1 **At point**
P2 **To point**
d1 **Horiz distance at-from**
d2 **Horiz distance at-to**

## 41.11 COGO Calculation - Horizontal Curve Method

**Horizontal Curve Calculator, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.

| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for a distance and an angle from two existing points. Available when a distance field or an angle field is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when a distance field or an angle field is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | Selectable list | The horizontal curve can either be defined by three points or by two parameters. |
| **Parameter 1**, **Parameter 2** | | Select which parameters are known. Available for **Method**: **2 parameters**. |
| | **Radius** | Radius of the curve. |
| | **Delta angle** | Angle in the radius point. |
| | **DOC - Arc** | The degree of curve defines the sharpness or flatness of the curve. Degree of curvature in arc definition. The central angle subtended by one station of circular arc. Mainly used in highway design.<br>SI units: 1 station = 20 m)<br>English system: 1 station = 100 ft |
| | **DOC - Chord** | The degree of curve defines the sharpness or flatness of the curve. Degree of curvature in chord definition. The central angle subtended by one station length of chord. Mainly used in railway design. |
| | **Arc length** | Total length of the circular curve from start point to end point measured along its arc. |
| | **Tangent** | Length of the tangent from the tangent point to the point of intersection. |
| | **External secant** | The distance from the point of intersection to the midpoint of the curve. The external distance bisects the interior angle at the point of intersection. |
| | **Mid ordinate** | The distance from the midpoint of the curve to the midpoint of the long chord. The extension of the middle ordinate bisects the central angle. |
| | **Delta angle** | The angle where the two tangents intersect. The angle between the tangents is also equal to the angle at the centre of the curve |

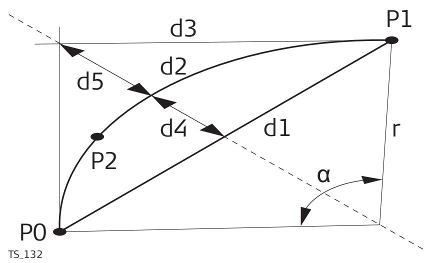
#### Next step

**Calc** calculates the result and accesses **Horizontal Curve Calculator**, **Results**.

## Horizontal Curve Calculator, Results page

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the **Input** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

### Description of fields

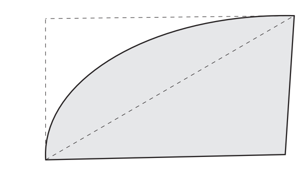



α **Delta angle**
P0 **Start point**
P1 **End point**
P2 **Second point**
r **Radius**
d1 **Chord length**
d2 **Arc length**
d3 **Tangent**
d4 **Mid ordinate**
d5 **External secant**

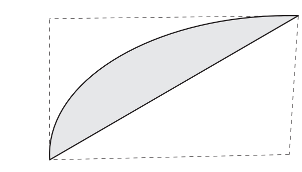
## Horizontal Curve Calculator, Areas page

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the **Input** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

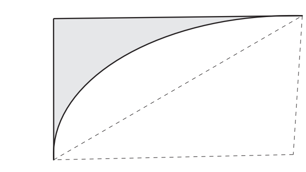
### Description of fields



**Sector**



**Segment**



**Fillet**

## 41.12 COGO Calculation - Triangle Method

**COGO Triangle, Input page**

For all point fields, the MapView interactive display on the **Map** page can be used to select the desired point.
To type in coordinates for a known point open a selectable list. Press **New..** to create a new point.

| Key | Description |
|---|---|
| **Calc** | To calculate the result. |
| **Inv..** | To calculate the values for a distance and an angle from two existing points. Available when a distance field or an angle field is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when a distance field or an angle field is highlighted. |
| **Survy..** | To manually measure a point for the COGO calculation. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit COGO calculation. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | Selectable list | The triangle can either be defined by three points or by three parameters. |
| **Parameters** | Selectable list | Select which combination of angle value and side length are known. Available for **Method**: **3 parameters**. |
| **Side a**, **Side b**, **Side c** | Editable field | The side lengths of the triangle. |
| **Angle A**, **Angle C** | Editable field | The angle values of the triangle. |
| **Point A**, **Point B**, **Point C** | Selectable list | The points forming the triangle. |

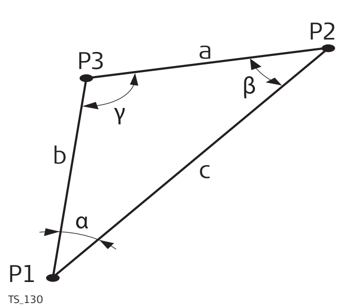
**Next step**

**Calc** calculates the result and accesses **COGO Triangle**, **Results**.

**COGO Triangle, Results page**

| Key | Description |
|---|---|
| **OK** | To accept changes and return to the **Input** page. |
| **Result1** or **Result2** | To view the first and second result. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To not store the COGO point and to exit COGO calculations. |

**Description of fields**




α **Angle A**
ß **Angle B**
γ **Angle C**
P1 **Point A**
P2 **Point B**
P3 **Point C**
a **Side a**
b **Side b**
c **Side c**

# 41.13 Selecting a Result from Previous COGO Inverse Calculations

**Description**

Azimuths, distances and offsets required within the COGO traverse and intersection calculations can be selected from previously calculated inverse results.

**Access**

In Traverse or Intersection, highlight **Azimuth**, **Horiz distance** or **Offset** and press **Last..**.

**Last Inverse Calculations**

All previous COGO inverse calculations stored in the working job are displayed, sorted by time with the most recent at the top. This screen consists of three columns. The information displayed can vary. **-----** is displayed for unavailable information, for example the **Azimuth** cannot be calculated if a height only point is used.

| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **View** | To view all calculated values for the highlighted COGO inverse calculation. Includes the height difference, the slope distance, the grade and the coordinate differences between the two known points. |
| **Delete** | To delete the highlighted COGO inverse calculation. |
| **More** | To display other information in the third column. |
| Fn **Quit** | To exit COGO calculation. |

**Description of columns**

| Column | Description |
|---|---|
| **From** | The point ID of the first known point for the COGO inverse calculation. |
| **To** | The point ID of the second known point for the COGO inverse calculation. |
| **Azimuth** | The direction from the first to the second known point. |
| **HDist** | The horizontal distance between the two known points. |
| **Date** and **Time** | When the COGO inverse calculation was stored. |

**Next step**

Highlight the COGO inverse calculation of which a result is to be taken over.

**OK**. The relevant result of the highlighted COGO inverse calculation is copied into the field which was initially highlighted on the **Input** page.

## 41.14 Modifying Values for Azimuths, Distances and Offsets

**Description**

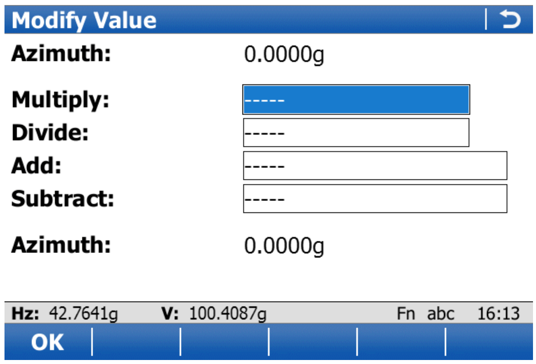
The values for the azimuth, the distance and the offset required within the COGO traverse and intersection calculation can be mathematically modified.

**Access step-by-step**

In Traverse or Intersection, highlight **Azimuth**, **Horiz distance** or **Offset** and press Fn Modif...

**Modify Value**

On this screen, numbers can be typed in for the multiplication, division, addition and subtraction with the original azimuth, distance or offset value. The standard rules of mathematical operations apply.




| Key | Description |
|---|---|
| **OK** | To accept the modified value and to return to the screen from where this screen was accessed. The modified value is copied into the field which was initially highlighted on the **Input** page. |
| Fn **Quit** | To exit COGO calculation. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Azimuth**, **Horiz distance** or **Offset** | Display only | The name of the field and the value which was highlighted before accessing **Modify Value**. |
| **Multiply** | Editable field | The number to multiply by.<br>• Minimum: -3000<br>• Maximum: 3000<br>• ----- performs a multiplication by 1. |
| **Divide** | Editable field | The number to divide by.<br>• Minimum: -3000<br>• Maximum: 3000<br>• ----- performs a division by 1. |
| **Add** | Editable field | The number to be added.<br>• For azimuths<br>Minimum: 0<br>Maximum: Full circle<br>• For distances and offsets<br>Minimum: 0 m<br>Maximum: 30000000 m<br>• ----- performs an addition of 0.000. |
| **Subtract** | Editable field | The number to be subtracted.<br>• For azimuths<br>Minimum: 0<br>Maximum: Full circle<br>• For distances and offsets<br>Minimum: 0 m<br>Maximum: 30000000 m<br>• ----- performs a subtraction of 0.000. |
| **Azimuth**, **Horiz distance** or **Offset** | Display only | The modified value for the field in the first line. This field is updated with every mathematical operation. Angles greater than the full circle are reduced accordingly. |

#### Next step

**OK** accepts the modified value and returns to the screen from where this screen was accessed.

**Example: Calculations for an azimuth**

| Step | Editable field | Value as calculated | Value as displayed |
|---|---|---|---|
| | | | **Azimuth: 250.0000 g** |
| 1. | **Multiply: 2** | 500 | **Azimuth: 100.0000 g** |
| 2. | **Divide: 3** | 166.667 | **Azimuth: 166.6670 g** |
| 3. | **Add: 300** | 466.667 | **Azimuth: 66.6670 g** |
| 4. | **Subtract: 100** | 366.667 | **Azimuth: 366.6670 g** |

**Example: Calculations for a distance**

The behaviour for an offset is identical.

| Step | Editable field | Value as calculated | Value as displayed |
|---|---|---|---|
| | | | **Horiz distance: 250.000 m** |
| 1. | **Multiply: 2** | 500 | **Horiz distance: 500.000 m** |
| 2. | **Divide: 3** | 166.667 | **Horiz distance: 166.667 m** |
| 3. | **Add: 300** | 466.667 | **Horiz distance: 466.667 m** |
| 4. | **Subtract: 100** | 366.667 | **Horiz distance: 366.667 m** |

# 42 Determine Coordinate System

## 42.1 Overview

**Description**

GPS measured points are always stored based on the global geocentric datum known as WGS 1984. Most surveys require coordinates in a local grid system. For example, based on a country's official mapping datum or an arbitrary grid system used in a particular area such as a construction site. To convert the WGS 1984 coordinates into local coordinates a coordinate system must be created. Part of the coordinate system is the transformation used to convert coordinates from the WGS 1984 datum to the local datum.

The Determine Coordinate System application allows:

- the parameters of a new transformation to be determined.
- the parameters of an existing transformation to be recomputed.

☞ With one common control point, it is still possible to calculate a Classic 3D transformation, as long as the rotations and the scale parameter are fixed. Such a transformation fits perfectly in the vicinity of the common control point, but is degraded by the distance from that point. This degradation is because the orientation of the local reference frame or any scale factor within the local datum cannot be taken into account.

**Requirements to determine a transformation**

To determine a transformation it is necessary to have common control points whose positions are known in both WGS 1984 coordinates and local coordinates. The more points that are common between datum, the more accurately the transformation parameters can be calculated. Depending on the type of transformation used, details about the map projection, the local ellipsoid and a local geoid model can also be needed.

**Requirements for control points**

- The control points used for the transformation should surround the area for which the transformation is to be applied. It is not good practice to survey or convert coordinates outside of the area covered by the control points as extrapolation errors can be introduced.
- When a geoid field file, and/or a CSCS field file is used in the determination of a coordinate system, the control points for the calculation must fall within the areas of the field files.

## 42.2 Selecting the Transformation Method

**Description**

Determine Coordinate System is the conventional method of determining a coordinate system. Parameters such as the height mode must be set by the user.
One or more control points for both the WGS 1984 and the local datum are needed.
Depending on the number of control points and available information, a Onestep, Twostep or Classic 3D transformation can be used.

**Access**

Select **Main Menu: Go to Work!\Survey+\Determine coord system**.

**Determine Coord System**

**Description of fields**

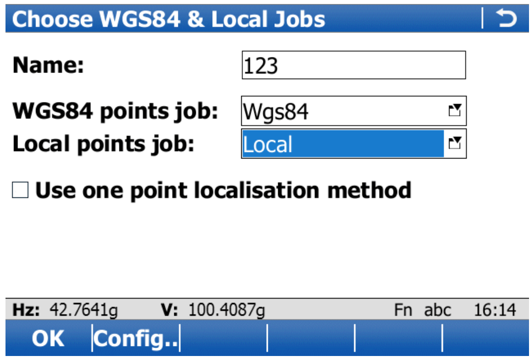
| Field | Option | Description |
|---|---|---|
| **Method** | | The type of transformation to be used when determining a coordinate system. |
| | **Onestep** | Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure:<br>1 The WGS 1984 coordinates are projected onto a temporary Transverse Mercator Projection. The central meridian of this projection passes through the centre of gravity of the common control points.<br>2 The results of 1. are preliminary grid coordinates for the WGS 1984 points.<br>3 These preliminary grid coordinates are matched with the local grid control points. The Easting and Northing shifts, the rotation and the scale factor between these two sets of points are then computed. This process is known as a classic 2D transformation.<br>4 The height transformation is a single dimension height approximation.<br>Refer to "Appendix J Glossary". |
| | **Twostep** | Combines the advantages of the Onestep and the Classic 3D transformation. It allows treating position and height separately, but is not restricted to smaller areas. Procedure:<br>1 The WGS 1984 coordinates of the common control points are shifted closely to the local datum using a given Classic 3D pre-transformation. This Classic 3D transformation is typically a rough transformation valid for the country of the local datum.<br>2 The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points.<br>3 A 2D transformation is applied, exactly as with the Onestep transformation.<br>Refer to "Appendix J Glossary". |

| Field | Option | Description |
|---|---|---|
| | **Classic 3D** | Also known as Helmert transformation. Transforms coordinates from WGS 1984 cartesian to local cartesian coordinates and vice versa. A map projection can then be applied to obtain grid coordinates. As a similarity transformation, it is the most rigorous transformation type and keeps the full geometrical information. Refer to "Appendix J Glossary". |
| | **Modify existing** | To modify an existing determine coordinate system. Refer to "42.3.3 Modifying a Coordinate System". |

### Next step

| IF the selected method is | THEN |
|---|---|
| **Onestep**, **Twostep** or **Classic 3D** | **OK** to access **Choose WGS84 & Local Jobs**. Refer to the following paragraph: **Choose WGS84 & Local Jobs**. |
| **Modify existing** | **OK** to access **Coordinate Systems**. Refer to "42.3.3 Modifying a Coordinate System". |

### Choose WGS84 & Local Jobs




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| **Config..** | To configure the selected coordinate system determination method. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the coordinate system. The name can be up to 16 characters in length and can include spaces. Input is mandatory.<br>Entering the name of a coordinate system will allow that existing system to be updated. |
| **WGS84 points job** | Selectable list | The job from which the points with WGS 1984 coordinates will be taken. |
| **Local points job** | Selectable list | The job from which the points with local coordinates will be taken. |
| **Use one point localisation method** | Check box | Number of control points needed: One control point for both the WGS 1984 and the local datum.<br>Transformation to use:<br>• Onestep or Twostep when information about the necessary rotations and scale factor is known.<br>• Classic 3D when the rotations are to be set to zero and the scale factor to one. |

#### Next step

Press **Config..** with **Use one point localisation method** NOT checked to access **Configuration**.

## 42.3 The Normal Method

### 42.3.1 Configuring the Normal Method

**Description**

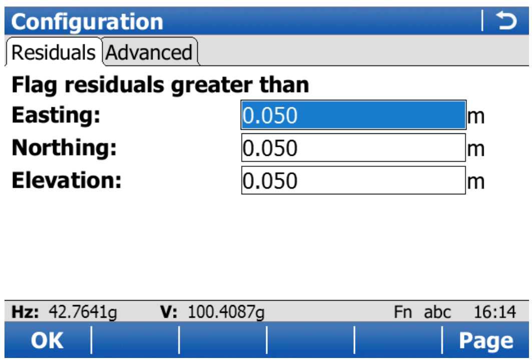
The configuration allows options to be set, which are used in the Determine Coordinate System application. These settings are stored within the active working style.

**Access**

Press **Config..** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** NOT checked.

**Configuration, Residuals page**

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Easting** | Editable field | The limit above which Easting residuals will be flagged as possible outliers. |
| **Northing** | Editable field | The limit above which Northing residuals will be flagged as possible outliers. |
| **Elevation** | Editable field | The limit above which Height residuals will be flagged as possible outliers. |

**Next step**

**Page** changes to the **Advanced** page.

**Configuration, Advanced page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Model** | **Bursa-Wolf** or **Molodensky-Badakus** | The transformation model to be used. Refer to standard surveying literature for details on the models. |
| **Prompt me to enter fixed transformation parameters** | Check box | To configure Classic 3D transformation parameters during the process of calculation. |

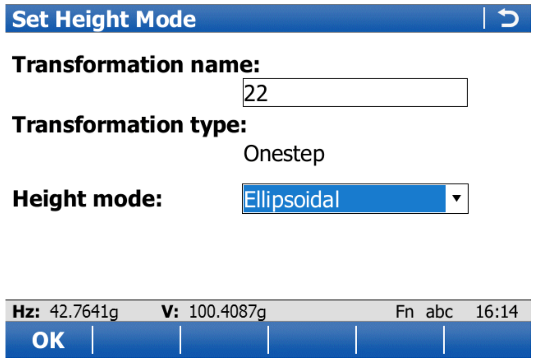
### Next step

**OK** returns to **Choose WGS84 & Local Jobs**.

**Access**

Press **OK** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** NOT checked.

**Set Height Mode**




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Transformation name** | Editable field | A unique name for the transformation. The name can be up to 16 characters in length and include spaces. If a coordinate system is being updated then its name is displayed. |
| **Transformation type** | Display only | The type of transformation to be used when determining a coordinate system. |
| **Height mode** | | The height mode to be used in the determination of a coordinate system. |
| | **Orthometric** or **Ellipsoidal** | Available when determining a new coordinate system. |
| | Display only | Available when updating a coordinate system. The height mode shown is the same as the mode used in the existing system. |

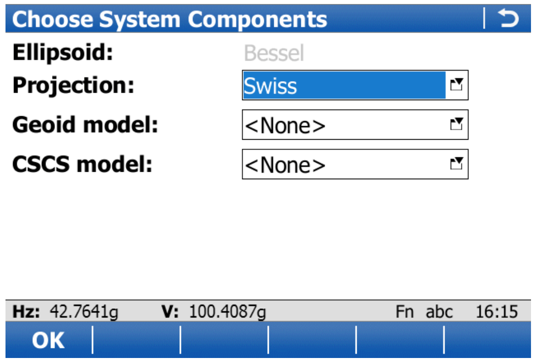
**Next step**

**OK** continues to **Choose System Components**.

If a coordinate system was chosen to be edited in **Choose WGS84 & Local Jobs**, pressing **OK** accesses **Matched Points (n)**. Pressing ESC does not reaccess **Choose WGS84 & Local Jobs** but accesses **Choose System Components** and **Set Height Mode**.

**Choose System Components**

This screen contains different fields, depending on what method was chosen in **Determine Coord System**.




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

**For Onestep**

**Description of fields**

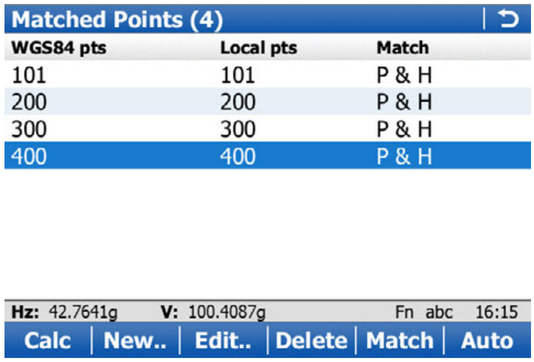
| Field | Option | Description |
|---|---|---|
| **Geoid model** | Selectable list | The geoid model to be used in the transformation. |
| **Pre Transform** | Selectable list | For Twostep: The pre-transformation to use for the preliminary 3D transformation. |
| **Ellipsoid** | Selectable list | For Twostep and Classic 3D: The ellipsoid to use in the transformation. |
| | Display only | For Twostep and Classic 3D: The ellipsoid being used by a fixed projection when selected in **Projection**. |
| **Projection** | Selectable list | For Twostep and Classic 3D: The projection to use in the transformation. |
| **CSCS model** | Selectable list | For Classic 3D: The CSCS model to use in the transformation. |

**Next step**

**OK** continues to **Matched Points (n)**.

**Matched Points (n)**

This screen provides a list of points chosen from **WGS84 points job** and **Local pts**. The number of control points matched between both jobs is indicated in the title. Unless there is no pair of matching points in the list all softkeys are available. Refer to "42.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points" for information on how to match points.




| Key | Description |
|---|---|
| **Calc** | To confirm the selections, compute the transformation and continue with the subsequent screen. |
| **New..** | To match a new pair of points. This pair is added to the list. A new point can be manually occupied. Refer to " Choose Matching Points/Edit Matching Points". |
| **Edit..** | To edit the highlighted pair of matched points. Refer to " Choose Matching Points/Edit Matching Points".<br>If a coordinate system to be updated contains a point that was deleted from the working job and a new point was created in that job with the same point ID but different coordinates, the coordinates of the old point will still be used for the calculation. Pressing **Edit..** to edit a highlighted pair of matched points containing the deleted point, will overwrite the coordinates of the old point. The coordinates of the new point will be used in the calculation. |
| **Delete** | To delete the highlighted pair of matched points from the list. |
| **Match** | To change the type of match for a highlighted pair of matched points. Refer to "42.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points". |
| **Auto** | To scan both jobs for points that have the same point ID. Points with matching point IDs are added to the list. |
| Fn **Quit** | To exit the screen. |

#### Description of columns

| Column | Description |
|---|---|
| **WGS84 pts** | The point ID of the points chosen from **WGS84 points job**. |
| **Local pts** | The point ID of the points chosen from **Local points job**. |
| **Match** | The type of match to be made between the points. This information is used in the transformation calculation. **P**osition **& H**eight, **P**osition **only**, **H**eight **only** or **None**.<br>• For Onestep or Twostep possible options are **P & H**, **P only**, **H only** or **None**.<br>• For Classic 3D, possible options are **P & H** or **None**.<br>**None** removes matched common points from the transformation calculation but does not delete them from the list. This option can be used to help improve residuals. |

#### Next step

**Calc** computes the transformation and continues to **Check Residuals** or to **Classic 3D Parameters** if **Prompt me to enter fixed transformation parameters** was checked during the configuration.

**Classic 3D Parameters**

The settings on this page define the parameters to be used in a Classic 3D transformation. Refer to "Appendix J Glossary" for more information about how many transformation parameters are computed, based on the number of points common to both datum.

| IF the value for a field is | THEN the value for this parameter will be |
|---|---|
| **-----** | calculated. |
| any number | fixed to that value. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Model** | **Bursa-Wolf** or **Molodensky-Badakus** | The transformation model to be used. Refer to standard surveying literature for details on the models. |
| **Shift dX** | Editable field | Shift in X direction. |
| **Shift dY** | Editable field | Shift in Y direction. |
| **Shift dZ** | Editable field | Shift in Z direction. |
| **Rotation X** | Editable field | Rotation around the X axis. |
| **Rotation Y** | Editable field | Rotation around the Y axis. |
| **Rotation Z** | Editable field | Rotation around the Z axis. |
| **Scale** | Editable field | Scale factor. |

### Next step

| IF | AND | THEN |
|---|---|---|
| a field displays **-----** | the parameter must be fixed to a value | highlight the field. **Fix**.<br>Enter the value of the parameter. |
| a field displays a value | the parameter must be calculated | highlight the field. **Adjust**. |
| all parameters are configured | - | **OK** computes the transformation and continues to **Check Residuals**. |

**Check Residuals**

Displays a list of the matched points used in the transformation calculation and their associated residuals.


| Key | Description |
|---|---|
| **OK** | To accept the residuals and to continue with the subsequent screen. |
| **Result** | To view results of the transformation. Refer to "42.3.5 Transformation Results for Onestep and Twostep". |
| **More** | To display information about height residuals. |
| Fn **Quit** | To exit the screen. |

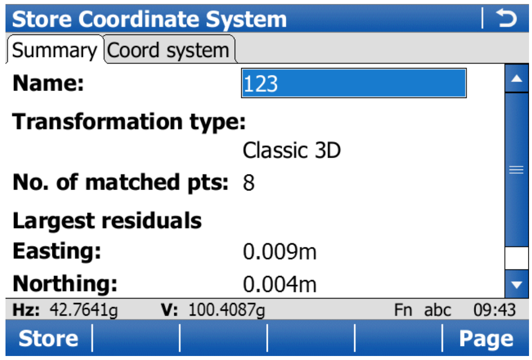
### Description of columns

| Column | Description |
|---|---|
| **WGS84 pts** | The point ID of the points chosen from **WGS84 points job**. |
| **East** | The Easting residual. If positions are not used in the transformation calculation then **-----** will be displayed. |
| **North** | The Northing residual. If positions are not used in the transformation calculation then **-----** will be displayed. |
| **Height** | The Height residual. If heights are not used in the transformation calculation then **-----** will be displayed. |
| **!** | Indicates residuals that exceed the residual limit defined in **Configuration**, **Residuals** page. |
| **!** | Indicates the largest residual in **East**, **North** and **Height**. |

### Next step

| IF the residuals are | THEN |
|---|---|
| unacceptable | ESC returns to **Matched Points (n)**. Matched points can be edited, deleted or temporarily removed from the list and the transformation recalculated. |
| acceptable | **OK** continues to **Store Coordinate System**. |

**Store Coordinate System, Summary page**




| Key | Description |
|---|---|
| **Store** | To store the coordinate system to the DBX and return to **Main Menu**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | The name of the coordinate system can be changed. The name can be up to 16 characters in length and include spaces. |
| **Transformation type** | Display only | The type of transformation used. |
| **No. of matched pts** | Display only | Number of matched points. |
| **Easting** | Display only | Largest Easting residual from the transformation calculation. |
| **Northing** | Display only | Largest Northing residual from the transformation calculation. |
| **Elevation** | Display only | Largest Height residual from the transformation calculation. |

### Next step

**Page** changes to the **Coord system** page.

**Store Coordinate System, Coord system page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Residuals** | **None**, **1/distance**, **1/distance²** or **1/distance³/²** | The method by which the residuals of the control points will be distributed throughout the transformation area. |
| **Geoid model** | Display only | Name of geoid model used. |
| **Pre Transform** | Display only | For Twostep: Name of the pre-transformation used. |
| **Transformation** | Display only | For Classic 3D: Name of transformation used. |
| **Ellipsoid** | Display only | For Twostep and Classic 3D: Name of ellipsoid used. |
| **Projection** | Display only | For Twostep and Classic 3D: Name of projection used. |
| **CSCS model** | Display only | For Classic 3D: Name of CSCS model used. |

### Next step

**Store** stores the coordinate system to the DBX and attaches it to the **WGS84 points job** selected in **Choose WGS84 & Local Jobs**, replacing any coordinate system attached to this job. **WGS84 points job** becomes the working job.

**Determine Coord System**

## Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | | The type of transformation to be used when determining a coordinate system. |
| | **Onestep** | Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure:<br>1 The WGS 1984 coordinates are projected onto a temporary Transverse Mercator Projection. The central meridian of this projection passes through the centre of gravity of the common control points.<br>2 The results of 1. are preliminary grid coordinates for the WGS 1984 points.<br>3 These preliminary grid coordinates are matched with the local grid control points. The Easting and Northing shifts, the rotation and the scale factor between these two sets of points are then computed. This process is known as a classic 2D transformation.<br>4 The height transformation is a single dimension height approximation.<br>Refer to "J.20 T". |
| | **Twostep** | Combines the advantages of the Onestep and the Classic 3D transformation. It allows treating position and height separately, but is not restricted to smaller areas. Procedure:<br>1 The WGS 1984 coordinates of the common control points are shifted closely to the local datum using a given Classic 3D pre-transformation. This Classic 3D transformation is typically a rough transformation valid for the country of the local datum.<br>2 The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points.<br>3 A 2D transformation is applied, exactly as with the Onestep transformation.<br>Refer to "J.20 T". |
| | **Classic 3D** | Also known as Helmert transformation.<br>Transforms coordinates from WGS 1984 cartesian to local cartesian coordinates and vice versa. A map projection can then be applied to obtain grid coordinates. As a similarity transformation, it is the most rigorous transformation type and keeps the full geometrical information. Refer to "J.20 T". |
| | **Modify existing** | To modify an existing determine coordinate system. Refer to "42.3.3 Modifying a Coordinate System". |

#### Next step

| IF the selected method is | THEN |
|---|---|
| **Onestep**, **Twostep** or **Classic 3D** | **OK** to access **Choose WGS84 & Local Jobs**. Refer to the following paragraph: **Choose WGS84 & Local Jobs**. |
| **Modify existing** | **OK** to access **Coordinate Systems**. Refer to "42.3.3 Modifying a Coordinate System". |

## 42.3.3 Modifying a Coordinate System

**Access**

**OK** in **Determine Coord System** when **Method: Modify existing**.

**Coordinate Systems**

Select an existing coordinate system and press **OK**.

All the following steps are identical with the determination of a new coordinate system from the **Matched Points (n)** screen onwards. Refer to "42.3.2 Determining a New Coordinate System"

## 42.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points

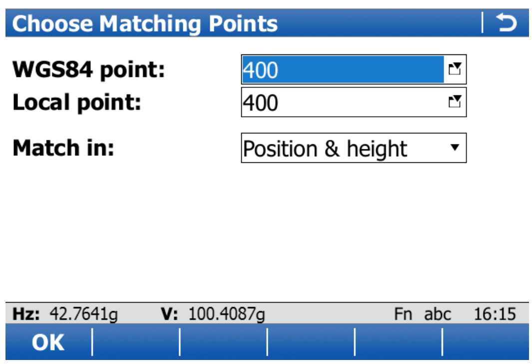
**Description**

Before calculating a transformation, it must be defined which points in **WGS84 points job** and **Local points job** are to be matched. Pairs of matched points are displayed in one line in **Matched Points (n)**. New pairs of matched points can be created, existing pairs of matched points can be edited and pairs of matched points can be deleted.

**Access**

Press **New..** or **Edit..** in **Matched Points (n)**.

**Choose Matching Points/Edit Matching Points**




| Key | Description |
|---|---|
| **OK** | To return to **Matched Points (n)** and to adds a new line of matched points to the matched points list. |
| **Survy..** | To manually occupy a point and store it in **WGS84 points job**. Available when **WGS84 point** is highlighted. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **WGS84 point** | Selectable list | A WGS 1984 control point. |
| **Local point** | Selectable list | A local control point. |
| **Match in** | | The type of match to be made between the points selected. |
| | **P & H**, **P only**, **H only** or **None**. | Available for Onestep and Twostep. |
| | **P & H** or **None** | Available for Classic 3D. |

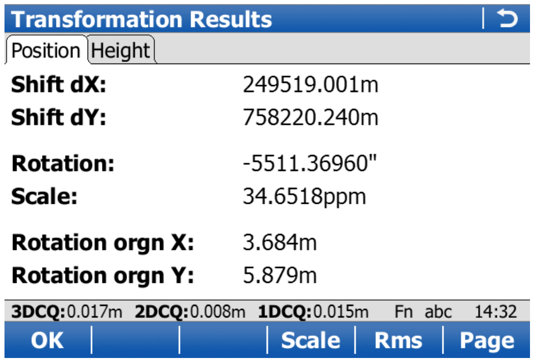
## 42.3.5 Transformation Results for Onestep and Twostep

**Access**

Press **Result** in **Check Residuals**.

**Transformation Results, Position page**

Results of the transformation between the WGS 1984 datum and the local datum are shown for each of the transformation parameters. This screen consists of the **Position** page and the **Height** page. The explanations for the softkeys given here are valid for the pages as indicated.




| Key | Description |
|---|---|
| **OK** | To return to **Check Residuals**. |
| **Scale..** or **Ppm** | Available on the **Position** page. To switch between displaying the true scale and displaying the ppm. |
| **Rms** or **Param..** | To switch between the root mean square values of the parameters and the actual parameter values. The name of the screen changes to **Transformation Results rms** when displaying rms values. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Shift dX** | Display only | Shift in X direction. |
| **Shift dY** | Display only | Shift in Y direction. |
| **Rotation** | Display only | Rotation of transformation. |
| **Scale** | Display only | Scale factor used in transformation. Either true scale or ppm. |
| **Rotation orgn X** | Display only | Position in the X direction of the origin of rotation. |
| **Rotation orgn Y** | Display only | Position in the Y direction of the origin of rotation. |

**Next step**

**Page** changes to the **Height** page.

**Transformation Results, Height page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Slope in X** | Display only | Tilt of the transformation in the X direction. |
| **Slope in Y** | Display only | Tilt of the transformation in the Y direction. |
| **Height shift** | Display only | Shift in height between WGS 1984 datum and local datum. |

**Next step**

**OK** returns to **Check Residuals**.

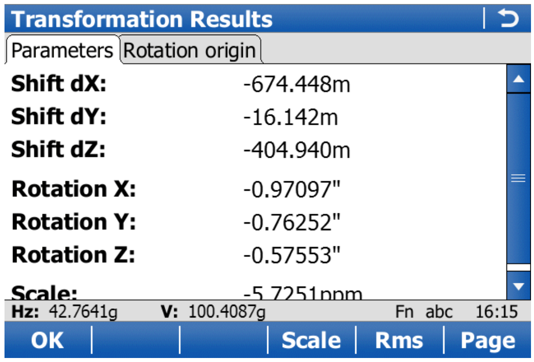
## 42.3.6 Transformation Results for Classic 3D

**Access**

Press **Result** in **Check Residuals**.

**Transformation Results, Parameters page**

Results of the transformation between the WGS 1984 datum and the local datum are shown for each of the transformation parameters. This screen consists of the **Parameters** page and the **Rotation origin** page. The explanations for the softkeys given here are valid for the pages as indicated.




| Key | Description |
|---|---|
| **OK** | To return to **Check Residuals**. |
| **Scale..** or **Ppm** | Available on the **Position** page. To switch between displaying the true scale and displaying the ppm. |
| **Rms** or **Param..** | To switch between the root mean square values of the parameters and the actual parameter values. The name of the screen changes to **Transformation Results rms** when displaying rms values. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Shift dX** | Display only | Shift in X direction. |
| **Shift dY** | Display only | Shift in Y direction. |
| **Shift dZ** | Display only | Shift in Z direction. |
| **Rotation X** | Display only | Rotation around the X axis. |
| **Rotation Y** | Display only | Rotation around the Y axis. |
| **Rotation Z** | Display only | Rotation around the Z axis. |
| **Scale** | Display only | Scale factor used in transformation. Either true scale or ppm. |

**Next step**

**Page** changes to the **Rotation origin** page.

**Transformation Results, Rotation origin page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Model** | Display only | Classic 3D transformation model used for the transformation. |
| **Rotation orgn X** | Display only | Available for **Model: Molodensky-Badakus**. Position in the X direction of the origin of rotation. |
| **Rotation orgn Y** | Display only | Available for **Model: Molodensky-Badakus**. Position in the Y direction of the origin of rotation. |
| **Rotation orgn Z** | Display only | Available for **Model: Molodensky-Badakus**. Position in the Z direction of the origin of rotation. |

### Next step

**OK** returns to **Check Residuals**.

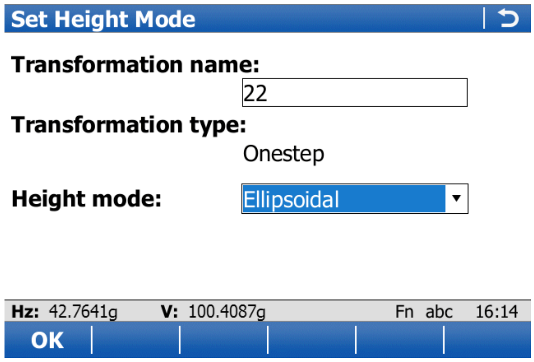
# 42.4 The One Point Localisation Method

## 42.4.1 Determining a New Coordinate System

**Access**

Press **OK** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** being checked.

**Set Height Mode**




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Transformation name** | Editable field | A unique name for the transformation. The name can be up to 16 characters in length and include spaces. If a coordinate system is being updated then its name is displayed. |
| **Transformation type** | Display only | The type of transformation to be used when determining a coordinate system. |
| **Height mode** | | The height mode to be used in the determination of a coordinate system. |
| | **Orthometric** or **Ellipsoidal** | Available when determining a new coordinate system. |
| | Display only | Available when updating a coordinate system. The height mode shown is the same as the mode used in the existing system. |

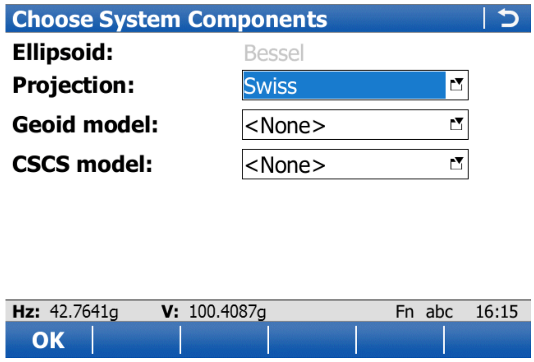
**Next step**

**OK** continues to **Choose System Components**.

**Azimuth** is used throughout this chapter. This term must always be considered to mean also **Bearing**.

**Choose System Components**

This screen contains different fields, depending on what method was chosen in **Determine Coord System**.



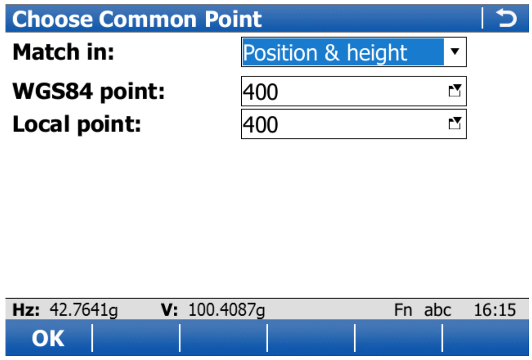

| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

### For Onestep
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Geoid model** | Selectable list | The geoid model to be used in the transformation. |
| **Pre Transform** | Selectable list | For Twostep: The pre-transformation to be used for the preliminary 3D transformation. |
| **Ellipsoid** | Selectable list | For Twostep and Classic 3D: The ellipsoid to be used in the transformation. |
| | Display only | For Twostep: The ellipsoid being used by a fixed projection when selected in **Projection**. |
| **Projection** | Selectable list | For Twostep and Classic 3D: The projection to be used in the transformation. |
| **CSCS model** | Selectable list | For Classic 3D: The CSCS model to be used in the transformation. |

### Next step
**OK** continues to **Choose Common Point**.

## Choose Common Point




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| **Survy..** | Available for **WGS84 point** being highlighted. To occupy a point manually and store it in **WGS84 points job**. |
| Fn **Quit** | To exit the screen. |

### Description of fields

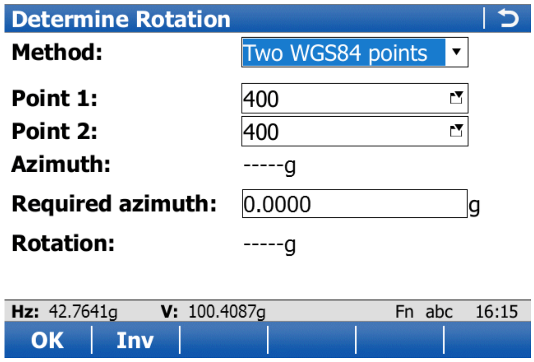
| Field | Option | Description |
|---|---|---|
| **Match in** | | For Onestep and Twostep: How the horizontal and vertical shifts of the transformation will be computed. |
| | **Position & height** | Position and height are taken from the same pair of matching points. |
| | **Position only** | Position is taken from one pair of matching points. The height can be taken from another pair of matching points. |
| **WGS84 point** | Selectable list | The point ID of the horizontal and/or vertical control point chosen from **WGS84 points job**. |
| **Local point** | Selectable list | The point ID of the horizontal and/or vertical control point chosen from **Local points job**. |
| **Match height** | Check box | For Onestep and Twostep: Available for **Match in: Position only**. Activates the determination of the vertical shift from a separate pair of matching points. |
| **Local height** | **Use WGS84 point ht** or **Use Local point ht** | For Classic 3D: The source of the height information to use in the transformation. |

### Next step

For Onestep and Twostep: **OK** continues to **Determine Rotation**.
For Classic 3D: **OK** continues to **Store Coordinate System**.

**Determine Rotation**

For Onestep and Twostep only.

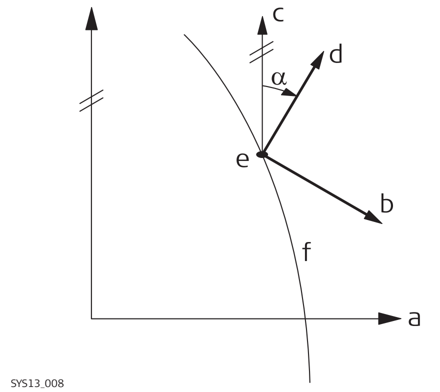



| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| **Inv** | Available for **Method: Two WGS84 points** and **Method: User entered**. To compute an azimuth between two local points. Refer to "42.4.2 Computing Required Azimuth". |
| **Survy..** | To manually occupy a point and store it in **WGS84 points job**. Available when **Point 1** or **Point 2** are highlighted for **Method: Two WGS84 points** or when **WGS84 point** is highlighted for **Method: Convergence angle**. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

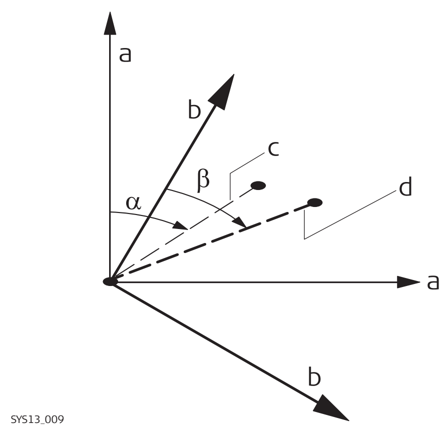
| Field | Option | Description |
|---|---|---|
| **Method** | **Use WGS84 north**, **User entered**, **Convergence angle** or **Two WGS84 points** | Method by which the rotation angle for the transformation is determined. |
| **Rotation** | Display only | • For **Method: Use WGS84 north**: Transformation will be rotated to North as defined by the WGS 1984 datum. North is 0.00000 °.<br>• For **Method: Convergence angle**: The rotation of the transformation calculated as 0.00000 ° minus the computed convergence angle. The field is updated as **Coord system** and **WGS84 point** are changed. |
| | Editable field | • For **Method: Two WGS84 points**: The rotation of the transformation calculated as required azimuth minus azimuth. The field is updated as **Point 1**, **Point 2** and **Required azimuth** are changed.<br>• For **Method: User entered**: Allows the orientation of the transformation to be manually typed in or calculated in **Compute Required Azimuth**. |
| **Coord system** | Selectable list | Coordinate system to provide the direction of grid North in the area where the control point used for determining the local coordinate system, is located. Available for **Method: Convergence angle**. |
| **WGS84 point** | Selectable list | WGS 1984 point of which the convergence angle will be calculated. Available for **Method: Convergence angle**. |
| **Point 1** | Selectable list | First point to use for computation of **Azimuth**. Available for **Method: Two WGS84 points**. |
| **Point 2** | Selectable list | Second point to use for computation of **Azimuth**. Available for **Method: Two WGS84 points**. |
| **Azimuth** | Display only | Computed azimuth between **Point 1** and **Point 2**. Available for **Method: Two WGS84 points**. |
| **Required azimuth** | Editable field | The required grid azimuth, computed between two local points. Refer to "42.4.2 Computing Required Azimuth". Available for **Method: Two WGS84 points**. |

### Diagram for Onestep, Method: Convergence angle




a) WGS 1984 coordinate system
b) Local coordinate system
c) Geodetic North
d) Grid North
e) Point on WGS 1984 datum
f) Meridian
α Convergence angle

### Diagram for Onestep, Method: Two WGS84 points




a) WGS 1984 coordinate system
b) Local coordinate system
c) Line between two WGS 1984 points
d) Line between two local points
α Azimuth of two WGS 1984 points
β Known azimuth or azimuth of two local points

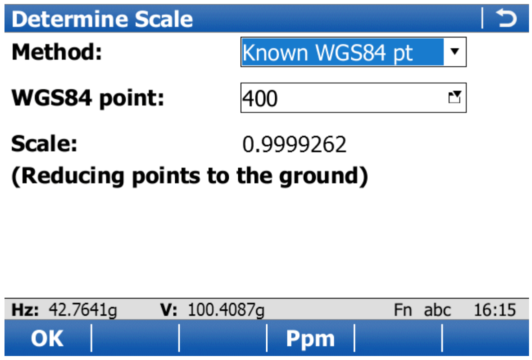
**Next step**

**OK** continues to **Determine Scale**.

**Determine Scale**

For Onestep and Twostep only.
The scale is calculated using the formula (r + h)/r where

r is the distance from the centre of the ellipsoid to the WGS 1984 point selected in **Choose Common Point**, and
h is the height of this point above the WGS 1984 ellipsoid.




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| **Grid..** | Available Twostep and for **Method: Combined SF**. To compute the grid scale factor. Refer to "42.4.3 Computing the Grid Scale Factor". |
| **Hgt..** | Available Twostep and for **Method: Combined SF**. To compute the height scale factor. Refer to "42.4.4 Computing the Height Scale Factor". |
| **Scale** or **Ppm** | To switch between displaying the true scale and displaying the ppm. |
| **Survy..** | To manually occupy a point and store it in **WGS84 points job**. **Method: Convergence angle** when **WGS84 point** is highlighted. |
| Fn **Quit** | To exit the screen. |

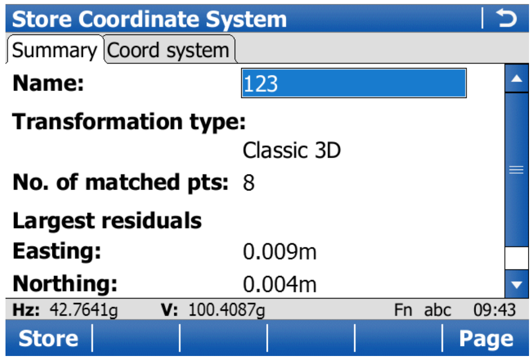
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | **Known WGS84 pt**, **Known WGS84 ht** or **User entered** | Available for Onestep: Method of determining the scale factor of the transformation. |
| | **User entered** or **Combined SF** | Available for Twostep. The default method for determining the **C**ombined **S**cale **F**actor to be used in the transformation process. |
| **Scale** (Reducing points to the ground) | Editable field | Available for Onestep. Allows the scale factor to be typed in manually. Available for **Method: User entered**. |
| | Display only | Available for Onestep. The calculated scale factor. Available for **Method: Known WGS84 pt** and **Method: Known WGS84 ht**. |
| **WGS84 point** | Selectable list | Available for Onestep. WGS 1984 point from which the scale factor will be calculated. The scale factor is calculated using the height of the known WGS 1984 point.<br>Available for **Method: Known WGS84 pt**. |
| **Known height** | Editable field | Available for Onestep. The WGS 1984 height of a point can be typed in. The scale factor is calculated using this height. Available for **Method: Known WGS84 ht**. |
| **Grid SF** | Display only | Available for Twostep and **Method: Combined SF**. The grid scale factor as computed in **Compute Grid Scale Factor**. Refer to "42.4.3 Computing the Grid Scale Factor". |
| **Height SF** | Display only | Available for Twostep and **Method: Combined SF**. The height scale factor as computed in **Compute Height Scale Factor**. Refer to "42.4.4 Computing the Height Scale Factor". |
| **Combined SF** | | Available for Twostep.<br>The combined scale factor of the transformation. |
| | Editable field | Available for **Method: User entered**. The scale factor can be typed in. |
| | Display only | Available for **Method: Combined SF**. The product of the grid scale factor and the height scale factor. |

### Next step

**OK** continues to **Store Coordinate System**.

**Store Coordinate System**




| Key | Description |
|---|---|
| **Store** | To store the coordinate system to the DBX, attach the system to **WGS84 points job** that was selected in **Choose WGS84 & Local Jobs** and return to **Main Menu**. |
| **Scale** or **Ppm** | For Onestep and Twostep. To switch between displaying the true scale and displaying the ppm. |
| **Coord** | For Classic 3D: To view other coordinate types. |
| Fn **Quit** | To exit the screen. |

### For Onestep

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | A unique name for the coordinate system. The name can be up to 16 characters in length and include spaces. |
| **Shift dX** | Display only | For Onestep and Twostep: Shift in X direction. |
| **Shift dY** | Display only | For Onestep and Twostep: Shift in Y direction. |
| **Shift dZ** | Display only | For Classic 3D: Shift in Z direction. |
| **Rotation** | Display only | For Onestep and Twostep: Rotation of transformation. |
| **Scale** | Display only | For Onestep and Twostep: Scale factor of transformation. |
| **Rotation orgn X** | Display only | For Onestep and Twostep: Position in the X direction of the origin of rotation. |
| **Rotation orgn Y** | Display only | For Onestep and Twostep: Position in the Y direction of the origin of rotation. |

### Next step

**Store** stores the coordinate system and returns to **Main Menu**.

## 42.4.2 Computing Required Azimuth

**Description**

Available for:

- One Point Localisation method with Onestep or Twostep transformation.
- **Method: Two WGS84 points** and **Method: User entered** in **Determine Rotation**.

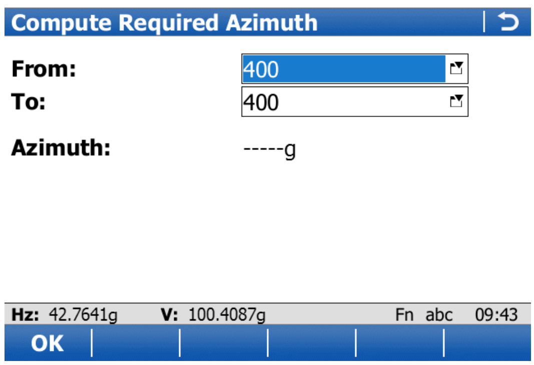
Allows two local points to be chosen from local job between which the required azimuth will be computed. This azimuth is then used with an azimuth computed between two WGS 1984 points chosen from the WGS84 job to calculate the rotation of the transformation.

The computed required azimuth appears in the **Required azimuth** field for **Method:** Two WGS84 points and the **Rotation** field for **Method: User entered** in **Determine Rotation**.

**Access**

Press **Inv** in **Determine Rotation**.

**Compute Required Azimuth**




| Key | Description |
|---|---|
| **OK** | To calculate the required azimuth and return to the screen from where this screen was accessed. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From** | Selectable list | The point ID of the first known point for the azimuth calculation. |
| **To** | Selectable list | The point ID of the second known point for the azimuth calculation. |
| **Azimuth** | Display only | The calculated azimuth. |

**Next step**

**OK** returns to **Determine Rotation**.

## 42.4.3 Computing the Grid Scale Factor

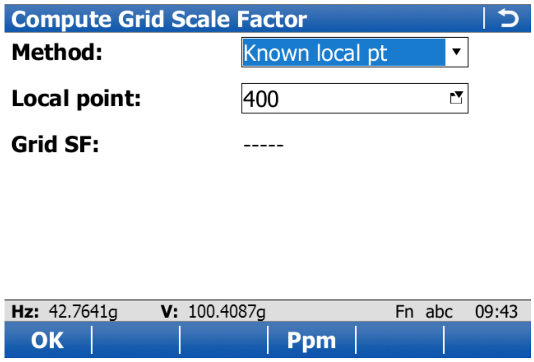
**Description**

For One Step Localisation method with Twostep transformation. Calculates the grid scale factor. The grid scale factor is the scale factor of the point chosen, relative to the projection being used.

**Access**

Press **Grid..** in **Determine Scale**.

**Compute Grid Scale Factor**




| Key | Description |
|---|---|
| **OK** | To confirm the selections and return to the screen from where this screen was accessed. |
| **Scale** or **Ppm** | To switch between displaying the true scale and displaying the ppm. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | | Method by which the grid scale factor is to be calculated. |
| | **User entered** | Grid scale factor can be manually typed in. |
| | **Known local pt** | Grid scale factor is computed using the position of a known local point. |
| **Local point** | Selectable list | Available for **Method: Known local pt**. The point ID of the point chosen from the local job from which the grid scale factor is computed using the projection selected. |
| **Grid SF** | | The grid scale factor. |
| | Editable field | Available for **Method: User entered**. To type in the grid scale factor. |
| | Display only | Available for **Method: Known local pt**. The computed grid scale factor. |

**Next step**

**OK** returns to **Determine Scale**.

## 42.4.4 Computing the Height Scale Factor

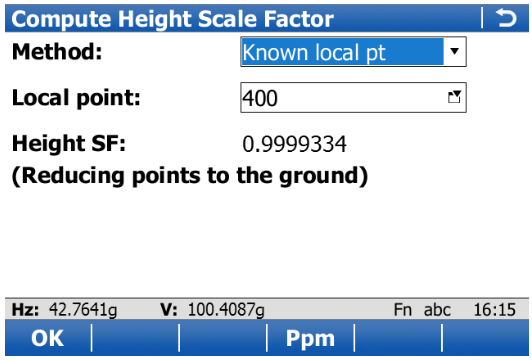
**Description**

For One Point Localisation method with Twostep transformation. Calculates the height scale factor of the point chosen.

**Access**

Press **Hgt..** in **Determine Scale**.

**Compute Height Scale Factor**




| Key | Description |
|---|---|
| **OK** | To confirm the selections and return to the screen from where this screen was accessed. |
| **Scale** or **Ppm** | To switch between displaying the true scale and displaying the ppm. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | | Method by which the height scale factor is to be calculated. |
| | **User entered** | Height scale factor can be manually typed in. |
| | **Known local pt** | Height scale factor is computed using the position of a known local point. |
| | **Known local ht** | Height scale factor is computed using an entered height value. |
| **Known local pt** | Selectable list | Available for **Method: Known local pt**. The point ID of the point chosen from the local job from which the height scale factor is computed. |
| **Known height** | Editable field | Available for **Method: Known local ht**. A known local height. |
| **Height SF** | | The height scale factor. |
| | Editable field | Available for **Method: User entered**. To type in the height scale factor. |
| | Display only | Available for **Method: Known local pt** and **Method: Known local ht**. The computed height scale factor. |

**Next step**

**OK** returns to **Determine Scale**.

# 43 QuickGrid GPS

## 43.1 Selecting the Transformation Method

☞ For an overview of determine coordinate systems, refer to "42.1 Overview"

**Description**

QuickGrid is designed to allow for quick coordinate system determination on site. Particularly for those users who must combine GPS and TPS data. All points must be measured by GPS, and therefore this method is not available in TPS mode. There are five different methods to choose from, Single point, Multi point, Single point from base, Orientate to line & Quickshift.

**Access**

Select **Main Menu: Go to Work!\Survey+\QuickGrid**.

**Choose QuickGrid Method**

**Description of fields**

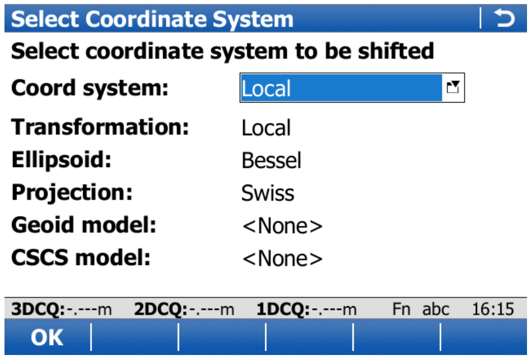
| Field | Option | Description |
|---|---|---|
| **Method** | **Single point** | This method is fast and targeted at the basic customer who wants to set up a local coordinate system based on a single point.<br>The orientation is fixed to WGS 1984 north.<br>A height scale is applied to bring GPS distances to “ground” using measured point WGS 1984 height. |
| | **Multiple points** | This method is fast and targeted at the more rigorous customer who wants to set up a local coordinate system based on multiple points.<br>Rotation and scale are as calculated. |
| | **Single point base** | This method is fast and targeted at the basic customer who wants to set up a local coordinate system based on the base station position.<br>The orientation is fixed to WGS 1984 north.<br>A height scale is applied to bring GPS distances to “ground” using measured point WGS 1984 height. |
| | **Orientate to line** | This method is fast and targeted at the more advanced customer who wants to set up a local coordinate system based on a single point, but set the orientation of the resulting grid by measuring a second point.<br>The rotation is as calculated.<br>A height scale is applied to bring GPS distances to “ground” using measured point WGS 1984 height. |
| | **QuickShift** | This method is fast and targeted at the more advanced customer who wants to shift their existing coordinate system based on a single point.<br>A 3D transformation is calculated. |

**Next step**

| IF the selected method is | THEN |
|---|---|
| **Single point**, **Multiple points**, **Single point base** or **Orientate to line** | **OK** to access **Define Local Quickgrid Point**. |
| **QuickShift** | **OK** to access **Select Coordinate System**. |

**Select Coordinate System**

This screen is only available for **Method: QuickShift**.




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

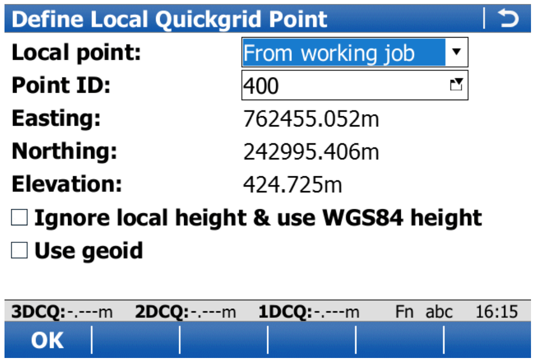
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Coord system** | Selectable list | Select the coordinate system to be shifted. |
| **Transformation** | Display only | The type of transformation. |
| **Ellipsoid** | Display only | The coordinates are based on this ellipsoid. |
| **Projection** | Display only | The map projection. |
| **Geoid model** | Display only | The geoid model. |
| **CSCS model** | Display only | The Country Specific Coordinate System model. |

### Next step

**OK** accesses **Define Local Quickgrid Point**.

**Define Local Quick-grid Point**




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Local point** | **User entered** | The local QuickGrid point is entered by the user. |
| | **From working job** | The local QuickGrid point is selected from the working job. |
| | **From control job** | The local QuickGrid point is selected from the control job. |
| **Point ID** | | The point ID of the local QuickGrid point. |
| | Editable field | For **Local point: User entered**. |
| | Selectable list | For **Local point: From working job** and **Local point: From control job**. |
| **Easting** | | The Easting coordinate of the local QuickGrid point. |
| | Editable field | For **Local point: User entered**. |
| | Display only | For **Local point: From working job** and **Local point: From control job**. |
| **Northing** | | The Northing coordinate of the local QuickGrid point. |
| | Editable field | For **Local point: User entered**. |
| | Display only | For **Local point: From working job** and **Local point: From control job**. |
| **Elevation** | | The orthometric height of the local QuickGrid point. |
| | Editable field | For **Local point: User entered**. |
| | Display only | For **Local point: From working job** and **Local point: From control job**. |
| **Ignore local height & use WGS84 height** | Check box | When this box is checked, no height adjustment is calculated. When this box is not checked, a height adjustment is calculated. |
| **Use geoid** | Check box | Check this box to select a geoid model for the calculation. |
| **Geoid model** | Selectable list | Available when **Use geoid** is checked. To select a geoid model. |

**Next step**

**OK** accesses **Measure QuickGrid Point**.

**Access**

Press **OK** in **Define Local Quickgrid Point**.

**Measure QuickGrid Point**

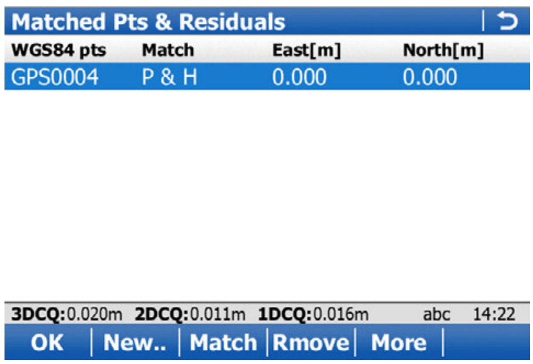
This screen is similar to the standard Survey screen. Refer to "57.1.2 Real-Time Rover Operations".

**Next step**

- For **Method: Multiple points**: After measuring and storing a point, **Matched Pts & Residuals** is accessed.
- For **Method: Orientate to line**: Measure the points of the line. Then **Store Coordinate System** is accessed.
- For all other QuickGrid methods: After measuring and storing a point, **Store Coordinate System** is accessed.

**Matched Pts & Residuals**

This screen shows what points have been matched so far. More points can be added, matched points can be deleted.




| Key | Description |
|---|---|
| **OK** | To confirm the selections, compute the transformation and continue with the subsequent screen. |
| **New..** | To survey another point and return to the Survey screen. |
| **Match** | To change the type of match for the highlighted point. |
| **Delete** | To delete the highlighted point from the list. |
| **More** | To display information about height residuals. |
| Fn **Quit** | To exit the screen. |

**Description of columns**

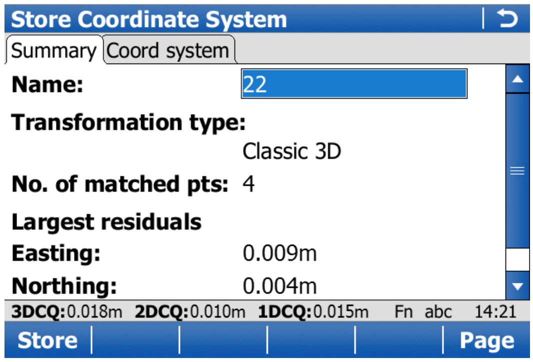
| Column | Description |
|---|---|
| **WGS84 pts** | The point ID of the points chosen from **WGS84 points job**. |
| **Match** | The type of match to be made between the QuickGrid point and the surveyed point. This information is used in the transformation calculation. **P**osition **&** **H**eight, **P**osition **only**, **H**eight **only** or **None**. |
| **East**, **North** and **Height** | The residuals of the matched points. |

**Next step**

Press **New..** to return to **Measure QuickGrid Point** and to survey another point for the calculation.
Press **OK** to continue with **Store Coordinate System**.

**Store Coordinate System, Summary page**

The available fields, keys and pages depend on the selected QuickGrid method.




| Key | Description |
|---|---|
| **Store** | To store the coordinate system and to exit the Determine Coordinate System application. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

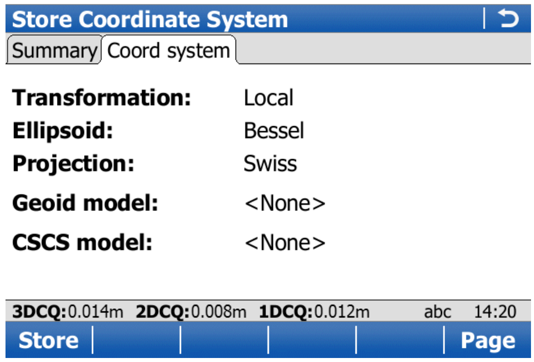
| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | The name of the new coordinate system. |
| **No. of matched pts** | Display only | Available for **Multiple points**.<br>The number of matched points. |
| **Largest residuals East**, **North** and **Height** | Display only | Available for **Multiple points**.<br>The largest residuals of the transformation. |
| **Rotation from north** | Display only | Available for **Orientate to line**.<br>The rotation is shown in the configured angle units. |
| **Shift dX** | Display only | Available for **QuickShift**.<br>Shift in X direction. |
| **Shift dY** | Display only | Available for **QuickShift**.<br>Shift in Y direction. |
| **Shift dZ** | Display only | Available for **QuickShift**.<br>Shift in Z direction. |

### Next step

**Page** changes to the **Coord system** page.

**Store Coordinate System, Coord system page**

The available fields, keys and pages depend on the selected QuickGrid method.




| Key | Description |
|---|---|
| **Store** | To store the coordinate system and to exit the Determine Coordinate System application. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Residuals** | | For **Multiple points**. The method by which the residuals of the control points will be distributed throughout the transformation area. |
| | **None** | No distribution is made. Residuals remain with their associated points. |
| | **1/distance**, 1/distance² or **1/distance³/²** | Distributes the residuals according to the distance between each control point and the newly transformed point. |
| | **Multiquadratic** | Distributes the residuals using a multiquadratic interpolation approach. |
| **Transformation** | Display only | Available for **QuickShift**. The type of transformation. |
| **Ellipsoid** | Display only | Available for **QuickShift**. The coordinates are based on this ellipsoid. |
| **Projection** | Display only | Available for **QuickShift**. The map projection. |
| **Geoid model** | Display only | Available for **Multiple points** and **QuickShift**. The geoid model used. |
| **CSCS model** | Display only | Available for **QuickShift**. The Country Specific Coordinate System model. |

### Next step

**Store** saves the new coordinate system.

# 44 Reference Line

## 44.1 Overview

**Description**

The Reference Line application can be used to set out or measure points relative to a line.

**Reference line tasks**

The Reference Line application can be used for the following tasks:
- Measuring to a reference line where the coordinates of a design point can be calculated from its position relative to the defined reference line.
- Staking to a reference line where the position of a design point is known and instructions to locate the point are given relative to the reference line.
- Gridstaking a reference line where a grid can be staked relative to a reference line.
- Viewing the position relative to a slope defined from the reference line.

Other functionality available includes:
- Shifting the reference line with parallel offsets.
- Referencing to a specific segment of a line.
- Reversing the direction of a reference line.

**Activating the application**

If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

☞ Measuring and staking out of points is possible for GPS and TPS.

**Point types**

Reference lines/arcs can be created from points stored as:
- WGS 1984 geodetic
- Local grid

A local grid must always be available when using the application.

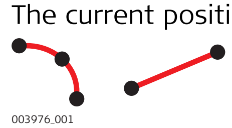
**Terms**

Reference point: Used in this chapter to refer to the point from which the perpendicular offset, from the reference line to the design point, is measured.

Design point: The design point.
- For measuring to a reference line, this term refers to the point with the coordinates of the current position and the designed or calculated height.
- For staking or grid staking to a reference line, this term refers to the point to be staked, defined by the user

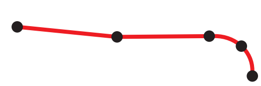
Measured point: The current position.

Line:




A line can be a straight line between two points, an arc or a multi-point line made up of multiple individual line sections. It may be constructed by joining many “point to points”, by creating the sections segment-by-segment, or by creating an alignment.

Line segment:




A line segment is an individual component of a multi-line such as a polyline or an alignment. The segment can be a straight or an arc.

**Preparing the data** Line data can be created by one of the following methods:

| Method | Description |
|---|---|
| **Create lines onboard** | |
| ☞ The Reference Line application supports DBX polylines. Lines created with SmartWorx Viva 4.50 or higher are DBX polylines. DBX areas can be also used as closed polylines. | |
| Data management | Refer to "6 Jobs & Data - Data". |
| Create Control Data | Lines can be created using the Create line function. Refer to "Create new line/arc". |
| Tap Map | From Tap Map, lines can be created, imported or selected to be used in Reference Line. Refer to "39 Tap Map". |
| Survey linework | Lines can be created by measuring points in the field. Lines can be made using the linework commands in the **Survey** page. Also, taking measurements with line objects open as well using **Jobs & Data** or line codes can create lines. |
| Road data in Alignment Editor | Using the Alignment Editor application, a simple centreline alignment can be created and be imported.<br>☞ Only straight and curve elements are supported. The alignment created with the Alignment Editor application has to be converted to a RoadRunner Job. |
| **Import lines** | |
| Import an individual line from DXF background map | Using a DXF file attached as a background map, lines can be selected and imported within the map screens of Tap Map, Survey or Reference Line applications. |
| Import all objects including lines from DXF | Copy the DXF files to the \Data directory on the data storage device of the Viva Series instrument. Once the card is back in the instrument the DXF import program can be used to bring the lines into the job. |
| Import from XML | Copy the DXF files to the \Data directory on the data storage device of the Viva Series instrument. Once the card is back in the instrument the XML import program can be used to bring the lines into the job. |
| Import Road alignments | The **Import alignment data** application in **Jobs & Data** supports various different formats like dxf, LandXml, MxGenio, Terramodel, Carlson. |
| **Create lines externally** | |
| Leica Geo Office | Refer to LGO Online Help. |
| Design to Field | Using the Design to Field tool of Leica Geo Office, the user is able to bring in lines from multitudes of formats. For example, XML, DXF, Microstation XML and many more. Refer to LGO Online Help for information on Design to Field. |
| Some 3$^{rd}$ party software export to Leica database | - |

☞ Refer to "Appendix C Directory Structure of the Memory Device" for the placements of the data files on the data storage device.

**Defining chainage** The chainage of the start point of a reference line can be defined.

**Coordinate systems** Lines and points defining the lines can be read from the control job using the active coordinate system. For this reason, the coordinate system in the control job must match the active one in the working job.

If using TPS, select the **<None>** or a local grid coordinate system.

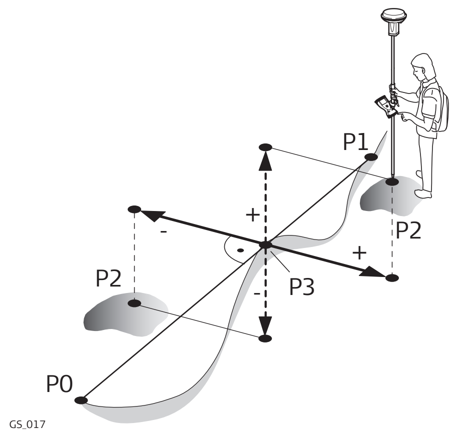
If using GPS, a local grid coordinate system must be used. Working in WGS84 coordinates is not supported. Measured WGS84 coordinates are converted to grid using the active coordinate system.

It is possible to use a valid coordinate system, but have the line or part of it lying outside the projection or CSCS model being used.

In these cases, the field values relating to the difference in coordinates between the design point and current position are shown as **-----**.

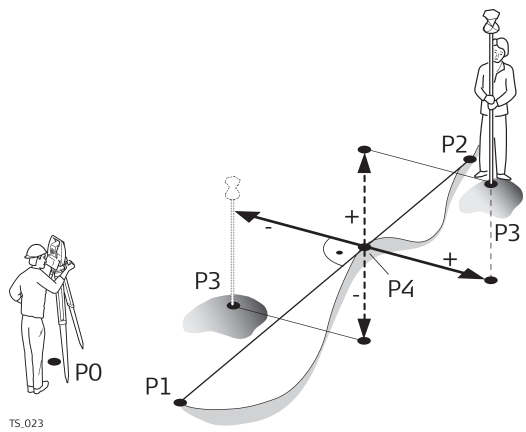
☞ **Azimuth** is used throughout this chapter. This term must always be considered to mean also **Bearing**.

**Direction of values** The following diagram shows the direction of positive and negative values for distance and height differences between the design point and the reference point for reference lines.




GPS

P0 Start point
P1 End point
P2 Design point
P3 Reference point

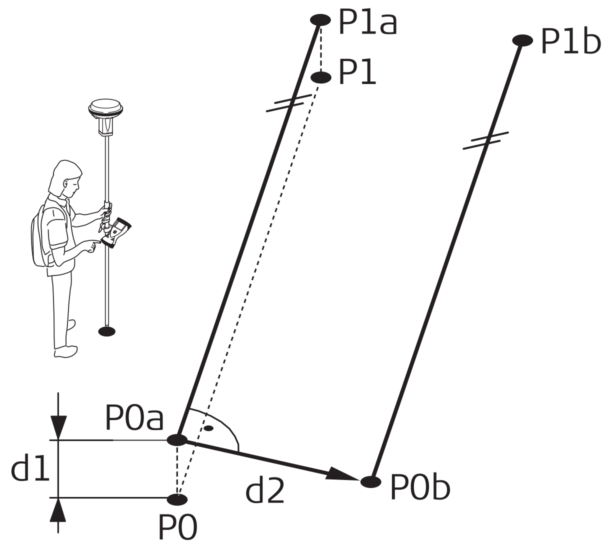



TPS

P0 Instrument station
P1 Start point
P2 End point
P3 Design point
P4 Reference point

**Shifts**

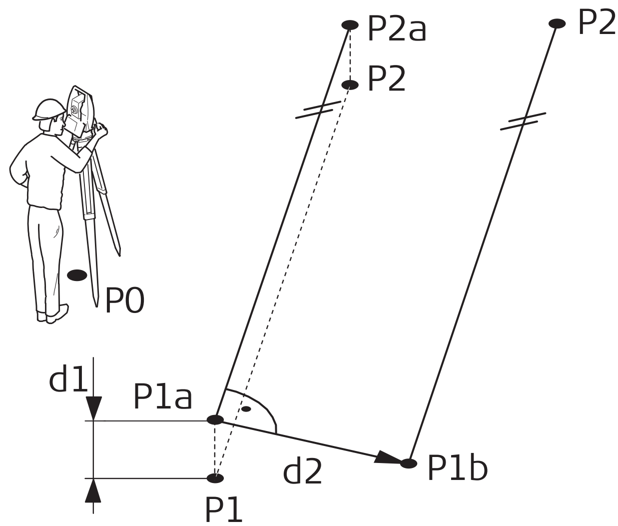
A reference line can be shifted. A shift is permanently applied to the reference line for the duration of the Reference Line task.




000237_002

GPS

P0 Start point
P1 End point
P0a Start point with **Up/down** shift
P1a End point with **Up/down** shift
P0b Start point with **Left/right** shift
P1b End point with **Left/right** shift
d1 **Up/down** shift
d2 **Left/right**




000407_002

TPS

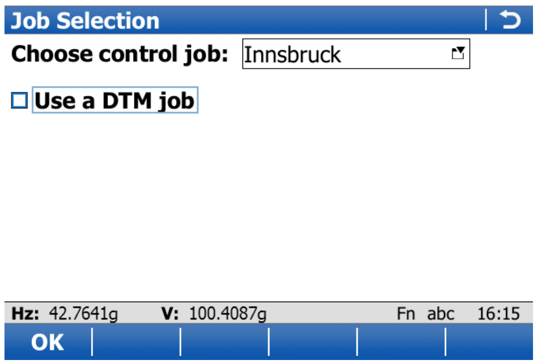
P0 Instrument station
P1 Start point
P2 End point
P1a Start point with **Up/down** shift
P2a End point with **Up/down** shift
P1b Start point with **Left/right** shift
P2b End point with **Left/right** shift
d1 **Up/down**
d2 **Left/right**

## 44.2 Accessing Reference Line

**Access**

- For measuring tasks:
  Select **Main Menu: Go to Work!\Survey+\Measure to ref line**.
- For staking tasks:
  Select **Main Menu: Go to Work!\Stakeout+\Stake to ref line**.
- From Tap Map:
  Tap & hold on a line from the displayed job or attached CAD. Select **Use in Reference Line** from the context menu. Select how to enter the application: **Stake task selection**, **Measure task selection**, **Stake line**, **Measure line with slope**, **Measure line**, **Stake line with slope**

**Job Selection**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

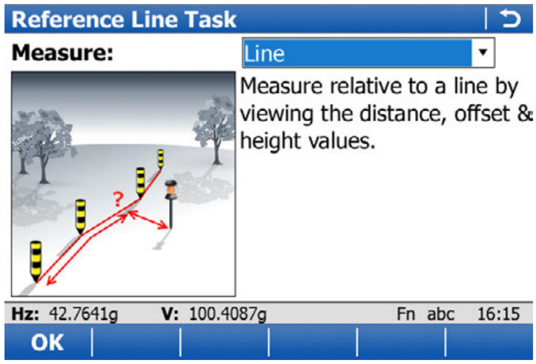
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Choose control job** | Selectable list | The reference lines are stored in this job.<br>☞ The measurements are stored to the working job. The coordinate systems in the control job and in the working job must match, otherwise a warning message appears to prevent any further step. |
| **Use a DTM job** | Check box | When this box is checked, a DTM job can be selected. A DTM job holds DTM (Digital Terrain Model) or TIN (Triangular Irregular Network) data. The files are stored in the \DBX folder or a subfolder of \DBX. |
| **DTM job** | Selectable list | Holds DTM (**D**igital **T**errain **M**odel) data or TIN (**T**riangular **I**rregular **N**etwork) data. The DTM job to be used must be stored in the \DBX directory on the active memory device.<br>The DTM job is a read-only source of information and cannot be selected as a working or control job. |
| **DTM layer** | Selectable list | To choose the DTM layer. |

**Next step**

**OK** accesses **Reference Line Task**.

## Reference Line Task




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| Fn **Config..** | To configure the Reference Line application. |
| Fn **Quit** | To exit the screen. |

### Description of the Reference Line tasks

### For measuring to a reference line

| Task | Description |
|---|---|
| **Line** | Measure relative to a line by viewing the distance, offset & height values. |
| **Line with slope** | Measure relative to a line by viewing the distance, offset & height values. Additionally view position relative to a defined slope from the line. |
| **Segment** | Measure relative to a line segment by viewing the distance, offset & height values. A segment may be an individual straight or arc, or a segment within a line. |
| **Segment with slope** | Measure relative to a line segment by viewing the distance, offset & height values. Additionally view position relative to a defined slope from the line. |
| **Quick Line** | Create a temporary line from 2 points & measure relative to it by viewing the distance, offset & height values. |

### For staking to a reference line

| Task | Description |
|---|---|
| **Line** | Stakeout relative to a line by defining the distance, offset & height. |
| **Line with slope** | Stakeout relative to a line by defining the distance, offset & height. Additionally view position relative to a defined slope from the line. |
| **Grid** | Define & stakeout a grid of points relative to a line. |
| **Segment** | Stakeout relative to a line segment, by defining the distance, offset & height. A segment may be an individual straight or arc, or a segment within a line. |
| **Segment with slope** | Stakeout relative to a line segment, by defining the distance, offset & height. Additionally view position relative to a defined slope from the line. |
| **Quick Line** | Create a temporary line from 2 points & stakeout relative to it by defining the distance, offset & height. |

### Next step

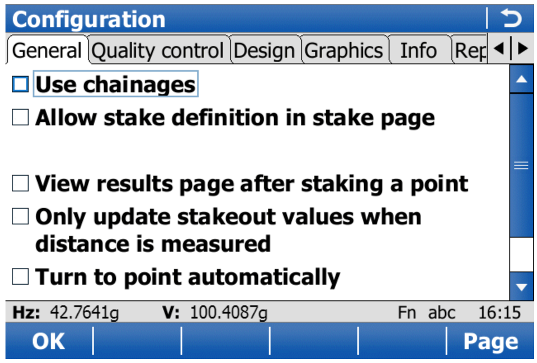
**OK** accesses **Define Line**.

## 44.3 Configuring Reference Line

**Access**

Press Fn **Config..** in the input screens of the Reference Line application.

**Configuration, General page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use chainages** | Check box | Activates the use of chainages within the reference line application. If this is deactivated, **Dist along line** will be used for data input purposes. |
| **Allow stake definition in stake page** | Check box | When this box is checked, stake values can be defined on the **Stake** page. |
| **Always enable editing of design height** | Check box | When this box is checked, the design height can be changed manually for **Heights to use**: **From line** or **Heights to use**: **Start point**. Available when **Allow stake definition in stake page** is checked. |
| **View results page after staking a point** | Check box | When this box is checked, the stake results are displayed after staking a point. |
| **Only update stakeout values when distance is measured** | Check box | TPS When this box is checked, angles and stakeout values are updated after a distance was measured. Then all values are frozen until the next distance is taken. |
| **Turn to point automatically** | Check box | TPS When this box is checked, the instrument positions automatically to the point to be staked. |
| **Turn to** | Selectable list | TPS Available when **Turn to point automatically** is checked. |
| | **Position only** | TPS Instrument positions horizontally to the point to be staked. |
| | **Position & height** | TPS Instrument positions horizontally and vertically to the point to be staked. |
| **Use two face measurements** | Check box | TPS To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |

### Next step

**Page** changes to the **Quality control** page.

**Configuration, Quality control page**

### Description

Especially when checking points it is useful to enable the **Quality control** criteria available. For every point stored the chosen parameters are checked. When **Quality control** criteria is fulfilled, green ticks are shown in the stake page, and the measured point can be directly stored. If the check limits are exceeded a warning is shown. This function guarantees a higher productivity as it is no longer necessary to check the values for every shot taken.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Check deltas to point before storing** | Check box | When this box is checked, a position check is done when storing a staked point. When the defined tolerance is exceeded, the stake out can be repeated, skipped or stored.<br>When this box is not checked, no quality check is done during stake out of points. |
| **Delta values** | | ☞ Depending on this selection the following lines are enabled/disabled. |
| | **Ch, offset & height** | Check for chainage, horizontal offset and height. |
| | **Ch & offset** | Check for chainage and horizontal offset. |
| | **Position & height** | Check for 2D position and height. |
| | **Position** | Check for 2D position. |
| | **Height** | Check for height. |
| **Chainage limit** | From **0.001** to **100** | Maximum difference in chainage. |
| **Offset limit** | From **0.001** to **100** | Maximum horizontal offset from defined position. |
| **Position limit** | From **0.001** to **100** | Maximum radial horizontal distance. |
| **Height limit** | From **0.001** to **100** | Maximum height difference. |

### Next step

**Page** changes to the **Design** page.

**Configuration, Design page**

On this page, additional design points to be staked are set. Refer to "44.6 Staking to a Reference Line" for a graphic.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Horizontal (PC, PT, AP)** | Check box | Horizontal type points occur at the junction between two segments in a line. |
| **Mid curve (MCP)** | Check box | Occurs in arc segments. |
| **Curve radius (RP)** | Check box | Occurs in arc segments. |
| **Offset bisected point (BP)** | Check box | Occurs when the junction between two segments in a line is not tangent AND when offsets are active. |
| **Offset in average direction (Avg)** | Check box | Occurs when the junction between two segments in a line is not tangent AND when offsets are active. |
| **Vertical (VPI, Low, High, VPC, VPT)** | Check box | Vertical type points occur at the junction between two segments in the vertical alignment of the line, or when a high or low element is found. Example: In a curve between two grades |

**Configuration, Graphics page**

This page is only available for staking operations.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Navigate direction** | | The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Reference Line application are based on this selection. |
| | **From instrument** | TPS The direction of the orientation is from the instrument to the point to be staked. |
| | **To instrument** | TPS The direction of the orientation is from the point to be staked to the instrument. |
| | **To north** | GPS The North direction shown in the graphical display based on the active coordinate system. |
| | **To sun** | GPS The position of the sun calculated from the current position, the time and the date. |
| | **To last point** | Time-wise, the last recorded point. |
| | **To point (cntrl job)** | A point from the control job selected in **Job Selection**. |
| | **To point** | A point from the working job. |
| | **To reference line** | The direction of the orientation is parallel to the reference line. |
| | **Following arrow** | The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. |
| **Point ID** | Selectable list | Available for **Navigate direction: To point (cntrl job)** and **Navigate direction: To point**. To select the point to be used for orientation. |
| **Navigate using** | | The method of staking out. |
| | **Direction & distance** | The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. |
| | **In/out, left/right** | The distance forwards/backwards to the point, the distance right/left to the point and the cut/fill is displayed. |
| **Switch to bulls eye when 0.5m from target** | Check box | When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked. |
| **Beep faster when getting close to point** | Check box | The instrument beeps when the horizontal radial distance from the current position to the point to be staked, is equal to or less than defined in **Start within**. |
| **Distance to use** | **Height** | The distance in height is used as indicator. |
| | **Horizontal distance** | The distance from Easting and Northing is used as indicator. |
| | **Position & height** | The distance from Easting, Northing and Height is used as indicator. |
| **Start within** | Editable field | The horizontal radial distance from the current position to the point to be staked when a beep will be heard. |

**Next step**

**Page** changes to the **Info** page.

**Configuration, Info page**

Two things can be configured on this page:

1) The required information for the stake or measure method to be displayed on the **Info** page.
2) If and which additional user-defined survey screen page is displayed.

| Key | Description |
|---|---|
| **OK** | To confirm the changes and continue. |
| **Clear** | To clear all parameters from all lines. |
| **Default** | To set the default value for all lines. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Show additional page from My Survey Screen** | Check box | Shows a selectable list for the survey screen pages. |
| **Page to show** | Selectable list | The user-defined survey screen page to be shown. All survey screens defined in **My Survey Screen Settings** can be selected. |
| **Method** | Display only | The method is based on the selected Reference Line task. The settings in the following lines can only be changed for the current task.<br>The method defines the parameters available to view on the **Info** page of the application. Different combinations of the parameters to view can be stored. |
| **1st line** to **16th line** | Selectable list | To modify the selection on any particular line, place the cursor on the line to modify using the arrow keys and press the ENTER key. Use the arrow keys to select the required parameter and press the ENTER key to confirm the choice.<br>Define which parameters are viewed on each line. Up to 16 lines of parameters can be defined.<br>☞ Some of the options are explained in graphics in the following chapters. |
| | **Always available** | |
| | **Point ID** | To enter the point ID. |
| | **Antenna height** | GPS To enter the antenna height. |
| | **Target height** | TPS To enter the target height. |
| | **Code** | Editable field for codes. |
| | **Code desc (free)** | Displays the description of free codes. |
| | **Attrib 01** and **Attrib 02** | Editable field for attributes for codes. |

| Field | Option | Description |
|---|---|---|
| | **Chainage** | Displays the current chainage. |
| | **Dist along line** | Displays the horizontal distance from the start point to the reference point along the reference line. |
| | **Line offset** | Displays the horizontal offset perpendicular from the line to the current position. |
| | **Line height diff** | Displays the height difference from the defined line to the current position. |
| | **Line name** | Displays the name of the reference line. |
| | **Line type** | Displays the line type as straight, arc or polyline. |
| | **Easting** | Displays the Easting coordinate of the current position. |
| | **Northing** | Displays the Northing coordinate of the current position. |
| | **Height** | Displays the height of the current position. |
| | **Quality 3D** | GPS Display only field for the current 3D coordinate quality of computed position. |
| | **Cut/fill** | Displays the height difference between the design height and the measured height. |
| | **Line space full** | Insert full line space. |
| | **Line space half** | Insert half line space. |
| | **For measure with/without slope also available** | |
| | **Dist to start point** | Displays the horizontal distance from the measured point to the start point of the line. |
| | **Dist to end point** | Displays the horizontal distance from the measured point to the end point of the line. |
| | **Line dist to end** | Displays the horizontal distance from the end point of the line to the base point of the measured point, along the line. |
| | **Perp distance** | Displays the slope distance between the reference point and the measured point, perpendicular to the reference line. Not displayed when shifts are applied. |
| | **Perp ht to line** | Displays the height difference perpendicular from the reference line to the horizontal base point. Not displayed when shifts are applied. |
| | **Spatial dist** | Displays the slope distance between the start point and the reference point. Not displayed when shifts are applied. |
| | **For stake with/without slope also available** | |
| | **Δ dist along line** | Displays the horizontal distance along the reference line from the current position to the defined design point. |
| | **Δ chainage** | Displays the difference between the defined chainage and the current chainage. |
| | **Δ height** | Displays the vertical offset between the defined position and the current position. |

| Field | Option | Description |
|---|---|---|
| | **Defined chainage** | Displays the defined chainage of the point to be staked out. |
| | **Defined line dist** | Displays the defined horizontal distance along the reference line from the start point to the design point. |
| | **Defined offset** | Displays the defined horizontal offset perpendicular from the reference line to design point. |
| | **Direction to point** | Displays the direction from the current position to the design point. |
| | **Distance to point** | Displays the distance from the current position to the design point. |
| | **Design easting** | Displays the Easting of the design point. |
| | **Design northing** | Displays the Northing of the design point. |
| | **Design height** | Displays the height of the design point, depending on the defined heights to use. |
| | **For slope only also available** | |
| | **Slope ratio meas** | Displays the ratio of the slope from the current position to the hinge. |
| | **Slope ratio defined** | Displays the ratio of the slope from the design point to the hinge, as defined by the user. |
| | **Slope dist hinge** | Displays the slope distance offset from the hinge to measured point. |
| | **Slope dist line** | Displays the slope distance offset from line to measured point. |
| | **Slope height diff** | Displays the height difference between the current position and the height of the slope at that position. A cut is above the slope. A fill is below the slope. |
| | **Hinge offset** | Displays the horizontal offset from the hinge point of the slope to the current position. |
| | **Hinge height diff** | Displays the height difference from the hinge point of the slope to the current position. |

**Next step**

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

**Page** changes to the first page on this screen.

# 44.4 Defining the Reference Line

## 44.4.1 Overview

**Description**

The definition of the reference line to be used can require up to three steps, depending on the selected task:

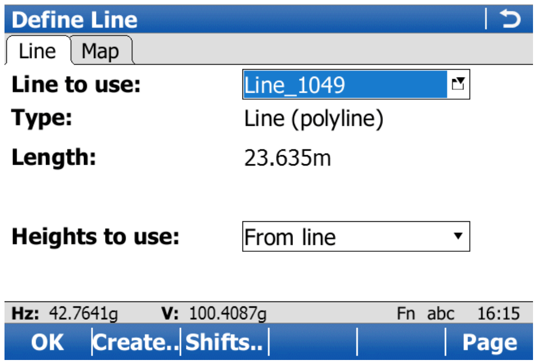
| Task | Define Line | Define Segment | Define Slope |
|---|---|---|---|
| **Line**<br>**Quick Line** | ✓ | - | - |
| **Segment**<br>**Grid** | ✓ | ✓ | - |
| **Line with slope** | ✓ | - | ✓ |
| **Segment with slope** | ✓ | ✓ | ✓ |

## 44.4.2 Defining the Line

**Access**

1) Select **Main Menu: Go to Work!\Survey+\Measure to ref line** or **Stake to ref line**.
2) In the job selection screen, select the required job and press **OK**.
3) In **Reference Line Task**, select the required task and press **OK**.

**Define Line, Line page**




| Key | Description |
|---|---|
| **OK** | To accept changes and continue with the subsequent screen. |
| **Create..** | To create a line. Refer to "9 Jobs & Data - Create control data". |
| **Shifts..** | To apply horizontal and vertical shifts to the selected line. Refer to "Shift Settings". Available for lines only. If using line segments, shifts are applied in the **Define Segment** screen. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Reference Line application. |
| Fn **Report** | To view an alignment report. Refer to "Line Report, Points page". |
| Fn **Quit** | To exit the screen. |

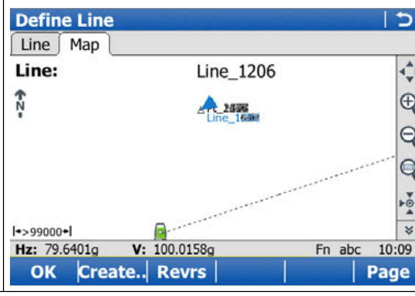
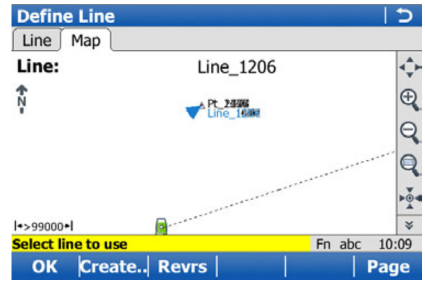
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line to use** | Selectable list | To select a line. Open the selectable list to access the **Line Selection** screen showing all selectable lines from the control job. |
| **Type** | Display only | The selected line type as straight, arc or polyline. |
| **Length** | Display only | The horizontal grid distance between the two points of the line. |
| **Start chainage** | Display only | The beginning chainage of the line. |
| **Heights to use** | Selectable list | Depending on the task chosen this parameter determines the design height.<br>• When measuring to a line, it affects the height difference value.<br>• When staking, it affects the delta height value. |
| | **From line** | Heights are computed along the reference line. |
| | **Manually enter** | Heights are typed in manually into the **Design height** field. |
| | **Start point** | Heights are computed relative to the height of the starting point of the line. |
| | **DTM** | The height computed from the DTM at the position of the reference point. |

**Next step**

**OK** accesses **Define Slope**, **Define Segment**, **Measure to Line** or **Define Stake**.

**Define Line, Map page**

| Key | Description |
|---|---|
| **Revrs** | To reverse the direction of the lines, so that the distance along line/chainage increment is in the opposite direction to the original:<br>Original:  <br>Reverse:   |

**Define Quick Line**

When **Quick Line** is the selected task, the line is defined by two points from the control job, instead of an existing line.

☞ When the task is finished or a new quick line is defined, the previously defined quick line is automatically deleted from the database.

| Key | Description |
|---|---|
| **OK** | To accept changes and continue with the subsequent screen. |
| **Shifts..** | To apply horizontal and vertical shifts to the defined line. Refer to "Shift Settings". |
| **Survy..** | To measure a point. Available when **Start point** or **End point** is highlighted. |
| Fn **Config..** | To configure the Reference Line application. |
| Fn **Quit** | To exit the screen. |

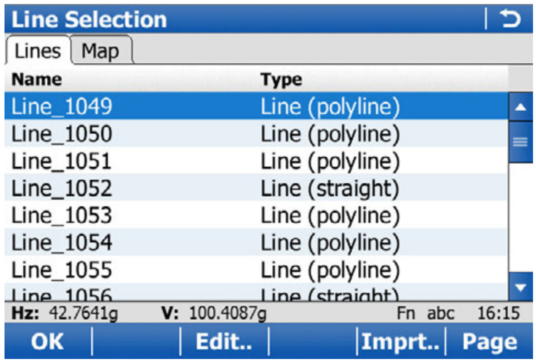
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Start point** | Selectable list | The first point forming the line. |
| **End point** | Selectable list | The last point forming the line. |
| **Length** | Display only | The horizontal grid distance between the two points of the line. |
| **Heights to use** | Selectable list | Depending on the task chosen this parameter determines the design height.<br>• When measuring to a line, it affects the height difference value.<br>• When staking, it affects the delta height value. |
| | **From line** | Heights are computed along the reference line. |
| | **Manually enter** | Heights are typed in manually into the **Design height** field. |
| | **Start point** | Heights are computed relative to the height of the starting point of the line. |
| | **DTM** | The height computed from the DTM at the position of the reference point. |

## Line selection and importing lines

### Selecting lines

In **Define Line**, open the selectable list for **Line to use**.
The list contains all selectable lines from the control job. The line ID and the start chainages of lines can be edited.




| Key | Description |
|---|---|
| **OK** | To select the highlighted reference line and to return to the screen from where this screen was accessed. |
| **Edit..** | To edit line ID and the start chainage. |
| **Import** | To import a line from a Road/Rail job or from an external survey job. |
| Fn **Quit** | To exit the screen. |

### Importing lines

Press **Import** to import a single alignment from a Road or Rail job, or a line/area from another survey job, to a line to be used in the application. The **Import Line** screen opens.

Only alignment geometry that contains lines and simple curves are supported. Clothoids are not supported and can not be imported.

If the source survey job for the importation is the same as the control job, for example when you want to import areas, the imported element is converted to a line with the suffix _001.

| Key | Description |
|---|---|
| **OK** | To import the selected alignment data to active raw alignment. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Data source** | | The file type of the data source. |
| | **Road job** | To import lines from an existing Road job. |
| | **Rail job** | To import lines from an existing Rail job. |
| | **Survey job** | To import lines/areas from an existing survey job. |
| | **Road+ (GSI format)** | To import lines from an existing Road job defined in GSI format. |
| **From job** | Selectable list | All jobs are available for selection. |
| **Line** | Selectable list | Line from the selected Road job. The line must be stored in the \dbx folder of the memory device to be selectable. |

**Line Report, Points page**

The report displays information on the points that have been measured with the current selected control job, and current select line.

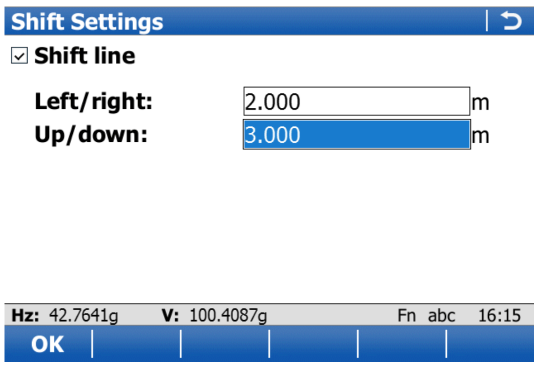
| Key | Description |
|---|---|
| **OK** | To return to the screen from which this screen was accessed. |
| **Edit..** | To edit details of the highlighted point. |
| **Save..** | To save the alignment report. |
| **More** | To change the values displayed between **Offset**, **Cut/fill**, **Measured height**, **Design height**, **Point ID** and **Pt code**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Next step

**Page** changes to the **Map** page. Use **Prev** and **Next** to the previous or next measured point.

**Shift Settings**

The **Map** page is not updated with shifts.




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to return to the previous screen. |
| Fn **Quit** | To exit Reference Line application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Shift line** | Check box | Check to apply a shift. |
| **Left/right** | Editable field | Distance to shift the reference line horizontally to the left or right. |
| **Up/down** | Editable field | The vertical shift of the reference line. |
| **Rotate line** | Editable field | Available for **Measure**: **Quick Line**.<br>To rotate the line by the defined angle value - clockwise if not defined otherwise in **Regional settings**.<br>If values are entered for both **Rotate line** and **Left/right**, the horizontal shift is applied to the rotated line. |

## 44.4.3 Defining a Segment of a Line

**Description**

**Define Segment**, **Segment** page appears when the selected method is **Segment**, **Segment with slope** or **Grid**. A segment can be a straight or an arc.

**Define Segment, Segment page**

| Key | Description |
|---|---|
| **OK** | To accept changes and continue with the subsequent screen. |
| **Shifts..** | To apply horizontal and vertical shifts to the selected segment. Refer to "Shift Settings". |
| **Seg-** or **Seg+** | To select the previous/next segment in the line. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Reference Line application. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line to use** | Display only | The current line. |
| **Segment no** | Editable field | The line segment number to work with. A polyline is split into segments, naming from 1 upwards. |
| **Segment type** | Display only | The selected line type as straight or arc. |
| **Segment length** | Display only | The horizontal grid distance between the two points of the line segment. |
| **Start chainage** | Display only | The beginning chainage of the line segment. |

**Next step**

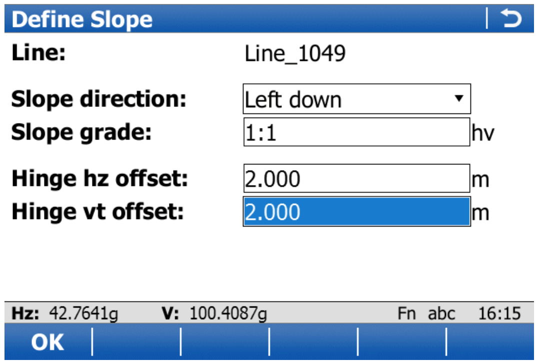
**Page** changes to the **Map** page. Refer to "Define Line, Map page".

## 44.4.4 Defining Reference Line Slopes

**Description**

It is possible to define slopes for reference line. When measuring or staking to the reference line, additional information about the position relative to the slope is displayed.
Stakeout values still refer to the reference line. For the **Info** page, additional information relative to the slope can be configured in **Configuration**, **Info** page.

**Define Slope**




| Key | Description |
|---|---|
| **OK** | To accept changes and to continue with the subsequent screen. |
| Fn **Config..** | To configure the Reference Line application. |
| Fn **Quit** | To exit Reference Line application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line to use** | Selectable list | To select a line. Or select a line on the **Map** page. |
| **Slope direction** | | The method how the slope is created. |
| | **Left down** | Creates a downward plane extending to the left of the defined reference line. |
| | **Right down** | Creates a downward plane extending to the right of the defined reference line. |
| | **Left up** | Creates an upward plane extending to the left of the defined reference line. |
| | **Right up** | Creates an upward plane extending to the right of the defined reference line. |
| **Slope grade** | Editable field | Inclination of the slope. |
| **Hinge hz offset** | Editable field | Horizontal offset from the line that sets where the slope starts. |
| **Hinge vt offset** | Editable field | Vertical offset from the line that sets where the slope starts. |

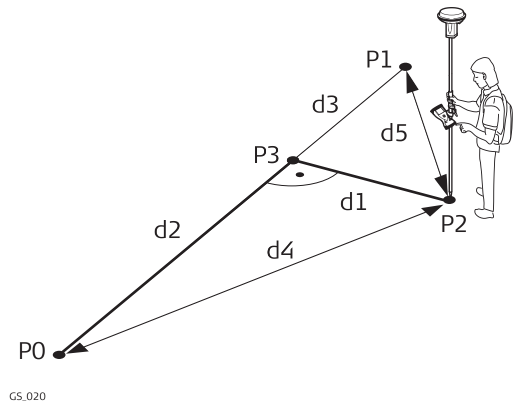
# 44.5 Measuring to a Reference Line

**Description**

The horizontal and vertical position and the distance along line/chainage of a manually measured point can be calculated relative to the defined reference line.

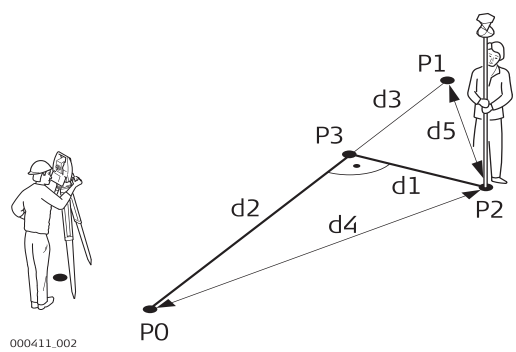
Information can be measured and displayed in the **Info** page, and then exported. Refer to "Configuration, Info page".

**Measure to line - straight segment - horizontal measurements**




GPS

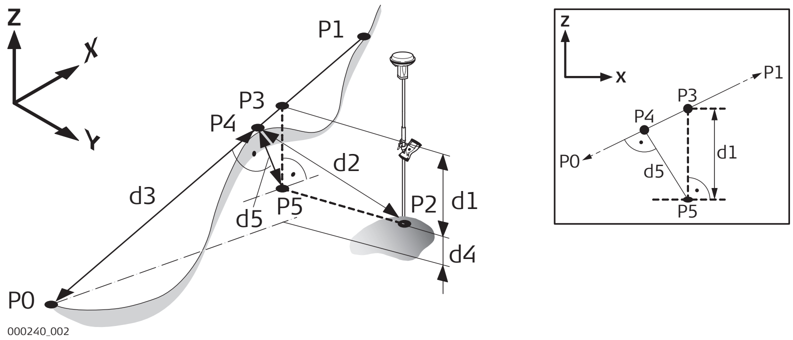
P0 Start point
P1 End point
P2 Measured point
P3 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Line dist to end**
d4 **Dist to start point**
d5 **Dist to end point**




TPS

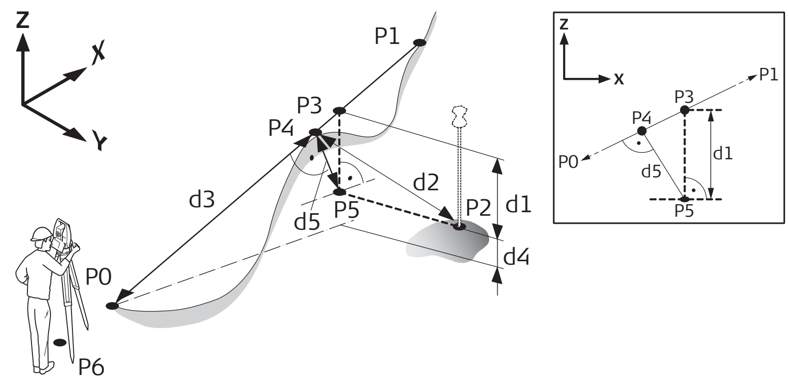
P0 Start point
P1 End point
P2 Measured point
P3 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Line dist to end**
d4 **Dist to start point**
d5 **Dist to end point**

#### Measure to line - straight segment - vertical measurements




GPS

P0 Start point
P1 End point
P2 Measured point
P3 Reference point
P4 Perpendicular point
P5 Horizontal base point
d1 **Line height diff**
d2 **Perp distance**
d3 **Spatial dist**
d4 **∆ height**
d5 **Perp ht to line**

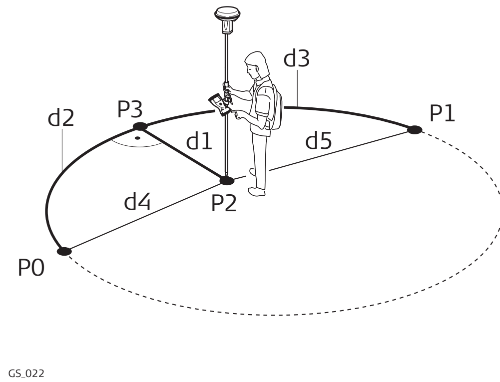



TPS

P0 Start point
P1 End point
P2 Measured point
P3 Reference point
P4 Perpendicular point
P5 Horizontal base point
P6 Instrument station
d1 **Line height diff**
d2 **Perp distance**
d3 **Spatial dist**
d4 **∆ height**
d5 **Perp ht to line**

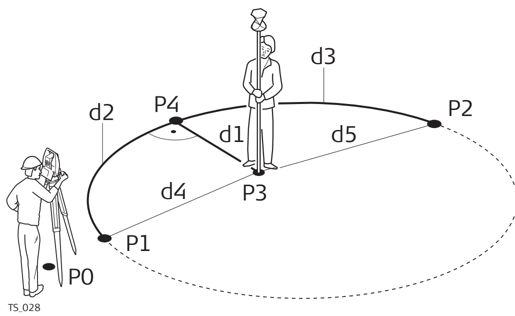
**Measure to line - arc segment - horizontal measurements**

**Design point inside arc**




GPS

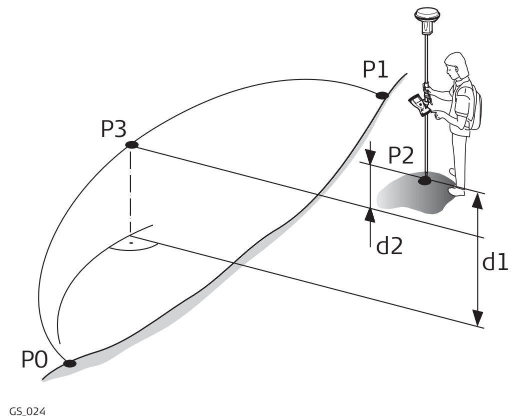
P0 Start point
P1 End point
P2 Measured point
P3 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Line dist to end**
d4 **Dist to start point**
d5 **Dist to end point**




TPS

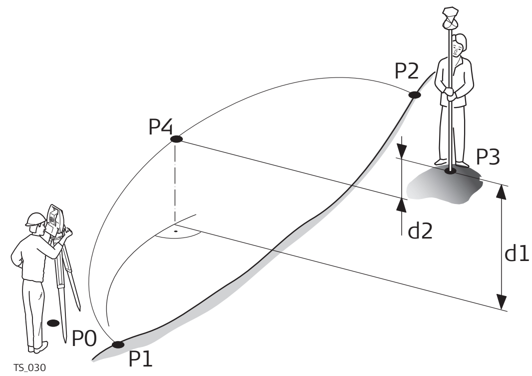
P0 Instrument station
P1 Start point
P2 End point
P3 Measured point
P4 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Line dist to end**
d4 **Dist to start point**
d5 **Dist to end point**

### Measure to line - arc segment - vertical measurements




GPS

P0 Start point
P1 End point
P2 Measured point
P3 Reference point
d1 Δ **height**
d2 **Line height diff**




TPS

P0 Instrument station
P1 Start point
P2 End point
P3 Measured point
P4 Reference point
d1 Δ **height**
d2 **Line height diff**

---

☞ **Design point outside the range of the selected element:**

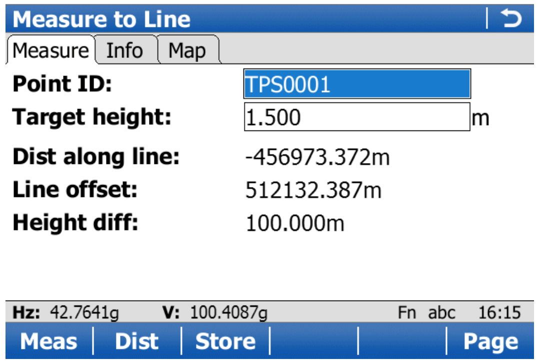
When measuring outside of the defined lines, lines and arcs are extended in a straight projection tangent to the start/end of the line. For **Heights to use**: **From line**, the start/end grade of the line is also extended. A warning appears when this is the case.

When working with segments, the same extension rules are applicable to the selected segment beyond its limits. For lines imported from a road alignment, heights are not extended outside the segment.

---

**Measure to Line, Measure page**

An additional page is available when a user-defined survey screen page is used.




| Key | Description |
|---|---|
| **Meas** | GPS To start measuring the point being staked. The key changes to **Stop**. The difference between the current position and the point being staked is still displayed.<br>TPS To measure a distance and store distance and angles. |
| **Stop** GPS | To end measuring the point being staked. When **Automatically stop point measurement** is checked in **Quality Control**, **General** page recording of positions ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. The key changes to **Store**. |
| **Store** | GPS To store the measured point. When **Automatically store point** is checked in **Quality Control**, **General** page, the measured point is stored automatically. The key changes to **Meas**.<br>TPS To store angles and distance. Distance must be measured before. |
| **Dist** TPS | To measure a distance. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Reference Line application. Available when **Meas** is displayed. Refer to "44.3 Configuring Reference Line". |
| Fn **Conect** and Fn<br>**Disco** GPS | To connect/disconnect from the GPS reference data. |
| Fn **Init..** GPS | To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "57.4 Initialisation for Real-Time Rover Operations". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list | The point ID of the point to be measured. |
| **Antenna height** | Editable field | GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **Target height** | Editable field | TPS The last used target height is suggested. An individual target height can be typed in. |
| **Chainage** | Display only | Chainage of the current position along the line. This value is the chainage of the start of the reference line plus **Dist along line**. |
| **Defined line dist** | Display only | Horizontal distance from the start point to the reference point along the reference line. |
| **Line offset** | Display only | Perpendicular offset from the reference line measured from the reference point to the measured point. |
| **Height diff** | Display only | Difference between measured height and design height. |

#### Next step

**Page** changes to the user definable **Info** page. Refer to "44.3 Configuring Reference Line" for information on all available items.

**Page** changes to the **Map** page. Displayed is

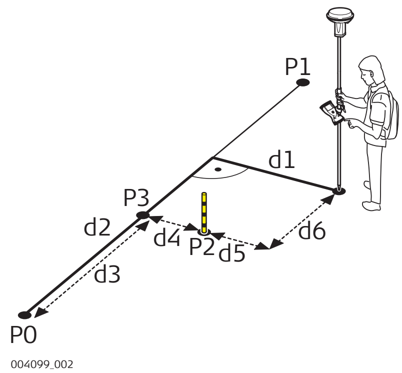
- the horizontal distance or chainage along the reference line from the start point to the reference point.
- the perpendicular offset from the reference line measured from the reference point to the measured point.
- the cut/fill value.

## 44.6 Staking to a Reference Line

**Description**

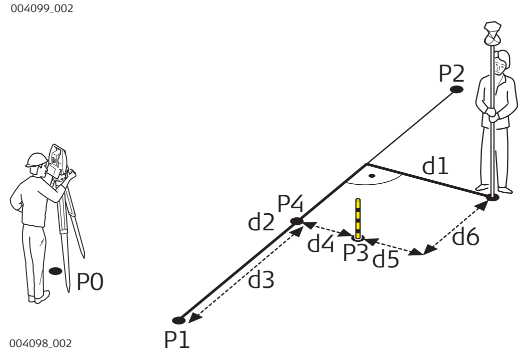
Allows for the position of a point to be defined relative to a reference line and then staked.

**Stake to line - horizontal measurements**




GPS

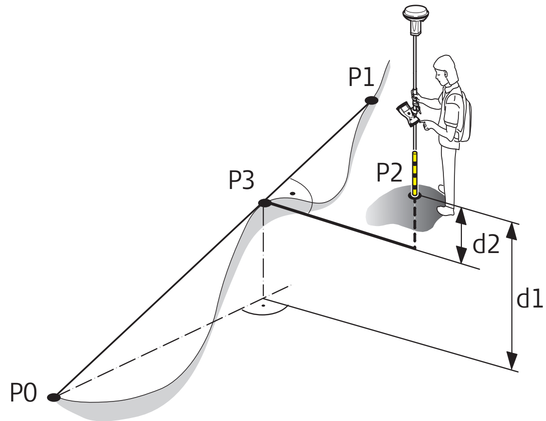
P0 Start point
P1 End point
P2 Design point
P3 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Defined line dist**
d4 **Defined offset**
d5 **Δ offset**
d6 **Δ dist along line**




TPS

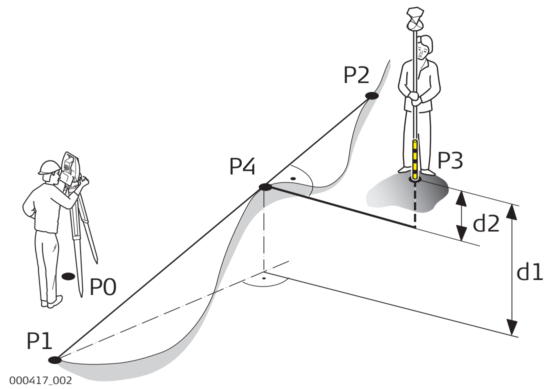
P0 Instrument station
P1 Start point
P2 End point
P3 Design point
P4 Reference point
d1 **Line offset**
d2 **Dist along line**
d3 **Defined line dist**
d4 **Defined offset**
d5 **Δ offset**
d6 **Δ dist along line**

### Stake to line - vertical measurements




GPS

P0 Start point
P1 End point
P2 Design point
P3 Reference point
d1 **Height offset**, for **Heights to use: Start point**
d2 **Height offset**, for **Heights to use: From line**

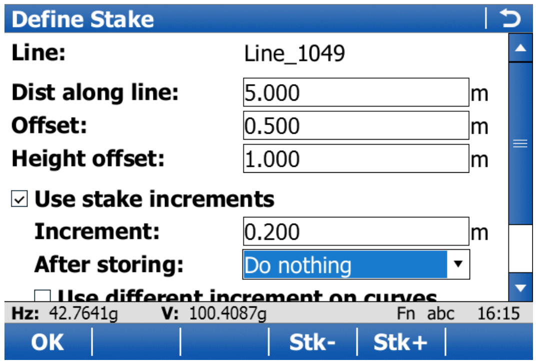



TPS

P0 Instrument station
P1 Start point
P2 End point
P3 Design point
P4 Reference point
d1 **Height offset**, for **Heights to use: Start point**
d2 **Height offset**, for **Heights to use: From line**

**Define Stake**

This screen is for typing in the stakeout values for a point relative to the reference line. The fields available depend on the options chosen in the **Configuration** screen.




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| **Stk-/Ch-** | To decrease the distance along line/the chainage by **Increment**. |
| **Stk+/Ch+** | To increase the distance along line/the chainage by **Increment**. |
| Fn **Config..** | To configure the Reference Line application. Refer to "44.3 Configuring Reference Line". |
| Fn **Report** | To view an alignment report. Refer to " Line Report, Points page". |
| Fn **Start** and Fn **End** | To change between the start point and the end point of the line. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line** | Display only | The name of the selected reference line. |
| **Start chainage** | Display only | The chainage of the start point of a reference line. |
| **Chainage** | Editable field | Chainage along the line. Define this value as chainage of the start of the reference line plus a distance along the line. |
| **Dist along line** | Editable field | Horizontal distance from the start point along the line to the design point. |
| **Offset** | Editable field | The offset from the reference line to the design point |
| **Height offset** | Display only | The height offset of the design point.<br>• For **Heights to use: Start point**<br>The height of the design point is calculated as the height of the start point plus **Height offset**.<br>• For **Heights to use: From line**<br>The height of the design point is calculated as the height of the reference point plus **Height offset**. |
| **Design height** | Editable field | • For **Heights to use: Manually enter**<br>The height of the design point is entered manually. |
| **Use stake incre-ments**/**Use chainage increments** | Check box | Activates the use of stake/chainage increments. |
| **After storing** | | Sets behaviour of the stake/chainage after a point is stored. |
| | **Do nothing** | Does not change the stake/chainage after a point is stored. |
| | **Move forwards** | Proceeds to the next point up stake/chainage after each stored staked point. |
| | **Move backwards** | Proceeds to the next point down stake/chainage after each stored staked point. |
| **Use different increment on curves** | Check box | Option to use a different chainage increment along a curve. |
| **Increment** | Editable field | Available when **Use different increment on curves** is checked. Chainage increment to be used along the small radius curve. |
| **Radius under** | Editable field | Available when **Use different increment on curves** is checked. Defines the threshold value of a small radius curve. For example, a curve with a radius smaller than this value, uses the chainage increment defined in the following field. |

**Next step**

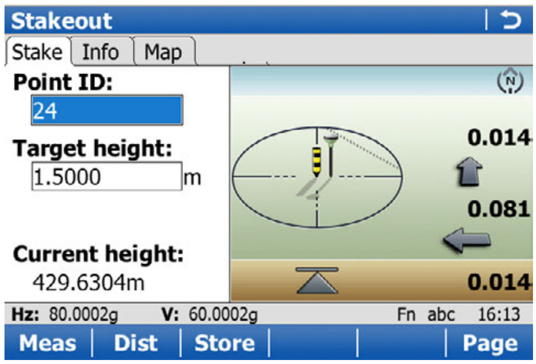
**OK** to accept changes and continue to **Stakeout**. Refer to "54.4 Staking Out".

**Stakeout, Stake page**

Once in the **Stakeout** screens, the user is guided to reach design positions.
The functionality of this screen is similar to the **Stakeout** screen. Differences between the two screens are outlined here. Refer to paragraph "54.4 Staking Out" for all other key and field explanations.

In the title bar is a description of where the stake point is on the alignment. This description can come from the position of the defined stake point someway along the line or a point of interestion. For points of interest refer to "Points of interest".

The availability of the fields depends on the configuration in **Configuration**, **General** page.




| Key | Description |
|---|---|
| **Stk-/Ch-** | To decrease the distance along line/the chainage by **Increment**. |
| **Stk+/Ch+** | To increase the distance along line/the chainage by **Increment**. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1.1 Accessing ID Template Configuration". |

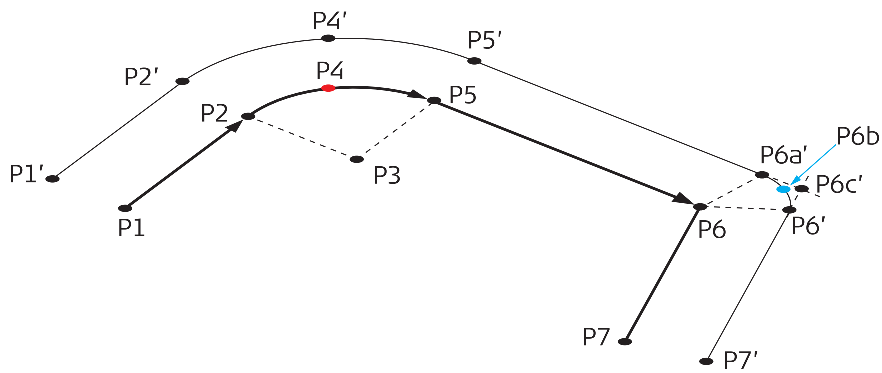
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The point ID of the point to be staked. |
| **Target height** | Editable field | TPS The last used target height as defined is suggested. An individual target height can be typed in. |
| **Antenna ht** | Editable field | GPS The default antenna height as defined in the active working style is suggested. |
| **Ch** | Editable field | The current chainage to be staked. |
| **Off** | Editable field | Current offset being staked. |
| **Current height** | Display only | Measured elevation. The orthometric height of the current position is displayed. |
| **Design height** | Editable field | Design elevation. The orthometric height of the point to be staked is displayed. |

**Next step**
**Page** changes to the **Results** page, if configured.

**Points of interest**

Points of interest are staked out if they appear within the defined **Ch-**/**Ch+**/**Stk-**/**Stk+** range and if checked in **Configuration**, **Design** page. Refer to "Configuration, Design page".



000262_002

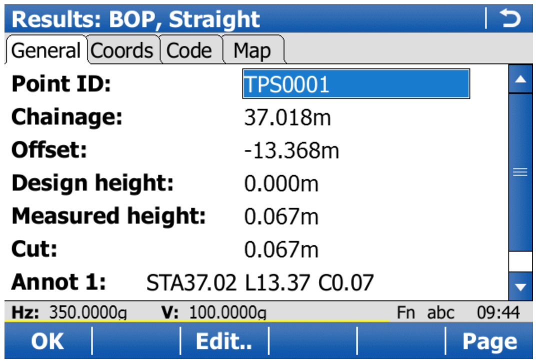
| On the original line: | On the offseted line: |
|---|---|
| P1 BOP - Beginning of project | P1' Offset BOP - Beginning of project |
| P2 PC - Beginning of curve | P2' Offset PC - Beginning of curve |
| P3 RP - Radius point of the centre of the curve | |
| P4 MCP - Mid point curve | P4' Offset MCP - Mid point curve |
| P5 PT - End of curve section - Start of straight segment | P5' Offset PT - End of curve section - Start of straight segment |
| P6 AP - Angle point | P6' AP-F - Offset angle point projected to the next segment |
| | P6a' AP-B - Offset angle point projected to the previous segment |
| | P6b' AVG - Offset in average direction |
| | P6c' BP - Offset bisected point |
| P7 EOP - End of project | P7' EOP - End of project |

General terms:

- Curve - Along a curve section
- Extension - Along an extended part of the line
- Curve mid point - Mid curve point
- Straight - Along a straight section
- VPI - Vertical interesection point
- Offset PI avg - Offset intersection point average element

**Results, General page**

If **View results page after staking a point** is checked in **Configuration**, **General** page, this screen opens automatically once a point is measured and stored.




| Key | Description |
|---|---|
| **OK** | To return to the stake screen. |
| **Edit..** | To add a vertical offset to the design height and to display the new height. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The point ID of the point staked. |
| **Chainage** | Display only | The chainage measured at the stored point. |
| **Offset** | Display only | The offset from the alignment measured at the stored point. |
| **Design height** | Display only | The entered design elevation. |
| **Measured height** | Display only | The height measured at the stored point. |
| **Cut/Fill** | Display only | The height difference between the **Design height** and the **Measured height**. |
| **Annot 1** | Display only | Fixed value recorded for certain software packages. |
| **Annot 2** to **Annot 4** | Editable field | Available for additional notes. |

### Next step

**Page** changes to the **Coords** page. This page displays the design coordinates as well as the differences between design and measured coordinates.

**Page** changes to the **Code** where codes can be selected or typed in.

**Page** changes to the **Map** page. This page provides an interactive display of the data.

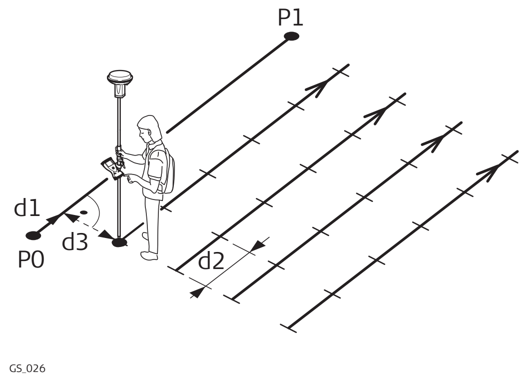
# 44.7 Gridstaking to a Reference Line

**Description**

A grid can be defined relative to a reference line and points staked out in that defined grid.

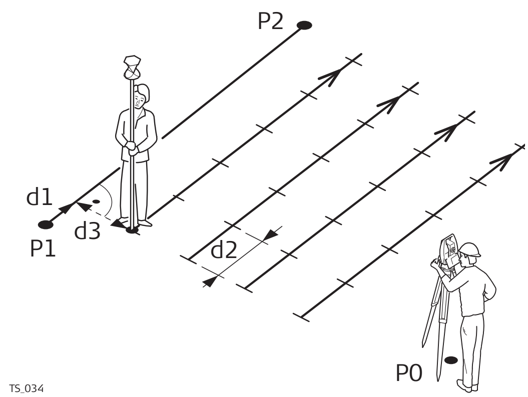
**Stake grid from line**

**In same direction**




GPS

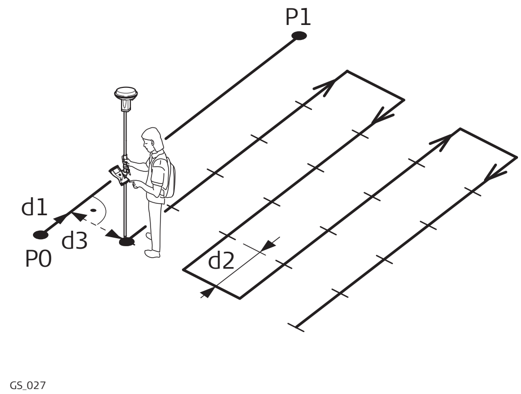
| | |
|---|---|
| P0 | Start point |
| P1 | End point |
| d1 | **Distance along line to first grid point** |
| d2 | Grid spacing along line |
| d3 | Grid spacing across line |




TPS

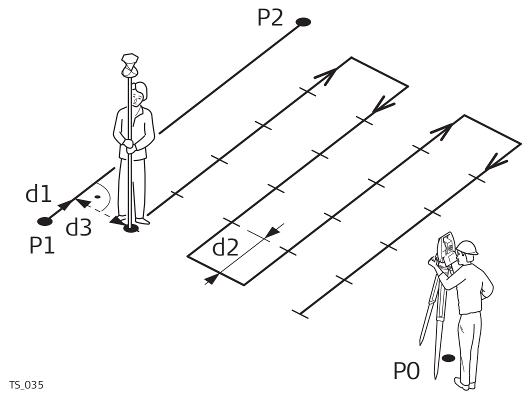
| | |
|---|---|
| P0 | Instrument station |
| P1 | Start point |
| P2 | End point |
| d1 | **Distance along line to first grid point** |
| d2 | Grid spacing along line |
| d3 | Grid spacing across line |

**In reverse direction**




GPS

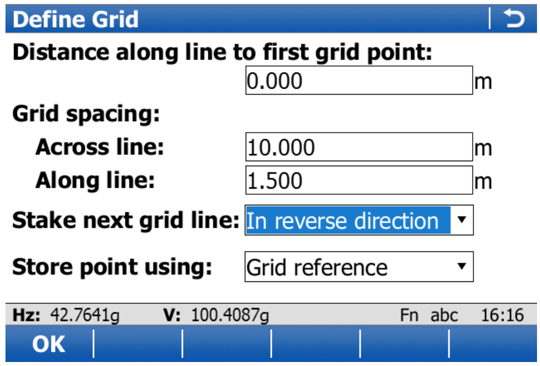
P0 Start point
P1 End point
d1 **Distance along line to first grid point**
d2 Grid spacing along line
d3 Grid spacing across line




TPS

P0 Instrument station
P1 Start point
P2 End point
d1 **Distance along line to first grid point**
d2 Grid spacing along line
d3 Grid spacing across line

## Define Grid




| Key | Description |
|---|---|
| **OK** | To confirm the selections and to continue with the subsequent screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

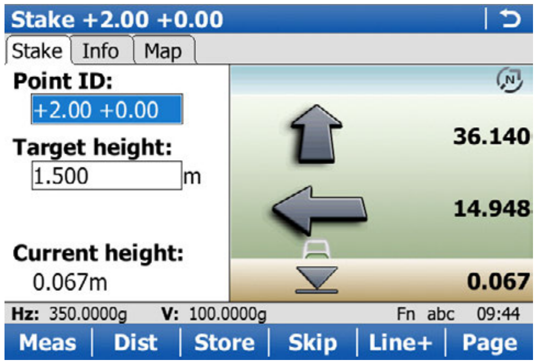
| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | Chainage of the first design point to be staked along the line. |
| **Across line** | Editable field | Spacing between grid lines. |
| **Along line** | Editable field | Spacing between points on the grid line. |
| **Stake next grid line** | | Method by which the grid will be staked out. |
| | **In same direction** | Each new grid line is started at the same end as where the previous grid line started. |
| | **In reverse direction** | Each new grid line is started at the same end as where the previous grid line finished. |
| **Store point using** | | Determines the format of the point ID for grid points. |
| | **Grid reference** | Point ID is shown as the position of the grid being staked, where +yyy.yy is the chainage position along the grid line, and +xxx.xx is the grid line offset. |
| | **Pt ID template** | The point ID template as defined in the active working style is used. The point ID template can be defined in **Main Menu: User\Work settings**. |

### Next step

**OK** to accept changes and continue to the stakeout screen.

**Stake +yyy.yy +xxx.xx**

The title of this screen indicates the position of the grid being staked, where +yyy.yy is the chainage position along the grid line, and +xxx.xx is the grid line offset.
The functionality of this screen is similar to the **Stakeout** screen. Differences between the two screens are outlined here. Refer to paragraph "54.4 Staking Out" for all other key and field explanations.




| Key | Description |
|---|---|
| **Skip** | To skip the currently displayed chainage and increment to the next chainage. Available when **Meas** is displayed. |
| **Line+** | To start staking the next grid line. Moves grid stake point to the next line (right) in the grid. There is no automatic **Line+** when the end of the line is reached. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| First field on the screen | Editable field | The point ID of the grid point to be staked. The point ID is based on the selection for **Store point using** in **Define Grid**. If a different point ID is typed in, the next point ID will still be shown as the next automatically computed point ID. |
| **Target height** | Editable field | TPS The last used target height as defined is suggested. An individual target height can be typed in. |
| **Antenna ht** | Editable field | GPS The default antenna height as defined in the active working style is suggested. |
| **Current height** | Display only | Measured elevation. The orthometric height of the current position is displayed. |
| **Design height** | Editable field | Design elevation. The orthometric height of the point to be staked is displayed. |

**Next step**

**Page** changes to the **Map** page. Displayed is

- the horizontal distance from the current position to the point to be staked.
- the height difference from the height of the current position to the height of the point to be staked.

# 45 Reference Plane & Grid Scan

## 45.1 Overview

**Description**

The Reference Plane & Grid Scan application can be used to measure points relative to a reference plane.

TPS Any surface can also be grid scanned. It is possible to measure either a regular grid on a predefined reference plane or any surface with an angle based resolution.

**Reference Plane & Grid Scan tasks**

The Reference Plane & Grid Scan application can be used for the following tasks:

- Measuring points to calculate and store the perpendicular distance to the plane.
- Viewing and storing the instrument and/or local coordinates of the measured points.
- Viewing and storing the height difference from the measured points to the plane.
- TPS Grid Scan a defined area on a predefined reference plane with a regular grid or on any surface with an angle based resolution.

☞ Planes can only be computed with grid coordinates.

☞ TPS Face scan is available for instruments with reflectorless EDM.

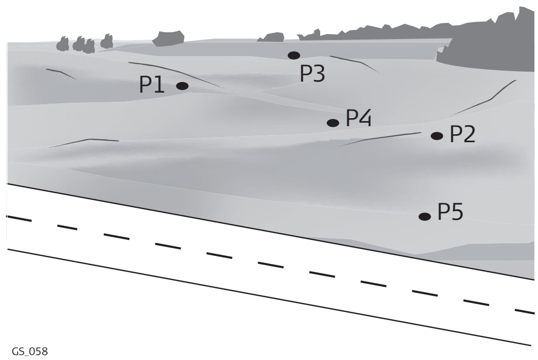
**Activating the application**

The Reference Plane & Grid Scan application must be activated via a licence key. Refer to "30.3 Load licence keys" for information on how to activate the application.

**Defining a reference plane**

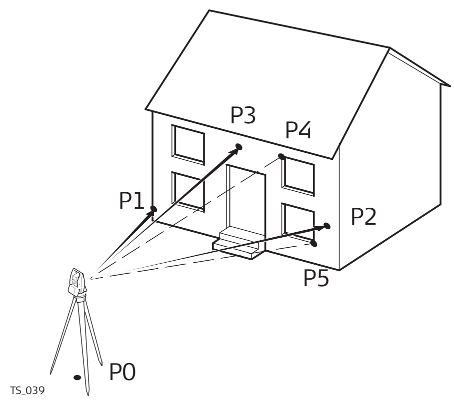
Reference planes are created using a right hand system. For two points defining a plane, a vertical plane is used. A reference plane is defined with the X axis and the Z axis of the plane. The Y axis of the plane defines the positive direction of the plane. A reference plane can be defined in the following ways:

- vertical
- tilted
- horizontal




GPS

P1 Point defining reference plane
P2 Point defining reference plane
P3 Point defining reference plane
P4 Point defining reference plane
P5 Point defining reference plane




TPS

P0 Instrument station
P1 Point defining reference plane
P2 Point defining reference plane
P3 Point defining reference plane
P4 Measured point
P5 Measured point

☞

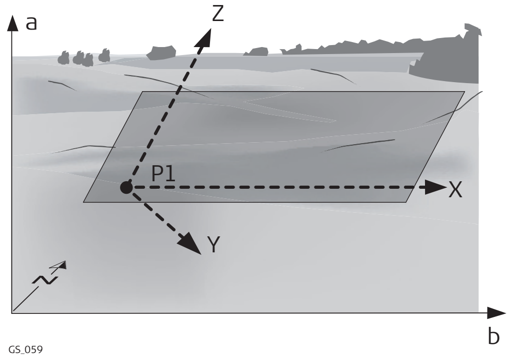
- GPS **Measure to plane** is applicable for tilted and horizontal plane definitions.
- TPS **Measure to plane** and **Grid scan on plane** is applicable for tilted and horizontal plane definitions.

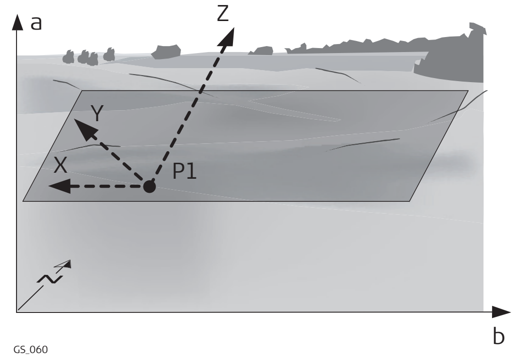
## Tilted plane

Any number of points define the plane. The axes of the tilted reference plane are:

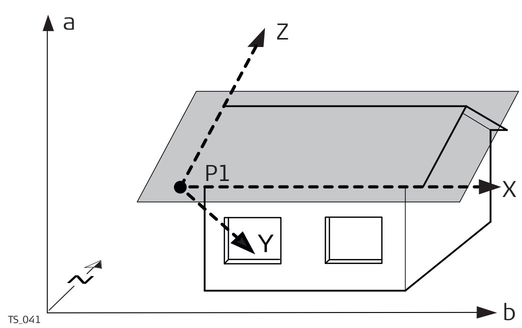
| | |
|---|---|
| X axis: | Horizontal and parallel to the plane |
| Z axis: | Defined by steepest direction of the plane |
| Y axis: | Perpendicular to the plane; increases in the direction as defined |
| ☞ | Offsets are applied in the direction of the Y axis. |

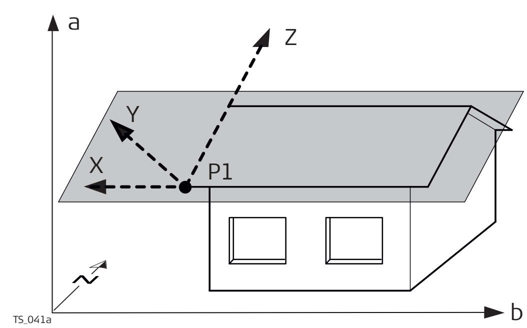
For GPS:




For TPS:



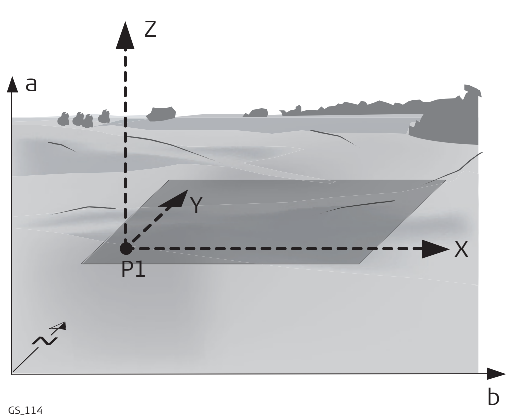

a Height
b Easting
N Northing
P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

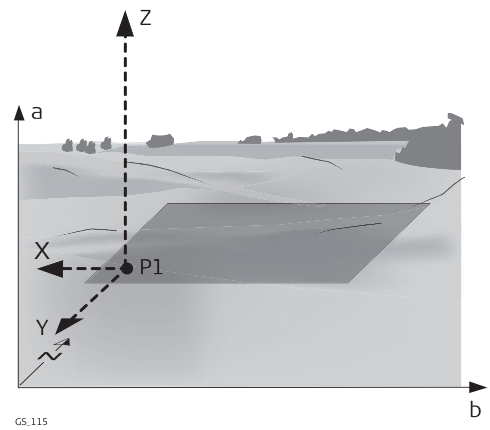
**Horizontal plane**

The axes of the horizontal reference plane are:

| | |
|---|---|
| X axis: | Horizontal and parallel to the plane |
| Z axis: | Perpendicular to the plane; increases in the direction as defined |
| Y axis: | Parallel to the plane |
| ☞ | Offsets are applied in the direction of the Z axis. |

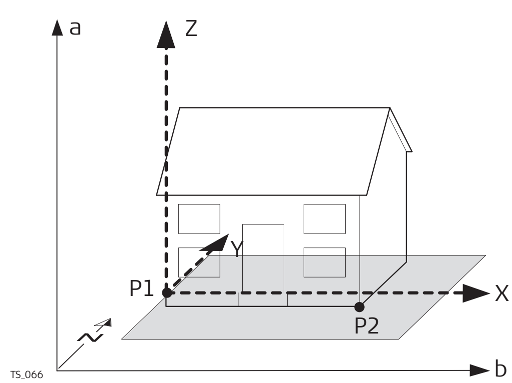
For GPS:

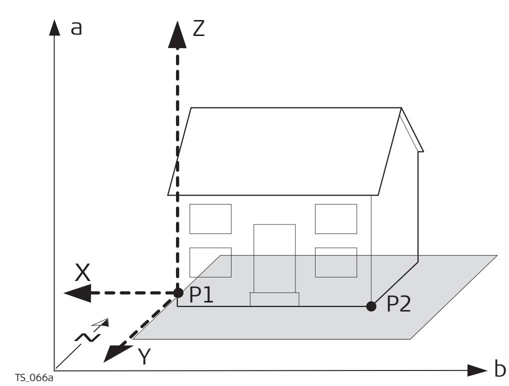



a Height
b Easting
N Northing
P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

For TPS:



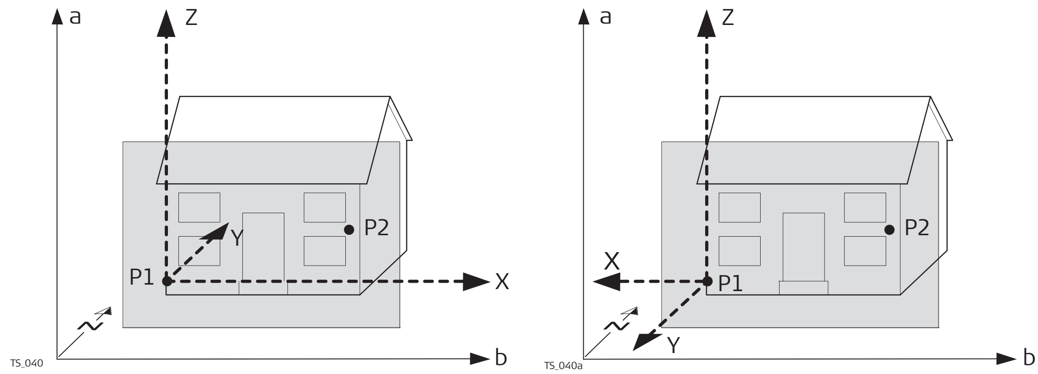




a Height
b Easting
N Northing
P1 Origin of plane
P2 Point of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

**Vertical plane** TPS

The axes of the vertical reference plane are:

| | |
|---|---|
| X axis: | Horizontal and parallel to the plane; X axis starts in point defined as origin point |
| Z axis: | Parallel to the instrument zenith and parallel to the plane |
| Y axis: | Perpendicular to the plane; increases in the direction as defined |
| ☞ | Offsets are applied in the direction of the Y axis. |




a Height
b Easting
N Northing
P1 Origin of plane
P2 Point of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

☞ With four or more points, a least squares adjustment is calculated resulting in a best fit plane.

**Origin**

The origin of the reference plane can be defined to be in the plane coordinates or in relation to the national coordinate system.

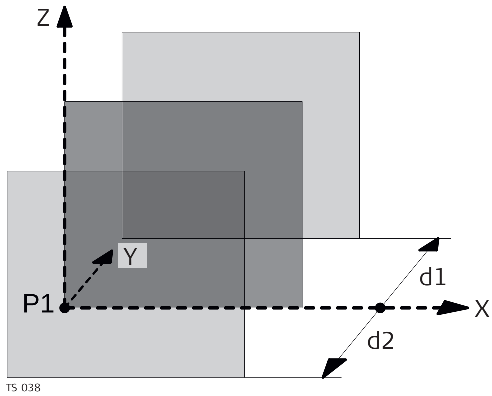
**Grid orientation**

The orientation of the grid is part of a reference plane. The orientation is defined during the reference plane definition and can be changed when editing a reference plane.

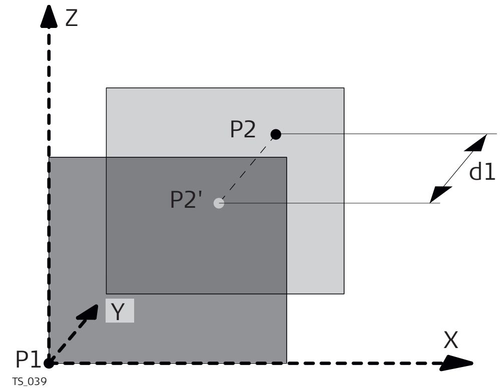
**Positive direction of plane**

The positive direction of the plane is defined by the direction of the Y axis. The direction of the Y axis can be redefined by selecting a point on the desired side of the plane.

**Offset of the plane**




P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane
d1 Positive offset
d2 Negative offset



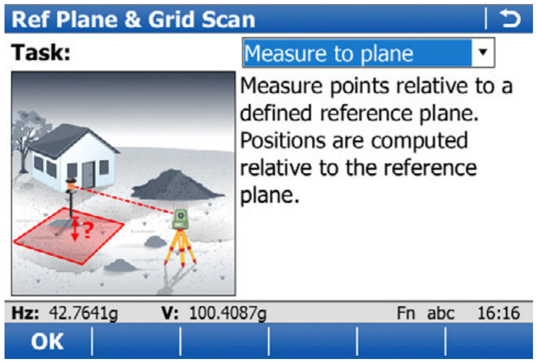

P1 Origin of plane
P2 Point defining offset of plane
P2' P2 projected on original plane
d1 Offset defined by P2
X X axis of plane
Y Y axis of plane
Z Z axis of plane

# 45.2 Accessing Reference Plane & Grid Scan

**Access**

Select **Main Menu: Go to Work!\ Survey+\ Ref plane & grid scan**.

**Ref Plane & Grid Scan**




| Key | Description |
|---|---|
| **OK** | To accept changes and to continue with the subsequent screen. |
| Fn **Config..** | To configure the reference plane. Refer to "45.5 Configuring Reference Plane & Grid Scan". |
| Fn **Quit** | To exit the application. |

**Description of the Reference Plane & Grid Scan tasks**

| Task | Description |
|---|---|
| **Measure to plane** | The coordinates of measured points are calculated relative to the reference plane. |
| **Grid scan on plane** | TPS Measures a regular grid on a defined reference plane within a defined area. |
| **Grid scan on surface** | TPS Measures any surface within a defined area. |

**Next step**

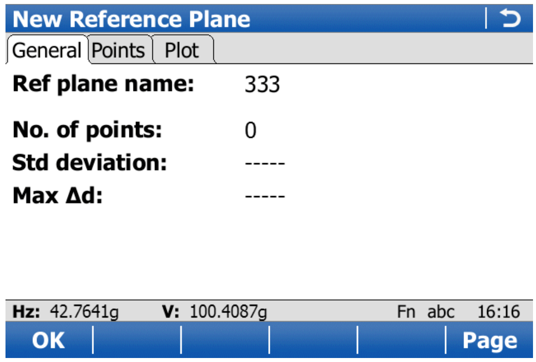
| IF | THEN |
|---|---|
| **Task**: **Measure to plane** or **Grid scan on plane** | **OK**.<br>• To create a new plane by measuring points, enter a name for the reference plane. New points can be measured by starting the Survey application.<br>• To create a new plane from previously stored points, enter a name for the reference plane. Refer to "45.3 Creating a Reference Plane From Previously Stored Points".<br>• For selecting an existing reference plane from a job, refer to "45.4 Selecting a Reference Plane from a Job". Only available when a reference plane has already been stored in the actual working job. |
| **Task**: **Grid scan on surface** | **OK** accesses **Define Grid Scan Area**. Refer to "45.9 Grid Scan on Surface". |

## 45.3 Creating a Reference Plane From Previously Stored Points

**Access**

In **Ref Plane & Grid Scan**, select **Create a new plane from previously stored points**. Press **OK**.

**New Reference Plane, General page**




| Key | Description |
| --- | --- |
| **OK** | To continue to the next screen. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

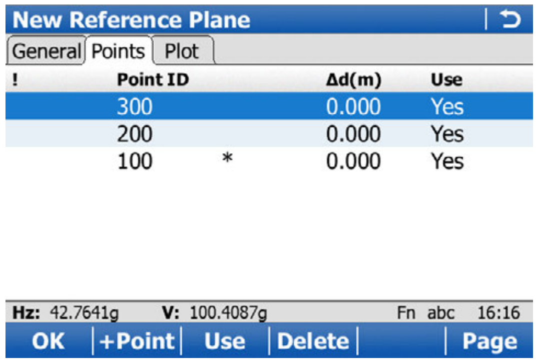
| Field | Option | Description |
| --- | --- | --- |
| **Ref plane name** | Display only | The name of the new reference plane. |
| **No. of points** | Display only | Number of points used for plane definition. |
| **Std deviation** | Display only | Standard deviation of used points for plane definition. **-----** is displayed unless more than four points are used to define the plane. |
| **Max** $\Delta$**d** | Display only | Maximum distance between measured point and defined plane. **-----** is displayed unless more than four points are used to define the plane. |

**Next step**

**Page** changes to the **Points** page.

**New Reference Plane, Points page**

- ***** is shown to the right of the point for a point which will be used as origin of the plane.
- **!** is shown to the left of the point if the point is outside maximum distance between a point and the calculated plane as defined on the **General** page.
- The column **Δd** displays the perpendicular distance of the point from the definition of the plane.




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| **+Point** | To add points from the working job to define the reference plane. Available when creating a new plane from previously stored points. |
| **Use** | To change between **Yes** and **No** in the **Use** for the highlighted point. |
| **Delete** | To remove the highlighted point from the list. |
| **Survy..** | To measure a point to be used for the plane. Available when creating a new plane by measuring new points. |
| **Page** | To change to another page on this screen. |
| Fn **Origin** | To use the highlighted point as the origin of the plane. |
| Fn **Quit** | To exit the application. |

**Next step**
**Page** changes to the **Plot** page.

**New Reference Plane, Plot page**

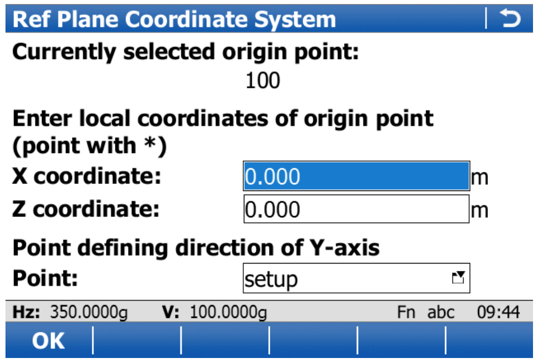
Points displayed depend on the settings in **Configuration**, **Parameters** page. Points defining the plane are displayed in black, the other points are displayed in grey.

Select the  icon to change between the face view and the plan view of the plane.

**Next step**
**OK** changes to the **Ref Plane Coordinate System**.

**Ref Plane Coordinate System**

This screen is displayed if **Use local plane coordinate system** is checked in **Configuration**, **Parameters** page.




| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **Survy..** | Available when **Point** is highlighted. To measure a point to define the plane direction. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Currently selected origin point** | Display only | Point which has been selected as origin point. To change the origin point, press ESC and Fn **Origin**. |
| **X coordinate** | Editable field | Enter local X coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| **Z coordinate** | Editable field | Enter local Z coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| **Point** | Selectable list | Defines the direction of the Y axis. |

**Ref Plane Grid Orientation**

Choose how you want to define the grid orientation on the reference plane.

| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| Fn **Quit** | To exit the application. |

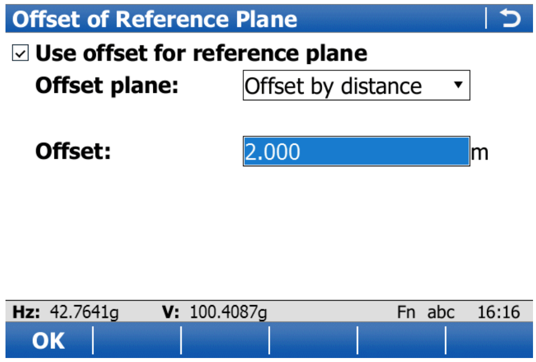
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Currently selected origin point** | Display only | Point which has been selected as origin point. To change the origin point, return to the previous screen and press ESC and Fn **Origin**. |
| **Use the fall line of the reference plane** | Check box | The fall line is the line of greatest slope. The fall line is a curve following the steepest slope. It is always orthogonal to the contour lines. Mathematically it is determined by the gradient of the height. |
| **Select a point of the reference plane besides the origin point** | Check box | The orientation is defined by the origin point and another point on the reference plane. |
| **Orientation Point** | Selectable list | The point which defines the orientation together with the origin point. |

### Next step

**OK** changes to the **Offset of Reference Plane**.

## Offset of Reference Plane




| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **Survy..** | Available when **Offset pt ID** is highlighted. To measure a point to define the offset point. |
| Fn **Quit** | To exit the application. |

### Description of fields

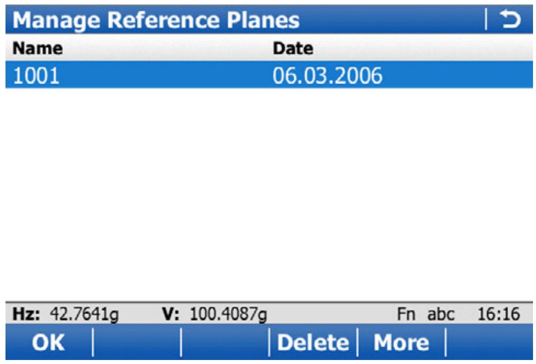
| Field | Option | Description |
|---|---|---|
| **Offset plane** | Selectable list | An offset can be defined by a point or a distance. The defined plane is shifted along the Y axis by the offset. |
| **Offset pt ID** | Selectable list | Available for **Offset plane: Offset to a point**. Point ID of offset point. |
| **Offset** | Display only or editable field | Distance by which to offset the plane along the Y axis.<br>For **Offset plane: Offset by distance**, the distance can be entered.<br>For **Offset plane: Offset to a point**, the calculated distance to the adjusted plane is displayed. **-----** if no values are available. |

# 45.4 Selecting a Reference Plane from a Job

**Access**

In **Ref Plane & Grid Scan**, select **Create a new surface from previously stored points**. Press **OK**. Highlight **Ref plane name**. Press ENTER.
Available if a reference plane has already been stored in the actual working job.

**Manage Reference Planes**




| Key | Description |
|---|---|
| **OK** | To select the highlighted reference plane. |
| **Delete** | To delete the highlighted reference plane. |
| **More** | To display information about date and time of when the reference plane was created and the number of points defining the plane. |
| Fn **Quit** | To exit the application. |

## 45.5 Configuring Reference Plane & Grid Scan

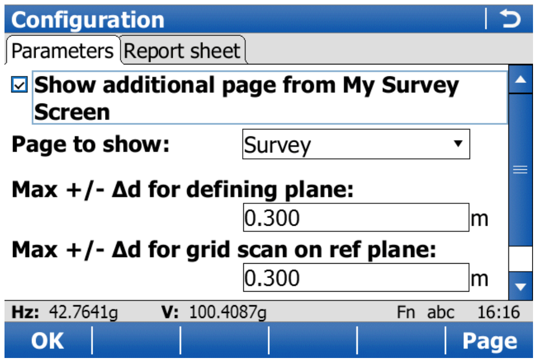
**Description**

Allows options to be set which are used within the Reference Plane & Grid Scan application. These settings are stored within the working style.

**Access**

Select **Main Menu: Go to Work!\ Survey+\ Ref plane & grid scan**. Press Fn **Config..**.

**Configuration, Parameters page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Config..** | To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "25.3 My Survey Screen". |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Page to show** | Selectable list | The names of the available survey screen pages. |
| **Max +/- Δd for defining plane** | Editable field | The maximum perpendicular deviation of a point from the calculated plane. |
| **Max +/- Δd for grid scan on ref plane** | Editable field | TPS The maximum perpendicular deviation of a measured point in grid scan on plane from defined plane. Measured points outside the defined limit are not stored. |
| **Display** | | This parameter defines the points displayed in the Plot and Map pages of the Reference Plane & Grid Scan application in the plan view. |
| | **All points** | Displays all points in the plan view. |
| | **Points within slice** | Displays points within the defined **Slice width** in the plan view. |
| **Slice width** | Editable field | Available for **Display: Points within slice**.<br>This parameter defines the distance from the plane in which points are displayed. This distance is applied to both sides of the plane. If lines and areas are displayed in a Map page, then the parts of lines and areas that fall within the defined slice are also displayed. |
| **Use local plane coordinate system** | Check box | When this box is checked, then point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system. The screen **Ref Plane Coordinate System** is displayed in the reference plane definition workflow. Local coordinates and the positive direction of the reference plane can be defined.<br>When this box is not checked, then points on the plane are transformed into the global coordinate system. |

#### Next step

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

**Page** changes to the first page on this screen.

## 45.6 Editing a Reference Plane

**Access**

After creating or selecting a reference plane, select **Edit Reference Plane** in **Measure to Plane** or **Grid Scan on Reference Plane**.

**Edit Reference Plane, General page**

| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Ref plane name** | Editable field | The name of the reference plane. |
| **No. of points** | Display only | Number of points used for plane definition. |
| **Std deviation** | Display only | Standard deviation of used points for plane definition. **-----** is displayed unless more than four points are used to define the plane. |
| **Max Δd** | Display only | Maximum distance between measured point and defined plane. **-----** is displayed unless more than four points are used to define the plane. |

**Next step**

**Page** changes to the **Points** page.

**Edit Reference Plane, Points page**

- ***** is shown to the right of the point for a point which will be used as origin of the plane.
- **!** is shown to the left of the point if the point is outside maximum distance between a point and the calculated plane as defined on the **General** page.
- The column **Δd** displays the perpendicular distance of the point from the definition of the plane.

| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **+Point** | To add points from the working job to define the reference plane. |
| **Use** | To change between **Yes** and **No** in the **Use** for the highlighted point. |
| **Delete** | To remove the highlighted point from the list. |
| **Survy..** | To measure a point to be used for the plane. |
| **Page** | To change to another page on this screen. |
| Fn **Origin** | To use the highlighted point as the origin of the plane. |
| Fn **Quit** | To exit the application. |

**Next step**

**Page** changes to the **Origin** page.

**Edit Reference Plane, Origin page**

| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **Survy..** | Available when **Point** is highlighted. To measure a point to define the plane direction. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use local plane coordinate system** | Check box | When this box is checked, then point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system. When this box is not checked, then points on the plane are transformed into the global coordinate system. |
| **Currently selected origin point** | Display only | The point which has been selected as origin point. To change the origin point, change to the **Points** page and Fn **Origin**. Set the highlighted point as the origin point. |
| **X coordinate** | Editable field | Enter local X coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| **Z coordinate** | Editable field | Enter local Z coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| **Point** | Selectable list | Defines the direction of the Y axis. |

### Next step

**Page** changes to the **Offset** page.

**Edit Reference Plane, Offset page**

| Key | Description |
|---|---|
| **OK** | To compute and store the reference plane. |
| **Survy..** | Available when **Offset pt ID** is highlighted. To measure a point to define the offset point. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use offset for reference plane** | Check box | When this box is checked, an offset can be defined for the reference plane. |
| **Offset plane** | Selectable list | An offset can be defined by a point or a distance. The defined plane is shifted along the Y axis by the offset. |
| **Offset pt ID** | Selectable list | Available for **Offset plane: Offset to a point**. Point ID of offset point. |
| **Offset** | Display only or editable field | Distance by which to offset the plane along the Y axis.<br>For **Offset plane: Offset by distance**, the distance can be entered.<br>For **Offset plane: Offset to a point**, the calculated distance to the adjusted plane is displayed. **-----** if no values are available. |

### Next step

**Page** changes to the **Plot** page.

**Edit Reference Plane, Plot page**

Points displayed depend on the settings in **Configuration**, **Parameters** page. Points defining the plane are displayed in black, the other points are displayed in grey.

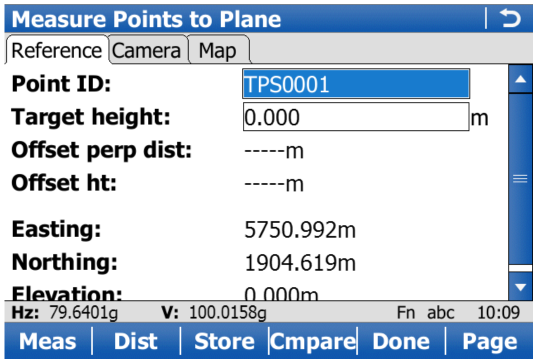
Select the icon to change between the face view and the plan view of the plane.

## 45.7 Measuring Points to a Reference Plane

**Access**

After creating or selecting a reference plane, select **Measure to plane** in **Measure to Plane**.

**Measure Points to Plane, Reference page**




| Key | Description |
|---|---|
| **Meas** GPS | To start measuring the point. The key changes to **Stop**. The difference between the current position and the adjusted plane is displayed. |
| **Stop** GPS | To end measuring the point. The key changes to **Store**. After ending the measurement, the differences between the measured point and the adjusted plane are displayed. |
| **Meas** TPS | To measure a distance and store distance and angles. |
| **Dist** TPS | To measure a distance. |
| **Store** | To store the point information. |
| **Cmpare** | To calculate offsets to previously measured points. |
| **Plane** | To edit the selected reference plane. |
| **Page** | To change to another page on this screen. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The number of the measured point. |
| **Target height** | Editable field | TPS The target height. |
| **Antenna height** | Editable field | GPS The height of the antenna. |
| **Offset perp dist** | Display only | The perpendicular distance between the measured point and the adjusted plane. |
| **Offset ht** | Display only | The vertical distance between the measured point and the adjusted plane. |
| **X coordinate**, **Y coordinate**, **Z coordinate** | Display only | For **Use local plane coordinate system** checked in **Configuration**, **Parameters** page. |
| **Easting**, Northing, **Elevation** | Display only | For **Use local plane coordinate system** not checked in **Configuration**, **Parameters** page. |

### Next step

**Page** changes to the **Map** page.

Select the  icon to change between the face view and the plan view of the plane.

## 45.8 Grid Scan on Plane TPS

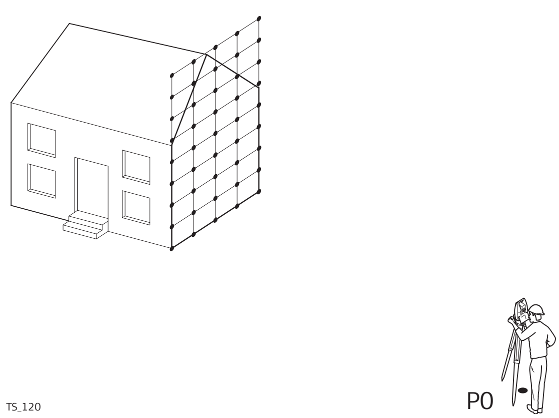
**Description**

Grid scan on plane automates the process of measuring a sequence of points along the defined vertical, tilted or horizontal reference plane. The window of interest can be either rectangular or polygonal. The boundaries of the window of interest and the increment values can be defined. Grid scan on plane can be run on instruments with the option "reflectorless EDM" only.

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | After creating or selecting a reference plane, select **Grid scan reference plane** in **Grid Scan on Reference Plane**. |
| 2. | Press **OK**. |
| 3. | Choose between:<br>• **Rectangular area**: Two opposite corner points define the rectangular grid scan area. The area must be defined from the first to the second point. Grid scan areas bigger than 180° are not allowed.<br>• **Polygonal area**: Three or more clockwise measured points define the polygonal grid scan area. The polygonal grid scan area is calculated based on the sequence of the points. Grid scan areas bigger than 180° are not allowed. |
| 4. | Press **OK**. |

**Diagram**




**Known**
P0 Station
**Unknown**
Grid point coordinates

**Measure corner**

For a rectangular grid scan area, measure two points at opposite corners.
For a polygonal grid scan area, measure all corner points in consecutive order.

| Key | Description |
|---|---|
| **OK** | To either measure another corner point of the grid scan area or to start grid scanning the area. |
| **Dist** | Available on the **Camera** page. To measure distances for displaying the fine-style crosshairs. |
| **Done** | For polygonal areas, this key appears for the first time after the third measured point. |
| **Cpture** | Available on the **Camera** page. To take an image with the current pixel resolution. The image is then displayed but not stored on the memory device yet. |
| Fn **Config..** | To configure what is displayed on the **Camera** page. Refer to "Camera View Settings, General page". |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |
| ESC | To delete the last measured point of the rectangular or polygonal grid scan area. This allows the remeasurement of scan area points. |

**Grid Scan Settings, Define grid spacing on the reference plane.**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Left / right** | Editable field | For tilted and vertical planes. Horizontal grid distance. |
| **Up / down** | Editable field | Up slope grid distance. |
| **Grid scan area** | Display only | Size of the grid scan area. |
| **Estimated points** | Display only | Estimated number of points to be grid scanned. >20'000 is shown for all resolution bigger than 20'000 points.<br>☞ It is not checked if all points from the scan resolution fall within the defined grid scan area. For more than 20'000 points, grid scanning the defined grid scan area with the selected resolution may take very long. |
| **Also measure the boundary of the defined scan area** | Check box | When this box is checked, the boundary of the grid scan area is also measured. |

**Grid Scan Settings, Define start point ID & increment.**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Start point** | Editable field | The point ID to start with. |
| **Increment** | Editable field | The incrementation used for **Start point**. No point ID template used<br>• For **Start point: RMS** and **Increment: 10** the points are RMS, RMS10, RMS20, ..., RMS100, ...<br>• For **Start point: 100** and **Increment: 10** the points are 100, 110, ..., 200, 210, ...<br>• For **Start point: abcdefghijklmn89** and **Increment: 10** the points are abcdefghijklmn99, point ID incrementing fails. |

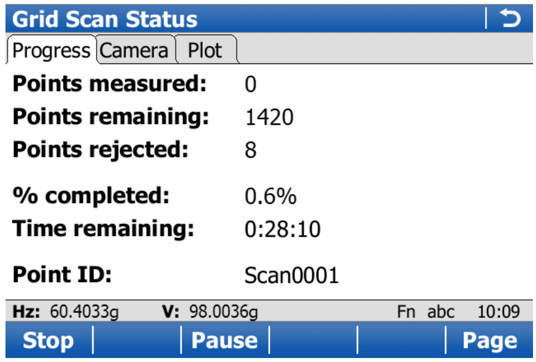
**Grid Scan Settings, Choose the grid scan mode to be used.**

This screen is only displayed for motorised instruments. For all other instrument types, the standard measurement mode is set.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Standard - accuracy & range optimised** | Check box | This measurement mode is accuracy and range optimized. It uses the reflectorless single distance measurement mode. |
| **Fast - speed & performance optimised** | Check box | Available for TS15. This measurement mode is speed and performance optimized. It uses the reflectorless continuous distance measurement mode. |

## Grid Scan Status, Progress page




| Key | Description |
|---|---|
| **Stop** | To stop the grid scanning of points. |
| **Pause** | To pause the grid scanning of points. |
| **Scan** | To continue grid scanning. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Points measured** | Display only | Number of points being measured. |
| **Points remaining** | Display only | Number of points remaining to be grid scanned. |
| **Points rejected** | Display only | Number of skipped points. |
| **% completed** | Display only | Percentage of points measured. |
| **Time left** | Display only | Estimated time remaining until grid scan is finished. |
| **Point ID** | Display only | Point ID of last stored point. |

### Next step

If the instrument has a camera and the camera functionality is activated, **Page** changes to the **Camera** page. Refer to "34 Camera & Imaging" for information on camera and imaging.

**Page** changes to the **Plot** page. Points currently scanned are displayed in black, previously measured points, lines and areas are displayed in grey.

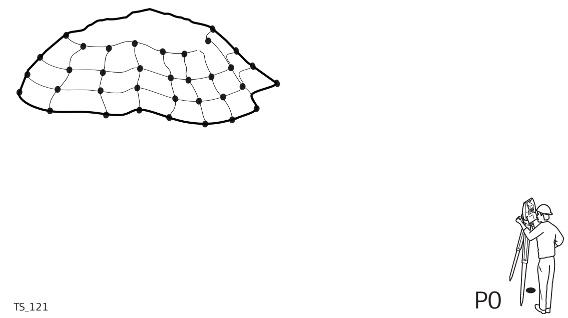
Select the  icon to change between the face view and the plan view of the plane.

## 45.9 Grid Scan on Surface TPS

**Description**

Grid Scan on Surface allows the measurement of a grid on any surface based on an angular resolution (constant delta horizontal and delta vertical values). No reference plane is required. The grid scan area can be either rectangular or polygonal. Optionally, the boundary of the grid scan area can be measured.
Grid Scan on Surface can be run on instruments with the option "reflectorless EDM" only.

**Diagram**



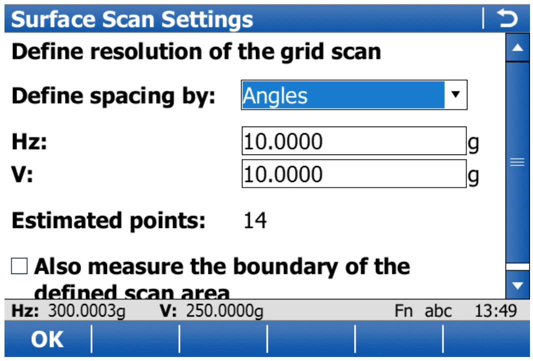

**Known**
P0 Station
**Unknown**
Grid point coordinates

**Access step-by-step**

| Step | Description |
|---|---|
| 1. | In **Ref Plane & Grid Scan**, select **Grid scan on surface**. |
| 2. | Press **OK**. |
| 3. | Choose between:<br>• **Rectangular area**: Two opposite corner points define the grid scan area. The area must be defined by pointing the instrument to opposite corners of the area. Grid scan areas bigger than 180° are allowed.<br>• **Polygonal area**: Three or more clockwise measured points define the grid scan area. The polygonal grid scan area is calcualated based on the sequence of the points. Grid scan areas bigger than 180° are allowed. |
| 4. | Press **OK**. |

☞ Most steps are identical with the steps for **Grid scan on plane**. Refer to "45.8 Grid Scan on Plane" for a description of the screens.

**Surface Scan Settings, Define grid scan spacing.**




| Key | Description |
|---|---|
| **OK** | To continue with the next screen. |
| **Dist** | Available when **Define spacing by**: **Distances** is selected.<br>To take a reflectorless distance measurement. The measured value is displayed in the **Horiz distance** field. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Define spacing by** | **Angles** | The scan resolution is defined by horizontal and vertical angle values. |
| | **Distances** | The scan resolution is defined by horizontal and vertical spacings at a certain range. |
| **Hz** and **V** | Editable field | Available for **Define spacing by**: **Angles**. The horizontal and vertical angle values defining the scan resolution. |
| **Horiz distance** | Editable field | Available for **Define spacing by**: **Distances**. The range for which the horizontal and vertical spacing are valid. |
| **Horizontal spacing** and **Vertical spacing** | Editable field | Available for **Define spacing by**: **Distances**. The horizontal and vertical spacing defining the scan resolution at the defined range. |
| **Also measure the boundary of the defined scan area** | Check box | When this box is checked, then the boundary of the grid scan area is also measured. |
| **Estimated points** | Display only | The number of points to be scanned according to the defined scan resolution.<br>**>20'000** is displayed for all scan resolution exceeding 20'000 points.<br>☞ It is not checked if all points from the scan resolution fall within the defined grid scan area. For more than 20'000 points, grid scanning the defined grid scan area with the selected resolution may take very long. |

# 46 Roads - General

## 46.1 Overview

☞ Please be aware that the terminology or workflow used on different construction sites can vary from the one used in this manual. However, basic principles remain the same.

**Description**

**Roads** is an umbrella term for four subapplications.

| Name of subapplication | Description |
|---|---|
| **Alignment Editor** | • Alignment Editor is an "add-on" component to the Roads application. It is only intended for quick and easy modification of existing alignments, or creation of new ones. Alignment Editor is not an onboard road planning and design application.<br>• This application supports the following alignment types:<br>  • Horizontal alignments<br>  • Vertical alignments<br>  • Cross section templates<br>  • Cross section assignments<br>  • Chainage equations<br>• This application is a free application provided by Leica Geosystems AG. If the application does not appear on your menu or you are otherwise unable to access it, please contact your Leica Geosystems AG representative. |
| **Roads** | • This subapplication allows the measuring and staking of roads and other alignments.<br>• It can be used with GPS and with total stations.<br>• It consists of two main functions:<br>  • **Roads - As built check** for checking or measuring existing lines, surface grade, slopes or surfaces and comparing the measurements against design data.<br>  • **Roads - Stakeout** for setting or staking out and adjusting road elements during construction using design data.<br>• The data can be typed in manually by using the Alignment Editor or data created in a design package can be converted. The **Import alignment data** application and the Design to Field component of Leica Geo Office offer converters from several road design and CAD packages. |
| **Rail** | • This subapplication allows the measuring and staking of railways and other alignments.<br>• It can be used with GPS and with total stations.<br>• It consists of two main functions:<br>  • **Rail - As built check** for checking or measuring an existing track and comparing the measurements against design data.<br>  • **Rail - Stakeout** for setting or staking out and adjusting track features during construction using design data. |

| Name of subapplication | Description |
|---|---|
| | • Single track or multiple track designs can be imported for use with this application.<br>  • For horizontal and vertical alignments, the data can be typed in manually by using the Alignment Editor application or data created in a design package can be converted.<br>  • For multiple track designs, it is possible to define one centreline which is common to all tracks.<br>• A superelevation table can be created for each track using the Rail Editor computer application. This application is part of the Design to Field component in Leica Geo Office. |
| **Tunnel** TPS | • This subapplication allows the measuring and staking of tunnels.<br>• It is for use with total stations only.<br>• It consists of two main functions:<br>  • **Tunnel - As built check** for checking a built or excavated tunnel with a tunnel design.<br>  • **Tunnel - Stakeout** for setting out tunnel features during construction.<br>• The centreline of the tunnel can be imported for use onboard the instrument using the industry standard LandXML data format. Alternatively the centreline can be imported in formats exported from many other tunnel design packages using the Design to Field component of the Leica Geo Office.<br>• Tunnel design profiles can be created using the Tunnel Profile Editor computer application. This application is integrated into the Design to Field component in Leica Geo Office. |

☞ Roads, Rail and Tunnel subapplications are licence protected. They can be activated through a licence key which is specific to the instrument. This licence key can be entered either through **Main Menu**: **User\Tools & other utilities\Load licence keys** or alternatively, the first time the program is started.

# 46.2 Jobs & Design Data

## 46.2.1 Accessing Roads Applications

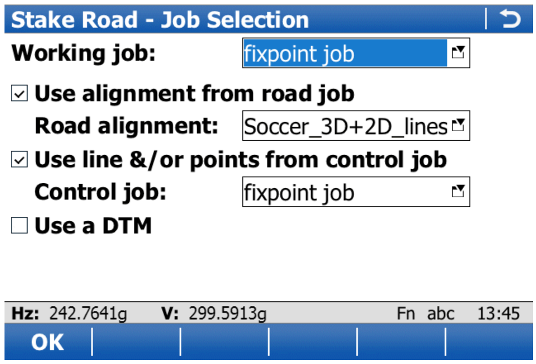
**Access**

Select **Main Menu**: **Go to Work!\Roads**.
Then select the subapplication required to access the job selection screen.

☞ For the **Alignment Editor**, refer to "47.2.1 Accessing Alignment Editor".

**Job selection**

When the application is resumed, the last active selections are remembered and can be accessed again. This ability means the settings do not need to be reselected every time after turning off the instrument.




| Key | Description |
|---|---|
| **OK** | To continue with the next screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

☞ The methods available in the **Define the Work to be Done** screen depend on the selected job types (road or control job). Refer to **Define the Work to be Done**.

| Field | Option | Description |
|---|---|---|
| **Working job** | Selectable list | Available for Road. The working job is the one data is stored to. If a CAD file is attached to this job and no **Control job** is used, then the CAD file is displayed in the background of **Map** pages. |
| **Use alignment from road job** | Check box | Available for Road. When this box is checked, a road alignment file can be selected. Contains all the information about the road design. For example, the geometry of the line, the formation layer of the road or the information related to the construction of cuttings and embankments. |
| **Road align-ment** | Selectable list | Available for Road. The files are stored in the \DBX folder or a subfolder of \DBX.<br>The data is either typed in manually in the Align-ment Editor application or converted from a road design package.<br>For tunnel projects, all road design information for road data outside of the tunnel must be stored in the road job.<br>The road job is a read-only source of information and cannot be selected as a working or control job. |

| Field | Option | Description |
|---|---|---|
| **Rail job** | Selectable list | Available for Rail. Contains all the information about the rail design including the geometry of the centreline and the rail definition (superelevation). The files are stored in the \DBX folder or a subfolder of \DBX.<br>The rail job is a read-only source of information and cannot be selected as a working or control job. |
| **Tunnel job** | Selectable list | Available for Tunnel. Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX.<br>The tunnel job is a read-only source of information. |
| **Use line &/or points from control job** | | When this box is checked, a control job can be selected. Individual lines and/or points of a control job can be staked out and set in relation to the alignment. |
| **Control job** | Selectable list | The control job is the one control points are stored in. The control job holds all control point information needed in the field, for example, control points, points with known coordinates used for a TPS setup. Lines of the control job can be used for **Roads - Stakeout** or **Roads - As built check**.<br>A CAD file attached to a control job can be used to view and import the CAD lines for working with. The CAD lines are viewable in any **Map** page of the Stake/Check screen. |
| **Use a DTM** | Check box | Available for Roads and Rail. When this box is checked, a DTM job can be selected. A DTM job holds DTM (Digital Terrain Model) or TIN (Triangular Irregular Network) data. The files are stored in the \DBX folder or a subfolder of \DBX. |
| **DTM** | Selectable list | Available for Roads and Rail. Holds DTM (**D**igital **T**errain **M**odel) data or TIN (**T**riangular **I**rregular **N**etwork) data. The DTM job to be used must be stored in the \DBX directory on the active memory device.<br>The DTM job is a read-only source of information and cannot be selected as a working or control job.<br>☞ If only a DTM job is selected, then only check measurements relative to the selected DTM layer can be done. |

**Next step**

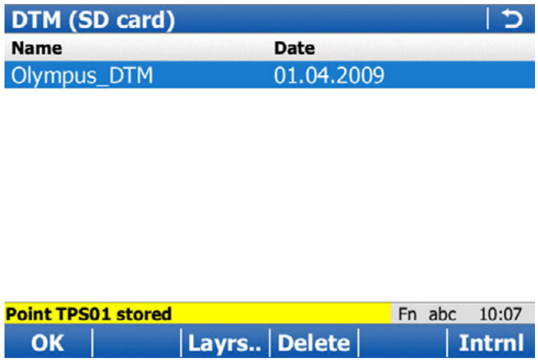
| IF you want to continue with | THEN refer to |
|---|---|
| configuration | "46.3 Configuring Roads Applications". |
| Roads | "48 Roads - Road". |
| Rail | "49 Roads - Rail". |
| Tunnel | "50 Roads - Tunnel". |

## 46.2.2 Working with a DTM Job

**Access**

Start the Roads or Rail subapplication.
In the job selection screen check **Use a DTM**.
Open the selectable list for **DTM**.

**DTM**




| Key | Description |
|---|---|
| **OK** | To select the highlighted DTM job and continue. |
| **Layrs..** | To view the DTM layers and the number of triangles of the highlighted DTM job.<br>A DTM job can consist of multiple DTM layers or surfaces. These DTM layers can cover different locations, be on top of each other or intersect each other. |
| **Delete** | To delete the highlighted DTM job. |
| **CF card**, **SD card**, **USB** or **Intrnl** | To change between viewing jobs stored on another data storage device or internal memory. |
| Fn **Quit** | To exit the application. |

## 46.2.3 Design Data

**Design data for Road**

**2D and 3D lines**

Depending on the method to be used, the design in all road jobs must consist of either 2D or 3D lines.

2D lines are required at least when working with lines, local lines, manual slope, local manual slope or layer. If the design consists of 2D lines, heights can be considered manually.

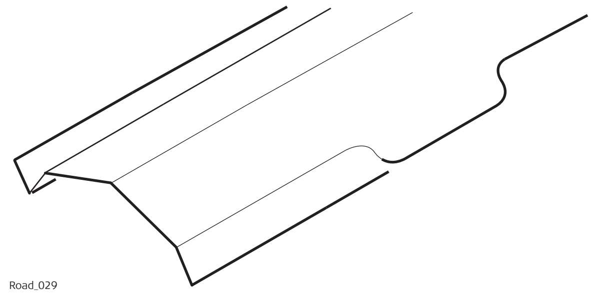
3D lines are required when working with slope, surface grade or crown. 3D lines can also be used when working with lines, local lines, manual slope, local manual slope or layer.

**Description**

Depending on the complexity of the road job, the design data can vary from a single horizontal alignment to a design containing profiles with dozens of defined vertices. Design elements can be grouped logically for faster access.

## Lines

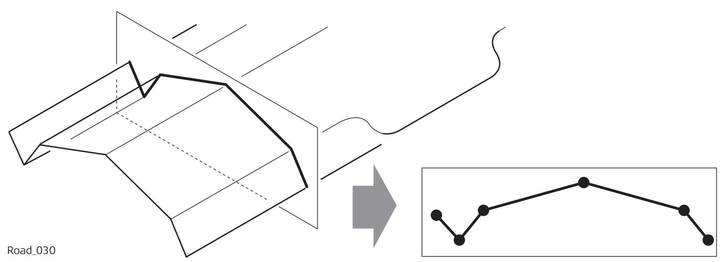
When manually typing in a road job, alignments and cross sections are used. Alignments are defined by geometric elements, for example straights and arcs, and the cross sections by vertices. Furthermore, at which chainage a certain cross section is used is also defined. By defining these elements the vertices are connected to create a series of lines representing the three-dimensional design of the road.




Line representation of a road design.

Such lines defining the design are called lines. Lines are the base elements used for stakeout and check activities. Lines have a project unique name by which they are identified and selected. Whenever a new road design is typed in or imported from a design package these lines are generated automatically in the background.

☞ A cross section can be derived from the line model by slicing the group of lines with a vertical plane orthogonal to the centreline.




Vertical cut of a line group defines a cross section.

☞ Lines are referenced by layers and can be used in more than one layer.

☞ Every layer is relative to a centreline. This centreline does not have to be a part of the layer. In the previous example, layer one - general fill - uses the centreline for calculation even though the centreline is not part of the layer surface. Whereas the centreline is part of layer three - final surface.

## Design data for Rail

### Horizontal and vertical alignments

All rail jobs must consist of at least one horizontal alignment. Each horizontal alignment can either be typed in manually using the **Alignment Editor** application, or converted from a rail design package using **Import alignment data** application or the Design To Field component within the Leica Geo Office program.

Horizontal alignments can consist of straights, circular curves, clothoids, parabolic curves and bloss curves.
Vertical alignments can consist of straights, circular curves and parabolic curves.

If a design comprises multiple tracks, one horizontal alignment can be defined as the chainage centreline. From the chainage centreline all chainages will be calculated and additional horizontal and vertical alignments can be used to define each track.

### Rail definition

Rails can be defined by:
- entering the design data manually in the field
- by using the **Alignment Editor**
- by using **Import alignment data** application
- by converting data from a rail design package using the Design To Field component and if required the Rail Editor (for defining the superelevation) component within the Leica Geo Office program

Rails are stored as lines (continuous 2D or 3D lines) within the rail job.

### Tracks

Tracks are used to group related lines (centreline and rails) together.
In the case of a single track, the track centreline and the two rails are grouped together in one track.
In the case of multiple tracks where one chainage centreline is used for all tracks, each track consists of four lines: the track centreline, the chainage centreline and the left and right rails.
In the case of multiple tracks where chainage is calculated relative to the track centreline, each track is stored as a single track as described previously.

---

## Design data for Tunnel

### Horizontal and vertical alignments

All tunnel jobs must consist of at least a horizontal and a vertical alignment. This data can be converted from a road design package using the Design To Field component within the Leica Geo Office application.

**Profiles**

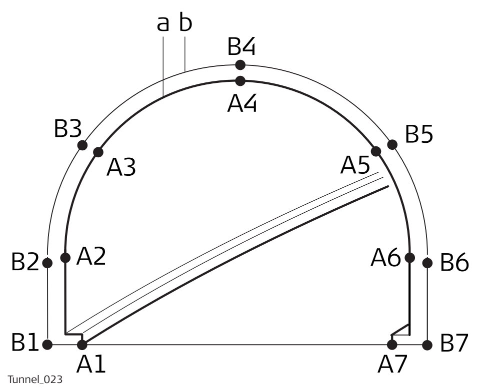
Depending on the complexity of the tunnel job, the design data can vary from a single horizontal and vertical alignment to a design containing many different design profiles with dozens of defined vertices.

Design profiles can be defined and edited using the Design To Field component within the Leica Geo Office application.

**Layers**

Tunnels generally consist of layers made of different materials, for example a shotcrete surface or a lining. At different times throughout a project, it may be required to work with different layers of the tunnel.

The Tunnel Profile Editor allows the possibility of creating such layers by grouping together design profiles that will be used at the same chainage.




a) The vertices **A1**-**A7** could be grouped together in a layer (**a**) and represent the final lining of the tunnel.
b) The vertices **B1**-**B7** could be grouped together in a layer (**b**) and represent the inner shotcrete layer of the tunnel.

Design Profile Layers can be assigned to chainages along the centreline using the Tunnel Profile Editor within the Design To Field component.

The layer of the tunnel to set out or check can be defined when creating a task.

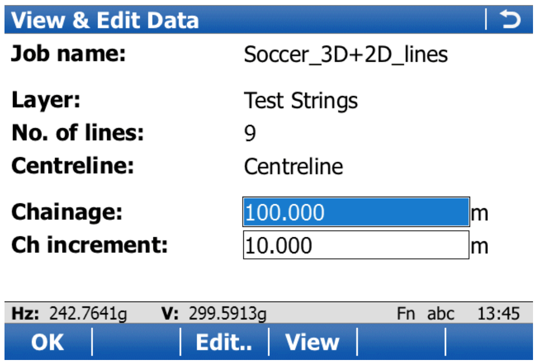
## 46.2.4 Viewing and Editing the Design Data

**Access**

Start the Roads subapplication required.
In the job selection screen highlight **Road Jobs**, **Rail job** or **Tunnel job**. Open the selectable list
In **Road Jobs**/**Rail jobs**/**Tunnel jobs** highlight a job and press **Data**.

**View & Edit Data**

The design data stored within the road/rail/tunnel job contains all information about the road/rail/tunnel design. This information includes the lines and layers, for example, the geometry of the centreline or the layers of the different materials/surfaces which form the road/tunnel. The design data can be viewed and partially edited on this screen.




| Key | Description |
|---|---|
| **OK** | To return to the job selection. |
| **Edit..** | To edit the general job details and the start chainage of the centreline of the selected layer.<br>For Road additionally to select another centreline and include/exclude lines from the selected layer. |
| **View** | To view geometry details of the lines and to view cross-section plots.<br>For Road and Rail additionally to view the list of all lines in the layer. |
| Fn **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

#### Description of fields

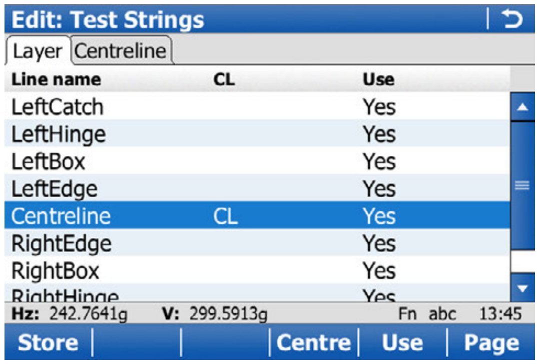
| Field | Option | Description |
|---|---|---|
| **Job name** | Display only | The name of the active road/rail/tunnel job, as selected in the job selection screen. |
| **Layer** | Display only | To select a layer from the active road/rail/tunnel job. All layers within the active road/rail/tunnel job can be selected. |
| **No. of lines** | Display only | Available for Road and Rail. The number of lines from the selected layer. |
| **Number of profiles** | Display only | Available for Tunnel. The number of profiles from the selected layer. |
| **Centreline** | Display only | The name of the layer centreline.<br>☞ Every layer must have a centreline. |
| **Chainage** | Editable field | To enter chainage to use when viewing the data. The default value is the start chainage of the layer centreline. |
| **Ch increment** | Editable field | To enter a chainage increment to use when stepping through the data. |

#### Next step

| IF you want to | THEN press |
|---|---|
| edit data | **Edit..** to access the screen **Edit:**. Refer to "Edit:, Layer page". |
| view data | **View** to access the screen **View at**. Refer to "View at, Line Info page". |

**Edit:,**
**Layer page**

Only available for Road.



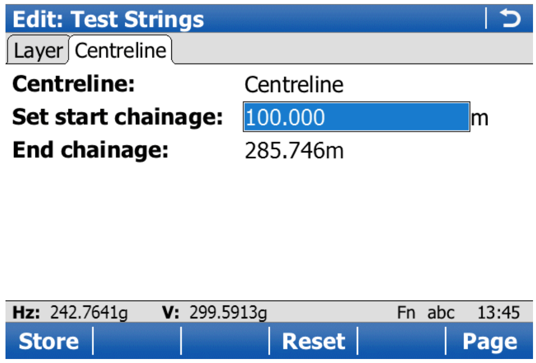

| Key | Description |
|---|---|
| **Store** | To store data and return to the previous screen. |
| **Centre** | To set the highlighted line as centreline. |
| **Use** | To set **Yes** or **No** in the **Use** column for excluding/including the highlighted line of selected layer. |
| **Page** | To change to the next page. |
| Fn **Quit** | To exit the application. |

**Description of columns**

| Column | Description |
|---|---|
| **Line name** | Displays the name of all the lines in the layer. |
| **CL** | Shows **CL** for the line selected as centreline. |
| **Use** | For **Yes**: The selected line is used for stake/check.<br>For **No**: The selected line is not used for stake/check. |

**Next step**
**Page** changes to the **Centreline** page.

**Edit:, Centreline/Chainage line page**




| Key | Description |
|---|---|
| **Store** | To store changes and return to the previous screen. |
| **Reset** | To clear all changes made and to reset to the original start chainage. The original start chainage is always remembered. |
| **Page** | To change to the next page. |
| Fn **Quit** | To exit the application. |

### Description of fields

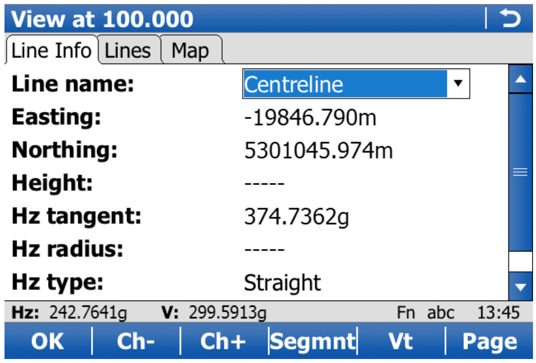
| Field | Option | Description |
|---|---|---|
| **Centre-line/Chainage line** | Display only | The name of the centreline. |
| **Set start chainage** | Editable field | To enter a start chainage for the layer centreline. |
| **End chainage** | Display only | The end chainage of the layer centreline. By using the centreline length, the end chainage is automatically calculated. |

### Next step

**Store** to store the changes.
**View** to access the screen **View at**.

**View at, Line Info page**

If a value is unavailable in the design data, the field is shown as **-----**.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Ch-** | To decrease the chainage by the chainage increment, as defined in the **View & Edit Data** screen. |
| **Ch+** | To increase the chainage by the chainage increment, as defined in the **View & Edit Data** screen. |
| **Segmnt** | To access **Segment Info - Start Point**. |
| **Hz** or **Vt** | To change between the vertical alignment data and the horizontal alignment data. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

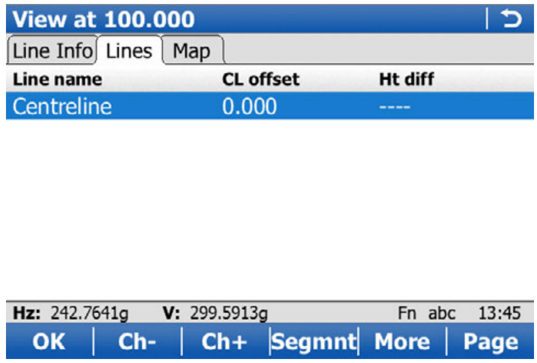
| Field | Option | Description |
|---|---|---|
| **Line name** | Selectable list | All lines available at the defined chainage are displayed and can be selected. |
| **Easting**, Northing and **Height** | Display only | The East/North coordinate and height of the line at defined chainage. |
| **Hz tangent** | Display only | The tangent direction of the line at defined chainage. |
| **Grade** | Display only | The grade of the line at defined chainage. |
| **Hz radius** | Display only | The horizontal radius of the line segment at defined chainage. |
| **Vertical radius** | Display only | The vertical radius of the line segment at defined chainage. |
| **Hz type** | Display only | The horizontal segment type at defined chainage. |
| **Vertical type** | Display only | The vertical segment type at defined chainage. |
| **Hz offset** | Display only | The horizontal offset to the layer centreline at defined chainage. |
| **Vertical offset** | Display only | The vertical offset to the layer centreline at defined chainage. |

**Next step**

**Page** to change to the **Lines** page.

**View at, Lines page**

Unavailable for Tunnel.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Ch-** | To decrease the chainage by the chainage increment, as defined in the **View & Edit Data** screen. |
| **Ch+** | To increase the chainage by the chainage increment, as defined in the **View & Edit Data** screen. |
| **Segmnt** | To access **Segment Info - Start Point**. |
| **More** | To change between the height differences or absolute heights at the selected chainage. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of columns

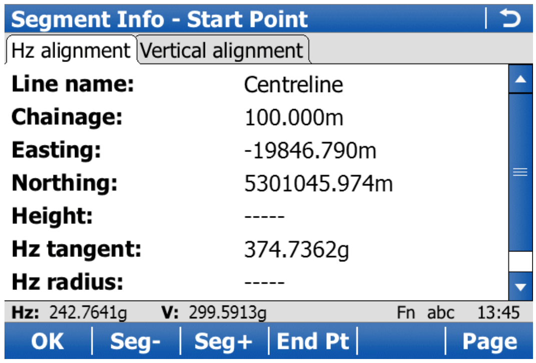
| Column | Description |
|---|---|
| **Line name** | The name of the lines available at defined chainage in the selected layer. |
| **CL offset** | The horizontal offset of the line from the layer centreline. |
| **Ht diff** | The height difference of the line to the layer centreline. |
| **Height** | The absolute height of the line. |

### Next step

**Page** to change to the **Map** page.
The **Map** page shows a cross section, profile and planar view of the design data at the selected chainage.
**Segmnt** to access **Segment Info - Start Point**/**Segment Info - End Point**.

**Segment Info - Start Point/Segment Info - End Point, Hz alignment page**

If a value is unavailable in the design data, the field is shown as **-----**.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Seg-** | To move to the previous segment. |
| **Seg+** | To move to the next segment. |
| **End Pt** or **Start Pt** | To change between the start point and the end point of the segment. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Line name** | Display only | The name of the selected line. |
| **Chainage** | Display only | The chainage of start/end point of the segment. |
| **Easting Northing** and **Height** | Display only | The East/North coordinate and height of the start/end point of the segment. |
| **Hz tangent** | Display only | The tangent direction at the start/end point of the segment. |
| **Hz radius** | Display only | The radius at the start/end point of the segment. |
| **Hz type** | Display only | The current segment type. |

### Next step

**Page** to change to the **Vertical alignment** page.

**Segment Info - Start Point/Segment Info - End Point, Vertical alignment page**

Refer to "Segment Info - Start Point/Segment Info - End Point, Hz alignment page" for a description of keys.
If a value has not been defined, the field is shown as **-----**.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Line name** | Display only | The name of the selected line. |
| **Chainage** | Display only | The chainage of start/end point of the segment. |
| **Easting**, Northing and **Height** | Display only | The East/North coordinate and height of the start/end point of the segment. |
| **Grade** | Display only | The grade at the start/end point of the segment. |
| **Vertical radius** | Display only | The radius at the start/end point of the segment. |
| **Vertical type** | Display only | The current segment type. |

**Next step**

**OK** returns to the previous screen.

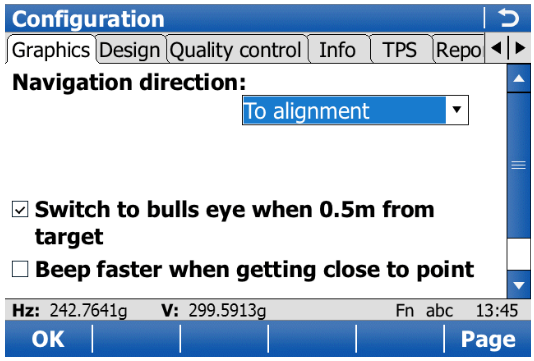
## 46.3 Configuring Roads Applications

### 46.3.1 Configuration Settings

**Access**

In the job selection screen press **OK** and then, depending on the subapplication **Config..** or Fn **Config...**

**Configuration, Graphics page**




| Key | Description |
|---|---|
| **OK** | To confirm the changes and move to the previous screen. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

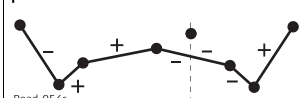
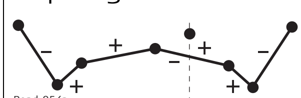
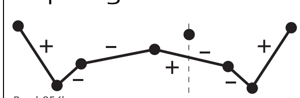
| Field | Option | Description |
|---|---|---|
| **Navigation direction** | | The reference direction used to stakeout points. The stakeout elements and the graphics displayed are based on this selection. |
| | **To alignment** | The stake out is relative to the alignment. |
| | **To north** | The North direction shown in the graphical display based on the active coordinate system. |
| | **To sun** | GPS The position of the sun calculated from the current position, the time and the date. |
| | **To last point** | Time-wise, the last recorded point. If no points are yet staked, **Navigation direction: To north** is used for the first point to be staked. |
| | **To point (cntrl job)** | A point from the control job is selected. |
| | **Following arrow** | The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. |
| | **From station** | TPS The reference direction is from the station to the current position. |
| | **To station** | TPS The reference direction is from the current position to the station. |
| **Point ID** | Selectable list | Available for **Navigation direction: To point (cntrl job)**. To select the point or line to be used for orientation. |
| **Navigate using** | | The method of staking out. |
| | **Direction & distance** | The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. |
| | **In/out, left/right** | The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed. |
| **Switch to bulls eye when 0.5m from target** | Check box | When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked. |
| **Beep faster when getting close to point** | Check box | The instrument beeps when the distance from the current position to the point to be staked is equal to or less than defined in **Start within**.<br>The closer the instrument is to the point to be staked the faster the beeps will be. |
| **Distance to use** | **Height**, **Horizontal distance** or **Position & height** | Available when **Beep faster when getting close to point** is checked. The type of distance to use for the stake beep. |
| **Start within** | Editable field | Available when **Beep faster when getting close to point** is checked. The horizontal radial distance, from the current position to the point to be staked, when a beep is to be heard. |

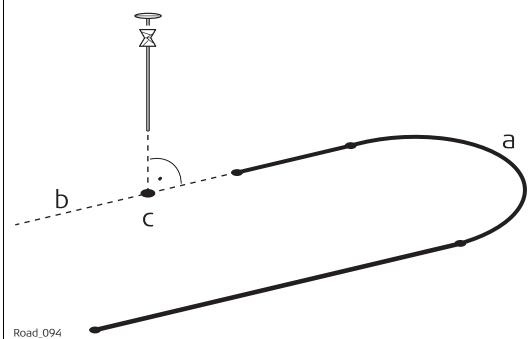
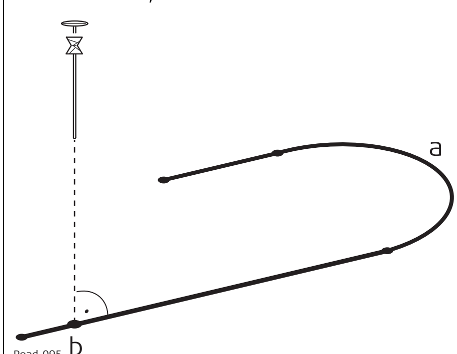
#### Next step

**Page** changes to the **Design** page.

**Configuration, Design page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Working corridor** | Editable field | Valid offset range defined by the working corridor left and right of the centreline. If a measured point is further away from the working corridor distance, an error message is displayed.<br>Refer to "46.6 Understanding Terms and Expressions" for more information on the working corridor. |
| **Show tangent points** | Check box | When this box is checked, a message box is shown when a tangent point (PI or PVI) has been detected within the chainage increment range. This tangent point can be selected for stakeout. Refer to "48.3.1 The Stake/Check Screen" for further details.<br>When this box is not checked, no tangent points are indicated. |
| **Type** | | Available when **Show tangent points** is checked. |
| | **Horizontal** | Indicates tangent points of the horizontal alignment only. |
| | **Vertical** | Indicates tangent points of the vertical alignment only. |
| | **Horizontal & vertical** | Indicates all tangent points. |
| **Slope signs** | | Available for Road only. Selects sign definition method for slopes and surface grades. |
| | **Mathematical** | All slope signs defined from left to right, independent of whether left or right of the centreline.<br> |
| | **Relative to CL** | Slope signs defined relative to the centreline.<br> |
| | **Relative from CL** | Slope signs defined relative from the centreline.<br> |
| **Extend slopes** | | When using slopes generated by a design package, the quality of the change from cut to fill or where slopes start and end, depends on the terrain model used for the project. Occasionally, one of the lines defining the slope ends before intersecting with the natural surface. A message appears asking to extended the slope, as soon as a measurement is taken outside of the defined design slope. |
| | **Yes (with warning)** | The slope is expanded beyond and above or below the hinge point. A warning is shown as soon as leaving the defined slope. |

| Field | Option | Description |
|---|---|---|
| | **Yes** | The slope is expanded beyond and above or below the hinge point. No warning is when leaving the defined slope. |
| | **No** | The slope is not expanded beyond and above or below the hinge point. |
| **Extend lines** | Check box | Extend each line or curve at its beginning and end with a tangent. The extension is used for projecting a point to the line and for intersecting the line. |
| | Checked | Intersection points on extended lines/curves are not shown in cross-sections and cannot be staked out.   a) Any type of line or curve<br>b) Extended line<br>c) Projected point on extended line |
| | Not checked | This option is recommended when working with closed alignments (for example roundabout, slip road, motorway exit).   a) Any type of line or curve<br>b) Projected point on line |
| **Project scale for length values** | Check box | When this box is not cheked, no scale factor is applied to length values. Length values are displayed in the grid format.<br>When this box is checked, a defined scale factor is applied to length values. All distance values (chainages, chainage increments, offsets, Δ chainage, Δ offset, Δ height, ...) are displayed in ground using the **Scale factor**.<br>The Road job data is still in grid format. |

| Field | Option | Description |
|---|---|---|
| | | ☞ All data is saved to the DBX in ground format. Only ground data is written to the log file. |
| **Scale factor** | Editable field | To apply an appropriate geodetic map projection to scale over the ground. The scale factor is only applied to Road, not to Rail or Tunnel. |

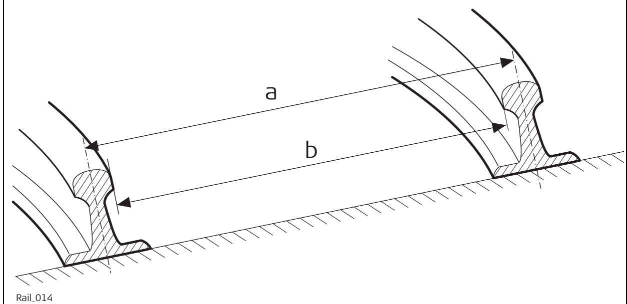
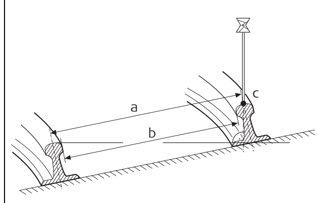
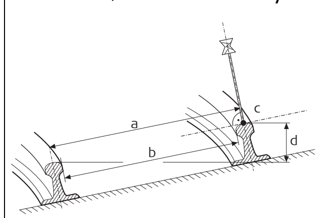
**Next step**

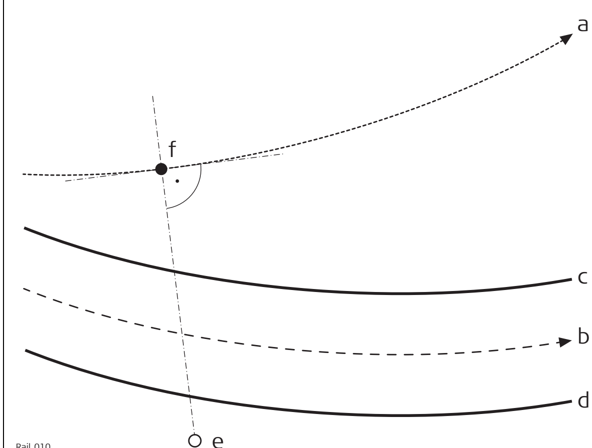
| IF you work with | THEN Page changes to the |
|---|---|
| Road | **Quality control** page. |
| Rail | **Rail design** page. |
| Tunnel TPS | **Tunnel design** page. |

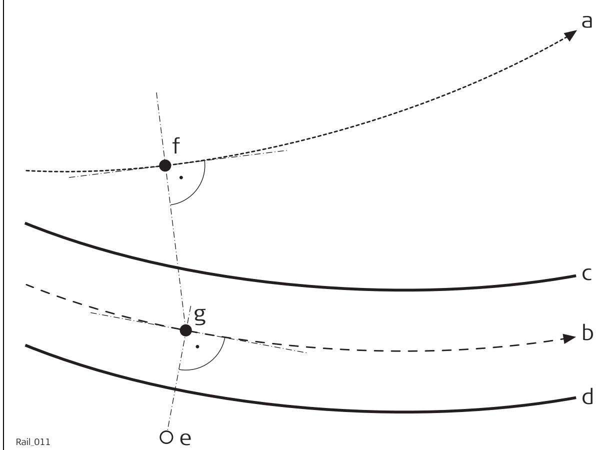
**Configuration, Rail design page**

Available for Rail only.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Nominal gauge** | Editable field | Nominal distance between the active (internal) faces of the left and right rails.<br><br>a) Superelevation base<br>b) Nominal gauge |
| **Superelevatn base** | Editable field | Distance over which the superelevation is to be applied. This distance normally corresponds to the distance between the rail axes. |
| **Supereleva-tion** | **Design** | To use the superelevation values from the design. If these values don't exist in the design, then all superelevation values are ignored. |
| | **Manual** | To ignore all superelevation values from the design and to enter them manually. |
| | **None** | All superelevation values are ignored. |
| **Apply target height** | **Plumbline** | The target height is applied in plumbline to the measured position.<br><br>a) Superelevation base<br>b) Nominal gauge<br>c) Measured point (Easting, Northing, Height) |
| | **Perpendicular** | Use this setting when working with a rail bar (solar gauge) with a fix mounted prism.<br>Easting, Northing and Elevation of the measured point is calculated using the design cant or, if enabled, the manually defined cant.<br><br>a) Superelevation base<br>b) Nominal gauge<br>c) Measured point (Easting, Northing, Height)<br>d) Superelevation |

| Field | Option | Description |
|---|---|---|
| **CL height** | **CL geometry** | The centreline height is taken from the alignment centreline. |
| | **Rail interpolated** | The centreline height is interpolated between the left rail height and right rail height. |
| | **Lower rail** | The height of the lower rail is used as centreline height. |
| **Calculate chainage directly onto chainage centreline** | Check box | Chainage calculation method when checking points of multiple tracks with respect to a chainage centreline. The direct measurement method is when the chainage is calculated by projecting the measured point directly onto the chainage centreline. The indirect measurement method is when the chainage is calculated by first projecting the measured point onto the track centreline, and then projecting the point onto the chainage centreline. |
| | Checked | Project measured point directly onto the chainage centreline.   a) Chainage centreline<br>b) Track centreline<br>c) Left rail<br>d) Right rail<br>e) Measured point<br>f) Direct chainage |

| Field | Option | Description |
|---|---|---|
| | Not checked | Project measured point onto track centreline and then make a second projection onto the chainage centreline.<br><br><br>a) Chainage centreline<br>b) Track centreline<br>c) Left rail<br>d) Right rail<br>e) Measured point<br>f) Indirect chainage<br>g) Measured point projected onto track centre-line |
| **Disable chainage centreline** | Check box | Only affecting multiple track designs. The defined chainage centreline is disabled and the track centreline is used for chainage calculations. |

**Next step**

**Page** changes to the **Quality control** page.

**Configuration, Gauge device page**

Available for Rail only.

A gauge device is used to measure the track geometry or the relative positions of the rails.

#### Requirements to connect to a gauge device

Configure an interface connection to be used with a device called **GAUGE DEVICE**. Create the device **GAUGE DEVICE** manually with the standard communication parameters for RS232. For example configure a **GeoCom** connection using **TS Bluetooth 1** with the device **GAUGE DEVICE**.

| Key | Description |
|---|---|
| **Adjust** | Available for **Gauge device**: **R500-FIX**.<br>To adjust the gauge device from within the software. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Gauge device** | **None** | No gauge device is used. |
| | Selectable list | Select a gauge device. The internal offsets are applied. |
| **Gauge target offset** | Editable field | Horizontal offset of the prism from the fix side of the gauge device. |
| **Gauge target hgt** | Editable field | Height of the prism on the gauge device. |

#### Next step

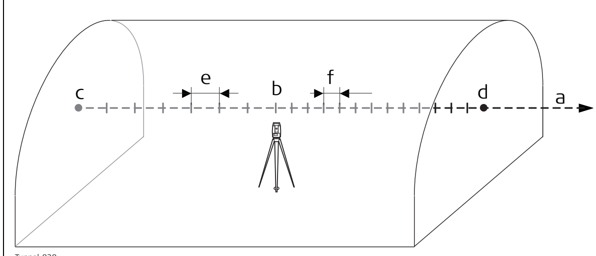
**Page** changes to the **Quality control** page.

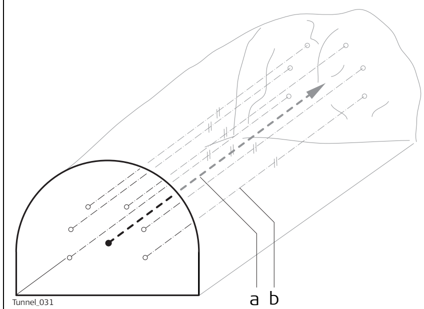
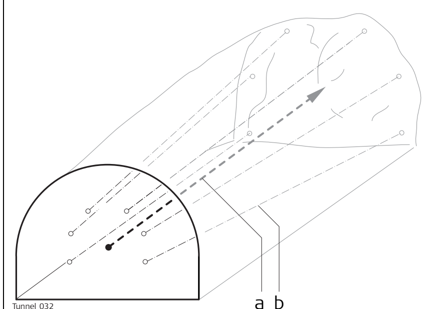
**Configuration, Tunnel design page**

TPS

Available for Tunnel only.

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Theoretical profile direction** | | Defines the direction in which the design profile is considered. The setting has an influence on the profile offset sign. |
| | **Clockwise** | The design profile is defined in a clockwise direction. In underbreak areas the profile offset values are negative where as in overbreak areas they are positive. |
| | **Counter-clockwise** | The design profile is defined in a counter-clockwise direction. In underbreak areas the profile offset values are positive where as in overbreak areas they are negative. |
| **Profile definition** | **Vertical** | Profiles are always defined as vertical. |
| | **Tilted** | Profiles are always defined perpendicular to the vertical alignment of the tunnel axis. |
| **Scan area defnd by** | | Available for **Method to use**: **Scan profile**.<br>When measuring tunnel profiles, it is possible to scan various profiles from one instrument position. |
| | **Chainage** | Allows a scan area to be defined by entering a back and forward chainage. |
| | **Distance** | Allow a scan area to be defined by measuring/entering a back distance and forward distance from the station chainage.<br>**Plan view**<br><br>a) Alignment<br>b) **Station chainage**<br>c) **Start chainage** or **Start distance**<br>d) **End chainage** or **End distance**<br>e) **Before stn every**<br>f) **After stn every** |
| **Drilling rig orientation** | **Parallel to alignment** | Guides a jumbo to drill in the direction parallel to the alignment. |

| Field | Option | Description |
|---|---|---|
| | | <br>a) Alignment<br>b) Drill direction |
| | **Drill Pattern** | Guides a jumbo to drill in the user defined direction. This must not be parallel to the alignment.<br><br>a) Alignment<br>b) Drill direction |

**Next step**

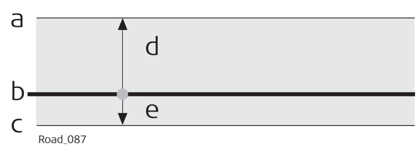
**Page** changes to the **Quality control** page.

**Configuration, Quality control page**

### Description

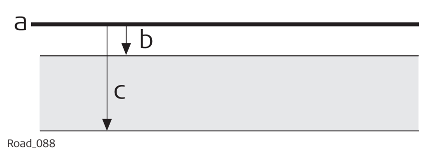
Especially when checking points in an as-built control or when staking out it is useful to enable the **Quality control** criteria available. For every point stored the chosen parameters are checked and if the check limits are exceeded a warning is shown. This function guarantees a higher productivity as it is no longer necessary to check the values for every shot taken. When checking layers of a road, a too thick layer results in higher costs as more material is used. Alternatively, a too thin layer can lead to problems and could cause serious damage. Therefore different check limits for above and below the design can be defined.

### Graphic




a) Layer is too thick
b) Design surface
c) Layer is too thin
d) **Upper ht limit**
e) **Lower ht limit**

Height limits below the design surface are entered as negative values (for example, the **Lower ht limit** with -10 mm in the previous diagram). By using the signs of the height limits, it is also possible to cover situations like the one shown in the following diagram, with a valid range between -10 to -50 mm below the design surface.




a) Design surface
b) **Upper ht limit**
c) **Lower ht limit**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Check deltas to point before storing** | Check box | When this box is checked, a position check is done when storing a staked or checked point. When the defined tolerance is exceeded, the stake out/check can be repeated, skipped or stored.<br>When this box is not checked, no quality check is done during stake out/check of points. |
| **Delta values** | | ☞ Depending on this selection the following lines are enabled/disabled. |
| | **Ch, offset & height** | Check for chainage, horizontal offset and height. |
| | **Ch & offset** | Check for chainage and horizontal offset. |
| | **Position & height** | Check for 2D position and height. |
| | **Position** | Check for 2D position. |
| | **Height** | Check for height. |
| | **Profile** | Available for Tunnel. Check for distance from design profile. |
| **Chainage limit** | From **0.001** to **100** | Maximum difference in chainage. |
| **Offset limit** | From **0.001** to **100** | Maximum horizontal offset from defined position. |
| **Position limit** | From **0.001** to **100** | Maximum radial horizontal distance. |
| **Upper ht limit** | From **-100** to **+100** | Maximum height difference. |
| **Lower ht limit** | From **-100** to **+100** | Maximum height difference. |
| **Profile tolerance** | From **0.001** to **100** | Available for Tunnel. Permitted distance from design profile. |

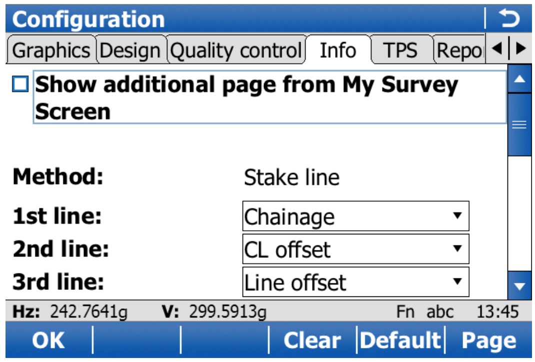
### Next step

**Page** changes to the **Info** page.

**Configuration, Info page**

Two things can be configured on this page:

1) The required information for each stakeout and check method to be displayed on the **Info** page. Depending on the working method used on the construction site, different information is written on the stakes. The information to be written on the stake is displayed on the **Info** page.
2) If and which additional user-defined survey screen page is displayed.




| Key | Description |
|---|---|
| **OK** | To confirm the changes and continue. |
| **Clear** | To clear all parameters from all lines. |
| **Default** | To set the default value for all lines. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Show additional page from My Survey Screen** | Check box | The user-defined survey screen page to be shown in the stake or check screen. |
| **Page to show** | Selectable list | The names of the available survey screen pages. |
| **Method** | Display only | The method is based on the selected subapplication and, if available, the setting for **Method to use**. The settings in the following lines can only be changed for the current method.<br>The method defines the parameters available to view on the **Info** page of the application. Different combinations of the parameters to view can be stored |
| **1st line** to **16th line** | Selectable list | To modify the selection on any particular line, place the cursor on the line to modify using the arrow keys and press the ENTER key.Use the arrow keys to select the required parameter and press the ENTER key to confirm the choice.<br>Define which parameters are viewed on each line. Up to 16 lines of parameters can be defined.<br>The available parameters depending on the **Method** selected are explained separately:<br>• For Road Line, refer to "46.3.2 Road Line - Info Page".<br>• For Road Local line, refer to "46.3.3 Road Local Line - Info Page".<br>• For Road Surface grade, refer to "46.3.4 Road Surface Grade - Info Page".<br>• For Road Manual slope, Local manual slope and Slope, refer to "46.3.5 Road Manual Slope, Local Manual Slope and Slope - Info Page".<br>• For Road Crown, refer to "46.3.6 Road Crown - Info Page".<br>• For Road Layer, refer to "46.3.7 Road Layer - Info Page".<br>• For Road DTM, refer to "46.3.8 Road DTM - Info Page".<br>• For Rail refer to "46.3.9 Rail - Info Page".<br>• For Tunnel refer to "46.3.10 Tunnel - Info Page". |

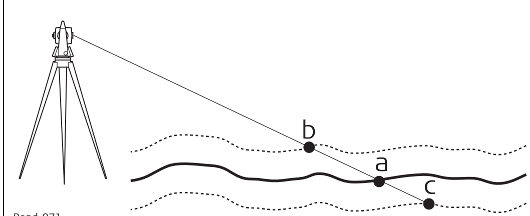
#### Next step

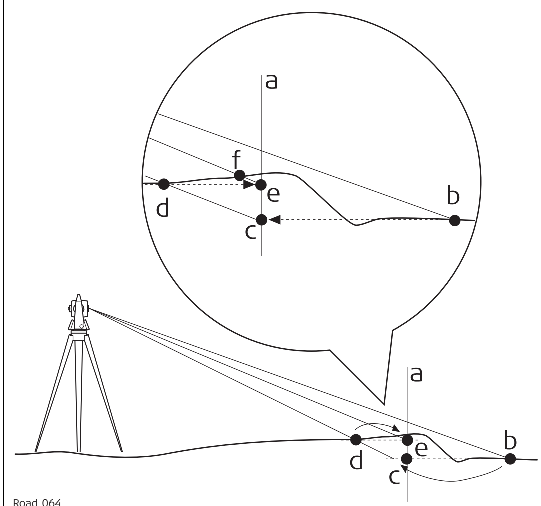
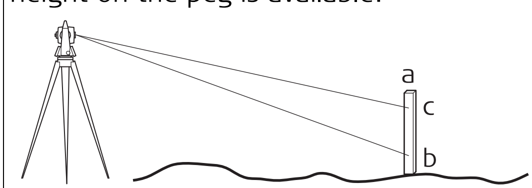
TPS **Page** changes to the **TPS** page.

GPS **Page** changes to the **Report sheet** page.

**Configuration, TPS page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Only update stakeout values when distance is measured** | Check box | When this box is checked, angles and stakeout values are updated after a distance measurement. All values are then frozen until the next distance is taken. When **Target aiming**: **Lock** is selected and the instrument is locked onto a target the angular values do not change.<br>When this box is not checked, angles are updated with telescope movement after a distance was measured. |
| **Turn to point** | Check box | Available for Road and Rail.<br>To make stake out of points even more efficient, a motorised instrument offers you the possibility to aim automatically at the stakeout position. |
| **Turn to** | | Available for Road and Rail and when **Turn to point** is checked. |
| | **Position only** | The instrument positions horizontally in the direction of the point to stake out. |
| | **Position & height** | The instrument positions horizontally and vertically to the point to stake out.<br>The instrument only points to the correct position on the ground if the point to stake out has the same height as the natural surface. If the natural surface is higher than the point to stake out, the measured point would be closer than the stakeout point. If the natural surface is lower than the point, the measured point would be further away.<br>With **Position & measure**, the possibility of iterative positioning using the auto position, this problem can be avoided.<br><br>a) Point to stake out, defined with 3D coordinates<br>b) Position if natural surface is higher than point to stake out<br>c) Position if natural surface is lower than point to stake out |
| | **Position & measure** | Allows the instrument to aim at a 2D position. As the natural surface height is unknown the correct position is calculated via iterations.<br>☞ Depending on the settings chosen for **Red laser pointer** the instrument will turn on the red laser as soon as the position is found. |

| Field | Option | Description |
|---|---|---|
| | | The first position (b) the instrument points to is defined by the 2D coordinates (a) of the point to stake out ( = horizontal direction) and the current vertical angle. Therefore, aim the instrument at the approximate position of the point to stake out.The measured 2D position is compared with the stakeout position to determine a new position (c) to aim at. As no information about the natural surface is available, a point at the same height as the measured position is calculated. The new position (d) is measured and compared again with the point to stake out (a).This iteration process runs until the tolerances defined for the stakeout are reached.<br><br>a) 2D position to stake out<br>b) First position measured defined by 2D coordinates and current vertical angle<br>c) New position calculated based on height of b<br>d) Second position measured<br>e) New position calculated based on height of d. The measured position for this point is within the defined tolerance, the correct position is found. |
| | **Prompt before turn** | The method how the instrument turns is not fixed but is selected when pressing **Positn**. Additionally to the three methods listed above, an option allowing the instrument to find the height on the peg is available:<br><br>a) Peg placed at the correct position<br>b) First height, manually chosen direction<br>c) Required height on the peg |

| Field | Option | Description |
|---|---|---|
| | | For more information refer to "46.3.11 Work-flow for Height (aim to stake ht)". |
| **Position limit** | From **0.001** to **10** | Maximum permitted radial horizontal distance.<br>Available for Tunnel and for Road/Rail with **Turn to**: **Position & measure** or **Turn to**: **Prompt before turn**. |
| **Height limit** | From **0.001** to **10** | Maximum height difference. Available for Road and Rail. |
| **Chainage limit** | From **0.001** to **10** | Chainage tolerance of the position to stake out.<br>Available for Tunnel and for Road/Rail with **Turn to**: **Position & measure** or **Turn to**: **Prompt before turn**. |
| **Offset limit** | From **0.001** to **10** | Maximum horizontal offset from defined position. Available for Road and Rail. |
| **Red laser pointer** | | Defines when the visible red laser beam is turned on during the automatic search of the position.<br>Available for Tunnel and for Road/Rail with **Turn to**: **Position & measure** or **Turn to**: **Prompt before turn**. |
| | **Always off** | Visible red laser is turned off. |
| | **On at point only** | Visible red laser is turned on as soon as the point is found. |
| | **Always on** | Visible red laser is turned on during the whole search.<br>☞ The laser can also be permanently turned on by using the instrument settings. Refer to "12.6 Lights / Lights & accessories" for more information. |
| **Max iterations** | From **2** to **10** | Maximum number of iterations for the distance measurement before stopping.<br>Available for Tunnel and for Road/Rail with **Turn to**: **Position & measure** or **Turn to**: **Prompt before turn**. |

**Next step**

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

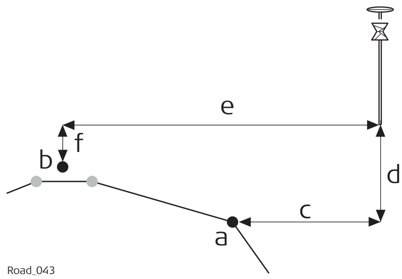
**Page** changes to the first page on this screen.

## 46.3.2 Road Line - Info Page

**Description**

This info page is used for staking and checking Road lines.

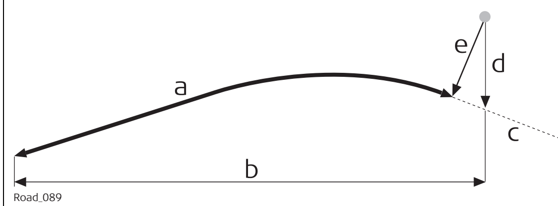
**Available fields**



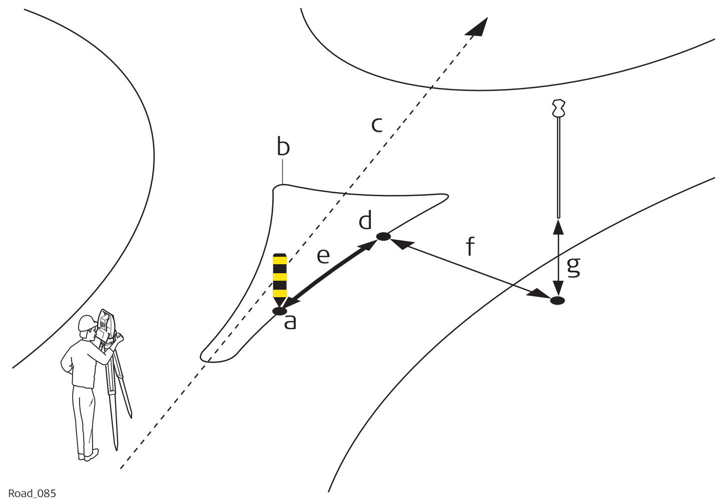

a) Line to stake out
b) Centreline
c) **Line offset**
d) **Line ht diff**
e) **CL offset**
f) **CL ht diff**

The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **Line task** | Name defined for the line task. |
| **Δ offset** | Horizontal offset between the defined position and the current position. |
| **Δ height** | Vertical offset between the defined position and the current position. |
| **Δ chainage** | Difference between the defined chainage **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ **chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Stake chainage** | Chainage to stake out. |
| **Line offset** | Horizontal offset from the line. |
| **Line ht diff** | Height difference from the defined line. |
| **Line name** | Name of the line to stake out or the stake out is relative to. |
| **Additional line** | The name of an additional line. |
| **Additnl line chnge** | Current local chainage of additional line. |
| **Additnl line offset** | Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the **Offsets** page. |
| **Additnl line ht diff** | Current height difference to the additional line including the defined stake/check height difference of the additional line of **Offsets** page. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |

| Field | Description |
|---|---|
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Offset angle** | The current angle to selected line. |
| **Nearest hz tngnt pt** | Refer to "48.3.1 The Stake/Check Screen" for details on this field. |
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **Vertical chainage** | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.<br><br><br>a) Vertical chainage<br>b) Chainage<br>c) Centreline<br>d) Centreline height difference<br>e) Vertical square offset |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Current dsgn east** | Easting of the design for the current position (relevant point at the selected line). |
| **Current dsgn north** | Northing of the design for the current position (relevant point at the selected line). |
| **Current dsgn ht** | Height of the design for the current position (relevant point at the selected line). |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

### Available fields

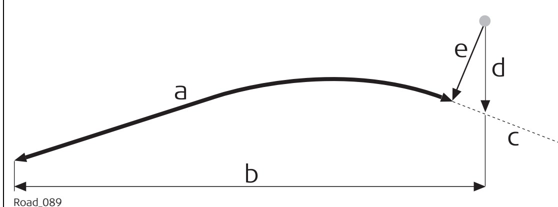



**Stake out of roundabout**

a) Position to stake out
b) Line to stake out
c) Centreline
d) **Chainage**
e) **∆ chainage**
f) **∆ offset**
g) **∆ height**

The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **Line task** | Name defined for the local line task. |
| **Additional line** | The name of an additional line. |
| **Additnl line chnge** | Current local chainage of additional line. |
| **Additnl line offset** | Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the **Offsets** page. |
| **Additnl line ht diff** | Current height difference to the additional line including the defined stake/check height difference of the additional line of **Offsets** page. |
| **∆ offset** | Horizontal offset between the defined position and the current position. |
| **∆ height** | Vertical offset between the defined position and the current position. |
| **∆ chainage** | Difference between the defined chainage **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page. ☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads **∆ chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Stake chainage** | Chainage to stake out. |
| **Line offset** | Horizontal offset from the line. |
| **Line ht diff** | Height difference from the defined line. |
| **Line name** | Name of the line to stake out or the stake out is relative to. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |

| Field | Description |
|---|---|
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Offset angle** | The current angle to selected line. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "48.3.1 The Stake/Check Screen" for details on this field. |
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **Vertical chainage** | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.<br><br>a) Vertical chainage<br>b) Chainage<br>c) Centreline<br>d) Centreline height difference<br>e) Vertical square offset |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point at the line). |
| **Current dsgn north** | Northing of the design for the current position (relevant point at the line). |
| **Current dsgn ht** | Height of the design for the current position (relevant point at the line). |

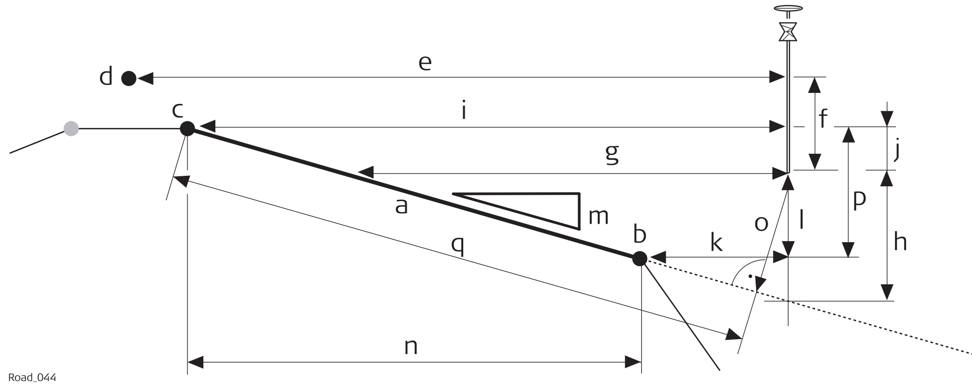
| Field | Description |
|---|---|
| **Ht end vert align** | Height at the endpoint of the vertical alignment of the line. |
| ∆ **ht end of v align** | Height difference to the endpoint of the vertical alignment of the line. |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

**Working with pipelines**

**Description**

When staking/checking pipes, a common task is to use height differences at the start/end of the pipe. The two **Info** page items for local lines enable the height difference to be added to the end of the vertical alignments ∆ **ht end of v align** and **Ht end vert align**.

## Available fields

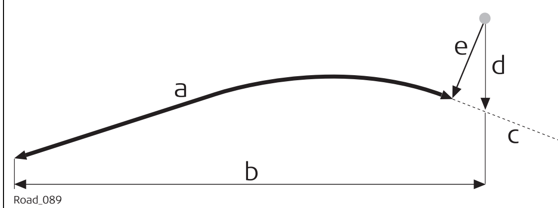



a) Surface grade to stake out
b) Right line of the surface grade **Right name**
c) Left line of the surface grade **Left name**
d) Centreline
e) **CL offset**
f) **CL ht diff**
g) **Surf. grade offset**
h) **Surf. grade ht diff**
i) **Left offset**
j) **Left ht diff**
k) **Right offset**
l) **Right ht diff**
m) **Surface grade ratio**
n) **Width**
o) **Square offset**
p) **Camber** (in this case negative)
q) **Square slope dist**

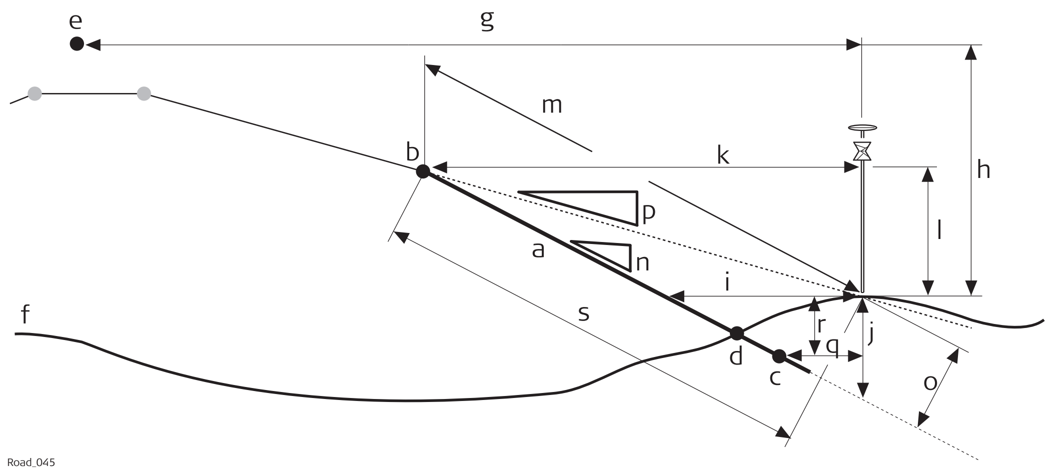
The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **Surface grade task** | Name defined for the surface grade task. |
| **Additional line** | The name of an additional line. |
| **Additnl line chnge** | Current local chainage of additional line. |
| **Additnl line offset** | Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the **Offsets** page. |
| **Additnl line ht diff** | Current height difference to the additional line including the defined stake/check height difference of the additional line of **Offsets** page. |
| **Δ offset** | Horizontal offset between the defined position and the current position. |
| **Δ height** | Vertical offset between the defined position and the current position. |
| **Δ chainage** | Difference between the defined chainage **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ **chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Stake chainage** | Chainage to stake out. |
| **Surf. grade offset** | Horizontal offset from the surface grade. |
| **Surf. grade ht diff** | Height difference to the surface grade. If no stake height difference is used **Surf. grade ht diff** = Δ **height**. |

| Field | Description |
|---|---|
| **Camber** | The superelevation of the active surface grade.<br>The calculation is always in relation to the defined reference line of the surface grade:<br>Camber = line – reference line |
| **Left name** | Name of the left line defining the surface grade. |
| **Left offset** | Horizontal offset from the left point of the surface grade. |
| **Left ht diff** | Height difference from the left point of the surface grade. |
| **Right name** | Name of the right line defining the surface grade. |
| **Right offset** | Horizontal offset from the right point of the surface grade. |
| **Right ht diff** | Height difference from the right point of the surface grade. |
| **Ref line** | Indicates which side of the surface grade the stake out is relative to. |
| **Ref offset** | Horizontal offset from the line of the surface grade used as reference. Depends on **Ref line** and is identical to **Right offset** or **Left offset**. |
| **Ref ht diff** | Height difference from the line of the surface grade used as reference. Depends on **Ref line** and is identical to **Right ht diff** or **Left ht diff**. |
| **Surface grade ratio** | Slope ratio of the surface grade. |
| **Square offset** | Offset from the surface grade, perpendicular to the surface grade. |
| **Square slope dist** | Slope distance from the slope reference line to the current position perpendicular to the slope. The slope distance is always at the same grade as the defined or current slope. If the current position is above or below the slope, the slope distance is projected square to the slope, and then the slope distance is calculated to the defined reference point.<br>The **Square slope dist** is measured from the current position to the reference line. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Width** | Horizontal width of the surface grade. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "48.3.1 The Stake/Check Screen" for details on this field. |

| Field | Description |
|---|---|
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **CL grade** | Grade of the centreline at the current position. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **Vertical chainage** | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.<br><br><br>a) Vertical chainage<br>b) Chainage<br>c) Centreline<br>d) Centreline height difference<br>e) Vertical square offset |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point on the surface grade = **Actual easting**). |
| **Current dsgn north** | Northing of the design for the current position relevant point on the surface grade = **Actual northing**). |
| **Current dsgn ht** | Height of the design for the current position (relevant point on the surface grade). |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

## Available fields

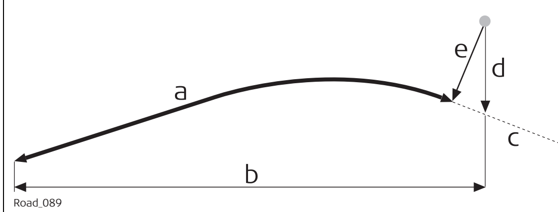



a) Slope to stake out/check
b) Hinge point **Hinge name**, reference line
c) Second line of slope **Additnl line name**
d) Real catch point
e) Centreline
f) Natural surface
g) **CL offset**
h) **CL ht diff**
i) **Slope offset**
j) **Slope height diff**
k) **Hinge offset**
l) **Hinge ht diff**
m) **Slope dist hinge**
n) **Slope ratio**
o) **Square offset**
p) **Current ratio**
q) **Additnl line offset**
r) **Additnl line ht diff**
s) **Square slope dist**

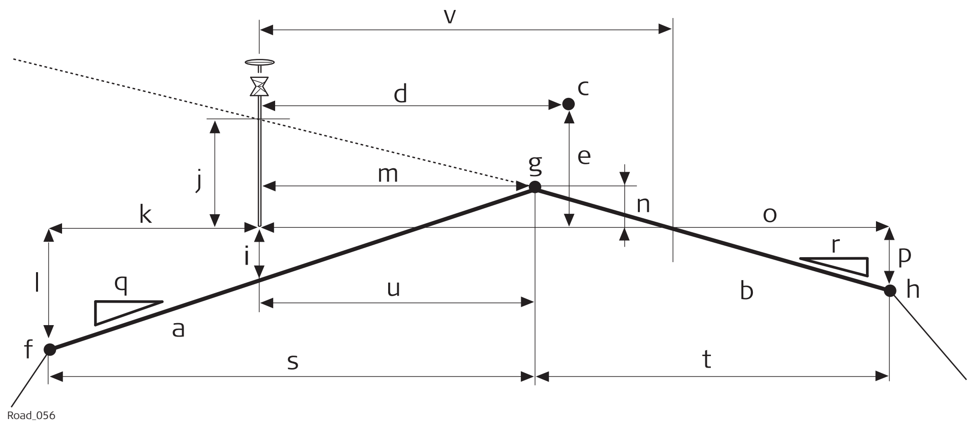
The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **Slope task** | Name defined for the slope task. |
| **∆ offset** | Horizontal offset between the defined position and the current position. |
| **∆ height** | Vertical offset between the defined position and the current position. |
| **∆ chainage** | Difference between the defined **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads **∆ chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Stake chainage** | Chainage to stake out. |
| **Slope offset** | Horizontal offset from the slope. |
| **Slope height diff** | Height difference from the slope. If no stake height difference is used **Slope height diff** = **∆ height**. |
| **Ht diff rail** | Height difference from the batter rail to mark the slope (for **Type**: **Batter rail vertical** in **Slope Stakeout Settings**). |
| **Hinge name** | Name of the line defining the hinge of the slope. |
| **Hinge offset** | Horizontal offset from the hinge point of the slope. |

| Field | Description |
|---|---|
| **Hinge ht diff** | Height difference from the hinge point of the slope. |
| **Additnl line name** | Name of the second line defining the slope. |
| **Additnl line offset** | Horizontal offset from the second line of the slope. |
| **Additnl line ht diff** | Height difference from the second line of the slope. |
| **Slope ratio** | Ratio of the slope.<br>☞ The display format is defined as system setting in **Regional Settings**, **Slope** page. |
| **Slope dist hinge** | Slope distance to the hinge point.<br>☞ All defined settings for a batter rail or reference point are already taken into account. This value is the information to write on the stake. |
| **Slope ratio gon** | Slope ratio in gon. |
| **Slope ratio degree** | Slope ratio in decimal degrees. |
| **Slope ratio %** | Slope ratio in percent. |
| **Current ratio** | Ratio of the slope from the current position to the hinge.<br>☞ For the catch point the **Current ratio** is identical to the **Slope ratio**. |
| **Square offset** | Offset from the slope, perpendicular to the slope. |
| **Square slope dist** | Slope distance from the slope reference line to the current position perpendicular to the slope. The slope distance is always at the same grade as the defined or current slope. If the current position is above or below the slope, the slope distance is projected square to the slope, and then the slope distance is calculated to the defined reference point.<br>For slope, the **Square slope dist** is measured from the current position to the reference line.<br>For manual slope and local manual slope, **Square slope dist** is measured from the current position to the hinge line. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Offset angle** | Available for manual slope. The defined value for the angle to alignment. |
| **Traveller height** | Height of the traveller in use.<br>Refer to "48.2.3 Advanced Slope Settings" for information on the different methods of slope staking. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "48.3.1 The Stake/Check Screen" for details on this field. |

| Field | Description |
|---|---|
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **Vertical chainage** | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.<br><br>a) Vertical chainage<br>b) Chainage<br>c) Centreline<br>d) Centreline height difference<br>e) Vertical square offset |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point on the slope = Act Easting). |
| **Current dsgn north** | Northing of the design for the current position relevant point on the slope = Act Northing). |
| **Current dsgn ht** | Height of the design for the current position (relevant point on the slope). |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

**Available fields**




a) Left surface grade of road crown
b) Right surface grade of road crown
c) Centreline
d) **CL offset**
e) **CL ht diff**
f) Left most line of the crown **Left name**
g) Middle line of the crown **Mid name**
h) Right most line of the crown **Right name**
i) **L surf. grade Δ ht**
j) **R surf. grade Δ ht**
k) **Left offset**
l) **Left ht diff**
m) **Mid offset**
n) **Mid ht diff**
o) **Right offset**
p) **Right ht diff**
q) **L surf. grade ratio**
r) **R surf. grade ratio**
s) **Left width**
t) **Right width**

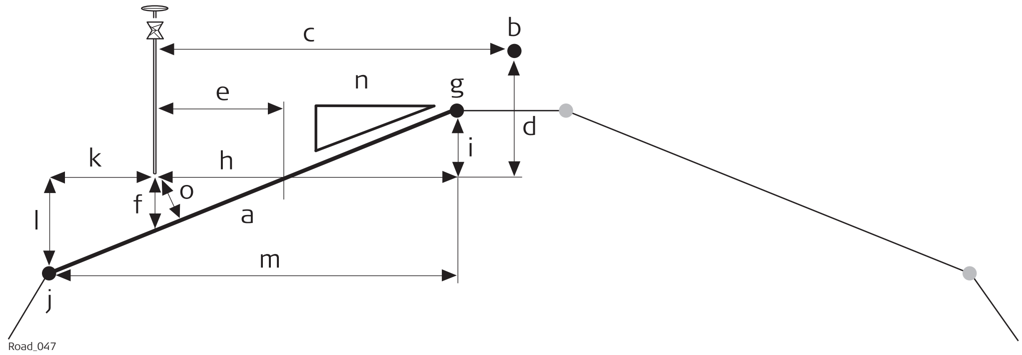
The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **Crown task** | Name defined for the road crown task. |
| **Additional line** | The name of an additional line. |
| **Additnl line chnge** | Current local chainage of additional line. |
| **Additnl line offset** | Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the **Offsets** page. |
| **Additnl line ht diff** | Current height difference to the additional line including the defined stake/check height difference of the additional line of **Offsets** page. |
| **Δ offset** | Horizontal offset to the line of the crown defined as the reference line.<br>If working in the toggle offset left/right mode, the correct line is automatically selected as the reference depending on whether the measured point is to the left or right of the middle line. Refer to "48.3.8 Measuring Road Crowns" for more information on the toggle offset left/right mode. |
| **Δ ht left** | Vertical offset to the left/right surface grade defining the road crown. |
| **Δ ht right** | Vertical offset to the left/right surface grade defining the road crown. |

| Field | Description |
|---|---|
| **Δ chainage** | Difference between the defined **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads **Δ chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Stake chainage** | Chainage to stake out. |
| **L surf. grade Δ ht** | Height difference from the road crowns left surface grade. |
| **R surf. grade Δ ht** | Height difference from the road crowns right surface grade. |
| **Ht diff crown** | Height difference from **Active surf. grade** of the crown. |
| **Active surf. grade** | Indicates if you are on the left or right surface grade of the road crown. |
| **Actv surf. grade ratio** | Slope ratio of **Active surf. grade**. This value is equal to **L surf. grade ratio** or **R surf. grade ratio** depending on the value of **Active surf. grade**. |
| **Left name** | Name of the left most line defining the road crown. |
| **Left offset** | Horizontal offset from the left line of the road crown. |
| **Left ht diff** | Height difference from the left line of the road crown. |
| **Right name** | Name of the left most line defining the road crown. |
| **Right offset** | Horizontal offset from the right line of the road crown. |
| **Right ht diff** | Height difference from the right line of the road crown. |
| **Mid name** | Name of the mid line defining the road crown. |
| **Mid offset** | Horizontal offset from the mid line of the road crown. |
| **Mid ht diff** | Height difference from the mid line of the road crown. |
| **L surf. grade ratio** | Slope ratio of the road crowns left surface grade. |
| **R surf. grade ratio** | Slope ratio of the road crowns right surface grade. |
| **Left width** | Horizontal width of the road crowns left surface grade. |
| **Right width** | Horizontal width of the road crowns right surface grade. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Curve type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "48.3.1 The Stake/Check Screen" for details on this field. |

| Field | Description |
|---|---|
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point on the crown = **Actual easting**). |
| **Current dsgn north** | Northing of the design for the current position relevant point on the crown = **Actual northing**). |
| **Current dsgn ht** | Height of the design for the current position (relevant point on the crown). |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

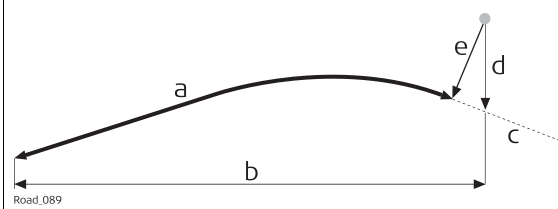
**Available fields**




a) Relevant part of the layer
b) Centreline
c) **CL offset**
d) **CL ht diff**
e) **Slope offset**
f) **Layer ht diff**
g) **Right name**
h) **Right offset**
i) **Right ht diff**
j) **Left name**
k) **Left offset**
l) **Left ht diff**
m) **Width**
n) **Slope ratio** or **Surface grade ratio**
o) **Square offset**

The following parameters are available. All fields are display only.

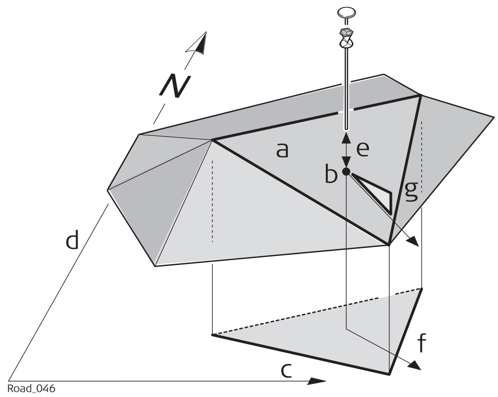
| Field | Description |
|---|---|
| **Layer task** | Name defined for the layer task. |
| **Layer name** | Name of the layer to check. |
| **Chainage** | Chainage of the current measured position. |
| **Δ chainage** | Difference between the defined **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads **Δ chainage**: **-----**. |
| **Stake chainage** | Chainage to stake out. |
| **Layer offset** | Horizontal offset from the layer. Surface between **Left line** and **Right line**. |
| **Layer ht diff** | Height difference of the measured position to the layer |
| **Δ height** | Height difference to the layer, including the stake or check height difference. |
| **Left name** | Name of the line next to the current position on the left side. |
| **Left offset** | Horizontal offset from the left line **Left name**. |
| **Layer ht diff** | Height difference to the left line **Left name**. |
| **Right name** | Name of the line next to the current position on the right side. |
| **Right offset** | Horizontal offset from the right line **Right name**. |
| **Right ht diff** | Height difference to the right line **Right name**. |
| **Slope ratio** | Ratio of the slope between the left line **Left name** and the right line **Right name**.<br>☞ The display format is defined as system setting in **Regional Settings**, **Slope** page. |
| **Surface grade ratio** | Ratio of the surface grade between the left line **Left name** and the right line **Right name**.<br>☞ The display format of the **Surface grade ratio** depends on the type chosen for **Surface grade** on **Regional Settings**, **Slope** page. |
| **Square offset** | Offset from the slope, perpendicular to the slope. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Curve type of the centreline. |
| **CL offset** | Horizontal offset from the centreline at the current chainage. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Traveller height** | The height of the traveller. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "48.3.1 The Stake/Check Screen" for details on this field. |

| Field | Description |
|---|---|
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **Vertical chainage** | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.<br><br>a) Vertical chainage<br>b) Chainage<br>c) Centreline<br>d) Centreline height difference<br>e) Vertical square offset |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point on the crown = **Actual easting**). |
| **Current dsgn north** | Northing of the design for the current position relevant point on the crown = **Actual northing**). |
| **Current dsgn ht** | Height of the design for the current position (relevant point on the crown). |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

## 46.3.8 Road DTM - Info Page

☞ An **Info** page for Road DTM is only available for **Roads - As built check**.

**Available fields**




a) Relevant triangle of the DTM
b) Projected point on DTM
c) Easting
d) Northing
e) **DTM height diff**
f) **Flow direction**
g) **Flow ratio**

The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| **DTM task** | Name defined for the DTM task. |
| **DTM height diff** | Vertical height difference to the DTM. |
| **Δ height** | Height difference to the layer including the stake or check height difference. |
| **DTM height** | Height of the DTM at the current measured position. |
| **Flow direction** | Direction of maximum slope ratio on the current DTM triangle. This direction is the direction water would flow toward from the projected point. |
| **Flow ratio** | Slope ratio of the DTM. This ratio is the maximum slope ratio of the triangle. |
| **DTM name** | Name of the DTM surface. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Actual height** | Height of the current position. |
| **Current dsgn east** | Easting of the DTM for the current position (= **Actual easting**). |
| **Current dsgn north** | Northing of the DTM for the current position (= **Actual northing**). |
| **Current dsgn ht** | Height of the DTM for the current position. |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |

## 46.3.9 Rail - Info Page

**Available fields**

The following parameters are available. All fields are display only.

| Field | Description |
|---|---|
| ∆ **offset** | Distance from the measured point to the point to set out in a direction perpendicular to the horizontal alignment. |
| ∆ **height** | Vertical offset between the defined position and the current position. |
| ∆ **chainage** | Difference between the defined **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads ∆ **chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL ht diff** | Height difference from the centreline. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the horizontal alignment at the chainage of the measured point. |
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Nearest hz tngnt pt** | Refer to "48.3.1 The Stake/Check Screen" for details on this field. |
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |
| **Actual easting** | Easting of the current position. |
| **Actual northing** | Northing of the current position. |
| **Current dsgn east** | Easting of the design for the current position (relevant point at the selected line). |
| **Current dsgn north** | Northing of the design for the current position (relevant point at the selected line). |
| **Current dsgn ht** | Height of the design for the current position (relevant point at the selected line). |
| **Quality 3D** | Standard deviation of the point measurement. |

| Field | Description |
|---|---|
| **Ht diff lower rail** | Height difference between the measured point and the lower rail. |
| **Ht lower rail** | Height of the lower rail at current chainage. |
| **Current design cant** | Design cant at the current position. |
| **Ref offset** | Horizontal distance between the measured point and the rail or centreline being used as a reference. |
| **Ref ht diff** | Height difference between the measured point and the rail or centreline being used as a reference. |
| **Offset (using cant)** | Offset calculated regarding the cant. |
| **Ht diff (using cant)** | Height difference calculated regarding the cant. |
| **Rail task** | Name of the current task. |
| **Rail name** | Name of the centreline or rail being used as a reference. |
| **Defined desgn cant** | Design cant at the defined chainage. |
| **Pendular length** | The pendulum length as distance value: The difference in elevation of the pendulum centre on the original track and above the axis point. |
| **Def pendulum displace-ment** | The defined horizontal displacement for the track. |
| **Def pendulum angle** | The pendulum angle is defined by the pendulum displacement and the superelevation (cant). |
| **Actl pendulum displace-ment** | The current horizontal displacement for the track. |
| **Line space half** and **Line space full** | Empty line. |
| **Current cant** | Available for Check. Superelevation of the current position. This value is calculated by using the 'Second Point of Cant' option, which is located in the Tools menu. |
| **Measured cant** | Displays the value entered on **Check Track**, **General** page. The value is usually measured with a camber measurement instrument.<br>Using **Second Point of Cant** of the Tools menu, **Measured cant** on the **Info** page is set to **-----** and is not stored in the DBX. This means, that the cant value of **Second Point of Cant** (current cant) is used and not the manually entered measured cant value. |
| **Cant difference** | The calculation depends on the setting for **Superelevation** in **Configuration**, **Rail design** page:<br>• For **Superelevation**: **Design**:<br>**Cant difference** = Measured cant - Current design cant<br>• For **Superelevation**: **Manual**:<br>**Cant difference** = Measured cant - Manually defined cant of **Check Track**, **General** page<br>• For **Superelevation**: **None**:<br>**Cant difference** = **-----** |
| Also available for **Method to use**: **Track + gauge device** or **Rails + gauge device**:: | |

| Field | Description |
|---|---|
| **∆ Offset** | Difference between the theoretical position of the rail director and the measured position. |
| **Left rail ∆ height** | Height difference between the theoretical left rail position and the measured position. |
| **Right rail ∆ height** | Height difference between the theoretical right rail position and the measured position. |
| **Measured gauge** | Gauge value measured by the gauge device. |
| **Measured gauge** | Cant value measured by the gauge device. |
| **∆ Gauge** | Difference between the nominal gauge and the gauge measured from the gauge device. |

## 46.3.10 Tunnel TPS - Info Page

**Available fields**

The following parameters are available. All fields are display only.

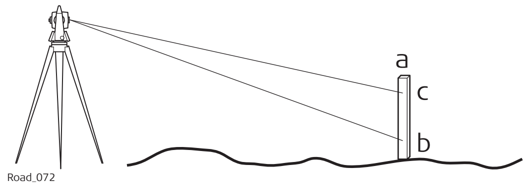
| Field | Description |
|---|---|
| **Line task** | Name of the current task. |
| **∆ offset** | Horizontal offset between the defined position and the current position. |
| **∆ height** | Vertical offset between the defined position and the current position. |
| **∆ chainage** | Difference between the defined chainage **Stake chainage** on the **General** page and the current chainage **Chainage** shown on the **Stake** page.<br>☞ If no defined chainage exists, for example if staking out random chainages or checking, this field reads ∆ **chainage**: **-----**. |
| **Chainage** | The current chainage. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **Line offset** | Horizontal offset from the line. |
| **Line ht diff** | Height difference from the defined line. |
| **Line name** | Name of the line to stake out or the stake out is relative to. |
| **CL ht diff** | Height difference from the centreline. |
| **Vertical sqr offset** | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| **CL height** | Height of the centreline at the current chainage. |
| **CL radius** | Radius of the centreline at the current chainage. |
| **CL type** | Element type of the centreline. |
| **CL offset** | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for **Navigation direction** and **Navigate using** in **Configuration**, **Graphics** page. |
| **CL tangent** | Tangent direction of the centreline at the current chainage. |
| **Nearest hz tngnt pt** | Distance to the nearest horizontal tangent point of the design. Refer to "The Stake/Check Screen" for details on this field. |
| **Nearst vt tngnt pt** | Distance to the nearest vertical tangent point of the design. |
| **CL grade** | Grade of the centreline at the current position. |
| **Direction to point** | Direction from the current position to the point to stake out. |
| **Distance to point** | Distance from the current position to the point to stake out. |
| **Defined easting** | Easting of the point to stake out. |
| **Defined northing** | Northing of the point to stake out. |
| **Defined height** | Height of the point to stake out. |

| Field | Description |
|---|---|
| **Actual easting** | Easting of the design for the current position (relevant point at the selected line). |
| **Actual northing** | Northing of the design for the current position (relevant point at the selected line). |
| **Actual height** | Height of the design for the current position (relevant point at the selected line). |
| **Quality 3D** | Standard deviation of the point measurement. |
| **Line space half** and **Line space full** | Empty line. |
| **ΔProf** | Distance from the design profile to the measured point. |
| **Profile element no.** | Element number of the closest design profile element to the measured point. |
| **Profile element(%)** | Distance in percentage terms of the measured point along the design profile element. |
| **Dist along profile** | Distance of the measured point along the design profile starting at the origin of the profile. |
| **Top distance** | Distance of the measured point along the design profile starting at the top of the profile. |
| **CL Off Rotated** | Perpendicular horizontal offset from the current position to the centreline, along the X-axis of the rotated tunnel profile |
| **CL Ht Diff Rotated** | Height difference from the current position to the centreline along the Y-axis of the rotated tunnel profile. |

## 46.3.11 Workflow for Height (aim to stake ht) TPS

**Step-by-step**

In this example, the height of the surface grade is marked on a peg by using the auto position function.




a) Peg placed at the correct position
b) First height, manually chosen direction
c) Required height on the peg

| Step | Description |
|---|---|
| 1. | In the **Configuration**, **TPS** page, select **Turn to**: **Prompt before turn**. |
| ☞ | Make sure that the instrument uses the reflectorless EDM mode. |
| 2. | After staking out the peg at the correct position with **Stake Surface Grade**, aim the instrument at the peg. |
| 3. | Press Fn **Positn** to open the **Configuration** screen. |
| 4. | **Configuration**<br>Highlight **Height (aim to stake ht)**. |
| 5. | Press **OK**. |
| ☞ | The instrument searches for the point on the peg at the required height without changing the horizontal direction. |
| ☞ | As soon as the defined **Upper ht limit**/**Lower ht limit** from **Configuration**, **Quality control** is reached, the instrument stops. |
| ☞ | Depending on the settings chosen, the instrument turns on the red laser to mark the height. |

## 46.4 Working with Shifts

**Description**

When working on site, often design data does not match the measured data. For example, an existing road surface that should intersect with the design surface may be 15 cm higher than the plans indicate. To guarantee a smooth intersection, this difference has to be distributed over the remaining 100m of paving. To handle these situations, shifts can be added to the existing design data. A shift is applied when selecting the element to stake out/check.

Horizontal and vertical shifts can be applied to the selected element. By using these shifts the design can be lifted/lowered and moved horizontally.

A shift is always an overlay of the existing design and is stored with the task. For a horizontal alignment, the shift is applied perpendicular to the centreline. For the vertical part of the alignment, shifts are applied following the plumb line.

☞ Shifts are applied temporarily to the design data. The original design data is not modified when a shift is applied.

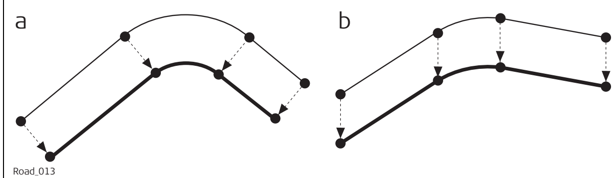
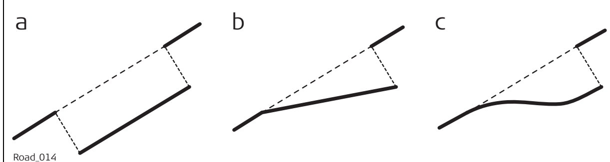
**Access**

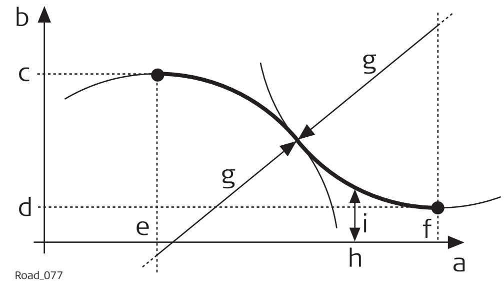
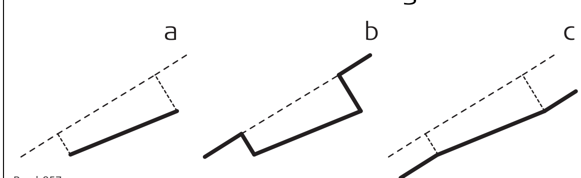
Press **Shifts..** in the Define screen.

**Shift Settings, Horizontal shift/Vertical shift/Scale profile/Apply an expand or shrink value to scale the tunnel profile page**

The parameters required for applying the shift are identical for all entities.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Apply horizontal shift/Apply vertical shift** | Check box | When this box is checked, shifts can be defined.<br>Horizontal shifts are always rectangular to the centreline of the element being worked with. Whereas vertical shifts are defined along the plumb<br>line.<br><br>a) Horizontal alignment with constant shift<br>b) Vertical alignment with constant shift |
| **Shift type** | | <br>a) Constant shift<br>b) Linear shift<br>c) Parabolic shift and reverse curve |
| | **Linear** | The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed in a linear fashion. |
| | **Constant** | A constant shift is applied from the begin chainage of the shift to the end chainage of the shift. The shift stays the same from its start chainage or station to the end chainage or station. |
| | **Parabolic** | Available for Road and Rail. The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed using a cubic parabola. Parabolic shifts allow a smooth transition between the existing curve and the shifted part. |
| | **Reverse curve** | Available for Road and Rail. Two arcs with the same radius are used to distribute the shift. As for parabolic shifts, reverse curves guarantee a smooth transition between the existing curve and the shifted part. |

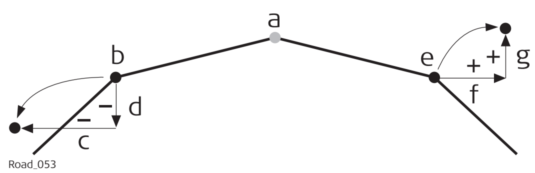
| Field | Option | Description |
|---|---|---|
| | | <br>a) Chainage<br>b) Shift<br>c) Start shift at chainage (e)<br>d) End shift at chainage (f)<br>e) Start chainage of the shift<br>f) End chainage of the shift<br>g) Radius of the two arcs used as transition curve<br>h) Random chainage between (e) and (f)<br>i) Shift applied at chainage (h) |
| **Begin chainage** | Editable field | Chainage from which the shift is applied. |
| **Begin shift** | Editable field | Magnitude of the shift to apply at the begin chainage. |
| **Shift value** | Editable field | Available for **Shift type**: **Constant**. The magnitude of shift. |
| **End chainage** | Editable field | Chainage at which the shift ends. |
| **End shift** | Editable field | Magnitude of the shift to apply at the end chainage. |
| **Before / after** | | Available for Road and Rail. Defines the object outside of the defined shift range.<br><br>a) **None**<br>b) **Step**<br>c) **Parallel** |
| | **None** | The object only exists within the defined shift range. |
| | **Parallel** | The begin shift and the end shift are continued parallel. The start shift is used from the start of the alignment until the start chainage. The end shift is used from the end chainage until the end of the alignment. |
| | **Step** | Before/after the defined shift range, no shift is added. Outside of the defined shift area the original design is used. This option means a "step" will appear at the start and/or end of the shifted area. |

**Plot page with shifts**

The application offers for all stakeout and check methods a page showing a graphical representation of the measured position in relation to the design. If shifts are applied to the design the plot shows the original unshifted cross section view of the design as well as the shifted element. The current element is shown in blue.

**Sign convention for shifts**

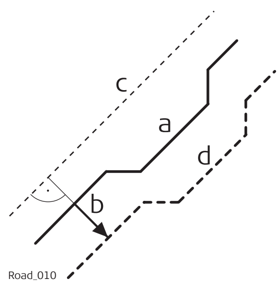
The sign convention for design shifts is identical to the convention used for stake offset and height difference.




a) Centreline
b) Line on left side
c) Negative horizontal shift
d) Negative vertical shift
e) Line on right side
f) Positive horizontal shift
g) Positive vertical shift

☞

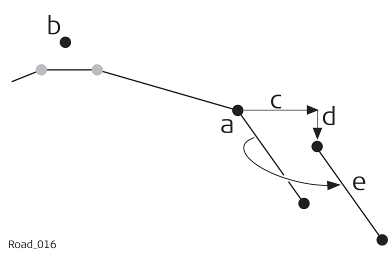
Horizontal stake offsets are always defined perpendicular to the centreline of the layer the line/s belongs to.




a) Line the horizontal shift is applied to
b) User defined horizontal shift for the line
c) Centreline
d) Shifted line

**Shifts for lines, slopes, layers and DTMs**

The shifts applied to lines, slopes, road crowns layers and DTMs are identical with one exception: Given that DTMs are not defined relative to a centreline and hold no orientation information, no horizontal shift is possible for a DTM.

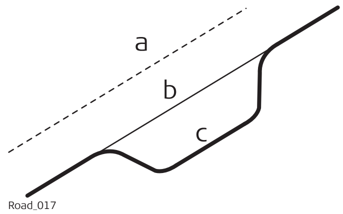



a) Slope to shift
b) Centreline
c) Value for horizontal shift
d) Value for vertical shift
e) Shifted slope

**Shift for surface grade and road crowns**

### Description

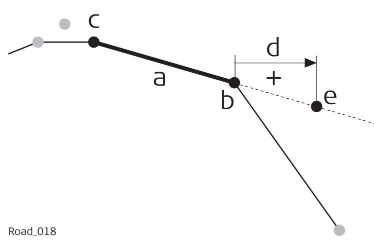
To allow widening and narrowing of surface grade and road crowns, only one of the two lines defining the surface grade or crown, is shifted when adding a horizontal shift. This behaviour is useful for small changes to the original design, for example to bus stops or emergency bays.




a) Centreline
b) Original line of the design
c) Line with horizontal parabolic shift

### Horizontal shift

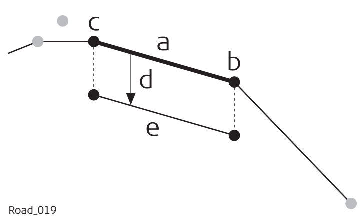
For surface grades and crowns, the horizontal shift is added to the line that is defined as the reference line. To maintain the original surface grade/crown ratio the line is shifted along the surface grade/crown.




a) Surface grade to shift
b) Reference line of the surface grade
c) Second line of the surface grade
d) Positive horizontal shift
e) Position of the shifted reference line

### Vertical shift

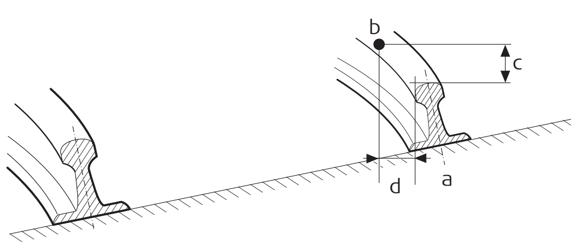
The vertical component of the shift for a surface grade or crown is applied to all lines.




a) Surface grade to shift
b) Right line of the surface grade
c) Left line of the surface grade
d) Negative vertical shift
e) Shifted surface grade

**Horizontal alignment with constant horizontal shift**

Horizontal shifts are always perpendicular to the centreline.




**Plan view**
a) Reference line
b) Point to stake
c) Stake height difference
d) Stake offset

# 46.5 Tasks

**Description**

When staking out or checking a road/rail/tunnel, often it is not possible to finish a particular task in one go. The element to be staked out or checked can be stored together with all defined settings as a work task.

Stored in a task are:
- Selected layer
- Working chainage
- Selected line(s) or element
- Shifts

Tasks are stored within the selected Road/Rail/Tunnel job. They can be created at any time when working in the field or during preparation in the office.
Deleting a task does not delete the referenced jobs.
Deleting a Road/Rail/Tunnel job deletes all referencing tasks.
Tasks are method-specific.

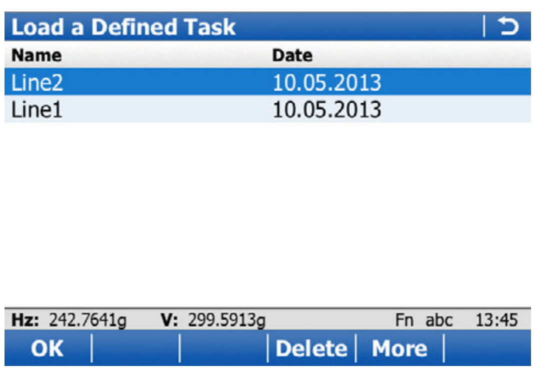
**Creating a task**

| Step | Description |
|---|---|
| 1. | Start the Roads/Rail/Tunnel application. |
| 2. | In the job selection screen, select the required jobs and press **OK**. |
| 3. | Select a method, if required, and press **OK**. |
| 4. | In the Define screen press **Save..**. |
| 5. | Type in a name for the task and press **OK**. |

**Loading a task**

**Access**
Press **Load..** in the Define screen.

**Load a Defined Task**

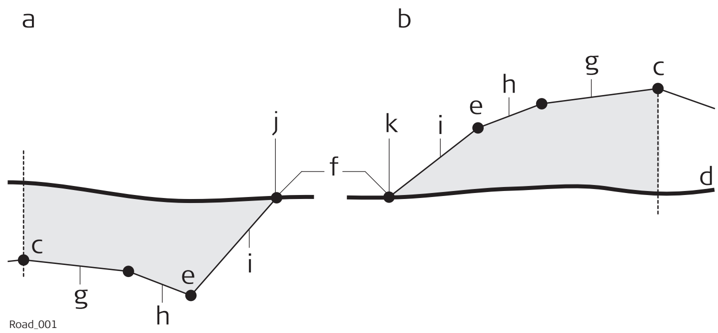



| Key | Description |
|---|---|
| **OK** | To select the highlighted task and continue. |
| **Delete** | To delete the selected task. |
| **More** | To display information about **Date**, **Time**, **Creator** and **Description**. |
| Fn **Name** or **Time** | To sort task list by name or time. |
| Fn **Quit** | To exit the application. |

## 46.6 Understanding Terms and Expressions

### 46.6.1 Road - Basic Terms

**Terms and expressions**




a) Cut situation
b) Fill situation
c) Centreline
d) Natural surface
e) Hinge point
f) Catch point
g) Carriage way
h) Shoulder
i) Slope
j) Top
k) Toe

| Term / expression | Description |
|---|---|
| **Carriage way** | The part of the road on which users drive once the road is finished. |
| **Shoulder** or **Verge** | Often located next to the carriage way, usually with a slightly higher slope ratio than the carriage way. |
| **Slope** | Located next to the verge and can be thought of as linking the road level with the natural surface. The ratio of the slope is greater than the ratio of the verge. A slope starts at the hinge point. |
| **Natural surface** or **original ground** | The undisturbed surface before project construction. |
| **Finished road level** | Describes the final road surface. |
| **Catch point** or **daylight point** | Indicates the point of intersection between the slope and the natural surface. Both the hinge point and the catch point lie on the slope. For a cut slope, the catch point forms part of the top of a bank. For a fill slope, the catch point forms part of the bottom of a bank. |
| **Chainage** or **station** | The cumulative distance along the centreline, frequently but not always starting at zero. |

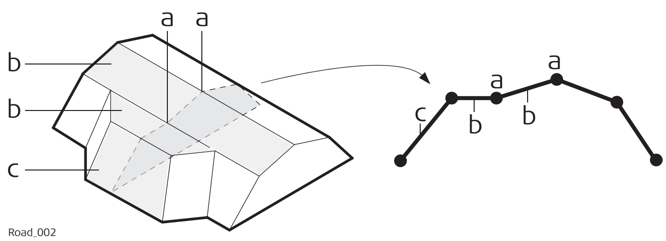
## 46.6.2 Road - Horizontal and Vertical Geometry Elements

| | |
|---|---|
| **Horizontal alignment** | The application supports the following elements in the horizontal component of alignments:<br>• Straights<br>• Arcs<br>• Clothoids, entry and exit as well as partial<br>• Cubic parabolas, entry and exit as well as partial<br>• Bloss curves, entry and exit as well as partial; only available for Rail<br>• Multipoints, all elements that cannot be described by one of the previous types are represented by discrete points along the curve. For example, a line parallel to a clothoid. |
| **Vertical alignment** | The application supports the following elements in the vertical component of alignments:<br>• Straights<br>• Arcs<br>• Quadratic parabolas<br>• Asymmetric quadratic parabola<br>• Multipoints, all elements that cannot be described by one of the previous types are represented by discrete points along the curve. |

### Description

In general, there are four different basic stakeout and check elements:

- Surface grades, for example, the final carriage way
- Lines, for example, a centreline
- Slopes, for example, the end-slopes of a cross section
- Surfaces, for example, a DTM surface



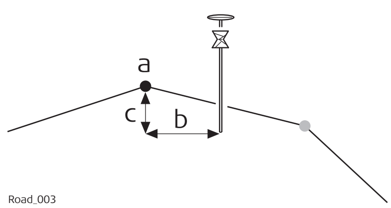

a) Lines
b) Surface grades
c) Slopes

Every stakeout or check is based on one or more of these four base elements. For example, a road crown consists of two surface grades with one common line.

### Lines

The stake out of a line is used in different situations:

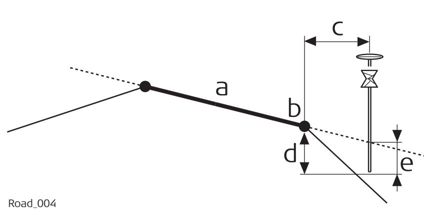
- Centre line of a road
- Edges of a road or any other change in slope
- Gutters
- Pipelines, cables and any other line-related design feature




a) Line to stake out or check, in this case the centreline
b) Line offset
c) Line height difference

### Surface grades

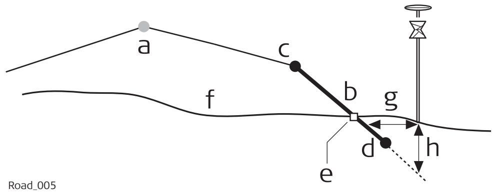
Surface grades are defined by two lines. The two lines define the right and left edge of the surface grade. One of the two lines is used as the reference line.




a) Surface grade to stake out or check
b) Reference line
c) Horizontal offset to reference line
d) Height difference to reference line
e) Height difference to expanded surface grade

**Slopes**

Slopes, like surface grades, are defined by two lines. Different to surface grades, only one edge of the slope, the hinge point, is known. The second edge, catch point or daylight point, is defined by the intersection of the slope and the natural surface. As the natural surface is unknown this edge can only be staked out in the field. Finding and staking out the catch point is the most important task when working with slopes.




a) Centreline
b) Slope
c) Hinge Point
d) Second line defining the slope
e) Catch point
f) Natural surface
g) Δ Offset from the slope
h) Height difference from the slope

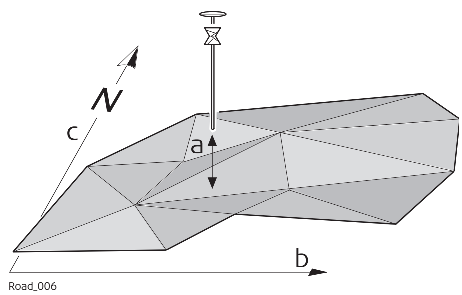
---

**Surfaces**

There are two types of surfaces supported that represent a three-dimensional design:

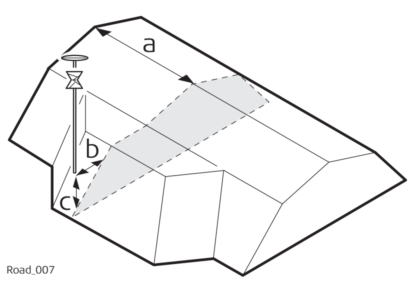
- DTM / TIN (**D**igital **T**errain **M**odel; **T**riangular **I**rregular **N**etwork)
- Layer

A DTM consists of several 3D triangles. DTMs do not include information relating the DTM to a centreline. Positions are defined by easting, nothing and height values.




a) Height difference from the triangle of the DTM found in the same vertical line as the measured point
b) Easting of coordinate system
c) Northing of the coordinate system

A layer is a combination of lines that form a 3D surface relative to a centreline. Thus it is possible to define points by chainage or station, offset and height. Refer to "46.2.3 Design Data" for more information.



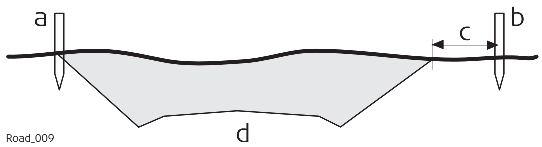

a) Chainage or station
b) Layer Offset
c) Layer height difference

---

## 46.6.4 Road - Stake Offset and Stake Height Difference

**Description**

When conducting a stake out, the aim is usually to mark the position of geometric elements defined by the design. For example, in the graphic below, the catch point of a slope. A point can be staked either directly or indirectly. For a directly staked point, the peg ends up at exactly the position of the point to be staked. Staking the same point indirectly, the peg will be placed with a certain offset to the point.




One reason to stake out a point indirectly is that the peg would not last long at the position of the actual point. In this example, the peg staked directly would be removed as soon as the excavation work starts.

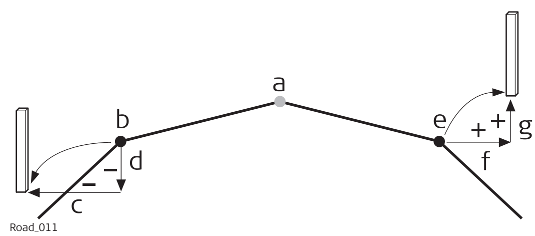
☞ Horizontal stake offsets are, like shifts, defined perpendicular to the centreline of the layer the line(s) belongs to, if no offset angle has been defined. For surface grades and road crowns, the stake offset is applied following the same rules as stated for horizontal shifts. Refer to "46.4 Working with Shifts" for more information.

**Stake offset**

For each stakeout method, a horizontal and/or vertical offset can be defined. The stake offset and stake height difference are defined on the **Offsets** page of the stake screen.

**Sign convention for stake offset and height difference**

The sign convention for stake offsets and height differences is identical to the convention used for design shifts.




a) Centreline
b) Line on left side
c) Negative stake offset
d) Negative stake height difference
e) Line on right side
f) Positive stake offset
g) Positive stake height difference

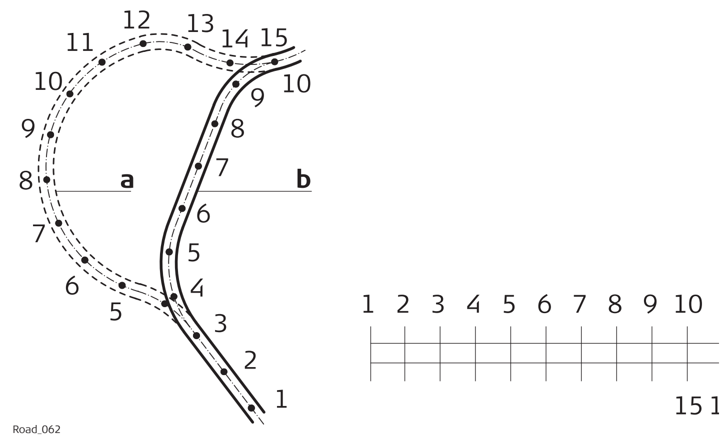
**Plot page with stake offset and stake height difference**

The application offers for all stake out methods a page showing a graphical representation of the measured position in relation to the design. If stake offset and/or stake height difference are used, the plot shows the original cross section view of the design as well as the position to stake out. The position to stake out is marked by a yellow/black peg.

## 46.6.5 Road - Chainage or Station Equations

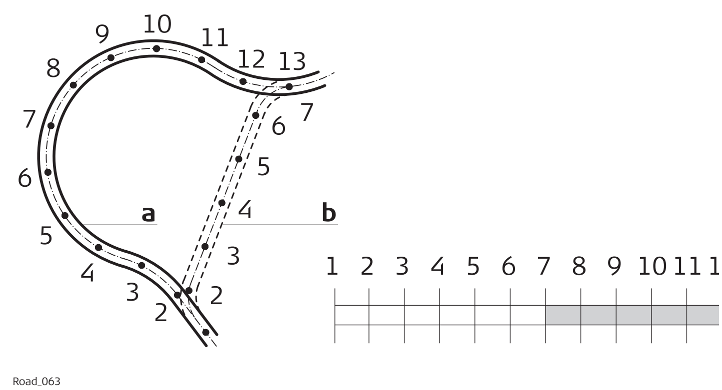
**Description**

Chainage or station equations are used to adjust the alignment chainage or station. The most common reason for doing so is the insertion or removal of curves during the design process. Inserting or removing a curve would require recalculating the chainage or station of an entire alignment. Using chainage or station equations eliminates this need. Chainage or station equations can create either a gap or an overlap as shown in the following diagrams.




Gap chainage or station equation. Chainage or station back 10 = chainage or station ahead 15.

a) Old
b) New




Overlap chainage or station equation. Chainage or station back 13 = chainage or station ahead 7.

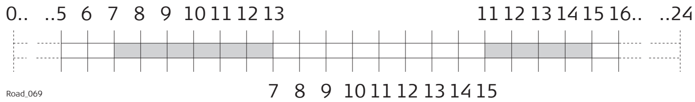
a) New
b) Old

**Multiple chainage or station**

In the case of the overlap shown in the example, the chainages or stations between seven and thirteen appear twice. When a duplicate chainage or station is entered, a message asks which one is to be used.

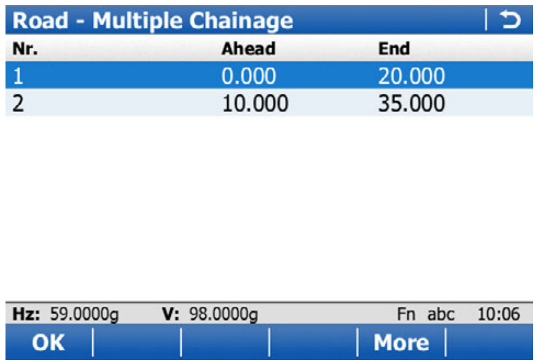
**Example**

As more than one chainage or station equation is possible, a chainage or station can appear more than twice on a design. In this example, the chainages or stations 11 to 13 appear three times.




Overlap chainage or station equation. Chainage back 13 = chainage ahead 7 and chainage back 15 = chainage ahead 11.

In this example, when chainage or station 12 is entered in **Road - Multiple Chainage**, the following screen shows how the option to select the right chainage or station is displayed:




| Key | Description |
|---|---|
| **OK** | To select the highlighted chainage or station equation and return to the stake out screen. |
| **More** | To switch the value displayed in the last column to show the end chainage or station of the chainage or station equation. |

**Description of columns**

| Column | Description |
|---|---|
| **End** | Shows the end chainage or station for the chainage or station equation. **End** shows to which chainage or station, the current chainage or station equation is valid. If for the first part of the alignment, no chainage or station equation exists, **Ahead** stays empty for the first row. |

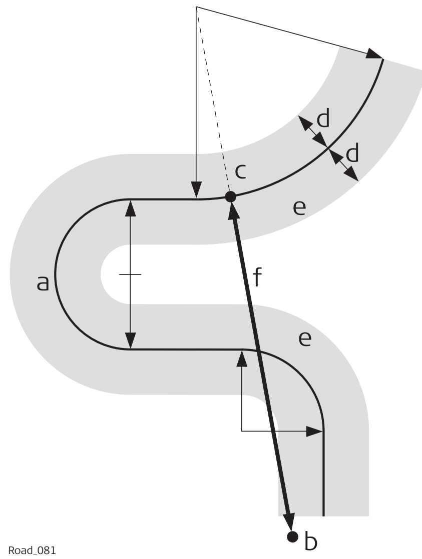
## 46.6.6 Road - Working Corridor

**Description**

A working corridor defines the valid offset range left and right of the centreline. When working with irregular alignments such as traffic islands and parking lots, working corridors are useful to avoid displaying results from the wrong centreline element.

The following example shows the result if working without a defined working corridor. For the measured position (b), the application finds the centreline point (c) with the minimum perpendicular offset (f).

With a defined working corridor (e), the application would display a message advising that the measured position is outside of the defined centreline.




a) Centreline
b) Measured position
c) Projected point on the centreline
d) Defined offset range for the working corridor
e) Working corridor
f) Offset from the centreline, if no working corridor is used

The working corridor is defined in **Configuration**, **Design** page. Refer to "46.3 Configuring Roads Applications" for more information.

## 46.6.7 Road - Extension of the Centreline

**Description**

Whenever centrelines must be extended, for example, at the start and end area of an alignment or slope. The projection of the measured position to the centreline is made using the tangent of the start/end point of the centreline.
In this case a warning appears informing that the original design is exceeded. The application will advise as soon as a measured position is within the design area once again.

**Concept**

When expanding the centreline the geometry will be continued using the tangent of the start/end point of the centreline.


a) Centreline
b) Extended centreline

**Method**

**Description**
When staking out in the region of the start/end area of the design centreline, situations occur where an expansion of the centreline is useful. As soon as measurements are outside the defined centreline, the application will prompt if, and with which method, the centreline should be expanded.

☞ The extension of a centreline is made following its start/end tangent. Outside of the original design area correct results cannot be guaranteed.

## 46.6.8 Road/Rail - Working with Heights

**Description**

Normally, heights stored with the design data are used. The Rail application offers the possibility to switch to either:

- a height which is entered manually by the user,
  This option enables the manual definition of a height, which can be applied for staking out or checking. This height is entered in the General page.
- a height which is retrieved from an existing Height Layer, as defined in the DTM job associated with the project. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments. 2D and 3D are possible.
  This option is configured in the Tools menu.

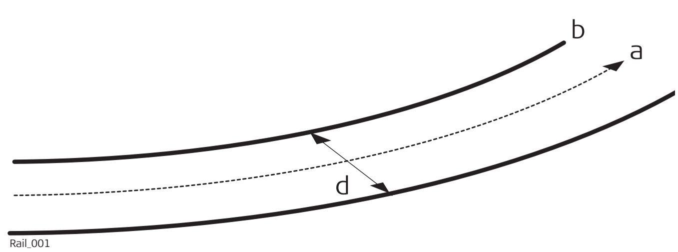
**Understanding priorities of various heights**

| Type of height | Overrules | Stake Height Diff |
|---|---|---|
| Manually entered | All other heights | Considered |
| Of individual point | All other heights | Considered |
| From height layer of DTM | Design height | Considered |
| From design | No other heights | Considered |

**Terms and expressions**

| Term / expression | Description |
|---|---|
| **Track** | A track comprises two separate rails. |
| **Single track** | A single track is defined as one track with one centreline and two rails. All chainages are calculated from the centreline. |
| **Track centreline** | Geometric alignment in two or three dimensions to which all design elements of the project are referenced. It could be that the vertical component of the alignment does not coincide with the plan component. In this case the vertical part of the alignment will generally coincide with the lowest rail. |
| **Chainage or station** | The cumulative distance along the centreline, frequently but not always starting at zero. |
| **Left/right rail** | Planimetric position of the left/right rail of a track.<br>The sense of the left/right rail is given by the direction of increasing chainage.<br>When a section of the track is viewed in the direction of increasing chainage, the left rail is to the left of the centre of the track. |
| **Nominal gauge** | The nominal distance between the active (internal) faces of the left and right rails. |
| **Superelevation base** | The distance over which the superelevation is applied. This distance is normally the distance between the centre of the left and right rail. |
| **Left/right superelevation**<br>**Left/right cant** | The superelevation or height difference of each rail with respect to the track centreline. Usually expressed in millimetres.<br>If one of the rails is used to rotate the track section, or the height of the vertical alignment coincides with the lowest rail, the superelevation of the rotation point or lowest rail will be zero.<br>Superelevation is also known by the term cant. These two words can be interchanged. |

**Diagram - Plan**



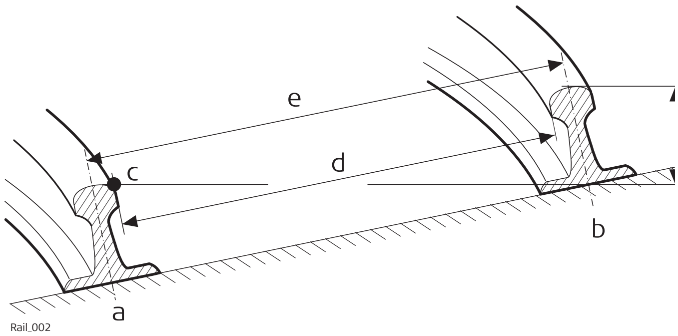

a) Track centreline
b) Left rail
c) Right rail
d) Nominal gauge

**Diagram - Section**

Two generic methods can be used to define the section of the track.

**Method 1 - A definition using rotation around a known point**

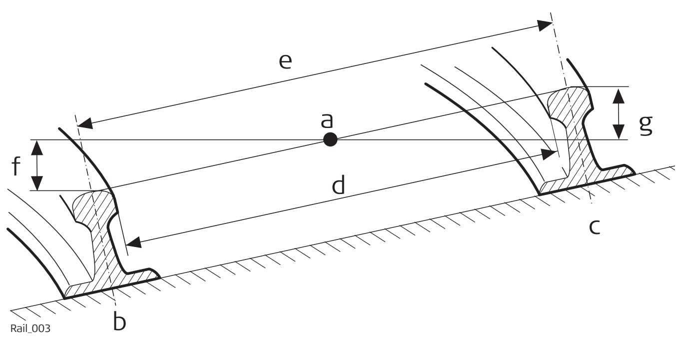
This method involves rotating the section around a known point, normally the lowest rail.




a) Left rail
b) Right rail
c) Rotation point
d) Nominal gauge
e) Superelevation base
f) Superelevation (cant)

**Method 2 - A definition using relative height distances**

This method uses height differences relative to the vertical alignment to define the height of the left and right rail.

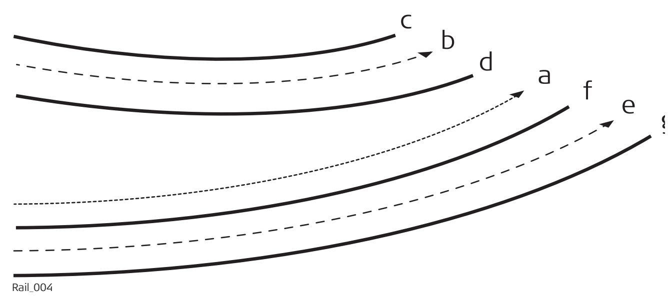



a) Track centreline
b) Left rail
c) Right rail
d) Nominal gauge
e) Superelevation base
f) Left superelevation (left cant)
g) Right superelevation (right cant)

**Description**

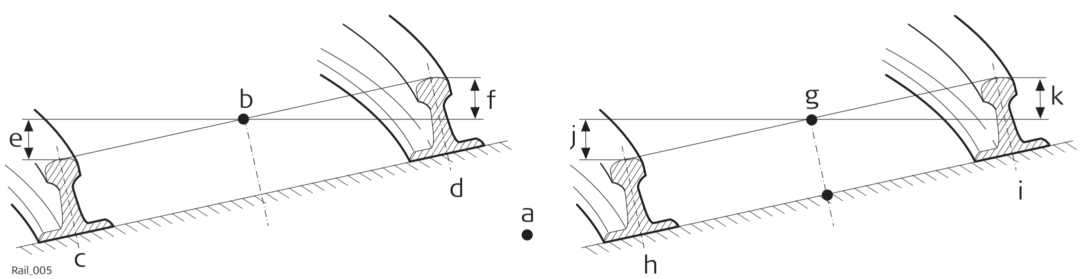
Multiple tracks are used when more than one track share a common centreline, from which all chainages are calculated.
When there are multiple tracks with independent centrelines for each track, each track is then considered as a single track. Refer to "46.6.9 Rail - Working with a Single Track" for details on single tracks.

**Diagram - Plan**




a) Chainage centreline
b) Left track centre ine
c) Left track left rail
d) Left track right rail
e) Right track centreline
f) Right track left rail
g) Right track right rail

**Diagram - Section**




a) Chainage centreline
b) Left track centreline
c) Left track left rail
d) Left track right rail
e) Left track left rail superelevation
f) Left track right rail superelevation
g) Right track centreline
h) Right track left rail
i) Right track right rail
j) Right track left rail superelevation
k) Right track right rail superelevation

**Calculations**

For multiple tracks, the chainage centreline is used only to calculate the chainage. The superelevation of each track is calculated with respect to the corresponding (left / right) vertical alignment. The chainage centreline can consist of a plan and a vertical component. Although the vertical component of the chainage centreline is not used for any calculation.

## 46.6.11 Rail - Check Elements and Stakeout Elements

**Description**

Points can be staked with respect to three basic elements of the track:

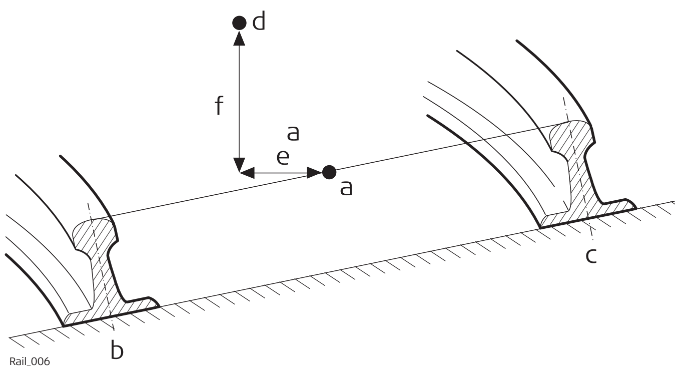
- Track centreline
- Left rail
- Right rail

**Centreline stakeout**

**Description**

The line to stake out can be a track centreline or, in the case of multiple tracks, the left or right track centreline. In both cases, a horizontal offset with respect to the centreline can be applied. Additionally, if a vertical alignment is available for a track centreline, a vertical offset can be applied.

**Diagram - Single track elements**




a) Track centreline
b) Left rail
c) Right rail
d) Point to stake
e) Horizontal offset from track centreline
f) Vertical offset from track centreline

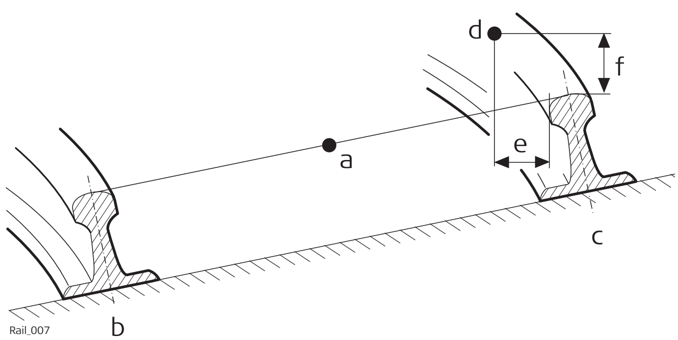
**Left/right rail stakeout**

**Description**

The left or right rail of a track can be staked out:

- directly,
- horizontal and/or vertical offsets can be used to stake any point relative to either rail.

**Diagram - Staking out a point relative to the right rail**



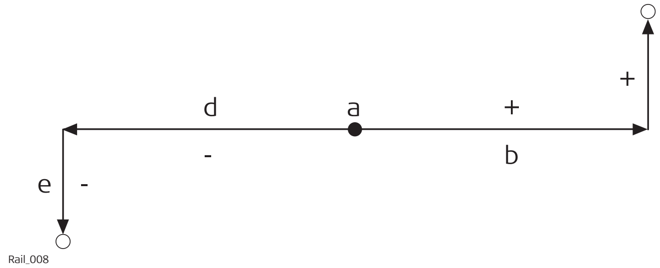

a) Track centreline
b) Left rail
c) Right rail
d) Point to stake
e) Horizontal offset from right rail
f) Vertical offset from right rail

☞ The position from which the horizontal and rail offsets will be applied depends on how the left and right rails were defined in the imported design data. Using standard practice, the horizontal offset would be defined from the active face of the rail, and the height offset would be defined from the highest part of the rail, as shown in the diagram.

## 46.6.12 Rail - Working with Offsets

**Sign convention for offsets**

The sign convention for offsets is:

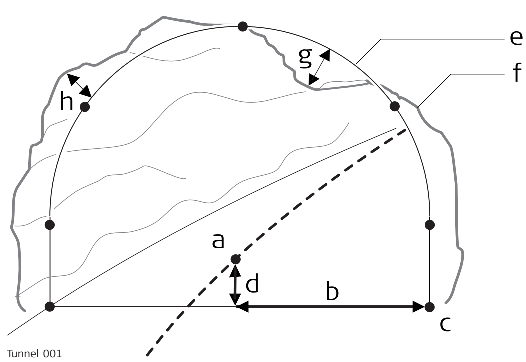



a) Centreline
b) Positive horizontal offset
c) Positive vertical offset
d) Negative horizontal offset
e) Negative vertical offset

**Terms and expressions**

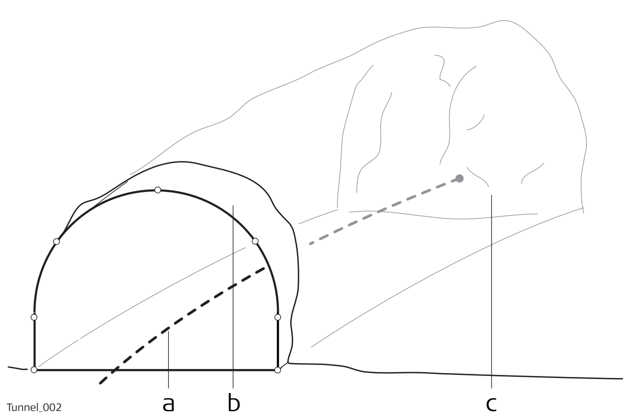
| Term / expression | Description |
|---|---|
| **Centreline** | Geometric alignment in two or three dimensions to which all design elements of the project are referenced. |
| **Chainage or station** | The cumulative distance along the centreline, frequently but not always starting at zero. |
| **Design Profile** | Geometric description of the designed shape of the cross-section of the tunnel. The design profile can contain straight or curve elements. |
| **Excavated Profile** | Shape of the cross-section of the tunnel that has been excavated. |
| **Underbreak** | When the excavated profile is inside the design profile, the underbreak is the perpendicular distance between the design profile and the excavated profile. |
| **Overbreak** | When the excavated profile is outside of the design profile, the overbreak is the perpendicular distance between the design profile and the excavated profile. |
| **Tunnel Portal** | The open end of a tunnel. |
| **Tunnel Face** | The point where the excavated tunnel meets existing terrain. |
| **Superelevation (Rotation)** | Angle of rotation of a design profile. Used to take into account the velocity of a moving vehicle through a curve. |
| **Rotation Point** | The point about which the design profile is rotated. This point may or may not coincide with the centreline. |

**General terms**



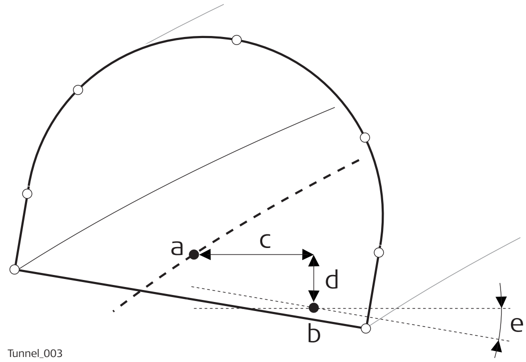

a) Centreline
b) Centreline offset
c) Point on design profile
d) Centreline height offset
e) Design profile
f) Excavated profile
g) Underbreak
h) Overbreak

**3D View**




a) Centreline or axis
b) Tunnel portal
c) Tunnel face

## Superelevation




a) Centreline or axis
b) Rotation point
c) Centreline offset
d) Centreline height offset
e) Superelevation (Rotation)

**Tunnel face**

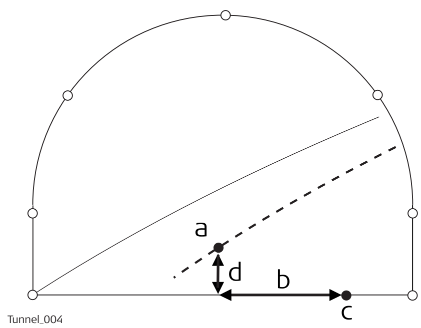
### Staking tunnel faces

It is usually required to stake out the tunnel face to indicate the position to excavate when certain tunnelling methods are used. For example, Drill and Blast or excavation using a roadheader.

The points to stake on the tunnel face can be defined in various ways:

### Horizontal and vertical offsets

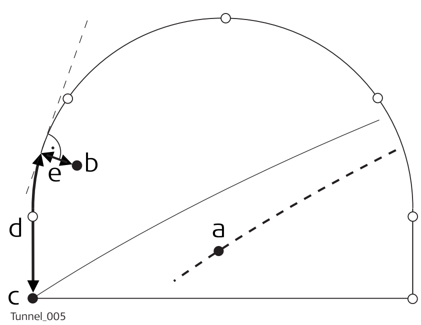
By horizontal and vertical offsets with respect to the centreline:




a) Centreline
b) Point on tunnel face to stake
c) Centreline offset
d) Centreline height offset

### Distance along profile

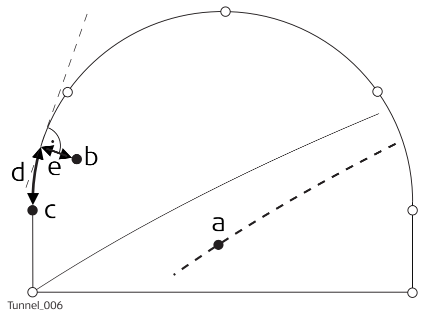
By the distance from the start of the design profile and an offset from the design profile.




a) Centreline
b) Point on tunnel face to stake
c) Point defining start of design profile
d) Distance from start of design profile
e) Offset perpendicular to design profile

**Distance along a particular element**

By the distance along a particular element of the design profile and an offset from the element.




a) Centreline
b) Point on tunnel face to stake
c) Element of design profile to stake
d) Distance from start of design profile element
e) Offset perpendicular to design profile

---

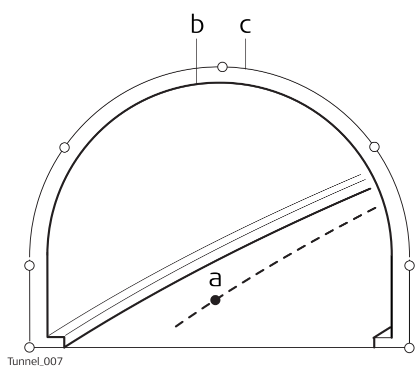
**Tunnel profiles**

**Staking tunnel profiles**

Tunnel profiles are normally staked after excavation to indicate the position of tunnel design elements or services such as lighting or ventilation.

**Basic terms**

Usually a tunnel under construction is designed and built in various stages such that a given chainage can have various design profiles. For example shotcrete or final lining. Each design profile is called a layer.



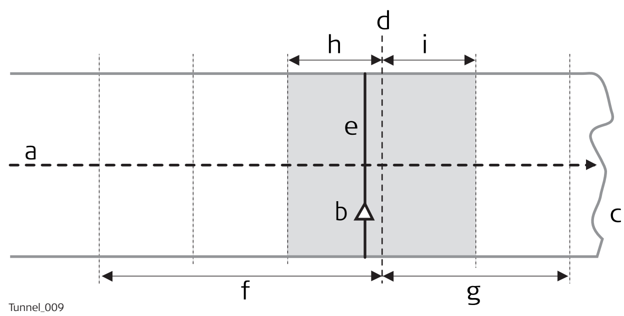

a) Centreline or axis
b) Final lining
c) Shotcrete

### Measuring tunnel profiles

Tunnel profiles are normally measured after excavation to compare the excavated profile with the design profile. This check can occur during the excavation phase of the project or for quality control checks of the built tunnel.

When measuring tunnel profiles, it is possible to scan various profiles from one instrument position. The profiles to scan are defined with respect to a defined chainage. Profiles can be scanned at a given forward and back interval within a given forward and back distance from the defined profile.

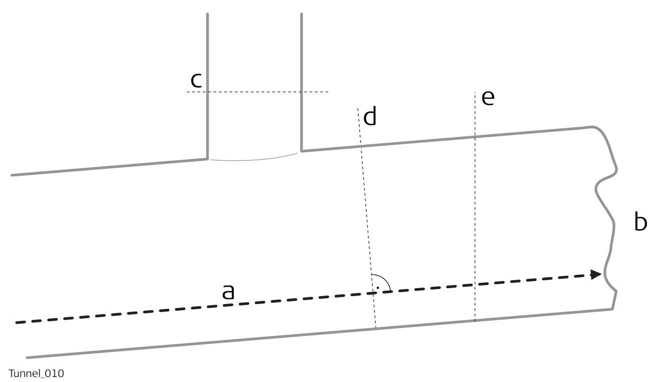
### Measuring tunnel profiles - Plan view




a) Centreline
b) Instrument position
c) Tunnel face
d) Defined profile to scan
e) Instrument profile
f) Back distance
g) Forward distance
h) Back interval
i) Forward interval

### Profile view

Tunnel profiles can be measured vertically, horizontally or perpendicular to the tunnel centreline.




a) Centreline
b) Tunnel face
c) Horizontal profile
d) Profile perpendicular to centreline
e) Vertical profile

## 46.6.15 Tunnel - Shifts TPS

**Description**

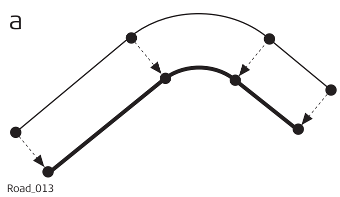
When working on site, often design data does not match the measured data. For example, an existing road surface that should intersect with the design surface may be 15 cm higher than the plans indicate. To guarantee a smooth intersection, this difference has to be distributed over the remaining 100 m of paving. To handle these situations, the application allows the possibility of adding shifts to the existing design data. A shift is applied when selecting the element to stake out/check.

☞ Shifts do not change the stored design. They are applied temporarily for stake out purposes.

**Centreline shifts**

**Horizontal and vertical shifts**

Horizontal shifts are always perpendicular to the centreline whereas vertical shifts are applied along the plumb line.



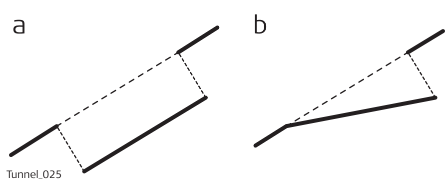

a) Horizontal alignment with constant shift (plan view)
b) Vertical alignment with constant shift (profile view)

**Constant and linear shifts are supported**

For both horizontal and vertical shifts, two different types can be applied:

**Constant:** The shift remains the same from its start chainage or station to the end chainage or station.

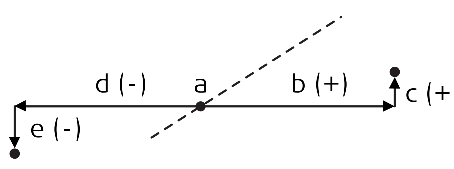
**Linear:** The shift is linearly interpolated along the chainage or station.




a) Constant shift
b) Linear shift

**Sign convention**

The sign convention for design shifts is identical to the conventions used for centreline offset and height shifts difference.

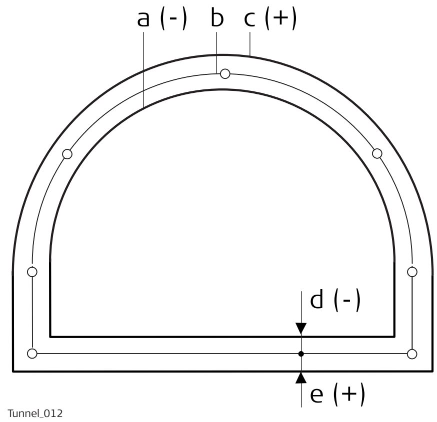



a) Centreline
b) Positive horizontal shift
c) Positive vertical shift
d) Negative horizontal shift
e) Negative vertical shift

**Design profile shift**

A shift can be applied to the design profile. The shift is applied perpendicularly to the design profile at any point along the design profile.

A positive shift will increase the size of the profile, a negative shift will decrease the size of the profile.




a) Design profile with negative shift
b) Original design profile
c) Design profile with positive shift
d) Negative shift
e) Positive shift

# 47 Roads - Alignment Editor

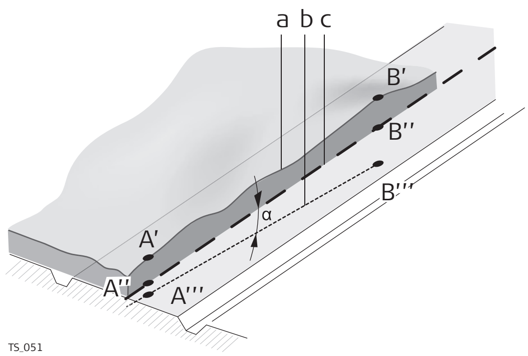
## 47.1 Basic Terms

**Description**

A road surface can be thought of three different types of design elements:

- the horizontal alignment
- the vertical alignment
- the cross section

**Basic concepts**




a - Natural surface.
b - The vertical alignment.
c - The horizontal alignment.
A′′/B′′ - Points on horizontal alignment
A′/B′ - Points on real surface
A′′′/B′′′- Points on vertical alignment

Any point A in a project has ENH coordinates in a determined coordinate system. Each point has three different positions:

- A′ - Point on real surface
- A′′ - Point on horizontal alignment
- A′′′- Point on vertical alignment

By adding a second point B to the project an alignment is defined. The alignment can be thought in three ways:

- Horizontal alignment (A′′-B′′)
- Projection of the horizontal alignment onto the real surface (A′-B′)
- Vertical alignment (A′′′-B′′′)

The angle between the horizontal and the vertical alignment is the grade ($\alpha$).

**Geometric elements**

A road design is fitted to a base plan or map using the three basic geometric elements:

- Straight
- Curve
- Spiral

☞ Refer to "Appendix J Glossary" for a definition of the terms.

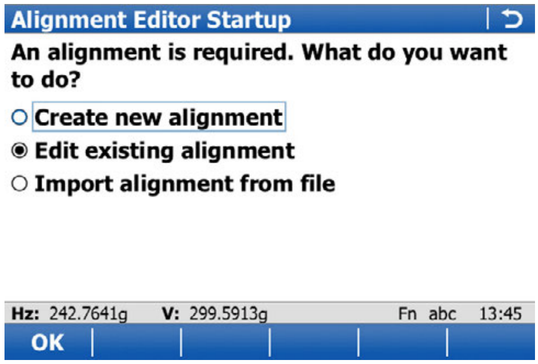
## 47.2 Starting Alignment Editor

### 47.2.1 Accessing Alignment Editor

**Access**

Select **Main Menu: Go to Work!\Roads\Alignment Editor**.

**Alignment Editor Startup**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Quit** | To exit the application. |

**Next step**

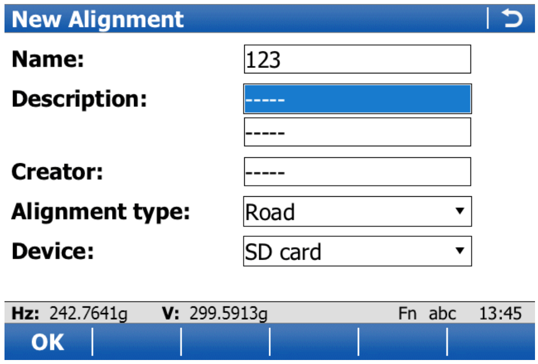
Select an option and press **OK**.

## 47.2.2 Creating a New Alignment

**Access**

Select **Create new alignment** in **Alignment Editor Startup** and press **OK**.

**New Alignment**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | The name of the new Alignment editor raw alignment. |
| **Description** | Editable field | Optional description of the new raw alignment. |
| **Creator** | Editable field | Optional description of the creator of this alignment. |
| **Alignment type** | Selectable list | Defines if the alignment is for Roadrunner Road or Rail applications. |
| **Device** | Selectable list | The device on which the new Alignment editor raw alignment will be stored. Depending on the inserted memory devices, this field may be a display only field. |

**Next step**

Press **OK** to access the **Alignment Editor Menu**. Refer to "47.2.5 Alignment Editor Menu".

## 47.2.3 Modifying an Existing Alignment

**Access**

Select **Edit existing alignment** in **Alignment Editor Startup** and press **OK**.

**Select Alignment**

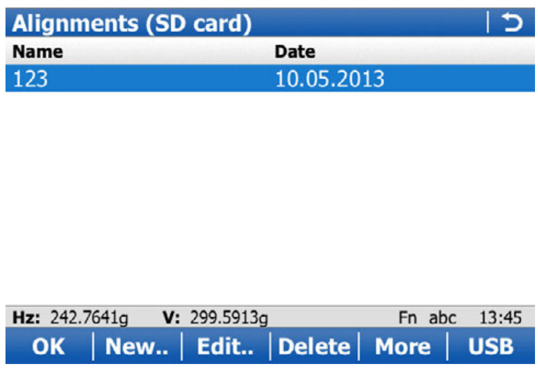
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Alignment name** | Selectable list | All existing Alignment editor raw alignments currently stored in the \Data\XML folder with the file extension *.xml. |
| **Alignment type** | Selectable list | Defines if the alignment is for Roadrunner Road or Rail applications. |

**Next step**

Highlight the **Alignment name** field and press ENTER.

**Alignments**




| Key | Description |
|---|---|
| **OK** | To select the highlighted raw alignment and continue. |
| **New..** | To create a new raw alignment. Refer to "47.2.2 Creating a New Alignment". |
| **Edit..** | To edit the name and description of an existing raw alignment. |
| **Delete** | To delete an existing raw alignment. |
| **More** | To switch the last column between **Date**, **Time** and **Size**. |
| **CF card**, **SD card** or **Intrnl** | To change between viewing jobs stored on another data storage device or internal memory. |
| Fn **Backup** | To restore a raw alignment file with the extension *.xmb currently stored in the \Data\XML folder. |
| Fn **Quit** | To exit the application. |

**Next step**

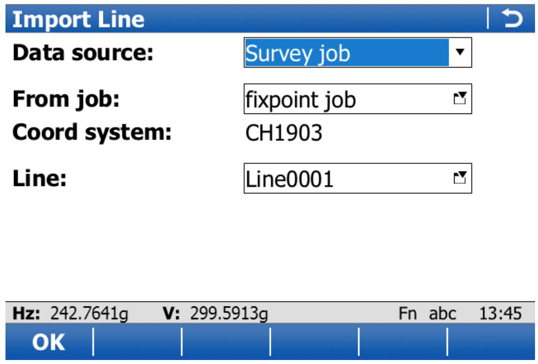
Press **OK** to select the highlighted raw alignment and return to the **Select Alignment** screen.
Press **OK** to access the **Alignment Editor Menu**. Refer to "47.2.5 Alignment Editor Menu".

## 47.2.4 Importing Alignment Data

**Access**

1) Select **Import alignment from file** in **Alignment Editor Startup** and press **OK**.
2) Create a new alignment in the **New Alignment** screen. Refer to "47.2.2 Creating a New Alignment".
3) Press **OK**.

**Import Line**




| Key | Description |
|---|---|
| **OK** | To import the selected alignment data to active raw alignment. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Data source** | | The file type of the data source. |
| | **Survey job** | To import lines or areas from the selected job. |
| | **Road job** | To import lines from an existing Road job. |
| | **Road+ (GSI format)** | To import GSI alignment data. |
| | **Rail job** | To import lines from an existing Rail job. |
| **From job** | Selectable list | All jobs are available for selection. Available for **Survey job**, **Road job** and **Rail job**. |
| **Coord system** | Display only | The coordinate system currently attached to the selected **Survey job**, **Road job** or **Rail job**. |
| **Line** | Selectable list | Line or area element from the selected job. Available for **Survey job**. |
| **Alignment** | Selectable list | Line from the selected Road job. The line must be stored in the \dbx folder of the memory device to be selectable. Available for **Road job** and **Rail job**. |
| **Alignment (.aln) file** | Selectable list | Horizontal alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the memory device to be selectable. Available for **Road+ (GSI format)**. |
| **Vertical (.prf) file** | Selectable list | Vertical alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the memory device to be selectable. Available for **Road+ (GSI format)**. |

**Next step**

**OK** imports the selected alignment data and accesses the **Alignment Editor Menu**. Refer to "47.2.5 Alignment Editor Menu".

## 47.2.5 Alignment Editor Menu

**Access**

This screen is always accessed after successfully creating, editing or importing an alignment file from the **Alignment Editor Startup** screen.

**Alignment Editor Menu**

**Description of options**

| Option | Description |
|---|---|
| **Edit horizontal alignment** | Depending on the setting for **Use PI instead of element for horizontal alignment definition** in **Configuration**, **Advanced** page:<br>• To create, edit and delete elements of a horizontal alignment. Refer to "47.4 Edit Horizontal Alignments Using Elements".<br>• To create, edit and delete PIs of a horizontal alignment. Refer to "47.5 Edit Horizontal Alignments Using PIs". |
| **Edit vertical alignment** | Depending on the setting for **Use PVI instead of element for vertical alignment definition** in **Configuration**, **Advanced** page:<br>• To create, edit and delete elements of a vertical alignment. Refer to "47.6 Edit Vertical Alignments Using Elements".<br>• To create, edit and delete PVIs of a vertical alignment. Refer to "47.7 Edit Vertical Alignments Using PIs". |
| **Edit cross section templates** | To create, edit and delete cross section templates. Refer to "47.8 Edit Cross Section Templates". Only available for road jobs. |
| **Edit cross section assignments** | To create, edit and delete cross section assignments. Refer to "47.9 Edit Cross Section Assignments". Only available for road jobs. |
| **Edit chainage equation** | To create, edit and delete chainage equations. Refer to "47.10 Edit Chainage Equation". |
| **Convert to job** | To convert existing LandXML alignments to a RoadRunner job. Refer to "47.11 Convert to job". |

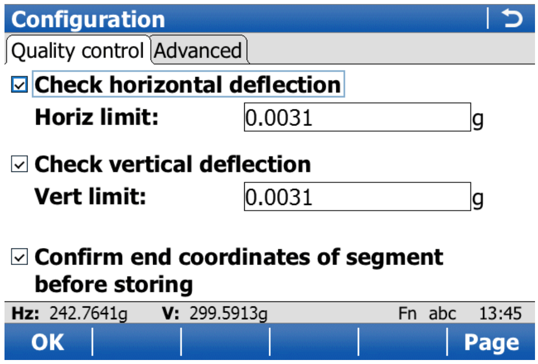
To be able to convert alignments to a Roadrunner job, at least a horizontal alignment must exist.

# 47.3 Configuring Alignment Editor

**Access**

Select **Main Menu: Go to Work!\Roads\Alignment Editor**. Press Fn **Config..**.

**Configuration, Quality control page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Check horizontal deflection** | Check box | Possibility to do a deflection check for the horizontal alignment. |
| **Horiz limit** | Editable field | The deflection tolerance for horizontal alignments. The tolerance value used for determining deflection errors. A deflection error occurs when the beginning curve tangent of an element does not match the ending tangent of the previous element. If the actual error in deflection is greater than this value, the error will be reported. |
| **Check vertical deflection** | Check box | Possibility to do a deflection check for the vertical alignment. |
| **Vert limit** | Editable field | The deflection tolerance for vertical alignments. |
| **Confirm end coordinates of segment before storing** | Check box | If this box is checked, then each time a new alignment element has been entered, a confirmation message displays the end coordinates for confirmation. |

**Next step**

**Page** changes to the **Advanced** page.

**Configuration, Advanced page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Vertical parabola definition** | | Parameter defining the parabola. |
| | **Parameter p** | |
| | **K factor** | K factor = Parameter p/100. |
| **Use PI instead of element for horizontal alignment definition** | Check box | When this box is not checked, elements such as straights, curves and parabolas define the horizontal alignment.<br><br>When this box is checked, the horizontal alignment is defined by **P**oints of **I**ntersection (tangent/geometrical points).<br>• Horizontal alignments are defined by the coordinates of the PI and the curve radius (for circular curves).<br>• Horizontal transitions are defined by coordinate of PI, the circular curve radius plus tangent length in and tangent length out. |
| **Use PVI instead of element for vertical alignment definition** | Check box | When this box is not checked, elements such as straights, curves and parabolas define the vertical alignment.<br><br>When this box is checked, the vertical alignment is defined by **P**oints of **V**ertical **I**ntersection (tangent/geometrical points).<br>• Vertical alignments with symmetrical curves are defined by the PVI chainage, the elevation of PVI and the total length of curve, where the tangent length is half the total length of the VC.<br>• Vertical Alignments with non-symmetrical curves are defined by the PVI chainage, the elevation of the PVI and both tangent lengths. |

# 47.4 Edit Horizontal Alignments Using Elements

## 47.4.1 Overview

**Description**

Allows creating, editing and deleting of the following elements:

- Start Point
- Straight (Tangent)
- Curve
- Clothoid
- Cubic Parabola
- Partial Bloss

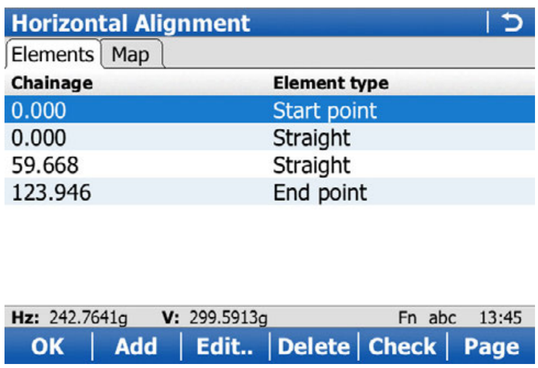
as well as checking the horizontal alignment.

**Access**

In **Alignment Editor Menu** highlight **Edit horizontal alignment**. Press **OK**.

☞ **Use PI instead of element for horizontal alignment definition** must be unchecked in **Configuration**, **Advanced** page.

**Horizontal Alignment, Elements page**



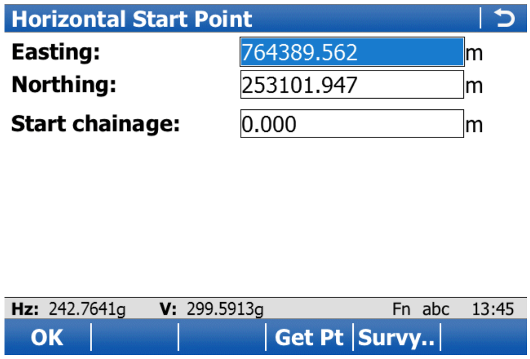

| Key | Description |
|---|---|
| **OK** | To accept the screen entries and return to the **Alignment Editor Menu**. |
| **Add** | To add a new horizontal element after the highlighted element. |
| **Edit..** | To edit the highlighted element of the horizontal alignment. |
| **Delete** | To delete the highlighted element of the horizontal alignment. Either all following elements or only the next element can be adjusted. |
| **Check** | To check the horizontal alignment. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

## 47.4.2 Editing the Start Point

**Access**

In **Horizontal Alignment**, highlight the start point and press **Edit..**.

**Horizontal Start Point**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Get Pt** | To apply coordinates or heights from an existing point in the working job. |
| **Survy..** | To go to **Survey** and measure a point. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Easting** | Editable field | Easting of the start point of the horizontal alignment. |
| **Northing** | Editable field | Northing of the start point of the horizontal alignment. |
| **Start chainage** | Editable field | Start chainage of the horizontal alignment. |

## 47.4.3 Inserting/Editing an Element in a Horizontal Alignment

**Access**

In **Horizontal Alignment**, **Elements** page, highlight the start point, or an element if one exists, and press **Add** or **Edit..**.

☞ Elements can be added after the start point and either before or after other elements.

☞ Creating and editing an alignment element are similar processes. For simplicity, only the creation of an alignment element is explained and differences are clearly outlined.

**Add Horizontal Element**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Element type** | **Straight** | To insert/edit a straight to/in a horizontal alignment. |
| | **Curve** | To insert/edit a curve to/in a horizontal alignment. |
| | **Spiral** | To insert/edit a clothoid to/in a horizontal alignment. |
| | **Cubic parabola** | To insert/edit a cubic parabola to/in a horizontal alignment. |
| | **Bloss** | To insert/edit a bloss curve to/in a horizontal alignment. |

The options available for the field **Method** depend on the **Element type** selected.

For **Element type**: **Straight**

| Field | Option | Description |
|---|---|---|
| **Method** | **Azimuth & length** | Using the azimuth and the length of the straight. |
| | **Azi & end chainage** | Using the azimuth and the end chainage of the straight. |
| | **End coords** | Using the end coordinates of the straight. |

For **Element type**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Method** | **Radius & length** | Using the radius of the curve and its length. |
| | **Radius & delta** | Using the radius and the delta angle of the curve. |
| | **Radius & end chain** | Using the radius of the curve and the end chainage. |
| | **Radius & end coords** | Using the radius and the end coordinates of the curve. |
| | **Center & end coords** | Using the coordinates of the centre point and the end point of the curve. |
| | **3 points** | Using three points. |

For **Element type**: **Spiral**

| Field | Option | Description |
|---|---|---|
| **Method** | **Radius & length** | Using the radius of the clothoid and its length. |
| | **Radius & end chain** | Using the radius of the clothoid and the end chainage. |
| | **Param & length** | Using the parameter A and the length of the connecting curve. |
| | **Param & end chain** | Using the parameter A and the end chainage of the spiral. |
| | **Radius & parameter** | Using the parameter A and the radius. |

For **Element type**: **Cubic parabola**

| Field | Option | Description |
|---|---|---|
| **Method** | **Radius & length** | Using the radius of the cubic parabola and its length. |
| | **Radius & end chain** | Using the radius of the cubic parabola and the end chainage. |

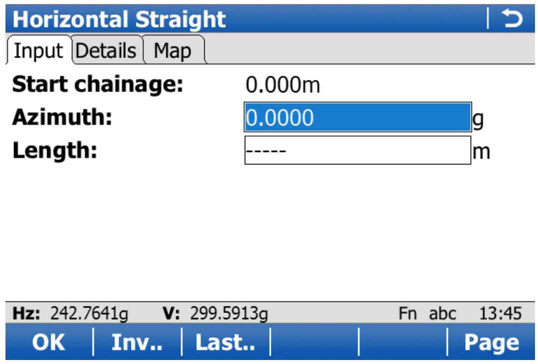
For **Element type**: **Bloss**

| Field | Option | Description |
|---|---|---|
| **Method** | **Radius & length** | Using the radius of the connecting curve and its length. |
| | **Radius & end chain** | Using the radius of the connecting curve and its end chainage. |
| | **Rad,lngth,end coord** | Using the radius, length and end coordinates of the bloss curve. |

**Next step**

**OK** to access the next screen.

**Horizontal Straight/Horizontal Curve/Horizontal Clothoid/Horizontal Cubic Parabola/Horizontal Bloss, Input page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Inv..** | To calculate the distance and angle between two points from the working job. |
| **Last..** | To select values from the last inverse calculations. |
| **Get Pt** | To apply coordinates or heights from an existing point in the working job. Available when coordinates must be typed in. |
| **Survy..** | To go to **Survey** and measure a point. Available when coordinates must be typed in. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access the Alignment Editor configuration. |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Start chainage** | Display only | The end chainage of the start point / previous element is automatically used and cannot be edited. |

The other fields and options available depend on the **Method** and **Element type** selected in **Add Horizontal Element**.

For **Element type**: **Straight**

| Field | Option | Description |
|---|---|---|
| **Azimuth** | Editable field | The azimuth displayed is from the previous element. Another value can be entered manually. Available for **Method: Azimuth & length** or **Method: Azi & end chainage**. |
| **End chainage** | Editable field | Chainage at the end of the element. Available for **Method: Azi & end chainage**. |
| **End easting** | Editable field | Easting for the end chainage. Available for **Method: End coords**. |
| **End northing** | Editable field | Northing for the end chainage. Available for **Method: End coords**. |
| **Length** | Editable field | Length of the straight element. Available for **Method: Azimuth & length**. |

For **Element type**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Start azimuth** | Editable field | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. Available for **Method: Radius & length**, **Method: Radius & delta** or **Method: Radius & end chain**. |
| **CP easting** | Editable field | Easting of the centre point of the curve. Available for **Method: Center & end coords**. |
| **CP northing** | Editable field | Northing of the centre point of the curve. Available for **Method: Center & end coords**. |
| **Curve direction** | **Right** or **Left** | The direction of the curve when looking in the direction of increasing chainage. Available for **Method: Radius & length**, **Method: Radius & delta**, **Method: Radius & end chain** or **Method: Radius & end coords**. |
| **Radius** | Editable field | Radius of the curve. The signs are set by the system depending on the curve direction defined in **Curve direction**. Available for **Method: Radius & length**, **Method: Radius & delta**, **Method: Radius & end chain** or **Method: Radius & end coords**. |
| **Delta** | Editable field | The deflection angle. Available for **Method: Radius & delta**. |
| **Length** | Editable field | Length from the start to the end point of the curve. Available for **Method: Radius & length**. |
| **End chainage** | Editable field | The end chainage of the curve element can be typed in. Available for **Method: Radius & end chain**. |
| **Int easting** | Editable field | Easting of the intermediate point of the 3-pt-arc. Available for **Method: 3 points**. |
| **Int northing** | Editable field | Northing of the intermediate point of the 3-pt-arc. Available for **Method: 3 points**. |
| **End easting** | Editable field | Easting for the end chainage. Available for **Method: Radius & end coords**, **Method: Center & end coords** and **Method: 3 points**. |
| **End northing** | Editable field | Northing for the end chainage. Available for **Method: Radius & end coords**, **Method: Center & end coords** and **Method: 3 points**. |

For **Element type**: **Spiral**

| Field | Option | Description |
|---|---|---|
| **Start azimuth** | Editable field | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. |
| **Spiral direction** | **Right** or **Left** | The direction of the clothoid looking in the direction of increasing chainage. |
| **Spiral in/out** | **Spiral in** | For transition from tangent to curve. |
| | **Spiral out** | For transition from curve to tangent. |
| **Radius** | Editable field | Radius of the clothoid. Available for **Method: Radius & length**, **Method: Radius & end chain** and **Method: Radius & parameter**. |
| **Parameter A** | Editable field | The parameter A defining the clothoids. Available for **Method: Param & end chain**, **Method: Param & length** and **Method: Radius & parameter**. |
| **Length** | Editable field | Length of the clothoid element. Available for **Method: Param & length** and **Method: Radius & length**. |
| **Start radius** | Editable field | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available for **Method: Radius & length** and **Method: Radius & end chain** when **Use partial spiral** is checked. |
| **End radius** | Editable field | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available for **Method: Radius & length** and **Method: Radius & end chain** when **Use partial spiral** is checked. |
| **End chainage** | Editable field | The end chainage of the clothoid can be typed in. Available for **Method: Radius & end chain** and **Method: Param & end chain**. |
| **Use partial spiral** | Check box | To create partial clothoids. Available for **Method: Radius & length** and **Method: Radius & end chain**. |

For **Element type**: **Cubic parabola**

| Field | Option | Description |
|---|---|---|
| **Start azimuth** | Editable field | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. |
| **Spiral direc-tion** | **Right** or **Left** | The direction of the cubic parabola looking in the direction of increasing chainage. |
| **Spiral in/out** | **Spiral in** | For a transition from tangent to curve. |
| | **Spiral out** | For a transition from curve to tangent. |
| **Radius** | Editable field | Radius of the cubic parabola. |
| **Start radius** | Editable field | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available when **Use partial spiral** is checked. |
| **End radius** | Editable field | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available when **Use partial spiral** is checked. |
| **Length** | Editable field | Length of the cubic parabola element. Available for **Method: Radius & length**. |
| **End chainage** | Editable field | The end chainage of the cubic parabola element can be typed in. Available for **Method: Radius & end chain**. |
| **Use partial spiral** | Check box | To create partial cubic parabolas. |

For **Element type**: **Bloss**

| Field | Option | Description |
|---|---|---|
| **Start azimuth** | Editable field | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. |
| **Spiral direction** | **Right** or **Left** | The direction of the bloss looking in the direction of increasing chainage. |
| **Spiral in/out** | **Spiral in** | For a transition from tangent to curve. |
| | **Spiral out** | For a transition from curve to tangent. |
| **Radius** | Editable field | Radius of the bloss. |
| **Start radius** | Editable field | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available for **Method: Rad,lngth,end coord**. |
| **End radius** | Editable field | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in **Spiral direction**. Available for **Method: Rad,lngth,end coord**. |
| **Length** | Editable field | Length of the bloss curve element. Available for **Method: Radius & length** and **Method: Rad,lngth,end coord**. |
| **End chainage** | Editable field | The end chainage of the bloss curve element can be typed in. Available for **Method: Radius & end chain**. |
| **End easting** | Editable field | Easting for the end chainage. Available for **Method: Rad,lngth,end coord**. |
| **End northing** | Editable field | Northing for the end chainage. Available for **Method: Rad,lngth,end coord**. |

**Next step**

**Page** changes to the **Details** page, where all entered and calculated elements are displayed.

# 47.5 Edit Horizontal Alignments Using PIs

## 47.5.1 Overview

**Description**

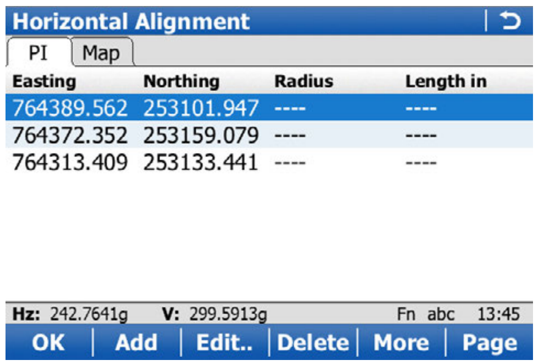
Allows creating, editing and deleting PIs by chainage, easting and northing.

**Access**

In **Alignment Editor Menu** highlight **Edit horizontal alignment**. Press **OK**.

**Use PI instead of element for horizontal alignment definition** must be checked in **Configuration**, **Advanced** page.

**Horizontal Alignment, PI page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and return to the **Alignment Editor Menu**. |
| **Add** | To add a new horizontal PI after the highlighted PI.<br>The chainage values must be added in the correct order. |
| **Edit..** | To edit the highlighted PI of the horizontal alignment. |
| **Delete** | To delete the highlighted PI of the horizontal alignment. Either all following elements or only the next element can be adjusted. |
| **More** | To display information about the length in/out and the parameter in/out in the fourth column. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

## 47.5.2 Inserting/Editing a PI in a Horizontal Alignment

**Access**

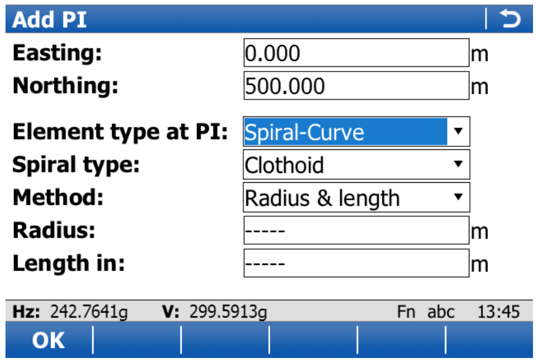
In **Horizontal Alignment**, **PI** page, highlight a PI and press **Add** or **Edit..**.

A PI can also be selected on the **Map** page.

Elements are added after the highlighted PI.

Creating and editing an alignment PI are similar processes. For simplicity, only the creation of an alignment PI is explained and differences are clearly outlined.

**Add PI**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and return to the **Alignment Editor Menu**. |
| **Get Pt** | To apply coordinates from an existing point in the working job. Available when **Easting** or **Northing** is highlighted. |
| **Survy..** | To go to **Survey** and measure a point. Available when **Easting** or **Northing** is highlighted. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Radius**, **Length in**, **Length out**, **Param in** or **Param out** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available when **Radius**, **Length in**, **Length out**, **Param in** or **Param out** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Easting** and **Northing** | Editable field | The coordinates of the PI. |
| **Element type at PI** | **None** | No element is defined at the PI. |
| | **Curve** | A curve is defined at the PI. |
| | **Spiral** | A spiral is defined at the PI. |
| | **Spiral-Curve** | Spiral - curve is defined at the PI. |
| | **Curve-Spiral** | Curve - spiral is defined at the PI. |
| | **Spiral-Spiral** | Two spirals are defined at the PI. |
| | **Spiral-Curve-Spiral** | Spiral - curve - spiral is defined at the PI. |

The other fields on the screen depend on the **Element type at PI** selected.

For **Element type at PI**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Radius** | Editable field | Using the radius of the curve. |

For **Element type at PI**: **Spiral**

| Field | Option | Description |
|---|---|---|
| **Spiral type** | **Clothoid**, **Cubic parabola** or **Bloss** | **Bloss** is available for Rail jobs only. |
| **Spiral in/out** | Selectable list | The type of spiral. |
| **Method** | | Available for **Spiral type: Clothoid**. |
| | **Radius & lengths** | Using the radius of the clothoid and its length. |
| | **Radius & parameters** | Using the radius of the clothoid and its parameters. |
| **Radius** | Editable field | The radius of the clothoid, parabola or bloss. Available unless **Use partial spiral** is checked. |
| **Radius in** and **Radius out** | Editable field | The radius of the partial spiral for a clothoid or parabola. Available when **Use partial spiral** is checked. |
| **Length in** and **Length out** | Editable field | The lengths of the clothoid, parabola or bloss. |
| **Param in** and **Param out** | Editable field | Depending on the configuration, the parameters P or factors K of the clothoid. Available for **Spiral type: Clothoid** with **Method: Radius & parameters**. |
| **Use partial spiral** | Check box | To create a partial clothoid. Available for **Spiral type: Clothoid** and **Spiral type: Cubic parabola**. |

For **Element type at PI**: **Spiral-Curve** and **Element type at PI**: **Curve-Spiral**

| Field | Option | Description |
|---|---|---|
| **Method** | | Available for **Spiral type: Clothoid**. |
| | **Radius & lengths** | Using the radius of the clothoid and its length. |
| | **Radius & parameters** | Using the radius of the clothoid and its parameters. |
| **Radius** | Editable field | The radius of the curve. |
| **Length in** | Editable field | The lengths of the connecting curve. |
| **Param in** | Editable field | Depending on the configuration, the parameters P or factors K of the clothoid. Available for **Spiral type: Clothoid** with **Method: Radius & parameters**. |

For **Element type at PI**: **Spiral-Spiral** and **Element type at PI**: **Spiral-Curve-Spiral**

| Field | Option | Description |
|---|---|---|
| **Method** | | Available for **Spiral type: Clothoid**. |
| | **Radius & lengths** | Using the radius of the clothoid and its length. |
| | **Radius & parameters** | Using the radius of the clothoid and its parameters. |
| **Radius** | Editable field | The radius of the curve. |
| **Length in** and **Length out** | Editable field | The lengths of the connecting curve. |
| **Param in** and **Param out** | Editable field | Depending on the configuration, the parameters P or factors K of the clothoid. Available for **Spiral type: Clothoid** with **Method: Radius & parameters**. |

**Next step**
**OK** to access the next screen.

# 47.6 Edit Vertical Alignments Using Elements

## 47.6.1 Overview

**Description**

Allows creating, editing and deleting of the following elements:

- Start Point
- Straight (Tangent)
- Parabola
- Asymmetric parabola
- Curve

as well as checking the vertical alignment.
Throughout the whole component height and elevation is used for local orthometric height. If no local orthometric height is available, the local ellipsoidal height is used instead.

**Access**

In **Alignment Editor Menu** highlight **Edit vertical alignment**. Press **OK**.

☞ **Use PVI instead of element for vertical alignment definition** must be unchecked in **Configuration**, **Advanced** page.

**Vertical Alignment, Elements page**

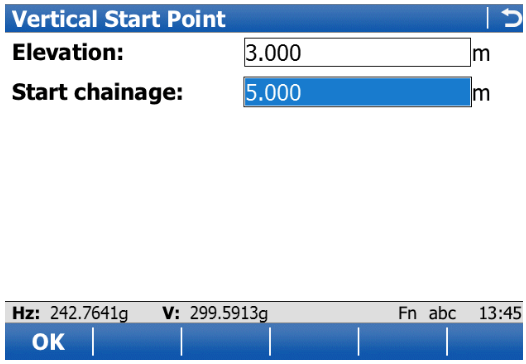
The available keys are identical to the keys in **Horizontal Alignment**. Refer to the paragraph "Horizontal Alignment, Elements page".

## 47.6.2 Editing the Start Point

**Access**

In **Vertical Alignment**, highlight the start point and press **Edit..**.

**Vertical Start Point**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Get Pt** | To apply heights from an existing point in the working job. |
| **Survy..** | To go to **Survey** and measure a point. |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Elevation** | Editable field | Elevation at the start chainage of the vertical alignment. |
| **Start chainage** | Editable field | Start chainage of the vertical alignment. |

## 47.6.3 Inserting/Editing an Element in a Vertical Alignment

**Access**

In **Vertical Alignment**, **Elements** page, highlight the start point and press **Add** or **Edit..**.

☞ Creating and editing an alignment element are similar processes. For simplicity, only the creation of an alignment element is explained and differences are clearly outlined.

☞ For grade units, the system settings are applied. Refer to "29.1 Regional settings" to change the system setting.

**Add Vertical Element**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Element type** | **Straight** | To insert/edit a straight to/in a vertical alignment. |
| | **Parabola** | To insert/edit a quadratic parabola to/in a vertical alignment. |
| | **Curve** | To insert/edit a curve to/in a vertical alignment. |

The options available for the field **Method** depend on the **Element type** selected.
For **Element type**: **Straight**

| Field | Option | Description |
|---|---|---|
| **Method** | **Length & end elev** | Using the length and the end elevation of the straight. |
| | **End chain & elev** | Using the end chainage and the elevation of the straight. |
| | **Length & grade** | Using the length and the grade of the straight. |
| | **End chain & grade** | Using the end chainage and the grade of the straight. |

For **Element type**: **Parabola**

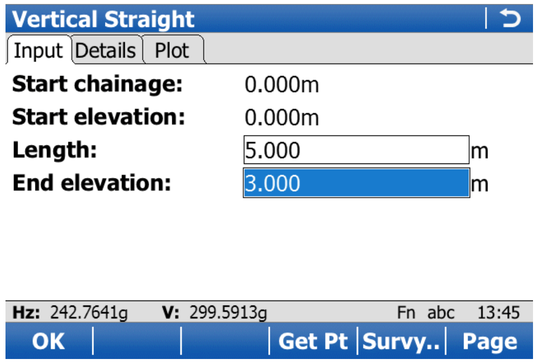
| Field | Option | Description |
|---|---|---|
| **Method** | **Length & grades** | Using the length and the grades of the parabola. |
| | **End chain & grades** | Using the end chainage and the grades of the parabola. |
| | **Param & end elev** | Using the parameter and the end elevation of the parabola. |
| | **3 elevations** | Using three elevations at defined chainages of the parabola. |

For **Element type**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Method** | **Radius & length** | Using the radius of the curve and its length. |
| | **Radius & end chain** | Using the radius and the end chainage of the curve. |
| | **Radius & grades** | Using the radius and the grades of the curve. |
| | **Length & grades** | Using the length and the grades of the curve. |
| | **End chain & grades** | Using start, intermediate and end elevation and chainage of the curve. |

**Next step**
**OK** to access the next screen.

**Vertical Straight/Vertical Parabola/Vertical Curve, Input page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Inv..** | To calculate the distance and angle between two points from the working job. |
| **Last..** | To select values from the last inverse calculations. |
| **Get Pt** | To apply coordinates or heights from an existing point in the working job. Available when coordinates must be typed in. |
| **Survy..** | To go to **Survey** and measure a point. Available when elevation must be typed in. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access the Alignment Editor configuration. |
| Fn **Reset** | To reset all screen entries. |
| Fn **%/V:H/H:V** | To switch between **h:v**, **v:h** and **%(v/h x 100)** for the grade unit. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Start chainage** | Display only | The end chainage of the previous element is automatically used and cannot be edited. |
| **Start elevation** | Display only | The end height of the previous element is automatically used and cannot be edited. |

The other fields and options available depend on the **Method** and **Element type** selected in **Add Vertical Element**.

For **Element type**: **Straight**

| Field | Option | Description |
|---|---|---|
| **Length** | Editable field | Length of the straight element as slope distance. Available for **Method: Length & end elev** and **Method: Length & grade**. |
| **End chainage** | Editable field | Chainage at the end of the element. Available for **Method: End chain & elev** and **Method: End chain & grade**. |
| **End elevation** | Editable field | Height at the end of the element. Type in manually or, alternatively, press **Get Pt** when the focus is on this line to select the height from an existing point in the working job. Available for **Method: Length & end elev** and **Method: End chain & elev**. |
| **Grade** | Editable field | The grade of the straight element. Positive inclines have positive values, negative inclines have negative values. Available for **Method: Length & grade** and **Method: End chain & grade**. |

For **Element type**: **Parabola**

| Field | Option | Description |
|---|---|---|
| **Curve type** | **Crest** | The curve type is convex. Available for **Method: Param & end elev**. |
| | **Sag** | The curve type is concave. Available for **Method: Param & end elev**. |
| **Parameter p** or **K factor** | Editable field | Parameter of the parabola. Available for **Method: Param & end elev**. The field name depends on the value chosen for the **Vertical parabola definition** in the **Configuration**, **Advanced** page. |
| **Length** | Editable field | Length of the parabola as horizontal distance. Available for **Method: Length & grades** and **Method: Param & end elev**. |
| **Int chainage** | Editable field | Chainage of the second elevation. Available for **Method: 3 elevations**. |
| **Int elevation** | Editable field | Second elevation. Type in manually or press **Get Pt** when the focus is on this line to select the height from an existing point in the working job. Available for **Method: 3 elevations**. |
| **End chainage** | Editable field | Chainage at the end of the element. Available for **Method: End chain & grades** and **Method: 3 elevations**. |
| **End elevation** | Editable field | Height at the end of the element. Type in manually or, alternatively, press **Get Pt** when the focus is on this line to select the height from an existing point in the working job. Available for **Method: Param & end elev** and **Method: 3 elevations**. |
| **Grade in** | Editable field | The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for parabolas with **Method: Length & grades** and **Method: End chain & grades**. |
| **Grade out** | Editable field | The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for **Method: Length & grades** and **Method: End chain & grades**. |

For **Element type**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Curve type** | **Crest** | The curve type is convex. |
| | **Sag** | The curve type is concave. |
| **Radius** | Editable field | Radius of the curve. Available for **Method: Radius & length**, **Method: Radius & end chain** and **Method: Radius & grades**. |
| **Length** | Editable field | Length of the curve along the segment. Available for **Method: Radius & length** and **Method: Length & grades**. |
| **End chainage** | Editable field | Chainage at the end of the element. Available for **Method: End chain & grades** and **Method: Radius & end chain**. |
| **End elevation** | Editable field | Height at the end of the element. Type in manually or, alternatively, press **Get Pt** when the focus is on this line to select the height from an existing point in the working job. Available for **Method: Radius & length** and **Method: Radius & end chain**. |
| **Grade in** | Editable field | The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for **Method: Radius & grades**, **Method: Length & grades** and **Method: End chain & grades**. |
| **Grade out** | Editable field | The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for **Method: Radius & grades**, **Method: Length & grades** and **Method: End chain & grades**. |

**Next step**

**Page** changes to the **Details** page, where all entered and calculated elements are displayed. Press **C&E** to query the elevation for a given chainage.

## 47.7 Edit Vertical Alignments Using PIs

### 47.7.1 Overview

**Description**

Allows creating, editing and deleting PIs by chainage, elevation and if required an element type (parabola, curve).

**Access**

In **Alignment Editor Menu** highlight **Edit vertical alignment**. Press **OK**.

☞ **Use PVI instead of element for vertical alignment definition** must be checked in **Configuration**, **Advanced** page.

**Vertical Alignment, PVI page**

The available keys are identical to the keys in **Horizontal Alignment**. Refer to the paragraph "Horizontal Alignment, PI page".

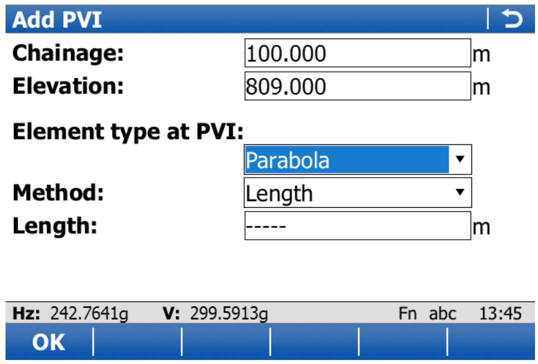
## 47.7.2 Inserting/Editing a PVI in a Vertical Alignment

**Access**

In **Vertical Alignment**, **PVI** page, highlight a PVI and press **Add** or **Edit..**.

☞ Creating and editing an alignment PVI are similar processes. For simplicity, only the creation of an alignment PVI is explained and differences are clearly outlined.

**Add PVI**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and return to the **Alignment Editor Menu**. |
| **Get Pt** | To apply heights from an existing point in the working job. Available when **Elevation** is highlighted. |
| **Survy..** | To go to **Survey** and measure a point. Available when **Elevation** is highlighted. |
| **Inv..** | To calculate the values for the distance and the offset from two existing points. Available when **Radius** or **Length** is highlighted. |
| **Last..** | To recall previous results from COGO inverse calculations. Available if **Radius** or **Length** is highlighted. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Alignment editor application. Refer to "47.3 Configuring Alignment Editor". |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage of the vertical PVI. |
| **Elevation** | Editable field | The elevation of the vertical PVI. |
| **Element type at PVI** | **None** | No element is defined at the vertical PVI. |
| | **Curve** | A curve is defined at the vertical PVI. |
| | **Parabola** | A quadratic parabola is defined at the vertical PVI. |

The other fields on the screen depend on the **Element type at PVI** selected.

For **Element type at PVI**: **Curve**

| Field | Option | Description |
|---|---|---|
| **Method** | **Length** | To define the curve by its length. |
| | **Radius** | To define the curve by its radius. |
| **Length** | Editable field | The length of the curve. |
| **Radius** | Editable field | The radius of the curve. |

For **Element type at PVI**: **Parabola**

| Field | Option | Description |
|---|---|---|
| **Method** | **Length** | To define the parabola by its length. |
| | **Parameter** | To define the parabola by its parameter. |
| **Length** | Editable field | The length of the parabola. |
| **Parameter p** | Editable field | Depending on the configuration, the parameters P or factors K of the parabola. |

**Next step**
**OK** to access the next screen.

## 47.8 Edit Cross Section Templates

### 47.8.1 Overview

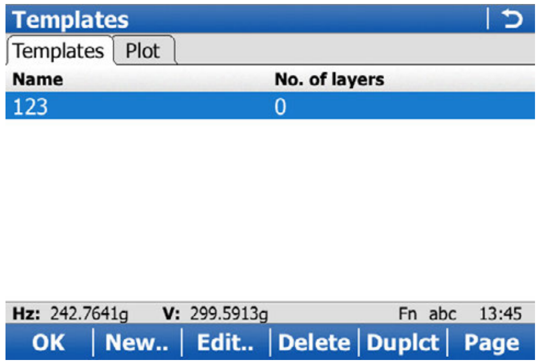
**Description**

Allows creating, editing, deleting and duplicating of cross section templates.

**Access**

In **Alignment Editor Menu** highlight **Edit cross section templates**. Press **OK**.

**Templates**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **New..** | To create a new cross section template. |
| **Edit..** | To edit the highlighted cross section template. |
| **Delete** | To delete the highlighted cross section template. |
| **Duplct** | To duplicate the highlighted template. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

# 47.8.2 Creating/Editing a Cross Section Template

**Access**

In **Templates**

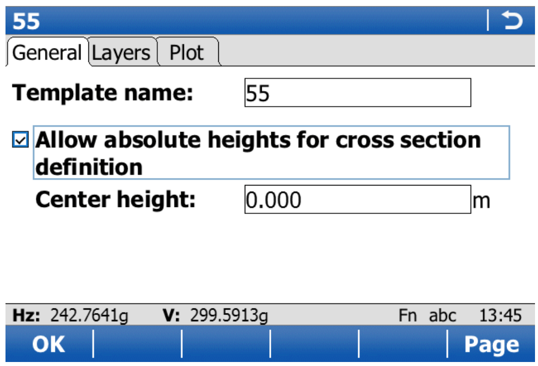
press **New..** to create a new cross section template

OR

highlight an existing template and press **Edit..**.

Creating and editing a cross section template are similar processes. For simplicity, only the creation of a cross section template is explained and differences are clearly outlined.

**New Template, General page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access the Alignment Editor configuration. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Template name** | Editable field | Name of the cross section template to be created/edited. |
| **Allow absolute heights for cross section definition** | Check box | If this box is checked, in addition to relative to line input methods, absolute heights can also be entered to define cross section segments. |
| **Center height** | Editable field | To be able to create segments using absolute heights, a centre height must be defined. Available if **Allow absolute heights for cross section definition** is checked. |

**Next step**

**Page** changes to the **Layers** page where the layers of the template are listed.

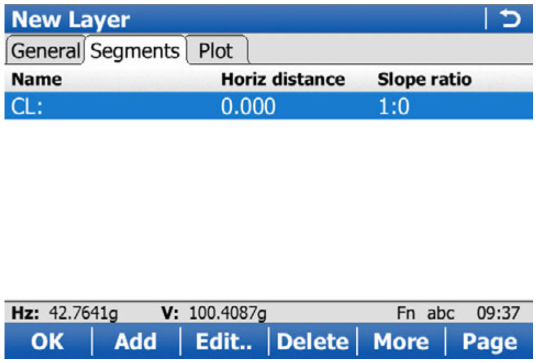
## 47.8.3 Add/Edit a Layer

**Access**

In **New Template**/**Edit Template**, **Layers** page, press **New..** or **Edit..**.

☞ Creating and editing a layer of a cross section template are similar processes. For simplicity, only the creation of a layer is explained and differences are clearly outlined.

**New Layer, Segments**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Add** | To create and add a new segment. |
| **Edit..** | To edit the highlighted segment. |
| **Delete** | To delete the highlighted segment. |
| **More** | To switch between **CL horizontal offset**, **Slope distance**, **Horiz distance** in the second column and between **CL vertical offset**, **Slope ratio**, **Vertical distance** in the third column. |
| **Page** | To change to another page on this screen. |
| Fn **Mirror** | To mirror the entered segments to the other side of the cross section. |
| Fn **Quit** | To exit the application. |

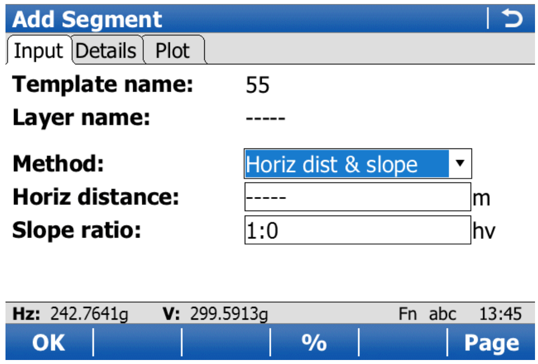
**Description of columns**

| Column | Description |
|---|---|
| **Name** | The name of the segment. |
| **CL horizontal offset** | Horizontal offset to the centre line of the segment. |
| **CL vertical offset** | Vertical offset to the centre line of the segment. |
| **Slope distance** | Slope distance to the neighbouring vertex. |
| **Slope ratio** | Slope ratio of the segment. |
| **Horiz distance** | Horizontal distance to the neighbouring vertex. |
| **Vertical distance** | Vertical distance to the neighbouring vertex. |

**Next step**

**Add** to add a segment.

**Add Segment, Input page**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **Inv..** | Available when **Horiz distance**, **CL horizontal offset** or **Slope distance** is highlighted. To calculate the distance and angle between two points from the working job. |
| **Last..** | Available when **Horiz distance**, **CL horizontal offset** or **Slope distance** is highlighted. To select values from the last inverse calculations. |
| **%/V:H/H:V** | To switch between **h:v**, **v:h** and **%(v/h x 100)** for the slope ratio. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access the Alignment Editor configuration. |
| Fn **Reset** | To reset all screen entries. |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Template name** | Display only | Name of the cross section template to be edited. |
| **Layer name** | Display only | Name of the layer to be edited. |
| **Method** | | Method to be used for defining the segment. |
| | **Horiz dist & slope** | Using a horizontal distance and slope ratio to define the segment. |
| | **Horiz dist & vert dist** | Using a horizontal distance and a vertical distance to define the segment. |
| | **CL offsets** | Using a horizontal and vertical offset in relation to the centre line. |
| | **Slope dist & ratio** | Using a slope distance and slope ratio to define the segment. |
| | **Horiz dist & height** | Using a horizontal and absolute height to define the segment. Only available for templates with **Allow absolute heights for cross section definition** enabled. |
| | **CL offset & height** | Using a horizontal offset in relation to the centre line and absolute height. Only available for templates with **Allow absolute heights for cross section definition** enabled. |
| **Horiz distance** | Editable field | Horizontal distance of the segment. Available for **Method: Horiz dist & slope** and **Method: Horiz dist & vert dist**. |
| **Vertical distance** | Editable field | Vertical distance of the segment. Available for **Method: Horiz dist & vert dist**. |
| **CL horizontal offset** | Editable field | Horizontal centre line offset of the segment. Only available for **Method: CL offsets**. |
| **CL vertical offset** | Editable field | Vertical centre line offset of the segment. Only available for **Method: CL offsets**. |
| **Slope distance** | Editable field | Slope distance of the segment. Only available for **Method: Slope dist & ratio**. |
| **Slope ratio** | Editable field | Slope ratio of the segment. Available for **Method: Horiz dist & slope** and **Method: Slope dist & ratio**. |

#### Next step

**Page** changes to the **Details** page, where all entered and calculated elements are displayed.

## 47.9 Edit Cross Section Assignments

### 47.9.1 Overview

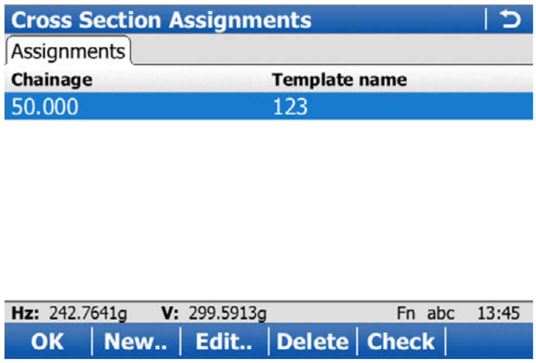
**Description**

Allows the creation, editing and deleting of cross section assignments as well as checking the cross section assignments.
A cross section assignment defines from which chainage on a cross section template is to be used.

**Access**

In **Alignment Editor Menu** highlight **Edit cross section assignment**. Press **OK**.

**Cross Section Assignments**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **New..** | To create a new cross section assignment. |
| **Edit..** | To edit a cross section assignment. |
| **Delete** | To delete a cross section assignment. |
| **Check** | To check the cross section assignments. |
| Fn **Quit** | To exit the application. |

## 47.9.2 Creating/Editing a Cross Section Assignment

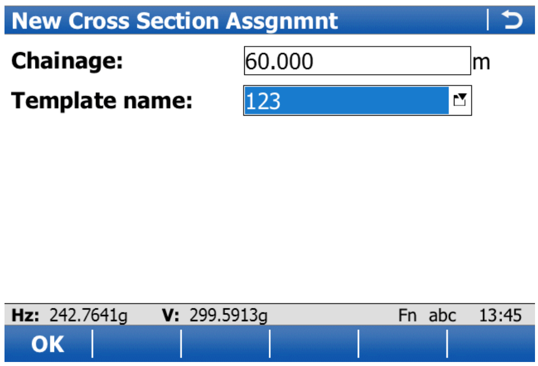
**Access**

In **Cross Section Assignments** press **New..** or **Edit..**.

Creating and editing a cross section assignment are similar processes. For simplicity, only the creation of a cross section assignment is explained and differences are clearly outlined.

Assigned cross section templates must contain the same number of vertices.

**New Cross Section Assgnmnt**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **StartCh** | To take the start chainage of the vertical alignment for **Chainage**. |
| **End Ch** | To take the end chainage of the vertical alignment for **Chainage**. |
| Fn **Config..** | To access Alignment Editor configuration. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage to which the cross section template is assigned to.<br>Type in or edit the value for Chainage. Alternatively press **StartCh** or **End Ch** to apply the start or end chainage of the vertical alignment. |
| **Template name** | Selectable list | The cross section template to be assigned to. All existing cross section templates currently stored to the alignment can be selected.<br>Select an existing template from the list or create a new one to be assigned to the **Chainage**. |

## 47.10 Edit Chainage Equation

### 47.10.1 Overview

**Description**

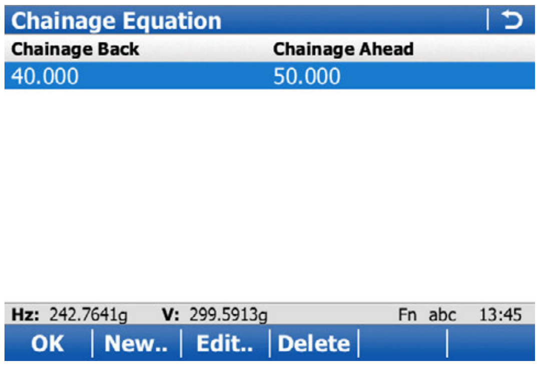
Allows creating, editing and deleting of:

- Gaps
- Overlaps

**Access**

In **Alignment Editor Menu** highlight **Edit chainage equation**. Press **OK**.

**Chainage Equation**




| Key | Description |
|---|---|
| **OK** | To accept the screen entries and continue. |
| **New..** | To create a new chainage equation. |
| **Edit..** | To edit a chainage equation. |
| **Delete** | To delete a chainage equation. |
| Fn **Quit** | To exit the application. |

### 47.10.2 Creating/Editing a Chainage Equation

**Access**

In **Chainage Equation** press **New..** or **Edit..**.

Creating and editing a Chainage equation are similar processes. For simplicity, only the creation of a Chainage equation is explained and differences are clearly outlined.

**New Chainage Equation**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage back** | Editable field | Chainage back. Type in or edit the value. |
| **Chainage ahead** | Editable field | Chainage ahead. Type in or edit the value. |

**Next step**

**OK** to create the chainage equation or to store the edited chainage equation.

## 47.11 Convert to job

**Description**

Allows the onboard conversion of existing LandXML alignments including horizontal alignment, vertical alignment, cross sections and chainage equations to a RoadRunner job.

**Access**

In **Alignment Editor Menu** highlight **Convert to job**. Press **OK**.

**Convert to Road Job/ Convert to Rail Job**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **From alignment** | Display only | Displays the modified or newly created alignment to be converted. |
| **To road job** | Selectable list | The Road job to which the alignment will be converted. Create a new job. Available if the **Alignment type** is set to **Road** in **Select Alignment**.<br>☞ If a new job with the same name as an existing job must be created, then the existing job must be deleted first. |
| **To rail job** | Selectable list | The Rail job to which the alignment will be converted. Create a new job. Available if the **Alignment type** is set to **Rail** in **Select Alignment**. |
| | | ☞ If a new job with the same name as an existing job must be created, then the existing job must be deleted first. |
| **Conversion mode** | | Defines the mode to be used for the conversion process. |
| | **Horiz & vert** | Only horizontal and vertical alignment will be converted. |
| | **Horizontal only** | Only horizontal alignment will be converted. |
| | **Hz,vert,cross section** | Horizontal alignment, vertical alignment and cross sections will be converted. Only available for road jobs. |

**Next step**

Press **OK** to start the conversion.

Alignment Editor creates a report sheet during the conversion. The file LandXml2Dbx.log can be found in the \Data\XML folder on the data storage device.

After the successful conversion, press **OK** to return to the **Main Menu** on the instrument.

# 48 Roads - Road

## 48.1 Creating a New Road Job

**Description**

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment Editor** application.

OR

Converting data created in a design package.

**Manually entered data**

Data can be typed in and edited with **Alignment Editor**. Refer to "47 Roads - Alignment Editor" for information on how to enter data manually.

**Converted data**

The **Import alignment data** application in **Jobs & Data** supports various different formats like dxf, LandXml, MxGenio, Terramodel, Carlson.

The Design to Field component of Leica Geo Office offers converters from several road/rail design and CAD packages. Several design packages also include a built-in converter to Roads/Rail. As different design packages follow different philosophies in representation, creation and storage of data the conversion process differs slightly.


Leica Geo Office can be found on the Leica Geo Office DVD.

The latest version of the Design to Field importers can be found in the downloads section of:

- myWorld@Leica Geosystems
  https://myworld.leica-geosystems.com

**Job selection**

Refer to "46.2.1 Accessing Roads Applications".

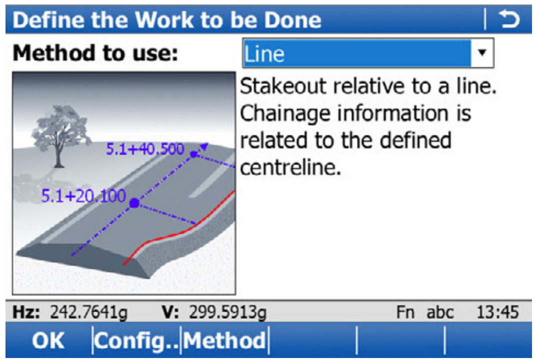
## 48.2 Defining the Work

### 48.2.1 Defining the Method and the Task

**Access**

1) Select **Main Menu**: **Go to Work!\Roads\Roads - Stakeout** or **Roads - As built check**.
2) In the job selection screen, select the required jobs. Refer to "46.2.1 Accessing Roads Applications".
3) Press **OK**.

**Define the Work to be Done**




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| Fn **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| **Method** | To define what is shown in the selectable list for **Method to use**.<br>☞ **Local line** can not be hidden. |
| Fn **Quit** | To exit the screen. |

#### Description of the methods

| Method | Description |
|---|---|
| **Line** | To stake/check any type of line, for example a centreline or kerb. Chainage information is related to the centreline. |
| **Local line** | Like the previous method when staking/checking any line of a layer. The stake/check is always in relation to the chainage of the line itself and not the centreline of the layer. |
| **Surface grade** | To stake/check a surface grade defined by the road design. Two lines define the surface grade (a lane or running surface). |
| **Manual slope** | To stake/check a manually defined slope relative to an existing centreline. The slope is defined by one line (hinge point) and the slope direction with ratio. The stake/check is always in relation to the chainage of the line itself and not the centreline of the layer. |
| **Local manual slope** | To stake/check a manually defined slope relative to an existing hinge line. The slope is defined by one line (hinge point) and the slope direction with ratio. |
| **Slope** | To stake/check a slope defined by two lines of the 3D road design. |
| **Crown** | To stake/check a road crown defined by two surface grades and one common line. The information for both surface grades is displayed at the same time. |
| **Layer** | To stake/check a layer surface defined by the road design relative to the layer centreline. |
| **DTM** | To check a DTM surface. Available for **Roads - As built check** only. |

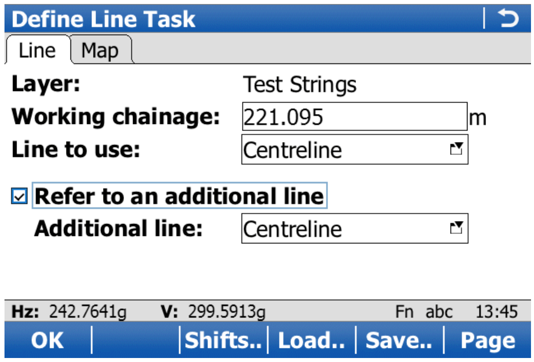
The available methods depend on the selected job types (road or control job):

| Available method | Road job only | Control job only | Road job & control job | DTM job only |
|---|---|---|---|---|
| **Line** | ✓ | - | ✓ | - |
| **Local line** | ✓ | ✓ | ✓ | - |
| **Surface grade** | ✓ | - | - | - |
| **Manual slope** | ✓ | - | ✓ | - |
| **Local manual slope** | ✓ | ✓ | ✓ | - |
| **Slope** | ✓ | - | - | - |
| **Crown** | ✓ | - | - | - |
| **Layer** | ✓ | - | - | - |
| **DTM** | - | - | - | ✓ |

#### Next step

**OK** accesses the **Define Task** screen.

## Define Task screen




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| **Slope** | Available for **Method to use**: **Manual slope**, **Method to use**: **Local manual slope** and **Method to use**: **Slope**. To define the slope parameters. Refer to "48.2.3 Advanced Slope Settings". |
| **Shifts..** | To apply horizontal and vertical shifts to the selected element. Refer to "46.4 Working with Shifts". |
| **Load..** | To load a task. Refer to "46.5 Tasks". |
| **Save..** | To save the settings as a task. Refer to "46.5 Tasks". |
| **Page** | To change, depending on the selected method, to **Hinge offset** and/or **Map** page.<br>Any line can be selected on the **Map** page.<br>Dxf lines have to be imported to a control job before they can be used for Roads. Refer to "38.6 Context Menu". |
| Fn **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

The fields available depend on the selection for **Method to use** in **Define the Work to be Done**.

### Description of fields

Common to all methods

| Field | Option | Description |
|---|---|---|
| **Layer** | Display only or selectable list | The selected layer in the Road job. |

For **Method to use**: **Line**

| Field | Option | Description |
|---|---|---|
| **Working chainage** | Editable field | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TPS and the current position for GPS. |
| **Line to use** | Selectable list | To select a line at the **Working chainage**. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line". |
| **Refer to an additional line** | Check box | When this box is checked, a second line can be selected.<br>Allows chainage, offset and height difference information to be obtained from any other string of the layer, independent from those strings currently selected for the chosen method. For example: Staking a surface grade where the height information comes from the surface grade, but the chainage information comes from a string which is not the centreline of the current layer.<br>For the additional line, an offset and a height difference can be defined on the **Offsets** page. |
| **Line to use** | Selectable list | The lines available as second lines, independent of the **Working chainage**. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line". |

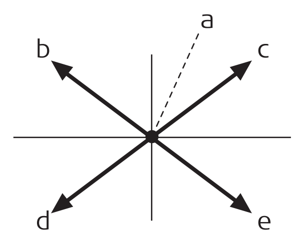
For **Method to use**: **Local line**

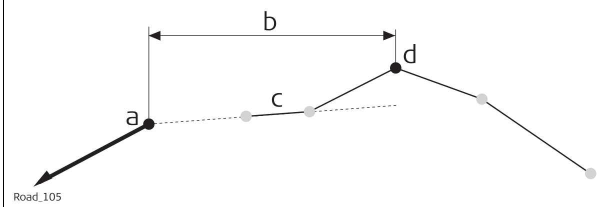
| Field | Option | Description |
|---|---|---|
| **Line to use** | Selectable list | To select a line at the **Working chainage**. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line". |
| **Refer to an additional line** | Check box | When this box is checked, a second line can be selected.<br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| **Line to use** | Selectable list | The lines available as second lines, independent of the **Working chainage**. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line". |

For **Method to use**: **Surface grade**

| Field | Option | Description |
|---|---|---|
| **Working chainage** | Editable field | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TPS and the current position for GPS. |
| **Left line** | Selectable list | The name of the left line defining the surface grade. Refer to "48.2.2 Selecting a Line". |
| **Right line** | Display only | The name of the right line defining the surface grade. |
| **Reference line** | **Left line** or **Right line** | To select one of the lines to be used as the reference line. |
| **Refer to an additional line** | Check box | When this box is checked, a second line can be selected.<br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| **Line to use** | Selectable list | The lines available as second lines, independent of the **Working chainage**. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line". |

For **Method to use**: **Manual slope** and **Method to use**: **Local manual slope**

| Field | Option | Description |
|---|---|---|
| On the **Slope** page: | | |
| **Chainage of slope** | Editable field | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage of selected line. |
| **Hinge line** | Selectable list | To select the hinge point of the slope. Or select a line on the **Map** page. Refer to "48.2.2 Selecting a Line".<br>☞ For **Manual slope**, only lines from the Road job can be selected. |
| **Slope location** | **Left** or **Right** | Defines if the slope is left or right of the hinge point.<br><br>Road_079<br>a) Hinge Point<br>b) Left, cut<br>c) Right, cut<br>d) Left, fill<br>e) Right, fill |
| **Use cut** and **Use fill** | Check box | When the box is checked, a cut/fill is used for the calculation. During the surveying process, the system calculates if it is a cut or a fill.<br>Check only one box to work only with cut or fill. |
| **Slope cut ratio** and **Slope fill ratio** | Editable field | Defines the cut/fill ratio of the slope.<br>☞ The slope ratio format is defined as system setting in **Regional Settings**, **Slope** page. |
| On the **Hinge offset** page: | | |
| **Apply hinge offsets** | Check box | When this box is checked, a horizontal and vertical offset of the hinge point can be defined. |
| **Ht offset type** | | The vertical offset type for the hinge point. |
| | **Absolute** | The only option available for 2D lines. |
| | **Relative to line** or **Relative to DTM** | Available for 3D lines. |
| | **Relativ to surf grade** | Available for **Method to use**: **Manual slope**. The manual slope is defined by the:<br>• Hinge offset relative to the selected hinge reference line<br>• Hinge height, calculated by using the hinge offset on the selected surface grade (left or right selected surface grade, depending on **Offset** – or +) |

| Field | Option | Description |
|---|---|---|
| | | <br>a) Hinge point of manual slope<br>b) Defined hinge offset (-)<br>c) Left surface grade of design<br>d) Selected hinge reference |
| **Offset** | Editable field | The horizontal offset of the hinge point from the centreline/reference line. |
| **Elevation** | Editable field | The elevation of the hinge point (absolute height). Available for **Ht offset type**: **Absolute**. |
| **Left line** | Editable field | The name of the left line. Available for **Ht offset type**: **Relativ to surf grade**. |
| **Right line** | Display only | The name of the right line. Available for **Ht offset type**: **Relativ to surf grade**. |
| **Height difference** | Editable field | For **Ht offset type**: **Relative to line**: A vertical offset for the hinge point using a height difference can be defined.<br>For **Ht offset type**: **Relative to DTM**: A height difference to the DTM height can be applied.<br>For **Ht offset type**: **Relativ to surf grade**: Height difference of the hinge point to the calculated height on the end slope. |

For **Method to use**: **Slope**

| Field | Option | Description |
|---|---|---|
| **Working chainage** | Editable field | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TPS and the current position for GPS. |
| **Left line** | Selectable list | The name of the left line defining the slope. |
| **Right line** | Display only | The name of the right line defining the slope. |
| **Reference line** | **Left line** or **Right line** | To select one of the lines to be used as the reference line (= hinge line). |

For **Method to use**: **Crown**

| Field | Option | Description |
|---|---|---|
| **Working chainage** | Editable field | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TPS and the current position for GPS. |
| **Crown line** | Selectable list | Line defining the middle line of the crown. Refer to "48.2.2 Selecting a Line". |
| **Left line** | Display only | The name of the line defining left line of the crown. |
| **Right line** | Display only | The name of the line defining right line of the crown. |
| **Reference line** | **Left line** or **Right line** | To select one of the lines to be used as the reference line. |
| **Refer to an additional line** | Check box | When this box is checked, a second line can be selected.<br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| **Line to use** | Selectable list | The lines available as second lines. |

For **Method to use**: **Layer**

| Field | Option | Description |
|---|---|---|
| **Layer** | Selectable list | A list of all available layers of the selected **Road job**. |
| **Centreline** | Display only | Active centreline of the selected layer. |
| **Extend end slopes** | Check box | When this box is checked, the left most and right most end slopes of the design are extended. |

For **Method to use**: **DTM**, available for **Roads - As built check**

| Field | Option | Description |
|---|---|---|
| **DTM layer** | Display only | A list of all DTM surfaces available in the selected DTM job. |
| **Number of triangles** | Display only | Number of triangles the selected DTM consists of. |

**Next step**

**OK** to access the **Stake** or **Check** screen.

## 48.2.2 Selecting a Line

**Access**

- In the Define screen, open a selectable list for a line, for example for **Line to use** or **Left line**.
- Or, tab on a line on the **Map** page.
- Or, for dxf lines, hold down the supplied stylus on an object for 0.5 second and select **Select Line**.

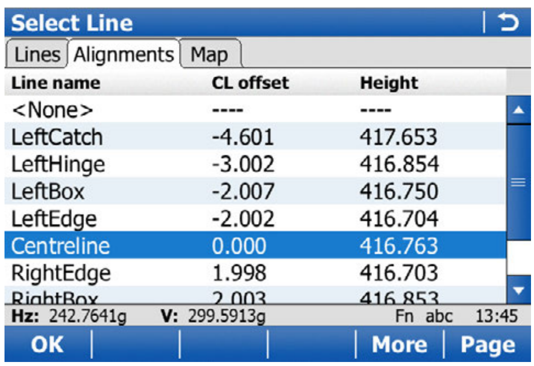
The selection of lines depends on:

- Availability of horizontal alignments
- Availability of vertical alignment information
- View (plan or cross section view)
- Working chainage defined or not
- Selected method

**Lines**

The screen can have a **Lines** page (if control job is selected), an **Alignments** page (if road alignment is selected) and a **Map** page.

If no working chainage has been entered, the lists show all lines of the current layer. If a working chainage is available, all lines existing at that chainage are listed only.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **More** | On the **Lines** and **Areas** page: To display information about the codes if stored with any line, the start time, the end time of when the last point was added to the line and the length of the line.<br>On the **Alignments** page: To display information about the absolute height or the height difference. Unavailable for local lines. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

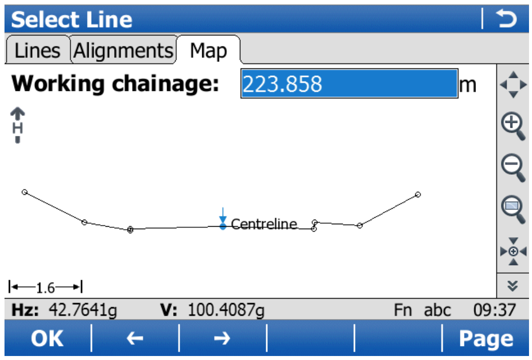
**Description of columns**

| Column | Description |
|---|---|
| **Line name** | The name of the line. |
| **CL offset** | The offset from the centreline. The format is defined as system setting in **Regional Settings**. |
| **Height** | The absolute height of the line. |
| **Ht diff** | The height difference to the centreline. |

☞ In addition to the list selection the required lines and slopes can also be selected on **Map** page.

Lines can be selected in a graphical way by using the

- cross section view. The cross section view is available if a working chainage has been defined. The selected line (3D only) or area from the control job is also displayed. Unavailable for **Method to use**: **Local manual slope**.
- planar view which is always available. The defined working chainage is displayed as a grey line. The size corresponds to the working corridor settings.




| Key | Description |
|---|---|
| ← | For lines from Road jobs: To select the previous line. |
| → | For lines from Road jobs: To select the next line. |

## 48.2.3 Advanced Slope Settings

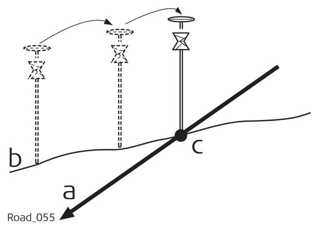
**Access**

Press **Slope** in the Define screen.

**General slope stakeout**

**Description**

This method involves a generic approach to slope stakeout for direct stakeout of the catch point. No special batter rails or reference point parameters are defined.




a) Slope to stake out
b) Natural surface
c) Catch point

**Workflow**

As the natural surface is unknown the catch point can only be staked out iteratively. If staking out on a horizontal natural surface, the values shown for Δ **offset** indicate how far the catch point is away. If the natural surface is not horizontal, more iterations could be needed.

**Slope Stakeout Settings**

| Key | Description |
|---|---|
| **OK** | To return to the Define screen. |
| **Types** | To define which slope stakeout types are shown and which are hidden. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

Common to all types

| Field | Option | Description |
|---|---|---|
| **Use advanced slope stakeout** | Check box | When this box is checked, slope stakeout settings are available. |
| **Type** | **Reference point** | Stakeout of a reference peg with a defined offset from the catch point. Refer to "Slope staking using Reference point". |
| | **Batter rail vertical** | Stakeout of batter rails using defined rail heights vertically above the batter.<br>Refer to "Slope staking using Batter rail vertical or Batter rail perpend". |
| | **Batter rail perpend** | Stakeout of batter rails using defined rail heights perpendicularly above the batter.<br>Refer to "Slope staking using Batter rail vertical or Batter rail perpend". |
| | **Ref batter vertical** | Stakeout of batter rails using defined rail heights vertically above the batter. The innermost peg/stake is offset at a defined horizontal distance from the catch point.<br>Refer to "Slope staking using Ref batter vertical or Ref batter perpend". |
| | **Ref batter perpend** | Stakeout of batter rails using defined rail heights perpendicularly above the batter. The innermost peg/stake is offset at a defined horizontal distance from the catch point.<br>Refer to "Slope staking using Ref batter vertical or Ref batter perpend" |
| | **Ref point surface** | Stakeout of a reference peg in the slope surface with a defined height difference to the hinge point. Slope values for the reference point cannot be entered.<br>Refer to "Slope staking using Ref point surface". |

For **Type**: **Reference point**

| Field | Option | Description |
|---|---|---|
| **Ref offset** | Editable field | The defined offset of the reference point from the catch point. |

For **Type**: **Batter rail vertical** and **Type**: **Batter rail perpend**

| Field | Option | Description |
|---|---|---|
| **Batter type** | **Cut** or **Fill** | Defines the cut or fill rail. |
| **Traveller height** | Editable field | Depending on the selected **Type**, the vertical or perpendicular height of the rail top above the batter. |
| **Rail over ground** | Editable field | The vertical height of the rail over the ground. |

For **Type**: **Ref batter vertical** and **Type**: **Ref batter perpend**

| Field | Option | Description |
|---|---|---|
| **Ref offset** | Editable field | The defined offset of the inner peg from the catch point. |
| **Traveller height** | Editable field | Depending on the selected **Type**, the vertical or perpendicular height of the rail above the batter. |

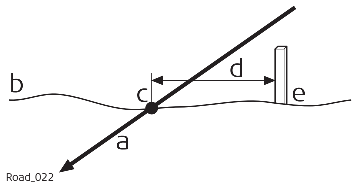
For **Type**: **Ref point surface**
The only available fields are **Use advanced slope stakeout** and **Type**.

**Next step**
**OK** returns to the Define screen.

## Slope staking using Reference point

### Description

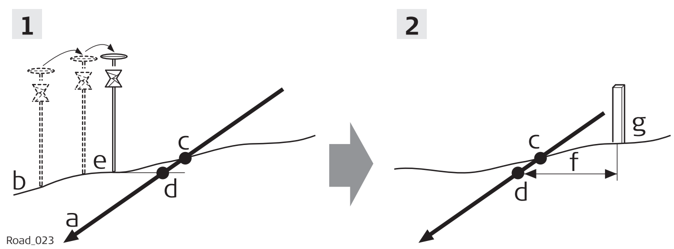
When staking out slopes using the reference point method, the catch point of the slope is marked with a reference peg using a defined offset. The grade of the slope is marked and controlled by "grade checkers".




a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Defined reference point offset
e) Reference peg

The reference point offset guarantees that all pegs are placed with the same horizontal offset to the catch point.

### Workflow




a) Slope to stake out
b) Natural surface
c) Real catch point
d) Projected catch point
e) Approximate staked out catch point after three iterations
f) Defined reference point offset
g) Reference peg

| Step | Description |
|---|---|
| 1. | The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, this process has to be done iteratively. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based on this approximate catch point, the projected catch point (d) on the slope is calculated.<br>No reference point offset and no traveller height are taken into account for this step. The projected catch point (d) is then used as a starting point for the stakeout of the reference peg (g). |
| 2. | The second step is to stake out the reference point relative to the projected catch point. Select **Place reference peg** from the Tools menu. Values in **Stake Slope Reference Point**, **Stake** page will guide the user to the position to place the peg. The defined reference point offset (f) is already taken into account.<br>The catch point is marked indirectly via the reference peg. Values to be marked on the reference peg can be found on **Stake Slope Reference Point**, **Info** page. |

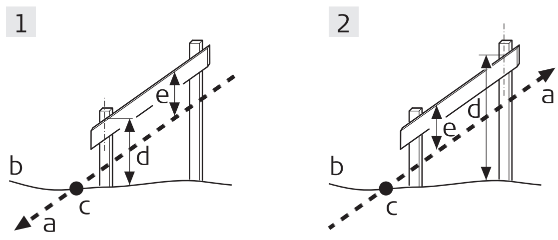
The closer the real catch point and the approximated stakeout catch point are, the closer the projected catch point gets to the real catch point.

## Slope staking using Batter rail vertical or Batter rail perpend

### Description

When staking out slopes with the **Batter rail vertical** or **Batter rail perpend** method, the grade of the slope is marked with a board. Using this method it is not necessary to stake out the catch point first.

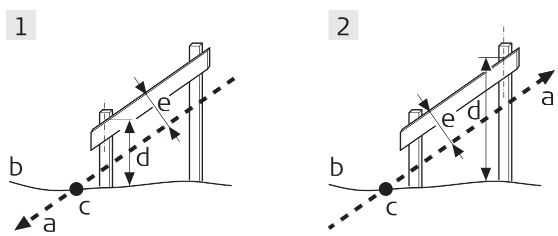
**For Batter rail vertical**




Road_024

1 Batter rail for a cut
2 Batter rail for a fill
a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Rail over ground
e) Rail over batter, vertical

**For Batter rail perpend**




Road_101

1 Batter rail for a cut
2 Batter rail for a fill
a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Rail over ground
e) Rail over batter, perpendicular

The defined rail over ground should guarantee that the rails are positioned as high as possible, to make them easier to use.

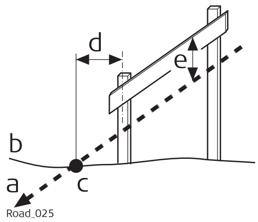
| Step | Description |
|---|---|
| 1. | The first peg to stake out is always the peg closest to the hinge point. Stake out the position of the first peg of the batter by using Δ **offset** on the **Stake** page of the Stake/Check screen. The height of the rail over ground **Rail over ground** is taken into account for Δ **offset**. This action means that when Δ **offset** is equal to zero the first peg is in the correct position. |
| 2. | Place the pole on top of the first peg. The value for Δ **height** indicates how far below the top of the batter has to be placed. |
| 3. | Stake out the second peg of the batter rail by using Δ **chainage** and place the peg. |
| 4. | Place the pole on the position of the batter rail to be used as a reference for the slope values to mark on the batter rail. Δ **height** should now read zero. ☞ All values shown under the **Info** page are relative to the original slope. |

## Slope staking using Ref batter vertical or Ref batter perpend

### Description

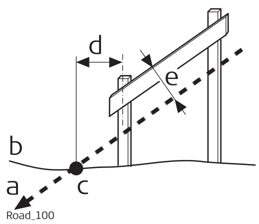
This method is used if batter rails with a constant distance from the inner peg to the catch point are required.

#### For Ref batter vertical




a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Defined reference point offset
e) Height of the "traveller", vertical

#### For Ref batter perpend




a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Defined reference point offset
e) Height of the "traveller", perpendicular

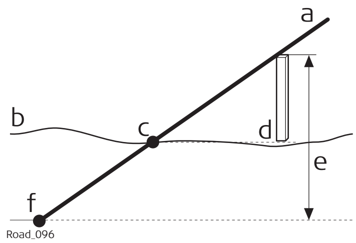
### Workflow

| Step | Description |
|---|---|
| ☞ | The first step is to stake out the catch point of the slope. The reference point offset and traveller height are not taken in account in this step. Based on this approximate catch point the projected catch point on the slope is calculated.<br>The projected catch point is used as a starting point for the stakeout of the reference peg. |
| 1. | Stake out the position of the catch point by using Δ **offset** and/or Δ **height** on the **Stake** page of the Stake/Check screen. When Δ **offset** and Δ **height** are equal to zero, the catch point has been located. |
| 2. | Fn **Tools..** to access the Tools screen. The measured position is used as the catch point for the stake out of the reference point. |
| 3. | Select **Place reference peg** to access the stakeout screen for the reference peg. |
| 4. | Stake out the reference point using Δ **offset**. When Δ **offset** is equal to zero the reference peg position has been found. |
| 5. | Place the pole on top of the reference peg. The value for Δ **height** indicates how far below the top of the peg the batter has to be placed. |
| 6. | Place the pole on the position of the batter rail to be used as a reference for the slope values to mark on the batter rail. Δ **height** should now read zero. All values shown under the **Info** page are relative to the original slope. |
| 7. | ⮌ to return to **Stake Slope**. Stake out the next catch point from this screen. |

## Slope staking using Ref point surface

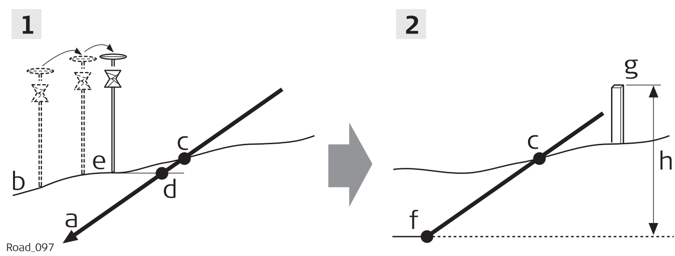
### Description

When staking out slopes using the reference point surface method, the reference peg is staked out with a defined height difference to the hinge point.




a) Slope to stake out
b) Natural surface
c) Catch point of the slope
d) Reference peg
e) Defined hinge height difference
f) Hinge point

### Workflow




a) Slope to stake out
b) Natural surface
c) Real catch point
d) Projected catch point
e) Approximate staked out catch point after three iterations
f) Hinge point
g) Reference peg
h) Defined hinge height difference

| Step | Description |
|---|---|
| | The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, this process has to be done iteratively. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based on this approximate catch point, the projected catch point (d) on the slope is calculated.<br>The projected catch point (d) is then used as a starting point for the stakeout of the surface reference peg (g). |
| 1. | Stake out the position of the catch point by using Δ **offset** and/or Δ **height** on the **Stake** page of the Stake/Check screen. When Δ **offset** and Δ **height** are equal to zero, the catch point has been located. |
| 2. | Define the hinge height difference.<br>Fn **Tools..** to access the Tools screen. |
| 3. | Select **Place surface reference peg** to access the define screen for the reference peg field. The measured position from step 1. is used as the catch point for the stake out of the reference point.<br>The **Actual hinge ht diff** field displays the **Hinge ht diff** value from the **Stake** page of the Stake/Check screen.<br>Type in the appropriate value for **Defined hinge ht diff**. |
| 4. | Stake out the surface reference point relative to the projected catch point. Values in **Stake Slope Ref Point Surface**, **Stake** page guide you to the position to place the peg. The defined hinge height difference (h) is already taken into account.<br>Values to be marked on the reference peg can be found on **Stake Slope Ref Point Surface**, **Info** page. |
| 5. | to return to **Stake Slope**. Stake out the next catch point from this screen. |

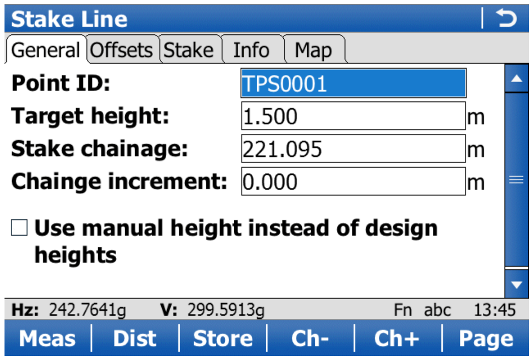
The closer the real catch point and the approximated stakeout catch point are, the closer the projected catch point gets to the real catch point.

## 48.3 Staking/Checking the Road

### 48.3.1 The Stake/Check Screen

**Stake/Check screen, General page**

The **Stake Line** is shown as example.




| Key | Description |
|---|---|
| **Meas** | GPS To start measuring the point being staked. The key changes to **Stop**.<br>TPS To measure a distance and store distance and angles. |
| **Stop** GPS | To end measuring the point being staked. When **Automatically stop point measurement** is checked in **Quality Control**, **General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| **Store** | GPS To store the measured point. When **Automatically store point** is checked in **Quality Control**, **General** page, the measured point is stored automatically. The key changes to **Meas**.<br>TPS To store angles and distance. Distance must be measured before. |
| **Dist** TPS | To measure a distance. |
| **Ch-** | Available for **Roads - Stakeout**. To decrease the chainage as defined by **Chainge increment**. |
| **Ch+** | Available for **Roads - Stakeout**. To increase the chainage as defined by **Chainge increment**. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Positn** TPS | To position the total station to the defined stakeout point, including defined offsets. This depends on the settings for **Turn to point** in **Configuration**, **TPS** page. Refer to " Configuration, TPS page". |
| Fn **Tools..** | To access the method-specific Tools Menu. Refer to "48.4 The Tools Menu". |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| ☞ The following fields are always shown in all Stake and Check methods. | | |
| **Point ID** | Editable field | Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored. |
| **Antenna height** GPS | Editable field | Height of the antenna. |
| **Target height** TPS | Editable field | Height of the prism. |
| ☞ The following fields are always shown in all Stake methods, except for method **Layer**. | | |
| **Stake chainage** | Editable field | Nominal chainage of the point to be staked out. |
| **Chainge increment** | Editable field | Chainage increment. Value by which the nominal chainage increases/decreases when pressing **Ch-**/**Ch+**. |
| ☞ The following field is shown in the Stake and Check methods except for **Slope** and **Manual slope**. | | |
| **Use manual height instead of design heights** | Check box | When this box is checked, a height value typed in manually is used instead of design height or DTM height. When this box is not checked, the height from design is used. |
| **Manual height** | Editable field | The height to be used. |

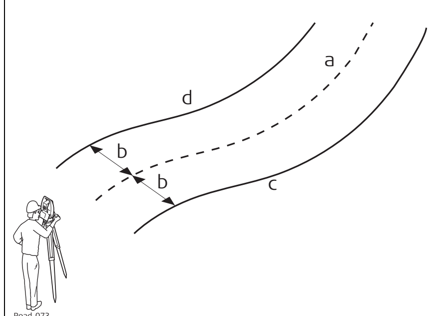
#### Next step

**Page** changes to the **Offsets** page.

**Stake/Check screen, Offsets page**

Refer to "Stake/Check screen, General page" for a description of keys.

**Description of fields**

<table>
<tr><th>Field</th><th>Option</th><th>Description</th></tr>
<tr><td>Apply offsets</td><td>Check box</td><td>When this box is checked, the defined stake/check offsets are applied.</td></tr>
<tr><td>Stake offset</td><td>Editable field</td><td>Available for Stake. Horizontal offset from the reference line (as defined by the chosen method) of the point to stake.<br>☞ When a stake offset is entered for line, local line, manual slope and local manual slope and Work with non-perpendicular offset is checked on the Offsets page: When coming to a corner when working at a stake chainage along an alignment, choose one of the following from the message:<br>• Prev: To stake out the point according to the tangent direction of the previous line.<br>• Avg: To stake the average tangent direction. The stake distance from the corner is the offset value defined.<br>• Next: To stake out the point according to the tangent direction of the next line.</td></tr>
<tr><td>CL stake offset</td><td>Editable field</td><td>Available for Stake with Layer. The Easting and Northing values for staking are calculated by the horizontal offset from the centreline. The height is derived from the layer.</td></tr>
<tr><td>Stake height diff</td><td>Editable field</td><td>Available for Stake. Vertical offset from the reference line or surface (as defined by the chosen method) of the point to stake.</td></tr>
<tr><td>Toggle offsets left/right</td><td>Check box</td><td>When this box is checked, points can be staked/checked on the left/right side of the selected line in one process.<br><br><br>a) Line<br>b) Defined Stake offset<br>c) Parallel right line<br>d) Parallel left line<br>This functionality is available for the following stake out/check methods:</td></tr>
</table>

| Field | Option | Description |
|---|---|---|
| | | • **Line**: Toggle between line left and right.<br>• **Surface grade**: Toggle between left and right line of the surface grade.<br>• **Crown**: Toggle between left and right surface grade.<br>The application automatically detects which side of the centreline is being used and selects the appropriate line as a reference.<br>**Auto position**<br>When pressing auto position Fn **Positn**, available in total station mode, a message box comes up prompting if either the left or right side should be staked out/checked. |
| **Check offset** | Editable field | Available for Check. Horizontal offset from the reference line, as defined by the chosen method, of the point to stake. |
| **CL check offset** | Editable field | Available for Check with **Layer**. The Easting and Northing values for checking are calculated by the horizontal offset from the centreline. The height is derived from the layer. |
| **Check height diff** | Editable field | Available for Check. Vertical offset from the reference line or surface, as defined by the chosen method, of the point to stake. |
| ☞ The following field is shown for the Stake methods **Line**, **Local line**, **Local manual slope** and **Manual slope**. | | |
| **Work with non-perpendicular offset** | Check box | When this box is not checked the measured point is projected in a right angle to the selected line.<br>When this box is checked, any projection angle can be defined. |
| **Offset angle** | Editable field | Manually defined projection angle. |
| ☞ The following fields are shown in the **Line**, **Local line**, **Surface grade** and **Crown** methods when **Refer to an additional line** is checked in the Define screen. | | |
| **Apply offsets to additional line** | Check box | When this box is checked, an offset to the additional line can be defined. |
| **Offset** | Editable field | Horizontal stake/check offset to the additional line. |
| **Height difference** | Editable field | Vertical stake/check height difference to the additional line. |

**Next step**

**Page** changes to the **Stake** page.

**Understanding priorities of various heights**

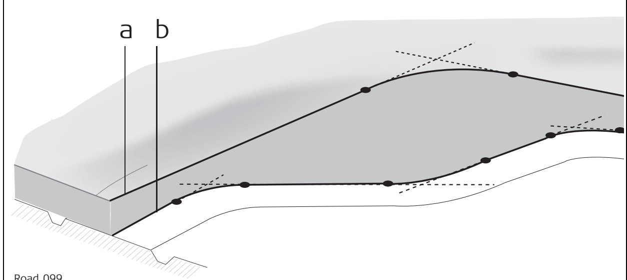
| Type of height | Overrules | Stake height diff |
|---|---|---|
| Manually entered<br>OR<br>Obtained from individual point | All other heights | Considered |
| Use DTM height for stakeout (Tools menu: **Use heights from DTM**) | Design height | Considered |
| From design | No other heights | Considered |
| Show DTM height difference on **Info** page (Tools menu: **Use heights from DTM**) | No influence on priorities<br>For additional info only | - |

**Stake screen, Stake page**

☞ This page is available for Roads - Stakeout only.

This page displays the differences between the measured points and stakeout points (delta values). If these values are zero, the measured point coincides with the stakeout point.
Refer to "Stake/Check screen, General page" for a description of keys.
Refer to "54.4 Staking Out" for a description of the elements of the graphical display.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Chainage** | Display only | The current chainage. |
| **CL O** | Display only | Perpendicular horizontal offset to the centreline. |
| Δ **chainage** | Display only | Difference between the defined **Stake chainage** and the current chainage **Chainage** of the measured position.<br>If no defined chainage exists, for example if staking out random chainages or checking, this field shows **-----**. |
| **NrTP** | Display only | The chainage difference between the measured point and the nearest tangent point (start/end point of a road segment) of the design is displayed.<br><br><br>a) Vertical alignment<br>b) Horizontal alignment<br>Only tangent points (start/end point of a road segment) are detected. |
| Δ **O** | Display only | Horizontal offset between the defined position and the current position. The **Stake offset** defined on the **Offsets** page is taken into account. |
| Δ **height** | Display only | Vertical offset between the defined position and the current position. The **Stake height diff** defined on the **Offsets** page is taken into account. |

### Next step

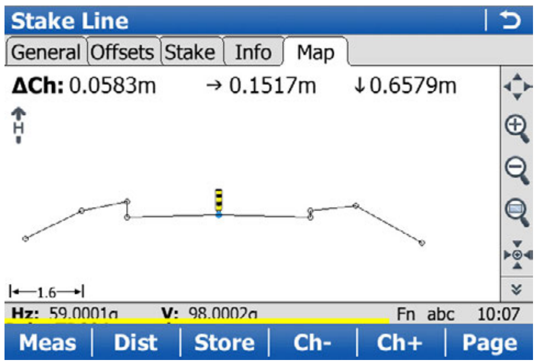
**Page** changes to the **Info** page.

**Stake/Check screen, Info page**

A user definable **Info** page exists for each of the stake methods and check methods. Refer to the chapters from "46.3.2 Road Line - Info Page"to "46.3.8 Road DTM - Info Page".
Refer to "Configuration, Info page" for information on all available items for the **Info** page and how to select them.

**Stake/Check screen, Map page**

The **Map** page for Stake shows information about the measured point relative to the design. The design is defined by the selected layer and line, and the values entered on the **General** page.
The **Map** page for Check and Stake are similar. The only difference is that the current chainage is always shown instead of Δ **chainage**.
For Check and when only a DTM job is used, the **Map** page shows the DTM and the lines of selected Road layer - always in plan view. At the top of the page, DTM height and delta height are shown.




| Key | Description |
|---|---|
| | Refer to "Stake/Check screen, General page" for a description of keys. |
| Fn **Layrs..** | To turn layers of background maps (CAD files) on and off. Refer to "5.2 Creating a New Job"for information on CAD files and CAD background maps. |

The following information is shown:

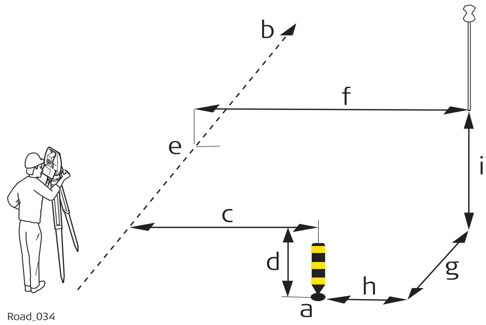
1. Chainage difference between the measured point and the defined chainage. When working with random chainages, for instance if no defined chainage has been entered on the **General** page, Δ**Ch** changes to **Ch**. **Ch** is the current chainage as shown on the **Stake** page.
2. Horizontal offset (left/right arrow) to the design
3. Height difference (up/down arrow) to the design
4. The measured point (prism pole or GPS antenna)
5. The element to stake is shown in bold and blue. The position to stake is marked with a yellow-black peg.
6. The plot can be shown as a cross plot or plan view by using the eye icon on second level of MapView toolbar. Displayed is:
   Cross plot:
   - Road job lines of the selected layer
   - Only selected line of the control job (not all lines)

   Plan view:
   - Road job lines of the selected layer
   - Lines of control job
   - Background maps, for example dxf(s), attached to control job
   - Working job items are displayed in grey

## 48.3.2 Measuring Points by Chainage and Offset

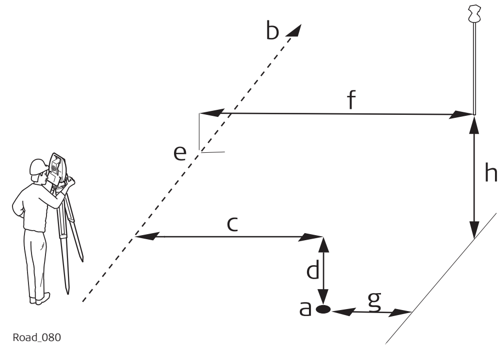
**Graphical overview**

**Roads - Stakeout**




a) Position to stake out, defined by chainage, stake offset and, optionally, stake height difference
b) Centreline/line the position is defined relative to
c) **Stake offset**
d) **Stake height diff**
e) **Chainage**
f) **CL offset**/**Ref offset**
g) **Δ chainage**
h) **Δ offset**
i) **Δ height**

**Roads - As built check**




a) Position to check, defined by check offset and, optionally, check height difference
b) Centreline/line the position is defined relative to
c) **Check offset**
d) **Check height diff**
e) **Chainage**
f) **CL offset**/**Ref offset**
g) **Δ offset**
h) **Δ height**

**Description**

- When staking points, the points are defined by the stake chainage and, if enabled, by the stake offset and the stake height difference relative to an existing 2D or 3D centreline or line.
- When checking points, the points are defined by the check offset and the check height difference relative to an existing 2D or 3D centreline or line.

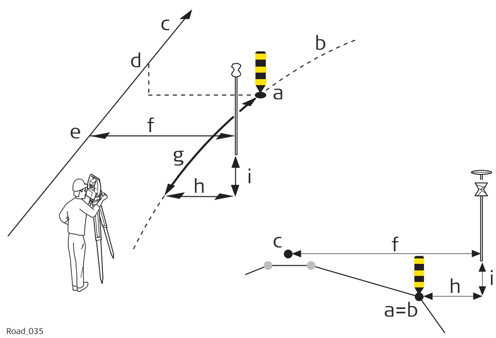
**Required elements**

- For 2D, a horizontal centreline is required.
- For 3D, a 3D centreline is required.

## 48.3.3 Measuring Lines Relative to a Centreline

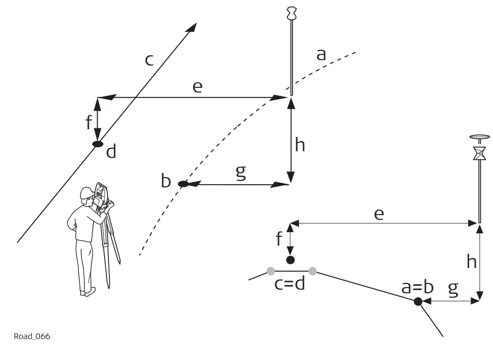
**Graphical overview**

**Roads - Stakeout**




a) Position to stake out
b) Line to stake out
c) Centreline
d) **Stake chainage**
e) **Chainage**
f) **CL offset**
g) ∆ **chainage**
h) ∆ **offset**
i) ∆ **height**

**Roads - As built check**




a) Line to check
b) Projected point on line
c) Centreline
d) **Chainage**
e) **CL offset**
f) **CL ht diff**
g) ∆ **offset**
h) ∆ **height**

**Description**

- Lines define various elements, including:
    - Centreline of the design
    - Change in slope ratio, for example, the edge of a carriage way
    - Gutter, cable, pipeline or any other type of alignment element
- Refer to "46.6.3 Road - Basic Elements for Stake and Check Measurements" for information on the usage of lines.

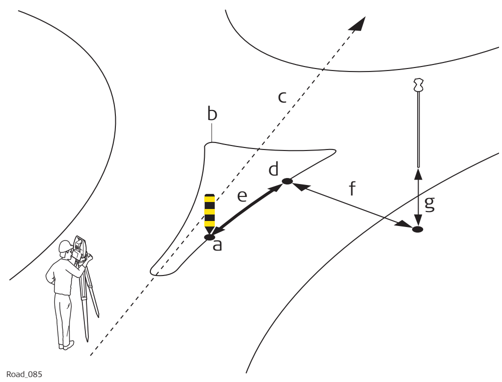
**Required elements**

- For 2D, at least a 2D line and a 2D centreline are required.
- For 3D, a 3D line and a 2D or 3D centreline are required.

## 48.3.4 Measuring Local Lines without Centrelines

**Graphical overview**

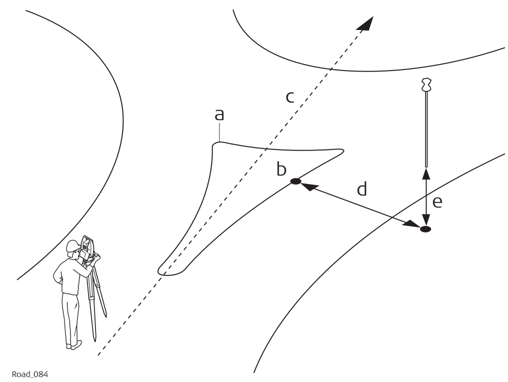
**Roads - Stakeout**




**Stakeout of Roundabout**

a) Position to stake out
b) Line to stake out
c) Centreline of the layer- is not used for the local line
d) **Chainage**
e) **Δ chainage**
f) **Δ offset**
g) **Δ height**

**Roads - As built check**




**Checking a Roundabout**

a) Line to check
b) **Chainage**
c) Centreline of the layer- is not used for the local line
d) **Δ offset**
e) **Δ height**

**Description**

This process is different to lines, where the stake/check is always relative to the centreline defined for the layer. Local lines no longer have a relationship to an overall centreline. Local lines are used to check roundabouts, parking bays, subdivision works and any other type of lines. The different lines to stake/check can be stored within one layer, which does not require a defined centreline. This ability is different to the stake/check of any other type which always require a centreline.

**Required elements**

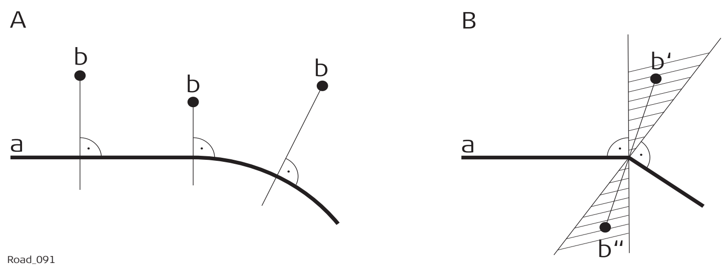
A 2D or 3D design of the line to stake/check is required.

## 48.3.5 Indefinite Triangle

**Description**

In almost all situations, a measured position is shown relative to the local line by the line chainage and a square offset to the line. However, situations can arise where a road design has extreme changes in the deflection angle of tangent points. In these cases, it is not always possible to show a measured position by the nominal chainage and offset. An indefinite triangle is a region in which these situations arise. Points measured within an indefinite triangle are shown relative to the tangent point.

**Graphic**




**Road Design A**

a) Local line

b) Measured position (displayed relative to the line by chainage and square offset)

**Road Design B**

a) Local line with extreme changes in the deflection angle of tangent points

b) Measured position within indefinite triangle
This position **cannot** be shown in the usual manner and is displayed relative to the tangent point

b")Measured position within indefinite triangle
This position **can** be shown in the usual manner and is displayed by chainage and square offset

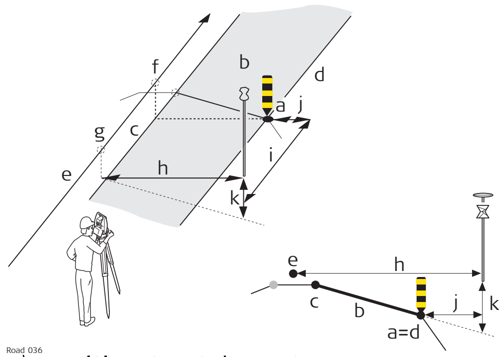
**Screen**

Points measured within an indefinite triangle are always shown relative to the tangent point.

## 48.3.6 Measuring Surface Grades

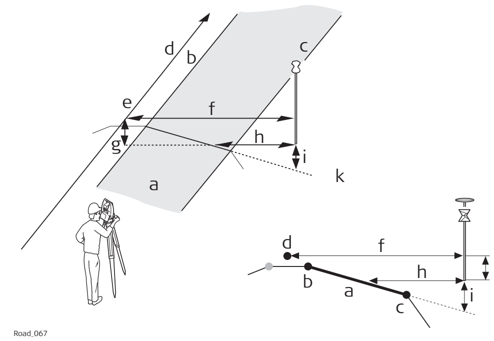
**Graphical overview**

**Roads - Stakeout**




a) Position to stake out
b) Surface grade to stake out
c) Left line
d) Right line
e) Centreline
f) **Working chainage**
g) **Chainage**
h) **CL offset**
i) **Δ chainage**
j) **Δ offset**
k) **Δ height**

**Roads - As built check**




a) Surface grade to check
b) Left line
c) Right line
d) Centreline
e) **Chainage**
f) **Δ offset**
g) **Δ height**
h) **Surf. grade offset**
i) **Surf. grade ht diff**

**Description**

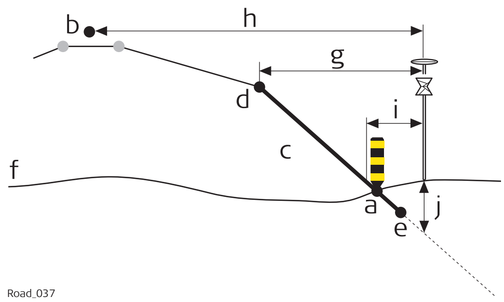
- Surfaces such as the final carriage way, are often staked/checked using surface grades. A surface grade consists of a combination of two lines.
- Refer to "46.6.3 Road - Basic Elements for Stake and Check Measurements" for information on the usage of surface grades.

**Required elements**

A 3D design of the road is required.

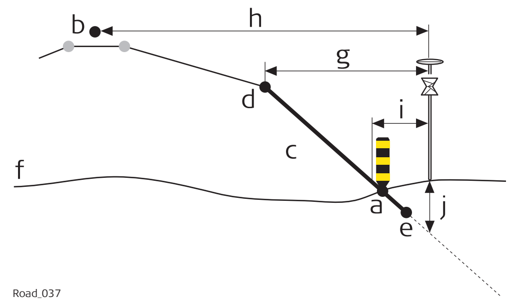
**Graphical overview**

**Roads - Stakeout**




a) Catch point
b) Centreline
c) Slope to stake out
d) Hinge point = left line
e) Second / right line
f) Natural surface
g) **Hinge offset**
h) **CL offset**
i) **Δ offset**
j) **Δ height**

**Roads - As built check**




a) Catch point
b) Centreline
c) Slope to check
d) Hinge point
e) Second line of the slope
f) Natural surface
g) **Hinge offset**
h) **CL offset**
i) **Slope offset**
j) **Slope height diff**

**Description**

- Surfaces, such as the end slopes of a cut or fill, are staked/checked using slope methods.
- Slopes are defined by two lines. Refer to "46.6.3 Road - Basic Elements for Stake and Check Measurements".
- When staking slopes, the point of interest is the intersection of the defined slope with the natural surface (= catch point). Refer to "48.2.3 Advanced Slope Settings" for information on the slope staking methods supported.
- When checking slopes, the slope check is independent of the slope method selected.

**Description of manual slopes**

The slope is defined manually relative to a selected 3D centreline, slope direction and slope ratio or relative to a 2D line using a manual height, slope direction and slope ratio. Chainage information is related to the centreline.

**Description of local manual slopes**

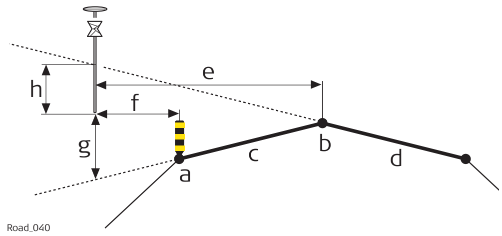
The slope is defined manually relative to a selected 3D line, slope direction and slope ratio or relative to a 2D line using a manual height, slope direction and slope ratio. Chainage information is related to the selected line itself and not the centreline of the layer.

**Description of design slopes**

For this method, a 3D representation of the slope, defined by two lines, is required.

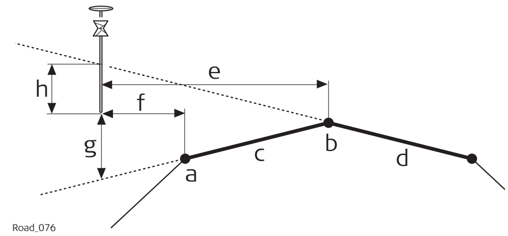
## Graphical overview

**Roads - Stakeout**




a) Position to stake out, in this case the left line of the crown
b) Middle line of the crown, in this case also the centreline
c) Left surface grade to stake out
d) Right surface grade to stake out
e) **CL offset**
f) ∆ **offset**
g) ∆ **ht left**
h) ∆ **ht right**

**Roads - As built check**




a) Left line of the crown
b) Middle line of the crown, common for both surface grades
c) Left surface grade to check
d) Right surface grade to check
e) **CL offset**
f) ∆ **offset**
g) ∆ **ht left**
h) ∆ **ht right**

## Description

- Staking road crowns allows the stake out of two surface grades at the same time. If **Toggle offsets left/right** is checked, the reference for ∆ **offset** is automatically switched between the right and left surface grade depending on whether the measured position is to the right or left of the middle line.
- When checking road crowns, it allows the check of two surface grades at the same time. The information for both surface grades is shown at the same time.

## Required elements

A 3D design of the road, defining a crown consisting of three lines, is required.

## Specific fields

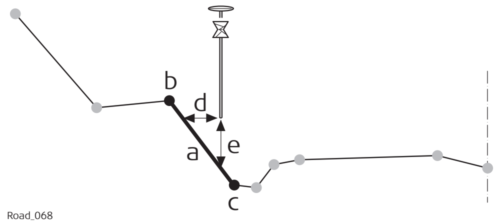
The following fields vary from the description used in "48.3.1 The Stake/Check Screen":

| Field | Option | Description |
|---|---|---|
| ∆ **ht left**/ ∆ **ht right** or **∆HtL**/**∆HtR** | Display only | Vertical offset to the left/right surface grade defining the road crown. |

## 48.3.9 Measuring Road Layers

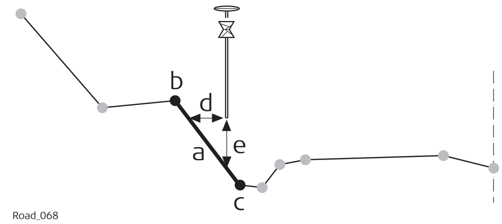
**Graphical overview**

**Roads - Stakeout**




a) Relevant part of the layer for the current position
b) Left line **Left name**
c) Right line **Right name**
d) ∆ **offset**
e) ∆ **height**

**Roads - As built check**




a) Relevant part of the layer for the current position
b) Left line **Left name**
c) Right line **Right name**
d) **Slope offset**
e) **Layer ht diff**

**Description**

All lines are grouped in layers. Such a layer describes a surface of the road. When staking/checking out a layer, it is automatically detected the line left and right of the measured position.

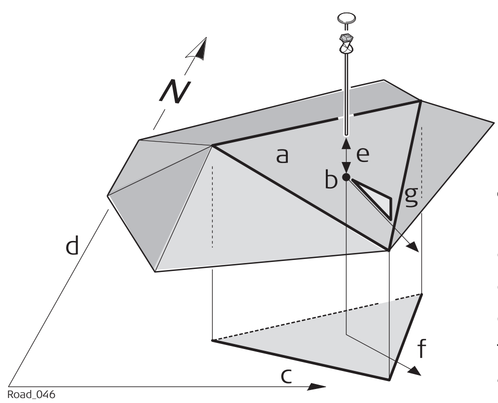
**Required elements**

A 3D design of the road is required.

## 48.3.10 Measuring Digital Terrain Models (DTM)

**Graphical overview**

**Roads - As built check**




a) Relevant triangle of the DTM
b) Projected point on DTM
c) Easting
d) Northing
e) **DTM height diff**
f) **Flow direction**
g) **Flow ratio**

**Description**

A DTM check returns the height difference between the current height and the height of the DTM at the measured position.

**Required elements**

A DTM job is required.

# 48.4 The Tools Menu

## 48.4.1 Overview

**Access**

Press Fn **Tools..** on any page of the Stake/Check screen.

**Description**

The Tools menu contains additional functionality for each of the stake and check methods. This functionality is additional to those already existing functions which are available via the function keys.
The functionality differs between the stake and check methods. Refer to these subchapters for a detailed description of the functionalities:


- "48.4.2 Use heights from DTM"
- "48.4.3 Apply current chainage"
- "48.4.4 Get current angle to alignment"
- "48.4.5 Stake individual point"
- "48.4.6 COGO Road - Alignment Information"
- "48.4.7 Additional Layer Information"
- "48.4.8 Box / base definition"
- "48.4.9 Get current slope"
- "48.4.10 Manual Slope"
- "48.4.11 Reset slope to design"
- "48.4.12 Shift reference line"
- "48.4.13 Re-initialise search"
- "48.4.14 Stake intersection point"

## 48.4.2 Use heights from DTM

**Availability**

This menu function is available for the following stake/check methods: Line, local line, surface grade, crown, layer.

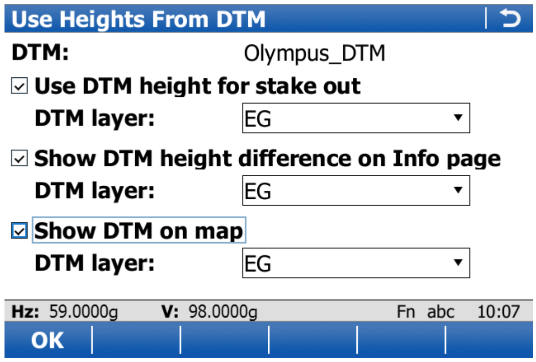
**Description**

The application offers the possibility to

- switch to a height which is retrieved from an existing height layer, as defined in the selected DTM job. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments.
- retrieve heights from an existing layer, as defined in the DTM job associated with the project. The DTM used is not considered for the stake values. Three new information lines are added to the **Info** page: **DTM Ht Diff**, **DTM Height** and **DTM Layer**.
- show the DTM triangles in the planar view and in the cross section view on the **Map** page.

Once defined, each layer remains active until it is turned off. DTM heights can be used for both 2D and 3D alignments.

#### Use heights from DTM




| Key | Description |
|---|---|
| **OK** | To confirm the settings and return to the Stake/Check screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **DTM** | Display only | DTM from the selected DTM job. |
| **Use DTM height for stake out** | Check box | When this box is checked, a layer of the DTM is used as a height reference.<br>When this box is not checked, no DTM heights are applied for stakeout or check. |
| **DTM layer** | Selectable list | Available when **Use DTM height for stake out** is checked. When selecting a DTM layer the relevant triangle of the DTM is shown on the **Map** page. |
| **Show DTM height difference on Info page** | Check box | When this box is checked, a layer of the DTM to be used as a height reference on the **Info** page.<br>When this box is not checked, no additional height information relative to the DTM is shown on the **Info** page. |
| **DTM layer** | Selectable list | Available when **Show DTM height difference on Info page** is checked. Layer of the DTM to be used as a height reference. When selecting a DTM layer the relevant triangle of the DTM is shown in cross section view on the **Map** page. |
| **Show DTM on map** | Check box | When this box is checked, the DTM triangles are displayed in planar view on the **Map** page.<br>The setting of for this check box is linked to the setting for the **Display DTM in map** check box in **Map View Settings**, **DTM** page. |
| **DTM layer** | Selectable list | All available layers are selectable. |

## 48.4.3 Apply current chainage

**Availability**

This menu function is available for all stake methods except layer.

**Description**

To set **Stake chainage** on the **General** page of the stakeout to the current chainage.

## 48.4.4 Get current angle to alignment

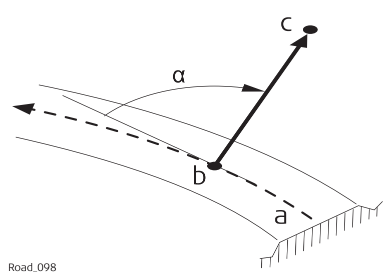
**Availability**

This menu function is available for the stake/check of lines and local lines.

**Description**

To project a measured point to the alignment considering the entered **Stake chainage**. This functionality is only available when **Work with non-perpendicular offset** is checked in the Stake screen on the **Offsets** page.

**Graphic**




a) Alignment
b) Defined chainage
c) Current position
α Angle to alignment

**Workflow**

| Step | Description |
|---|---|
| 1. | Measure a point:<br>TPS **Dist**<br>GPS **Meas** and **Stop** |
| 2. | Press Fn **Tools..** to access the Tools menu. |
| 3. | Select **Get current angle to alignment**. |
| 4. | At the defined chainage, the angle between the tangent direction and the direction to the current position is calculated. This angel is set as **Offset angle** for **Work with non-perpendicular offset** on the **Offsets** page. |
| 5. | Continue with staking out using the calculated **Stake chainage** and **Offset angle** values. These values are valid until new values are defined manually or by using **Get current angle to alignment**. |

## 48.4.5 Stake individual point

**Availability**

This menu function is available for the stake/check of lines and local lines.

**Description**

To select the point to stake from the selected **Working job**.
If a control job has been selected on the job selection screen, a point from the control job can be selected. When staking out/checking an individual point, the selected point is set in relation to the alignment and all line relevant values are calculated and displayed.

To access **Data:**, **Points** page, which allows staking out points with known Easting, Northing and Height. Points can either be selected from the **Working job** or manually typed in.

The **Stake chainage** and **Stake offset** of the Stake screen are calculated based on the coordinates of the selected point.

The height for the stakeout can be set as **Manual height**.

☞ If the chosen point has no height the design height will be used. If the point has a height it is possible to use that one or continue working with the design height.

## 48.4.6 COGO Road - Alignment Information

**Availability**

This menu function is available for staking/checking a line/local line.

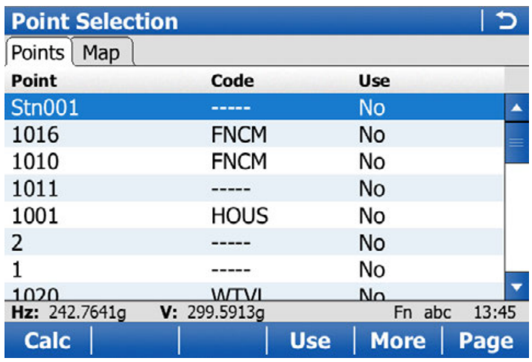
**Description**

This function allows
- the selection of existing single or multiple points from a job.
- viewing the selected points along the alignment.
- displaying the respective alignment chainage and offset information.

Any job containing points from any data storage device can be used.

The calculated alignment information is stored and a report sheet can be used for extracting the data.

**Point Selection**




| Key | Description |
|---|---|
| **Calc** | To perform the chainage and offset calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored. |
| **Use** | To change between **Yes** and **No** in the **Use** column for the highlighted point. |
| **More** | To display information about the codes if stored with any point, the Easting, Northing, Elevation, time, date and 3D coordinate quality. The order in which the Easting and Northing columns are shown depends on the **Grid format** configured to be used in **Regional Settings**, **Coords** page. The Easting, Northing and Elevation values are shown in the unit configured in **Regional Settings**, **Distance** page. |
| **Page** | To change to another page on this screen. |
| Fn **None** or Fn All | To deactivate or activate all points for the COGO calculation. |
| Fn **Quit** | To exit the application. |

Point selection/deselection is possible on the **Map** page.

| IF | THEN |
|---|---|
| a single point is to be selected/deselected | tap on the point. |
| multiple points are to be selected/dese-lected | click the icon, drag the stylus on the screen in a diagonal line to make a rectan-gular area. |
| all points are to be selected | press **All** or **None**. |

**Next step**

**Calc** computes the alignment information.

**Alignment Results, Points page**

| Key | Description |
|---|---|
| **Store** | To store the results. Points are stored in the working job together with the alignment information. The points can be exported with a report sheet later. The information is the same as if the points had been measured along the alignment. |
| **More** | To display information about the calculated alignment information: Horizontal offset from the line, height difference from the defined line and horizontal offset from the centreline. |
| **Page** | To change to another page on this screen. |
| **Config..** | To configure if the calculated points are stored with the original point ID, a prefix or a suffix. |
| Fn **Quit** | To exit the application. |

**Next step**

**Page** changes to another page.

The fields and information displayed on the **Info** page are as defined in **Configuration**, **Info** page. Refer to "Configuration, Info page".

The **Plot** page displays all the calculated points against the design data.

**Configuration**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Store point ID with** | **Same point ID** | The same point ID from the selected job is used when storing to the working job. If a point exists with the same point ID in the working job a warning appears. Choose to over-write the existing point or not. |
| | **Prefix** | Adds the setting for **Store point ID with** in front of the original point IDs. |
| | **Suffix** | Adds the setting for **Store point ID with** at the end of the original point IDs. |
| **Prefix / suffix** | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the calculated COGO points. |

## 48.4.7 Additional Layer Information

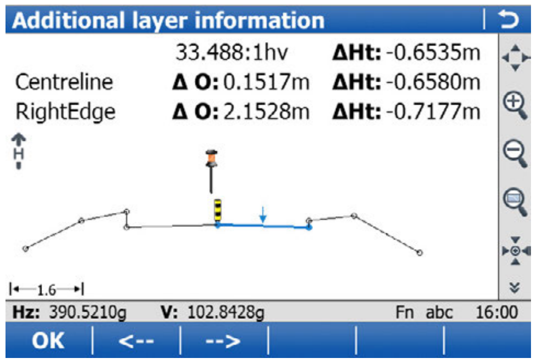
**Availability**

This menu function is available for all stake/check methods except layer.

**Description**

This function allows additional road data to be obtained during a check or stake survey of a road element.
Road elements include centrelines, kerb and gutters and slopes.
The map shows cross section view only and allows setting the vertical exaggeration.

**Additional Layer Information**




| Key | Description |
|---|---|
| **OK** | To store the selected element, which is then automatically recalled. |
| ← or → | To select the relevant element in the plot. The information displayed shows the current slope ratio and the height difference of the element. Also displayed are the offset and height differences from the left and right vertices of the element. |
| Fn **Config..** | To configure MapView. Refer to "38.3 Configuring MapView". |
| Fn **Layrs..** | To turn layers of background maps (CAD files) on and off. Refer to "5.2 Creating a New Job" for information on CAD files and CAD background maps. |
| Fn **Quit** | To exit the application. |

## 48.4.8 Box / base definition

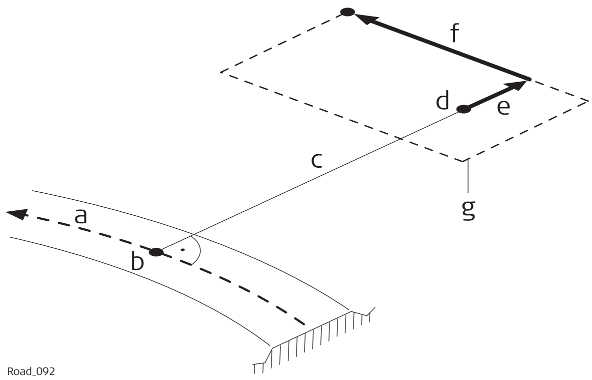
**Availability**

This menu function is available for the stake/check of lines and local lines.

**Description**

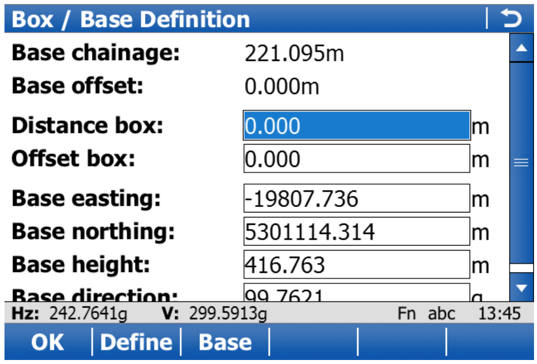
This function allows a box or similar structure to be set out during a check or stake survey of a road element. The box is set out relative to a line chainage and parallel offset. A base point of the box, user-defined dimensions of the box (a base distance and a base offset) are required.

**Diagram**




a) Centreline
b) Defined chainage
c) Stake offset
d) Base point
e) Base offset
f) Base distance
g) Box to stake out

## Box / base definition



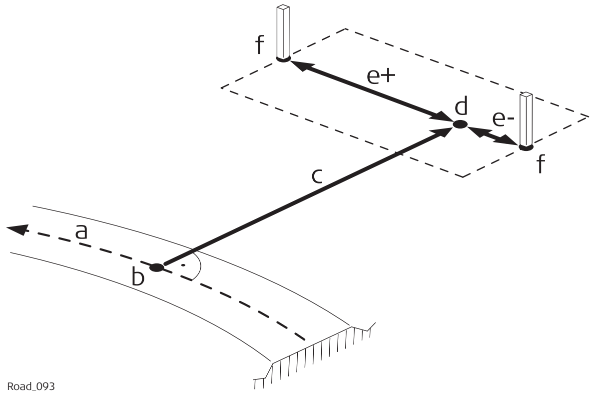

| Key | Description |
|---|---|
| **OK** | To store the selected element, which is then automatically recalled. |
| **Define** | To overwrite the values before pressing **Base** If a different base had been defined before. |
| **Base** or **Clear** | To freeze or unfreeze the values of the base point. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Base chainage** | Display only | The position defined by **Stake chainage**. |
| **Base offset** | Display only | The position defined by **Stake offset**. |
| **Distance box** | Editable field | The distance in the direction of increasing chainage of base point is positive. |
| **Offset box** | Editable field | The offset to the right of base point is positive. |
| **Base easting**, **Base northing** and **Base height** | Editable field | The coordinates of the base point, either from the **Working job** or from a surveyed point. |
| **Base direction** | Editable field | The orientation of the local coordinate system (azimuth). |

**Example**

The following steps describe the stakeout of two reference pegs from a centreline chainage and offset.




a) Centreline
b) Defined chainage
c) Stake offset
d) Base point
e) Base distance, positive (e+), negative (e-)
f) Peg to stake out

| Step | Description |
|---|---|
| 1. | Define the base point for the box/base stakeout using **Stake offset** and **Stake height diff** from the **Offsets** page. |
| 2. | Press Fn **Tools..** to access the Tools menu. |
| 3. | Select **Box / base definition**.<br>Press **OK** to continue to the next screen. |
| 4. | The position defined by **Stake chainage** and **Stake offset** is used as **Base chainage** and **Base offset** when accessing **Box / base definition** for the first time within a stakeout session. |
| 5. | Similar to the stakeout of individual points in the Tools menu. The Box/Base functionality calculates the new point to stake out and changes the according values of **Stake chainage** and **Stake offset**. The Box/Base functionality also activates the **Manual height** functionality. |
| 6. | To avoid these values being used as the next base point when accessing the box/base menu, press **Base** in the Box/Base Definition screen. Pressing this key freezes the values of the base point. **Base** is now replaced by **Clear**. If a different base had been defined before, use **Define** to overwrite the values before pressing **Base**. |
| 7. | Define the **Distance box** and **Offset box**. Both follow the same rules as used for the definition of offsets and chainages in general. That is; offset to the right = positive; distance in direction of increasing chainage = positive. |
| 8. | Press **OK** to continue to the next screen. |
| 9. | The values of **Stake chainage**, **Stake offset** and the **Manual height** are adjusted accordingly. |
| 10. | The fields Δ **chainage**, Δ **offset** and Δ **height** on the **Stake** page guide you to the new position to stake out.<br><br>Press Fn **Tools..** to access Tools menu. |
| 11. | Select **Box / base definition**.<br>Press **OK** to continue to the next screen. |
| 12. | The next point of the box to stake out can now be defined.<br><br>To change back to the original chainage and offset defined for the base point definition use **Clear**. |
| 13. | Start with step 1. to define a new box/base. |

## 48.4.9 Get current slope

**Availability**

This menu function is available for the stake/check of slopes, local manual slopes and manual slopes.

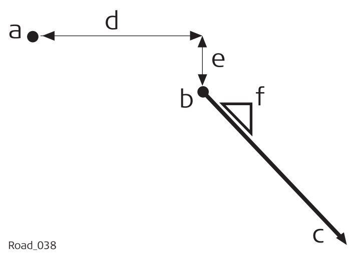
**Description**

To access **Slope Definition**. The slope ratio **Current ratio** of the last measured position is used as the defined **Slope cut ratio**/**Slope fill ratio**. All other values in **Slope Definition** are filled in with the last measured position. The defined manual slope is used for all points to stake out or check.

☞ The manual slope is active until it is turned off with **Reset slope to design** from the Tools menu.

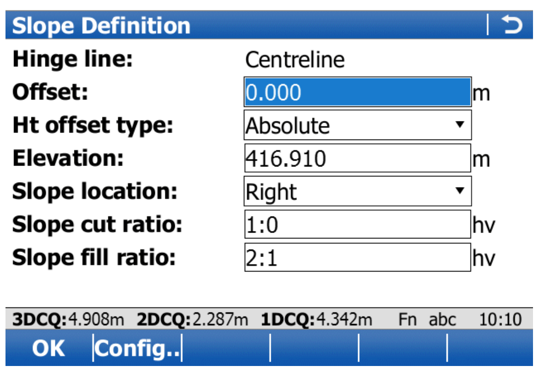
**Graphic**

Slopes are defined relative to the centreline.



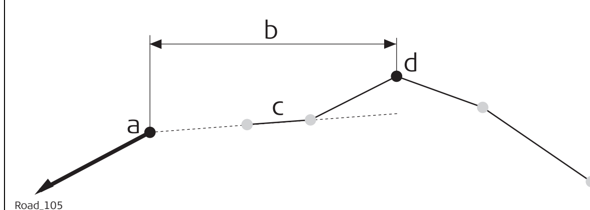
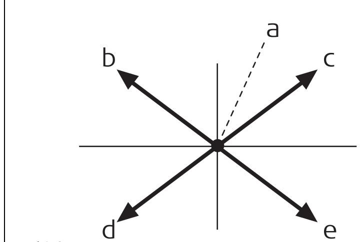

a) Centreline
b) Hinge point
c) New slope
d) Defined hinge offset **Offset**
e) Defined hinge height difference **Height difference**
f) **Slope cut ratio**/**Slope fill ratio**

**Slope Definition**




| Key | Description |
|---|---|
| **OK** | To accept changes and move to the next screen depending on the settings for slope staking. |
| **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Hinge line** | Display only | The line the slope is defined relative to. |
| **Offset** | Editable field | The horizontal offset of the hinge point from the centreline/reference line. |
| **Ht offset type** | | The vertical offset type for the hinge point. |
| | **Absolute** | The only option available for 2D lines. |
| | **Relative to line** or **Relative to DTM** | Available for 3D lines. |
| | **Relativ to surf grade** | Available for **Method to use**: **Manual slope**. The manual slope is defined by the:<br>• Hinge offset relative to the selected hinge reference line<br>• Hinge height, calculated by using the hinge offset on the selected surface grade (left or right selected surface grade, depending on **Offset** – or +)<br><br>a) Hinge point of manual slope<br>b) Defined hinge offset (-)<br>c) Left surface grade of design<br>d) Selected hinge reference |
| **Elevation** | Editable field | The elevation of the hinge point (absolute height). Available for **Ht offset type**: **Absolute**. |
| **Slope location** | Selectable list | Differentiates if the defined slope is a cut/fill and left/right.<br><br>a) Hinge point<br>b) Left cut<br>c) Right cut<br>d) Left fill<br>e) Right fill |
| **Slope cut ratio** and **Slope fill ratio** | Editable field | Defines the cut/fill ratio of the slope.<br>☞ The slope ratio format is defined as system setting in **Regional Settings**, **Slope** page. |

## 48.4.10 Manual Slope

**Availability**

This function is available for stake/check of slopes.

**Description**

To access **Slope Definition**. Allows a manual slope to be defined. The defined manual slope is then used for all points to stake out or check. Refer to "Slope Definition"for a description of the screen.

☞ The manual slope is active until it is turned off with **Reset slope to design** from the Tools menu.

## 48.4.11 Reset slope to design

**Availability**

This function is available for stake/check of slopes.

**Description**

This option is only available if a slope has been defined by using **Get current slope**. The manually defined slope is deactivated and reset to the design slope.

## 48.4.12 Shift reference line

**Availability**

This menu function is available for the stake/check of slopes and surface grades.

The **Shift reference line** item of the Tools menu stays disabled until the first measured position is available. The current chainage is used for the cross section shown to pick the reference line.

**Description**

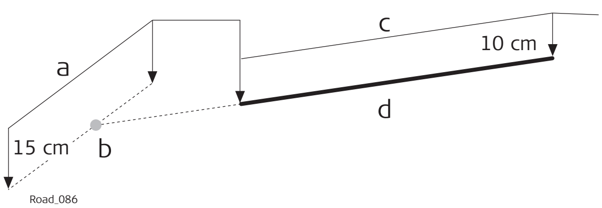
When staking out or checking different layers of the road strata, such as the subgrade, gravel or asphalt, it is often found that not all these layers are available in the design. For such cases, the application offers the possibility to apply either a negative or positive height shift to the design values.

**Example**

A gravel layer with a thickness of 10 cm is to be staked out. A negative vertical shift to the final design surface is applied. This shift is applied:

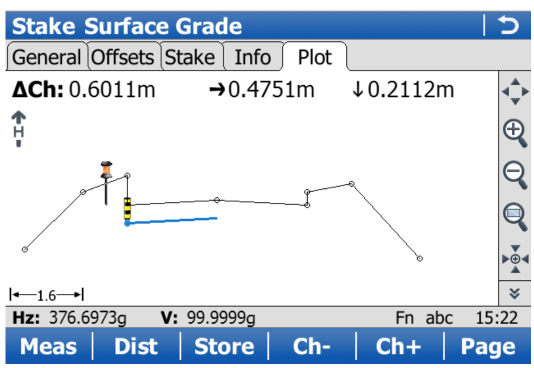
- by pressing **Shifts..** in the **Define** screen and
- by applying a vertical shift of -10 cm.

As shown, the selected surface grade is shifted by 10 cm.

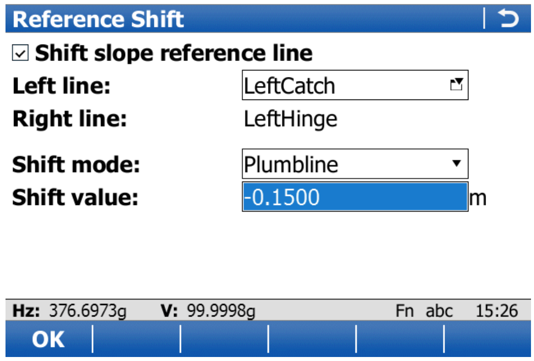



a) Reference surface
b) Shifted reference point
c) Original surface grade
d) Shifted surface grade

When staking out the newly shifted surface grade, the original left edge of the shifted surface grade is of little interest. It is the intersection with the left end slope that is of greater interest.



### Reference Shift

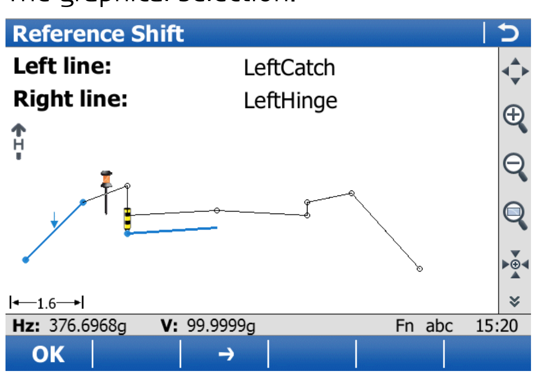



| Key | Description |
|---|---|
| **OK** | To confirm the settings and return to the **Stake/Check** screen. |
| Fn **Quit** | To exit the application. |

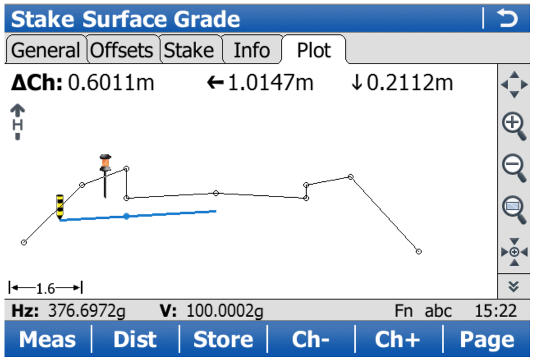
#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Shift slope reference line** | Check box | When this box is checked, the settings for the shift can be set. |
| **Left line** | Display only | Shows the name of the left line from the surface. |
| **Right line** | Display only | Shows the name of the right line from the surface. |
| **Shift mode** | | The vertical shift applied to the surface selected. |
| | **Plumbline** | The shift defined under **Shift value** gets applied following the plumb line. |
| | **Perpendicular** | The shift defined under **Shift value** gets applied perpendicular to the selected surface. |
| **Shift value** | Editable field | Value the selected surface gets shifted following the chosen **Shift mode**. |

The graphical selection.



The expanded element and the shifted reference line, marked with a cross, are shown in the **Map** page in the **Stake/Check** screen.
On the **Stake** page, the Δ **offset** and Δ **height** guide you to the new shifted position.



## 48.4.13 Re-initialise search

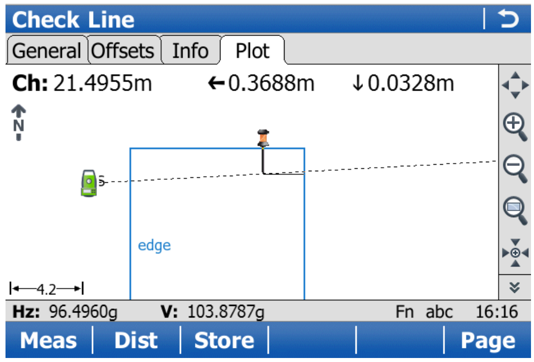
**Availability**

This menu function is available for all stake/check methods except layer.

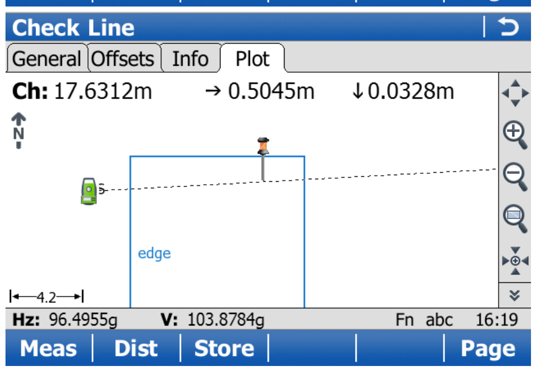
**Description**

When staking or checking complex road designs it can happen that the current position is not projected to the desired segment of the alignment. The **Re-initialise search** forces a re-projection of the current position.

**Example**




**Before initialisation**
This screen shows the projection of the current position to the left segment, although the distance to the right segment is shorter.




**After initialisation**
This screen shows the projection after the reinitialisation.

## 48.4.14 Stake intersection point

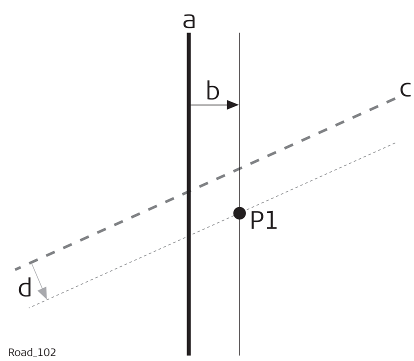
**Availability**

This menu function is available for staking a line with **Refer to an additional line** checked in **Define Line Task**
The additional line must be a Straight.
Offsets for the selected line and the additional line can be defined.

☞ The menu function **Stake intersection point** is only available if the offsets are defined perpendicular to the selected line. **Work with non-perpendicular offset** must not be checked.

**Description**

**Stake intersection point** is commonly used to stake out bridge abutment positions. The graphic shows an example.



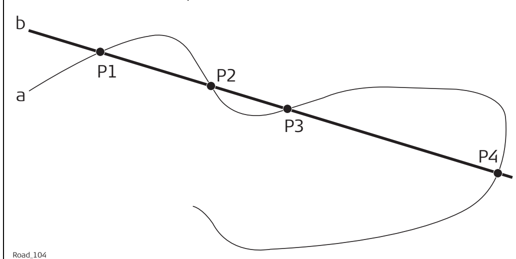
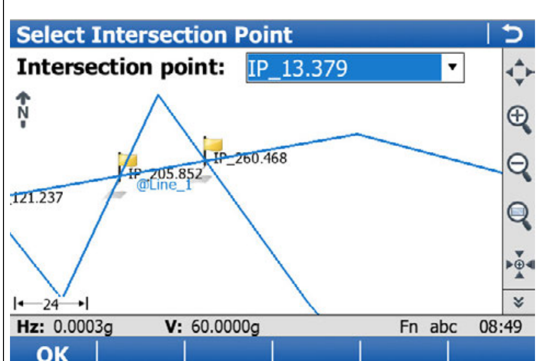

a) Selected line, for example bridge centreline
b) Perpendicular offset from the selected line
c) Selected additional line, for example abutment line
d) Perpendicular offset from the selected line
P1 Required intersection point for stakeout

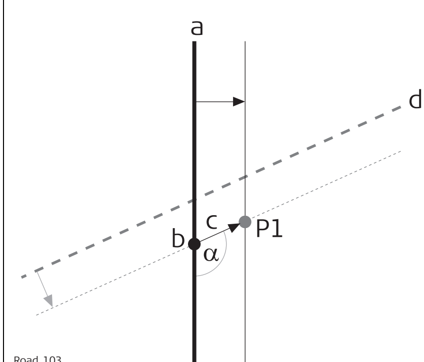
**Calculation of the stake intersection point and chainage**

The calculation of the intersection point is based on:

- A perpendicular offset from the selected line, for example bridge centreline
- A perpendicular offset from the additional line

### Step-by-step

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>1.</td><td>Define Line Task<br><br>Select the line to work with (bridge centreline) and select a second intersecting line (abutment centreline) under Refer to an additional line.</td></tr>
<tr><td>2.</td><td>Stake Line, Offsets page<br><br>If necessary, check Apply offsets. Type in the offset of the intersection point in relation to selected line (bridge centreline).<br><br>☞ Non-perpendicular offsets are not allowed. If necessary, check Apply offsets to additional line. Type in the offset of the intersection point in relation to selected additional line (abutment centreline).</td></tr>
<tr><td>3.</td><td>Fn Tools.. to access the Tools menu and select Stake intersection point.<br><br>In some cases, more than one intersection point can be calculated.<br><br>
<br>a) Selected line<br>b) Additional line<br>P1 Intersection point 1<br>P2 Intersection point 2<br>P3 Intersection point 3<br>P4 Intersection point 4<br><br>In this case a plot with the possibility to select the desired intersection point appears. The selection is made using the touch screen and a selectable list. All intersection points are marked with a yellow flag.<br>The point ID and the point symbol of a selected intersection point are displayed in blue.<br><br>
</td></tr>
<tr><td>4.</td><td>Height confirmation<br>Depending on the available height information of the selected lines the following possibilities are available to define the height of the intersection point which has been selected for stakeout.</td></tr>
</table>

| Step | Description |
|---|---|
| | • Using the design height, which is the height of the selected line (bridge centreline). This option is used by default or by pressing **None**.<br>• Using the height of the additional line as manual height. This option appears when the additional line contains height information.<br>• Using the average height of the selected line and of the additional line as manual height. This option appears when the additional line contains height information.<br>• Using **Use heights from DTM** from the Tools menu. This option is only available if a DTM has been selected in the job selection screen. |
| 5. | **Stake Line**, **General** page<br>Depending on the height selection, the check box **Use manual height instead of design heights** is enabled automatically and the selected height is used for staking out.<br>**Stake chainage** is the intersection of the original line (bridge centreline) and the line which is offset from the additional line. This value is updated automatically.<br><br><br>a) Selected line, for example bridge centreline<br>b) Stake chainage of intersection point<br>c) Non-perpendicular offset from the selected line<br>d) Selected additional line, for example abutment line<br>α Non-perpendicular offset angle<br>P1 Required intersection point for stakeout |
| 6. | **Stake Line**, **Offsets** page<br>**Stake offset**: After pressing Fn **Tools..** and selecting **Stake intersection point**, the value is updated automatically to the non-perpendicular offset of the intersection point to the selected line (bridge centreline).<br>**Work with non-perpendicular offset**: The check box is checked automatically after pressing Fn **Tools..** and selecting **Stake intersection point**. **Offset angle** is updated automatically to the non-perpendicular offset angle of the intersection point to the selected line (bridge centreline).<br>☞ To stake further points along the same alignment to the additional line, update the value for **Stake offset** by the required distances. In this case, **Stake offset** is the distance along/parallel to the additional alignment. |
| 7. | **Stake Line**, **Stake** page<br>To stake out the selected intersection point, all delta values must be 0.000. |

# 49 Roads - Rail

## 49.1 Creating a New Rail Job

### 49.1.1 Overview

**Description**

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment Editor** application.

OR

Converting data created in a design package.

**Manually entered data**

Data can be typed in and edited with **Alignment Editor**. Refer to "47 Roads - Alignment Editor" for information on how to enter data manually.

**Converted data**

The **Import alignment data** application in **Jobs & Data** supports various different formats like dxf, LandXml, MxGenio, Terramodel, Carlson.

The Design to Field component of Leica Geo Office offers converters from several road/rail design and CAD packages. Several design packages also include a built-in converter to Roads/Rail. As different design packages follow different philosophies in representation, creation and storage of data the conversion process differs slightly.


Road_065

Leica Geo Office can be found on the Leica Geo Office DVD.

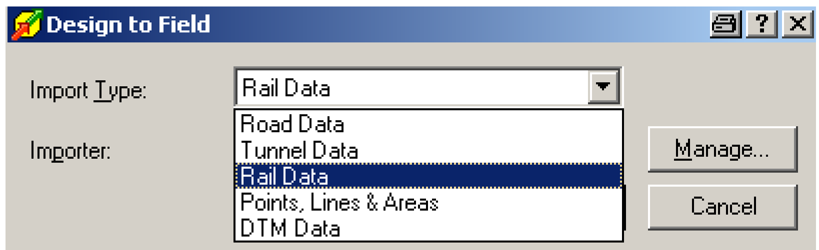
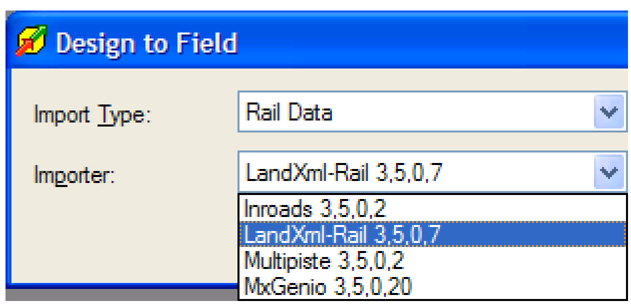
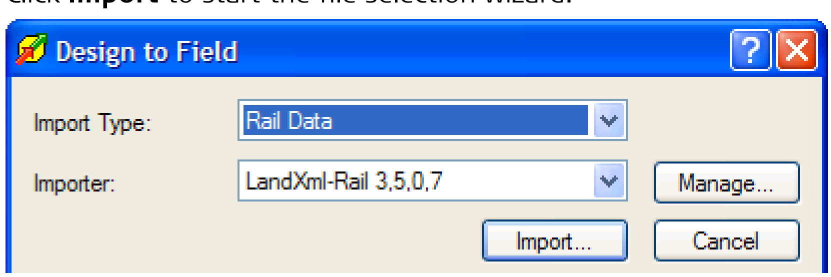
The latest version of the Design to Field importers can be found in the downloads section of:

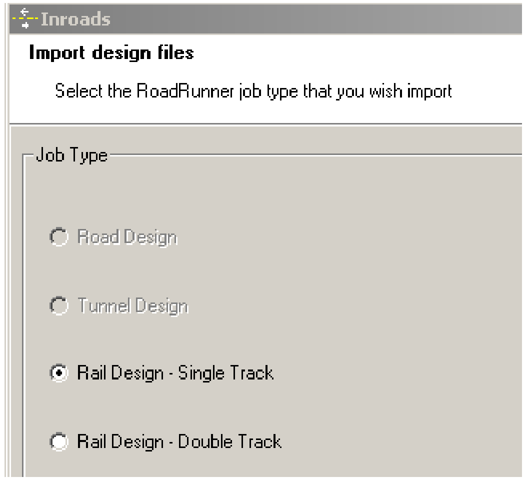
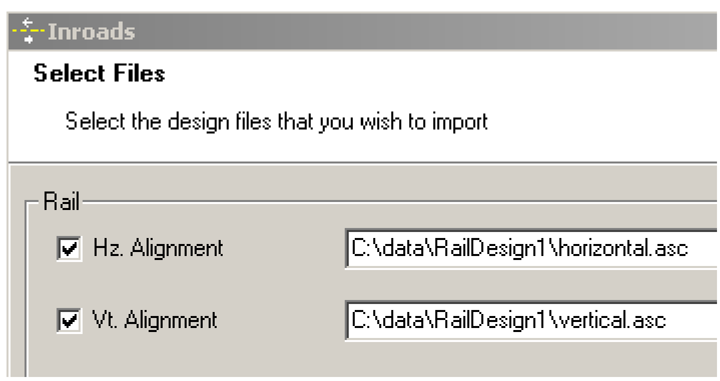
- myWorld@Leica Geosystems
  https://myworld.leica-geosystems.com

## 49.1.2 Installing all necessary Software

| | |
|---|---|
| **Install Leica Geo Office** | LGO runs under WindowsXP or Windows Vista and can only be installed successfully if the user is logged in as the Administrator. To install LGO, run the setup file from the DVD and follow the instructions on the screen. |
| **Install Design To Field** | To prepare the track design for use on the instrument successfully, the data must first be converted from its original format to an onboard job. This conversion is achieved using Design to Field, a component of LGO which is automatically installed with LGO. |
| **Install Importers** | The field importers are used by Design to Field to read in the track design. These importers are installed separately and have the file extension *.rri.<br>The latest version of the Design to Field importers can be found in the downloads section of:<br>• myWorld@Leica Geosystems:<br>https://myworld.leica-geosystems.com |
| **Install Rail Editor** | Rail Editor is a computer program for defining the height of the rails relative to the horizontal and vertical alignments (superelevation). Rail Editor is automatically installed into LGO from the Field Importers install package, which can be found in the downloads section of the Leica Geosystems website. Rail Editor can be run either externally or within Design To Field. |
| **Install Roads and Rail** | Roads and Rail are the onboard programs which are loaded onto the instrument:<br>• via a data storage device (under the System folder), which is inserted into the instrument,<br>• via a serial cable and LGO. |

**Importing the design**

| Step | Description |
|---|---|
| 1. | **Starting the Design to Field program**<br>To import a track centreline select Design to Field from the Tools menu in LGO.<br><br> |
| 2. | **Selecting an Import Type**<br>To prepare track design for onboard use successfully, it has to be converted from its original data format to an onboard job which will run on the instrument.<br><br>Select **Importer Type: Rail Data**<br><br> |
| 3. | **Selecting a Field Importer**<br>Importers are used to convert the data. Additional importer formats can be added to the selectable list by clicking **Manage**.<br><br>Select the importer related to the track design from the selectable list of available importers.<br><br> |
| 4. | **Importing**<br>Click **Import** to start the file selection wizard.<br><br> |

| Step | Description |
|---|---|
| 5. | **Selecting the job type**<br><br><br>• For single tracks, select **Rail Design-Single Track**.<br>A single track design can consist of a horizontal alignment, a vertical alignment and superelevation.<br>• For double tracks, select **Rail Design-Double Track**.<br>A double track design can consist of a horizontal alignment, a vertical alignment and superelevation for each track. Alternatively, a third horizontal alignment can also be defined and used for calculating the chainage of both tracks (chainage centreline).<br>Click **Next** to move to the next page of the wizard. |
| 6. | **Selecting the horizontal and vertical alignment files**<br><br> |

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td></td><td>

- For a single track, select the horizontal and vertical alignments using the browse button.
- For a double track, three screens are used to define the design data. The arrows at the bottom of the screens can be used to move between the different screens.

  First screen - Centreline: The first screen defines the horizontal and vertical alignment of the chainage centreline. If the chainage for each track is to be calculated relative to each track centreline, then it is not mandatory to select a chainage centreline. The horizontal and vertical alignment on the first screen can be left blank.

  Second screen - Left track: The second screen defines the horizontal and vertical alignments and the rail definition (superelevation) of the left track.

  Third screen - Right track: The third screen defines the horizontal and vertical alignments and the rail definition (superelevation) of the right track.

Click **Next** to move to the next page of the wizard.

</td></tr>
<tr><td>7.</td><td>

**Superelevation (rail definition)**

- Design data which is compulsory:

  A track design must contain a horizontal alignment.
- Design data which is optional:

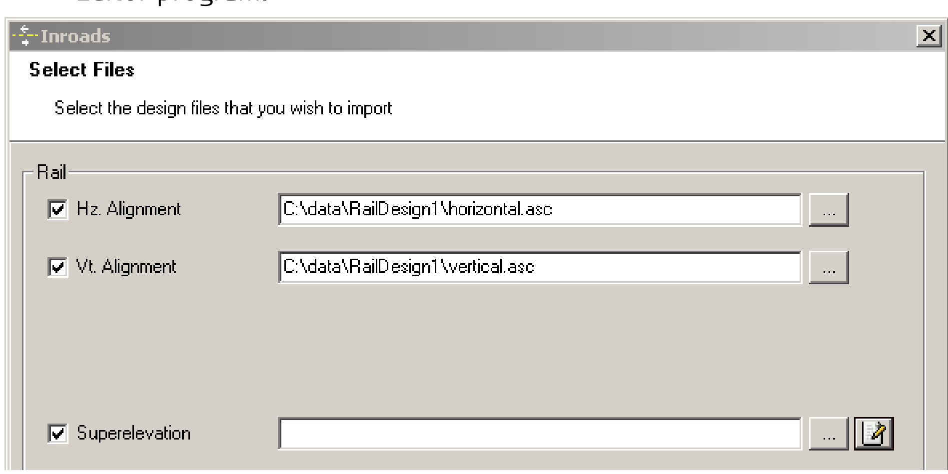
  A track design can include a vertical alignment and a rail definition (super-elevation). Superelevation is only possible when the track design includes a vertical alignment.

A superelevation file can be obtained in the following ways:

- by selecting an existing superelevation file.
- by selecting an existing superelevation file and modifying it with Rail Editor.
- by creating a new superelevation file with Rail Editor.

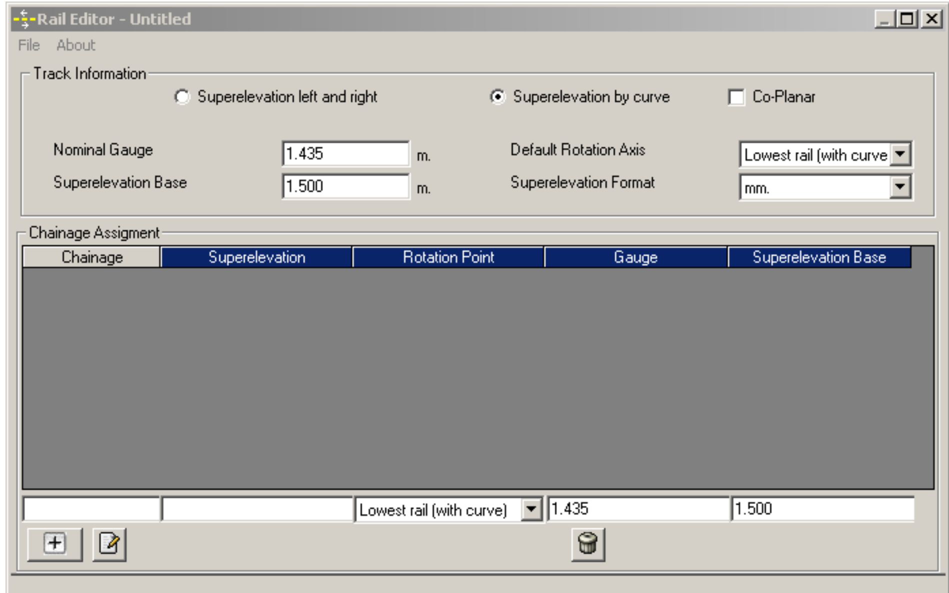
**Creating a superelevation (rail definition)**

To create a rail definition (superelevation) for any track, click the **Edit** button next to the Superelevation file name. This action starts the Rail Editor program.




</td></tr>
</table>

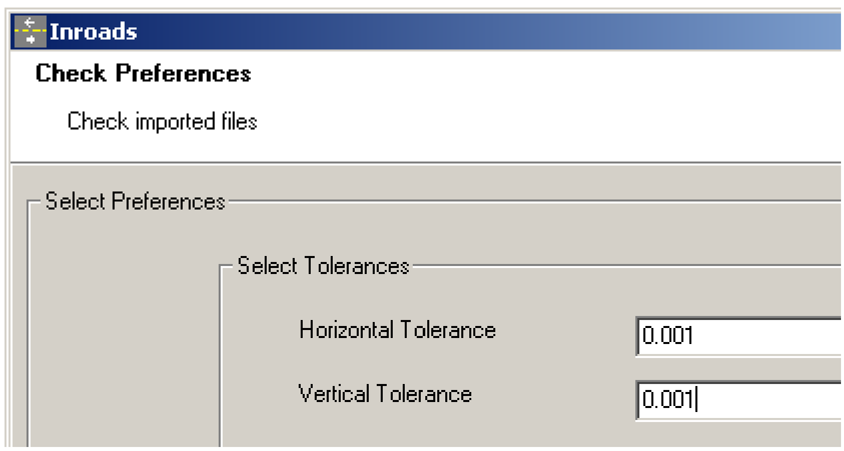
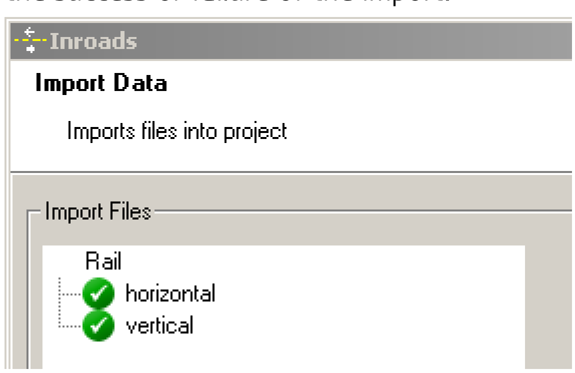
| Step | Description |
|---|---|
| | The Rail Editor program is used to define the height of the rails at a given chainage. The height of the rails can be defined by a rotation point and a cant or by a left and right cant. |

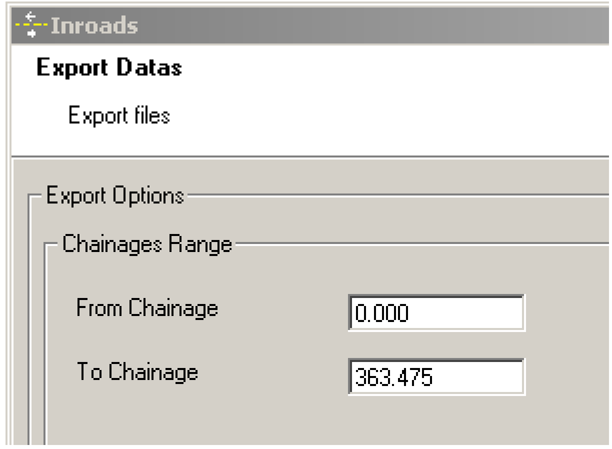
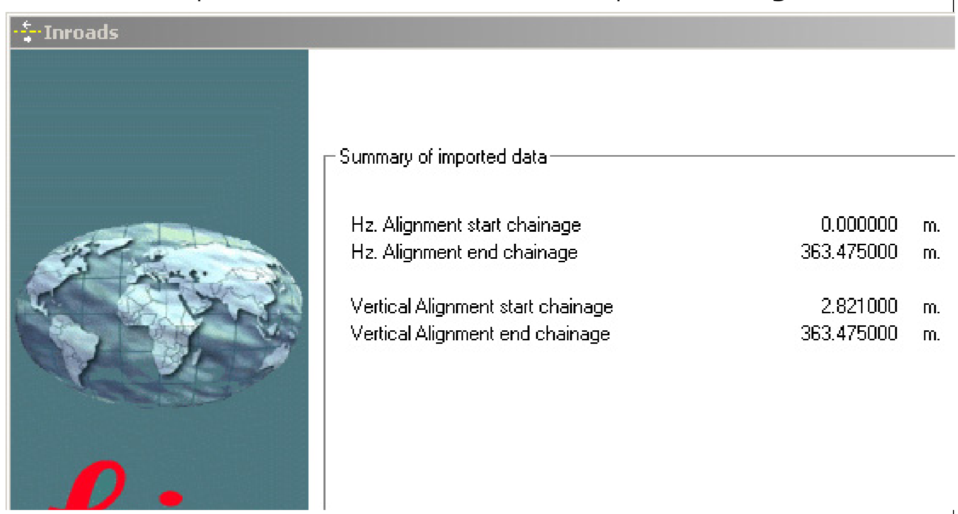


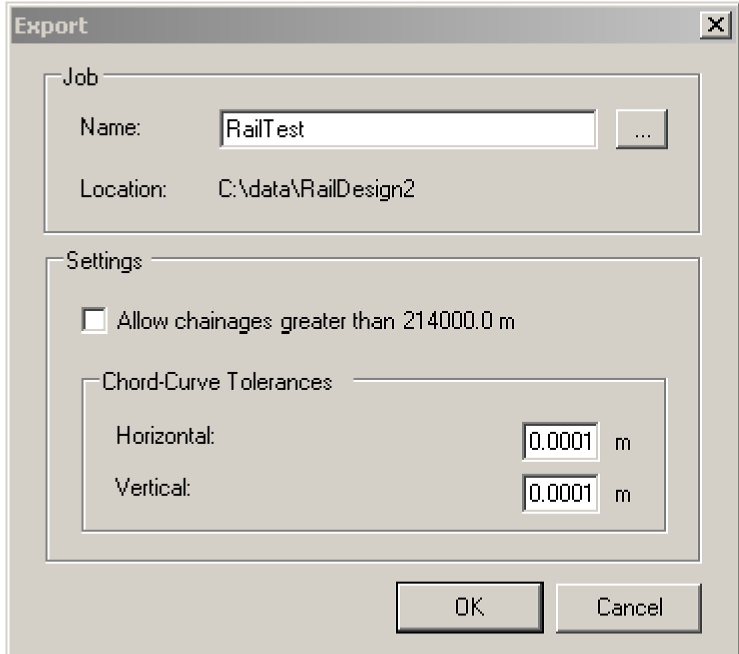

**Describing the screen elements - Entering Track Information**

| | |
|---|---|
| **Superelevation left and right** | To define the height of the rails using one superelevation value for the left rail and another superelevation value for the right rail. |
| **Superelevation by curve** | To define the rails using a rotation point and a superelevation value. |
| ☞ | Once the method by which the superelevation values are defined has been selected, it cannot be changed |
| **Co-Planar (for multiple tracks)** | To define the height of the rails of the second track by extending the plane which runs through the rails of the first track. |
| **Nominal Gauge** | The default nominal distance between the active (internal) faces of the left and right rails. This value can be changed if necessary for any rail definition (superelevation). |
| **Superelevation Base** | The distance over which the superlevation is applied. This distance is normally the distance between the centre of the left and right rail. This value can be changed if necessary for any rail definition (superelevation). |
| **Default Rotation Axis** | If a rotation point is used, this selection will be used as the default for all new rail definitions. This value can be changed if necessary for any rail definition (superelevation). |
| **Superelevation Format** | The format in which the superelevation values are entered. |

Once all superelevation data has been entered, press the button to add the data to the chainage assignment screen.

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td></td><td> To delete an element, select the element and press the button.<br><br> To modify an existing element, select the element, modify the data and press the button.<br><br>Once all values have been entered for the entire alignment, the file can be saved in an XML format using Save from the File menu.<br><br>To return to the Design To Field converter, select Exit from the File menu.<br><br>To modify an existing rail definition (superelevation) file, for example XML files, use Load option from the File menu.</td></tr>
<tr><td>8.</td><td>Entering the alignment tolerances<br>Enter the appropriate horizontal and vertical tolerances to be used during the checking of the alignments.<br>
<br>Click Next to move to the next page of the wizard.</td></tr>
<tr><td>9.</td><td>Checking the track design<br>When the track design has been imported, information is displayed to show the success or failure of the import.<br>
<br>• When the import is successful: Click Next to move to the next page of the wizard.<br>• When the import is unsuccessful: Click Back to step back through the wizard.<br>• If a problem is encountered a red symbol appears. Double click on the red symbol and a window containing a description of the problem appears.</td></tr>
</table>

| Step | Description |
|---|---|
| 10. | **Entering the range of chainages to be used**<br>Enter the range of chainages to be exported.<br><br>Click **Next** to move to the next page of the wizard. |
| 11. | **Checking the summary report**<br>• When the report is correct: Click **Finish** to complete the wizard.<br>• When the report is incorrect: Click **Back** to step back through the wizard.<br> |
| 12. | **Viewing the track design**<br>The track design can be viewed graphically.<br><br>Click **Export** to create the files for onboard use. |

<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>13.</td><td>Creating the files for onboard use<br>The track design can now be prepared.<br>

<br>Click OK to create the files for onboard use. The database files are created and are located in the same folder as the source alignment files.</td></tr>
</table>

☞

Refer to the Design to Field User Manual for details on importing various types of data with various field importers. This manual is included in the Design to Field Converters install application RR_Design_to_Field.exe, which can be downloaded.

## 49.1.4 Loading the Track Design onto the Instrument

**Loading the design**

Once the track design has been converted, copy all the database files to the \DBX folder of the data storage device of the instrument. Refer to "Appendix C Directory Structure of the Memory Device".

## 49.2 Defining the Work

**Access**

1) Select **Main Menu**: **Go to Work!\Roads\Rail - Stakeout** or **Rail - As built check**.
2) In the job selection screen, select the required jobs. Refer to "46.2.1 Accessing Roads Applications".
3) Press **OK**.

**Define the Work to be Done**

| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| Fn **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the screen. |

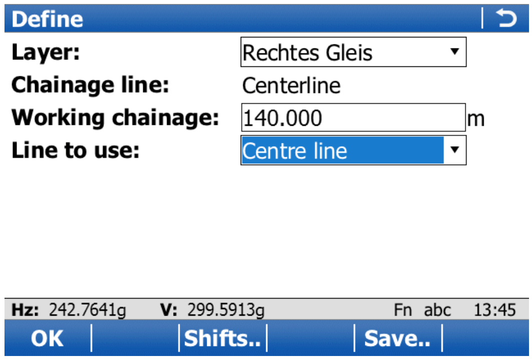
**Description of the methods**

| Method | Description |
|---|---|
| **Track** | To stake the track geometry using a pole. |
| **Track + gauge device** | To stake the track geometry using a gauge device.<br>When a measurement is made, the values are retrieved from the gauge device. The current track geometry (both rail position, gauge and cant) is checked against the theoretical track geometry. |
| **Rails + gauge device** | Available for **Rail - As built check** only.<br>This method does not take into account any rail design and is not intended to check the absolute positioning of the rails. However, the current position can be recorded.<br>Chainages are only used, if the gauge device provides them from the odometer. |

**Next step**

**OK** accesses the **Define Task** screen.

## Define




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| **Shifts..** | To apply horizontal and vertical shifts to the selected element. Refer to "46.4 Working with Shifts". |
| **Load..** | To load a task. Refer to "46.5 Tasks". |
| **Save..** | To save the settings as a task. Refer to "46.5 Tasks". |
| Fn **Config..** | To access the Rail configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Layer** | Display only or selectable list | Layers contained in the active rail job can be selected, for example layer of left or right track design. |
| **Chainage line** | Display only | Shows the name of the chainage line, at the selected layer. |
| **Working chainage** | Editable field | Available for **Method to use**: **Track**. To enter a chainage (ranging between the start chainage and end chainage) of the chainage centreline. The default is the setup point for TPS and the current position for GPS. Only those elements which appear at this chainage can then be selected from **Line to use**. |
| **Line to use** | | Available for **Method to use**: **Track**. The measured point values can be compared with the left rail, the right rail or the track centreline. The selectable list allows the selection of the line with which measured values are then compared. |
| | **Centre line** | The track centreline. |
| | **Left rail** or **Right rail** | • For design data including the rails: When working with design data including the rails, the horizontal and vertical alignment of the design is used. Depending on the rail design configuration setting, the superelevation of the design or the manually defined superelevation can be used. |

| Field | Option | Description |
|---|---|---|
| | | • For design data without rails (only track centreline):<br>If the design data does not contain the rail design, then the position of the left rail is calculated. The nominal gauge entered in the program configuration is used for the calculation.<br>• When working with horizontal alignments only:<br>The height of the rails is calculated by using the values for **Manual cant definition** defined on **Stake Track**/**Check Track**, **General** page. |
| **Rail director** | Selectable list | Available for **Method to use**: **Track + gauge device**.<br>The reference point for the delta values. The delta values displayed in the middle of MapView refer to this selection. |
| **Chainage increment** | Selectable list | Available for **Method to use**: **Track + gauge device** and **Method to use**: **Rails + gauge device**.<br>Determines the left/right rule the information is displayed. Distance in direction of increasing chainage = positive. The selection influences the geometry of the track in the MapView. |
| **Position of the gauge sensor** | Selectable list | Available for **Method to use**: **Track + gauge device** and **Method to use**: **Rails + gauge device**.<br>The location of the mobile part of the gauge device. |
| **Start chainage for the odometer** | Editable field | Available for **Method to use**: **Rails + gauge device**.<br>Relevant if the gauge device includes an odometer. Otherwise leave value to 0.00. |

# 49.3 Staking/Checking the Track

## 49.3.1 The Stake/Check Screen

**Staking points**

It is possible to stakeout points using a rail job with and without a stored rail design.

When the position of the rails is not stored in the rail job, it is possible to stake out:

- The horizontal and vertical alignment of the track centreline
- Points with a known horizontal and vertical offset from the horizontal and vertical alignment of track centreline
- The rails of the track by entering the track superelevation, superelevation base and nominal gauge
- Points with known horizontal and vertical offsets from the manually defined rails.

When the position of the rails is stored in the rail job, it is possible to stake out:

- The horizontal and vertical alignment of track centreline
- Points with a known horizontal and vertical offset from the horizontal and vertical alignment of track centreline
- The rails of the track
- Points with known horizontal and vertical offsets from the defined rails.

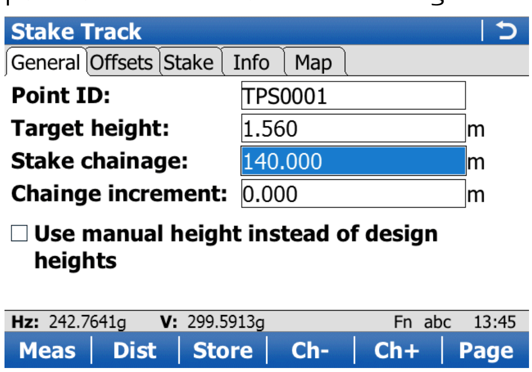
**Checking points**

Besides checking points, it is also possible to work with cants (superelevation):

- The cant value can be entered manually. The value is measured using a device to measure the cant with an inclination sensor (camber measurement instrument).
- The difference of the manually entered cant value and the current design cant can be displayed on Info page and is stored in the DBX.
- The cant value can be measured by using the option **Second point of cant** of the Tools menu. A second point on the track is measured to calculate the cant using the measured height difference and the configured superelevation base.

**Stake Track/Check Track, General page**

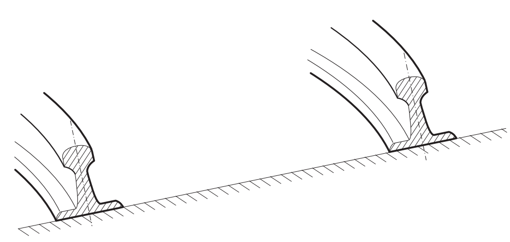
Information regarding the measured point can be entered. This screen allows any point of the track to be checked against design values.

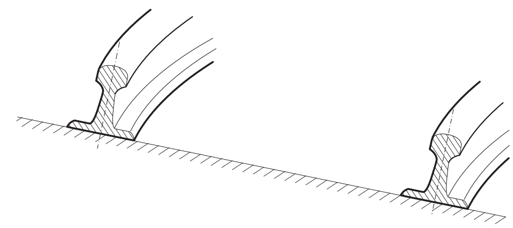



| Key | Description |
|---|---|
| **Meas** | GPS To start measuring the point being staked. The key changes to **Stop**.<br>TPS To measure a distance and store distance and angles. |

| Key | Description |
|---|---|
| **Stop** GPS | To end measuring the point being staked. When **Automatically stop point measurement** is checked in **GPS Settings Quality Control**, **General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| **Store** | GPS To store the measured point. When **Automatically store point** is checked in **GPS Settings Quality Control**, **General** page, the measured point is stored automatically. The key changes to **Meas**.<br>TPS To store angles and distance. Distance must be measured before. |
| **Dist** TPS | To measure a distance. |
| **Ch-** | Available for **Rail - Stakeout**. To decrease the chainage as defined by **Chainge increment**. |
| **Ch+** | Available for **Rail - Stakeout**. To increase the chainage as defined by **Chainge increment**. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access Rail configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Positn** TPS | To position the total station to the defined stakeout point, including defined offsets. This depends on the settings for **Turn to point** in **Configuration**, **TPS** page. Refer to " Configuration, TPS page". |
| Fn **Tools..** | To access the Tools Menu. Refer to "49.4 The Tools Menu". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored. |
| **Antenna height** GPS | Editable field | Height of the antenna. |
| **Perp. antenna ht** GPS | Editable field | Perpendicular height of the antenna. Available when the perpendicular height is configured. Refer to " Configuration, Rail design page". |
| **Target height** TPS | Editable field | Height of the prism.<br>When using a gauge device, the target height is always applied perpendicular. On this case, the setting for **Apply target height** in **Rail Configuration**, **Rail design** page is ignored. |
| **Perp. target height** TPS | Editable field | Perpendicular height of the prism. Available when the perpendicular height is configured. Refer to " Configuration, Rail design page". |
| **Stake chainage** | Editable field | The defined chainage of the point to be staked out. For multiple tracks that have a defined chainage centreline, the chainage to be staked out always refers to the chainage of the chainage centreline, not to the chainage of the track centreline. |
| **Chainge increment** | Editable field | Value by which the nominal chainage increases/decreases when pressing **Ch-**/**Ch+**.<br>If a point is to be staked at more than one chainage, a chainage increment can be defined. |
| **Use cant device** | Check box | When this box is checked, the cant value (superelevation) which was measured with an inclination sensor can be entered manually. The difference of the manually entered cant value and the current design cant is displayed on **Info** page.<br>When this box is not checked, no cant difference (superelevation) is calculated of the current design cant and the measured cant. The current cant can be measured using the option **Second point of cant** from the Tools menu. |
| **Measured cant** | Editable field | Available when **Use cant device** is checked. Positive or negative signs must be entered. Seen in increasing chainage direction:<br>• Negative cant value (example: -0.1900 m)<br> |

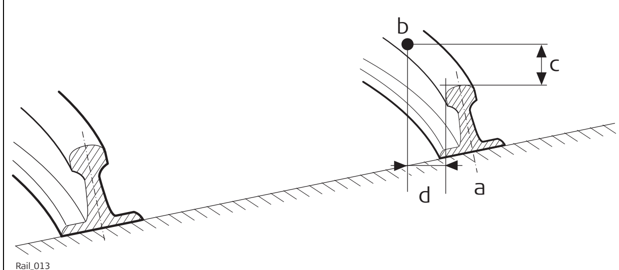
| Field | Option | Description |
|---|---|---|
| | | • Positive cant value (example: 0.1900 m)<br><br><br>☞ When **Second Point of Cant** of the Tools menu is active, the current cant value is used for the cant difference calculation, not the value for **Measured cant**. |
| **Use manual height instead of design heights** | Check box | When this box is checked, a height value typed in manually is used instead of design height or DTM height.<br><br>When this box is not checked, the height from design is used.<br>Available for **Superelevation**: **Design** in **Configuration**, **Rail design** page. |
| **Manual height** | Editable field | Available when **Use manual height instead of design heights** is checked. The height to be used. |
| **Manual cant definition** | Display only | This field and the following fields are available for **Superelevation**: **Manual** in **Configuration**, **Rail design** page. |
| **Ht lower rail** | Editable field | Defines the absolute height of the lowest rail at the defined chainage. |
| **Cant left** | Editable field | Defines the superelevation at the left rail.<br>• When working with horizontal alignments only: If the superelevation is rotated around the left rail, the superelevation would be zero.<br>• When working with horizontal and vertical alignments: If the track is rotated around the left rail, the vertical alignment would coincide with the left rail and the superelevation would thus be zero. |
| **Cant right** | Editable field | Defines the superelevation at the right rail.<br>• When working with horizontal alignments only: If the track is rotated around the right rail, the superelevation would be zero. The total superelevation (left + right) is applied across the distance defined as the superelevation base in the configuration.<br>• When working with horizontal and vertical alignments: If the track is rotated around the right rail, the vertical alignment would coincide with the right rail and the superelevation would thus be zero. The total superelevation (left + right) is applied across the distance defined as the superelevation base in the configuration. |

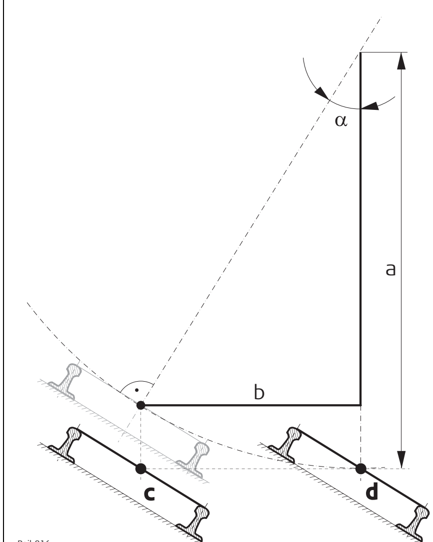
**Next step**
**Page** changes to the **Offsets** page.

**Stake Track/Check Track, Offsets page**

Refer to "Stake Track/Check Track, General page" for a description of keys.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Apply offsets** | Check box | When this box is checked, offsets can be typed in. Often it is necessary to set out points with a fixed plan offset and fixed height offset from a known reference line (track centreline or rail). Offsets are applied in the same way, irrespective of how the rail design has been entered, whether the offsets are manually entered or if library offsets are used. The sign of the offsets conforms to the offset sign convention described in "46.6 Understanding Terms and Expressions".   a) Reference line (right rail)<br>b) Point to stake<br>c) **Stake height diff**<br>d) **Stake offset** |
| **Offsets** | **Manual** | Offsets can be entered in **Stake offset**/**Check offset** or **Stake height diff**/**Check height diff**. |
| | **From library** | The offset is stored as part of the rail job and recalled whenever required. |
| **Offsets** | Selectable list | Available for **Offsets**: **From library**. The point ID of the stored stake offsets. To select a different stored offset or to create a new point, highlight this field and open the selectable list. Refer to "49.3.2 Offset Library". |
| **Stake offset** | Editable field | Available for Stake. Horizontal offset applied to the position of the reference line as defined by the design data or as calculated from manually entered data using the nominal gauge. |
| **Stake height diff** | Editable field | Available for Stake. Vertical offset applied to the height of the reference line as defined by the design data or as calculated from manually entered data using the superelevation and super-elevation base. |
| **Check offset** | Editable field | Available for Check. Horizontal offset applied to the position of the reference line as defined by the design data or as calculated using manually entered data using the nominal gauge. |

| Field | Option | Description |
|---|---|---|
| **Check height diff** | Editable field | Available for Check. Vertical offset applied to the height of the reference line as defined by the design data or as calculated from manually entered data using the superelevation and super-elevation base. |
| **Work with pendular displacement** | Check box | This functionality is used in railway tunnels.<br>The functionality is available for **Rail - Stakeout** and **Rail - As built check**.<br>Some rail projects require additional pendular displacement calculation for the design axis.<br>The track is rotated based on a line with a defined height offset (pendulum length) from the track centreline. This action defines a horizontal displacement for the track. The vertical alignment is independent from the pendular displacement and does not change.<br>☞ The pendular displacement calculation only influences the horizontal position of the design axis. It does not change the height of the track.<br>When this box is checked, a pendulum length can be entered. From the original track definition, a pendulum centre is defined exactly above the axis point. The difference in elevation of the pendulum centre is the pendulum length. With the help of the superelevation, a displacement is calculated. The effect of the pendular displacement is displayed on the **Info** page.<br><br>a) Pendulum length: The difference in elevation of the pendulum centre on the original track and above the axis point<br>b) Resulting pendular displacement<br>c) Displaced design axis based on pendular displacement calculation<br>d) Design axis defined in horizontal alignment<br>α Pendulum angle |

| Field | Option | Description |
|---|---|---|
| **Pendular length** | Editable field | Available when **Work with pendular displacement** is checked. The pendulum length as distance value. Positive values (0 - 9999.9999) point upwards. Negative values are not allowed. |

### Next step

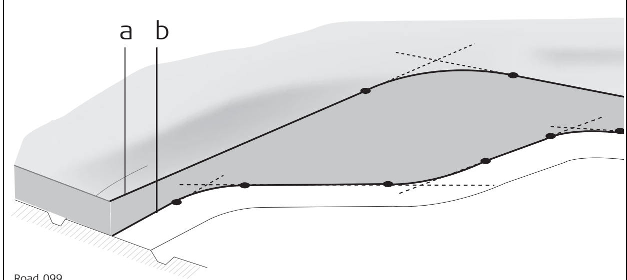
| IF you work with | THEN Page changes to the |
|---|---|
| **Rail - Stakeout** | **Stake** page. |
| **Rail - As built check** | **Info** page. |

**Stake Line, Stake page**

☞ This page is available for Rail - Stakeout only.

This page displays the differences between the measured point and the defined point. The position of the point to stake is reached when all difference values are close to zero.
The chainage can be de-/incremented by pressing left/right arrow key. The defined value for chainage increment is applied.
Refer to "Stake Track/Check Track, General page" for a description of keys.
Refer to "54.4 Staking Out" for a description of the elements of the graphical display.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Chainage** | Display only | The current track chainage. |
| **CL O** | Display only | Perpendicular horizontal offset from the centre-line. |
| Δ **chainage** | Display only | Difference between the defined **Stake chainage** and the current chainage **Chainage** of the measured position.<br>If no defined chainage exists, for example if staking out random chainages or checking, this field shows **-----**. |
| **NrTP** | Display only | The chainage difference between the measured point and the nearest tangent point (start/end point of a road segment) of the design is displayed.<br><br>a) Vertical alignment<br>b) Horizontal alignment<br>Only tangent points (start/end point of a road segment) are detected. |
| Δ **O** | Display only | Horizontal offset between the defined position and the current position. The **Stake offset** defined on the **Offsets** page is taken into account. |
| Δ **height** | Display only | Vertical offset between the defined position and the current position. The **Stake height diff** defined on the **Offsets** page is taken into account. |

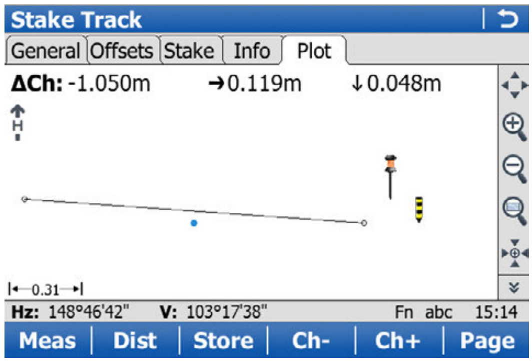
**Next step**
**Page** changes to the **Info** page.

### Stake Track/Check Track, Info page

The **Info** page displays the differences between the measured and design data.
The fields viewed on this page can be configured in **Rail Configuration**, **Info** page.
Refer to "Configuration, Info page" for information on all available items for the **Info** page and how to select them.

### Stake Track/Check Track, Map page

The **Map** page displays a plot of the measured point with respect to the track design. The design is defined by the selected rail or track centreline, and the values entered on the **General** page.
The **Map** page for Check and Stake are similar. The only difference is that the current chainage is always shown, as shown on the **Info** page.

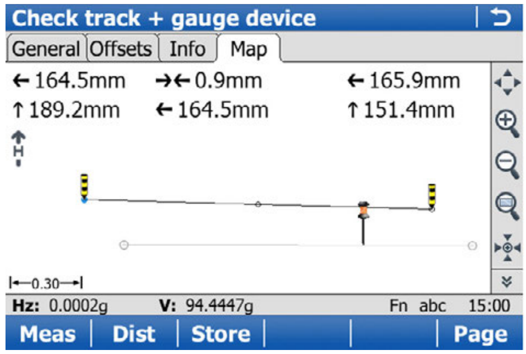



| Key | Description |
|---|---|
|  | Refer to "Stake Track/Check Track, General page" for a description of keys. |
| Fn **Layrs..** | To turn layers of background maps (CAD files) on and off. Refer to "5.2 Creating a New Job"for information on CAD files and CAD background maps. |

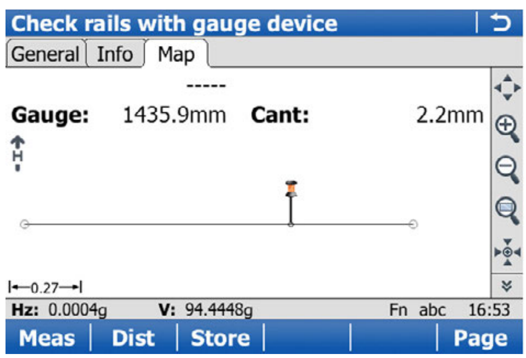
The following information is shown:

1) Chainage difference between the measured point and the defined chainage. When working with random chainages, for instance if no defined chainage has been entered on the **General** page, **ΔCh** changes to **Ch**. **Ch** is the current chainage as shown on the **Stake** page.
2) Horizontal offset (left/right arrow) to the design
3) Height difference (up/down arrow) to the design
4) The measured point
5) The element to stake is shown in bold and blue. The position to stake is marked with a yellow-black peg.
6) The plot can be shown as a cross plot or plan view by using the  eye icon on second level of MapView toolbar.

**For measurements with Method to use: Track + gauge device:**
The cross-section view shows the geometry of the track design with two pegs in each of the rails. The actual geometry retrieved from the gauge device is displayed in grey.
In the upper edges of the screen, the values referring to the left and right rails are displayed on each of the sides.
In the upper central part of the screen, the Δ **Offset** and Δ **Gauge** values related to the rail director are presented.




**For measurements with Method to use: Rails + gauge device:**
The cross-section view shows the geometry of the track resulting from the gauge device measurements.
In the upper part of the screen, the chainage, gauge and cant values retrieved from the gauge device are displayed.



## 49.3.2 Offset Library

**Description**

To select a different stored offset or to create a new point.

**Access**

1) In **Stake Track**/**Check track**, **Offsets** page, select **Offsets**: **From library**.
2) Highlight **Offsets** and open the selectable list.

**Rail job: Job name**

This screen allows offsets relative to a reference line to be defined and stored in the rail job. These points can be recalled at any time.


| Key | Description |
|---|---|
| **OK** | To select a defined offset and to continue. |
| **Add** | To enter an offset. |
| **Edit..** | To edit an existing offset. |
| **Delete** | To delete an existing offset. |
| **More** | To display information about the reference rail or the Offset and the height difference. |
| Fn **Quit** | To exit the application. |

**Next step**

Press **Add** or **Edit..**.

**Rail job: Job name, Offsets**

This screen allows the values of the stake/check offsets to be entered/edited. In addition to the horizontal and vertical offsets, an offset name (point ID) can be entered for each item.

**Next step**

Press **OK** twice to return to **Stake Track**/**Check track**.

### 49.3.3 Working with Pendular Displacements

**Requirements**

In **Stake Track**/**Check Track**, **Offsets** page, check **Work with pendular displacement** and type in a value for **Pendular length**.

**Specific values on the Info page**

| Value | Description |
|---|---|
| **Pendular length** | The defined pendulum length as entered on **Offsets** page. |
| **Def pendulum displacement** | Resulting horizontal displacement at defined chainage. |
| **Actl pendulum displacement** | Resulting horizontal displacement at current chainage. |
| **Def pendulum angle** | Resulting pendulum angle at defined chainage. |
| **Actl pendulum angle** | Resulting pendulum angle at current chainage. |

# 49.4 The Tools Menu

## 49.4.1 Overview

**Access**

Press Fn **Tools..** on any page of the Stake/Check screen.

**Description**

Additional functions for staking/checking the track can be accessed through the Tools menu. This functionality is additional to those already existing functions which are available via the function keys.

The functionality differs between the stake and check methods. Refer to these subchapters for a detailed description of the functionalities:

- "49.4.2 Use heights from DTM"
- "49.4.3 Apply current chainage"
- "49.4.4 Stake individual point"
- "49.4.5 Second point of cant"
- "49.4.6 COGO Rail"

## 49.4.2 Use heights from DTM

**Availability**

This menu function is available for stake and check.

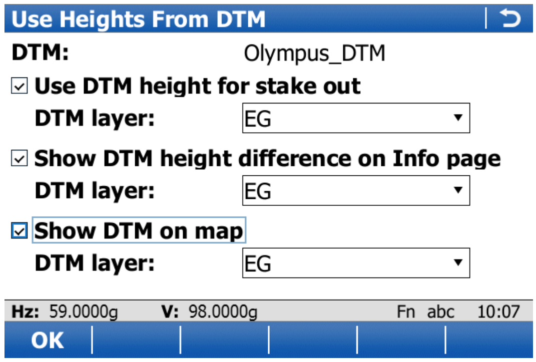
**Description**

The application offers the possibility to

- switch to a height which is retrieved from an existing height layer, as defined in the selected DTM job. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments.
- retrieve heights from an existing layer, as defined in the DTM job associated with the project. The DTM used is not considered for the stake values. Three new information lines are added to the **Info** page: **DTM Ht Diff**, **DTM Height** and **DTM Layer**.
- show the DTM triangles in the planar view and in the cross section view on the **Map** page.

Once defined, each layer remains active until it is turned off. DTM heights can be used for both 2D and 3D alignments.

#### Use heights from DTM




| Key | Description |
|---|---|
| **OK** | To confirm the settings and return to the Stake/Check screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **DTM** | Display only | DTM from the selected DTM job. |
| **Use DTM height for stake out** | Check box | When this box is checked, a layer of the DTM is used as a height reference.<br>When this box is not checked, no DTM heights are applied for stakeout or check. |
| **DTM layer** | Selectable list | Available when **Use DTM height for stake out** is checked. When selecting a DTM layer the relevant triangle of the DTM is shown on the **Map** page. |
| **Show DTM height difference on Info page** | Check box | When this box is checked, a layer of the DTM to be used as a height reference on the **Info** page.<br>When this box is not checked, no additional height information relative to the DTM is shown on the **Info** page. |
| **DTM layer** | Selectable list | Available when **Show DTM height difference on Info page** is checked. Layer of the DTM to be used as a height reference. When selecting a DTM layer the relevant triangle of the DTM is shown in cross section view on the **Map** page. |
| **Show DTM on map** | Check box | When this box is checked, the DTM triangles are displayed in planar view on the **Map** page.<br>The setting of for this check box is linked to the setting for the **Display DTM in map** check box in **Map View Settings**, **DTM** page. |
| **DTM layer** | Selectable list | All available layers are selectable. |

### 49.4.3 Apply current chainage

**Availability**

This menu function is available for stake.

**Description**

To set **Stake chainage** on the **General** page of the stakeout to the current chainage.

### 49.4.4 Stake individual point

**Availability**

This menu function is available for stake.

**Description**

To select the point to stake from the selected **Working job**.
If a control job has been selected on the job selection screen, a point from the control job can be selected. When staking out/checking an individual point, the selected point is set in relation to the alignment and all line relevant values are calculated and displayed.

To access **Data:**, **Points** page, which allows staking out points with known Easting, Northing and Height. Points can either be selected from the **Working job** or manually typed in.

The **Stake chainage** and **Stake offset** of the Stake screen are calculated based on the coordinates of the selected point.

The height for the stakeout can be set as **Manual height**.

☞ If the chosen point has no height the design height will be used. If the point has a height it is possible to use that one or continue working with the design height.

## 49.4.5 Second point of cant

**Availability**

This menu function is only available for check.

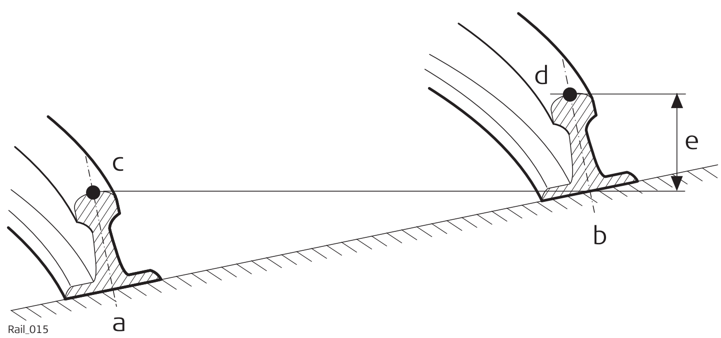
**Description**

To determine the current cant of two rails.
In order to calculate the current cant, it is necessary to measure two points, one on each rail. A mechanical device can be used to measure these points if necessary.

Additionally, the current cant can be calculated by first measuring any two points (example, the track centreline and lower rail) and then using the superelevation base. The calculation is dependent upon the superelevation base.

☞ When **Second point of cant** is active, the **Current cant** is used for the calculation of the cant difference, not the measured cant value from a cant device as seen in **Check Track**, **General** page.

**Diagram**




a) Left rail
b) Right rail
c) first point
d) Second point of cant
e) Current cant

**Procedure**

**Measuring the first point**
The first point can be measured directly from the **Check Track** screen.

**Measuring the second point**
The second point is measured after accessing the **Second point of cant** in the Tools menu. Once the second point has been measured, the value **Current cant** is displayed on the **Info** page.

### 49.4.6 COGO Rail

☞ The functionality of **COGO Rail** is identical with **COGO Road**. Refer to "48.4.6 COGO Road - Alignment Information".

# 50 Roads - Tunnel TPS

## 50.1 Creating a New Tunnel Job

### 50.1.1 Preparing Design Data

**Downloads section**

The tunnel design data is imported for use onboard the instrument using
- the industry standard LandXML data format
- formats exported from some other design packages using the Design to Field component of the Leica Geo Office computer application.

Converters are available for more than 15 different design packages.

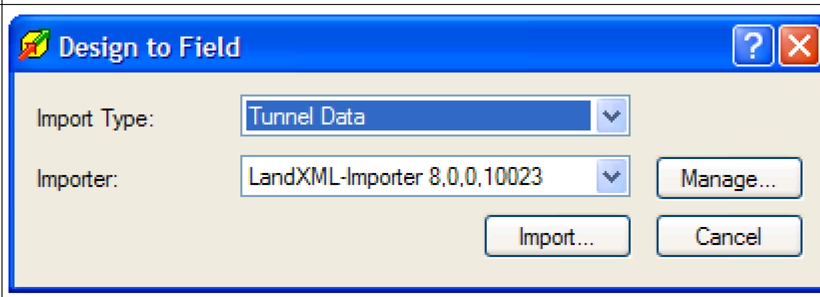
The latest version of the Design to Field importers can be found in the downloads section of:
- myWorld@Leica Geosystems
  https://myworld.leica-geosystems.com

### 50.1.2 Tunnel Centreline

**Basics**

The tunnel centreline is defined in two or three dimensions. If design profiles are to be used, a three-dimensional centreline is required.

**Design to field**

| Step | Description |
|---|---|
| 1. | To import a centreline using the Design to Field component select the **Tools/Design to Field** option of the Leica Geo Office computer application.<br>  |
| 2. |   |

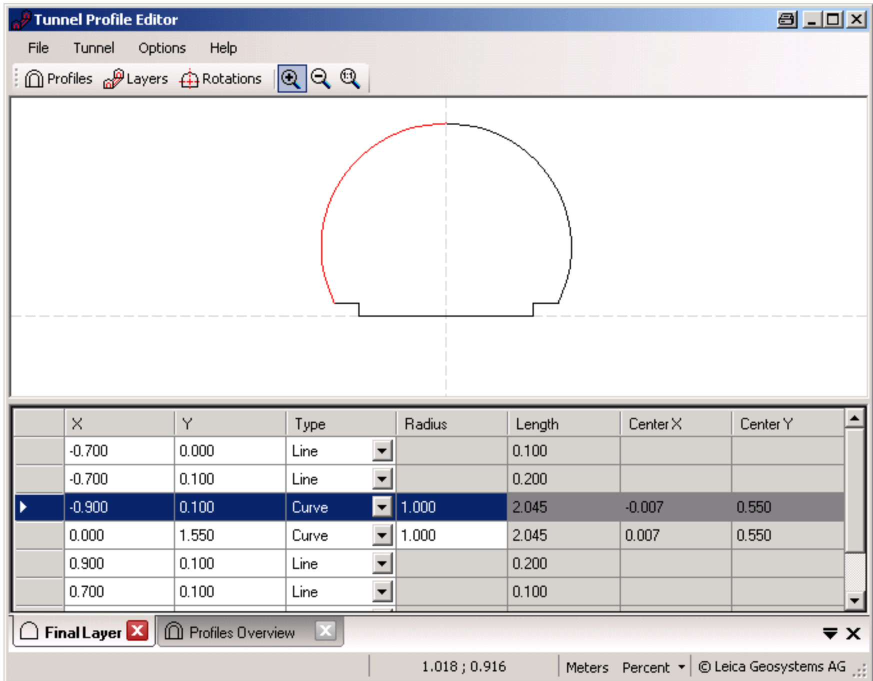
For general information about Design to Field, please refer to the Leica Geo Office manual or Online Help.

## 50.1.3 Design Profiles

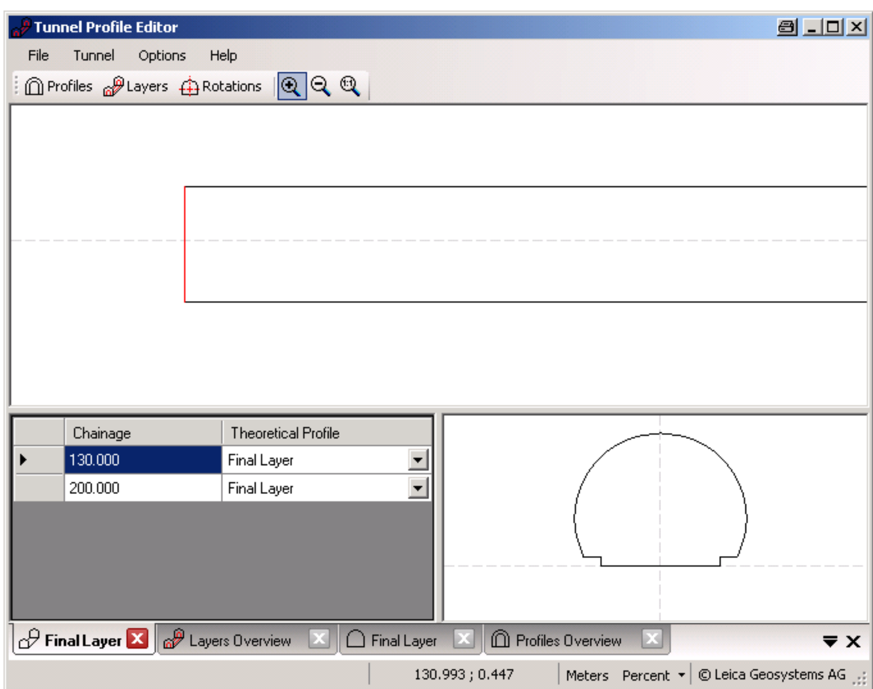
**Tunnel design profiles**

If tunnel design profiles are available, they are created using the Tunnel Profile Editor computer application. This application is integrated in the Design to Field viewer. It allows users to import or create tunnel data like profiles, layers and rotations. Refer to the Tunnel Profile Editor online help for more information.

**Tunnel Profile Editor, Profile details view**

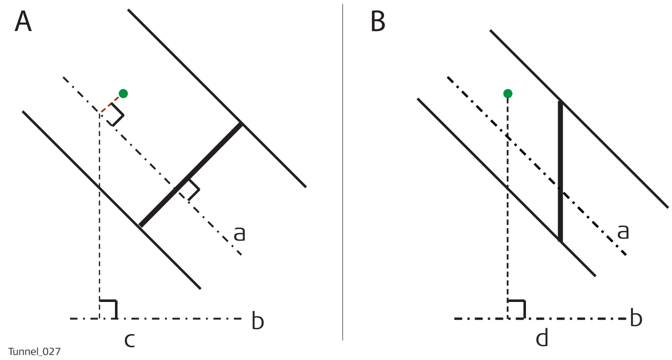



**Tunnel Profile Editor, Layer details view**



**Vertical or perpendicular profiles**

The Tunnel Profile Editor allows users to define tunnel profiles vertically or perpendicular to the vertical alignment of the tunnel axis. This results in different tunnel sizes for equal profile definitions as shown in the graphic.




A Perpendicular (tilted) profile
B Vertical profile
a) Vertical alignment of tunnel axis
b) Horizontal alignment of tunnel axis
c) Chainage for perpendicular profile definition
d) Chainage for vertical profile definition

## 50.1.4 Data Transfer to Instrument

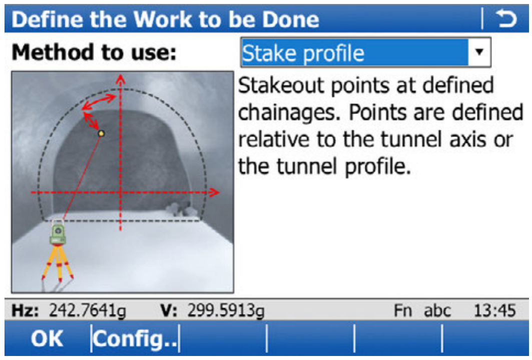
**Getting data onboard**

Once the design data have been converted, copy the database files to the DBX folder of the data storage device that is used on the instrument. The file names are jobname.x**.

**Access**

1) Select **Main Menu**: **Go to Work!\Roads\Tunnel - Stakeout** or **Tunnel - As built check**.
2) In the job selection screen, select the required jobs. Refer to "46.2.1 Accessing Roads Applications".
3) Press **OK**.

**Define the Work to be Done**




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the screen. |

**Description of the methods**

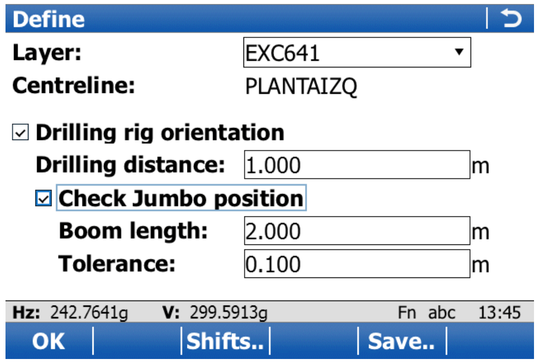
| Method | Description |
|---|---|
| **Stake face** | Stakeout points at the tunnel face. Points are defined relative to the tunnel axis or the tunnel profile. |
| **Stake profile** | Stakeout points at defined chainages. Points are defined relative to the tunnel axis or the tunnel profile. |
| **Check profile** | Measure deviations of the built tunnel to the original design. |
| **Scan profile** | Automatically scan profiles in a defined section of the tunnel |

**Next step**

**OK** accesses the **Define** screen.

**Define**

The screen is an example valid for **Method to use**: **Stake face**.




| Key | Description |
|---|---|
| **OK** | To continue to the next screen. |
| **Shifts..** | To apply horizontal, vertical and profile shifts to the selected element. Refer to "46.4 Working with Shifts". |
| **Load..** | To load a task. Refer to "46.5 Tasks". |
| **Save..** | To save the settings as task. Refer to "46.5 Tasks". |
| Fn **Config..** | To access the configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

### Description of fields

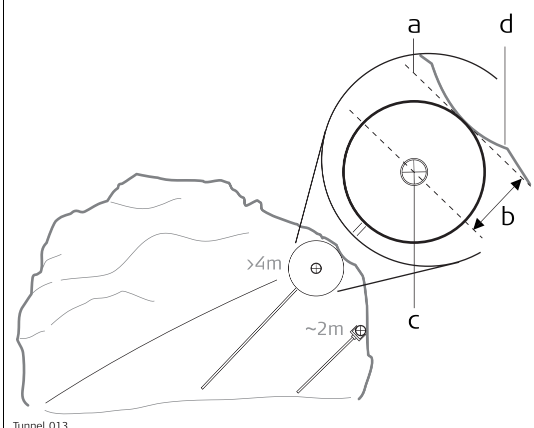
Common to all methods

| Field | Option | Description |
|---|---|---|
| **Layer** | Display only or selectable list | Layers contained in the active tunnel job can be selected. |
| **Centreline** | Display only | The name of the layer centreline. |

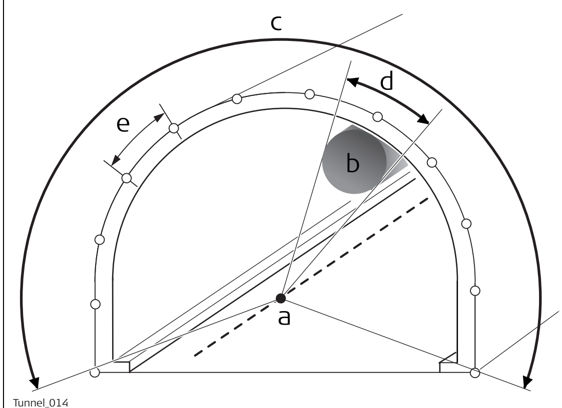
For **Method to use**: **Stake face**

| Field | Option | Description |
|---|---|---|
| **Drilling rig orientation** | Check box | Available for **Method to use**: **Stake face**.<br>This functionality helps to orientate the drilling rig when drilling holes parallel to the tunnel axis direction. The entry point at the tunnel face is marked and delta angles to align the drilling rig are provided. |
| The following fields are available when **Drilling rig orientation**: **Parallel to alignment** is selected in **Tunnel Configuration**, **Tunnel design** page: | | |
| **Drilling distance** | Editable field | The bore hole length. Available when **Drilling rig orientation** is checked and used to calculate the direction parallel to the alignment. |
| **Check Jumbo position** | Check box | When this box is checked, the jumbo position is checked after measuring to the back of the boom. |
| **Boom length** | Editable field | The length of the boom is used for calculating and checking the jumbo position when **Check Jumbo position** is checked. |
| **Tolerance** | Editable field | Defines how accurately the boom must be positioned to calculate the delta angles (max 10% of boom length). Available when **Check Jumbo position** is checked. |
| The following fields are available when **Drilling rig orientation**: **Drill Pattern** is selected in **Tunnel Configuration**, **Tunnel design** page: | | |
| **Apply drill pattern from** | **Meas Chainage** | The drill pattern is directly applied to the measured chainage.<br>To acquire the measured chainage, take a measurement, press Fn **Tools..** and select **Apply current chainage**. |
| | **Defined Chainage** | This chainage is typed manually into the **Stake chainage** editable field. It is used to calculate the corresponding position and drill direction at the measured chainage. |

For **Method to use**: **Check profile**

| Field | Option | Description |
|---|---|---|
| **Apply target radius** | Check box | Available for **Method to use**: **Check profile.** When using a prism to check a design profile, it is important to take the prism radius into account.<br>The measured point is projected by a distance equivalent to the radius of the prism in a direction perpendicular to the tangent of the design profile.<br>When this box is not checked, the design profile is compared to the coordinates of the centre of the prism at the measured position.<br><br><br>a) Tangent to design profile<br>b) Prism radius<br>c) Prism<br>d) Design profile<br>If reflectorless measurements are used or no design profile has been defined, the prism radius parameter will not be used in the calculation.<br>In **Check Profile**, **Map** page a plot of the measured point regarding the design profile is displayed. |
| **Target radius** | Editable field | Available for **Method to use**: **Check profile** and when **Apply target radius** is checked. The radius of the prism. |

For **Method to use**: **Scan profile**

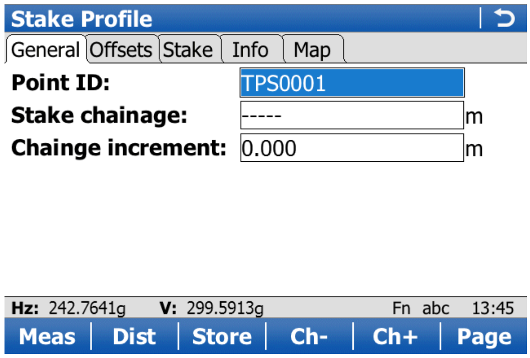
| Field | Option | Description |
|---|---|---|
| **Define a scan task** | **Scan whole profile** | Each profile is scanned 360°/400 gon. |
| | **Scan using segment** | The tunnel profile can be split into user-defined segments. Each segment can be assigned as a scan segment or non scan segment.<br><br>a) Instrument axis<br>b) Ventilation shaft<br>c) Scan segment, included<br>d) Scan segment, excluded<br>e) Scan interval |
| **Scan interval** | Editable fields | Available for **Define a scan task**: **Scan whole profile**. Defines at what interval to measure a point around the profile. |
| **Scan Mode** | **Accuracy optimised** | This measurement mode is accuracy and range optimized. It uses the reflectorless single distance measurement mode. |
| | **Speed optimised** | This measurement mode is speed and performance optimized. It uses the reflectorless continuous distance measurement mode. |
| | **Quick Profiler** | It uses the reflectorless continuous distance measurement mode and stores the measured data once the whole profile has been scanned or the scan is paused.<br>☞ The **Quick Profiler** mode does not store TPS observations. |
| **TPS handle is on** | Check box | When this box is checked, scanning a segment above the instrument is excluded automatically. The TPS handle would otherwise interfere with measurements.<br>☞ If scanning at the station chainage, then the scan does not include the profile segment beneath the total station. |
| **Handle type** | **Normal handle** | If this option is selected, then it is not scanned between 386 gon and 7 gon. |
| | **Radio handle** | If this option is selected, then it is not scanned between 380 gon and 25 gon. |

# 50.3 Staking/Checking the Tunnel

## 50.3.1 Overview

**Stake face/Stake profile/Check profile, General page**

This screen is an example valid for **Method to use**: **Stake profile**.




| Key | Description |
|---|---|
| **Meas** | To measure a distance and store distance and angles. |
| **Dist** | To measure a distance. |
| **Store** | To store angles and distance. Distance must be measured before. |
| **Ch-** | Available for **Tunnel - Stakeout**. To decrease the chainage as defined by **Chainge increment**. |
| **Dist+** | To increase the distance along the profile. Available for **Input method**: **Profile, dist & offset** and **Input method**: **Dist from top&offset**. |
| **Ch+** | Available for **Tunnel - Stakeout**. To increase the chainage as defined by **Chainge increment**. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Positn** | Available for **Tunnel - Stakeout**. To stake the point automatically. The instrument aims toward the point at the given chainage and offsets and measures a distance. If this distance is not within the required tolerance an iterative process is started until:<br>• the number of iterations set as the configuration parameter **Max iterations** is reached, or<br>• the difference between the measured point and the design point is less than the value set as the configuration parameter **Position limit**. |
| Fn **Tools..** | Available for **Tunnel - Stakeout**. To access the tools menu. Refer to "48.4 The Tools Menu". |
| Fn **Quit** | To exit the application. |

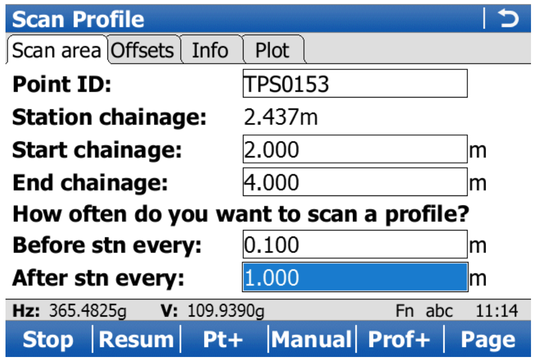
#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The point identifier of the point to be staked. |
| **Stake chainage** | Editable field | Available for **Tunnel - Stakeout**. The defined or approximate chainage of the point to be staked out. |
| **Chainge increment** | Editable field | Available for **Method to use**: **Stake profile**.Chainage increment. Value by which the nominal chainage increases/decreases when pressing **Ch+**/**Ch-**.<br>If a point is to be staked at more than one chainage, a chainage increment can be defined. |
| **Target height** | Editable field | Available for **Method to use**: **Check profile**. The height of the prism. If a prism is used, type in the vertical difference between the point to be measured and the point of the prism pole. |

#### Next step

**Page** changes to the **Offsets** page.

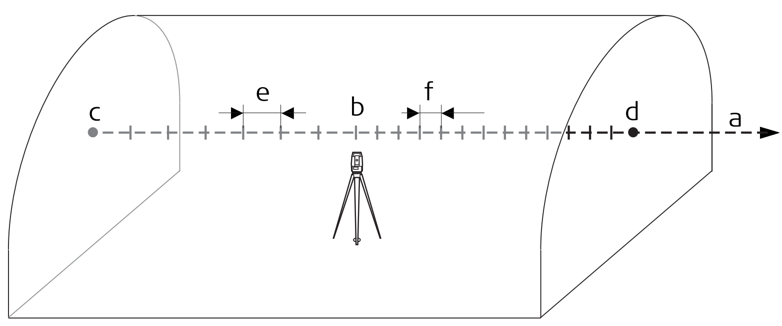
**Scan profile, Scan area page**




| Key | Description |
|---|---|
| **Scan** | Available for automatic scanning. To start the scanning process. Refer to "During a scan". |
| **Stop** | Available for automatic scanning. To stop the scanning process. |
| **Pause** | To pause the scan. |
| **Resum** | To re-start scanning. |
| **Get Ch** | Point the telescope to the start or end chainage and press **Get Ch** to measure to the start/end chainage. |
| **Meas** | Available for manual scanning. To measure a distance and store distance and angles. |
| **Dist** | Available for manual scanning. To measure a distance. |
| **Store** | Available for manual scanning. To store angles and distance. Distance must be measured before. |
| **Pt+** | To skip the point being measured and move onto the next profile point. |
| **Prof+** | To stop scanning the current profile and move onto the next profile. |
| **Manual** or **Auto** | To switch between manual and automatic scanning. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Temp** | To define a temporary scan interval. This will result in all scan segments being scanned at the defined temporary scan interval until the temporary scan interval is disabled. |
| Fn **Tools..** | To access the tools menu. Refer to "50.4 The Tools Menu". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The point identifier of the point to be staked. |
| **Station chainage** | Editable field | The chainage of the instrument station. |
| **Start chainage** and **Start distance** | Editable field | Enter/measure a chainage/distance value where scanning starts along the alignment. This can be before or after the station chainage. If entering a distance value to indicate start scanning before the station chainage use a negative. If entering a distance value to indicate start scanning after the station chainage use positive. |
| **End chainage** and **End distance** | Editable field | Enter/measure a chainage/distance value where scanning ends along the alignment. This can be before or after the station chainage. If entering a distance value to indicate end scanning before the station chainage use a negative. If entering a distance value to indicate end scanning after the station chainage use positive. |
| **Before stn every** | Editable field | If the scan area starts before the station chainage then define how often to scan a profile along the alignment from this chainage until the defined end chainage or station chainage (which ever comes first). |
| **After stn every** | Editable field | If the scan area ends after the station chainage then define how often to scan a profile along the alignment from the station chainage or start chainage (which ever has a greater chainage) until the defined end chainage/distance. |




a) Alignment
b) **Station chainage**
c) **Start chainage** or **Start distance**
d) **End chainage** or **End distance**
e) **Before stn every**
f) **After stn every**

#### Next step

**Page** changes to the **Offsets** page.

**Stake face/Stake profile/Check profile/Scan profile, Offsets page**

Refer to "Stake face/Stake profile/Check profile, General page" for a description of keys.

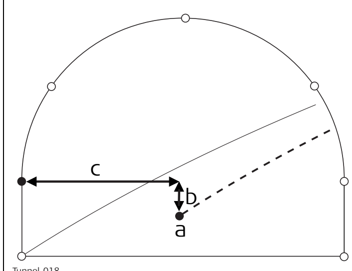
### Description of fields

Common for all methods

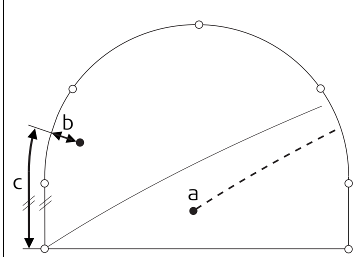
| Field | Option | Description |
|---|---|---|
| **Apply offsets** | Check box | When this box is checked, horizontal and vertical offsets can be applied.<br>☞ For **Scan profile** this does NOT offset or expand/shrink the design profile. |

For **Tunnel - Stakeout**

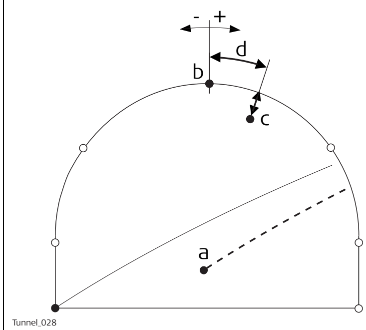
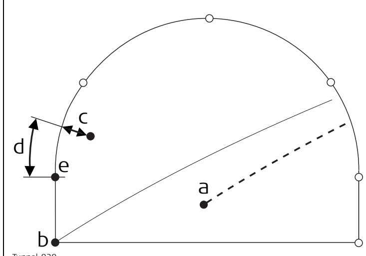
<table>
<tr><th>Field</th><th>Option</th><th>Description</th></tr>
<tr><td>Input method</td><td></td><td>To define the position of the point to be staked out.</td></tr>
<tr><td></td><td>Offset & height</td><td>The point is staked out with a known perpendicular and vertical offset from the horizontal and vertical alignments respectively.

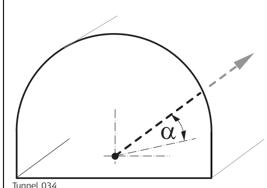
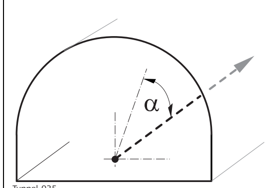



a) Centreline<br>b) Centreline height difference<br>c) Centreline offset</td></tr>
<tr><td></td><td>From job</td><td>The offsets of the point are stored as coordinates in the Working job. The Stake offset is stored as the X coordinate and the Stake height diffis stored as the Y coordinate.</td></tr>
<tr><td></td><td>Profile, dist & offset</td><td>The point is defined by the distance from the start of the profile and an offset perpendicular to the design profile.




a) Centreline<br>b) Profile offset<br>c) Distance from start of design profile</td></tr>
<tr><td></td><td>Dist from top&offset</td><td>The point is defined by the distance from the top of the tunnel and an offset perpendicular to the design profile.</td></tr>
</table>

| Field | Option | Description |
|---|---|---|
| | | <br>a) Centreline<br>b) Top of profile<br>c) Offset perpendicular to the profile segment<br>d) Distance from the top of the profile |
| | **Element & offset** | The point to stake out is defined by:<br>1) The number of the element on which the point lies<br>2) The percentage of the distance along the element of the point to stake out<br>3) The offset perpendicular to the design profile.<br><br>a) Centreline<br>b) Point defining start of design profile<br>c) Offset perpendicular to profile segment<br>d) Distance from start of start point of segment in %<br>e) Start point of segment |
| **Stake offset** | Editable field | Applies a horizontal offset perpendicular to the centreline. Available for **Input method**: **Offset & height**. |
| **Stake height diff** | Editable field | Applies a vertical offset to the centreline. Available for **Input method**: **Offset & height**. |
| **Point ID** | Selectable list | Available for **Input method**: **From job**. |
| **Profile distance** | Editable field | The distance from start of design profile. Available for **Input method**: **Profile, dist & offset**. |
| **Top distance** | Editable field | The distance from the top of the tunnel. Available for **Input method**: **Dist from top&offset**. |
| **Profile offset** | Editable field | The offset from the design profile. Available for **Input method**: **Profile, dist & offset**, **Input method**: **Dist from top&offset** and **Input method**: **Element & offset**. |

| Field | Option | Description |
|---|---|---|
| **Increment** | Editable field | To increment the distance for offset definitions as distance and offset. Available for **Input method**: **Profile, dist & offset** and **Input method**: **Dist from top&offset**. |
| **Element no.** | Editable field | Element number 1 is the first element of the design profile. |
| **% Element** | Editable field | Distance in percentage terms of the measured point along the design profile element. |
| **Check offset** | Editable field | Available for **Method to use**: **Check profile**. Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point. |
| **Check height diff** | Editable field | Available for **Method to use**: **Check profile**. Applies a vertical offset to the centreline used for comparing to the measured point. |
| **Drill hz angle** | Editable field | The horizontal direction 0 is along the centreline of the tunnel alignment.   α **Drill hz angle** |
| **Drill v angle** | Editable field | The vertical direction 0 is along the centreline of the tunnel alignment.   α **Drill v angle** |

For **Tunnel - As built check**

| Field | Option | Description |
|---|---|---|
| **Check offset** | Editable field | Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point. |
| **Check height diff** | Editable field | Applies a vertical offset to the centreline used for comparing to the measured point. |

### Next step

| IF you work with | THEN Page changes to the |
|---|---|
| **Tunnel - Stakeout** | **Stake** page. |
| **Tunnel - As built check** | **Info** page. |

**Stake face/Stake profile, Stake page**

☞ This page is available for Tunnel - Stakeout only.

This page displays the differences between the measured point and the defined point. The position of the point to stake is reached when all difference values are close to zero.
Refer to "Stake face/Stake profile/Check profile, General page" for a description of keys.
Refer to "54.4 Staking Out" for a description of the elements of the graphical display.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Chainage** | Display only | The current chainage. |
| **CL O** | Display only | Perpendicular horizontal offset from the centre-line. |
| ∆ **chainage** | Display only | Difference between the **Stake chainage** and the current chainage.<br>If no defined chainage exists, for example if staking out random chainages or checking, this field shows **-----**. |
| ∆ **O** | Display only | Horizontal offset between the defined position and the current position. The offset defined on the **Offsets** page is taken into account. |
| ∆ **height** | Display only | Vertical offset between the defined position and the current position. The height difference defined on the **Offsets** page is taken into account. |

### Next step

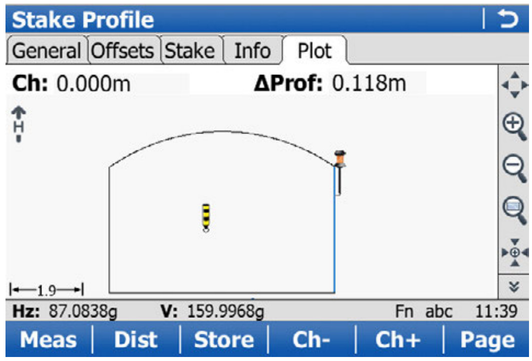
**Page** changes to the **Info** page.

**Stake face/Stake profile/Check profile/Scan profile, Info page**

The **Info** page displays the differences between the measured and design data.
The fields viewed on this page are be configurable.
Refer to " Configuration, Info page" for information on all available items for the **Info** page and how to select them.

**Stake face/Stake profile/Check profile/Scan profile, Map page**

The **Map** page displays a plot of the measured point regarding the tunnel design. This screen is an example valid for **Method to use**: **Stake profile**.




| Key | Description |
|---|---|
| **Ch-** | Available for **Tunnel - Stakeout**. To decrease the chainage as defined by **Chainge increment**. |
| **Ch+** | Available for **Tunnel - Stakeout**. To increase the chainage as defined by **Chainge increment**. |

## Stake face

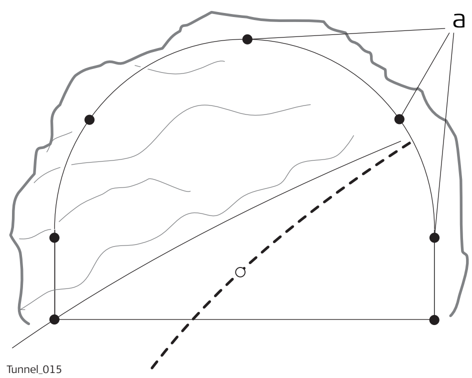
### Overview

When excavating a tunnel, it is required to stake out the tunnel portal before excavation can begin. In addition, for excavation methods other than those involving tunnel boring machines (TBMs), it is then required to stake out the tunnel face at given intervals during the excavation.

The tunnel face can be staked out at any time within the Tunnel application using **Stake face**.

This function allows the setting out of a series of points perpendicular to the horizontal alignment. The horizontal alignment indicates the position of the design profile at the chainage of the tunnel face.

### Cross section view

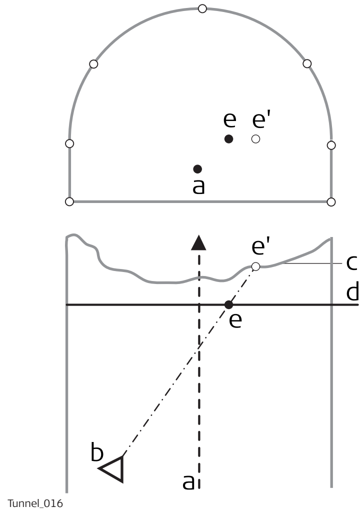



a) Points to stake out

Given that it is likely that a degree of rock debris is present at the tunnel face or that inexact excavation techniques such as blasting are used, it cannot be assumed that the tunnel face at any stage of the excavation is perpendicular to the horizontal alignment.
This situation in turn implies that we cannot stake out a point on the tunnel face at a given chainage as the chainage of the tunnel face at any particular point is unknown. Iterative techniques are necessary to enable any defined point on the tunnel face to be staked out accurately.

The **Stake face** function involves setting out a point on the tunnel face at this unknown chainage. First of all the point to stake out on the tunnel face is staked out at an approximate chainage (e).
The point is defined by offsets regarding the centreline or by its position along the design profile and its offset from the profile. Given that the excavated tunnel face does not intersect the defined chainage, another point (e') is measured.

#### First iteration

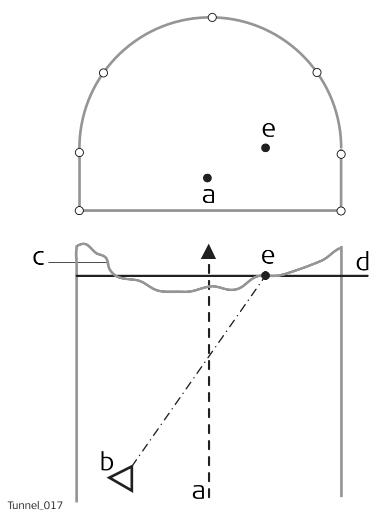



a) Centreline
b) Instrument position
c) Tunnel face
d) Approximate chainage to stake out
e) Point to stake out at approximate chainage
e') Point to stake out on tunnel face

The true chainage of the measured point of the first iteration (e') is then calculated. The defined point (e) is staked out at the calculated chainage (d).

#### Second iteration

This process is repeated until the differences between staked point and the defined point are within a tolerance set by the user.




a) Centreline
b) Instrument position
c) Tunnel face
d) Calculated chainage from first iteration
e) Point to stake out at calculated chainage

## Drilling rig orientation

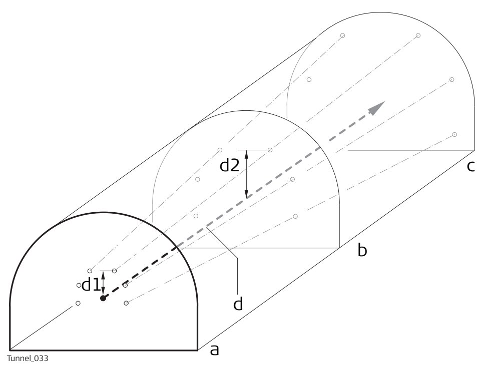
### Description

This functionality helps to orientate the drilling rig when drilling holes parallel to the tunnel axis or using a drilling pattern, that is manual entry of drill direction.

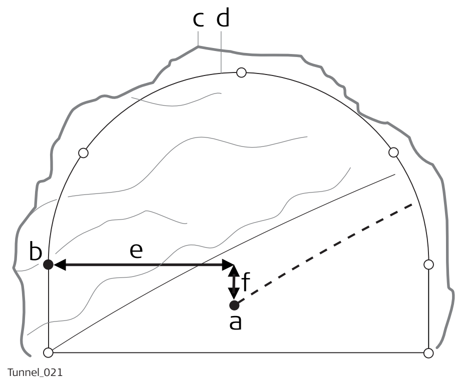
### Drilling rig orientation step-by-step with Drilling rig orientation: Parallel to alignment

| Step | Description |
|---|---|
| 1. | Make sure that **Tunnel - Stakeout** and **Method to use**: **Stake face** is selected. |
| 2. | In **Tunnel Configuration**, **Tunnel design** page, set **Drilling rig orientation**: **Parallel to alignment**. Refer to "Configuration, Tunnel design page". |
| 3. | In the **Define** screen check **Drilling rig orientation** and type in the values. Refer to "Defining the Work". |
| 4. | If **Drilling rig orientation**: **Parallel to alignment** was selected in **Tunnel Configuration**, **Tunnel design** page and **Check Jumbo position** was checked in the **Define** screen, then proceed to define the drill entry position on the tunnel face by entering the respective centreline offset in **Stake Face**, **Offsets** page. |
| 5. | In **Stake Face**, **General** page, enter the approximate tunnel face chainage. To position the laser pointer to the drill entry point press Fn **Positn** to find the point. |
| 6. | Position the drill bit to the laser point on the tunnel face. |
| 7. | Now the jumbo boom moves onto line between the laser point on wall and the telescope so that the laser now points at the back of the boom. Press Fn Tools... Select **Check Jumbo position** to get the delta angles which will be used by the drilling rig to move the boom parallel to the alignment.<br>$\alpha$ Horizontal angle<br>$\beta$ Vertical angle |

### Drilling rig orientation step-by-step with Drilling rig orientation: Drill Pattern

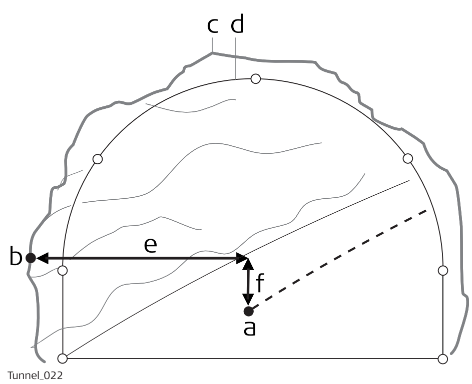
| Step | Description |
|---|---|
| 1. | Make sure that **Tunnel - Stakeout** and **Method to use**: **Stake face** is selected. |
| 2. | In **Tunnel Configuration**, **Tunnel design** page, set **Drilling rig orientation**: **Drill Pattern**. Refer to "Configuration, Tunnel design page". |
| 3. | In the **Define** screen, check **Drilling rig orientation** and select the application of the drill pattern. Refer to "Defining the Work". |
| 4. | If **Apply drill pattern from**: **Defined Chainage** was selected, then proceed to define the drill entry position for the measured chainage by entering the defined chainage centreline offsets in the **Stake Face**, **Offsets** page and the drill angles according to the defined chainage. |
| 5. | In the **Stake Face**, **General** page, enter the defined chainage value in the **Stake chainage** editable field. To position the laser pointer correctly on the measured tunnel face press Fn **Positn**.<br>☞ The delta chainage value after using Fn **Positn** is the difference between the defined and measured chainage. It is normal if this is large. The delta position and delta height values after this step should equal zero. |
| 6. | Position the drill bit to the laser point on the tunnel face. |
| | **Example:**<br><br><br>a Chainage 10<br>b Chainage 15<br>c Chainage 20<br>d Centreline<br>d1 **Stake height diff** at defined chainage 10<br>d2 **Stake height diff** at defined chainage 15<br>☞ Stake face point 1 at chainage 10 (point1). Stake face point 1 at chainage 15 as defined at chainage 10. Position and direction at chainage 15 are a result of the **Stake offset**, **Stake height diff** and drilling angles as defined for chainage 10. |
| 7. | Now the jumbo boom moves onto line between the laser point on wall and the telescope so that the laser now points at the back of the boom. Press Fn Tools... Select **Check Jumbo position** to get the delta values which will be used by the drilling rig to move the boom for the correct drilling direction. |

**Stake/Check point on surface**



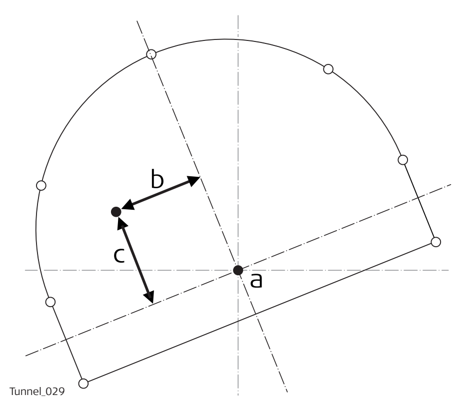

a) Centreline
b) Design point to stake out
c) Excavated profile
d) Design profile
e) Centreline offset
f) Centreline height difference

If it is not possible to stake out the defined point between successive iterations, the instrument will maintain the chainage and height difference from the vertical alignment fixed. The horizontal offset from the centreline to calculate the new position of the point are modified. The point that will be staked out will thus maintain the defined chainage and height difference but will have a modified offset value from the centreline.




a) Centreline
b) Point to stake out on excavated profile
c) Excavated profile
d) Design profile
e) Centreline offset
f) Centreline height difference

**Rotated profile**




a) Centreline
b) Rotated centreline offset
c) Rotated centre height difference

## 50.3.4 Scan profile

**Overview**

A tunnel surface is scanned in detail during construction and/or at the completion of construction to detect overbreak, underbreak and/or to create an 'as built plan' of the finished tunnel surface.

**Scan profile** allows measuring a user-defined number of tunnel profiles along an existing tunnel alignment.
It can be defined:
- Whether to scan the whole tunnel profile or just a segment of it.
- The interval between measurements around the profile.

It does not matter if a design profile exists in the job or not.

☞ If the job does not contain a design profile, then before scanning the defined scan area the instrument will first scan a profile at the instrument chainage.

☞ For a description of the **Scan profile**, **Scan area** page, refer to "50.3.1 Overview".

**During a scan**

**During a scan**
- **Pt+**: To skip the point being measured and move onto the next profile point.
- **Prof+**: To stop scanning the current profile and move onto the next profile.
- **Temp**: To enter a temporary scan interval.

**Pause and options before continuing**

It is possible to end the scan once started using **Stop**. To pause the scan, for example to allow passing site traffic through, use **Pause**.

Once the scan has been paused, several options are available before continuing:
- **Stop**: To end the scan.
- **Resum**: To continue the scan at the next position.
- **Manual**: To interrupt the current scan so aiming can be done manually and points added.
- **Auto**: After measuring points manually, press **Auto** to continue scanning where you finished before pressing **Manual**.

**Define Temp Scan Interval**

By pausing the current scan and pressing **Temp**, a temporary scan interval can be entered. This results in all scan segments being scanned at the defined temporary scan interval until the **Define Temp Scan Interval** screen is re-entered and **Use a temporary scan interval** is unchecked.

**Description of fields**

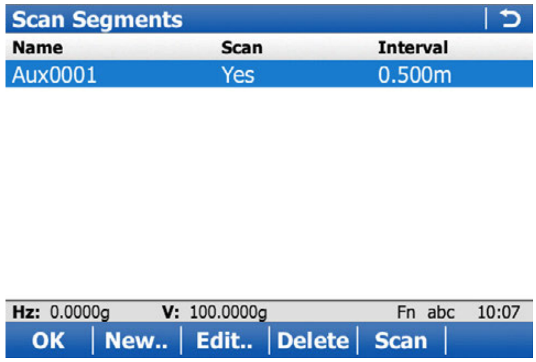
| Field | Option | Description |
|---|---|---|
| **Use a temporary scan interval** | Check box | If this box is checked, then scanning stops and any defined scan interval is ignored and replaced by the temporary scan interval. |
| **Temporary scan interval** | Editable field | How often a point is measured around a profile. |

**Invalid measurements**

This process is repeated until the measured point is within the chainage limit or the maximum number of iterations has been reached.
Invalid measurement situations could occur, for example:
- in irregular tunnel surfaces, where the horizontal alignment is formed by a curve with a small radius.
- if the end distance or start distance defined in **Scan Profile**, **Scan area** page were too large.

**Scan Segments**

If **Define a scan task**: **Scan using segment** was selected in the **Define** screen, then the **Scan Segments** screen allows creating, editing or deleting scan segments.




| Key | Description |
|---|---|
| **OK** | To continue to **Scan Profile** after defining the scan segments. |
| **New..** | To create a new scan segment. |
| **Edit..** | To edit a defined scan segment. |
| **Delete** | To delete a defined scan segment. |
| **Scan** | To set **Yes** or **No** in the **Scan** column for the highlighted segment. |
| Fn **Quit** | To exit the application. |

### Description of columns

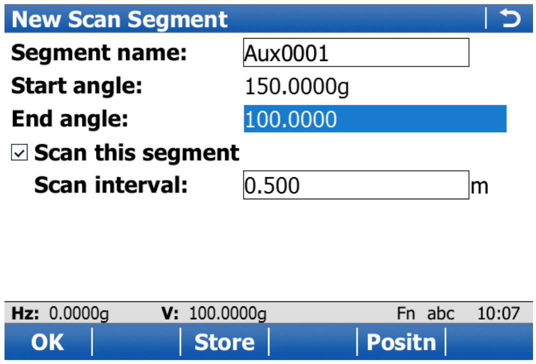
| Column | Description |
|---|---|
| **Name** | Name of the scan segment. |
| **Scan** | Status to scan or not scan a segment. |
| **Interval** | How often a point is measured around the profile. |

### Next step

**New..** to access **New Scan Segment**.

**New Scan Segment**

This screen allows the definition of one or multiple segment(s) of the scan profile as opposed to scanning the whole profile.




When defining the scan segment, define the start and end angles in the station profile. The vertical circle values are used not the horizontal circle values so transit the telescope between face 1 and 2 as needed.

| Key | Description |
|---|---|
| **OK** | To store the defined scan segment and return to **Scan Segments**. |
| **Dist** | To measure the distance to points at the starting angle and the end angle of a segment. When **Start angle** or **End angle** is highlighted, set the verticle circle values by aiming the telescope at the relevant point and press **Dist**. |
| **Positn** | To review the position of the segment once it has been defined. The instrument turns to the corresponding angle. Available when **Start angle** or **End angle** is highlighted. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Segment name** | Editable field | The name of the scan segment. |
| **Start angle** | Display only | The angle measured to the point at the beginning of the segment.<br>Highlight this field, aim at the start of the segment and press **Dist** to see the angle value in this field. |
| **End angle** | Display only | The angle measured to the point at the end of the segment.<br>Highlight this field, aim at the end of the segment and press **Dist** to see the angle value in this field. |
| **Scan this segment** | Check box | When this box is checked, the segment is scanned.<br>When this box is not checked, the segment is not scanned. |
| **Scan interval** | Editable field | Defines how often a point is measured in this segment of the profile. |

If overlapping segments are defined, then a non scan segment has priority over a scan segment.

# 50.4 The Tools Menu

## 50.4.1 Profile Viewer

**Availability**

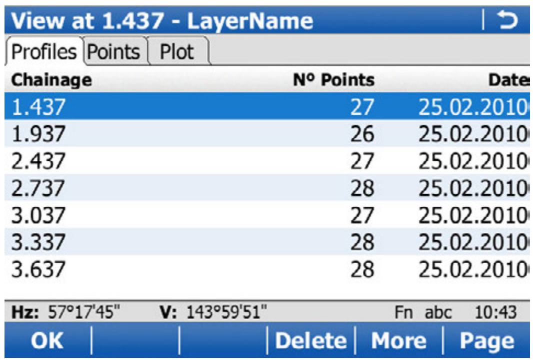
This menu function is available for the check method **Scan profile**.
This menu option is always available. The data that can be viewed depends on those data available in the working job. It is independent of the currently measured **Scan Profile** points.

The measured profiles to be viewed must be saved in the working job.

**Access**

Press Fn **Tools..** on the **Scan Profile** page.

**View at - Layer Name, Profiles page**




| Key | Description |
|---|---|
| **OK** | To confirm the settings and return to the **Scan Profile** screen. |
| **Delete** | To delete the highlighted profile. |
| **More** | To display information about the time and the date of when the profile was stored. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

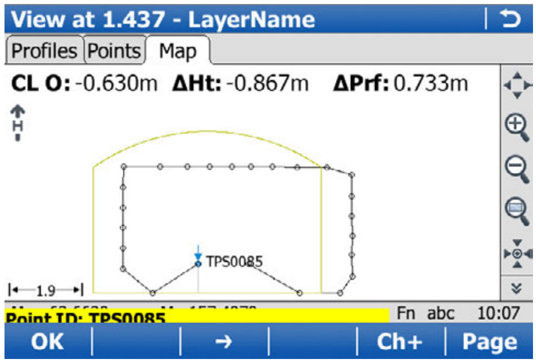
**Description of columns**

| Column | Description |
|---|---|
| **Chainage** | The chainage of the profile. |
| **Nº Points** | The number of points in the profile. |
| **Time** and **Date** | The time and the date of when the profile was stored. |

**Next step**

**Page** changes to the **Points** page. The points belonging to the profile which is highlighted on the **Profiles** page are displayed. Points can be deleted from the profile.
**Page** changes to the **Map** page.

**View at - Layer Name, Map page**




| Key | Description |
|---|---|
| **OK** | To accept the settings and return to the **Scan Profile** screen. |
| ← or → | To select the relevant point in the plot. The information displayed shows the centreline offset, the delta height and delta profile of the point.<br>Points can also be selected on the touch screen. |
| **Ch-** or **Ch+** | To decrease/increase the chainage. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access MapView configuration settings. Refer to "38.3 Configuring MapView". |
| Fn **Positn** | To position the total station to the defined point, including defined offsets. |
| Fn **Quit** | To exit the application. |

## 50.4.2 Stake face auto

**Description**

To stakeout tunnel face points automatically. The surveyor configures and selects the points to use in the stakeout. The person driving the drilling machine can see the stakeout points looking to the current position of the laser.

**Availability**

This menu function is available for the stake method **Stake face**.
This menu option is available if the defined chainage has a valid value.
**Measure mode**: **Continuous** is supported.

**Access**

| Step | Description |
|---|---|
| 1. | Press Fn **Tools..** in **Stake Face**. |
| 2. | Select **Stake Face Auto** in **Stake Face Toolbox**. |

**Stake Face Auto, General page**

| Key | Description |
|---|---|
| **OK** | To access the **Stake Face Auto** screen. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Store staked points** | Check box | When this box is checked, the staked points are stored. |
| **Wait time after staked point** | Check box | When this box is checked, a time delay is active after staking a point and before staking the next point starts. |
| **Delay** | Editable field | The time delay after staking a point and before staking the next point starts. Available when **Wait time after staked point** is checked. |
| **Verify orientation** | Check box | When this box is checked, the system checks orientation automatically in a defined interval. If the orientation error is greater than the defined **Hz tolerance**, then the auto mode is stopped. |
| **Orientation job** | Selectable list | A point for the orientation check can be selected from a job on a data storage device. Available when **Verify orientation** is checked. |
| **Orientation point** | Selectable list | The point ID of the point for the orientation check. Available when **Verify orientation** is checked. |
| **Hz tolerance** | Editable field | Tolerance for horizontal directions. If the orientation error is greater than the defined angle, then the auto mode is stopped. Available when **Verify orientation** is checked. |

**Next step**
**Page** changes to the **Points** page.

**Stake Face Auto, Points page**

Select the points to include in the stakeout.

| Key | Description |
|---|---|
| **OK** | To access the **Stake Face Auto** screen. |
| **Use** | To set **Yes** or **No** in the **Use** column for excluding/including the highlighted point.<br>Any line can be selected on the **Map** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of columns

| Column | Description |
|---|---|
| **Point ID** | Displays the name of all points in the selected **Tunnel job**. |
| **Use** | For **Yes**: The selected point is used for stake.<br>For **No**: The selected point is not used for stake. |
| **CL offset** | The horizontal offset of the point from the layer centreline. |
| **CL ht diff** | The height difference of the point to the layer centreline. |

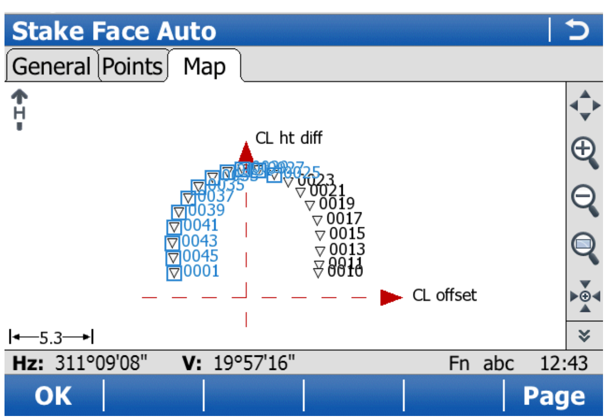
### Next step

**Page** changes to the **Map** page.

The **Map** page shows a cross section, profile and planar view of the design data at the selected chainage.

Point selection/deselection is possible on the **Map** page.

| IF | THEN |
|---|---|
| a single point is to be selected/deselected | tap on the point. |
| multiple points are to be selected | click the icon, drag the stylus on the screen in a diagonal line to make a rectangular area. |



**Stake Face Auto**

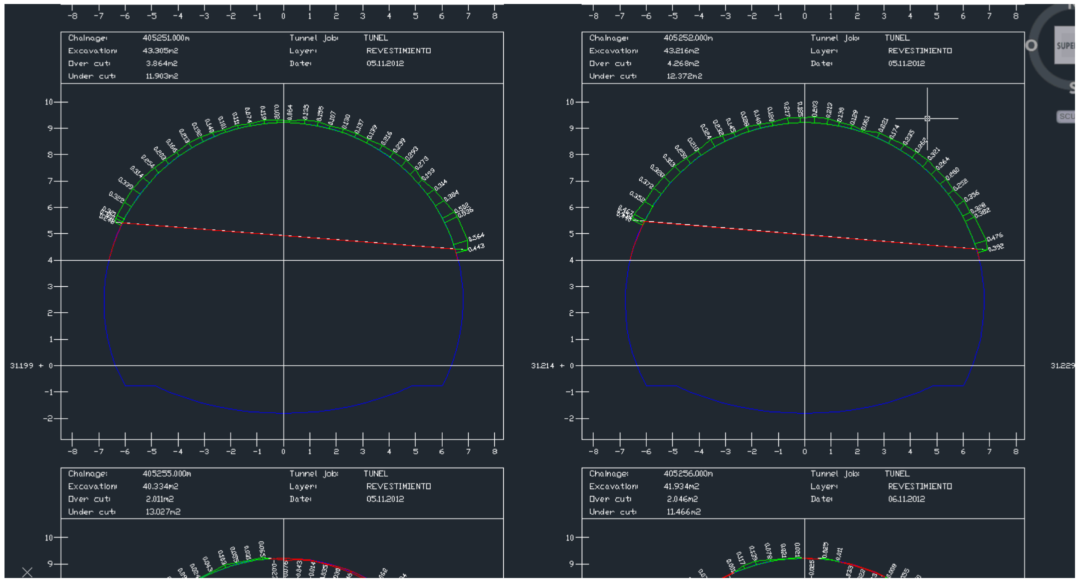
When **Stake face auto** is activated, the measurement screen opens. In a loop, all selected points are automatically staked indefinitely until the user stops the measurement, or the orientation check is out of tolerance.

| Key | Description |
|---|---|
| **Stop** | To stop the automatic stakeout. |
| **Pause** | To pause the automatic stakeout. |
| **Resum** | To re-start the automatic stakeout. |
| ← | To select the previous point. |
| → | To select the next point. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To access configuration settings. Refer to "46.3 Configuring Roads Applications". |
| Fn **Quit** | To exit the application. |

## 50.4.3 Export DXF Profiles

**Description**

To export the measured profiles against the selected tunnel section in a DXF file.
Example of a result:




**Availability**

This menu function is available for the check method **Scan profile**.

**Access**

| Step | Description |
|---|---|
| 1. | Press Fn **Tools..** in **Scan profile**. |
| 2. | Select **Export Dxf Profiles** in **Scan Profile Toolbox**. |

**Export Dxf Profiles**

| Key | Description |
|---|---|
| **OK** | To accept the settings. |
| **Config..** | To define what is exported. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Folder** | Selectable list | Defines if the data is exported to the \DATA directory or to the folder where the selected job is located. |
| **Export to** | Selectable list | Available for **Folder: Data**. Defines which data storage device the data is exported to. |
| | Display only | Available for **Folder: Same as job**. Displays the data storage device of the selected **Job**. |
| **Working job** | Display only | The working job is the one data is stored to. |
| **Tunnel job** | Display only | Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX. The tunnel job is a read-only source of information. |
| **Layer** | Display only | The layer from the active tunnel job, selected in the **Define** screen. |
| **Begin chainage** and **End chainage** | Editable field | Define the range from which DXF profiles are exported. |
| **File name** | Editable field | The name of the file to which the data will be exported. |

**Next step**

**Config..** goes to **Dxf Export Configuration**.

**Dxf Export Configuration**

| Key | Description |
|---|---|
| **OK** | To save the settings and return to **Export Dxf Profiles**. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Columns** | Editable field | The number of columns to organize the DXF. Example: With **4** selected, four profiles will be exported per line. |
| **Export excavation areas** | Check box | When this box is checked, the excavation areas of the tunnel are exported. |
| **Close the measured profiles** | Check box | When this box is checked, the exported profiles are closed for display purposes. |
| **Use a comparison plane** | Check box | When this box is checked, a plane is added to the export file for comparison purposes. The plane is added in the defined difference from the centreline. |
| **CL hgt difference** | Editable field | Height difference from the centreline. |
| **Use a profile offset filter** | Check box | When this box is checked, only the profiles for which the perpendicular offset to the design profile is smaller than the defined limit are exported. |
| **Offset limit** | Editable field | Maximum horizontal offset from defined profile. |

# 51 Scanning

## 51.1 Accessing Scanning

**Availability**

Available for MS50 R2000 and on CS when connected to MS50 R2000.

**Access**

Select **Main Menu: Go to Work!\Survey+\Scanning**.

**Scanning**

Depending on the status of the job and actual instrument setup, the icons are active or not. If a new working job and a new setup have been created, then only **Create scan definition** and **Scan settings** are active.

## 51.2 Defining a Scan

**Access**

Select **Create scan definition** in **Scanning**.
The New Scan Definition wizard starts.

**Create Scan Definition**

A unique name for the new scan definition. The name can be up to 16 characters long and include spaces. Input required.
**Next** changes to the next screen.

**Choose Scanning Method**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Method** | | Select one of the following options to define a scan area. |
| | **Rectangular area** | Area defined by upper left and lower right corner. Either turn the telescope manually. Or use the **Turn to point** option from the context menu. Refer to "38.6 Context Menu".<br>If the first point is the top left corner, then the second point is then to the bottom right corner point.<br>Or the first corner is the bottom left corner point and the second point is then the top right corner point. |
| | **Polygonal area** | Area defined by three or more corners in clockwise direction. Either point the telescope to the corners (actual position of the crosshair). Or draw the polygonal scan area on the **Camera** tab.<br>The closing line between the first and the last point has a different line style. |
| | **Manually entered** | To define a scan area manually by typing in the HZ and V value of two diagonal corners of a rectangle.<br>If scan definitions have already been defined from the current instrument setup, the scan areas are displayed on the **Camera** tab in **Manually Entered Extents**. A new scan area can be defined in addition to the existing scan areas. |
| | **Full dome scan area** | The scan area is the full field of view of the instrument. |

**Next step**
**Next** changes to the next screen.

**Camera view and Camera page**

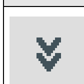
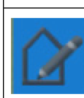
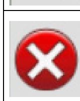
The scan area can be defined on the camera view/**Camera** page of the telescope camera and overview camera. Switching between both cameras is possible.

### Description of keys

| Key | Description |
|---|---|
| **Next** | Available when defining rectangular areas. To accept the selected point and to continue with the subsequent screen within the wizard.<br>Available when defining a scan area manually. To accept the defined extension of the scan area and to continue with the subsequent screen within the wizard. |
| **Add** | Available when defining polygonal areas. To add the current crosshair position as a next point to the polygonal area. |
| **Dist** | To correct the paralaxe by taking a reflectorless distance measurement. The crosshair style changes from the coarse style to the fine style. |
| **Done** | Available when defining polygonal areas. To confirm the defined scan area and to proceed to the subsequent screen. At least three points must be defined. |
| **Back** | To return to the previous screen where the definition mode can be selected. |
| Fn **Config..** | To configure the camera view. Refer to "Camera View Settings, General page". |
| Fn **Quit** | To exit the screen. |

### Description of icons

If **Display TS camera zooming toolbar** is checked in **Camera View Settings**, **General** page, icons are available in a toolbar located on the right side of the screen. Refer to "Overview of keys, softkeys and icons" for the right toolbar icons.
The toolbar on the left side of the screen is always active.

| Icon | Description |
|---|---|
|  | To scroll the toolbar. |
|  | Drawing mode is active. To add a point to the polygonal area tap the point on the display. Moving by joystick is active in the drawing mode. |
|  | Tab and turn mode is active. To add a point to the polygonal area tab a point on the display. The instrument turns so that the digital crosshairs on the display point to the tapped point. Check the point and press **Add**. |
|  | To delete the last selected point of the polygonal area. |
|  | To delete the whole boundary of the polygonal area and to re-start the definition of the polygonal scan area. |

**Scan Resolution**

The resolution has a direct influence on the file size.

| Key | Description |
|---|---|
| **Next** | To accept changes and to continue with the subsequent screen within the wizard. |
| **Dist** | Available when **Define spacing by**: **Distances** is selected. To take a reflectorless distance measurement. The measured value is displayed in the **Slope distance**. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Define spacing by** | **Angles** | The scan resolution is defined by horizontal and vertical angle values. |
| | **Distances** | The scan resolution is defined by horizontal and vertical spacings at a certain range. |
| **Hz** and **V** | Editable field | Available for **Define spacing by**: **Angles**. The horizontal and vertical angle values defining the scan resolution. |
| **Slope distance** | Editable field | Available for **Define spacing by**: **Distances**. The range for which the horizontal and vertical spacing are valid. |
| **Horizontal spacing** and **Vertical spacing** | Editable field | Available for **Define spacing by**: **Distances**. The horizontal and vertical spacing defining the scan resolution at the defined range. |
| **Estimated points** | Display only | The estimated number of points to be scanned according to the defined scan resolution. |

#### Next step

**Next** changes to the next screen.

**Scan Mode**

| Key | Description |
|---|---|
| **Next** | To accept and record the scan mode. |
| **Dist** | To measure and display distances. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Optimise scan for..** | **1000 pts/s, up to 300m** | • 1000 Hz scanning mode.<br>• Range up to 300 m.<br>• Optimal to use when time is critical. |
| | **250 pts/s, up to 400m** | • 250 Hz scanning mode.<br>• Range up to 400 m.<br>• Optimal for use when time and accuracy are critical. |
| | **62 pts/s, up to 500m** | • 62 Hz scanning mode.<br>• Range up to 500 m.<br>• Optimal for use when accuracy and range are critical. |
| | **Approx 1 pt/s, up to 1000m** | • 1 Hz long range mode.<br>• Range up to 1000 m.<br>• Optimal for long range applications |
| **Time required** | Display only | The time that the measurement needed. |
| **Average scan distance (optional)** | Editable field | Slope distance to the scanning object. This distance is optional. By knowing the distance to the object, the system optimises the scanning speed. |

### Next step

**Next** changes to the next screen.

**Scan Distance Filter**

| Key | Description |
|---|---|
| **Finish** | To exit the wizard. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use distance filter - only objects within the minimum & maximum distance will be scanned** | Check box | When this box is checked, only objects within the defined distance range are scanned. |
| **Min distance** | Editable field | Minimum distance of the scan distance. |
| **Max distance** | Editable field | Maximum distance of the scan distance. |

### Next step

**Finish** to exit the wizard.

## 51.3 Configuring Scanning

**Access**

Select **Scan settings** in **Scanning**.

**Scan Settings**

| Key | Description |
|---|---|
| **OK** | To return to **Scanning**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Store signal to noise ratio (SNR) values with scan points** | Check box | When this box is checked, the value of the **S**ignal to **N**oise **R**ation of the returned signal is stored as additional information to the scan area. |
| **Store scan area on panoramic image (if panoramic image is captured)** | Check box | When this box is checked, the scan area is laid over the image and stored with the image when a panoramic image is captured. |
| **Pause scanning when a message is shown** | Check box | When this box is checked, a scan is paused when a message is shown. |
| **Apply filter to optimise the point cloud** | Check box | When this box is checked, the filter creates an optimum of the point cloud regarding data quality. |

## 51.4 Starting a Scan

**Access**

Select **Start scan** in **Scanning**.

**Scan Status, Progress page**

| Key | Description |
|---|---|
| **Start** | To start scanning. |
| **Stop** | To end scanning. By stopping the scan, the already scanned points are stored in a file. The scan gets the status **Scan completed**. |
| **Pause** and **Scan** | To pause/re-start scanning. |
| **Cpture** | Available as long as the scan has not yet started. To take an image with the current pixel resolution. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Scan name** | Display only | Then name of the first or current scan. |
| **Points scanned** | Display only | The total number of scanned points. |
| **% completed** | Display only | In percent, the number of scans taken against the total number of scans which must be taken. |
| **Time remaining** | Display only | Estimated time remaining until the scan is finished. |
| **Scans completed** | Display only | Number of scans being measured / Number of total scans |

# 52 Sets of Angles TPS

## 52.1 Overview

**Description**

Sets of Angles:

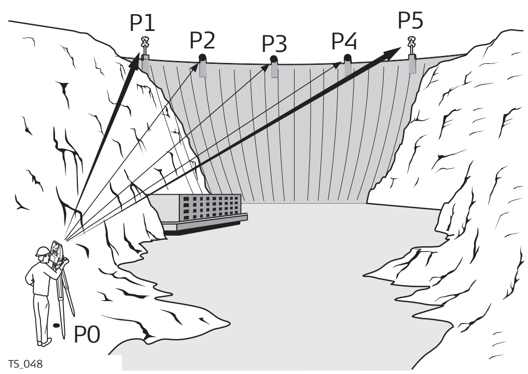
- This application is used to measure multiple sets of directions and distances (optional) to pre-defined target points in one or two faces. The application can include Monitoring as an option.
- The mean direction and mean distance (optional) to each target point, within a set is calculated. The residual for each direction and distance (optional) within a set is also calculated.
- The reduced average direction and average distance (optional) to each target point, for all active sets is calculated.
- Coordinates to each target point are calculated using the reduced average direction and average distance (optional).

Monitoring:

- This module can be integrated within the Sets of Angles program.
- With this module, it is possible to use a timer to enable repeated and automated angle and distances measurements to pre-defined target points at defined intervals.

☞ If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

**Diagram**




**Known**:
P1 Pre-defined target point - E,N,Height (optional)
P2 Pre-defined target point - E,N,Height (optional)
P3 Pre-defined target point - E,N,Height (optional)
P4 Pre-defined target point - E,N,Height (optional)
P5 Pre-defined target point - E,N,Height (optional)

**Unknown**:
a) Mean direction and mean distance (optional) to each target point, within a set
b) Mean coordinates (optional) for each target point, for all active sets
c) Residual for each direction and distance (optional ), within a set
d) Reduced average direction and average distance (optional) to each target point, for all active sets

| | |
|---|---|
| **Automatic aiming** | Automatic aiming (search and measurements) can be performed to a prism. After completing the first measurements to each target point, the measurements to the target points in subsequent sets are automated. |
| **Station setup and station orientation** | If oriented grid coordinates are to be recorded, a station set up and station orientation is required before starting the Sets of Angles application. |
| **Point averaging** | Sets of Angles points are never calculated as an average, even if a measured point of class **Meas** already exists with the same point ID. |

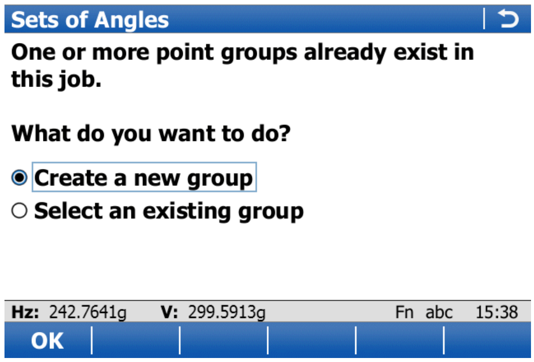
# 52.2 Sets of Angles

## 52.2.1 Accessing Sets of Angles

**Access**

Select **Main Menu: Go to Work!\Survey+\Sets of angles**.

**Sets of Angles**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the next screen. |
| Fn **Config..** | To configure the Sets of Angles application. Refer to "52.2.2 Configuring Sets of Angles". |
| Fn **Quit** | To exit the application. |

**Description of options**

| Options | Description |
|---|---|
| **Create a new group** | To define the target points. Refer to "52.2.3 Creating New Point Groups". |
| **Select an existing group** | To select, edit and manage a points group of the target points for the survey. Refer to "52.2.4 Managing Existing Point Groups". |

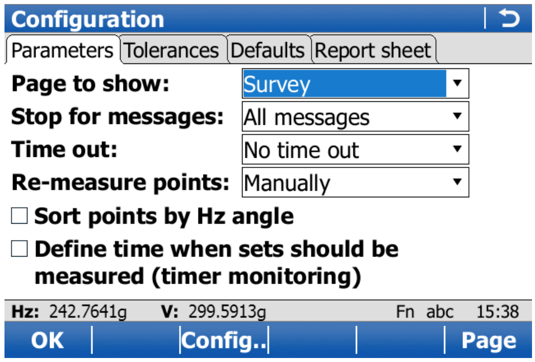
## 52.2.2 Configuring Sets of Angles

**Access**

Select **Main Menu: Go to Work!\Survey+\Sets of angles**. Press Fn **Config...**

**Configuration, Parameters page**

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Config..** | To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "25.3 My Survey Screen". |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Page to show** | Selectable list | The names of the available survey screen pages. |
| **Stop for messages** | | To define what action is taken when a message screen appears during a measurement set. |
| | **All messages** | All message screens are displayed as per normal and are closed as defined by the settings in **Time out**. |
| | **Tol exceeded only** | Only the message screen relating to the exceeding of tolerances is displayed and is closed as defined by the settings in **Time out**. |
| | **Never stop** | No message screens are displayed except for specific warnings.<br>Specific warnings which affect the instrument and its ability to continue with the monitoring process will be displayed and will remain on the screen. These warnings include the overheating of the instrument, low battery levels, or unavailable space on the data storage device. |

| Field | Option | Description |
|---|---|---|
| **Time out** | | To define the time delay for the automatic closing of message screens during a measurement set. This selectable list is not available when **Stop for messages: Never stop**. |
| | **No time out** | There is no automatic closure, only by user interaction in a message screen. When a message screen appears, press **Yes** to close. |
| | **1 sec** to **60 sec** | All message screens are automatically closed as defined by these individual time settings. |
| **Re-measure points** | | To define the action if a target point cannot be measured. |
| | **Never** | The target point is skipped and the next target point in the list is measured. |
| | **Automatically** | The measurement to the target point is repeated automatically.<br>☞ The option for **Measure mode** in **Measure & Target Settings** is also changed for the repeated measurement. If the option is changed, then it is applied to all following sets. |
| | **Manually** | The measurement to the target point can be repeated manually or the target point can be skipped. |
| **Sort points by Hz angle** | Check box | Check this box to sort the target points automatically. The instrument will work in a clockwise direction and find the shortest path to move between the target points. |
| **Define time when sets should be measured (timer monitoring)** | Check box | This field is only available when Monitoring is registered through the licence key. |
| | | When this box is checked, automatic monitoring of target points is activated. |
| | | When this box is not checked, automatic monitoring of target points is not activated. The Sets of Angles application will apply. |

**Next step**

**Page** changes to the **Tolerances** page.

**Configuration, Tolerances page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use tolerances** | Check box | If checked, the entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements. |
| **Hz tolerance** | Editable field | Tolerance for horizontal directions. |
| **V tolerance** | Editable field | Tolerance for vertical directions |
| **Distance tolerance** | Editable field | Tolerance for distances. |

### Next step

**Page** changes to the **Defaults** page.

**Configuration, Defaults page**

Define the default target properties for points that are added to the point group by importing.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Target height** | Editable field | The default prism height. |
| **Target** | Selectable list | Target names as configured in the **Targets** screen. |
| **Leica constant** | Display only | The additive constant as stored for the selected prism in the SmartWorx Viva software. |
| **Target aiming** | **Manual** | Measurements are done without any automation. ATR search and/or ATR measurement are not performed. |
| | **Automatic** | Positioning to static prisms. The ATR sensor is used for measurements to static prisms. If needed an ATR measurement or ATR search is performed after pressing **Meas** or **Dist**. |
| | **Lock** | Availability depends on instrument type. The instrument locks onto and follows the moving prism. |
| **Visibility** | **Good** | If weather conditions are normal, then select this mode. |
| | **Rain & fog** | To increase the instrument measuring ability during suboptimal weather conditions. This mode is automatically deactivated when the instrument is turned off. |
| | **Rain & fog always** | As for **Rain & fog**, however this mode stays active when the instrument is turned off. |
| | **Sun & reflections** | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This mode has a considerable influence on the range. This mode is automatically deactivated when the instrument is turned off. |
| | **Sun & rflctns always** | As for **Sun & reflections**, however this mode stays active when the instrument is turned off. |
| **Use precise target aiming** | Check box | Available for the 0.5" instruments of TS50/TM50. When this check box is checked, ATR measurements with higher accuracy are performed. |
| **Use ultra fine aiming** | Check box | Reduces the field of view of the ATR. The setting is only applied for **Target aiming**: **Automatic** in **Measure & Target Settings**. |
| **Automatically survey points** | Check box | Check this box to survey the target points automatically. The instrument will automatically turn and measure the target point. For instruments with automatic aiming. |

**Next step**

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

**Next step**

**Page** changes to the first page on this screen.

## 52.2.3 Creating New Point Groups

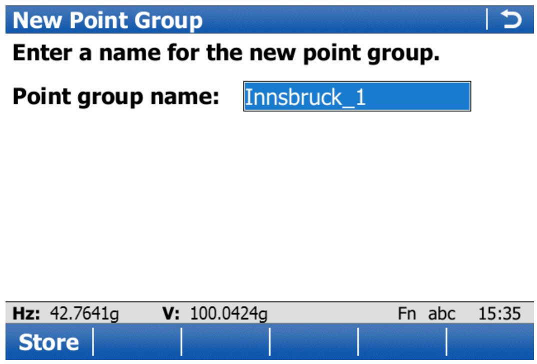
**Description**

The points to be used for Sets of Angles can be selected and the first set measured. The measurement settings of the first measurement to each point are used for all further sets.

**Access**

Highlight **Create a new group** in **Sets of Angles** and **OK**.

**New Point Group**




| Key | Description |
|---|---|
| **Store** | To store the new points group. |
| Fn **Config..** | To configure the Sets of Angles application. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point group name** | Editable field | The name of the points group. |

**Add Points To Group**

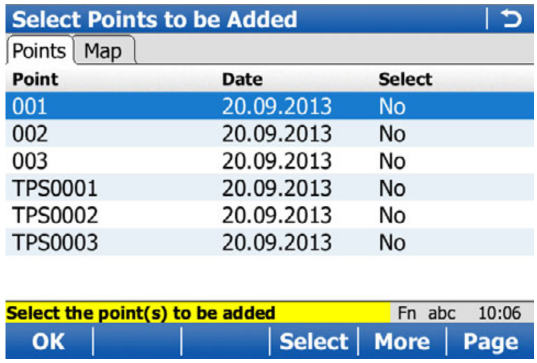
| Key | Description |
|---|---|
| **OK** | To select the checked option and to continue with the next screen. |
| Fn **Quit** | To exit the application. |

**Description of options**

| Option | Description |
|---|---|
| **Measure points** | When this box is checked, the points to be used for Sets of Angles can be measured. |
| **Use for sets** | Available when **Measure points** is checked. To select the measuring sequence. |
| **Add individual points from a job** | When this box is checked, a control job can be selected. Individual points can be selected from this job. Refer to "Select Points - Survey, Sets page". |
| **Add all points from a job** | When this box is checked, a control job can be selected. All points from the control job are added to the point group by pressing **OK**. |

**Select Points to be Added, Points page**

☞ The points are sorted in alphabetical order. To sort points by horizontal angle, check **Sort points by Hz angle** in **Configuration Parameters**, page.

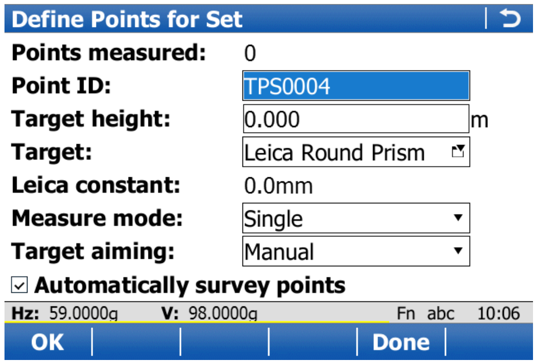



| Key | Description |
|---|---|
| **OK** | To store the points to the group. |
| **Select** | To change the setting in the **Select** column for the highlighted point. |
| **More** | To display information about the 3D coordinate quality, the class, Easting, Northing and Elevation, the time and the date of when the point was stored, |
| **Page** | To change to another page on this screen. |
| Fn **All** or Fn None | To change the setting in the **Select** column for all scans at once. |
| Fn **Quit** | To exit the application. |

**Next step**

**Page** changes to the **Plot** page. The points from the list are displayed in black. The other points from the working job are displayed in grey.

**Define Points for Set**




| Key | Description |
|---|---|
| **OK** | To measure the entered point and to access **Select Points - Survey**. |
| **Done** | To finish selection of points and access **Sets of Angles** for further steps. |
| Fn **Config..** | To configure the Sets of Angles application. |
| Fn **Get Pt** | To select points stored in the database. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

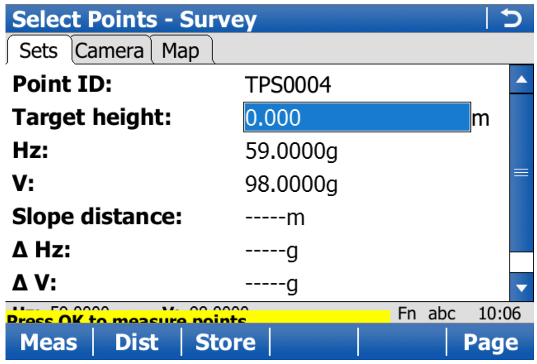
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use ultra fine aiming** | Check box | Reduces the field of view of the ATR. The setting is only applied for **Target aiming**: **Automatic** in **Measure & Target Settings**. |
| **Automatically survey points** | Check box | Available for instruments with automatic aiming and **Target aiming: Automatic**. If checked, search and measurements are done to specified targets in additional sets. |

### Next step

| IF | THEN |
|---|---|
| new or selected points are to be measured | **OK** to access **Select Points - Survey**. |
| existing points are to be selected | Fn **Get Pt** to select a point from **Data**, **Points** page. |
| all desired points have been selected and measured | **Done** to return to the **Manage Point Group:**. |

**Select Points - Survey, Sets page**




| Key | Description |
|---|---|
| **Meas** | To measure and store the angles and distance, and to return to **Define Points for Set**. |
| **Dist** | To measure a distance. |
| **Store** | To store data and to return to **Define Points for Set**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Δ Hz** | Display only | Difference between the current horizontal angle and the horizontal angle to this target when selected. |
| Δ **AR** | Display only | Available when **Hz angle display**: **Angle right** is configured in **Regional Settings**, **Angle** page. Difference between the current angle right and the angle right to this target when selected. |
| **Δ V** | Display only | Difference between the current vertical angle and the vertical angle to this target when selected. |
| **Δ slope** | Display only | Difference between the current slope distance to the target and the slope distance to this target when selected. |

### Next step

**Meas** to measure and store the angles and distance, and to return to **Define Points for Set**.

## 52.2.4 Managing Existing Point Groups

**Description**

A point group of the target points for the survey can be selected.

**Access**

Highlight **Select an existing group** in **Sets of Angles** and **OK**.

**Existing Point Groups**

| Key | Description |
|---|---|
| **OK** | To continue with the next screen. |
| Fn **Config..** | To configure the Sets of Angles application. Refer to "52.2.2 Configuring Sets of Angles". |
| Fn **Quit** | To exit the application. |

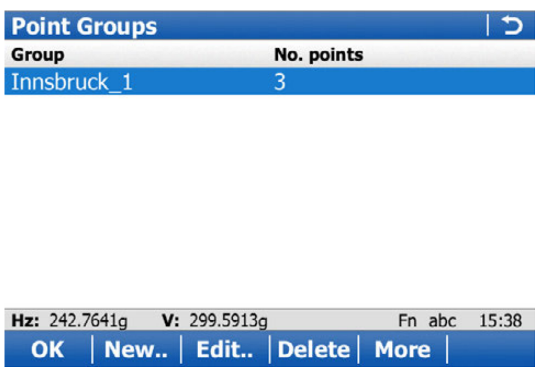
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point Groups** | Selectable list | The name of the points group. |
| **No. of points** | Display only | The number of points in the group. |
| **Creation date** | Display only | The date of when the point group was created. |
| **Creation time** | Display only | The time of when the point group was created. |

**Next step**

**OK** to access **Point Groups**.

**Point Groups**




| Key | Description |
|---|---|
| **OK** | To continue with the next screen. |
| **New..** | To create a new point group. |
| **Edit..** | To edit the highlighted point group. |
| **Delete** | To delete an existing points group. |
| **More** | To display additional information. |
| Fn **Quit** | To exit the application. |

**Edit Point Group, Points page**

| Key | Description |
|---|---|
| **OK** | To store the points to the group. |
| **+ Pts** | To add points to the group. |
| **Prop..** | To view or change the settings for a point.<br>☞ **Prev** to display the previous point of the point group. Available unless the beginning of the list is reached.<br>☞ **Next** to display the next point in the list of points. Available unless the end of the list is reached. |
| **More** | To display information about the date, the 3D coordinate quality, the point code, the target height and fine aiming. |
| **Page** | To change to another page on this screen. |
| Fn **- One** | To remove all points from the group. |
| Fn **- All** | To remove the highlighted point from the group. The point itself is not deleted. |
| Fn **Quit** | To exit the application. |

## 52.2.5 Measuring the Sets

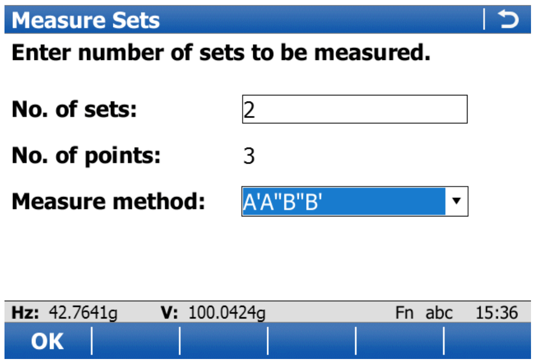
**Description**

The points defined in the point group are measured with the defined measurement method and for the defined number of sets.

**Access**

Highlight **Measure Sets** in **Sets of Angles** and **OK**.

**Measure Sets**




| Key | Description |
|---|---|
| **OK** | Opens a screen to measure the points. When auto survey is activated, measurements are done automatically. |
| Fn **Config..** | To configure the Sets of Angles application. Refer to "52.2.2 Configuring Sets of Angles". |
| Fn **Quit** | To exit the application. |

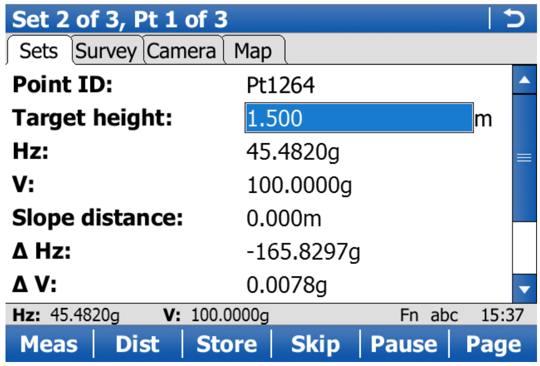
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **No. of sets** | Editable field | The number of sets to measure with the target points. The maximum of sets allowed is 200. |
| **No. of points** | Display only | The number of target points. |
| **Measure method** | | Determines the order in which the target points are to be measured. |
| | **A'A"B"B'** | The target points are measured in face I and face II.<br>point A I - point A II - point B II - point B I ... |
| | **A'A"B'B"** | The target points are measured in face I and face II.<br>point A I - point A II - point B I - point B II ... |
| | **A'B'A"B"** | The target points are measured in face I and face II.<br>point A I - point B I... point A II - point B II ... |
| | **A'B'B"A"** | The target points are measured in face I and face II.<br>point A I - point B I... point B II - point A II... |
| | **A'B'C'D'** | The target points are only measured in face I.<br>point A I - point B I - point C I - point D I ... |

**Next step**

**OK** to measure further sets of the defined points.

**Set n of n, Pt n of n, Sets page**




| Key | Description |
|---|---|
| **Meas** | To measure and store the angles and distances, and to increment to the next point. |
| **Dist** | To measure a distance. |
| **Store** | To store data and to increment to the next point. |
| **Skip** | To skip measuring the displayed point and continue with the next point. |
| **Pause** or **Resume** | To pause/re-start the set measurement. |
| **Page** | To change to another page on this screen. |
| Fn **Done** | To end the sets of angles measurements and to return to **Sets of Angles**. |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Δ Hz** | Display only | Difference between the current horizontal angle and the horizontal angle to this target when selected. |
| **Δ V** | Display only | Difference between the current vertical angle and the vertical angle to this target when selected. |
| **Δ slope** | Display only | Difference between the current slope distance to the target and the slope distance to this target when selected. |
| **Target aiming** | **Manual** | Measurements are done without any automation. ATR search and/or ATR measurement are not performed. |
| | **Automatic** | Positioning to static prisms. The ATR sensor is used for measurements to static prisms. If needed an ATR measurement or ATR search is performed after pressing **Meas** or **Dist**. |
| | **Lock** | Availability depends on instrument type. The instrument locks onto and follows the moving prism. |
| **Visibility** | **Good** | If weather conditions are normal, then select this mode. |
| | **Rain & fog** | To increase the instrument measuring ability during suboptimal weather conditions. This mode is automatically deactivated when the instrument is turned off. |
| | **Rain & fog always** | As for **Rain & fog**, however this mode stays active when the instrument is turned off. |
| | **Sun & reflec- tions** | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This mode has a consider- abel influence on the range (restriction 100 - 150 m). This mode is automatically deactivated when the instrument is turned off. |
| | **Sun & rflctns always** | As for **Sun & reflections**, however this mode stays active when the instrument is turned off. |
| **Use precise target aiming** | Check box | Available for the 0.5" instruments of TS50/TM50. When this box is checked, four ATR measure- ments are performed and the mean value out the measurements is considered for the angle value. |
| **Use ultra fine aiming** | Check box | Reduces the field of view of the ATR. The setting is only applied for **Target aiming**: **Automatic** in **Measure & Target Settings**. |

#### Next step

**Meas** to measure further sets of the selected points.

☞

- Motorised instruments point automatically in the direction of the targets.
- Instruments with automatic aiming and auto survey activated, measure the targets automatically.

**Measurement Summary**

This screen is displayed automatically at the end of the sets measurement.

| Key | Description |
|---|---|
| **OK** | To continue with the next screen. |
| Fn **Quit** | To exit the application. |

### Description of columns

| Column | Description |
|---|---|
| **Point** | This column is always visible. Points of the point group in the same order as in the point group. |
| **Compl meas** | How many times the point was successfully measured.<br>Example: 4/6 - The point was measured four times, six sets were measured. |
| **In tolerance** | How many times the tolerance configured was met.<br>Example: 4/6 - The point falls within the defined tolerance four times, six sets were measured. |
| **Compl sets** | How many sets are completed. The value is the same for all points.<br>Example: 4/6 - The point was measured in a complete set four times, six sets were measured. |

**After measuring sets**

Depending on points skipped or not, select how to continue.

| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the next screen. |
| Fn **Quit** | To exit the application. |

### Description of options

| Options | Description |
|---|---|
| Always available: | |
| **Measure more sets** | To measure additional sets. |
| Available for sets incomplete: | |
| **Re-measure incomplete sets** | To re-measure the skipped points in the face that was skipped. To fill in the missing measurements in the sets. |
| **Remove incomplete points** | To calculate results. The skipped points are discarded. Only points measured in all sets are used for the calculation. |
| **Remove incomplete sets** | To calculate results. The sets that contain skipped points are discarded. Only the complete sets are used for the calculation. |
| Available for sets complete: | |
| **View and manage results** | Available when no points are skipped. Refer to "52.2.6 Managing Results". |
| **Compute points from results** | Available when no points are skipped. To compute points from set results. |
| **Calculate and Exit Sets of Angles** | To end the Sets of Angles program. |

## 52.2.6 Managing Results

**Description**

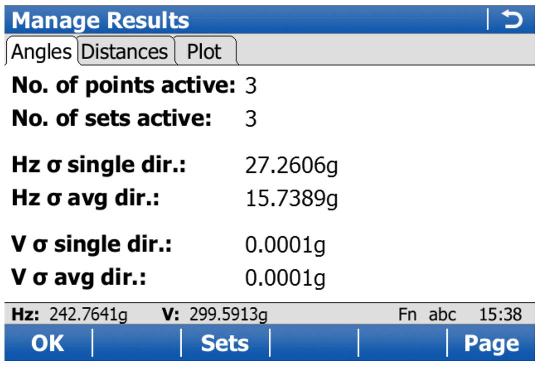
For two and more sets measured with angles and distances in two faces, calculations for angles and distances can be done.

For sets measured in one face, the standard deviation and average values can be viewed.

If only one set or point is measured, only some of the values are displayed.

**Manage Results**

if points measured with method **A'B'C'D'**, the points results are limited and only standard deviation and average values are shown.




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Sets** | To view angle/distance results. |
| **Use** | To activate/deactivate sets. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

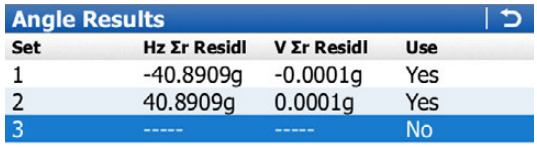
**Description of fields**

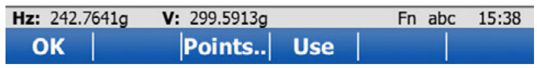
| Field | Option | Description |
|---|---|---|
| **No. of points active** | Display only | Number of active points which are set to **Yes** in the **Use** column in the **Sets of Angles** screen. Refer to "Residuals in Set n". |
| **No. of sets active** | Display only | Number of active sets which are set to **Yes** in the **Use** column in the **Angle Results**/**Distance Results** screen. Refer to "Angle Results/Distance Results". |
| **Hz σ single dir.** | Display only | Standard deviation of the single horizontal direction. |
| **Hz σ avg dir.** | Display only | Standard deviation of the average horizontal direction. |
| **V σ single dir.** | Display only | Standard deviation of a single vertical direction. |
| **V σ avg dir.** | Display only | Standard deviation of the average vertical direction. |
| **σ single distance** | Display only | Standard deviation of a single distance. |
| **σ avg distance** | Display only | Standard deviation of the average distance. |

**Next step**

**Sets** accesses the **Angle Results**/**Distance Results** screen.

**Angle Results/Distance Results**




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Points..** | To access **Residuals in Set n**. |
| **Use** | To set **Yes** or **No** in the **Use** column for the highlighted set. |
| Fn **Quit** | To exit the application. |

**Description of columns**

| Column | Description |
|---|---|
| **Set** | Displays the number of the sets. |
| **Hz Σr Residl** | Shows the calculated absolute sum of residuals in Hz of the selected set. The sum of residuals is the sum of the difference between the reduced average direction and each sets directions. For sets not used in the calculation, **-----** is shown. |
| **V Σr Residl** | Shows the calculated absolute sum of residuals in V of the selected set. The sum of residuals is the sum of the difference between the average vertical angles and each sets vertical angles. For sets not used in the calculation, **-----** is shown. |
| **Max Residl SD** | Shows the calculated maximum residuals in slope distance of the selected set. The sum of residuals is the sum of the difference between the average distance and each sets distance. For sets not used in the calculation, **-----** is shown. |
| **Use** | For **Yes**: The selected set is used for calculations.<br>For **No**: The selected set is not used for calculations. |

**Next step**
**Points..** to access **Residuals in Set n**.

## Residuals in Set n


| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **Use** | To set **Yes** or **No** in the **Use** column for the highlighted point. |
| **More** | To view additional information. |
| Fn **Quit** | To exit the application. |

### Description of columns

| Column | Description |
|---|---|
| **Point** | This column is always visible.<br>Point ID of the measured points in the order they were defined and measured. |
| **Hz Residual** | Residual in the Hz value of the selected point within the single set. |
| **V Residual** | Residual in the V value of the selected point within the single set. |
| **Avg Hz** | Reduced Average Hz value of the point in all active sets. |
| **Avg V** | Average V value of the point in all active sets. |
| **Mean Hz** | Mean Hz value of the point within the single set. |
| **Mean V** | Mean V value of the point within the single set. |
| **SD Residual** | Residual in the distance value of the point within the single set. |
| **Avg SD** | Average distance value of the point in all active sets. |
| **Mean SD** | Mean distance value of the point within the single set. |
| **Use** | For **Yes**: The selected point is used for calculations in all sets.<br>For **No**: The selected point is not used for calculations in any set. |

#### Compute Points, General page

| Key | Description |
|---|---|
| **Store** | To store the point with class **CTRL** in the database.<br>The averaged angles and distances are stored as point results to the point. |
| **Page** | To change to another page on this screen.<br>The functionality and softkeys available on the **Plot** page are described in the MapView chapter. Refer to "38.4.1 Screen Area" for information functionality. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **No. of points active** | Display only | The number of selected points having been measured. |
| **No. of sets active** | Display only | The number of sets having been measured. |
| **Store Point ID with** | **Prefix** | Adds the setting for **Prefix/suffix** in front of the original point IDs. |
| | **Suffix** | Adds the setting for **Prefix/suffix** at the end of the original point IDs. |
| **Prefix/suffix** | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the calculated points. |
| **Use a point as reference** | Check box | When this box is checked, the point selected is considered fixed: known coordinates and therefore Δ **Easting** and Δ **Northing** are made equal to zero.<br>The values shown on the **Points** page are updated accordingly. |

#### Compute Points, Points page

| Key | Description |
|---|---|
| **Store** | To store the calculated points which are set to **Yes** in the **Accept** column. |
| **Accept** | To set **Yes** or **No** in the **Accept** column for the highlighted point. |
| Fn **Quit** | To exit the application. |

**Description of columns**

| Column | Description |
|---|---|
| **Point** | Point ID of the measured points in the order they were defined and measured. |
| Δ **Easting** | The difference in Easting between the original and the calculated points. |
| Δ **Northing** | The difference in Northing between the original and the calculated points. |
| **Accept** | For **Yes**: The selected point is used for calculations in all sets.<br>For **No**: The selected point is not used for calculations in any set. |

## 52.3 Monitoring

**Description**

Monitoring is a module integrated within the Sets of Angles application.
Monitoring uses a timer to enable repeated and automated angle and distances measurements to pre-defined target points at defined intervals. The ability to configure the handling of message screens during measurement sets is also enabled.

**Important aspects**

For monitoring, instruments must be motorised.

☞ Monitoring is licence protected and is only activated through a licence key. The licence key can be entered manually or loaded from the data storage device.

**Monitoring preparation**

This step-by-step description is an example on preparing a set for monitoring.

| Step | Description |
|---|---|
| 1. | Select the control and the working job. |
| 2. | Set station coordinates and station orientation. |
| 3. | Select **Main Menu: Go to Work!\Survey+\Sets of angles**. |
| 4. | In **Sets of Angles** press Fn **Config..** to configure Sets of Angles for monitoring.<br>For the **Parameters** page set:<br>• **Page to show: None** (for example purposes only).<br>• **Stop for messages: All messages** (for example purposes only).<br>• **Time out: 10 secs** (for example purposes only).<br>• **Define time when sets should be measured (timer monitoring)** (this option must be selected for monitoring). This setting will enable access to the **Define Monitoring Timer** screen. |
| 5. | Press **OK** to access the **Sets of Angles** screen. |
| 6. | Select **Create a new group**. |
| 7. | Press **OK** to access the **Define Points for Set** screen. |
| 8. | Enter details of the target point as required.<br>For each target point, ensure that auto survey is activated. This setting will enable the automated measurement and recording of the target point in the other face. The setting also enables the automated measurement and recording of all target points during monitoring. |
| 9. | Press **OK** to access the **Select Points - Survey** screen. |
| 10. | Measure and record the measurement to the target point as required. |
| 11. | Continue with steps 8. to 10. until all target points for the first measurement set have been measured and recorded. |
| 12. | Press **Done** to complete the selection of the target points for the first measurement set in one face. This action then begins the measurement of the target points in the other face. On completion, the **Sets of Angles** screen will be accessed. |
| 13. | Select **Measure Sets**. |
| 14. | Press **OK** to access the **Define Monitoring Timer** screen. |

**Define Monitoring Timer**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Begin date** | Editable field | Start date for monitoring. |
| **Begin time** | Editable field | Start time for monitoring. |
| **End date** | Editable field | End date for monitoring. |
| **End time** | Editable field | End time for monitoring. |
| **Interval** | Editable field | The time between the start of each scheduled measurement set. |
| **Measure method** | | Determines the order in which the target points are to be measured. |
| | **A'A"B"B'** | The target points are measured in face I and face II.<br>point A I - point A II - point B II - point B I ... |
| | **A'A"B'B"** | The target points are measured in face I and face II.<br>point A I - point A II - point B I - point B II ... |
| | **A'B'A"B"** | The target points are measured in face I and face II.<br>point A I - point B I... point A II - point B II ... |
| | **A'B'B"A"** | The target points are measured in face I and face II.<br>point A I - point B I... point B II - point A II... |
| | **A'B'C'D'** | The target points are only measured in face I.<br>point A I - point B I - point C I - point D I ... |

### Next step

When all required information is entered press **OK** to begin the monitoring process.
A screen displays a notice that monitoring is in progress. If necessary, press **Cancel** to stop the monitoring process and return to **Sets of Angles**.
Refer to "52.2 Sets of Angles" for information about calculations and the viewing of results.

**Monitoring interval**

**Description**

The dates and times entered define the timeframe for when the monitoring will take place.

The time interval defines the time between the start of each measurement set during the monitoring period. The interval time begins at the start of a measurement set and ends at the start of the next measurement set.

**Example**

Data;

- 3 target points
- Begin Date: 03.11.2010
- End Date: 06.11.2010
- Interval: 30 min
- 4 measure sets
- Begin Time: 14:00:00
- End Time: 14:00:00

Results;

- The time taken to measure 4 sets of 3 target points in both faces is 10 minutes.
- The measurements will start at 14:00:00 on 03.11.2010.
- At 14:10:00, the first measurement set is complete.
- The instrument will wait until 14:30:00 for the next scheduled measurement set.

# 53 Setup TPS

## 53.1 Overview

**Description**

The Setup application is only available for use with TPS instruments. Setup determines the station coordinates and the instrument orientation using TPS measurements and/or GPS measurements.

| Setup with GPS using SmartPole | Setup with GPS using SmartStation |
|---|---|
| SmartPole allows target points to be determined using GPS measurements. The new points are then used as control points for the TPS setup. | SmartStation allows TPS station coordinates (position and height) to be determined from GPS measurements. |

**Setup methods**

| Setup Method | "Standard" setup type | "On-the-Fly" setup type | Methods for TPS | Methods for SmartPole | Methods for SmartStation |
|---|---|---|---|---|---|
| Set orientation | ✓ | - | ✓ | - | ✓ |
| Known backsight | ✓ | - | ✓ | ✓ | ✓ |
| Multiple backsights | ✓ | ✓ | ✓ | ✓ | ✓ |
| Transfer height | ✓ | - | ✓ | ✓ | - |
| Resection | ✓ | ✓ | ✓ | ✓ | - |
| Orientate to line | ✓ | - | ✓ | - | ✓ |

- Each setup method requires different input data and a different number of target points.
- All setup methods are described in "53.7 Setup Methods".

**Setup types**

| "Standard" setup | "On-the-Fly" setup |
|---|---|
| This type of setup is the traditional type. The user must always measure all setup points consecutively to complete the setup. The TPS station coordinates and TPS orientation must be set before measuring survey points. | This setup type allows the user to move between setup and survey before completing the setup (working "on the fly"). When leaving setup the TPS station coordinates and orientation do not have to be final, they can be set at anytime during the survey.<br>This setup can only be used when measuring survey points. When staking out points, the TPS station coordinates and TPS orientation must be set first. |

**Incomplete setups**

- For a "Standard" setup, the user must always measure all setup points consecutively to complete the setup. This type of setup is always regarded as a complete setup.
- For "On-the-Fly" setups, the setup points can be measured together with the survey points. It is not necessary to complete the setup before measuring survey points. Until the user selects **Set** in **Station Results**, this type of setup is regarded as incomplete.

**An incomplete setup, or a setup where more targets can be added, can be accessed in the following ways:**

1. In the Survey application, Setup can be accessed by selecting the **Setup** softkey.
2. When entering any panel where it is possible to do a measurement, a message is displayed to notify that the setup is incomplete. It is then possible to:

| | |
|---|---|
| a) continue with the existing application, or | **OK** |
| b) start Setup and create a new station setup, or | **New..** |
| c) start Setup and continue to measure additional fixpoints. | **Setup** |

3. Assigning the function **TPS - Continue open setup** to the favourites or a hot key.

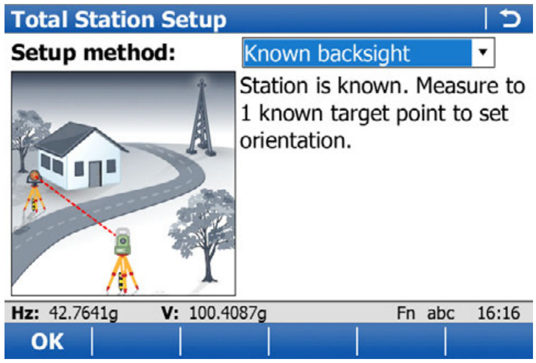
## 53.2 Accessing Setup

**Access**

Select **Main Menu: Go to Work!\Setup**.

**Total Station Setup**

An illustration and a description is shown for each Setup method.



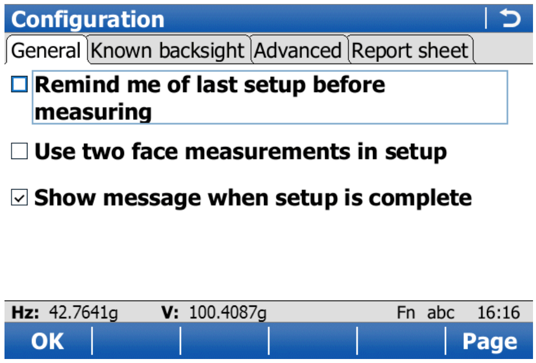

| Key | Description |
|---|---|
| **OK** | To accept changes and access the subsequent screen. The chosen settings become active. Refer to "53.4 Set Station Point" or "53.5 Enter Station Information". |
| Fn **Config..** | To configure the Setup application. Refer to "53.3 Configuring Setup". |
| Fn **Quit** | To exit the wizard. |

## 53.3 Configuring Setup

**Access**

Press Fn **Config..** in **Total Station Setup**.

**Configuration, General page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the application name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Remind me of last setup before measuring** | Check box | Current instrument setup details can be displayed to remind the user to either keep the current instrument setup, check the backsight, or create a new setup.<br>Refer to "53.6 Setup Reminder" for details. |
| **Use two face measurements in setup** | Check box | Defines if the instrument measures the second face automatically after storing the first.<br><br>When this box is checked, after storing a measurement with **All** or **Store** motorised instruments change face automatically, non-motorised instruments access **Telescope Positioning**. The measurements of face I and face II are averaged. The averaged value is stored.<br>When this box is not checked, no automatic measurement in two faces.<br>☞ When using two face measurements, then the angle right value is averaged between both two face measurements. |
| **Use graphics to help choose setup method** | Check box | When this box is checked, the setup methods are displayed in a screen accompanied by a graphic and text describing each setup method.<br>When this box is not checked, the setup methods are selected from the drop-down menu in **Go to Work!**. |
| **Show message when setup is complete** | Check box | When this box is checked, a message informs when the setup is finished. |

#### Next step

**Page** changes to the **Known backsight** page.

**Configuration, Known backsight page**

For **Setup method: Known backsight**, the settings on this page apply.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Check backsight position** | Check box | Allows a check to be made on the horizontal coordinate difference between the existing and the measured known backsight point. If the defined **Position limit** is exceeded, the setup can be repeated, skipped or stored. |
| **Position limit** | Editable field | Available when **Check backsight position** is checked. Sets the maximum horizontal coordinate difference accepted in the position check. |
| **Check backsight height** | Check box | Allows a check to be made on the vertical difference between the existing and the measured known backsight point. If the **Height limit** is exceeded, the setup can be repeated, skipped or stored. |
| **Height limit** | Editable field | Available when **Check backsight height** is checked. Sets the maximum vertical difference accepted in the height check. |

### Next step

**Page** changes to the **Advanced** page.

**Configuration, Advanced page**

For **Setup method: Resection** and **Setup method: Multiple backsights**, the settings on this page apply.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Auto position to setup targets** | Check box | When this box is checked, the instrument positions horizontally and vertically to the point. |
| **Calculate scale from target observations** | Check box | Only available if the job properties do not have **Compute scale using** set to **Stn & coord system**.<br>If checked, a station scale will be calculated from the target observations. The user will have the option to apply this new scale (calculated ppm + current ppm = new ppm) to all survey observations, including the setup observations, from that setup.<br>If not checked, then the calculated ppm will not be displayed and therefore not applied to any survey observations. |
| **Use Helmert method for resection** | Check box | Helmert calculation is used. |
| **Height weighting** | **1/distance** or **1/distance²** | Available when **Use Helmert method for resection** is checked. To change the distance weighting that is used in the calculation of the station height in the resection. |
| **Edit default station quality checks** | Check box | Check to type in values for standard deviation, position and height accuracy. If the limits are exceeded, a message will be shown when **Calc** is selected. |
| **Orientation limit** | Editable field | Available when **Edit default station quality checks** is checked. Define a limit for the standard deviation of the orientation. |
| **Position limit** | Editable field | Available when **Edit default station quality checks** is checked. Define a position accuracy of the target point. |
| **Height limit** | Editable field | Available when **Edit default station quality checks** is checked. Define a height accuracy of the target point. |

### Next step

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

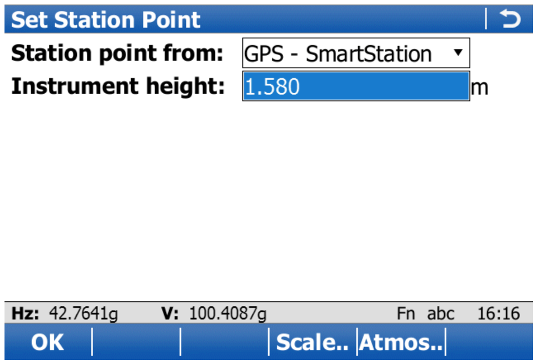
**Page** changes to the first page on this screen.

## 53.4 Set Station Point

**Access**

A station point must be selected for **Setup method: Set orientation**, **Setup method: Known backsight**, **Setup method: Multiple backsights** and **Setup method: Transfer height**. **Set Station Point** is then accessed automatically from **Setup**.

**Set Station Point**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Scale..** | To type in values for the scale corrections. Refer to "New Job, TPS scale page". |
| **Atmos..** | To type in values for the atmospheric corrections. Refer to "Atmospheric Corrections, Atmospheric ppm page". |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Instrument height** | Editable field | The height of the instrument. |
| **Station point from** | | The selection made here determines the availability of the other fields on this screen. |
| | **Job** | A station point can be selected from a job on a data storage device. |
| | **Enter new point** | Pressing **OK** opens a screen where a new point can be typed in. After pressing **Store** there, the Setup application continues. |
| | **GPS - SmartStation** | Available when TPS and GPS are used. Pressing **OK** opens the GPS Survey application. After measuring a point with **Meas**, **Stop**, **Store** there, the Setup application continues. Refer to "57.1.2 Real-Time Rover Operations". |
| | | ☞ In order to use GPS, a coordinate system for the setup is required and must be attached to the working job. If not, then a coordinate system must be selected, or local coordinates for the station must be typed in, during the setup process. |
| | | ☞ To obtain the correct elevation of the setup point, measure the instrument height as usual and ensure the antenna type is set to the relevant SmartStation antenna. |
| | | ☞ If SmartPole is used in the setup or later in Survey, remember to update the antenna type after finishing the SmartStation measurement. |
| | **Last used station** | The station used last in the Setup application is displayed. |
| **Job** | Selectable list | The job from which the station is to be selected. Refer to "5.4 Choosing a Job". |
| **Point ID** | Display only | The point ID of the station point. |
| **Easting**, **Northing** and **Elevation** | Display only | The coordinates of the station point. |
| **Current scale** | Display only | The scale according to the scale settings for the selected station. |

☞ Refer to "14 Antenna Heights" for further information regarding height values used in a SmartStation.

## 53.5 Enter Station Information

**Access**

Station information must be typed in for **Setup method: Resection** and **Setup method: Orientate to line**. **Enter Station Information** is accessed after selecting **OK** in **Total Station Setup** with one of these setup methods selected.

**Enter Station Information**

For a description of keys refer to "53.4 Set Station Point".

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Station ID** | Editable field | Type in an ID for the station point. |
| **Point code** | Selectable list | Select a point code for the station point if desired. |
| **Instrument height** | Editable field | The height of the instrument. |
| **Use control job for the target points** | Check box | Target points can be selected from the control job. |
| **Job** | Selectable list | The control job from which the target points can be selected. Refer to "5.4 Choosing a Job". |
| **Current scale** | Display only | The scale according to the scale settings for the selected station. |

☞ Refer to "14 Antenna Heights" for further information regarding height values used in a SmartStation.

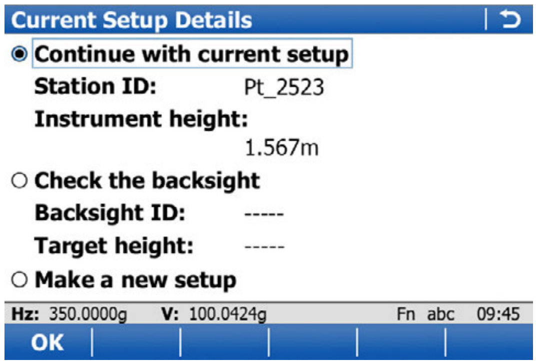
## 53.6 Setup Reminder

**Description**

When activated, the setup reminder appears whenever the user enters a measurement screen. The reminder allows the user to check the current station setup details before proceeding with the survey. When this reminder appears, three options are available to the user:

1) To keep the current station setup and proceed with the survey.
2) To check the backsight point.
3) To create a new station setup.

**Current Setup Details**




| Key | Description |
|---|---|
| **OK** | To accept the selection. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Description |
|---|---|
| **Continue with current setup** | The last setup is used and recorded in the working job. |
| **Check the backsight** | To open the **Check Point** screen. The point suggested is the point which Setup uses as the reference orientation. For the setup methods **Set orientation** and **Known backsight**, the orientation target point is suggested. For the setup methods **Multiple backsights**, **Transfer height**, **Resection** and **Orientate to line**, the first target is suggested. |
| **Make a new setup** | To start the Setup application and create a new station setup. |

# 53.7 Setup Methods

## 53.7.1 Set orientation and Known backsight

**Requirements**

The position coordinates of the station point are required.

For **Set orientation**: The instrument is set up and oriented to either a known or unknown target point, to which a true or assumed azimuth is set.

For **Known backsight**: The instrument is set up and oriented to a known backsight target.

For SmartStation, the position coordinates of the station are unknown and are determined with GPS. The instrument is set and oriented to either a known or unknown target point, to which a true or assumed azimuth is set.

**Updating Hz measurements**

A station setup using the **Set orientation** method, is always automatically flagged with an 'update later' attribute. If the backsight point is measured again, for example from another station, and found to have different coordinates, then a message will appear. The user can then select whether to update the original setup or not. The update will use the backsight point coordinates to recalculate the orientation and subsequently update all measured points connected to the setup.

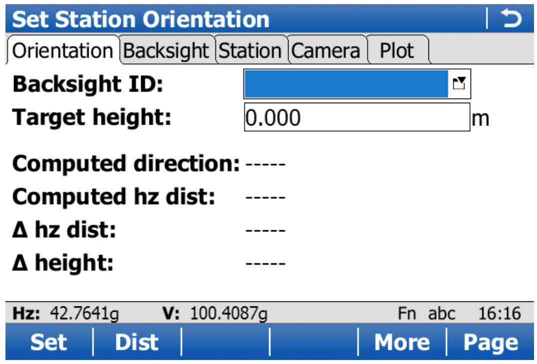
☞ For information on camera and images refer to "34.3.3 Within Applications".

**Access**

In **Total Station Setup**, select **Setup method: Set orientation** or **Known backsight**. Press **OK**.

In **Set Station Point**, select a station. Press **OK**.

**Set Station Orientation, Orientation page**




| Key | Description |
|---|---|
| **Set** | To set the station and orientation and exit the Setup application. |
| **Dist** | To measure a distance to the point being used to set the azimuth. For **Set orientation**: A distance measurement is **NOT** required when setting the Station and the Orientation with **Set**. |
| **GPS** | For **Known backsight** applicable when using SmartPole. To enter the GPS Survey screen and measure a point with GPS. The antenna height is automatically converted from the target height. |
| **Store** | To store the measurement with or without a distance. Only available when **Use two face measurements in setup** is selected in the **Setup** configuration. |
| **More** | To change between the slope and the horizontal distance. |
| **Page** | To change to another page on this screen. |
| Fn **Run** / **IndivID** | Available for **Setup method: Set orientation** only. **Run** automatically chooses the next available point ID from the list of points already stored. **IndivID** allows the user to type in any value for **Backsight ID**. |
| Fn **Quit** | To exit the screen. |

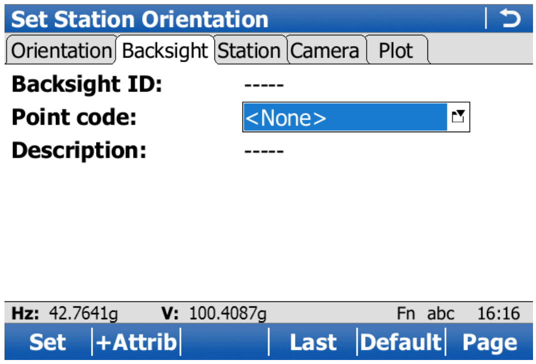
#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Backsight ID** | | Point ID of the backsight point. |
| | Editable field | For **Set orientation**. |
| | Selectable list | For **Known backsight**. Select a point from the points stored in the control job. |
| **Target height** | Editable field | Height of the target above or below the backsight point. The last setup target height is always remembered. |
| **Direction** | Editable field | Available for **Set orientation**. The direction is set to 0 by default. This value can be edited. The value is not set to the system until **Set** is pressed. |
| **Slope distance** | Display only | Available for **Set orientation**. The slope distance measured between the station point and the backsight point. |
| **Horiz distance** | Display only | Available for **Set orientation**. Press **Dist** to measure a distance to the target point being used to set the azimuth. |
| **Height difference** | Display only | Available for **Set orientation**. The vertical distance between the station point and the backsight point. |
| **Computed direction** | Display only | Available for **Known backsight**. Displays the calculated azimuth from the selected station to the backsight point. |
| **Computed hz dist** | Display only | Available for **Known backsight**. Displays the calculated horizontal distance between the selected station and backsight point. |
| **Computed slp dist** | Display only | Available for **Known backsight**. Displayed after **More** was pressed. The calculated slope distance to the backsight point. |
| **Δ hz dist** | Display only | Available for **Known backsight**. The difference between the calculated horizontal distance from station to backsight point and the measured horizontal distance. |
| **Δ slope dist** | Display only | Available for **Known backsight**. Displayed after **More** was pressed. The difference between the calculated slope distance from station to backsight point and the measured slope distance. |
| **Δheight** | Display only | Available for **Known backsight**. The difference between the control height of the backsight point and the measured height of the backsight point. If the backsight point is a 2D point, this field shows **-----**. |
| **Angle right** | Display only | Available when **Hz angle display**: **Angle right** is configured in **Regional Settings**, **Angle** page. Displays the horizontal angle difference between the backsight point and the current telescope position. |

#### Next step

**Page** changes to the **Backsight** page.

**Set Station Orientation, Backsight page**




| Key | Description |
|---|---|
| **Set** | To set the station and orientation and exit the Setup application. |
| **+Attrib** | To create additional attributes for this point code. |
| **Name** or **Value** | Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. |
| **Last** | To recall the last used attribute values for the selected code. |
| **Default** | To recall the default attribute values for the selected code. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

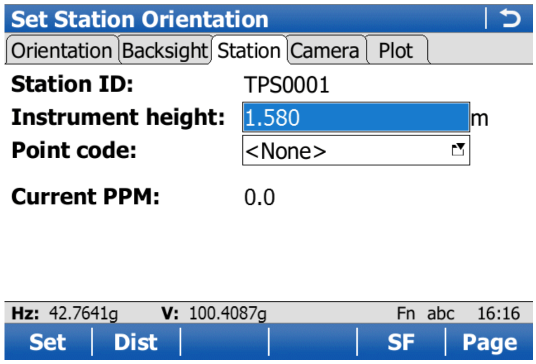
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Backsight ID** | Editable field or display only | Point ID of the backsight point. |
| **Point code** | Selectable list | The code for the backsight point. |
| **Description** | Display only | A short description of the code. |

### Next step

**Page** changes to the **Station** page.

## Set Station Orientation, Station page




| Key | Description |
|---|---|
| **Set** | To set the station and orientation and exit the Setup application. |
| **Dist** | To measure a distance to the point being used to set the azimuth. A distance measurement is **NOT** required when setting the Station and the Orientation with **Set**. |
| **SF** / **Ppm** | To switch between displaying the current scale as a scale factor or ppm value. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Station ID** | Display only | Station ID as selected in **Set Station Point**. |
| **Instrument height** | Editable field | The instrument height. |
| **Point code** | Selectable list | The code for the backsight point. |
| **Current PPM** / **Current scale** | Display only | The current job scale. Refer to " New Job, TPS scale page" for more information on scale corrections. |

### Next step

**Page** changes to the **Plot** page.

## 53.7.2 Multiple backsights

**Requirements**

The position coordinates of the station point are required. The instrument is set up and oriented to one or more known backsight targets.

For SmartStation, the position coordinates of the station are unknown and are determined with GPS. The instrument is set up and oriented to one or more known backsight targets.

For TPS and SmartStation, the orientation is determined by sighting to one or more known target points (maximum of ten target points). Only angles or both angles and distances can be measured. The height of the station point can also be derived from the target points.

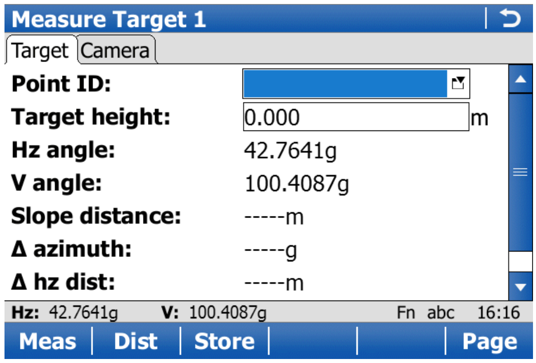
☞ For information on camera and images refer to "34.3.3 Within Applications".

**Access**

In **Total Station Setup**, select **Setup method: Multiple backsights**. Press **OK**.
In **Set Station Point**, select a station. Press **OK**.

**Measure Target**

Unless otherwise stated the following screen and description applies to the setup methods: **Multiple backsights**, **Transfer height**, **Resection**, and **Orientate to line**.




| Key | Description |
|---|---|
| **Meas** | To measure and store the distances and angles made to the control points. After storing the measurement data, the next point ID in the job is displayed. The instrument positions to the point if enough data is available. |
| **Dist** | To measure and display distances. |
| **Store** | Records displayed values temporarily. The target measurements will not be stored to the current job until the station is set. A distance measurement is not necessary before pressing **Store**. After recording the measurement data, the next point ID in the job is displayed. The instrument positions to the point if enough data is available and the instrument is robotic. |
| **GPS** | Applicable when using SmartPole. To enter the GPS Survey screen and measure a point with GPS. The antenna height is automatically converted from the target height. |
| **Done** | For **Resection** only. To temporarily exit the Setup application. The station setup will be incomplete but can be continued and completed at a later time. This softkey is replaced by **Calc** when sufficient data is available. |
| **Calc** | For **Multiple backsights**: Available after the first measurement. Allows the user to see the calculated station orientation and other results.<br>For **Resection**: Available after measuring two target points or as soon as a preliminary station and orientation can be calculated. The calculated station coordinates and overall “quality” of the results are displayed. |
| Fn **Find** | Stakeout values are provided to guide the prism holder to the selected target point.<br>For **Resection**: Available once sufficient data is available for calculation.<br>Refer to "53.9 Finding a Target Point". |
| Fn **Positn** | To position the instrument to the selected target point.<br>For **Resection**: Available once sufficient data is available for calculation. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list | The point ID of the target point to be measured. |
| **Target height** | Editable field | The height of the target above or below the backsight point. The last setup target height is always remembered. |
| **Hz angle** | Display only | The current horizontal angle. |
| **Angle right** | Display only | Available when **Hz angle display**: **Angle right** is configured in **Regional Settings**, **Angle** page. Displays the horizontal angle difference between the backsight point and the current telescope position. |
| **V angle** | Display only | The current vertical angle. |
| **Slope distance** | Display only | The measured slope distance after **Dist** was pressed. |
| **Δ azimuth** | Display only | Displays the difference between the calculated azimuth and the current horizontal angle. If **Setup method: Resection**, displays **-----** until sufficient data for calculation is available. |
| **Δ hz dist** | Display only | The difference between the calculated and the measured horizontal distance. |
| **Δ height** | Display only | The difference between the given and the measured height of the target point. |

☞ A maximum of ten target points can be measured and used for the calculation. When the maximum number of points is exceeded, a message will appear. The user can remove previous points or finish the setup. Points can be removed from the **Station Results**, **Targets** page.

## 53.7.3 Transfer height

**Requirements**

This method is used to compute a station height to apply to the selected station. Only the height is updated, the orientation is not updated.
The position coordinates of the station point are required.

**Access**

In **Total Station Setup**, select **Setup method: Transfer height**. Press **OK**.
In **Set Station Point**, select a station. Press **OK**.

☞ For a description of the **Measure Target** screen, refer to "53.7.2 Multiple backsights".

## 53.7.4 Resection

**Requirements**

The coordinates of the station point are unknown. The coordinates and orientation are determined by sighting to at least two or more known target points (maximum of ten target points). Only angles or both angles and distances can be measured. For a resection, least squares or robust calculations are used. The resection calculations can be done using the Helmert method, robust method or least squares method, after three measurements to known backsights have been completed.

**Access**

In **Total Station Setup**, select **Setup method: Resection**. Press **OK**.
In **Enter Station Information**, type in the required information. Press **OK**.

☞ For a description of the **Measure Target** screen, refer to "53.7.2 Multiple backsights".

## 53.7.5 Orientate to line

**Description**

This method can be used to calculate the 2D or 3D local coordinates for the instrument station and the orientation of the horizontal circle. The calculation is done using the distance and angle measurements to two target points.

The first target point always defines the origin of the local coordinate system. The second target point, in conjunction with the first target point, always defines the local direction of North or East (depending on the working style).

**Requirements**

Important features:

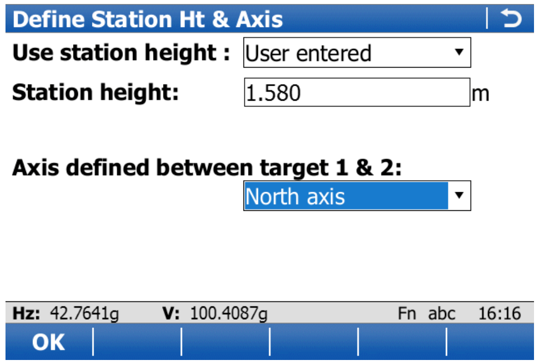
- All coordinates calculated are local coordinates.
- The first target point always defines the origin of the local coordinate system (North=0, East=0, Height=0 (optional))
- The second target point, in conjunction with the first target point, always defines the local direction of North or East.

**Access**

In **Total Station Setup**, select **Setup method: Orientate to line**. Press **OK**.

In **Enter Station Information** type in the required information. Press **OK**.

## Define Station Ht & Axis




| Key | Description |
|---|---|
| **OK** | To accept all settings and continue. The chosen settings are activated and the next screen, **Measure Target**, is displayed. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use station height** | **User entered** | The height value of the station will be entered by the user and used to calculate the height of the measured points. |
| | **Transfer from trgt 1** | The height of the station will be calculated relative to the first measured point. |
| **Station height** | Editable field | Available for **Use station height: User entered**. The elevation of the instrument station. |
| **Target 1 height** | Editable field | Available for **Use station height: User entered**. The height of the first measured point. |
| **Axis defined between target 1 & 2** | | To define the positive North or positive East axis. |
| | **North axis** | The second point measured defines the direction of the positive North axis. |
| | **East axis** | The second point measured defines the direction of the positive East axis. |

For a description of the **Measure Target** screen, refer to "53.7.2 Multiple backsights".

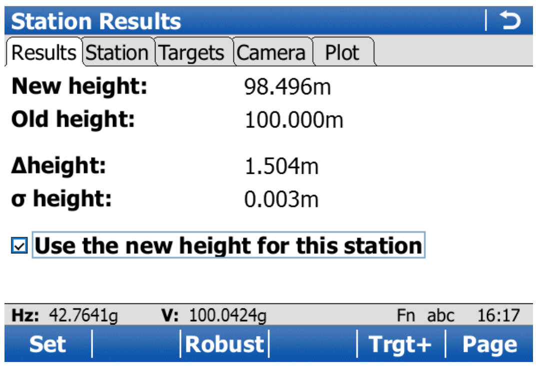
## 53.8 Setup Results

**Description**

The results screen is displayed after pressing **Calc** in the **Measure Target** screen. The results screen is part of the **Multiple backsights**, **Transfer height**, **Resection** and **Orientate to line** setup methods.
Excluding **Orientate to line**, after three measurements to known targets, the calculations can be done using the robust method or the least squares method. For **Resection**, the calculations can also be done using the Helmert method. After the station is set, all following measurements will be related to this new station and orientation.

For information on camera and images refer to "34.3.3 Within Applications".

**Station Results, Results page**




| Key | Description |
|---|---|
| **Set** | To set the orientation, to store all setup data and exit the application. For **Transfer height**: To store all setup data and exit the application. |
| **Done** | To exit the setup without setting it, the setup is incomplete. |
| **Robust** or **LSqrs** | To display the results for the robust or the least squares calculation method. |
| **Trgt+** | To access **Measure Target** and to measure more target points. |
| **Page** | To change to another page on this screen. |
| Fn **3 par** or Fn **4 par** | Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new station calculation. For 4 parameter, the current scale is applied. The station coordinates will be automatically updated according to the setting used. Defaults to 4 parameter. |
| **SF** or **ppm** | To display the scale results by scale factor or as a ppm value. |
| Fn **Quit** | To exit the screen. |

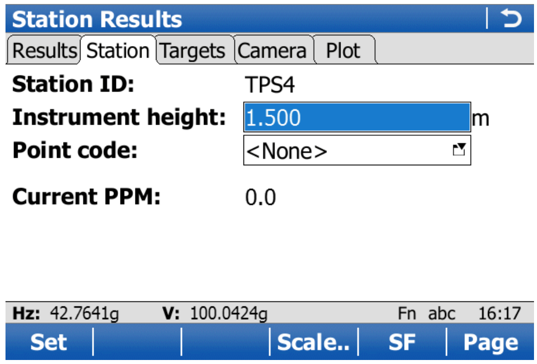
### Description of fields

| Field | Option | Description |
|---|---|---|
| **New orientation** | Display only | New oriented azimuth with running angle as telescope moves. Not available for setup method **Transfer height**. |
| **Angle right** | Display only | Available when **Hz angle display**: **Angle right** is configured in **Regional Settings**, **Angle** page. Displays the horizontal angle difference between the backsight point and the current telescope position. |
| **Δheight** | Display only | The difference between the new calculated height and the old height.<br>Available for setup methods **Multiple backsights** and **Transfer height**. |
| **Use the new height** | Check box | For setup method **Multiple backsights**: When this box is checked, both orientation and height are updated. If not checked, only the orientation is updated.<br>For setup method **Transfer height**: When this box is checked, the station height is updated. If not checked, the station height does not change.<br>Not available for any other setup methods. |
| **New height** | Display only | The calculated height is displayed.<br>Available for setup methods **Multiple backsights** and **Transfer height**. |
| **Old height** | Display only | The original height is displayed.<br>Available for setup methods **Multiple backsights** and **Transfer height**. |
| **σ height** | Display only | Standard deviation of the calculated station height.<br>Available for setup methods **Transfer height**. |
| **Easting** | Display only | The calculated Easting is displayed.<br>Available for setup methods **Resection** and **Orientate to line**. |
| **Northing** | Display only | The calculated Northing is displayed.<br>Available for setup methods **Resection** and **Orientate to line**. |
| **Elevation** | Display only | The calculated Height is displayed.<br>Available for setup methods **Resection** and **Orientate to line**. |
| **Apply the computed elevation for this station** | Check box | When this box is checked, then the height from the solution is set as the station height. When this box is not checked, then the height is not updated.<br>Available for setup method **Resection**. |

### Next step

**Page** changes to the **Station** page.

**Station Results, Station page**




| Key | Description |
|---|---|
| **Set** | To set the orientation, to store all setup data and exit the application. For **Transfer height**: To store all setup data and exit the application. |
| **Done** | To exit the setup without setting it, the setup is incomplete. |
| **Scale..** | To type in values for the scale corrections. Refer to "New Job, TPS scale page". |
| **ppm/SF** | To switch between displaying the station scale factor and the station ppm. |
| **Page** | To change to another page on this screen. |
| Fn **3 par** or Fn **4 par** | Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new station calculation. For 4 parameter, the current scale is applied. The station coordinates will be automatically updated according to the setting used. Defaults to 4 parameter. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Station ID** | Display only | Station ID of the current station set up. |
| **Instrument height** | Editable field | The current instrument height. |
| **Point code** | Selectable list | Select a point code for the station point if desired. |
| **Current PPM** / **Current scale** | Display only | The current job scale. Refer to " New Job, TPS scale page" for more information on scale corrections. |

**Next step**

**Page** changes to the **Quality** page.

**Station Results, Quality page**

For a description of the softkeys refer to "Station Results, Station page".
This page is not available for setup methods **Transfer height** or **Orientate to line**.

### Description of fields

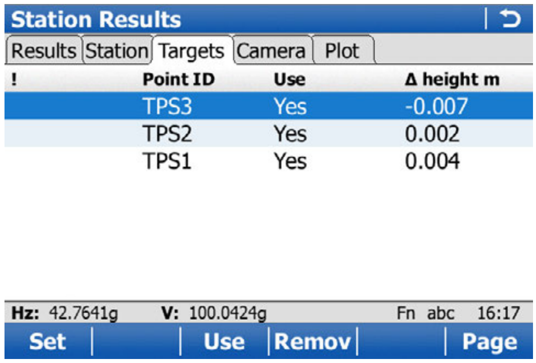
| Field | Option | Description |
|---|---|---|
| **New orientation** | Display only | New oriented azimuth with running angle as telescope moves.<br>Available for setup method **Multiple backsights**. |
| **σ new orientation** | Display only | Standard deviation of the calculated orientation. |
| **Δheight** | Display only | Delta height, the difference between original and calculated height.<br>Available for setup method **Multiple backsights**. |
| **σ height** | Display only | Standard deviation of the calculated station height. |
| **σ easting** | Display only | Standard deviation of the calculated station Easting.<br>Available for setup method **Resection**. |
| **σ northing** | Display only | Standard deviation of the calculated station Northing.<br>Available for setup method **Resection**. |

### Next step

**Page** changes to the **Targets** page.

**Station Results, Targets page**

This screen displays information about the accuracy of the measured target points and allows exclusion of measurements that are not to be used in the calculation.
Additional measurements can be made and measurements can be deleted.
This page is not available for setup method **Orientate to line**.




| Key | Description |
|---|---|
| **Set** | To recalculate the station data and update all values after target points have been deleted or excluded from the calculation. |
| **Use** | To change between using the selected point as 3D, 2D, 1D or not at all, in the calculation. The change automatically updates any new coordinate or orientation values. |
| **Remov** | To delete a point from the list of measured target points and exclude it from the Setup calculation. |
| **More** | To change the value displayed in the fourth column.<br>For **Resection**: To change between **ΔHz**, **Δ hz dist**, **Δ height**, **Δ easting** and **Δ northing**.<br>For **Multiple backsights**: To change between **ΔHz** and **Δ height**.<br>For **Transfer height**: Only **Δ height** available. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

### Description of columns

| Column | Description |
|---|---|
| **!** | The **!** indicates that the delta value of either measured horizontal angle, distance or height exceeds the calculation limit. |
| **Point ID** | The point ID of the measured target points. |
| **Use** | Indicates if and how a target point is used in the station calculation. Choices are **3D**, **2D, 1D** and **No**. |
| **ΔHz** | Can be displayed by pressing **More**.<br>Difference between calculated and measured horizontal angle for the target points. If a target point does not have coordinates, **-----** are displayed. Differences exceeding the defined limit are indicated by a **!**. |
| **Δ hz dist** | Can be displayed by pressing **More**.<br>Difference between calculated and measured distance from the station to the target points. If a target point does not have coordinates, **-----** are displayed. Differences exceeding the defined limit are indicated by a **!**. |
| **Δ height** | Can be displayed by pressing **More**.<br>Difference between the known control point height and the measured height of the target point. If a target point does not have a height coordinate, **-----** are displayed. Differences exceeding the defined limit are indicated by a **!**. |
| **Δ easting** | Can be displayed by pressing **More**.<br>Difference between control point and measured point, calculated from new station coordinates. |
| **Δ northing** | Can be displayed by pressing **More**.<br>Difference between control point and measured point, calculated from new station coordinates. |

### Next step

**Page** changes to the **Plot** page.

## 53.9 Finding a Target Point

**Description**

The **Find Target** screen can be accessed, to guide the prism to the selected target point.

The screen is only available if the Stakeout application is available on the instrument.

The functionality of this screen is similar to a stake out routine and is intended to help find hidden survey bench marks or base points.

**Access**

Press Fn **Find** in **Measure Target** once enough data is available to calculate roughly the new orientation.

**Find Target**

This screen is similar to the **Stakeout**, **Stake** page and is configured through the **Stakeout** configuration settings. Refer to "Stakeout, Stake page" for a detailed description of this screen.

# 54 Stakeout

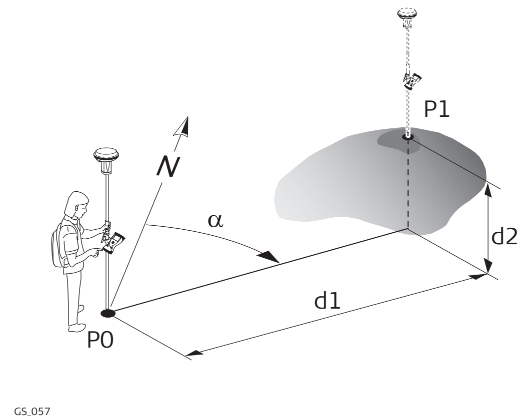
## 54.1 Overview

**Description**

The Stakeout application is used to place marks in the field at predetermined points. These predetermined points are the points to be staked. The points to be staked can

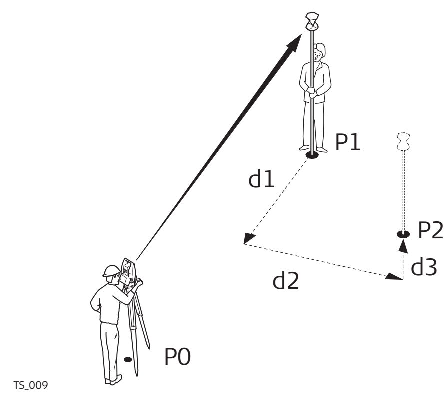
- be uploaded to a job on the instrument using LGO.
- already exist in a job on the instrument.
- be uploaded from an ASCII file to a job on the instrument using **Main Menu: Jobs & Data\Import data\Import ASCII data**.

**Diagram**




GPS

| | |
|---|---|
| P0 | Current position |
| P1 | Point to be staked |
| d1 | Stake out distance |
| d2 | Height difference between current position and point to be staked |
| α | Stake out direction |




TPS

| | |
|---|---|
| P0 | Station |
| P1 | Current position |
| P2 | Point to be staked |
| d1 | Stake out element |
| d2 | Stake out element |
| d3 | Stake out element |

**Stakeout modes**

Points can be staked using different modes:

- Polar mode.
- Orthogonal mode.

☞ Staking out is possible for RTK rover and TPS.

☞ The points to be staked must exist in a job on the active memory device or can be typed in.

**Coordinate system**

If staking local grid points with GNSS, always ensure that the correct coordinate system is being used. For example, if the points to be staked are stored in WGS 1984, the active coordinate system must also be WGS 1984.

**Point types**

It is possible to stake:
- Position only points.
- Height only points.
- Points with full sets of coordinates.

**Height types**

| | |
|---|---|
| Height type of the point to be staked: | Orthometric OR ellipsoidal |
| Height type computed for current position: | Orthometric OR ellipsoidal depending on the<br>• configured transformation,<br>• availability of a geoid model,<br>• height type of the point to be staked.<br>If possible, the height type of the point to be staked is computed for the current position. |

**Height source**

Heights can be taken into account from
- the vertical component of a coordinate triplet.
- a **D**igital **T**errain **M**odel.

The DTM licence key must be loaded. Refer to "30.3 Load licence keys" for information on how to enter the licence key.
If loaded, the height of the points to be staked can be edited in the field.

**Coding of staked points**

Codes can be attached to staked points, lines and areas. The behaviour of the coding functionality depends on the definition of a survey screen page with editable fields for coding and attributes.

**Averaging of staked points**

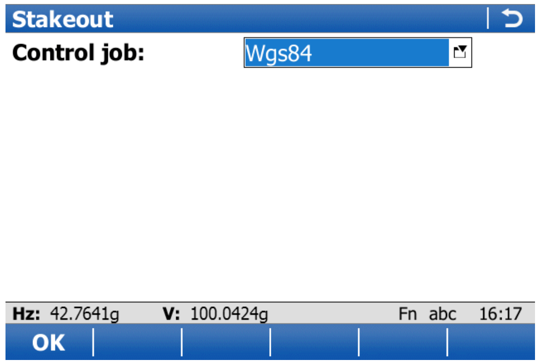
The principles for averaging are identical to the averaging principles of the Survey application.

## 54.2 Accessing Stakeout

**Access**

Select **Main Menu: Go to Work!\Stakeout**.

**Stakeout**




| Key | Description |
|---|---|
| **OK** | To accept changes and access the subsequent screen. The chosen settings become active. |
| Fn **Config..** | To configure Stakeout application. Refer to "54.3 Configuring Stakeout". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Control job** | Selectable list | The job containing the points to be staked. ☞ Points which are measured during staking out are stored in the working job. |

**Next step**

| IF the Stakeout application | THEN |
|---|---|
| is to be accessed | **OK** accepts the changes and accesses Stakeout application. Refer to "54.4 Staking Out". |
| is to be configured | **Config...** Refer to "54.3 Configuring Stakeout". |

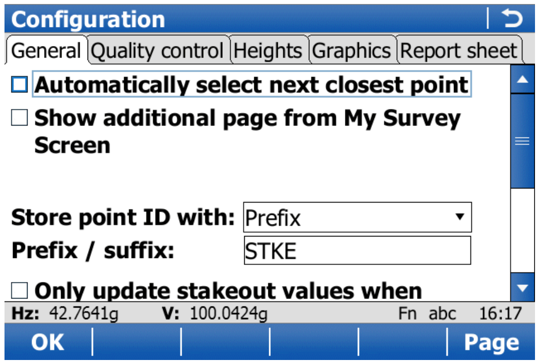
## 54.3 Configuring Stakeout

**Access**

Select **Main Menu: Go to Work!\Stakeout**. Press Fn **Config..**.

**Configuration, General page**

This screen consists of five pages. The explanations for the softkeys given here are valid for all pages, unless otherwise stated.




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Automatically select next closest point** | Check box | The order of the points suggested for staking out. When this box is checked, then the next point suggested for staking out is the point closest to the point which was staked. If there are many points in the job, the search can take a few seconds. When this box is not checked, the next point suggested for staking out is the subsequent one in the job. |
| **Show additional page from My Survey Screen** | Check box | The user-defined survey screen page to be shown in the **Stakeout** screen. |
| **Page to show** | Selectable list | The names of the available survey screen pages. |
| **Store point ID with** | **Stake point ID** | The staked points are stored with the same point IDs as the points to be staked. |
| | **Prefix** | Adds the setting for **Prefix / suffix** in front of the original point IDs. |
| | **Suffix** | Adds the setting for **Prefix / suffix** at the end of the original point IDs. |
| | **Individual point ID** | The staked points are stored with an alphanumerical point ID entered. |

| Field | Option | Description |
|---|---|---|
| **Prefix / suffix** | Editable field | Available for **Store point ID with: Prefix** and **Store point ID with: Suffix**. The identifier with up to four characters is added in front of or at the end of the ID of the staked point. |
| **Individual point ID** | Editable field | Available for **Store point ID with: Individual point ID**. The ID of the staked point. The point IDs are incremented automatically by 1. |
| **Only update stakeout values when distance is measured** | Check box | TPS When this box is checked, angles and stakeout values are updated after a distance was measured. Then all values are frozen until the next distance is taken. |
| **Automatically turn to point** | Check box | TPS When this box is checked, the instrument positions automatically to the point to be staked. |
| **Turn to** | | Available when **Automatically turn to point** is checked. |
| | **Horiz distance** | TPS Instrument positions horizontally to the point to be staked. |
| | **Position & height** | TPS Instrument positions horizontally and vertically to the point to be staked. |
| **Show direction message to next point** | | TPS For each point which is selected for staking, angle and distance information is momentarily displayed in the message line. |
| | **Instrument** | The delta horizontal angle that the instrument must turn to the point, and the distance from the instrument to the point, is displayed in the message line. |
| | **Last point** | The delta horizontal angle that the instrument must turn to the point, and the distance from the last staked point, is displayed in the message line. |
| **Use two face measurements** | Check box | TPS To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |

**Next step**

**Page** changes to the **Quality control** page.

**Configuration, Quality control page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Check distance before storing (set Limit to 0 if you wish to always be shown differences before storing)** | Check box | Allows a check to be made on the horizontal coordinate difference between the staked point and the point to be staked. If the defined **Limit** is exceeded, the stake out can be repeated, skipped or stored. |
| **Limit** | Editable field | Available when **Check distance before storing (set Limit to 0 if you wish to always be shown differences before storing)** is checked. Sets the maximum horizontal coordinate difference accepted in the position check. |
| **Check cut/fill before storing** | Check box | Allows a check to be made on the vertical difference between the staked point and the point to be staked. If the defined **Limit** is exceeded, the stake out can be repeated, skipped or stored. |
| **Limit** | Editable field | Available when **Check cut/fill before storing** is checked. Sets the maximum vertical difference accepted in the height check. |

### Next step

**Page** changes to the **Heights** page.

**Configuration, Heights page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Allow height of point being staked to be edited** | Check box | When this box is checked, the field **Design height** is displayed in **Stakeout**, **Stake** page. The design height is the height of the point to be staked. The value for **Design height** can be changed.<br>When this box is not checked, the field **Current height** for the height of the current position is displayed in **Stakeout**, **Stake** page. The value for **Current height** cannot be changed. |
| **Offset height of all points being staked** | Check box | Allows a constant height offset to be applied to the height of the points being staked. |
| **Height offset** | Editable field | The height offset that is applied. |

### Next step

**Page** changes to the **Graphics** page.

**Configuration, Graphics page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Navigate direction** | | The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Stakeout application are based on this selection. |
| | **From instrument** | TPS The direction of the orientation is from the instrument to the point to be staked. |
| | **To instrument** | TPS The direction of the orientation is from the point to be staked to the instrument. |
| | **To north** | The North direction shown in the graphical display based on the active coordinate system. |
| | **From north** | TPS The direction of the orientation is from the North direction to the point to be staked. |
| | **To sun** | GPS The position of the sun calculated from the current position, the time and the date. |
| | **To last point** | Time-wise, the last recorded point. If no points are yet staked, **Navigate direction: To north** is used for the first point to be staked. |
| | **To point** | A point from the working job. |
| | **To point (cntrl job)** | A point from the **Control job** selected in **Stakeout**. |
| | **To line (cntrl job)** | The direction of the orientation is parallel to a reference line from the **Control job**. Open the listbox to create, edit or delete a reference line. |
| | **To line** | The direction of the orientation is parallel to a reference line from the working job. Open the listbox to create, edit or delete a reference line. |
| | **Following arrow** | The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. |
| **Point ID** or **Line** | Selectable list | Available for **Navigate direction: To point (cntrl job)**, **Navigate direction: To point**, **Navigate direction: To line** and **Navigate direction: To line (cntrl job)**. To select the point or line to be used for orientation. |
| **Navigate using** | | The method of staking out. |
| | **Direction & distance** | The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. |
| | **In/out, left/right** | The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed. |
| **Switch to bulls eye when 0.5m from target** | Check box | When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked. |

| Field | Option | Description |
|---|---|---|
| **Beep faster when getting close to point** | Check box | The instrument beeps when the distance from the current position to the point to be staked is equal to or less than defined in **Start within**.<br>The closer the instrument is to the point to be staked the faster the beeps will be. |
| **Distance to use** | **Height**, **Horizontal distance** or **Position & height** | The type of distance to use for staking. |
| **Start within** | Editable field | Available when **Beep faster when getting close to point** is checked. The horizontal radial distance, from the current position to the point to be staked, when a beep is to be heard. |

**Next step**

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

**Description of fields**

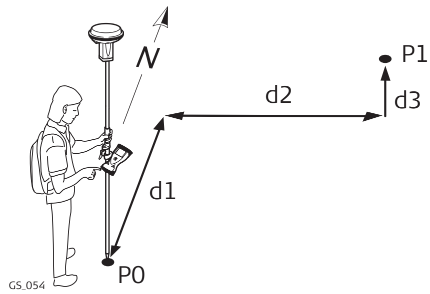
| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

**Next step**

**Page** changes to the first page on this screen.

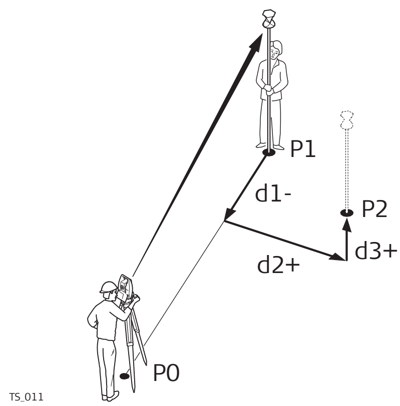
**Diagram**

This diagram shows an example for **Navigate using: In/out, left/right**.




GPS

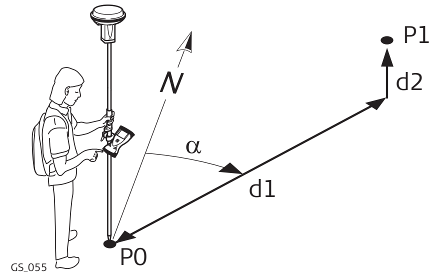
P0 Current position
P1 Point to be staked
d1 Forwards or backwards
d2 Right or left
d3 Fill or cut




TPS

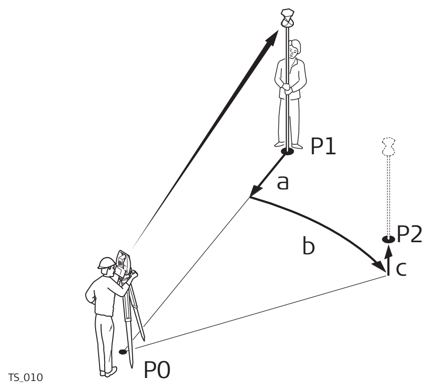
P0 Station
P1 Current position
P2 Point to be staked
d1 Forward or backwards
d2 Right or left
d3 Cut or fill

This diagram shows an example **Navigate using: Direction & distance**.




GPS

| | |
|---|---|
| P0 | Current position |
| P1 | Point to be staked |
| d1 | Distance |
| d2 | Cut or fill |
| α | Direction |



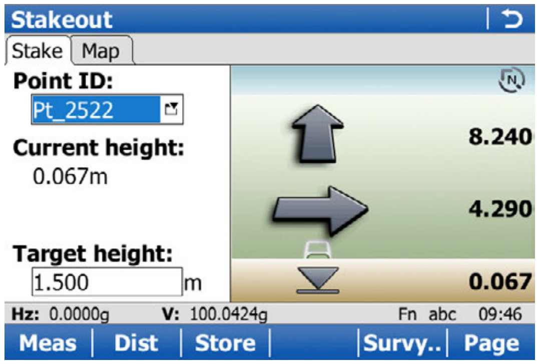

TPS

| | |
|---|---|
| P0 | Station |
| P1 | Current position |
| P2 | Point to be staked |
| a | Distance |
| b | Horizontal angle |
| c | Cut or fill |

☞ For information on camera and images refer to "34.3.3 Within Applications".

**Stakeout, Stake page**

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.

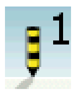
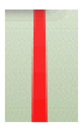
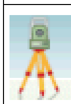
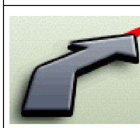
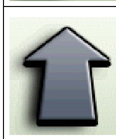
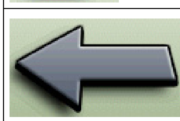
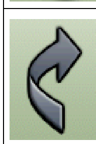
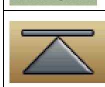



| Key | Description |
|---|---|
| **Meas** | GPS To start measuring the point being staked. The key changes to **Stop**. The difference between the current position and the point being staked is still displayed.<br>TPS To measure a distance and store distance and angles. |
| **Stop** GPS | To end measuring the point being staked. When **Automatically stop point measurement** is checked in **Quality Control**, **General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| **Store** | GPS To store the measured point. When **Automatically store point** is checked in **Quality Control**, **General** page, the measured point is stored automatically. The key changes to **Meas**.<br>TPS To store angles and distance. Distance must be measured before. |
| **Dist** TPS | To measure a distance. |
| **Near** GPS | To search the **Control job** for the point nearest to the current position when the key is pressed. The point is selected as the point to be staked and is displayed in the first field on the screen. After staking and storing the nearest point, the next point suggested for staking out is the one which was suggested before the key was pressed. Available when **Meas** is displayed. |
| **Revers** GPS | To reverse the graphical display top to bottom. A reversed graphical display can be used when the point to be staked lies behind the current position. |
| **Survy..** | To survey additional points which may be needed during staking out. To return to Stakeout application, press Fn **Quit** or ESC. Available when **Meas** is displayed. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Stakeout application. Refer to "54.3 Configuring Stakeout". |
| Fn **Conect** and Fn **Disco** GPS | To connect/disconnect from the GPS reference data. |
| Fn **Init..** GPS | To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "57.4 Initialisation for Real-Time Rover Operations". |

| Key | Description |
|---|---|
| Fn **2D Pos** TPS | To position the telescope (X,Y) onto the point to be staked. |
| Fn **3D Pos** TPS | To position the telescope (X,Y,Z) onto the point to be staked. |
| Fn Mnual.. TPS | To enter angle and distance values to stake out a point. |
| Fn **Quit** | To exit Stakeout application. |

### Description of the elements of the graphical display

The graphical display provides a guide to find the point to be staked out.

| Element | Description |
|---|---|
|  | Point to be staked / known point |
|  | North |
|  | Sun |
|  | Defined line |
|  | From instrument |
|  | Follow arrow |
|  | Forward arrow, distance to point |
|  | Side arrow, distance to point |
|  | Polar arrow, direction to point |
|  | Height |
|  | The current position and/or height is within the configured stake out limit for position and/or height. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list | The point ID of the point to be staked. |
| **Antenna ht** | Editable field | GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **Target height** | Editable field | TPS The default prism height. |
| **Current height** | Display only | Available when **Allow height of point being staked to be edited** is not checked in **Configuration**, **Heights** page.<br>The orthometric height of the current position is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. The value for **Height offset** configured in **Configuration**, **Heights** page is taken into account. |
| **Design height** | Editable field | Available when **Allow height of point being staked to be edited** is checked in **Configuration**, **Heights**.<br>The design height, which is the orthometric height of the point to be staked, is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. The value for **Height offset** configured in **Configuration**, **Heights** page is not taken into account.<br>Changing the value for **Design height** changes the values displayed for cut and fill. |

#### Next step

**Page** changes to the **Map** page. Refer to "38 MapView Interactive Display Feature" for information on the functionality and softkeys available.

## 54.5 Stakeout Difference Limit Exceeded

**Description**

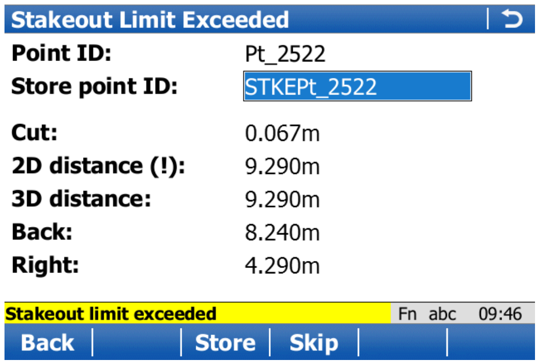
If configured a check is made on the horizontal and/or vertical coordinate distance from the staked point to the point to be staked. Refer to "54.3 Configuring Stakeout" for information on configuring the check and the limits.

**Access**

If either of the configured difference limits are exceeded, the following screen is accessed automatically when the point is stored.

**Stakeout Limit Exceeded**

The availability of the fields depends on the configuration for **Navigate using**. The limits that have been exceeded are shown in bold and indicated by a **!**.




| Key | Description |
|---|---|
| **Back** | To return to the **Stakeout** screen without storing the point. Staking out of the same point continues. |
| **Store** | To accept the coordinate differences, store the point information and return to the **Stakeout** screen. |
| **Skip** | To return to the **Stakeout** screen without storing the point. According to filter and sort settings the next point is suggested for staking out. |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Display only | The point ID of the point to be staked. |
| **Store point ID** | Editable field | The unique number which is used to store the staked point. Allows a different point ID to be typed in, if needed. |
| **Cut** | Display only | The negative height difference from the height of the staked point to the height of the point to be staked. To move down. |
| **Fill** | Display only | The positive height difference from the height of the staked point to the height of the point to be staked. To move up. |
| **2D distance** | Display only | Displays the horizontal difference from the staked point to the point to be staked. |
| **3D distance** | Display only | Displays the spatial difference from the staked point to the point to be staked. |
| **ΔHz** | Display only | The bearing from the staked point to the point to be staked. |
| **ΔDist** | Display only | Horizontal distance from the staked point to the point to be staked. |
| **Forward** | Display only | The horizontal distance from the current position to the point to be staked in the direction of the orientation. |
| **Back** | Display only | The horizontal distance from the current position to the point to be staked in the reverse direction of the orientation. |
| **Right** | Display only | Horizontal distance from the staked point to the point to be staked orthogonal to the right of the orientation direction. |
| **Left** | Display only | Horizontal distance from the staked point to the point to be staked orthogonal to the left of the orientation direction. |

# 54.6 Staking Out a DTM or Points & DTM

**Description**

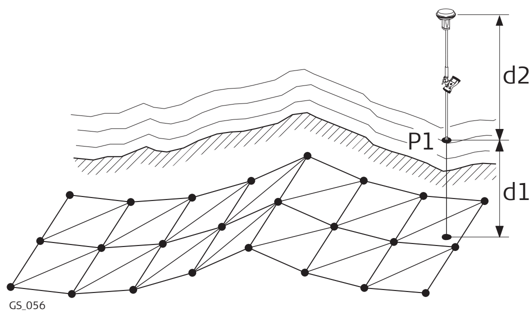
A **D**igital **T**errain **M**odel can be staked alone or together with points. The heights of the current positions are compared against the heights of a selected DTM job. The height differences are calculated and displayed.

Staking a DTM can be used for

- staking out where the DTM represents the surface to be staked.
- quality control purposes where the DTM represents the final project surface.

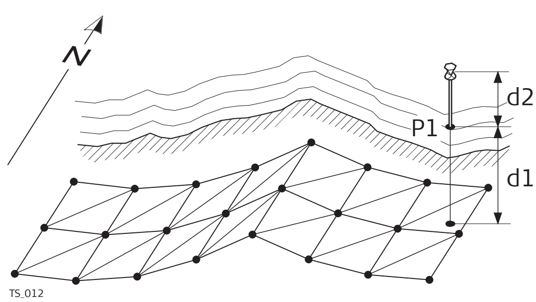
DTM jobs are created in LGO. DTM jobs are stored in the \DBX directory on the active memory device.

**Diagram**




GPS

P1 Point to be staked
d1 Cut or fill
d2 Antenna height




TPS

P1 Point to be staked
d1 Cut or fill
d2 Reflector height

**Access**

If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

To stake out DTM heights only:

Select **Main Menu:Go to Work!\Stakeout+\Stakeout DTM**.

To stake out positions of points and DTM heights:

Select **Main Menu:Go to Work!\Stakeout+\Stake points & DTM**.

**Stakeout**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Control job** | Selectable list | The positions of points in the job selected here are staked out. Heights to be staked out are taken from the DTM job. ☞ Points which are measured during staking out are stored in the working job. |
| **DTM** | Selectable list | The DTM job to be used must be stored in the \DBX directory on the active memory device. Heights without positions are staked out relative to the selected DTM job. |

☞ The stake out procedure is identical as for the normal Stakeout application but the heights to be staked are taken from the selected DTM job. The negative or positive height differences from the current position to the equivalent point in the selected DTM job is calculated and displayed. Height offsets apply.

Refer to "54.3 Configuring Stakeout", "54.4 Staking Out" and "54.5 Stakeout Difference Limit Exceeded".

# 55 Seismic Stakeout

## 55.1 Overview

**Description**

The Seismic Stakeout application includes all the standard stakeout functionality plus extra features that are specific to seismic survey. It supports exclusion zone files in order to warn users when the selected preplot point position or the current measured position falls inside a protected area. It provides a specific **Offset** page in the main stakeout screen to help staking, offsetting or skidding preplot points. A "default line width annotation" feature is available for users who need to report the width of the cut line.

**Terms**

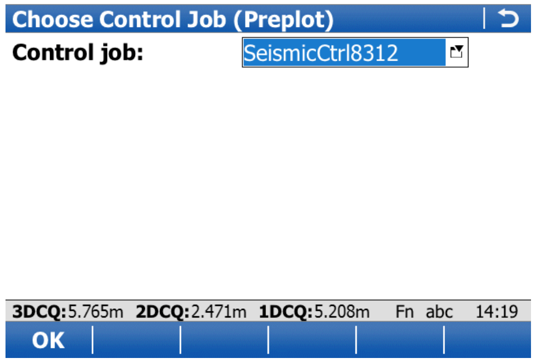
| | |
|---|---|
| Exclusion zone: | Protected area where drilling is not allowed. |
| Preplot: | Refers to design. For example preplot points and preplot job – not control points or control job. |
| Track and bin: | The preplot point IDs are comprised of a track(line) and bin(station). For example, if the point ID 162304 has 3 bin characters then its track would be 162 and its station 304. |

## 55.2 Accessing Stakeout

**Access**

Select **Main Menu: Go to Work!\Stakeout+\Seismic stakeout**.

**Choose Control Job (Preplot)**

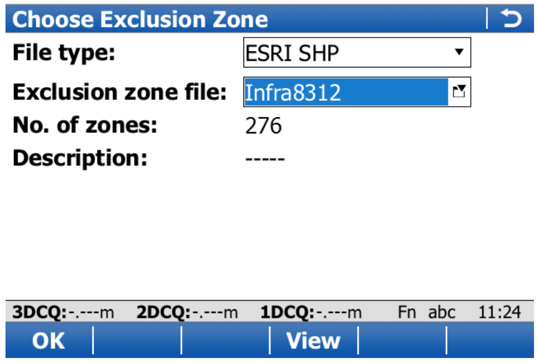



| Key | Description |
|---|---|
| **OK** | To activate the selected control job (preplot job). |
| Fn **Config..** | To configure Seismic Stakeout application. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Control job** | Selectable list | Job that contains preplot points to be staked. |

**Choose Exclusion Zone**

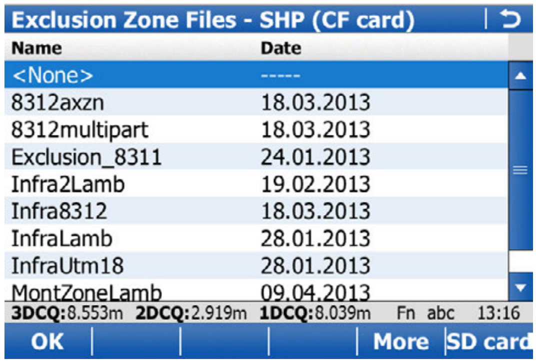



| Key | Description |
|---|---|
| **OK** | To validate the selected exclusion zone file. Opens the **Define Line Settings** screen. The file is converted to an internal format (*.xnz) when used for the first time. |
| **View** | To open the Exclusion zone viewer after loading the zones in memory. The file is converted to an internal format (*.xnz) when used for the first time. Refer to "Exclusion zone viewer". |
| Fn **Config..** | To configure Seismic Stakeout application. |
| Fn **Quit** | To exit the screen. |

### Description of fields

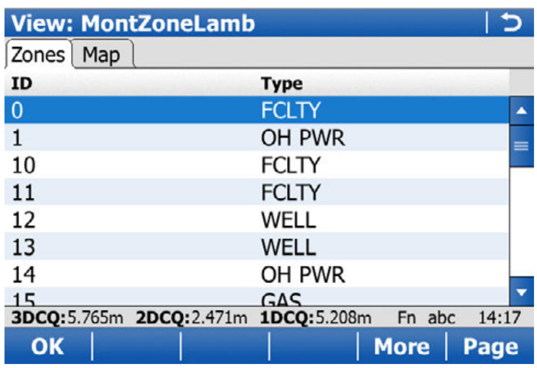
| Field | Option | Description |
|---|---|---|
| **File type** | **ESRI SHP** | Polygon shapefile in local grid coordinate system |
| | **GPSeismic LZO** | Leica exclusion zone format by GPSeismic software |
| **Exclusion zone file** | Selectable list | The file that contains exclusion zones against which the measured or selected preplot position will be tested. The file must be stored in the DATA\ZONE directory on the data storage device. Open the selectable list to change the memory device as needed. Select **<None>** if no file is available for a given project area. Refer to "Exclusion Zone Files - SHP". |
| **No. of zones** | Display only | Numbers of exclusion zones included in the selected file. |
| **Description** | Display only | File description as read in the file's header. |

### Exclusion Zone Files - SHP




| Key | Description |
|---|---|
| **OK** | To accept the selection. |
| **More** | To display information about the file name, size and last modification date/time. |
| **CF card**, **SD card** or **Intrnl** | To change between viewing exclusion zone files stored on another data storage device or internal memory. |
| Fn **Quit** | To exit the screen. |

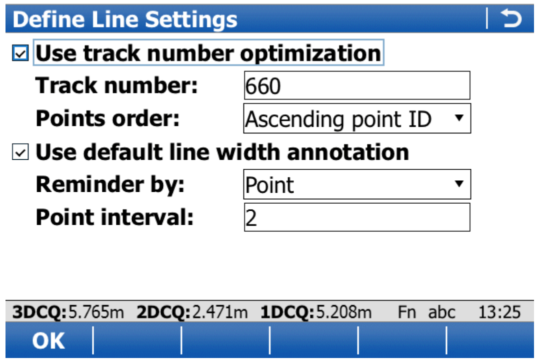
### Exclusion zone viewer




| Key | Description |
|---|---|
| **OK** | To return to the previous screen. |
| **More** | To display information about the zone ID, type and geometry. |
| Fn **Quit** | To exit the screen. |

## Define Line Settings

Seismic stakeout is usually done following a line of preplot points. The application can take advantage of line settings definitions to improve the seismic stakeout.




| Key | Description |
|---|---|
| **OK** | To open the **Seismic Stakeout** screen. |
| Fn **Config..** | To configure Seismic Stakeout application. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Use track number optimization** | Check box | The track(line) number can be used internally by the application to filter preplot points that belong to the current line being staked. This option also increase the performance of the preplot point test by reducing the number of exclusion zones loaded into memory. |
| **Track number** | Editable field | Track number of the line being staked. Common prefix identifier of all preplot points that belong to a given line. |
| **Points order** | Selectable list | Line walking direction as defined by preplot point IDs. |
| **Use default line width annotation** | Check box | This option is for users who need to report the width of the cut line. It allows to store automatically the last entered line width in the staked point annotation (Annot 4). Depending on the reminder method, a dialog will show-up after point store that recall the user to measure and update the line width value. |
| **Reminder by** | | Reminder method for line width annotation update. |
| | **Point** | Reminds after a point interval |
| | **Distance** | Reminds after a distance interval |
| **Point interval** | Editable field | Number of staked point after which the default line width annotation must be updated. |
| **Distance interval** | Editable field | The distance after which the default line width annotation must be updated. |

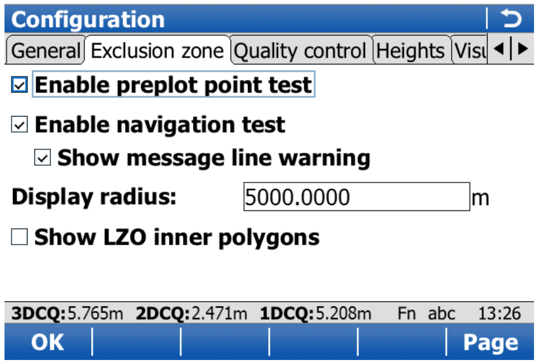
# 55.3 Configuring Stakeout

**Access**

Select **Main Menu: Go to Work!\Stakeout+\Seismic stakeout**. Press Fn **Config..**.

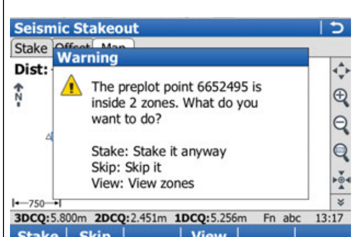
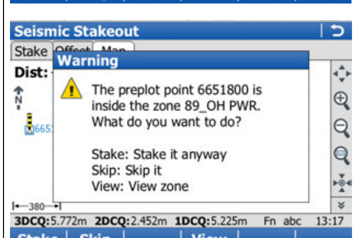
**Configuration, Seismic stakeout page**

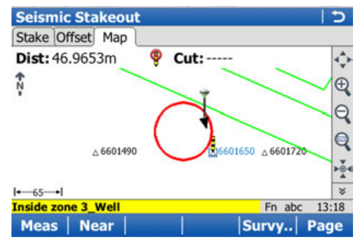
For all other pages on this screen, refer to "54.3 Configuring Stakeout".




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

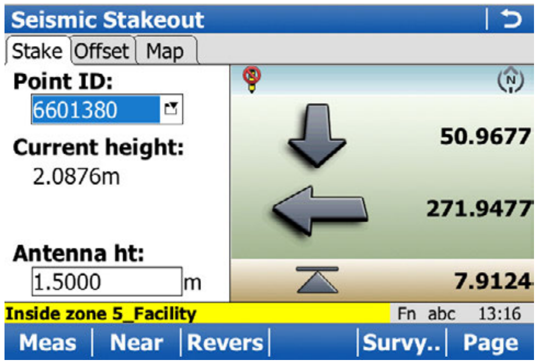
| Field | Option | Description |
|---|---|---|
| **Enable preplot point test** | Check box | The preplot point test is done each time the current point ID selection changes (in **Stake** or **Map** page from **Seismic Stakeout** screen). The preplot point position is tested against exclusion zones and an appropriate warning message appears when the position is inside one or more zones.   |

| Field | Option | Description |
|---|---|---|
| **Enable navi-gation test** | Check box | The navigation test is done continuously on the current measured position. The current position is tested against all exclusion zones in the surrounding area as defined by **Display radius**.<br> Appears in the **Stake** and **Map** page when the measured position falls inside one or more exclusion zones.<br>In addition, the touched zone is highlighted in red in the map (that could be more than one zone).<br><br> Appears in the **Stake** and **Map** page when an exclusion zone file is active and the navi-gation test is disabled. |
| **Show message line warning** | Check box | Inside zone warning displayed at the message line when the current measured position falls inside one or more exclusion zones. The message line stays on for seven seconds when triggered even if the user gets out of the zone(s). |
| **Display radius** | Editable field | This radius defines the area around the current measured position for which the exclusion zones will be added to the stakeout map.<br>☞ It is better to keep this value as small as possible to not load too many exclusion zones in memory. The application auto-matically readjusts this radius when more than 200 zones overlap the defined area |
| **Show LZO inner poly-gons** | Check box | An inner polygon is created when adding an offset to an exclusion zone in GPSeismic (LZO format). Use this option to display inner polygons on the stakeout map. Inner polygons are displayed in yellow and no inclusion test is done against them. |

# 55.4 Staking Out

**Seismic Stakeout, Stake page**

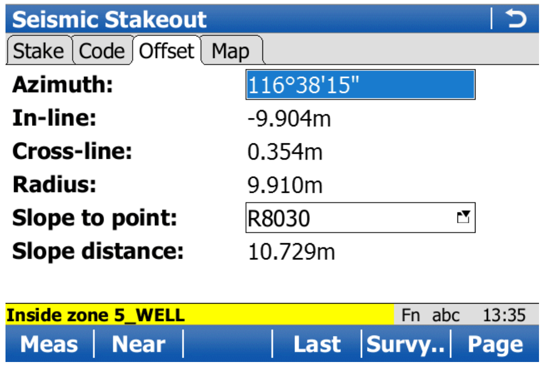
Same as standard Stakeout application, except for specific warning icons that appear in the left upper corner of the bulls-eye. Refer to "54.4 Staking Out" for a description of keys, fields and standard elements of the graphical display.




**Description of specific elements of the graphical display**

| Element | Description |
|---|---|
|  | Indicates that current measured position falls inside one or more exclusion zones. |
|  | Indicates that an exclusion zone file is active but navigation test is disabled. |

## Seismic Stakeout, Offset page




Refer to "54.4 Staking Out" for a description of the standard keys.

| Key | Description |
|---|---|
| **Last** | To set the **Slope to point** to the last staked point. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Azimuth** | Editable field | Direction from the current preplot point for which the **In-line** and **Cross-line** offsets are computed.<br>This azimuth value is automatically updated each time the selected preplot point changes in the **Stake** and **Map** page.<br>The computed azimuth is based on the next preplot point in the list. If no next point is available then it will be from previous point to current one.<br>Or enter an azimuth value for specific validation. |
| **In-line** | Display only | Measured position in/out offset based on the line from the current preplot point to the given azimuth direction. Negative value is in. |
| **Cross-line** | Display only | Measured position left/right offset based on the line from the current preplot point to the given azimuth direction. Negative value is left. |
| **Radius** | Display only | Horizontal distance from the measured position to the current preplot point. |
| **Slope to point** | Selectable list | Point stored in the working job for which the slope distance from the current measured position is required. Useful when offsetting a preplot point to validate cable length from previous staked point. |
| **Slope distance** | Display only | Slope distance from measured position to selected **Slope to point**. |

# 56 Base Menu - Start base GPS

## 56.1 Start base over known point

**Description**

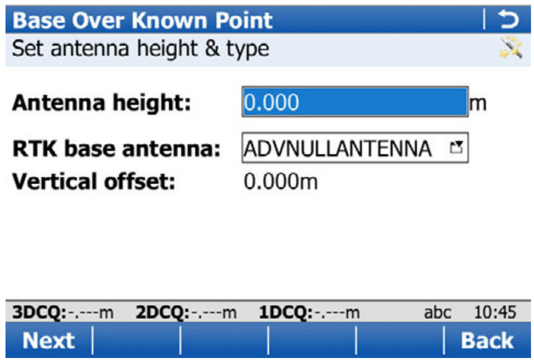
In this option, a known point stored in the working job is used to set up the RTK base.

**Access**

Select **Base Menu\Go to Work!\Start base over known point**.

**Set antenna height & type.**

Type in the antenna height and select the antenna being used.




| Key | Description |
|---|---|
| **Next** | To accept changes and access the subsequent screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Antenna height** | Editable field | The height of the antenna that is being used. |
| **RTK base antenna** | Selectable list | Leica Geosystems antennas are predefined as default and can be selected from the list. Default antennas contain an elevation-dependent correction model. New antenna correction models can be set up and transferred to the instrument using LGO. Open the list to define or edit additional antennas. Refer to **Antennas** for information on antennas. |
| **Vertical offset** | Display only | The vertical offset of the measurement reference point. |

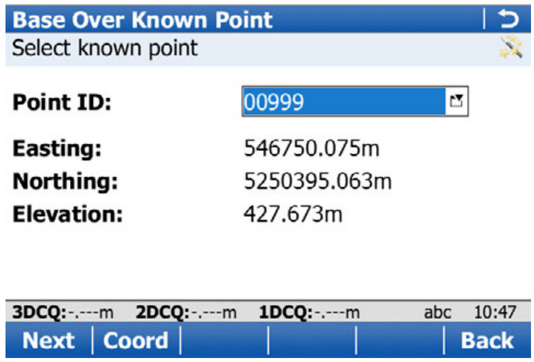
**Next step**

**Next** to access **Select known point**.

**Select known point**

Select the point to be used as base station.

- A point could already be stored in the control job either by manual entry, by measuring or by transfer from LGO.
- If a new point is to be created, open the selectable list for **Point ID** and press **Point ID**.
- If an existing point is to be edited, open the selectable list for **Point ID** and press **Edit...**.




| Key | Description |
|---|---|
| **Next** | To accept changes and access the subsequent screen. |
| **Coord** | To view other coordinate types. Local coordinates are available when a local coordinate system is active. |
| **Back** | To return to the previous screen. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Next** to access **Base setup complete.**. Follow the instructions on the screen.

## 56.2 Start base over last setup

**Description**

To use the same coordinates as when the instrument was last used as a base. Available when the instrument has previously been used as a base and no point in the control job has the same point ID as the one last used.
After turning off, the base coordinates are stored in the System RAM. They can be used again the next time the instrument is used as a base. This functionality means that even if the data storage device that previously contained the base coordinates is formatted, the last used coordinates can still be used.

**Access**

Select **Base Menu\Go to Work!\Start base over last setup**.

**Set antenna height & type.**

This screen is identical with the one in **Start base over known point**. Refer to "56.3 Start base over any point".

**Next step**
**Next** to access **Last used RTK base point.**.

**Last used RTK base point.**

The point ID and coordinates of the last used base are displayed in grid. When no local coordinate system is active, WGS 1984 coordinates are displayed. Refer to "56.3 Start base over any point" for information on the keys.

**Next step**
**Next** to access **Base setup complete.**. Follow the instructions on the screen.

## 56.3 Start base over any point

**Description**

To use the coordinates of the current navigation position as base coordinates.

**Access**

Select **Base Menu\Go to Work!\Start base over any point**.

**Set antenna height & type.**

This screen is identical with the one in **Start base over known point**. Refer to **Start base over any point**.

**Next step**
**Next** to access **Measure new point.**.

**Measure new point.**

Type in a point ID for this new point. Refer to **Start base over any point** for information on the keys.
Code information or annotations can be added in the rover menu in **View & edit data**.

**Next step**
**Next** to access **Base setup complete.**. Follow the instructions on the screen.

# 57 Survey - General GPS

## 57.1 Surveying Points

### 57.1.1 Post-Processed Kinematic and Static Operations

**Requirements**

- A typical working style for a static or post-processed kinematic operation is used. Ensure that the working style has **Log data for post-processing** selected in the **Raw Data Logging Settings** screen.

☞ For information on camera and images refer to "34.3.3 Within Applications".

**Access**

For RTK rover:

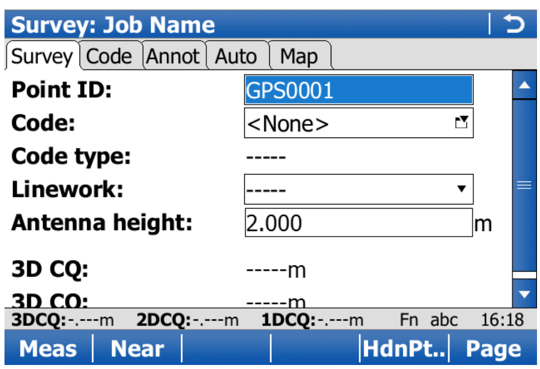
Select **Main Menu: Go to Work!**, **Survey**.

☞ If configured for post-processed kinematic operations, the logging of moving observations begins.

**Survey, Survey page**

The fields shown are from a typical working style for static or post-processed kinematic operations. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Code** page and the **Annot** page. Refer to "38 MapView Interactive Display Feature" for information on the keys on the **Map** page.

The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.



| Key | Description |
|---|---|
| **Meas** | To start logging of static observations. The key changes to **Stop**. |
| **Stop** | To end recording of positions when enough data is collected. When **Automatically stop point measurement** is checked in **Quality Control**, **General**, recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. |
| **Store** | To store the point information. When **Automatically store point** is checked in **Quality Control**, **General**, the measured point is stored automatically. The key changes to **Meas**. |
| **Near** | To compare the user's current position with the coordinates of all points already stored in the job and find the nearest point. This point ID is then suggested as the next point ID to be used. |
| **HdnPt..** | To measure a hidden point. Refer to "61 Survey - Hidden Points". |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure SmartCodes, auto points and hidden point measurements. Refer to "26.5 SmartCodes", "59 Survey - Auto Points" and "61 Survey - Hidden Points". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways:<br>• To start a new sequence of point IDs type over the point ID.<br>• For an individual point ID independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Antenna height** | Editable field | The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **3D CQ** | Display only | The current 3D coordinate quality of the computed position. |

## 57.1.2 Real-Time Rover Operations

**Requirements**

- A typical working style for real-time rover operations is used.
- The appropriate real-time device is attached and working properly.

☞ For information on camera and images refer to "34.3.3 Within Applications".

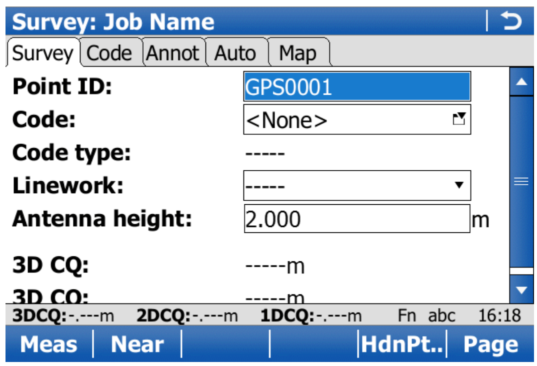
**Access**

For RTK rover:
Select **Main Menu: Go to Work!**, **Survey**.

**Survey, Survey page**

The fields shown are from a typical working style for real-time rover operations. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Code** page and the **Annot** page. Refer to "38 MapView Interactive Display Feature" for information on the keys on the **Map** page.

The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.



| Key | Description |
|---|---|
| **Meas** | To start logging of static observations. The key changes to **Stop**. |
| **Stop** | To end recording of positions when enough data is collected. When **Automatically stop point measurement** is checked in **Quality Control**, **General**, recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. |
| **Store** | To store the point information. When **Automatically store point** is checked in **Quality Control**, **General**, the measured point is stored automatically. The key changes to **Meas**.<br>It may happen that a point with the same point ID exists in the job. If the codes and/or attribute values of the new and the existing point do not match, a screen opens where they can be corrected. Refer to "26.6 Code and Attribute Mismatch". |
| **Near** | To compare the user's current position with the coordinates of all points already stored in the job and find the nearest point. This point ID is then suggested as the next point ID to be used. |
| **HdnPt..** | To measure a hidden point. Refer to "61 Survey - Hidden Points". |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure SmartCodes, auto points and hidden point measurements. Refer to "26.5 SmartCodes", "59 Survey - Auto Points" and "61 Survey - Hidden Points". |
| Fn **Avg** | To check the residuals for the averaged position. Available for **Mode:** Average in **Job Properties:**, **Averaging** page and for more than one measured coordinate triplet recorded for the same point. Refer to "6.3.3 Mean Page". |
| Fn **Abs** | To check the absolute difference between measurements. Available for **Mode: Average** in **Job Properties:**, **Absolute differences** page and for more than one measured coordinate triplet recorded for the same point. Refer to "6.3.3 Mean Page". |
| Fn **Conect** and Fn **Disco** | To connect/disconnect from the GPS reference data. |
| Fn **Init..** | To select an initialisation method and to force a new initialisation. Available for working styles allowing phase fixed solutions. Refer to "57.4 Initialisation for Real-Time Rover Operations". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways:<br>• To start a new sequence of point IDs type over the point ID.<br>• For an individual point ID independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Antenna height** | Editable field | The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **3D CQ** | Display only | The current 3D coordinate quality of the computed position. |

## 57.2 Adding Annotations

**Description**

Annotations can be used to add either field notes or comments to points being surveyed.

**Access**

For RTK rover:

Select **Main Menu: Go to Work!**, **Survey**. Go to the **Annot** page.

☞ If it is not already displayed, the **Annot** page can be configured to appear in the Survey application through the **My Survey Screen Settings** screen. Refer to "25.3 My Survey Screen"for more information.

**Survey, Annot page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Annot 1** to **Annot 4** | Editable field | Type in the annotation. The annotation can be up to 16 characters long and include spaces.<br>☞ When the ASCII input interface is configured to be used and an annotation is reserved for the incoming ASCII string, then no other information can be typed in for the particular annotation.<br>☞ CE to clear the entry. |
| | | ☞ **Last** to recall all annotations entered for the previously surveyed point. Any annotations just entered are overwritten. |
| | | ☞ ENTER. The next line is highlighted. |

**Next step**

| Step | Description |
|---|---|
| 1. | **Meas** to start the point measurement. |
| 2. | **Stop** to end the point measurement. |
| 3. | **Store** to store the point information including the annotations. |

## 57.3 Timed Measurements

**Description**

Surveying regulations in some countries require that several instruments in a session start the point measurement simultaneously at a predefined time. Timed measurements are possible for all types of GPS operations, except for real-time base operations.

**Requirements**

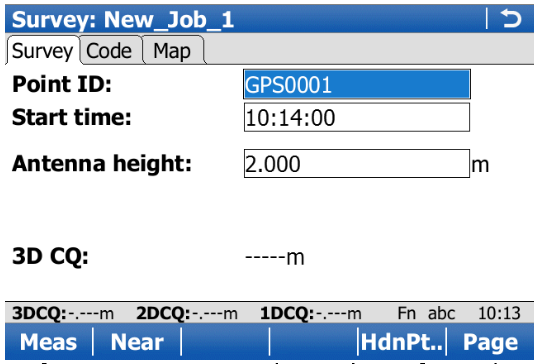
- **Automatically start measuring point on entering survey: Timed** is configured in **Quality Control**, **Advanced** page. Refer to "13.4 Quality control".
- **Time at point** is configured for one of the lines in one of the survey screen pages. Refer to "25.3 My Survey Screen".

**Access**

For RTK rover:

Select **Main Menu: Go to Work!**, **Survey**.

**Survey, Survey page**




Refer to "57.1 Surveying Points" for a description of keys.

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Start time** | Editable field | The current local time with the seconds rounded to 00, for example for the current local time 07:37:12 it is 07:38:00.<br>Type in the start time in hours, minutes and seconds for when the point measurement will begin.<br>Press **Meas**. The point measurement does not start yet. The name of the field changes to **Time to go**. |
| **Time to go** | Display only | The countdown time in hours, minutes and seconds before the point measurement starts automatically. The point measurement starts when it is 00:00:00.<br>Then, data is logged as configured in the working style. Any measurement counter defined to be used in survey screen page is displayed and starts incrementing. The name of the field changes to **Time at point**. |
| **Time at point** | Display only | The time in hours, minutes and seconds from when the point is measured until point measurement is stopped.<br>Press **Stop** and **Store** when enough data is collected. The name of the field changes to **Start time**. |

## 57.4 Initialisation for Real-Time Rover Operations

### 57.4.1 Accessing Initialisation for Real-Time Rover Operations

**Requirements**

- The active working style is a real-time rover configuration.

**Access**

For RTK rover:

- Select **Main Menu: Go to Work!**, **Survey**. Press **Init..**.
- Access is possible from other screens where individual point measurements are needed, for example from **Inverse Pt - Pt** with **Survy..**.

**Re-initialise the RTK**

| Initialisation method | Description | Refer to chapter |
|---|---|---|
| **Initialise while moving** | The rover antenna can be moved during the initialisation process. | "57.4.2 Initialise while Moving" |
| **Initialise while static** | ☞ The antenna setup must be static on a pillar, a tripod or on a pole with a quick-stand. | "57.4.3 Initialise while Static" |
| **Initialise on a known point** | ☞ The antenna setup must be static on a pillar, a tripod or on a pole with a quick-stand.<br>☞ The coordinates of the point must be stored in, or able to be converted to, the WGS 1984. They must be stored in the working job either by manual entry or by measuring. | "57.4.4 Initialise on Known Point" |

### 57.4.2 Initialise while Moving

**Initialise while moving step-by-step**

| Step | Description |
|---|---|
| 1. | Does the instrument currently have a fixed solution?<br>• If yes, continue with step 3.<br>• If no, continue with the next row. |
| ☞ | The initialisation starts automatically. |
| 2. | Continue with the row after step 3. |
| 3. | **Yes** to start the initialisation. The current ambiguity solution is discarded. |
| ☞ | **Meas** is available but must not be pressed until the ambiguity solution is gained. |
| 4. | The initialisation is gained when the ambiguities are solved. |
| 5. | Continue with the surveying operation. |

## 57.4.3 Initialise while Static

**Initialise while static step-by-step**

| Step | Description |
|---|---|
| 1. | Does the instrument currently have a fixed solution?<br>• If yes, continue with step 3.<br>• If no, continue with the next row. |
| ☞ | The initialisation starts automatically. |
| 2. | Continue with step 6. |
| 3. | **Yes** to start the initialisation. The current ambiguity solution is discarded. |
| ☞ | **Stop** is available but must not be pressed until the ambiguity solution is gained. |
| ☞ | The initialisation is gained when the ambiguities are solved. |
| 4. | Any configurations for **Automatically stop point measurement** in **Quality Control**, **General** page are ignored. **Stop** when enough data is collected. |
| 5. | When **Automatically stop point measurement** is not checked in **Quality Control**, **General** page, **Store** to store the point information. |
| 6. | Continue with the surveying operation. |

## 57.4.4 Initialise on Known Point

**Initialise on known point step-by-step**

| Step | Description |
|---|---|
| 1. | Does the instrument currently have a fixed solution?<br>• If yes, continue with step 3.<br>• If no, continue with step 4. |
| 2. | **Yes** to start the initialisation. The current ambiguity solution is discarded. |
| 3. | In **Data:**, **Points** page, highlight the known point for the initialisation. |
| 4. | **OK** starts the initialisation. |
| ☞ | **Survey** screen<br>**Point ID**: The ID of the selected known point is displayed.<br>**Antenna height**: The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.<br>Enter the correct antenna height. |
| ☞ | If desired, add a code. |
| ☞ | If desired, add an annotation. |
| ☞ | **Stop** is available but must not be pressed until the ambiguity solution is gained. |
| ☞ | The initialisation is gained when the ambiguities are solved. |
| 5. | Any configurations for **Automatically stop point measurement** in **Quality Control**, **General** page are ignored. **Stop** when enough data is collected. |
| 6. | When **Automatically stop point measurement** is not checked in **Quality Control**, **General** page, **Store** to store the point information. |
| ☞ | An average is automatically calculated with the known coordinates. |
| 7. | Continue with the surveying operation. |

**Description**

The Survey application is used for point measurement. Angles and distances for points can be measured and the calculated coordinates stored using **Meas**, **Dist** and **Store**.

☞ For information on camera and images refer to "34.3.3 Within Applications".

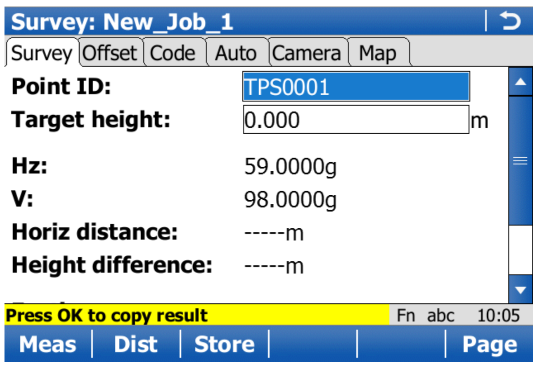
**Access**

Select **Main Menu: Go to Work!\Survey**.

**Survey, Survey page**

The fields shown are from a typical working style. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Offset** page, and the **Code** page. Refer to "38 MapView Interactive Display Feature" for information on the keys on the **Map** page.

The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.



| Key | Description |
|---|---|
| **Meas** | To measure and store distances and angles. |
| **Stop** | Available if **Measure mode: Continuous** and **Dist** was pressed. Stops the distance measurements. The key changes back to **Meas**. |
| **Dist** | To measure and display distances. |
| **Store** | To record data.<br>If **Measure mode: Continuous** and/or **Log auto points** is checked, records measured point and continues tracking. |
| **RmtHt.** | To access **Survey Remote Point**. Available if **Measure remote points** is checked in **Configuration**, **Remote points** page. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure SmartCodes, auto points and remote point measurements. When Fn **Avg** or Fn **Abs** are active, this key is not available. Refer to "26.5 SmartCodes", "59 Survey - Auto Points" and to "63 Survey - Remote Point" for information on the fields and keys. |
| Fn **Avg** | To check the residuals for the averaged point. Available for **Mode:** Average in **Job Properties:**, **Averaging** page and for more than one measured coordinate triplet recorded for the same point. Refer to "6.3.3 Mean Page". |
| Fn **Abs** | To check the absolute difference between the measurements. Available for **Mode: Average** in **Job Properties:**, **Absolute differences** and for more than one measured coordinate triplet recorded for the same point. Refer to "6.3.3 Mean Page". |
| Fn **2Store** | To aim manually at the target and only record the angle measurement (Hz/V) in face I and face II. The point stored is an average of the two measurements. |
| Fn **2Face** | Available for **Measure mode**: **Single** and **Measure mode**: **Single (fast)**. To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for measured points. The configured point ID template is used. The ID can be changed:<br>• To start a new sequence of point IDs overtype the point ID.<br>• For an individual number independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Target height** | Editable field | The last used target height is suggested when accessing the Survey application. An individual target height can be typed in. |
| **Hz** | Display only | The current horizontal angle. |
| **V** | Display only | The current vertical angle. |
| **Horiz distance** | Display only | The horizontal distance after **Dist** was pressed. No distance is displayed when accessing the screen and after **Store** or **Meas**. |
| **Height difference** | Display only | The height difference between station and measured point after **Dist**. Displays **-----** when accessing the screen and after **Store** or **Meas**. |
| **Easting** | Display only | Easting coordinate of the measured point. |
| **Northing** | Display only | Northing coordinate of the measured point. |
| **Elevation** | Display only | Elevation of the measured point. |

# 59 Survey - Auto Points

## 59.1 Overview

**Description**

Auto points are used to automatically log points at a specified rate. Additionally, individual auto points can be stored outside the defined rate.
Auto points can be collected in the Survey application. An **Auto** page is visible when logging of auto points is active.
Auto points are used in moving applications to document a track which was walked or driven along. Auto points that are logged between starting and stopping logging of auto points form one chain. A new chain is formed each time logging of auto points is started.
Up to two offset points related to one auto point can be logged. The offset points can be both to the left or right and they can be coded independently of each other and of the auto points.

☞ Logging of auto points is possible for TPS and in the GPS rover menu.

**Coding of auto points**

Coding of auto points is similar to coding manually occupied points. Refer to "26 Coding" for information on coding.
The differences are:

- Thematical coding: GPS Available for **Store points:To DBX (pts&codes)** in **Configuration**, **Log auto points** page.
  TPS Always available.
- Free coding: Always available.
- Quick coding: Not available.
- Codes of auto points overwrite the codes of points with the same point ID but a different code, existing in the working job.
- Codes of auto points can be changed when no auto points are being logged.
- Up to three attributes can be stored with a code.

**Averaging of auto points**

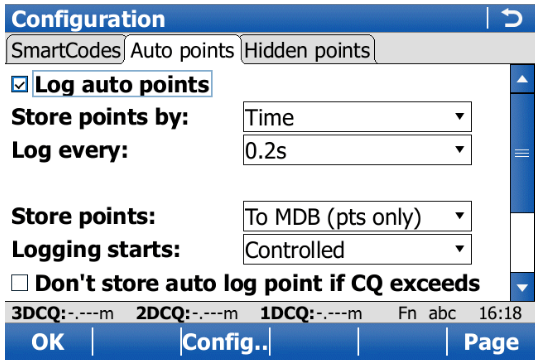
An average is never calculated for auto points even if a manually occupied point of class **Meas** already exists with the same point ID.

## 59.2 Configuring Auto Points

**Access**

Select **Main Menu: Go to Work!**, **Survey**. Press Fn **Config...**.

**Configuration, Auto points page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Config..** | To configure what is viewed in the **Auto** page in the Survey application. Available for **Log auto points** checked. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

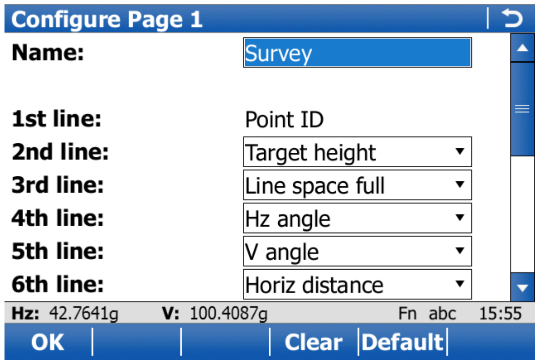
| Field | Option | Description |
|---|---|---|
| **Log auto points** | Check box | Activates the logging of auto points.<br>☞ All other fields on the screen are active and can be edited. |
| **Store points by** | **Time** | Auto points are logged according to a time interval. The time interval is independent from the update interval for the position on the screen. |
| | **Distance** | The difference in distance from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position. |
| | **Height difference** | The height difference from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position. |
| | **Distance or height** | Before the next auto point is logged, either the difference in distance or the difference in height must be reached. The auto point is logged with the next available computed position. |
| | **Stop & go** | An auto point is stored when the position of the antenna/prism does not move more than the distance configured in **Minimum distance between points** within the **Stop time**.<br>Once a point has been stored, the position must change more than the distance configured in **Minimum distance between points** before the routine starts again. |
| | **User decides** | An auto point is stored upon pressing **Meas** (GPS) / **Store** (TPS) in **Survey**, **Auto** page. In the beginning, the chain to which the auto points will be assigned must be started with **Start**. In the end, the chain must be closed with **Stop**. |
| **Log every** | | Available unless **Store points by: Distance or height**. |
| | Editable field | For **Store points by: Distance** and **Store points by: Height difference**. The difference in distance or height before the next auto point is logged. |
| | From **0.05s** to **60.0s** | For **Store points by: Time**. The time interval before the next auto point is logged.<br>For GS05/GS06/GS08plus/GS12 logging rates of **0.2s** and slower are supported. |
| **Max distance** | Editable field | Available for **Store points by: Distance or height**. The value for the difference in distance before the next auto point is logged. |
| **Max height** | Editable field | Available for **Store points by: Distance or height**. The value for the height difference before the next auto point is logged. |

| Field | Option | Description |
|---|---|---|
| **Minimum distance between points** | Editable field | Available for **Store points by: Stop & go**. The distance within which the position is considered stationary. |
| **Stop time** | Editable field | Available for **Store points by: Stop & go**. The time while the position must be stationary until an auto point is stored. |
| **Store points** GPS | | ☞ Changing this setting while auto points are being logged stops the logging. It must then be restarted. |
| | **To MDB (pts only)** | Logs auto point to a job file. Point logging at up to 20 Hz. Coding and logging of offset points is not possible. Points cannot be displayed in MapView or output via format files. |
| | **To DBX (pts&codes)** | Logs auto points to the DBX. Point logging at up to 1 Hz. Coding and logging of offset points is possible. Points can be displayed in MapView or output via format files. |
| **Logging starts** GPS | **Automatically** | Logging of auto points starts immediately when the **Survey** screen is accessed. |
| | **Controlled** | Logging of auto points starts upon pressing **Start** on the **Auto** page in **Survey**. |
| **Don't store auto log point if CQ exceeds limit** GPS | Check box | If checked, monitoring of the coordinate quality is activated. Auto points are stored when the coordinate quality is within the defined limit. For example, only phase fixed solutions can be logged by defining a CQ limit. |
| **3D CQ limit** GPS | Editable field | Available if **Don't store auto log point if CQ exceeds limit** is checked.<br>Limit for the coordinate quality above which an auto point is no longer automatically stored. When the CQ of the auto point falls again below the defined value then the storing of auto points begins again. |
| **Beep when auto logged point is stored** GPS | **Logging** | Instrument beeps when storing an auto point. |
| | **Never** | Instrument never beeps. |

### Next step

| IF the survey screen mask | THEN |
|---|---|
| is not to be configured | **OK** closes the screen and returns to the previous screen. |
| is to be configured | **Config...** |

## Configure Page




| Key | Description |
|---|---|
| **OK** | To accept changes and to return to previous screen. |
| **Clear** | To set all fields to **Line space full**. |
| **Default** | To recall the default settings. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Name** | Editable field | The name of the page is shown as page name in **Survey**. |
| **Show in the Survey application** | Check box | Shows or hides the page as a page in **Survey**. |
| **1st line** | Display only | Fixed to **Point ID**. |
| **2nd line** to **16th line** | | For each line, one of the following options can be selected. |
| | **Angle right** TPS | Displays the horizontal angle difference between the backsight point and the current telescope position. |
| | **% completed** GPS | Display only field for the percentage of the time for which the point has been occupied based on the setting for **Stop criteria** in screen **Quality Control**. Appears in the page during the point occupation if **Quality Control** is checked. |
| | **Annotation 1** to **Annotation 4** | Editable field for comments to be stored with the point. |
| | **Antenna height** GPS | Input field for antenna height for static observations. |
| | **Attrib (free) 01** to **Attrib (free) 20** | Display only field for attributes for free codes. |
| | **Attrib 01** to **Attrib 20** | Editable field for attributes for codes. |
| | **Target aiming** TPS | Unavailable for SmartStation. Select automation type. |
| | **Avg max #distances** TPS | Input field for maximum number of distance measurements in the averaging EDM mode. |
| | **Azimuth** TPS | Display only field for the azimuth. |

| Field | Option | Description |
|---|---|---|
| | **Backsight pt ID** TPS | Display only field for the point ID of the backsight point. |
| | **Code** | Editable field for codes. |
| | **Code (free)** | Editable field for free codes. |
| | **Code desc (free)** | Display only field for the description of free codes. |
| | **Code information** | Editable field for additional information relating to the code, such as instructions to the CAD package to start a line and string number and curve information. |
| | **Description** | Display only field for the description of codes. |
| | **Easting** TPS | Display only field for Easting coordinate of measured point. |
| | **GDOP** GPS | Display only field for the current GDOP of the computed position. |
| | **HDOP** GPS | Display only field for the current HDOP of the computed position. |
| | **Elevation** TPS | Display only field for the height coordinate of the measured point. |
| | **Height difference** TPS | Display only field for the height difference between station and reflector. |
| | **Horiz distance** TPS | Display only field for horizontal distance. |
| | **Humidity** GPS | Editable field for relative humidity to be stored with point. |
| | **Hz angle** TPS | Display only field for the horizontal angle. |
| | **Instrument height** TPS | Display only field for the instrument height. |
| | **Line space full** | Insert full line space. |
| | **Line space half** | Insert half line space. |
| | **Linework** | Selectable list with option for flagging a line/area. |
| | **Local ellipsoid ht** GPS | Display only field for the elevation of the current GNSS position. |
| | **Measure mode** TPS | Select EDM measurement mode. |
| | **Measure** TPS | Select EDM type. |
| | **Moving antenna ht** GPS | Input field for antenna height for moving observations. |
| | **Msd PP obs** GPS | Display only field for the number of static observations recorded over the period of point occupation. Appears in the page when recording of static observations is configured. |
| | **Northing** TPS | Display only field for Northing coordinate of measured point. |
| | **Number of dists** TPS | Display only field for number of averaged distances measured with EDM mode averaging. |

| Field | Option | Description |
|---|---|---|
| | **Offset left/right** TPS | Input field for horizontal distance offset for measured point, perpendicular to the line of sight. |
| | **Offset height** TPS | Input field for height offset for measured point. |
| | **Offset in/out** TPS | Input field for horizontal distance offset, in the direction of line of sight. |
| | **Offset mode** TPS | Select offset mode. |
| | **PDOP** GPS | Display only field for the current PDOP of the computed position. |
| | **PPM atmos** TPS | Display only field for atmospheric ppm. |
| | **PPM geometric** TPS | Display only field for geometric ppm value. |
| | **PPM total** TPS | Display only field for the total ppm value. |
| | **Point ID** | Editable field for the point ID. |
| | **Pressure** GPS | Editable field for atmospheric pressure. |
| | **Prism constant** TPS | Display only field for additive constant of currently selected reflector. |
| | **Quality 1D** GPS | Display only field for the current height coordinate quality of computed position. |
| | **Quality 2D** GPS | Display only field for the current 2D coordinate quality of computed position. |
| | **Quality 3D** GPS | Display only field for the current 3D coordinate quality of computed position. |
| | **RTK positions** GPS | Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover configurations. |
| | **SD (last recorded)** TPS | Display only field for the last recorded distance. |
| | **Slope distance** TPS | Display only field for measured slope distance. |
| | **Station ID** TPS | Display only field for current station ID. |
| | **Station easting** TPS | Display only field for current station Easting coordinates. |
| | **Station height** TPS | Display only field for current station height coordinates. |
| | **Station northing** TPS | Display only field for current station Northing coordinates. |
| | **Std deviation** TPS | Display only field of standard deviation in millimetres of averaged distances. |
| | **Target** TPS | Select a prism. |
| | **Target height** TPS | Input field for prism height. |
| | **Temp dry** GPS | Editable field for dry temperature to be stored with point. |

| Field | Option | Description |
|---|---|---|
| | **Temp wet** GPS | Editable field for wet temperature to be stored with point. |
| | **Time at point** GPS | Display only field for the time from when the point is occupied until point occupation is stopped. Appears in the page during the point occupation. |
| | **Type** | Display only field for the type of code, for example point code, line code or area code. |
| | **V angle** TPS | Display only field for vertical angle. |
| | **V angle display** TPS | Select vertical angle display. |
| | **VDOP** GPS | Display only field for the current VDOP of the computed position. |
| | **WGS84 ellipsoid ht** GPS | Display only field for the current GNSS position. |
| | **WGS84 latitude** GPS | Display only field for the current GNSS position. |
| | **WGS84 longitude** GPS | Display only field for the current GNSS position. |

## 59.3 Measuring Auto Points

**Requirements**

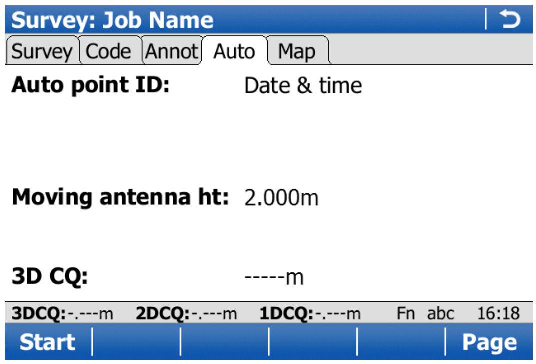
- **Log auto points** in **Configuration**, **Log auto points** page.
- GPS The rover menu must be used.

**Access**

Select **Main Menu: Go to Work!**, **Survey**. Go to the **Auto** page.

**Survey, Auto page**

Before logging of auto points has started, the page appears as shown:




| Key | Description |
|---|---|
| **Start** | For **Logging starts: Automatically** in **Configuration**, **Log auto points** page, logging of auto points starts immediately when the **Survey** screen is accessed and **Start** need not be pressed.<br>To start logging of auto points and offset points if configured or, for **Store points by: User decides**, to start the chain to which the auto points will be assigned. The first auto point is stored.<br>TPS **Measure mode: Continuous** becomes active. For **Measure: Prism** instrument locks onto prism. For **Measure mode-Long range (>4km)**, **Measure: Prism** is set and instrument locks onto the prism. |
| **Stop** | To end recording of auto points and offset points if configured or, for **Store points by: User decides**, to end the chain to which the auto points are assigned. |
| **Meas** GPS | Available for **Stop**. To store an auto point at any time. |
| **Store** TPS | Available for **Stop**. To store an auto point at any time. |
| **Offst1..** | To configure recording of the first type of offset points. Refer to "59.4.2 Configuring Offset Points".<br>GPS Available for **Store points: To DBX (pts&codes)** in **Configuration**, **Log auto points** page. |
| **Offst2..** | To configure recording of a second type of offset points. Refer to "59.4.2 Configuring Offset Points".<br>GPS Available for **Store points: To DBX (pts&codes)** in **Configuration**, **Log auto points** page. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure auto points. Refer to "59.2 Configuring Auto Points". |
| Fn **Quit** | To exit the Survey application. Point information logged until pressing Fn **Quit** is saved in the database. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Auto point ID** | Editable field | Available unless **GPS auto points: Date & time**/**TPS auto points: Date & time** in **ID Templates**. The identifier for auto points. The configured ID template for auto points is used. The ID can be changed. To start a new sequence of point IDs, type over the point ID. |
| | **Date & time** | Available for **GPS auto points: Date & time**/**TPS auto points: Date & time** in **ID Templates**. The current local time and date is used as identifier for auto points. |
| **Moving antenna ht** GPS | Editable field | The default antenna height for auto points as defined in the active working style is suggested. |
| **Target height** TPS | Editable field | The default reflector height as defined in the active configuration set is suggested. |
| **Code (auto)** | | The thematical code for the auto point.<br>• If a point code is selected then any open line/area is closed. The occupied point is stored with the selected code independently of any line/area.<br>• If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The occupied point is assigned to that line. The line stays open until it is closed manually or another line code is selected.<br>• If an area code is selected then the behaviour is as for lines. |
| | Selectable list | Available if **Use a list box to view codes** is checked. The attributes are shown as display only, editable field or selectable list fields depending on their definition. |
| | Editable field | Available if **Use a list box to view codes** is not checked. Codes can be typed in but not selected from a codelist. A check is performed to see if a code of this name already exists in the job. If so, the according attributes are shown.<br>Configure a survey screen mask with a selectable list for code types to define if a point, line or area code is typed in. |
| **Description** | Display only | The description of the code. |
| **Msd auto points** | Display only | Available after pressing **Start**. The number of auto points logged since **Start** has been pressed. |
| **3D CQ** GPS | Display only | The current 3D coordinate quality of the computed position. |
| **Slope distance** | Display only | The measured slope distance.<br>When **Start** is pressed, **Measure mode: Continuous** is set and the slope distance is constantly updated. |
| **Hz** | Display only | The current horizontal angle. |
| **V** | Display only | The current vertical angle. |

### Next step

| IF | THEN |
|---|---|
| auto points are to be logged | **Start**. Then, for **Store points by: User decides**, **Meas** whenever an auto point is to be logged. |
| offset points are to be configured | **Offst1..** or **Offst2...** Refer to "59.4 Offset Points of Auto Points". |

# 59.4 Offset Points of Auto Points

## 59.4.1 Overview

**Description**

Offset points
- can be created with auto points when auto points are stored to the DBX.
- can be to the left or to the right of auto points.
- are automatically computed with the logging of auto points, if configured.
- form a chain relative to the chain of auto points to which they are related. Subsequent computed chains are independent from each other.
- can be coded independently of auto points.
- have the same time of when they were stored as the auto points to which they are related.
- have the same coding functionality, properties and averaging functionality as auto points.

Up to two offset points can be related to one auto point.
The screens for the configuration of offset points are identical except for the title **Auto Points - Offset 1** and **Auto Points - Offset 2**. For simplicity, the title **Auto Points - Offset 1** is used in the following description.

**Computation of offset points**

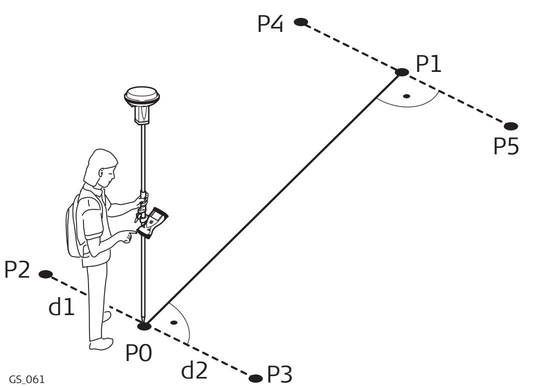
The computation of offset points depends on the number of auto points in one chain.

**One auto point**

No offset points are computed or stored.

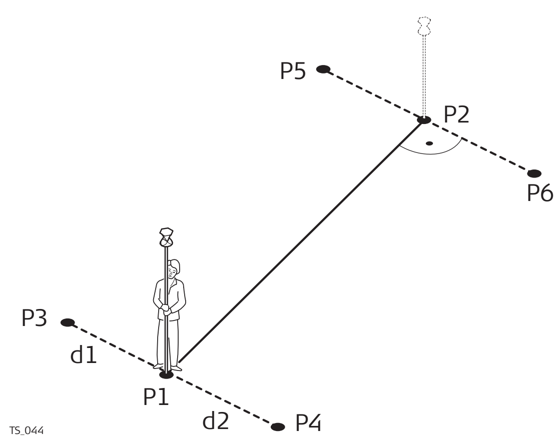
**Two auto points**

The configured offsets are applied perpendicular to the line between two auto points.




GPS

| | |
|---|---|
| P0 | First auto point |
| P1 | Second auto point |
| P2 | First offset point for P0 |
| P3 | Second offset point for P0 |
| P4 | First offset point for P1 |
| P5 | Second offset point for P1 |
| d1 | Horizontal offset to the left |
| d2 | Horizontal offset to the right |




TPS

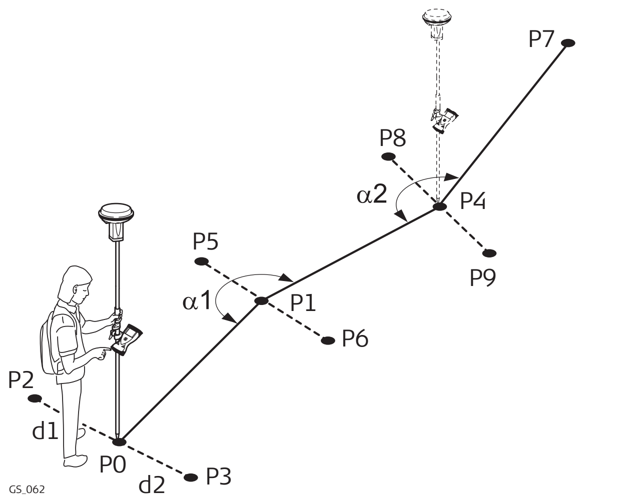
| | |
|---|---|
| P1 | First auto point |
| P2 | Second auto point |
| P4 | First offset point for P1 |
| P3 | Second offset point for P1 |
| P5 | First offset point for P2 |
| P6 | Second offset point for P2 |
| d1 | Horizontal offset to the left |
| d2 | Horizontal offset to the right |

### Three or more auto points

The first offset points are computed perpendicular to the line between the first and the second auto point.

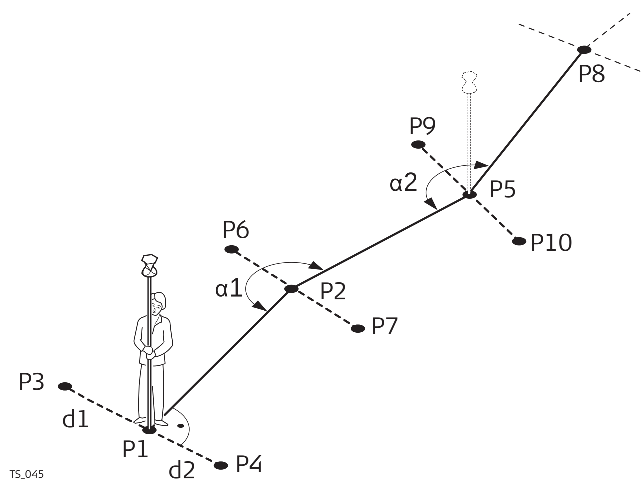
The last offset point is computed perpendicular to the line between the last auto point and the one before.

All other offset points are computed on a bearing. The bearing is half of the angle between the last and the next measured auto point.




GPS

| | |
|---|---|
| P0 | First auto point |
| P1 | Second auto point |
| P2 | First offset point for P0 |
| P3 | Second offset point for P0 |
| P4 | Third auto point |
| P5 | First offset point for P1 |
| P6 | Second offset point for P1 |
| P7 | Fourth auto point |
| P8 | First offset point for P4 |
| P9 | Second offset point for P4 |
| d1 | Horizontal offset to the left |
| d2 | Horizontal offset to the right |
| α1 | Angle between P0 and P4 |
| α2 | Angle between P1 and P7 |




TPS

| | |
|---|---|
| P1 | First auto point |
| P2 | Second auto point |
| P3 | First offset point for P1 |
| P4 | Second offset point for P1 |
| P5 | Third auto point |
| P6 | First offset point for P2 |
| P7 | Second offset point for P2 |
| P8 | Fourth auto point |
| P9 | First offset point for P5 |
| P10 | Second offset point for P5 |
| d1 | Horizontal offset to the left |
| d2 | Horizontal offset to the right |
| α1 | Angle between P1 and P5 |
| α2 | Angle between P2 and P8 |

## 59.4.2 Configuring Offset Points

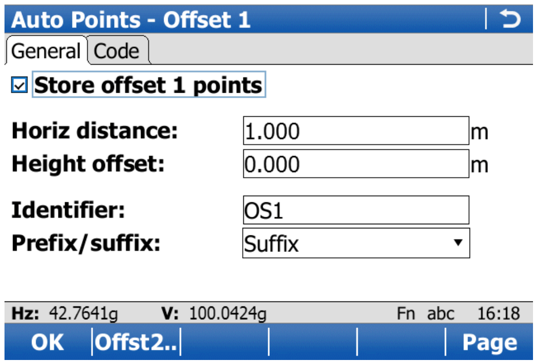
**Requirements**

GPS Available for **Store points: To DBX (pts&codes)** in **Configuration**, **Log auto points** page.

**Access**

Press **Offst1..** or **Offst2..** in **Survey**, **Auto** page.

**Auto Points - Offset 1, General page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Offst2..** and **Offst1..** | To switch between configuring offset point type one and two. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

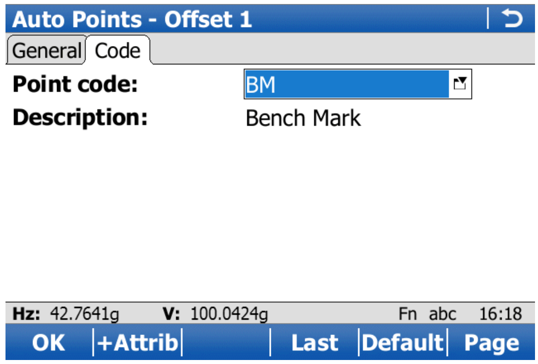
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Store offset 1 points** and **Store offset 2 points** | Check box | Activates logging of offset points.<br>☞ All other fields on the screen are active and can be edited with this setting. |
| **Horiz distance** | Editable field | The horizontal offset between -1000 m and 1000 m at which the offset point is collected. |
| **Height offset** | Editable field | The height offset between -100 m and 100 m from the related auto point. |
| **Identifier** | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the auto point. This ID is then used as the point ID for the related offset point. This functionality could support an automatic workflow into CAD packages including setting symbols and stringing lines. |
| **Prefix/suffix** | **Prefix** | Adds the setting for **Identifier** in front of the auto point ID. |
| | **Suffix** | Adds the setting for **Identifier** at the end of the auto point ID. |

**Next step**

**Page** changes to the **Code** page.

**Auto Points - Offset 1, Code page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **+Attrib** | To create additional attributes for the selected code. Available if **Use a list box to view codes** is checked. |
| **Name** or **Value** | To highlight the attribute field or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. Available if **Use a list box to view codes** is checked. Available for attributes for which an attribute name can be typed in. |
| **Last** | To recall the last used attribute values for the selected code. Available if **Use a list box to view codes** is checked. |
| **Default** | To recall the default attribute values for the selected code. Available if **Use a list box to view codes** is checked. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point code** | Selectable list | The thematical code for the offset point. Available if **Use a list box to view codes** is checked. The attributes are shown as display only, editable field or selectable list fields depending on their definition. |
| **Code** | Editable field | The thematical code for the offset point. Available if **Use a list box to view codes** is checked. Codes can be typed in but not selected from a codelist. A check is performed to see if a point code of this name already exists in the job. If so, the according attributes are shown. |
| **Description** | Display only | Available if **Use a list box to view codes** is checked. The description of the code. |
| Attributes | Editable field | Available if **Use a list box to view codes** is checked. Up to three attribute values can be stored. |

**Next step**

| IF | THEN |
| --- | --- |
| offset point configuration is finished | **OK** to return to the survey screen. |
| a second offset point is to be configured | **Page** and then **Offst2..** or **Offst1..** to change to configuration screen for the second point. |

**Example for offset point IDs**

The offset point ID is a combination of the auto point ID and an identifier as a prefix or suffix.
The right most part of the auto point ID is incremented within the point ID. If the length of the auto point ID plus identifier is greater than 16 characters, then the auto point ID is truncated from the left.

| Auto point ID | Identifier | Prefix/Suffix | Offset point ID |
| --- | --- | --- | --- |
| Auto1234<br>Auto1235 | OS1 | Prefix | OS1Auto1234<br>OS1Auto1235<br>... |
| Auto1234<br>Auto1235 | OS1 | Suffix | Auto1234OS1<br>Auto1235OS1<br>... |

☞ Refer to "25.1 ID templates" for more information on point IDs.

# 60 Survey Cross Section

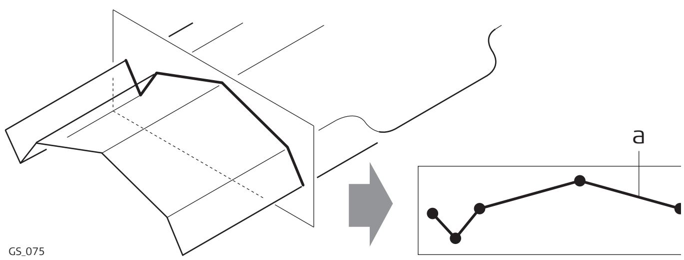
## 60.1 Overview

**Description**

The Survey Cross Section application allows for the automatic changing of codes during a survey. This function is useful when surveying multiple cross sections. Examples could include surveys of railway lines, roads, small waterways, driveways and paths.

The codes for the elements in the cross section to be surveyed are all stored and pre-defined in a template. The codes are then automatically changed after each point observation.

**Diagram**




a) Cross section element

**Template**

Templates are used to pre-define the order of the codes for the survey.
A template pre-defines

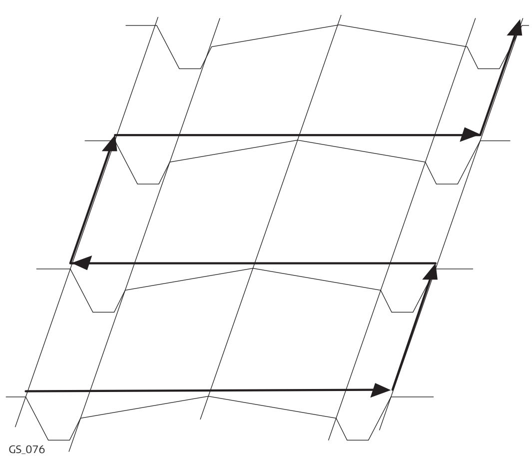
- the coding sequence of a cross section.
- the type of coding.

**Cross section methods and directions**

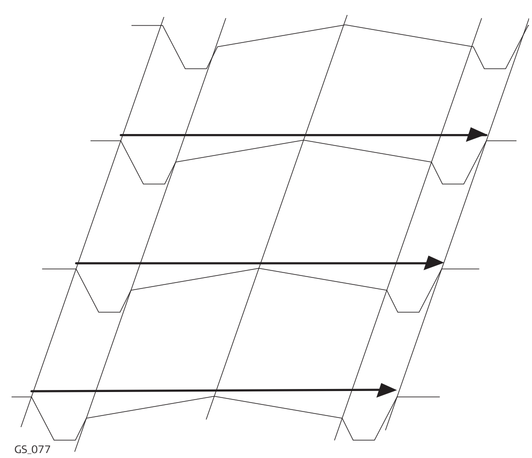
Templates can be applied

- to the ZigZag method or the Same Direction method.
- in either a forward direction or in a backward direction.

**ZigZag**




**Same Direction**




☞ Survey Cross Section is possible for RTK rover and TPS.

| | |
|---|---|
| **Coding of cross section elements** | Codes can be attached to cross section elements. Refer to "26 Coding" for information on coding.<br>• Thematical coding: Available<br>• Free coding: Available<br>• Quick coding: Not available |
| **Averaging of cross section elements** | The principles for averaging are identical to the principles use in the Survey application. Refer to "6.3.3 Mean Page" for information on averaging. |
| **Exporting data** | The points and lines are recorded as for all other applications. The data can be exported as normal. |

## 60.2 Accessing Survey Cross Section

**Access**

Select **Main Menu: Go to Work!\Survey+\Survey cross section**.

**Description**

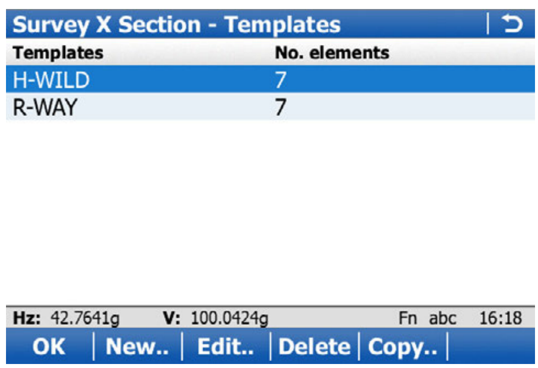
Cross section templates
- pre-define the sequence of codes for a cross section.
- consist of elements.

Elements can be defined such that the surveyed points of a cross section are
- stored with a point code.
- stored with a free code.

During the process of surveying a cross section, the code for the next element to be measured is then selected and suggested automatically.

**Survey X Section - Templates**

All cross section templates stored in the working job are listed in alphabetical order, including the number of elements in each cross section template.




| Key | Description |
|---|---|
| **OK** | To select the highlighted cross section template and to start surveying a cross section. |
| **New..** | To create a cross section template. |
| **Edit..** | To edit the highlighted cross section template. |
| **Delete** | To delete the highlighted cross section template. |
| **Copy..** | To create a cross section template based on the one currently highlighted. |
| Fn **Quit** | To exit the application. |

## 60.3 Creating/Editing a Cross Section Template

**Access**

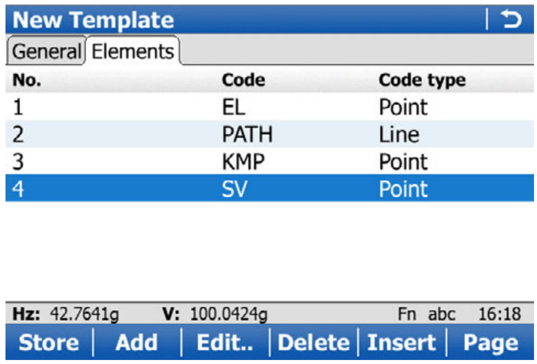
In **Survey X Section - Templates**, press **New..**, **Copy..** or **Edit..**.

**New Template/Edit Template/Copy Template, General page**

Type in a name for the new cross section template.

**Next step**
**Page** changes to the **Elements** page.

**New Template/Edit Template/Copy Template, Elements page**




| Key | Description |
|---|---|
| **Store** | To store the cross section template and to return to the screen from where this screen was accessed. |
| **Add** | To add one or more elements to the end of the current list. |
| **Edit..** | To edit the highlighted element. |
| **Delete** | To delete the highlighted element from the list. |
| **Insert** | To insert one element before the currently highlighted element of the list. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

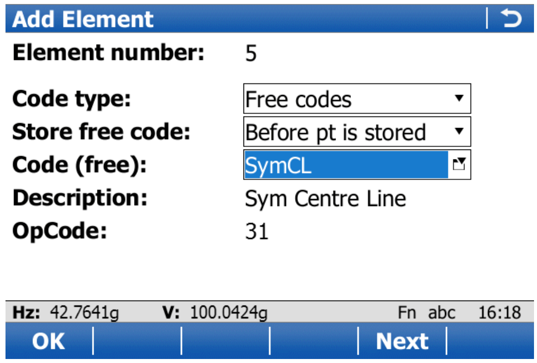
**Description of columns**

| Field | Description |
|---|---|
| **No.** | The number of the element. |
| **Code** | The code assigned to the element.<br>If no code is assigned to the element, **-----** is displayed. |
| **Code type** | The type of the code assigned to the element. |

**Next step**
**Add**, **Edit..** or **Insert** accesses **Add Element**/**Edit Element**/**Insert Element**.

## Add Element/Edit Element/Insert Element

The functionality of the screens adding, editing and inserting an element are similar. Differences are outlined.




| Key | Description |
|---|---|
| **OK** | To add the element at the end of the cross section template or to store the changes. To return to the screen from where this screen was accessed. |
| **Next** | In **Add Element**: To add the element to the end of the **Elements** list and stay in the **Add Element** screen to add further elements.<br>In **Edit Element**: To update the element in the **Elements** list and stay in the **Edit Element** screen to edit details of the next element in the list. |
| **Prev** | Available in **Edit Element**. To update the element in the **Elements** list and stay in the **Edit Element** screen to edit details of the previous element in the list. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Element number** | Display only | For **Add Element** and **Insert Element**: The number of the element to be added.<br>For **Edit Element**: Displayed as x/y.<br>x Number of the element to be edited.<br>y Total number of elements on the active template. |
| **Code type** | | The type of code to be used with the element. |
| | **Free codes** | To store a code independent of the element as time-related information. |
| | **Thematic codes** | To store a code together with the element. |
| **Store free code** | **After pt is stored** or **Before pt is stored** | Determines if a free code is stored before or after the point. Available for **Code type: Free codes**. |
| **Code (free)** | Selectable list | The code which will be stored before or after the point/line. Available for **Code type: Free codes**. |
| **Code** | Selectable list | The code which will be stored with the next point/line. Available for **Code type: Thematic codes**. |
| **Description** | Display only | A line for a detailed description of the code. |

**Next step**

**OK** adds the element or stores the changes.

## 60.4 Surveying Cross Sections

**Description**

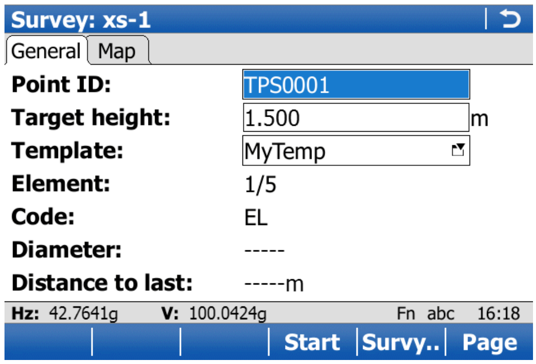
The fields on this screen indicate which cross section element is to be surveyed next.

**Access**

Press **OK** in **Survey X Section - Templates**.

**Survey, General page**

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.




| Key | Description |
|---|---|
| **Meas** | Available if a template has been opened with **Start**. GPS To start measuring the next point of the cross section. The key changes to **Stop**. TPS To measure a distance and store distance and angles. |
| **Stop** GPS | To end measuring the point. The key changes to **Store**. |
| **Store** | GPS To store the measured point. The key changes to **Meas**. TPS To store angles and distance. Distance must be measured before. |
| **Dist** TPS | To measure a distance. |
| **Start** and **End** | To open and close the selected cross section template. While the template is open, the elements of the cross section can be surveyed. |
| **Survy..** | To manually measure a point that is not part of the cross section. The point is not treated as an element of the cross section. The open template remains open. Available if a template has been opened with **Start**. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Cross Section Survey application. Refer to "60.5 Configuring Survey Cross Section". |
| Fn **Prev** | To select the previous element of the cross section template. The currently measured element will not be stored. Available when **End** is displayed. |
| Fn **Next** | To select the next element of the cross section template. The currently measured element will not be stored. Available when **End** is displayed. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways:<br>• To start a new sequence of point IDs type over the point ID.<br>• For an individual point ID independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Antenna ht** | Editable field | GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **Target height** | Editable field | TPS The default prism height. |
| **Template** | | The active template for the cross section. |
| | Selectable list | The cross section template is closed.<br>Opening the selectable list accesses **Survey X Section - Templates** where a new template can be created and an existing template can be selected or deleted. Refer to "60.3 Creating/Editing a Cross Section Template". |
| | Display only | The cross section template is open. |
| **Element** | Display only | Displayed as x/y.<br>x The number of the next element on active template. The number increases/decreases as moving across the cross section depending on the selection for **Method** in **Configuration**.<br>y Total number of elements on active template. |
| **Code** | Display only | The name of the code.<br>Point codes will be stored with the measured point.<br>Free codes will be stored, depending on the configuration, before or after the measured point. |
| **Distance to last** | Display only | The horizontal distance from the current position to the last surveyed element position in the previous cross section. **-----** is displayed for unavailable information. |

**Next step**

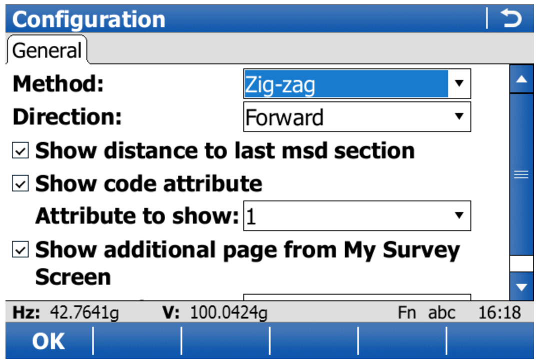
| IF | THEN |
|---|---|
| a cross section template is to be opened | select the desired template and press **Start**. |
| an element of a cross section is to be surveyed | GPS **Meas**, **Stop** and then **Store**.<br>TPS **Meas**, or **Dist** and then **Store**.<br>☞ Once the end of a cross section is surveyed then the next cross section will be measured. Depending on the **Method** selected in **Configuration**, **General** page, the measurement is either in the same direction or in the reverse direction. |
| a cross section template is to be closed | select the desired template and press **End**. |
| data is to be viewed graphically | **Page**. An element of a cross section template can also be surveyed from the **Map** page.<br>Refer to "38 MapView Interactive Display Feature" for information on the functionality and softkeys available. |
| the application is to be exited | Fn **Quit**. |

## 60.5 Configuring Survey Cross Section

**Access**

In the survey screen of the cross section application, press **Config..**.

**Configuration, General page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Config..** | To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "25.3 My Survey Screen". |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Method** | | Method by which subsequent cross sections will be surveyed. Refer to "60.1 Overview" for a diagram. |
| | **Zig-zag** | Each new cross section is started at the same end as where the previous cross section finished. |
| | **Same direction** | Each new cross section is started at the same end as where the previous cross section started. |
| **Direction** | | The way of surveying the cross section. This influences in which order the elements of a template will be applied. Refer to "60.1 Overview" for a diagram. |
| | **Forward** | The cross sections will be surveyed in the same way as the elements are defined in the selected template. |
| | **Backward** | The cross sections will be surveyed in the reverse way as the elements are defined in the selected template. |
| **Show distance to last msd section** | Check box | Activates a display only field in the survey screen. The horizontal distance from the current position to the last surveyed element position in the previous cross section will be displayed. |
| **Show code attribute** | Check box | When this box is checked, some attribute fields are displayed in the survey screen. Useful if the surveyor is stringing, to see that the correct string attribute value is being used. |
| **Attribute to show** | From **1** to **20** | The number of attribute fields which is displayed in the survey screen. Available when **Show code attribute** is checked. |
| **Show additional page from My Survey Screen** | Check box | When this box is checked, a user-defined survey screen page is shown in the survey screen. |
| **Page to show** | Selectable list | The names of the available survey screen pages. Available when **Show additional page from My Survey Screen** is checked. |

#### Next step

**OK** returns to the screen from where this screen was accessed.

# 61 Survey - Hidden Points GPS

## 61.1 Overview

**Description**

Hidden points are points which cannot be measured directly by GPS, because, either they cannot be physically reached, or because satellites are obstructed, for example by trees or tall buildings.

- A hidden point can be calculated by measuring distances and/or azimuths to the hidden point using a hidden point measurement device. Or for distances a tape can be used.
- Additional auxiliary points can be manually measured.
- Bearings can be computed from previously measured points.

In contrast to the COGO application, hidden point measurements is more of a measuring application than a calculation application.

**Example**

| | |
|---|---|
| Application: | Completing a survey of telegraph poles for a telecommunication company. |
| Aim: | The telegraph poles must be surveyed to 0.3 m accuracy in plan but height is not of concern. |
| Use of hidden point measurements: | For poles surrounded by heavy undergrowth, where it is not possible to measure the pole directly without taking time to cut a path through the undergrowth. |

☞ Changing coordinates of a point which has been previously used in hidden point measurements does not result in the hidden point being recomputed.

**Hidden point measurement methods**

A hidden point can be measured by

- Bearing and distance
- Two bearings
- Two distances
- Chainage and offset
- Backwards bearing and distance

☞ A hidden point measurement device can be attached to the instrument such that the measurements are automatically transferred to the instrument.

**Heights**

If configured, heights are taken into account. Refer to "61.7 Hidden Point Measurement Including Heights" for information on configuring height offsets.
**Device height** and **Target height** configured in **Hidden Point Device Offsets** are applied when the hidden points are computed. **Δ height** in **Hidden Point Connection** is the value directly from the hidden point measuring device.

**Coding of hidden points**

- Thematical coding: Available in **Hidden Point Result** after the calculation of a hidden point. Thematical coding of hidden points is identical to coding of manually measured points.
- Free coding: Can be started while in **Hidden Point Connection**. Free coding of hidden points is identical to coding of manually measured points.
- Quick coding: Not available.

| | |
|---|---|
| **Averaging of hidden points** | An average is calculated for hidden points if a point of class **Meas** already exists with the same point ID. |
| ☞ | **Azimuth** is used throughout this chapter. This term must always be considered to mean also **Bearing**. |
| **Auxiliary points** | Auxiliary points are used to compute azimuths required for the calculation of hidden point coordinates. Auxiliary points can be points existing in the job or they can be manually measured. The point ID template configured for **Auxiliary points** in **ID Templates** is applied. |

## 61.2 Hidden Point Methods

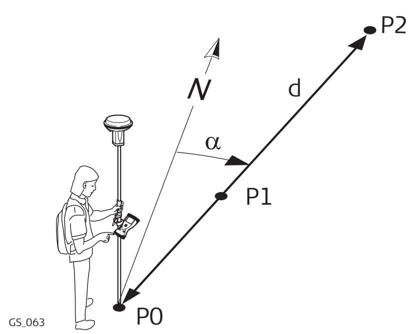
### 61.2.1 Bearing & Distance

**Description**

One point must be known. It
- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distance and the bearing from the known point to the hidden point are to be determined. An auxiliary point helps compute the bearing which might not be known. The auxiliary point can be determined in the direction from the known point to the hidden point.

**Diagram**




**Known**
P0 Known point
**To be measured**
d Distance from P0 to P2
α Bearing from P0 to P2
P1 Auxiliary point, optional
**Unknown**
P2 Hidden point

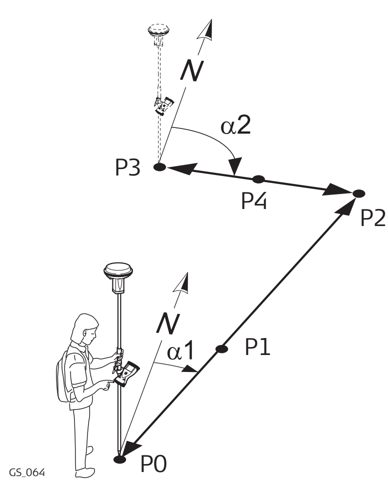
### 61.2.2 Using 2 Bearings

**Description**

Two points must be known. They
- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The bearings from the known points to the hidden point are to be determined. Auxiliary points help compute the bearings which might not be known. Auxiliary points can be measured in the direction from the known points to the hidden point.

**Diagram**




**Known**
P0 First known point
P3 Second known point
**To be measured**
α1 Bearing from P0 to P2
α2 Bearing from P3 to P2
P1 First auxiliary point, optional
P4 Second auxiliary point, optional
**Unknown**
P2 Hidden point

## 61.2.3 Using 2 Distances

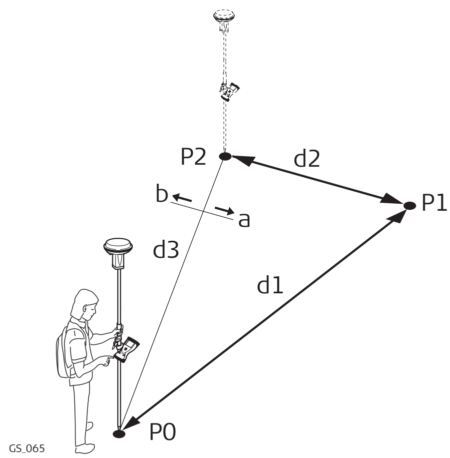
**Description**

Two points must be known. They

- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distances from the known points to the hidden points are to be determined. The location of the hidden point relative to the line between the two known points is to be defined.

**Diagram**




**Known**
P0 First known point
P2 Second known point
d3 Line from P0 to P2
a Right of d3
b Left of d3
**To be measured**
d1 Distance from P0 to P1
d2 Distance from P2 to P1
**Unknown**
P1 Hidden point

## 61.2.4 Chainage & Offset

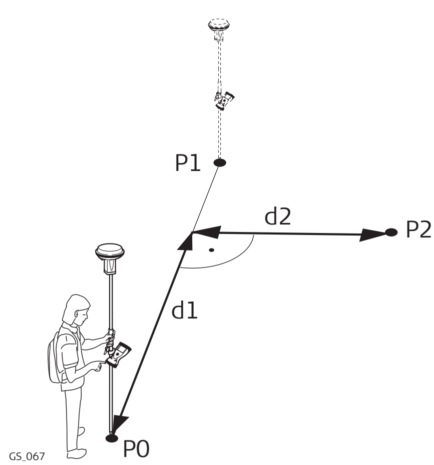
**Description**

Two points must be known. They

- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The chainage from one known point along the line between the two known points must be determined. The offset of the hidden point to the line between the two known points must be determined.

**Diagram**




**Known**
P0 First known point
P1 Second known point
**To be measured**
d1 Chainage
d2 Offset
**Unknown**
P2 Hidden point

## 61.2.5 Backwards Bearing & Distance

**Description**

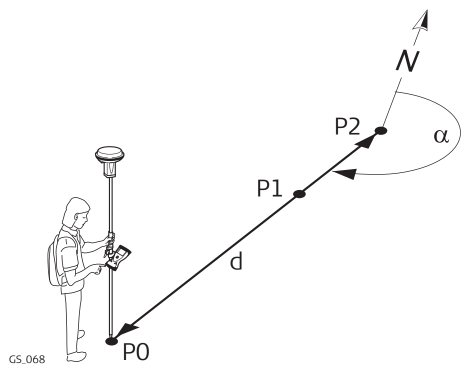
In order to compute the hidden point, the measurements are taken from the hidden point.

One point must be known. It

- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distance and the bearing from the hidden point to the known point are to be determined. An auxiliary point helps compute the bearing which might not be known. An auxiliary point can be measured in the direction from the hidden point to the known point.

**Diagram**




**Known**

P0 Known point

**To be measured**

α Bearing from P2 to P0

d Distance from P2 to P0

P1 Auxiliary point, optional

**Unknown**

P2 Hidden point

# 61.3 Hidden Point Measurements

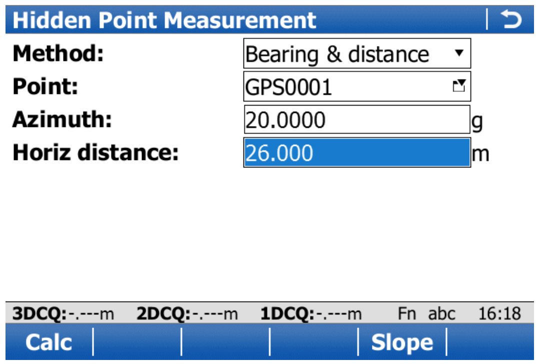
☞ Hidden point measurements are possible from the Survey application and when the Survey application screen is called from another application, for example from Stakeout.

**Access**

Press **HdnPt..** in the survey screen.

**Hidden Point Measurement**

The setting for **Method** on this screen determines the availability of the subsequent fields and softkeys.




| Key | Description |
|---|---|
| **Calc** | To calculate the hidden point and to display the results. |
| **EAO** | Available for **Angle offset: New for each point** or **Angle offset: Permanent** in **Hidden Point Device Offsets**. To change or enter an **E**xternal **A**ngle **O**ffset. |
| **Hts..** | To type in the device and target heights to be considered. |
| **Sun** | Available when **Azimuth** is highlighted. The azimuth from the direction of the sun to the known point is computed. |
| **Azmth** | Available when **Azimuth** is highlighted. To select or manually measure an auxiliary point and to compute the azimuth. |
| **Posn ?** | To determine chainage and offset of the current position relative to the line between the two known points. The values are displayed in **Chainage** and **Offset**. The point from where the chainage has been measured is selected in **Chainage from**. |
| **Slope** | Available when **Horiz distance** or **Chainage** is highlighted. To measure a slope distance and an elevation angle or percentage grade. The values are used to compute the horizontal distance. |
| **Survy..** | Available when a point field is highlighted. To measure the known point manually for the calculation of the hidden point. |
| Fn **Config..** | To configure hidden point measurements. Refer to "19 Connections.. - All other connections". |
| Fn **Quit** | To exit the screen. |

### Description of fields

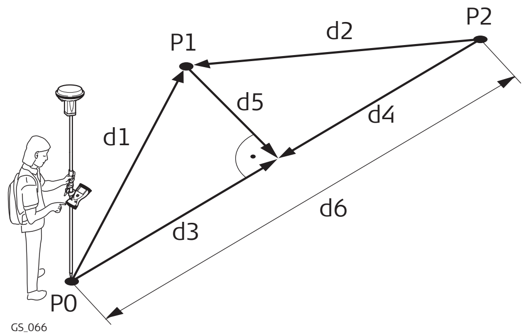
| Field | Option | Description |
|---|---|---|
| **Method** | Selectable list | The method for measuring hidden points. Refer to "61.2 Hidden Point Methods" for a description of the methods. |
| **Point** | Selectable list | The point ID of the current position. This point is the known point for the calculation of the hidden point.<br>☞ To type in coordinates manually for the known point open the selectable list and create a new point. |
| **Point A** | Selectable list | The point ID of the current position. This point is the first known point for the calculation of the hidden point.<br>☞ To type in coordinates manually for the known point open the selectable list and create a new point. |
| **Point B** | Selectable list | The point ID of the current position. This point is the second known point for the calculation of the hidden point.<br>☞ To type in coordinates manually for the known point open the selectable list and create a new point. |
| **Azimuth** | Editable field | The azimuth from the known point to the hidden point. Type in an azimuth. When a hidden point measurement device is attached to the instrument to measure the azimuth, the value is automatically transferred. |
| **Horiz distance** | Editable field | The horizontal distance from the known point to the hidden point. Type in a distance. When a hidden point measurement device is attached to the instrument to measure the distance, the value is automatically transferred. |
| **Location** | Selectable list | Available for **Method: Using 2 distances**. The location of the hidden point relative to the line from **Point A** to **Point B**. |
| **Chainage from** | Selectable list | Available for **Method: Chainage & offset**. The chainage from one known point along the line between the two known points. Looking from the point selected in **Chainage from**, a positive chainage is towards the second known point. A negative chainage is into the opposite direction of the second known point. |

### Next step

**Calc** calculates the hidden point and displays the results in **Hidden Point Result**.

## 61.4 Hidden Point Results

**Computed distances on Hidden Point Result**




P0 First known point
P1 Hidden point
P2 Second known point
d1 Distance from P0 to P1
d2 Distance from P2 to P1
d3 **Check chainage A**
d4 **Check chainage B**
d5 **Check offset**
d6 **Check distance AB**

**Hidden Point Result**

| Key | Description |
|---|---|
| **Store** | To store the result. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. |
| **Next** | To store the hidden point and to return to **Hidden Point Measurement**. Another hidden point can be measured. |
| Fn **Quit** | To not store the hidden point and to exit the screen. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for the hidden point. The configured point ID template is used. The ID can be changed. Type in a point ID. |
| **Check distance AB** | Display only | Available for **Method: Using 2 bearings** and **Method: Using 2 distances**. The computed horizontal distance between **Point A** and **Point B**. |
| **Check bearing AB** | Display only | Available for **Method: Using 2 bearings** and **Method: Chainage & offset**. The computed bearing from **Point A** to **Point B**. |
| **Check distance A** | Display only | Available for **Method: Using 2 bearings** and **Method: Chainage & offset**. The computed horizontal distance between **Point A** and the hidden point. |
| **Check distance B** | Display only | Available for **Method: Using 2 bearings** and **Method: Chainage & offset**. The computed horizontal distance between **Point B** and the hidden point. |
| **Check chainage A** | Display only | Available for **Method: Using 2 distances**. The computed distance on the line from **Point A** to **Point B** from **Point A** to the point of intersection with **Check offset**. |
| **Check chainage B** | Display only | Available for **Method: Using 2 distances**. The computed distance on the line from **Point B** to **Point A** from **Point B** to the point of intersection with **Check offset**. |
| **Check offset** | Display only | Available for **Method: Using 2 distances**. The computed perpendicular distance from the hidden point to the line from **Point A** to **Point B**. |

#### Next step

On the **Code** page, type in a code if desired.

On the **Map** page, measured distances are indicated by solid arrows, bearings are indicated by half solid and half dashed arrows.

**Store** stores the hidden point.

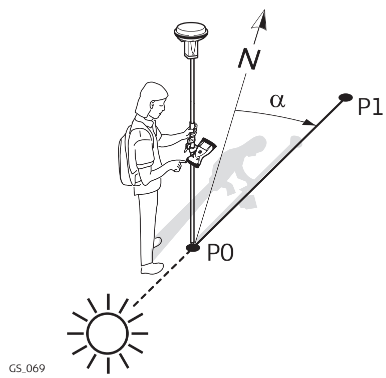
# 61.5 Computing an Azimuth

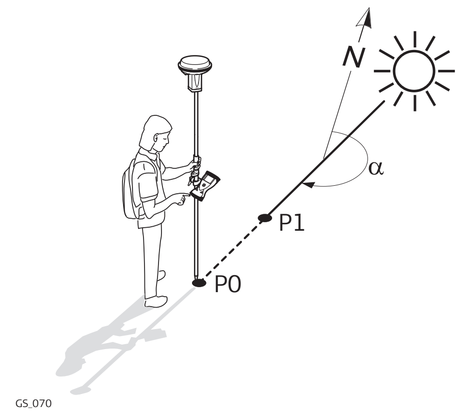
## 61.5.1 Using the Sun

**Description**

The azimuth for a hidden point measurement can be computed using a known point and the sun. The known point can be manually measured. The location of the hidden point can be away from the sun or in the direction towards the sun. Ensure that the shadow of the pole falls in the direction of the point.

**Diagram**




| | |
|---|---|
| P0 | Known point |
| P1 | Hidden point |
| α | Bearing from P0 to P1 |

| | |
|---|---|
| P0 | Known point |
| P1 | Hidden point |
| α | Bearing from P0 to P1 |

**Requirements**

**Bearing & distance**, **Using 2 bearings** or **Back brng & distance** must be selected for **Method**.

**Access**

In **Hidden Point Measurement** highlight **Azimuth**. Press **Sun**.
Follow the instructions on the screen.

## 61.5.2 Using Auxiliary Point

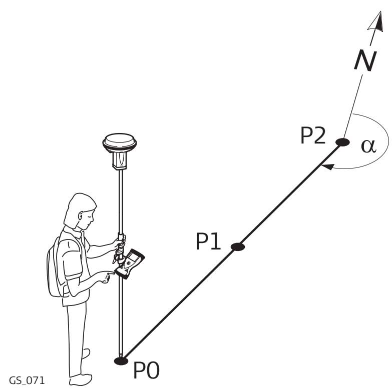
**Description**

The azimuth for a hidden point measurement can be computed using an auxiliary point. The auxiliary point

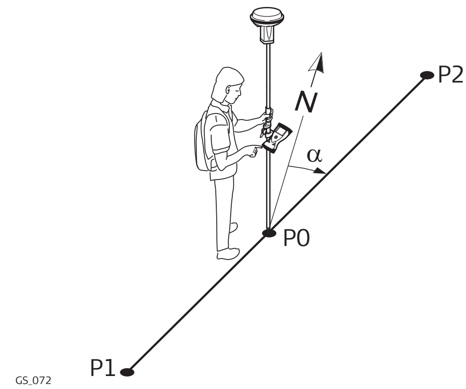
- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The location of the auxiliary point can be in the direction towards the hidden point or away from the hidden point.

**Diagram**




P0 Known point
P1 Auxiliary point, **Azimuth Pt**
P2 Hidden point
α Bearing from P2 to P0




P0 Known point
P1 Auxiliary point, **Azimuth Pt**
P2 Hidden point
α Bearing from P0 to P2

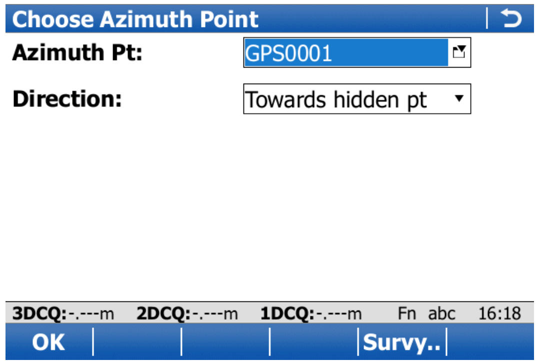
**Requirements**

**Bearing & distance**, **Using 2 bearings** or **Back brng & distance** must be selected for **Method**.

**Access**

In **Hidden Point Measurement** highlight **Azimuth**. Press **Azmth**.

## Choose Azimuth Point




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. The azimuth is computed and displayed in **Azimuth** in **Hidden Point Measurement**. |
| **Survy..** | Available for **Azimuth Pt** being highlighted. To measure the auxiliary point manually for the calculation of the azimuth. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Azimuth Pt** | Selectable list | The auxiliary point for the calculation of the azimuth. |
| **Direction** | Selectable list | The location of the auxiliary point relative to the hidden point. |

### Next step

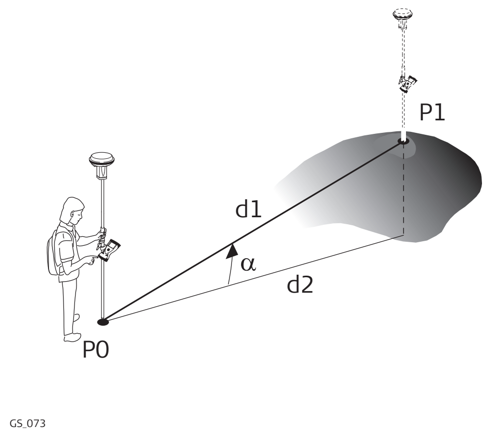
**OK** closes the screen.

## 61.6 Computing Horizontal Distances from Slope Distances

**Description**

The horizontal distance for a hidden point measurement can be computed using a slope distance, and an elevation angle or percentage grade. The slope distance and the elevation angle can either be typed in or measured with a hidden point measurement device.

**Diagram**




P0 Known point
P1 Hidden point
d1 Slope distance
d2 Horizontal distance
α Elevation angle

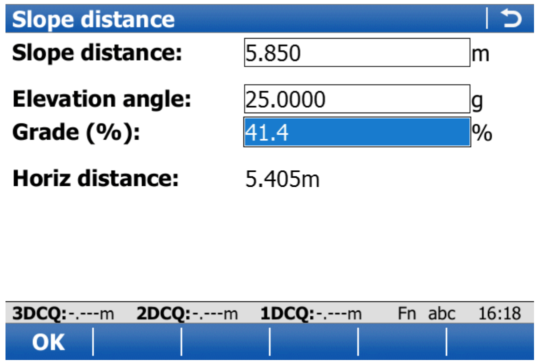
**Requirements**

**Bearing & distance**, **Using 2 bearings** or **Back brng & distance** must be selected for **Method**.

**Access**

In **Hidden Point Measurement** highlight **Horiz distance**. Press **Slope**.

**Slope distance**




| Key | Description |
|---|---|
| **OK** | To take over the result. |
| Fn **Quit** | To exit the screen. |

### Description of fields

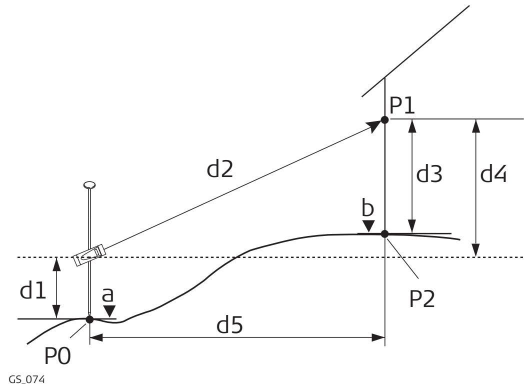
| Field | Option | Description |
|---|---|---|
| **Slope distance** | Editable field | Type in a distance from the known point to the hidden point. When a hidden point measurement device is attached to the instrument to measure the distance, the value is automatically transferred. |
| **Elevation angle** | Editable field | Type in the elevation angle from the known point to the hidden point. When a hidden point measurement device is attached to the instrument to measure the elevation angle, the value is automatically transferred. |
| **Grade (%)** | Editable field | The grade from the known point to the hidden point is automatically computed from the slope distance and the elevation angle. The value for **Grade (%)** can be typed in instead of the value for **Elevation angle**. Then **Elevation angle** is computed automatically. |
| **Horiz distance** | Display only | The horizontal distance from the known point to the hidden point is automatically computed from the slope distance and the elevation angle. |
| **Δ height** | Display only | Available if using heights is configured. The height difference between the known point and the hidden point is automatically computed from the slope distance and the elevation angle. |

### Next step

**OK** returns to **Hidden Point Measurement**. The horizontal distance is displayed in **Horiz distance**.

## 61.7 Hidden Point Measurement Including Heights

**Diagram**




| | |
|---|---|
| P0 | Known point |
| P1 | Target point |
| P2 | Hidden point |
| a | Height of P0 |
| b | Height of P2 = a + d1 + d4 - d3 |
| d1 | Device height: Height of hidden point measurement device above P0 |
| d2 | Slope distance |
| d3 | Target height: Height of P1 above P2 |
| d4 | Height difference between hidden point measurement device and P1 |
| d5 | Horizontal distance |

**Configuration step-by-step**

| Step | Description |
|---|---|
| 1. | **Compute height for hidden points** is checked in **Configuration**. |
| 2. | **Height offset: Device & target ht** in **Hidden Point Device Offsets**. |

**Hidden Point Measurement**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Δ height** | Selectable list | The positive or negative height difference between the centre of the hidden point measurement device and the target point. Type in the value. When a hidden point measurement device is attached to the instrument to measure the height difference, the value is automatically transferred.<br>☞ For hidden point measurement methods using two known points, **Δ height** must be determined from each known point.<br>Refer to "61.3 Hidden Point Measurements" for a description of all other fields on the screen. |

**Next step**

Press **Hts..**.

**Device & Target Height**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Device ht at pt A** | Editable field | The height of the hidden point measurement device above **Point A**. |
| **Target height** | Editable field | The height of the target point above the hidden point when measured from **Point A**. |
| **Device ht at pt B** | Editable field | Available for hidden point measurement methods using two known points. The height of the hidden point measurement device above **Point B**. |
| **Target height** | Editable field | Available for hidden point measurement methods using two known points. The height of the target point above the hidden point when measured from **Point B**. |

### Next step

**OK** closes the screen and returns to **Hidden Point Measurement**.

There, **Δ height** still displays the positive or negative height difference between the centre of the hidden point measurement device and the target point. The heights of the hidden point measurement device above the ground, and the target point above the hidden point, are applied when the hidden point is computed. For hidden point measurement methods using two known points, this computation is done for each known point. In this case, the height of the hidden point is the average.

# 62 Hidden Point TPS

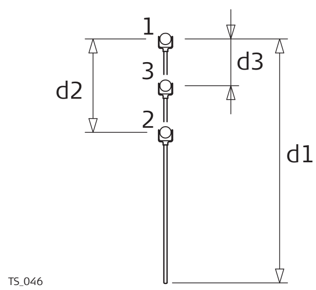
## 62.1 Overview

**Description**

Hidden points cannot be measured directly by a TPS instrument, because they are not directly visible.
A hidden point can be calculated from measurements to prisms mounted on a hidden point rod. The spacing and length of the hidden point rod are known. The hidden point rod can be held at any angle, as long as it is stationary for all measurements.
Measurements for the hidden point are calculated as if the hidden point was observed directly. These calculated measurements can also be recorded.
The hidden point rod can have either two or three prisms. If three prisms are used the average will be calculated.

**Hidden point rod**

The prisms on the hidden point rod are also called auxiliary points after they have been measured.




| | |
|---|---|
| 1 | Prism 1 |
| 2 | Prism 2 |
| 3 | Prism 3 |
| d1 | Rod length |
| d2 | Distance from prism 1 to prism 2 |
| d3 | Distance from prism 1 to prism 3 |

**Hidden point tasks**

The Hidden Point application can be used for the following tasks:

- The hidden point application can be used to obtain accurate three-dimensional coordinates for a point that is blocked from direct measurement by an obstruction.
- Determination of flow line locations and elevations in manholes, without measuring from the manhole rim to the flow line, and then estimating corrections for nonverticality of the measuring tape and eccentricity from the rim measurement to the flow line.
- Determination of recesses in building corners for detailed surveys, without estimating right angle offsets, with or without taping of the dimensions.
- Measurements behind overhangs, buttresses and columns for quantity determinations in underground construction or mining, without estimating right angle offsets, with or without taping of the dimensions.
- Measurements of industrial process piping or other equipment in close quarters.
- Detailed architectural surveys for remodelling or cultural preservation or restoration work
- Any place where accurate measurements would require many more instrument setups in order to achieve line of sight from the instrument to the points being measured.

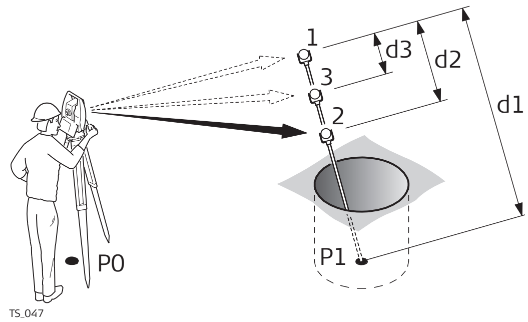
☞ The TPS Hidden Point application does not generate a report sheet.

## 62.2 Accessing Hidden Point and Measuring

**Access**

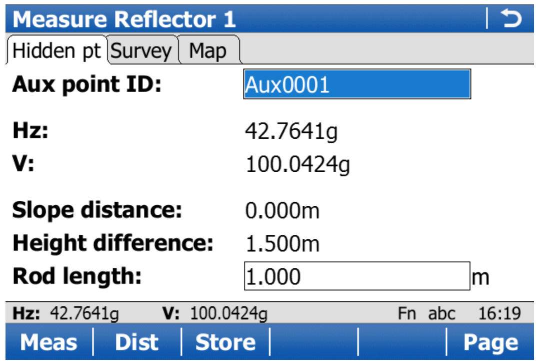
Select **Main Menu: Go to Work!\Survey+\TPS hidden point**.

**Diagram**




d1 Rod length
d2 Distance from prism 1 to prism 2
d3 Distance from prism 1 to prism 3

**Measure Reflector 1, Hidden pt page**




| Key | Description |
|---|---|
| **Meas** | To measure and store the prism, and access the next screen. |
| **Dist** | To measure a distance. |
| **Store** | To store data. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the **TPS hidden point** application. Refer to "62.3 Configuring Hidden Point". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

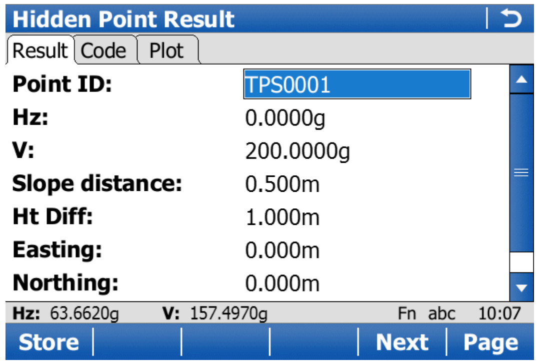
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Aux point ID** | Editable field | The point ID of the auxiliary point, the prism on the hidden point rod. The Auxiliary Points ID template is used. |
| **Hz** | Display only | The horizontal angle to prism 1, the auxiliary point, is displayed. |
| **V** | Display only | The vertical angle to prism 1, the auxiliary point, is displayed. |
| **Slope distance** | Display only | The slope distance to prism 1, the auxiliary point, is displayed. |
| **Height difference** | Display only | The height difference to prism 1, the auxiliary point, is displayed. |
| **Rod length** | Editable field | The length of the rod can be adjusted before the hidden point result is displayed. The rod length always keeps the distances R1-R2 for two prisms and R1-R3 for three prisms into account. |

### Next step

Take the measurements to prism 2 and, if desired, to prism 3. After the last prism of the hidden point rod is measured, **Hidden Point Result**, **Result** page is accessed.

**Hidden Point Result, Result page**




| Key | Description |
|---|---|
| **Store** | To measure the prism and exit the application. |
| **Next** | To store the hidden point and to access **Measure Reflector 1** to take more hidden point measurements. |
| **Page** | To change to another page on this screen. |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The name of the hidden point. The configured point ID template is used. |
| **Hz** | Display only | The calculated horizontal angle to the computed hidden point. **-----** is displayed for unavailable information. |
| **V** | Display only | The calculated vertical angle to the computed hidden point. **-----** is displayed for unavailable information. |
| **Slope distance** | Display only | The calculated slope distance to the computed hidden point. **-----** is displayed for unavailable information. |
| **Height difference** | Display only | The calculated height difference from instrument to computed hidden point. **-----** is displayed for unavailable information. |
| **Easting**, **Northing** and **Height** | Display only | The calculated coordinates of the computed hidden point. **-----** is displayed for unavailable information. |

### Next step

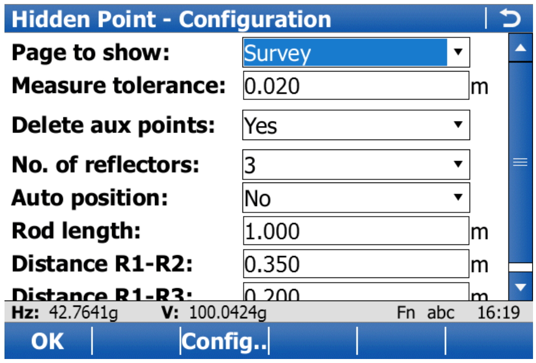
**Page** changes to the **Code** page. Type in a code if desired. **Page** changes to the **Plot** page. Measured distances are indicated by solid arrows.

# 62.3 Configuring Hidden Point

**Access**

Select **Main Menu: Go to Work!\Survey+\TPS hidden point**. Press Fn **Config..**.

**Configuration**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Config..** | To configure the selected survey screen page. Refer to "25.3 My Survey Screen". |
| Fn **About** | To display information about the program name, the version number, the date of the version, the copyright and the article number. |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Page to show** | Selectable list | The user-defined survey screen page to be shown in **Measure Reflector 1**, **Measure Reflector 2** and **Measure Reflector 3**. |
| **Measure tolerance** | Editable field | Limit of the difference between input and measured spacing of the prisms.<br>☞ For three prisms being used, limit for maximum deviation of the three measurements. |
| **Delete aux points** | **Yes** or **No** | The auxiliary points are deleted when the hidden point is stored.<br>The auxiliary points are prism 1, prism 2 and prism 3 of the hidden point rod.<br>The Auxiliary Points ID template is used for the auxiliary points. The Survey Points ID template is used for the computed hidden point. |
| **No. of reflectors** | **2** or **3** | Two or three prisms are used on the rod. |
| **Auto position** | **Yes** or **No** | Available for **No. of reflectors: 3**. The third prism is aimed at automatically. |
| **Rod length** | Editable field | Total length of hidden point rod. |
| **Distance R1-R2** | Editable field | Spacing between the centres of prism 1 and prism 2. |
| **Distance R1-R3** | Editable field | Available for **No. of reflectors: 3**. Spacing between the centres of prism 1 and prism 3. Prism 3 is situated between prism 1 and prism 2. |

### Next step

**OK** returns to the screen from where this screen was accessed from.

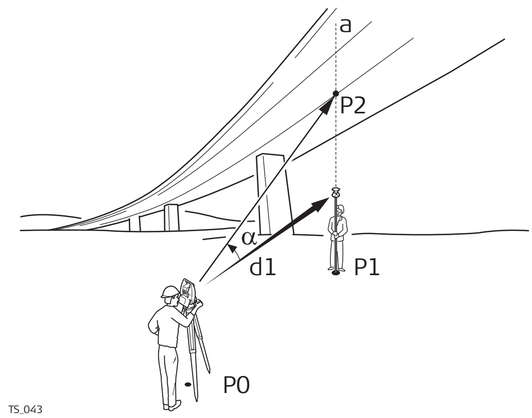
# 63 Survey - Remote Point TPS

## 63.1 Overview

**Description**

Remote point is used to determine the 3D coordinates of inaccessible points, for example on bridges. The horizontal distance to a base point directly underneath or above the remote point is measured. Then the instrument is aimed at the remote point. The coordinates of the remote point are calculated with the distance measured to the base point and the angles measured to the remote point.

**Diagram**




P0 Instrument station
P1 Base point
P2 Remote point
d1 Horizontal distance to the base point
α Vertical angle between base point and remote point
a Vertical axis from P1 to P2

☞ To ensure correct results, the remote point and the prism must be lined up vertically. If it is not possible to maintain an exactly vertical line, the acceptable **Hz dist tolerance** must be chosen. The horizontal distance to the remote point and to the base point should coincide.

**Averaging of remote points**

An average can be calculated for remote points if a measured point of class **Meas** already exists with the same point ID. The average flag for the point is **Auto**.

## 63.2 Accessing Remote Point

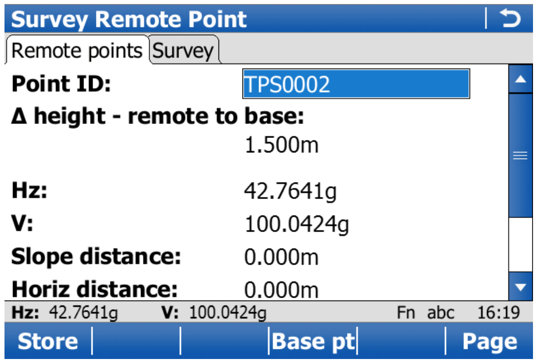
**Description**

Remote point measurements are possible from the Survey application when **Measure remote points** is checked in the **Configuration**, **Remote points** page and a valid distance measurement is available.

**Access**

Press **RmtHt.** in **Survey**, **Survey** page after one point is measured with **Dist**.

**Survey Remote Point, Remote points page**




| Key | Description |
|---|---|
| **Store** | Stores the remote point. Stays in this screen. |
| **Base pt** | Returns to the **Survey** screen. The distance measurement is cleared. |
| **Page** | To change to another page on this screen. The page available depends on the **Page to show** selected in the **Configuration**, **Remote points** screen. Refer to "63.3 Configuring Remote Point". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | Displays the point ID for the remote point. The point ID in **Survey Remote Point** is always identical to the point ID in **Survey**. |
| **Δ height - remote to base** | Display only | The elevation difference between the base point and the remote point. |
| **Hz** | Display only | The current horizontal angle. |
| **V** | Display only | The current vertical angle. |
| **Slope distance** | Display only | The current slope distance to the remote point calculated from the horizontal distance to the base point and the current vertical angle. |
| **Horiz distance** | Display only | The horizontal distance measured to the base point. |
| **Easting** | Display only | Calculated Easting coordinate for the remote point. |
| **Northing** | Display only | Calculated Northing coordinate for the remote point. |
| **Elevation** | Display only | Calculated height for the remote point. |

#### Next step

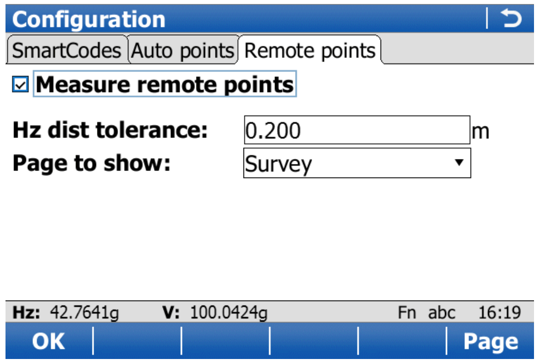
| IF | THEN |
|---|---|
| if a remote point is to be stored | **Store**. |
| a new base point is to be measured | **Base pt** to return to the **Survey** screen. |

## 63.3 Configuring Remote Point

**Access**

In **Survey** press Fn **Config..** to access **Configuration**.

**Configuration, Remote points page**




| Key | Description |
|---|---|
| **OK** | To accept changes and return to the screen from where this screen was accessed. |
| **Page** | To change to another page on this screen. |
| **Config..** | To configure the selected survey screen page. Available when **Page to show** is highlighted. Refer to "25.3 My Survey Screen". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Measure remote points** | Check box | If checked, the remote point function is active. **RmtHt.** is added to the function keys in **Survey** after **Dist** is pressed. |
| **Hz dist tolerance** | Editable field | The horizontal distance to the remote point is equal to the horizontal distance of the base point. The value for **Hz dist tolerance** is the maximum tolerated length of the chord between the base point and the remote point. |
| **Page to show** | Selectable list | All survey screen pages from **Main Menu:** User**Work settings\My Survey Screen** can be selected. |

# 64 Traverse TPS

## 64.1 Overview

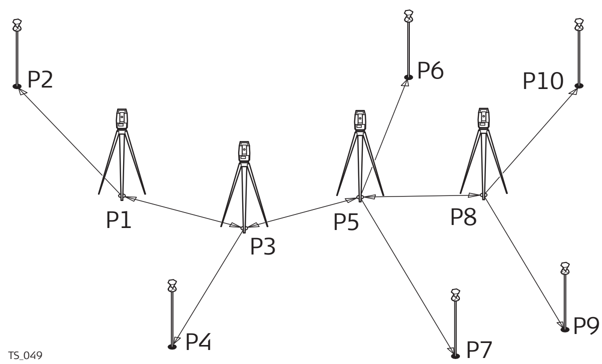
**Description**

The Traverse application is used to fulfil one of the most common operations done by surveyors; to establish a control point base system to be used as a skeleton for other survey operations. For example, topographic survey, point stakeout, line stakeout or road stakeout.

☞ If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

**Types of traverse**

- External reference & closed loop
- Internal reference & position check
- Open end & position check
- Closed end traverse




| | |
|---|---|
| P1 | Traverse point |
| P2 | Backsight point |
| P3 | Traverse point |
| P4 | Sideshot point |
| P5 | Traverse point |
| P6 | Sideshot point |
| P7 | Sideshot point |
| P8 | Closing point |
| P9 | Sideshot point |
| P10 | Closing angle point |

**Averaging of Traverse points**

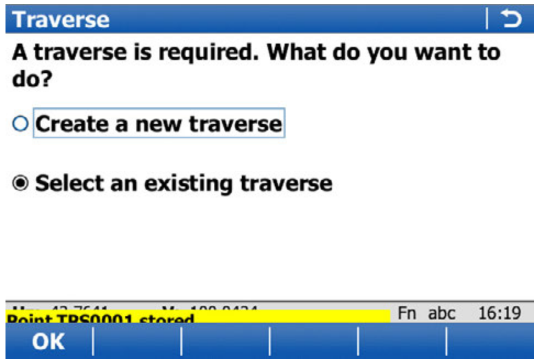
An average point of class **Meas** is calculated by the Traverse application.

## 64.2 Accessing Traverse

**Access**

Select **Main Menu:Go to Work!\Survey+\Traverse**.

**Traverse**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

**Next step**

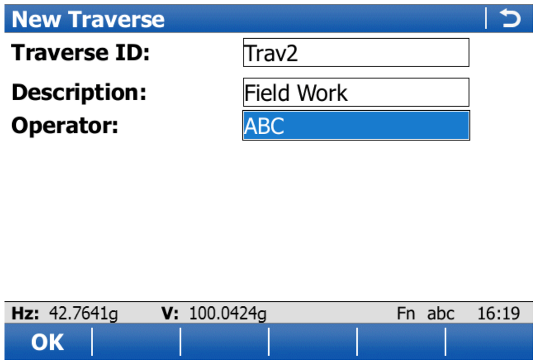
| IF | THEN |
|---|---|
| a traverse is to be created or selected | highlight the relevant option and press **OK**. |
| Traverse is to be configured | Fn **Config..**. Refer to "64.6 Configuring Traverse". |

## 64.3 Creating/Editing a Traverse

**Access**

- In **Traverse**, select **Create a new traverse**. Press **OK**.
- In **Manage Traverses**, press **New..** or **Edit..**.

**New Traverse/Edit Traverse**




| Key | Description |
|---|---|
| **OK** | To store the settings. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

**Description of fields**

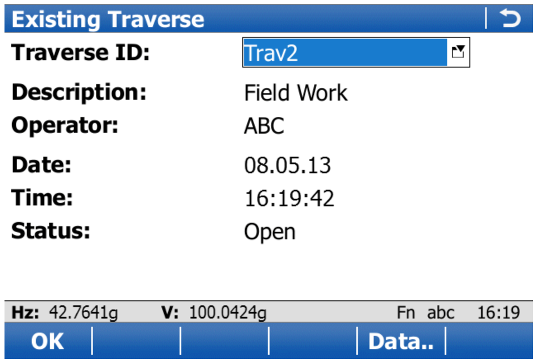
| Field | Option | Description |
|---|---|---|
| **Traverse ID** | Editable field | The ID of the traverse. |
| **Description** | Editable field | A line for a detailed description of the traverse, for example, work to be performed. Optional. |
| **Operator** | Editable field | The person's name who is creating the traverse. Optional. |
| **Date** | Display only | The date of when the traverse was created. Available in the **Edit Traverse** screen. |
| **Time** | Display only | The time of when the traverse was created. Available in the **Edit Traverse** screen. |
| **Status** | **Open** | The traverse is not closed in position. Available in the **Edit Traverse** screen. |
| | **Position closed** | The traverse has been closed in position on a control point. Available in the **Edit Traverse** screen. |
| | **Posn & angle closed** | The traverse has been closed both in position and angularly. Available in the **Edit Traverse** screen. |
| | **Adjusted** | The traverse data is the result from an adjustment. Available in the **Edit Traverse** screen. |

# 64.4 Selecting an Existing Traverse

**Access**

In **Traverse**, select **Existing Traverse**. Press **OK**.

**Existing Traverse**




| Key | Description |
|---|---|
| **OK** | To accept the settings. |
| **Data..** | To display traverse data. Refer to "64.5 Traverse Data". Not available for adjusted traverses. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

### Description of fields

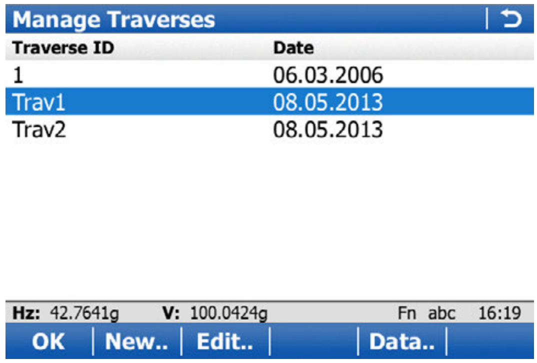
The fields are identical with those fields in the **Edit Traverse** screen. Refer to "64.3 Creating/Editing a Traverse".

### Next step

ENTER when **Traverse ID** is highlighted. Accesses **Manage Traverses**.

**Manage Traverses**

All traverses of the working job are displayed.




| Key | Description |
|---|---|
| **OK** | To confirm selection of highlighted traverse and return to **Select an existing traverse**. |
| **New..** | To create a new traverse. Refer to "64.3 Creating/Editing a Traverse". |
| **Edit..** | To edit the traverse ID and description of the highlighted traverse. Refer to "64.3 Creating/Editing a Traverse". |
| **Data..** | To display traverse data. Refer to "64.5 Traverse Data" for more information. |
| Fn **Quit** | To exit the application. |

# 64.5 Traverse Data

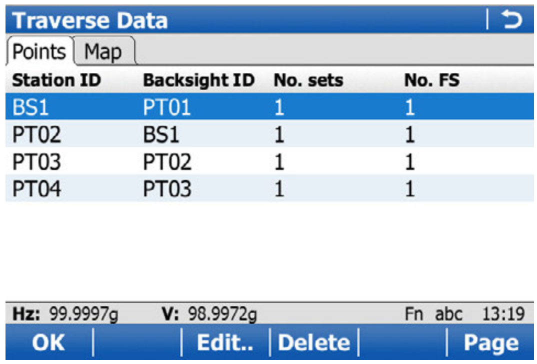
**Description**

This screen allows the review and editing of traverse stations inside of a traverse and allows the user to access **Point Results** for editing.

**Access**

**Data..** in **Manage Traverses**.
OR
**Data..** in a **Confirmation** window of the **Point Results** screen.

**Traverse Data**




| Key | Description |
|---|---|
| **OK** | To return to where this screen was accessed from. |
| **Edit..** | To access the **Point Results** screen. Refer to "64.8 Traverse Point Results". |
| **Delete** | To permanently delete the LAST traverse station. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of columns**

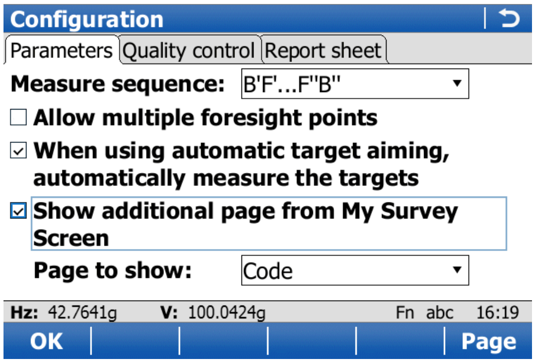
| Column | Description |
|---|---|
| **Station ID** | Point ID of the station. |
| **Backsight ID** | The backsight point measured from the current station ID. |
| **No. sets** | Number of measured sets. |
| **No. FS** | Number of measured foresight points. |

## 64.6 Configuring Traverse

**Access**

Select **Main Menu:Go to Work!\Survey+\Traverse**. Press Fn **Config..**.

**Configuration, Parameters page**




| Key | Description |
|---|---|
| **OK** | To accept changes and to return to the screen from where this screen was accessed. |
| **Config..** | To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "25.3 My Survey Screen". Available on the **Parameters** page. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Measure sequence** | **B'F'...F"B"** | All points are measured in face I, then measured in face II in reverse sequential order. |
| | **B'F'...B"F"** | All points are measured in face I, then measured in face II. |
| | **B'B"F'F"...** | Backsight point is measured in face I immediately followed by face II. Other points are measured in face I, face II order. |
| | **B'B"F"F'...** | Backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order. |
| | **B'F'...** | All points are measured in face I only. |
| **Allow multiple foresight points** | Check box | Option to define if only one foresight point or multiple points are used during the sets. |
| **When using automatic target aiming, automatically measure the targets** | Check box | For instruments with automatic aiming and this option checked, automatic aiming search and automatic aiming measurements are done to specified targets and subsequent sets. |
| **Show additional page from My Survey Screen** | Check box | The user-defined survey screen page to be shown in the Traverse screen. |
| **Page to show** | Selectable list | The names of the available survey screen pages. |

**Next step**

**Page** changes to the **Quality control** page.

**Configuration, Quality control page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Check for errors before storing** | Check box | The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements. |
| **Hz tolerance** | Editable field | Tolerance for horizontal directions. |
| **V tolerance** | Editable field | Tolerance for vertical directions. |
| **Distance tolerance** | Editable field | Tolerance for distance. |
| **Check for back-sight height** | Check box | The entered height tolerance for the backsight point is checked during the measurements to verify accurate pointing and measurements. |
| **Height limit** | Editable field | Tolerance for the backsight height. |

### Next step

**Page** changes to the **Report sheet** page.

**Configuration, Report sheet page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

### Next step

**Page** changes to the first page on this screen.

# 64.7 Traverse Methods

## 64.7.1 Starting Traverse

**Start traverse step-by-step**

The quickest setup method is described.

| Step | Description |
|---|---|
| 1. | Start the Traverse application. |
| 2. | **Traverse**<br>Select **Create a new traverse**. |
| 3. | **OK** to access **New Traverse**. |
| 4. | **New Traverse**<br>Type in the name of the new traverse. |
| 5. | **OK** to access **Configuration**.<br>Check the settings. |
| 6. | **OK** to access **Total Station Setup**.<br>Any standard setup method can be used. |
| 7. | **Set** to set the station and orientation. |
| 8. | A confirmation window is displayed.<br>**FS Pt..** |
| 9. | **Foresight, Set:**<br>**Foresight ID** The name of the foresight point.<br>**Target height** The target height of the foresight point.<br>**Number of sets** The number of sets to be measured. |
| 10. | **Meas** to measure and record. The measurement settings for the first measurement to each point are used for all further sets. |
| 11. | **Point Results**<br>**OK** to move to the next station, to return to the **Point Results** screen (and set a point as a closing point), to survey a sideshot, to view traverse data or to end the traverse. |
| 12. | **Move** to move to the next station. |
| ☞ | After pressing **Move**, Traverse is exited. To continue with the traverse from the next station refer to "64.7.2 Continuing an Existing Traverse". |

## 64.7.2 Continuing an Existing Traverse

**Measure traverse step-by-step**

| Step | Description |
|---|---|
| 1. | Start the Traverse application. |
| 2. | **Traverse**<br>Select **Select an existing traverse**. |
| 3. | **OK** to access **Existing Traverse**. |
| 4. | **Existing Traverse**<br>**Traverse ID** The name of the traverse. ENTER to select a different existing traverse. |
| ☞ | **Data..** to view data of the active traverse. |
| ☞ | Fn **Config..** to change the working style settings. |
| 5. | **OK** to access **Backsight, Set:**.<br>Enter **Instrument height**.<br>**Hz**, **V** and **Horiz distance** The measured values are displayed.<br>**Calc azimuth** The calculated azimuth from the current station point to the backsight point.<br>**Δ hz dist** and **Δ height** The difference between the computed and measured values. |
| ☞ | **More** to change between the displayed values. |
| 6. | **Meas** to measure and record the backsight point. |
| 7. | **FS Pt..** to measure a foresight point. |
| 8. | **Foresight, Set:**<br>**Foresight ID** The name of the foresight point.<br>**Target height** The target height of the foresight point.<br>**Number of sets** The number of sets to be measured. |
| ☞ | **Survy..** to measure sideshot points. |
| 9. | **Meas** to measure and record the foresight points. The measurement settings for the first measurement to each point are used for all further sets. |
| 10. | **Point Results**<br>**OK** |
| 11. | A confirmation window is displayed.<br>**Move** to move to the next station. |
| 12. | Repeat steps 1. to 11. until traverse is ready to be closed. |

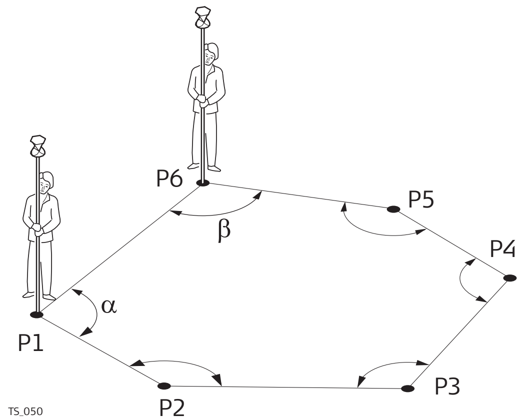
## 64.7.3 Closing Traverse

**Close traverse step-by-step**

| Step | Description |
|---|---|
| 1. | Refer to paragraph "64.7.2 Continuing an Existing Traverse" to measure a traverse. Measure a backsight on a new station. |
| 2. | The confirmation window in **Foresight, Set:** is displayed.<br>**Close..** to begin the process for closing the traverse. |
| 3. | The confirmation window to select a known point is displayed.<br>**OK** |
| 4. | The **Data:** screen for the control job is displayed.<br>Highlight the closing point. |
| 5. | **OK** to select the highlighted point. |
| 6. | **Foresight, Set:**<br>**Meas** to measure and record the closing point. |
| 7. | **Point Results**<br>**OK** to view traverse results. |
| 8. | **Traverse Results**<br>**OK** to display the confirmation window. |
| 9. | **C Ang..** to close the traverse with angular closure. |
| ☞ | Optionally the traverse can be adjusted. |
| 10. | Move to the closure point and start Traverse application. |
| 11. | **Traverse**<br>Select **Select an existing traverse**. |
| 12. | **OK** to access **Existing Traverse**. |
| 13. | **Existing Traverse**<br>**Traverse ID** The name of the traverse to be closed is displayed. |
| 14. | **OK** to access **Close Angle**. |
| 15. | **Close Angle**<br>**Closing method** To measure onto a known point or a known azimuth.<br>**Foresight ID** The point ID of the foresight point.<br>**Known azimuth** Available for **Closing method : By known azimuth**. Known azimuth for foresight point. |
| 16. | **OK** to access **Backsight, Set:**. |
| 17. | **Meas** to measure all sets. |
| 18. | **Point Results**<br>**OK** to view traverse results. |
| 19. | **Traverse Results**<br>**OK** to exit viewing traverse results. |
| 20. | **Quit** to quit the Traverse application. |
| ☞ | Optionally the traverse can be adjusted. |

**Close traverse on internal reference**

This option is used for determining the closure of a closed loop traverse, consisting of a single control point with an arbitrary backsight azimuth. This function allows completion of a traverse without having to reoccupy the initial station setup to measure a closing angle. The positional closure is calculated by comparing the control position of the initial station setup to the measured position of the final foresight. The angular closure is calculated by comparing the set azimuth of the initial backsight to the azimuth of the final measured leg.




The first station setup is on P1, and an assumed direction to backsight P6. Upon closing this traverse, with the last setup over P6, the closing point is P1. In this case the only point that is considered as a control is P1.

| Step | Description |
|---|---|
| 1. | The first station setup is on P1 in the diagram shown. Begin the traverse, moving in the direction P1, P2...P6. |
| 2. | When on the last setup point (P6 in the diagram shown), measure a backsight. |
| 3. | **Close** |
| 4. | **Data:**<br>Select the closing point from the available list (P1 in the diagram shown).<br>**OK** |
| 5. | Measure all the sets to the closing point as per a standard traverse. |
| 6. | **Point Results**<br>**OK** when the review of the results is completed. |
| 7. | **Yes** to confirm the automatic calculation. |
| 8. | **Traverse Results**<br>The traverse closure is shown with positional and angular values. |

## 64.7.4 Creating a Control Point from Backsight by Azimuth

**Description**

If a traverse is to be established on existing control points, two control points must be defined to start the traverse. If the traverse absolute position is arbitrary, it can be convenient to define the control in the field with arbitrary values. This functionality is an option to turn the averaged position value into a control point when a backsight by azimuth is collected.

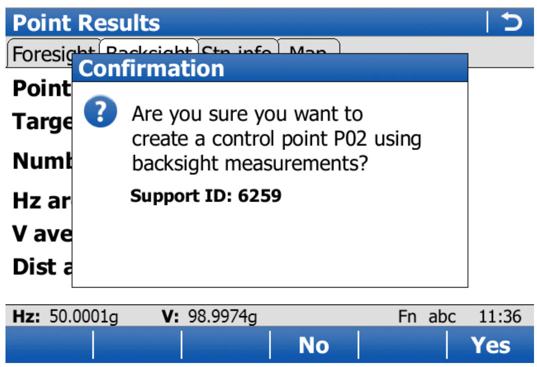
**Access**

At the beginning of a traverse, when all the measurements are completed to the backsight: On the **Point Results** screen, select **Page** to reach the **Backsight** page. Fn **Ctrl**.

OR

Anytime during the traverse: On the **Traverse Data** screen, highlight the first station setup then **Edit...**. On the **Point Results** screen, select **Page** to reach the **Backsight** page. Fn **Ctrl**.

**Point Results Confirmation**




| Key | Description |
|---|---|
| **No** | To close the confirmation window without further action. |
| **Yes** | To store the point as control point. |

## 64.8 Traverse Point Results

**Description**

Point observation results are displayed on this screen.

**Access**

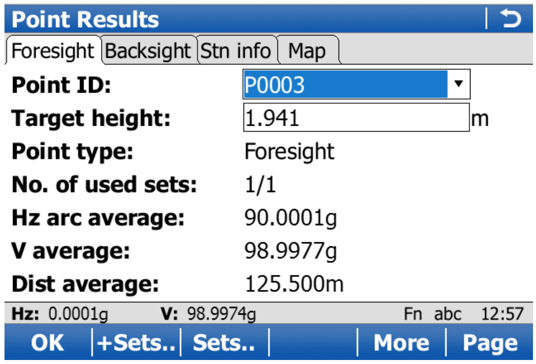
Is displayed automatically after measuring all sets from the current station.

OR

In **Traverse Data** press **Edit..**.

**Point Results, Foresight page and Backsight page**

The softkeys are explained, except for the softkeys on the **Map** page.




| Key | Description |
|---|---|
| **OK** | While measuring a traverse: Displays a confirmation window with traverse measurement options. Otherwise: To return to **Traverse Data**. |
| **+Sets..** | To add more sets while still at the setup. It could be necessary on particular legs of a traverse that more than the designated number of sets is required. Possibly some of the sets from the first run exceeded the tolerance limit and must be disabled. |
| **Sets..** | To include or exclude measured sets in the calculation of a foresight point. In the **Sets, Point** screen press **Use** to include or exclude a set and **Spread**/**Resid** to review the effect of using the set. |
| **Close..** | To set a point as a closing point if not selected before measurement. Or to revert a closing point to a normal foresight. |
| **More** | To display additional information. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Edit..** | To edit point code and annotations. |
| Fn **Check..** | Available on the **Foresight** page. To check inverse distances and closure between the selected point and a point from the fixpoint job. |
| Fn **Ctrl** | Available on the **Backsight** page of the initial station. Refer to "64.7.4 Creating a Control Point from Backsight by Azimuth". |
| Fn **Quit** | To exit the application. |

#### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Selectable list or display only | Selected point ID. |
| **Target height** | Selectable list or display only | The target height of the target point. |
| **Point type** | **Foresight**, Closing point or **Closing angle** | The current point type. Available on the **Foresight** page. |
| **No. of used sets** | Display only | The number of sets out of all measured sets used for the calculation. Available on the **Foresight** page. |
| **Number of sets** | Display only | The number of sets the point was measured in. Available on the **Backsight** page. |
| **Hz arc average** | Display only | Average horizontal angle. |
| **V average** | Display only | Average vertical angle. |
| **Dist average** | Display only | Average distance. |
| **Hz arc std dev** | Display only | Standard deviation of horizontal angle. |
| **V std dev** | Display only | Standard deviation of vertical angle. |
| **Dist std dev** | Display only | Standard deviation of distance. |
| **Hz spread** | Display only | Spread of horizontal angle. |
| **V spread** | Display only | Spread of vertical angle. |
| **Dist spread** | Display only | Spread of distance. |

#### Next step

**Page** changes to the **Stn info** page.

**Point Results, Stn info page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Station ID** | Display only | The station ID of the instrument station. |
| **Instrument height** | Editable field | Current instrument height. Editable. |
| **Easting** | Display only | Easting value of the station position. |
| **Northing** | Display only | Northing value of the station position. |
| **Elevation** | Display only | Orthometric height of the station position. |
| **Scale** | Display only | Scale factor used in the calculation. |
| **Temperature** | Display only | Temperature set on the instrument. |
| **Pressure** | Display only | Atmospheric ppm set on the instrument. |

### Next step

**Page** changes to the **Map** page which provides an interactive display of the data.

| IF accessed | THEN |
|---|---|
| after sets measurement | **OK** opens a confirmation window with options that are dependent on traverse status:<br>• For an open traverse:<br>Move to next station, return to **Point Results**, to survey a sideshot, to view traverse data or to quit the traverse application.<br>• For a closed traverse:<br>Move to close angle, return to **Point Results**, to survey a sideshot, to adjust the traverse or to quit the traverse application. |
| from **Traverse Data** | **OK** returns to **Traverse Data**. |

# 64.9 Traverse Results

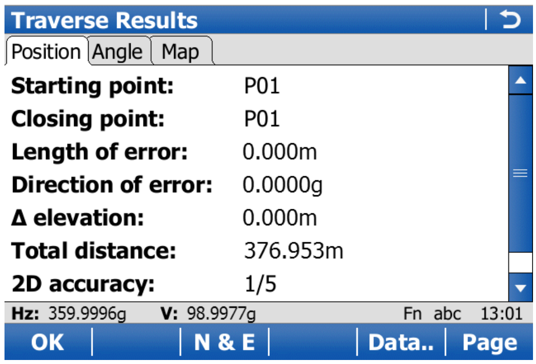
**Description**

Traverse closure results are displayed on this screen.

**Access**

Is displayed automatically after the traverse closing point is measured or selected.
OR
**Reslt..** in **Traverse Data** when a traverse is closed.

**Traverse Results, Position page**




| Key | Description |
|---|---|
| **OK** | To move to close angle, to return to **Traverse Results**, to survey a sideshot, to adjust the traverse or to quit the Traverse application. |
| **N & E** or **L & D** | To view the misclosure error in north/east or length/direction. |
| **Adjust..** | To adjust the traverse. |
| **Data..** | To display traverse data. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Starting point** | Display only | The point ID of the traverse start point. |
| **Closing point** | Display only | The point ID of the traverse closing point. |
| **Length of error** | Display only | The length of the misclosure error. |
| **Direction of error** | Display only | The direction of the misclosure error. |
| **Δ north** | Display only | Error in north. |
| **Δ east** | Display only | Error in east. |
| **Δ elevation** | Display only | Error in height. |
| **Total distance** | Display only | Total length of the traverse. |
| **2D accuracy** | Display only | Position ratio of misclosure. |
| **1D accuracy** | Display only | Height ratio of misclosure. |

**Next step**

**Page** changes to the **Angle** page.

**Traverse Results, Angle page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Foresight ID** | Display only | Point ID of the closing angle point. Displays **-----** if no values are available. |
| **Known azimuth** | Display only | Defined azimuth of closing line. Displays **-----** if no values are available. |
| **Azimuth average** | Display only | Mean value of the measured azimuth closing line. Displays **-----** if no values are available. |
| **Angular misclo-sure** | Display only | Angular misclosure of traverse. Displays **-----** if no values are available. |

### Next step

**OK** to move to close angle, to return to **Traverse Results**, to survey a sideshot, to adjust the traverse or to quit the Traverse application.

## 64.10 Traverse Adjustment

### 64.10.1 Accessing Traverse Adjustment

**Description**

- A traverse adjustment can be performed on three components: 2D positions, angles and elevations.
- Various adjustment methods are available for selection. Once the adjustment is performed, the results can be reviewed. Adjusted points are stored into a new job, and a report can be generated.
- If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

☞ Survey points have to be measured while Traverse is running to be part of the adjustment calculations.

**Access**

The traverse adjustment option can be reached in different ways based on specific conditions.

Upon completing the observations onto the closing point, **Adjust..** to access **Traverse Adjustment**.

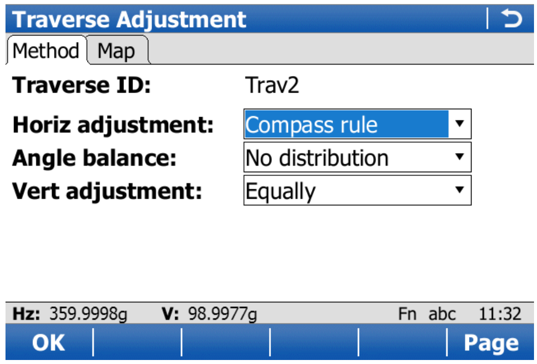
OR

After the measurements are done on the closing line for angular closure, **Adjust..** to access **Traverse Adjustment**.

OR

When the traverse is closed: **Reslt..** in **Traverse Data**, then **Adjust..** in **Traverse Results** to access **Traverse Adjustment**.

**Traverse Adjustment, Method page**




| Key | Description |
|---|---|
| **OK** | To calculate the result. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Traverse ID** | Display only | The ID of the traverse. |
| **Horiz adjustment** | **Compass rule** | Suitable for surveys, where angles and distances were measured with equal precision. |
| | **Transit rule** | Suitable for surveys, where angles were measured with a higher precision than the distances. |
| | **No distribution** | No distribution is made. |
| **Angle balance** | **Equally** | The angle misclosure is distributed equally. |
| | **No distribution** | No distribution is made. |
| **Vert adjustment** | **Equally** | The height error is distributed equally. |
| | **By distance** | The height error is distributed by distance. |
| | **No distribution** | No distribution is made. |

### Next step

**OK** starts the adjustment calculation.

## 64.10.2 Adjustment Results

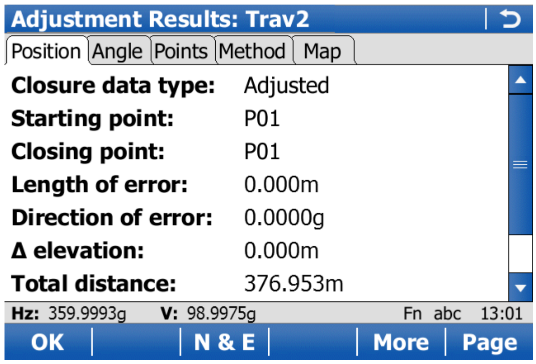
**Description**

The results of the adjustment calculations can be reviewed by accessing the different pages.

**Access**

**OK** in **Traverse Adjustment**.

**Adjustment Results, Position page**




| Key | Description |
|---|---|
| **OK** | To access the next screen. |
| **N & E** or **L & D** | To view the misclosure error in north/east or length/direction. |
| **More** | To display the values for the unadjusted, the balanced and the adjusted solution. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Traverse application. Refer to "64.6 Configuring Traverse". |
| Fn **Quit** | To exit the application. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Closure data type** | **Adjusted**, Unadjusted or **Balanced** | **More** to change between the options and display the values accordingly. |
| **Starting point** | Display only | The point ID of the traverse start point. |
| **Closing point** | Display only | The point ID of the traverse close point. |
| **Length of error** | Display only | The length of the misclosure error. |
| **Direction of error** | Display only | The direction of the misclosure error. |
| **Δ north** | Display only | Error in north. |
| **Δ east** | Display only | Error in east. |
| **Δ elevation** | Display only | Error in height. |
| **Total distance** | Display only | Total length of the traverse. |
| **2D accuracy** | Display only | Position ratio of misclosure. |
| **1D accuracy** | Display only | Height ratio of misclosure. |

**Next step**

**Page** changes to the **Angle** page.

**Adjustment Results, Angle page**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Closure data type** | Display only | **More** to change between the options. |
| **Known azimuth** | Display only | Defined azimuth of closing line. Displays **-----** if no values are available. |
| **Azimuth average** | Display only | Mean value of the measured azimuth closing line. Displays **-----** if no values are available. |
| **Angular misclosure** | Display only | Angular misclosure of traverse. Displays **-----** if no values are available. |

### Next step

**Page** changes to the **Points** page.

**Adjustment Results, Points page**

The adjusted points are listed. The **Point type** column shows the function for each point.
**View** shows the coordinate values of the highlighted point.

### Next step

**Page** changes to the **Method** page.

**Adjustment Results, Method page**

The adjustment methods previously selected in **Traverse Adjustment** and used for the adjustment are displayed.

### Next step

**Page** changes to the **Map** page. The **Map** page provides an interactive display of the data.
**OK** accesses **Adjustment Store**.

**Adjustment Store**

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Traverse ID** | Display only | The ID of the traverse. |
| **Store adjusted job to** | Selectable list | The location to save the adjusted job. The job can be saved to the **CF card**, **SD card**, **USB** or **Internal memory**. |
| **New job** | Editable field | The new job name. Once adjustment results have been reviewed and accepted, the adjusted position of the points are stored in a separate job. |
| **Include survey points** | Check box | Survey points can be included or not. Adjusted points are stored in the new job as a triplet of class **ADJ** (adjusted). |
| **Store point ID with** | **Same point ID** | Adjusted points are stored in the new job with the original point IDs. |
| | **Prefix** | Adjusted points are stored in the new job with a prefix in front of the original point IDs. |
| | **Suffix** | Adjusted points are stored in the new job with a suffix at the end of the original point IDs. |
| **Prefix / suffix** | Editable field | Available when **Prefix** or **Suffix** is selected in **Store point ID with**. The value that is added to the front or end of the original point ID. |

### Next step

**Store..** stores the results.

# 65 Volumes & Surfaces

## 65.1 Overview

**Description**

The Volume Calculations application allows surfaces to be measured and volumes (and other information) to be computed from these surfaces.

**Volume calculations tasks**

The Volume calculations application can be used for the following tasks:

- Measuring points (surface points and boundary points) defining a new surface or extending existing surfaces from the working job.
- Calculating the triangulation of the measured surface points to establish the surface.
- Calculating volumes from a base (3D point, entered elevation) or by a stockpile method.

The surface calculation can be made from:

- existing point data in the job.
- manually occupied points.
- entered coordinates.

**Activating the application**

If the message panel appears which requires that the application must be activated via a license key then refer to "30.3 Load licence keys".

☞ Volume Calculations are possible for RTK rover and TPS.

**Point types**

Surfaces can be created from points stored as:

- Local grid
- Height mode can be ellipsoidal or orthometric.

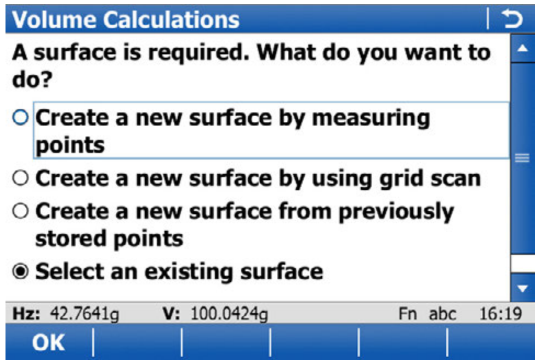
Heights and positions are always taken into account. Points must have full coordinate triplets.

## 65.2 Accessing Volumes & Surfaces

**Access**

Select **Main Menu: Go to Work!\Survey+\Volume calculations**.

**Volume Calculations**




| Key | Description |
|---|---|
| **OK** | To select the highlighted option and to continue with the subsequent screen. |
| Fn **Config..** | To configure the Volume Calculations application. Refer to "65.3 Configuring Volumes & Surfaces". |
| Fn **Quit** | To exit the screen. |

**Next step**

| IF | THEN |
|---|---|
| a Volume Calculations method is to be started | highlight the relevant option and press **OK**. |
| Volume Calculations is to be configured | Fn **Config..**. Refer to "65.3 Configuring Volumes & Surfaces". |

## 65.3 Configuring Volumes & Surfaces

**Access**

Select **Main Menu: Go to Work!\Survey+\Volume calculations**. Press Fn **Config..**.

**Configuration, Report sheet page**

**Description of fields**

| Field | Option | Description |
| --- | --- | --- |
| **Create report sheet** | Check box | To generate a report sheet when the application is exited.<br>A report sheet is a file to which data from an application is written to. It is generated using the selected format file. |
| **Report sheet** | Selectable list | Available when **Create report sheet** is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file.<br>Opening the selectable list accesses the **Report Sheets** screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted. |
| **Format file to use** | Selectable list | Available when **Create report sheet** is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "30.1 Transfer user objects" for information on how to transfer a format file.<br>Opening the selectable list accesses the **Format Files** screen where an existing format file can be selected or deleted. |

**Next step**

**Page** changes to the first page on this screen.

# 65.4 Calculating Volumes

## 65.4.1 Create a New Surface by Measuring New Points

**Access**

Select **Create a new surface by measuring points** in **Volume Calculations**.

**New Surface**

### Description of fields

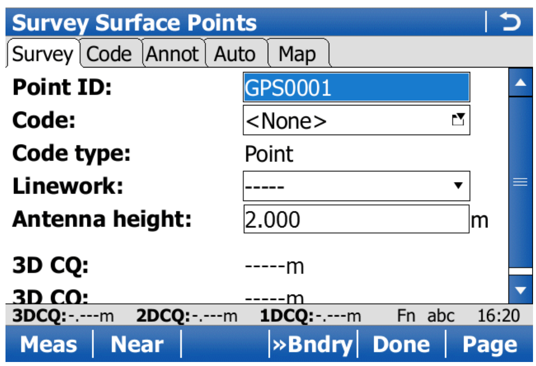
| Field | Option | Description |
|---|---|---|
| **Surface ID** | Editable field | The name/number of the new surface. |

### Next step

**OK** to access **Survey Surface Points**. After measuring surface points, more points can be surveyed, points can be grid scanned or a surface can be reviewed and edited.

**Survey Surface Points, Survey page**

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.



| Key | Description |
|---|---|
| **Meas** | GPS To start measuring the surface point. The key changes to **Stop**.<br>TPS To measure a distance and store distance and angles. |
| **Stop** GPS | To end measuring the surface point. When **Automatically stop point measurement** is checked in **Quality Control**, **General** page recording of positions ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. The key changes to **Store**. |
| **Dist** TPS | To measure a distance. |
| **Store** | To store the measured surface point. When **Automatically store point** is checked in **Quality control**, **General**, the measured point is stored automatically. The key changes to **Meas.** |
| **Near** GPS | To search the working job for the point nearest to the current position when the key is pressed. The point is selected as the point to be measured and is displayed in the first field on the screen. After measuring and storing the nearest point, the next point suggested is the one which was suggested before the key was pressed.<br>Available when **Meas** is displayed. |
| **»Bndry** and **»Surf** | To change the type of point to be measured between surface point and boundary point. |
| **Done** | To finish measuring. |
| **Page** | To change to another page on this screen. |
| Fn<br>2Store TPS | To aim manually at the target and only record the angle measurement (Hz/V) in face I and face II. The point stored is an average of the two measurements. |
| Fn<br>2Face TPS | Available for **Measure mode**: **Single** and **Measure mode**: **Single (fast)**. To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |
| Fn **Conect** and Fn<br>**Disco** GPS | To connect/disconnect from the GPS reference data. |
| Fn **Init..** GPS | To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "57.4 Initialisation for Real-Time Rover Operations". |
| Fn **IndivID** and Fn **Run** | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to "25.1 ID templates". |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Point ID** | Editable field | The identifier for manually occupied points. The configured point ID template is used. The ID can be changed in the following ways:<br>• To start a new sequence of point IDs type over the point ID.<br>• For an individual point ID independent of the ID template Fn **IndivID**. Fn **Run** changes back to the next ID from the configured ID template. |
| **Antenna height** | Editable field | GPS The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. |
| **3D CQ** | Display only | The current 3D coordinate quality of the computed position. |
| **Target height** | Editable field | TPS The last used target height is suggested when accessing this screen. An individual target height can be typed in. |
| **Hz** | Display only | TPS The current horizontal angle. |
| **V** | Display only | TPS The current vertical angle. |
| **Horiz distance** | Display only | TPS The horizontal distance after **Dist** was pressed. No distance is displayed when accessing the screen and after **Store** or **Meas**. |
| **Height difference** | Display only | TPS The height difference between station and measured point after **Dist**. Displays **-----** when accessing the screen and after **Store** or **Meas**. |

### Next step

Measure all points. Then press **Done**.

## 65.4.2 Create a New Surface by Using Grid Scan TS

**Access**

Select **Create a new surface by using grid scan** in **Volume Calculations**.

**New Surface**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Editable field | The name/number of the new surface. |

**Next step**

**OK** to access **Survey Surface Points**. After measuring surface points, more points can be surveyed, points can be grid scanned or a surface can be reviewed and edited.

**Grid scan points to surface**

Refer to "45.9 Grid Scan on Surface" for defining the grid scan area, defining the scan settings as well as starting and ending grid scanning.

## 65.4.3 Create a New Surface from Previously Stored Points

**Access**

Select **Create a new surface from previously stored points** in **Volume Calculations**.

☞ When accessing the **Edit Surface** screen after selecting **Create a new surface from previously stored points** the **Points** page is active. Any other time this screen is accessed the **General** page is active.

**New Surface**

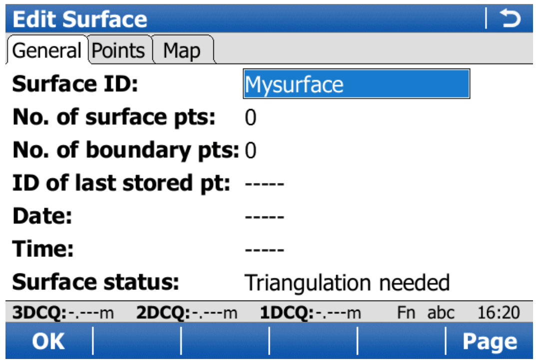
**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Editable field | The name/number of the new surface. |

**Next step**

**OK** to access **Survey Surface Points**. After measuring surface points, more points can be surveyed, points can be grid scanned or a surface can be reviewed and edited.

**Edit Surface, General page**




| Key | Description |
|---|---|
| **OK** | To accept all settings and continue with the next screen. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Volume Calculations application. Refer to "65.3 Configuring Volumes & Surfaces". |
| Fn **Del Srf** | To delete the surface. |
| Fn **Quit** | To exit the screen. |

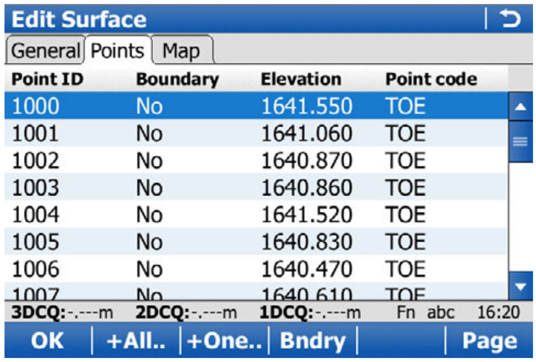
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Selectable list | Name of the surface to be triangulated. |
| **No. of surface pts** | Display only | Number of points inside the surface. |
| **No. of boundary pts** | Display only | Number of boundary points of the surface. |
| **ID of last stored pt** | Display only | ID of the last measured point of the chosen surface. |
| **Date** | Display only | Date of the last measured point of the chosen surface. |
| **Time** | Display only | Time of the last measured point of the chosen surface. |
| **Surface status** | **Triangulation done** | The surface has been triangulated and not been modified since the last triangulation. |
| | **Triangulation needed** | The surface has been modified since the last triangulation or no triangulation exists. |

### Next step

**Page** changes to the **Points** page.

**Surface status, Points page**




| Key | Description |
|---|---|
| **OK** | To accept all settings and continue with the next screen. |
| **+All..** | To add all points from the working job to the surface. |
| **+One..** | To add one point from the working job to the surface. |
| **Bndry** | To use this point for the boundary. |
| **Page** | To change to another page on this screen. |
| Fn **-One** | To remove the marked point from the surface. |
| Fn **-All** | To remove all points from the surface. |
| Fn **Quit** | To exit the screen. |

**Next step**

**OK** continues to **Surface Task Selection**. Refer to "65.4.5 Selecting the Surface Task".

## 65.4.4 Choosing an Existing Surface

**Access**

Select **Create a new surface from previously stored points** in **Volume Calculations**.

**Existing Surface**

The fields available are identical with the fields in **Surface status**, **General** page. Refer to "65.4.3 Create a New Surface from Previously Stored Points".

**Next step**

Select the desired surface ID then press **OK**. **OK** continues to **Surface Task Selection**. Refer to **Selecting the Surface Task**.

## 65.4.5 Selecting the Surface Task

**Surface Task Selection**

**Description of the options**

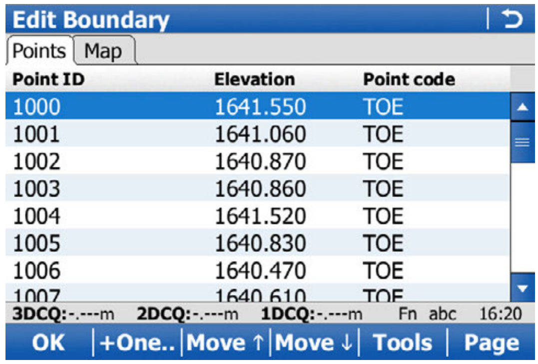
| Options | Description |
|---|---|
| **Measure more points to the surface** | To measure points defining a new surface or extending existing surfaces and boundaries by surveying. Refer to "65.4.1 Create a New Surface by Measuring New Points". |
| **Grid scan more points to the surface** | To add more points to the surface by grid scanning new points. The grid scan procedure restarts. |
| **Review & edit the surface** | To view the surface summary and add/remove points from the surface. Refer to "65.4.3 Create a New Surface from Previously Stored Points". |
| **Edit the boundary & triangulate surface** | To define/redefine the boundary using manual point selection, or one of the existing automatic methods, and then create a triangulation. A DXF model can then be exported if desired. Refer to "65.4.6 Boundary Definition". |
| **Calculate the volume** | To compute the volume of a surface by a reference (3D point, entered elevation) or by the stockpile method. Refer to "65.4.7 Compute Volumes". Available when a valid triangulation of the surface exists. |
| **Exit the Volumes app** | To end the application and return to the screen from where Volume Calculations was accessed. |

**Next step**

Select the task to do next. **OK** selects an option.

## 65.4.6 Boundary Definition

**Edit Boundary, Points page**



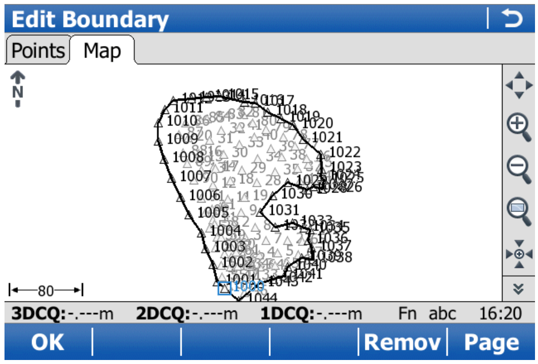

| Key | Description |
|---|---|
| **OK** | To start calculating the triangulation. |
| **+One..** | To add points from the working job to the surface. |
| **Move ↑** | To move the focused point one step up within the boundary definition. |
| **Move ↓** | To move the focused point one step down within the boundary definition. |
| **Tools** | To access the **Boundary Tools Menu**. |
| **Page** | To change to another page on this screen. |
| **Home** | To move the focus to the first point within the boundary definition. |
| **End** | To move the focus to the last point within the boundary definition. |
| Fn **-One** | To remove the marked point from the boundary definition or completely from the surface. |
| Fn **Quit** | To exit the screen. |

**Next step**

**Page** changes to the **Map** page.

| IF you want to | THEN |
|---|---|
| change to the **Map** page | **Page** to change to the **Map** page. |
| check the triangulation results | **OK** to access **Triangulation Results**. |
| access the Tools menu | **Tools** accesses **Boundary Tools Menu**. |

**Edit Boundary, Map page**



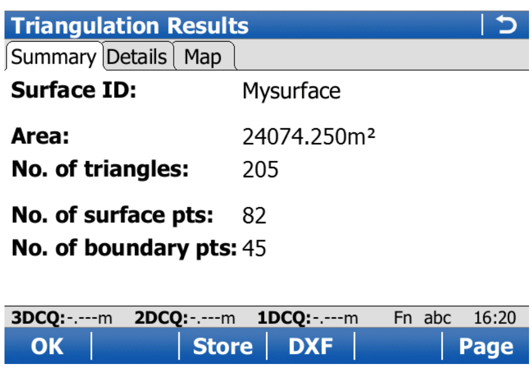

| Key | Description |
|---|---|
| **OK** | To start calculating the triangulation. |
| **Remov** | To remove the marked point from the boundary definition or completely from the surface. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure MapView. Refer to "38.3 Configuring MapView". |
| Fn **Quit** | To exit the screen. |

**Next step**

| IF you want to | THEN |
|---|---|
| check the triangulation results | **OK** to access **Triangulation Results**. |

**Triangulation Results**

The **Summary** page and the **Details** page contain only display only fields. Information such as the number of triangles/surface points/boundary points, the minimum/maximum elevation or the 3D area is shown.
The **Map** page contains a plot of the triangles of the surface's triangulation and also its boundary.




| Key | Description |
|---|---|
| **OK** | To return to **Surface Task Selection**. |
| **Store** | To go to a screen where the surface can be saved as DTM job. |
| **DXF** | To go to a screen where the triangulation can be saved as a DXF. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the report sheet. |
| Fn **Quit** | To exit the screen. |

**Boundary Tools Menu**

### Description of fields

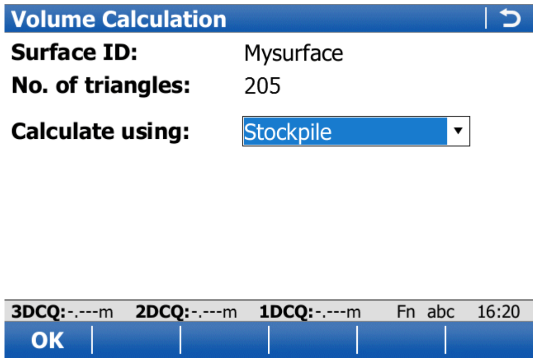
| Field | Description |
|---|---|
| **Add many points** | Lists all points in the working job. |
| **Remove all points** | Method to remove all points that are indicated in **Edit Boundary**, **Points** page. |
| **Sort points by time** | Method to sort all points in **Edit Boundary**, **Points** page by the time they were stored. |
| **Sort points by proximity** | Method to sort all points **Edit Boundary**, **Points** page by the closest proximity. |
| **Compute rubber band bndry** | Method to define a new boundary as if a rubber band was placed around the points. The current list of boundary points will be ignored. |

### Next step

Select the task to do next. **OK** selects an option and returns to **Edit Boundary**.

## 65.4.7 Compute Volumes

**Volume Calculation**




| Key | Description |
|---|---|
| **OK** | To compute the volume. |
| Fn **Config..** | To configure the Volume Calculations application. Refer to "65.3 Configuring Volumes & Surfaces". |
| Fn **Quit** | To exit the screen. |

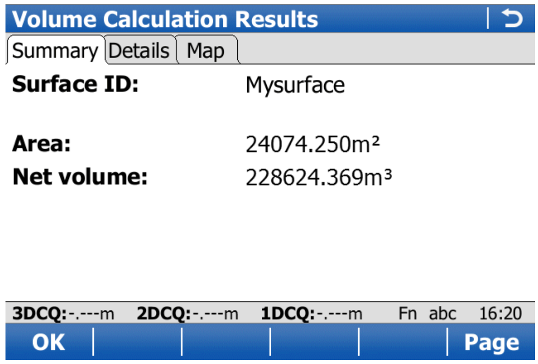
### Description of fields

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Selectable list | Surface chosen from the triangulated surfaces currently stored to the working job. |
| **No. of triangles** | Display only | Number of triangles from the triangulation of the surface. |
| **Calculate using** | | To calculate the volume of the triangulated surface. |
| | **Stockpile** | Volume between the triangulated surface and the plane defined by the boundary points of the surface. |
| | **Surface to elevation** | Volume between the triangulated surface and the height entered by the user. |
| | **Surface to point** | Volume between the triangulated surface and the height of a selected point. |

### Next step

**OK** calculates the volume and continues to **Volume Calculation Results**.

**Volume Calculation Results, Summary page**




| Key | Description |
|---|---|
| **OK** | To close the triangulation of the surface. |
| **DXF** | To export the triangulation results to a DXF file on the data or root directory of the CF Card. |
| **Page** | To change to another page on this screen. |
| Fn **Config..** | To configure the Volume Calculations application. Refer to "65.3 Configuring Volumes & Surfaces". |
| Fn **Quit** | To exit the screen. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Display only | Name of the surface used for the calculation. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |
| **Point ID** | Display only | The point to which the volume is calculated. Available for **Calculate using: Surface to point**. |
| **Elevation** | Display only | The elevation of the point to which the volume is calculated. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |
| **Area** | Display only | Area of the base plane. |
| **Net volume** | Display only | Volume of the surface. |
| **Volume above reference surface** | Display only | Cut of the volume. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |
| **Volume below reference surface** | Display only | Fill of the volume. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |

### Next step

**Page** changes to the **Details** page.

**Volume Calculation Results, Details page**

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Minimum elevation** | Display only | Minimal elevation of the triangulated surface. |
| **Maximum elevation** | Display only | Maximal elevation of the triangulated surface. |
| **Average thickness** | Display only | Average thickness of the calculated volume. |
| **Perimeter** | Display only | Perimeter of the measured surface area (intersection of the measured surface to the reference datum). |

**Next step**

**Page** changes to the **Plot** page.

# 66 QuickVolume

## 66.1 Overview

**Description**

The application allows volumes to be computed from ALL scans and/or ALL measured points stored in a job.

## 66.2 Accessing Volume Calculations

**Access**

Select **Main Menu: Go to Work!\Survey+\QuickVolume**.

**Choose Job**

| Key | Description |
|---|---|
| **OK** | To accept changes and access the subsequent screen. The chosen settings become active. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Job** | Selectable list | The job from which a volume will be computed. |

**Surface Name**

| Key | Description |
|---|---|
| **OK** | To start the triangulation. All points and scans within the selected job are used in the triangulation. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Surface name** | Selectable list | Name of the surface to be triangulated. |

## 66.3 Volume Calculations

**Volume Calculation**

| Key | Description |
|---|---|
| **OK** | To accept all settings and continue with the next screen. |
| **MinElv** | To set the minimum elevation point of the current surface as elevation value. Available for **Calculate using: Surface to elevation**. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Calculate using** | | To calculate the volume of the triangulated surface. |
| | **Stockpile** | Volume between the triangulated surface and the plane defined by the boundary points of the surface. |
| | **Surface to elevation** | Volume between the triangulated surface and the height entered by the user. |
| | **Surface to point** | Volume between the triangulated surface and the height of a selected point. |

**Next step**

**OK** calculates the volume and continues to **Volume Calculation Results**.

**Volume Calculation Results, Summary page**

| Key | Description |
|---|---|
| **Store** | To return to **Surface Task Selection**. |
| **Page** | To change to another page on this screen. |
| Fn **Quit** | To exit the screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Surface ID** | Display only | Name of the surface used for the calculation. |
| **Point ID** | Display only | The point to which the volume is calculated. Available for **Calculate using: Surface to point**. |
| **Elevation** | Display only | The elevation of the point to which the volume is calculated. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |
| **Area** | Display only | Area of the base plane. |
| **Net volume** | Display only | Volume of the surface. |
| **Volume above reference surface** | Display only | Cut of the volume. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |
| **Volume below reference surface** | Display only | Fill of the volume. Available for **Calculate using: Surface to elevation** and **Calculate using: Surface to point**. |

**Next step**

**Page** changes to the **Details** page.

# Appendix A Menu Tree

**Menu tree for GNSS RTK rover and TPS**

```
|—— Go to Work!
|       |
|       |—— Setup (TPS)
|       |
|       |—— Survey
|       |
|       |—— Stakeout
|       |
|       |—— Survey+
|       |       |
|       |       |—— Scanning for MS50
|       |       |
|       |       |—— Measure to ref line
|       |       |
|       |       |—— Ref plane & grid scan
|       |       |
|       |       |—— Volume calculations
|       |       |
|       |       |—— QuickVolume
|       |       |
|       |       |—— TPS hidden point (TPS)
|       |       |
|       |       |—— Sets of angles (TPS)
|       |       |
|       |       |—— Determine coord system
|       |       |
|       |       |—— QuickGrid (GPS)
|       |       |
|       |       |—— Traverse (TPS)
|       |       |
|       |       |—— Survey cross section
|       |
|       |—— Stakeout+
|       |       |
|       |       |—— Stake to ref line
|       |       |
|       |       |—— Stakeout DTM
|       |       |
|       |       |—— Stake points & DTM
|       |
|       |—— COGO..
|       |       |
|       |       |—— Inverse
|       |       |
|       |       |—— Traverse
|       |       |
|       |       |—— Intersection
|       |       |
|       |       |—— Line & arc calculations
|       |       |
|       |       |—— Area division
|       |       |
|       |       |—— Shift, rotate & scale
|       |       |
|       |       |—— Angle
```

```
|       |       |
|       |       |—— Horizontal curve
|       |       |
|       |       |—— Triangle
|       |
|       |—— Roads..
|       |       |
|       |       |—— Alignment Editor
|       |       |
|       |       |—— Roads - Stakeout
|       |       |
|       |       |—— Roads - As built check
|       |       |
|       |       |—— Rail - Stakeout
|       |       |
|       |       |—— Rail - As built check
|       |       |
|       |       |—— Tunnel - Stakeout (TPS)
|       |       |
|       |       |—— Tunnel - As built check (TPS)
|       |
|       |—— Switch to Base menu (GPS)
               Unavailable for GS05/GS06
|
|—— Jobs & Data
|       |
|       |—— New job
|       |
|       |—— View & edit data
|       |
|       |—— Create control data
|       |
|       |—— Job properties
|       |
|       |—— Choose working job
|       |
|       |—— Choose control job
|       |
|       |—— Import data
|       |       |
|       |       |—— Import ASCII data
|       |       |
|       |       |—— Import alignment data
|       |       |
|       |       |—— Import DXF data
|       |       |
|       |       |—— Import DTM data
|       |       |
|       |       |—— Import XML data
|       |
|       |—— Export & copy data
|               |
|               |—— Export ASCII data
|               |
|               |—— Export custom data
|               |
|               |—— Export DXF data
|               |
```

```
|         |—— Export XML Data
|         |
|         |—— Export Data Using Stylesheet
|         |
|         |—— Export FBK/RW5/RAW data
|         |
|         |—— Copy data between jobs
|
|—— Instrument
|    |
|    |—— TPS settings (TPS)
|    |    |
|    |    |—— Measure mode & target
|    |    |
|    |    |—— Prism search settings
|    |    |
|    |    |—— Atmospheric corrections
|    |    |
|    |    |—— Level bubble & compensator
|    |    |
|    |    |—— Offsets & Quality Control
|    |    |
|    |    |—— Lights / Lights & accessories (TS)
|    |
|    |—— GPS settings
|    |    |
|    |    |—— RTK rover wizard
|    |    |
|    |    |—— Satellite tracking
|    |    |
|    |    |—— Antenna heights
|    |    |
|    |    |—— Quality control
|    |    |
|    |    |—— Raw data logging
|    |
|    |—— Connections..
|    |    |
|    |    |—— GPS connection wizard (GPS)
|    |    |
|    |    |—— TPS connection wizard (TPS)
|    |    |
|    |    |—— Internet wizard
|    |    |
|    |    |—— CS connection wizard (TS)
|    |    |
|    |    |—— All other connections
|    |
|    |—— Instrument status info
|    |    |
|    |    |—— Battery & memory
|    |    |
|    |    |—— Satellite tracking (GPS)
|    |    |
|    |    |—— RTK data link status (GPS)
|    |    |
|    |    |—— Current GPS position (GPS)
|    |    |
```

```
|       |       |—— Raw data logging (GPS)
|       |       |
|       |       |—— Connection status
|       |       |
|       |       |—— Internet connection status
|       |       |
|       |       |—— TPS current station info (TPS)
|       |
|       |—— TPS camera settings (TPS, CS)
|
|—— User
        |
        |—— Work settings
        |       |
        |       |—— ID templates
        |       |
        |       |—— Coding & linework
        |       |
        |       |—— My Survey Screen
        |       |
        |       |—— Hot keys & favourites
        |       |
        |       |—— Prompt before storing
        |
        |—— Working style wizard
        |
        |—— System settings
        |       |
        |       |—— Regional settings
        |       |
        |       |—— SmartWorx options
        |       |
        |       |—— Screen & audio
        |       |
        |       |—— Admin settings
        |
        |—— Tools & other utilities
        |       |
        |       |—— Transfer user objects
        |       |
        |       |—— Load firmware & Apps
        |       |
        |       |—— Load licence keys
        |       |
        |       |—— Ftp data transfer
        |       |
        |       |—— Format memory devices
        |       |
        |       |—— View contents of ASCII files
        |       |
        |       |—— Leica Exchange
        |
        |—— Check & Adjust (TS)
        |
        |—— About Leica Viva
```

**Menu tree for GPS RTK base**

```
|—— Go to Work!
|      |
|      |—— Start base over known point
|      |
|      |—— Start base over last setup
|      |
|      |—— Start base over any point
|      |
|      |—— Go to Rover menu
|
|—— Instrument
       |
       |—— Base settings
       |
       |—— Satellite tracking
       |
       |—— Base raw data logging
       |
       |—— Base connections
       |      |
       |      |—— Connect to base sensor
       |      |
       |      |—— All other connections
       |
       |—— Base status info
              |
              |—— Battery & memory
              |
              |—— Satellite tracking
              |
              |—— Current position
              |
              |—— Raw data logging
              |
              |—— Connection status
```

# Appendix B Internal Memory

| | |
|---|---|
| **Available memory** | > 500 MB. |
| **Data stored to the internal memory** | The following are examples of the data types that can be stored to the internal memory.<br>• Applications<br>• Codelists<br>• Coordinate systems<br>• Format files<br>• Geoid and CSCS files<br>• Jobs & Data<br>• System languages<br>• Working styles |

# Appendix C Directory Structure of the Memory Device

**Description**

On the memory device, files are stored in certain directories. The following diagram of the directory structure refers to the data storage devices and the internal memory.

All files are fully compatible with Leica System 1200 and vice versa, with the exception of the following listed files which are not compatible between the systems:

- Working styles and configuration sets
- System.ram and VivaSystem.zip
- Licence files
- Language files, and
- Application files.

**Directory structure**

```
|—— CODE                      • Codelists, various files
|
|—— CONFIG                    • Working style files (*.xfg)
|     |
|     |—— RTK_PROFILE         • RTK profile files (*.rpr)
|     |
|     |—— SKETCH_TEMPLATE     • Custom templates (*.jpg) for sketching
|     |
|     |—— USERMANAGEMENT      • Administration settings files (*.usm)
|
|—— CONVERT                   • Format files (*.frt)
|
|—— DATA                      • ASCII (*.txt), DXF (*.dxf), LandXML (*.xml),
|     |                         Terramodel (*.xml), Carlson (*.cl) and Shape files
|     |                         (*.shp, *.shx and *.dbf and all other shape file
|     |                         components) for import/export to/from job
|     |                       • Section files for Carlson (*.sct) and ASCII report
|     |                         files for Terramodel (*. txt) for import to job
|     |                       • Report sheets created from applications
|     |
|     |—— GPS
|     |     |
|     |     |—— CSCS          • CSCS field files (*.csc)
|     |     |
|     |     |—— GEOID         • Geoid field files (*.gem)
|     |     |
|     |     |—— RINEX         • RINEX files
|     |
|     |—— Geocom              •
|     |     |
|     |     |—— Images        •
|     |           |
|     |           |—— ATR     • Image files (*.jpg) taken with Geocom commands
|     |                         using the ATR.
|     |           |
|     |           |—— Overview • Image files (*.jpg) taken with Geocom commands
|     |                          using the overview camera.
|     |           |
|     |           |—— Telescope • Image files (*.jpg) taken with Geocom commands
|     |                           using the telescope camera.
|     |
```

| | |
|---|---|
| \| \|—— Map_Images | • Map background image files (*.jpg, *.jgw, *.archive)<br>*.jpg + *.jgw with same file name = world file<br>*.archive = SmartWorx format |
| \| \|—— XML | • Alignment Editor Alignments (*.xml) |
| \| | |
| \|—— DBX | • DTM jobs, various files |
| \| \| | • Coordinate system file (Trfset.dat) |
| \| \| | • Job files for System 1200 |
| \| \|—— JOB | • Job files, various files. Jobs are stored in a folder per job. |
| \| \|—— MAP | • Map related files (for example *.mpl), stored in a subfolder per job. |
| \| \|—— IMAGES | • Image files (*.jpg), stored in a subfolder per job. |
| \| \|—— SCANS | • Scan database files (*.sdb files) |
| \| \| | • Bitmaps of intensity values (*.bmp files) |
| \| \|—— SURFACES | • Surface files (*.dxf) |
| \| | |
| \|—— DOWNLOAD | • Various files, downloaded by the Ftp data transfer application (*.*) |
| \|—— GPS | • Antenna file (List.ant) |
| \| | • GSM/Modem station list (*.fil) |
| \| | • Server list (*.fil) |
| \| | |
| \|—— GSI | • GSI files (*.gsi) |
| \| | • ASCII files for export from job (*.*) |
| \| | |
| \|—— SYSTEM | • Application files (*.axx) |
| | • Firmware files (*.fw) |
| | • Language files (*.s*) |
| | • Licence file (*.key) |
| | • System files (VivaSystem.zip) |

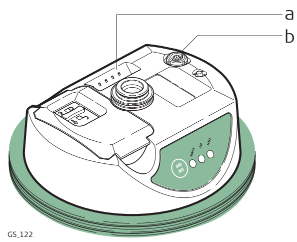
# Appendix D Pin Assignments and Sockets

## D.1 GS08plus

**Description**

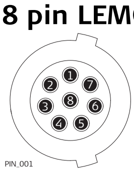
Some applications require knowledge of the pin assignments for the GS08plus/GS12 ports.
In this chapter, the pin assignments and sockets for the ports of the GS08plus/GS12 are explained.

**Ports at the instrument underside**




a) Clip on contacts (only GS12)
b) Lemo port (USB and serial)

**Pin assignments for 8 pin LEMO-1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | TRM_ON/USB_ID | RS232, general purpose signal | In or out |

**Sockets**

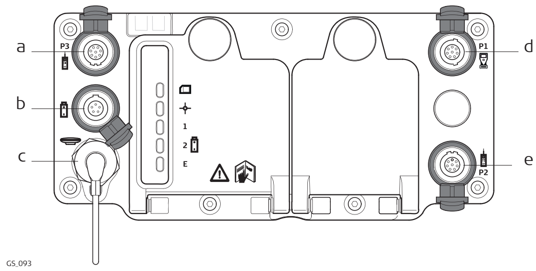
8 pin LEMO-1: LEMO-1, 8 pin, LEMO EGI.1B.308.CLN

## D.2 GS10

**Description**

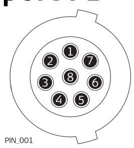
Some applications require knowledge of the pin assignments for the GS10 ports. In this chapter, the pin assignments and sockets for the ports of the GS10 are explained.

**Ports at the instrument front panel**



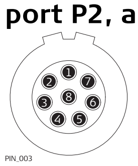

a) Port P3: Power out, data in/out or remote interface in/out. 8 pin LEMO
b) Port PWR: Power in. 5 pin LEMO
c) Port ANT: GNSS antenna in
d) Port P1: CS field controller in/out or remote interface in/out. 8 pin LEMO
e) Port P2: Power out, data in/out or remote interface in/out. 8 pin LEMO

**Pin assignments for port P1**



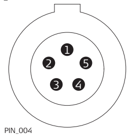

| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | TRM_ON/USB_ID | RS232, general-purpose signal | In or out |

**Pin assignments for port P2, and port P3**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | RTS | RS232, ready to send | Out |
| 2 | CTS | RS232, clear to send | In |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In |
| 7 | GPIO | RS232, configurable function | In or out |
| 8 | +12 V | 12 V power supply out | Out |

**Pin assignments for port PWR**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR1 | Power input, 11 V-28 V | In |
| 2 | ID1 | Identification pin | In |
| 3 | GND | Signal ground | - |
| 4 | PWR2 | Power input, 11 V-28 V | In |
| 5 | ID2 | Identification pin | In |

**Sockets**

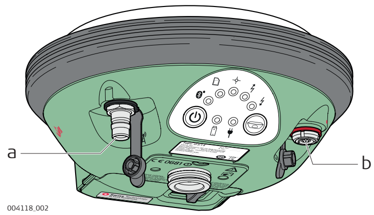
| | |
|---|---|
| Port P1 | LEMO-1, 8 pin, LEMO EGI.1B.308.CLN |
| Port P2 and port P3: | LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP |
| Port PWR: | LEMO-1, 5 pin, LEMO HMG.1B.305.CLNP |

## D.3 GS14

**Description**

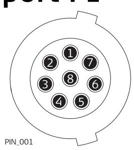
Some applications require knowledge of the pin assignments for the instrument ports. In this chapter, the pin assignments and sockets for the instrument ports are explained.

**Ports at the instrument underside**




a) QN-connector, only for models with UHF radio
b) Port 1 (USB and serial)

**Pin assignments for port P1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | GPIO | RS232, general-purpose signal | In or out |

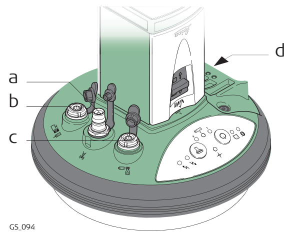
**Sockets**

Port 1: LEMO-1, 8 pin, LEMO HMI.1B.308.CLWP

**Description**

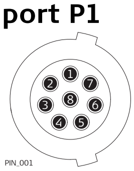
Some applications require knowledge of the pin assignments for the GS15 ports. In this chapter, the pin assignments and sockets for the ports of the GS15 are explained.

**Ports at the instrument underside**



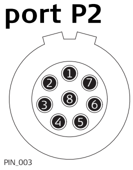

a) QN-connector
b) Port 2
c) Port 1 (USB and serial)
d) Port 3

**Pin assignments for port P1**



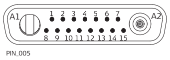

| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | TRM_ON/USB_ID | RS232, general-purpose signal | In or out |

**Pin assignments for port P2**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | RTS | RS232, ready to send | Out |
| 2 | CTS | RS232, clear to send | In |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In |
| 7 | GPIO | RS232, configurable function | In or out |
| 8 | +12 V | 12 V power supply out | Out |

**Pin assignments for port P3**



| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR | 4 V power supply in | In |
| 2 | Tx | Transmit data | In |
| 3 | Rx | Receive data | Out |
| 4 | GPO/DCD | General-purpose out, carrier detect out | Out |
| 5 | RTS | Request to send | In |
| 6 | CTS | Clear to send | Out |
| 7 | GPI/CFG | General-purpose in, config mode in | In |
| 8 | PWR | 6 V power supply in | In |
| 9 | GPIO | General-purpose signal | In or out |
| 10 | GND | Signal and chassis ground | - |
| 11 | USB+ | USB data line (+) | In or out |
| 12 | USB- | USB data line (-) | In or out |
| 13 | GND | Signal and chassis ground | - |
| 14 | ID | Identification pin | In or out |
| 15 | GPIO | General-purpose signal | In or out |
| A1 | NC | Not used | - |
| A2 | RF1 | Antenna port, radio to antenna | - |

**Sockets**

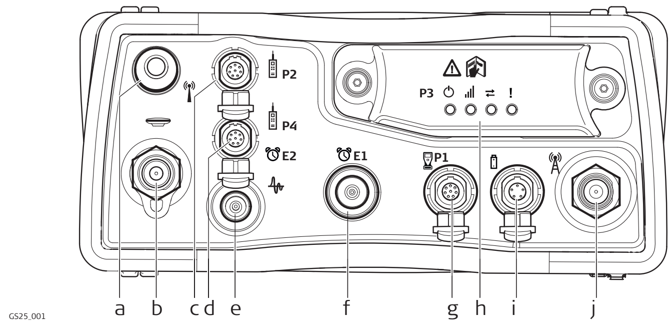
| | |
|---|---|
| Port 1: | LEMO-1, 8 pin, LEMO EGI.1B.308.CLN |
| Port 2: | LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP |
| Port 3: | 15 pin RS232:RS232, 15 pin, DE15 |

## D.5 GS25

**Description**

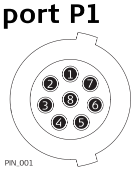
Some applications require knowledge of the pin assignments for the GS25 ports. In this chapter, the pin assignments and sockets for the ports of the GS25 are explained.

**Ports at the instrument back panel**



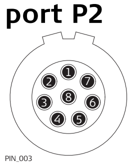

a) Port BT: Bluetooth antenna
b) Port ANT: GNSS antenna in
c) Port P2: Power out, data in/out or remote interface in/out. 8 pin LEMO
d) Port P4 and E2: Serial/Event port. 8 pin LEMO
e) Port PPS: Puls per second output
f) Port E1: Event 1
g) Port P1: CS field controller in/out or remote interface in/out. 8 pin LEMO
h) Port 3: Communication slot-in port and LEDs
i) Port PWR: Power in. 5 pin LEMO
j) Communication Slot-in port, Antenna, TNC

**Pin assignments for port P1**



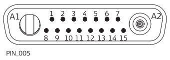

| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | TRM_ON/USB_ID | RS232, general-purpose signal | In or out |

**Pin assignments for port P2**



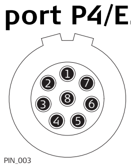

| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | RTS | RS232, ready to send | Out |
| 2 | CTS | RS232, clear to send | In |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In |
| 7 | GPIO | RS232, configurable function | In or out |
| 8 | +12 V | 12 V power supply out | Out |

**Pin assignments for port P3**



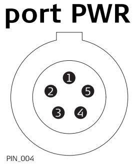
| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR | 4 V power supply in | In |
| 2 | Tx | Transmit data | In |
| 3 | Rx | Receive data | Out |
| 4 | GPO/DCD | General-purpose out, carrier detect out | Out |
| 5 | RTS | Request to send | In |
| 6 | CTS | Clear to send | Out |
| 7 | GPI/CFG | General-purpose in, config mode in | In |
| 8 | PWR | 6 V power supply in | In |
| 9 | GPIO | General-purpose signal | In or out |
| 10 | GND | Signal and chassis ground | - |
| 11 | USB+ | USB data line (+) | In or out |
| 12 | USB- | USB data line (-) | In or out |
| 13 | GND | Signal and chassis ground | - |
| 14 | ID | Identification pin | In or out |
| 15 | GPIO | General-purpose signal | In or out |
| A1 | NC | Not used | - |
| A2 | RF1 | Antenna port, radio to antenna | - |

**Pin assignments for port P4/E2**



| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | RTS | RS232, ready to send | Out |
| 2 | CTS | RS232, clear to send | In |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | GPIO/EVT2 IN | RS232, general purpose input/output | In or out |
| 8 | +12 V | 12 V power supply out | Out |

**Pin assignments for port PWR**



| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR1 | Power input, 11 V-28 V | In |
| 2 | ID1 | Identification pin | In |
| 3 | GND | Signal ground | - |
| 4 | PWR2 | Power input, 11 V-28 V | In |
| 5 | ID2 | Identification pin | In |

**Sockets**

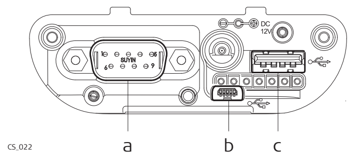
| | |
|---|---|
| Port P1 | LEMO-1, 8 pin, LEMO EGI.1B.308.CLN |
| Port P2 and P4/E2: | LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP |
| Port 3: | 15 pin RS232:RS232, 15 pin, DE15 |
| Port PWR: | LEMO-1, 5 pin, LEMO HMG.1B.305.CLNP |
| PPS: | LEMO ERN.OS.250.CTL |
| E1: | LEMO HGP.00.250.CTL |

## D.6 CS10/CS15

**Description**

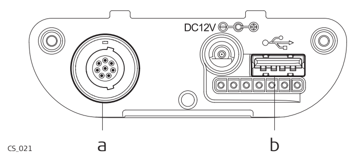
Some applications require knowledge of the pin assignments for the CS10/CS15 ports. In this chapter, the pin assignments and sockets for the ports of the CS10/CS15 are explained.

**Ports at the instrument bottom panel - DSUB9 connector**



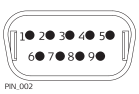

a) DSUB9 port
b) USB Mini port
c) USB A Host port

**Ports at the instrument bottom panel - Lemo connector**



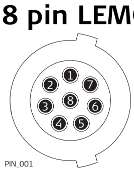

a) Lemo port (USB and serial)
b) USB A Host port

**Pin assignments for RS232 serial port**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | NC | Not connected | - |
| 2 | RxD | RS232, receive data | In |
| 3 | TxD | RS232, transmit data | Out |
| 4 | NC | Not connected | - |
| 5 | GND | Signal Ground | - |
| 6 | NC | Not connected | - |
| 7 | RTS | RS232, request to send | Out |
| 8 | CTS | RS232, clear to send | In |
| 9 | NC | Not connected | - |

**Pin assignments for 8 pin LEMO-1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, 10.5 V-28 V | In |
| 8 | TRM_ON/USB_ID | RS232, general purpose signal | In or out |

**Sockets**

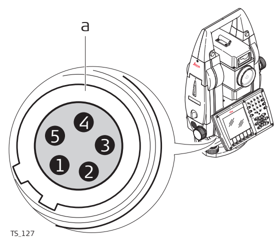
| | |
|---|---|
| 9 pin RS232: | RS232, 9 pin, DB9 |
| 8 pin LEMO-1: | LEMO-1, 8 pin, LEMO EGI.1B.308.CLN |

# D.7 TS11/TS15/TS12 Lite

**Description**

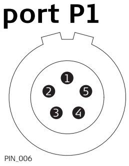
Some applications require knowledge of the pin assignments for the instrument port. In this chapter, the pin assignments and socket for the port 1 of the TS11/TS15/TS12 Lite instrument are explained.

**Ports at the TS11/TS15/TS12 Lite instrument**




a) Port 1

**Pin assignments for port P1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR | Power input, + 12 V nominal (11 V - 16 V) | In |
| 2 | - | Not used | - |
| 3 | GND | Single ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |

**Sockets**

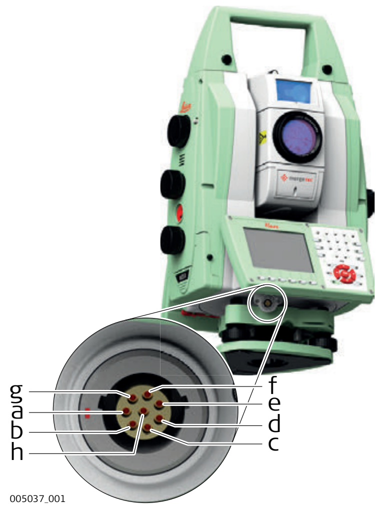
Port 1: LEMO-0, 5 pin, LEMO ENA.OB.305.CLN

## D.8 MS50/TS50/TM50

**Description**

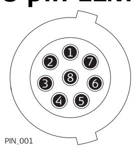
Some applications require knowledge of the pin assignments for the instrument port. In this chapter, the pin assignments and socket for the port 1 of the MS50/TS50/TM50 instrument are explained.

**Ports at the MS50/TS50/TM50 instrument**




a) Pin 1
b) Pin 2
c) Pin 3
d) Pin 4
e) Pin 5
f) Pin 6
g) Pin 7
h) Pin 8

**Pin assignments for 8 pin LEMO-1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | USB_D+ | USB data line | In or out |
| 2 | USB_D- | USB data line | In or out |
| 3 | GND | Signal ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |
| 6 | ID | Identification pin | In or out |
| 7 | PWR | Power input, nominal +12 V (11 V - 16 V) | In |
| 8 | NC | Not connected | - |

**Sockets**

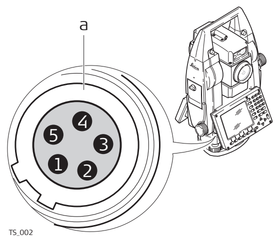
Port 1: LEMO-1, 8 pin, LEMO EGI.1B.308.CLN

## D.9 TPS1200+

**Description**

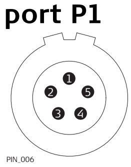
Some applications require knowledge of the pin assignments for the instrument port. In this chapter, the pin assignments and socket for the port 1 of the TPS1200+ instrument are explained.

**Ports at the TPS instrument**




a) Port 1

**Pin assignments for port P1**




| Pin | Signal Name | Function | Direction |
|---|---|---|---|
| 1 | PWR | Power input, + 12 V nominal (11 V - 16 V) | In |
| 2 | - | Not used | - |
| 3 | GND | Single ground | - |
| 4 | RxD | RS232, receive data | In |
| 5 | TxD | RS232, transmit data | Out |

**Sockets**

Port 1: LEMO-0, 5 pin, LEMO ENA.OB.305.CLN

# Appendix E Cables

## E.1 GPS Cables

**Power cables**

| Name | Description |
|---|---|
| GEV97 | • Allows GS10 (power port) to be externally powered<br>• LEMO-1, 5 pin, 30° / LEMO-1, 5 pin, 30°<br>• 1.8 m |
| GEV71 | • Allows powering of any device from car battery.<br>• Crocodile clips / LEMO-1, 5 pin , 30° (female)<br>• 4.0 m |
| GEV172 | • Allows GS10 (power port) to be externally powered from two external batteries<br>• LEMO-1, 5 pin / LEMO-1, 5 pin, 30°<br>• 2.8 m |
| GEV219 | • Allows CS10/CS15 (with LEMO CBC01 connector module) to be externally powered via the LEMO port<br>• Allows GS10/GS14/GS15 (port 1) to be externally powered<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30°<br>• 1.8 m |
| GEV235 | • Allows CS10/CS15 (with either connector modules) to be externally powered via the power jack<br>• Wall adapter / 3 mm barrel connector<br>• 1.5 m |

**Y cables**

| Name | Description |
|---|---|
| GEV172 | • Allows GS10 (power port) to be externally powered from two external batteries<br>• LEMO-1, 5 pin / LEMO-1, 5 pin, 30°<br>• 2.8 m |
| GEV205 | • Allows connections between GS10/GS15 (port 1), an external radio in GFU1200 housing and the GEB71, with GS10/GS15 and a radio being externally powered<br>• LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135° (female) / LEMO-1, 5 pin<br>• 1.8 m |
| GEV215 | • Allows connections between CS10/CS15 (with LEMO CBC01 connector module), the GS10/GS15 (port 1) and the GEB71, with the GS10/GS15 being powered from the GEB71.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30° / LEMO-1, 5 pin, 30°<br>• 2.0 m |
| GEV261 | • Allows connections between MS50/TS50/TM50, external battery GEB171 and a PC with either USB or 9 pin D-Sub RS232.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin/USB/9pol D-Sub<br>• 1.8 m |

## Radio programming cables

| Name | Description |
| --- | --- |
| GEV231 | • Allows an “SLR” radio device to be externally powered and programmed by a computer<br>• 15 pin (GS15 slot-in port) (female) / 9 pin, RS232 serial / LEMO-1, 5 pin<br>• 1.8 m |
| GEV171 | • Allows a radio within a GFU1200 device to be externally powered and programmed by a computer<br>• LEMO-1, 8 pin, 135° (female) / 9 pin, RS232 serial / LEMO-1, 5 pin<br>• 1.8 m |

## Radio cables

| Name | Description |
| --- | --- |
| GEV67 | • Allows System 500 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2)<br>• LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30°<br>• 0.5 m |
| GEV125 | • Allows a Satel modem (not inside housing) to be connected to a GS10 (port 2 and 3), or GS15 (port 2)<br>• LEMO-1, 8 pin, 30° / 15 pin, RS232 serial<br>• 1.8 m |
| GEV232 | • Allows System 1200 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2)<br>• LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female)<br>• 2.8 m |
| GEV233 | • Allows System 1200 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2)<br>• LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female)<br>• 0.8 m |

## Serial data transfer cables

| Name | Description |
| --- | --- |
| GEV160 | • Allows serial connection between GS10 (port 2 and 3), or GS15 (port 2) to a computer to stream NMEA or RTK data<br>• LEMO-1, 8 pin, 30° / 9 pin, RS232 serial<br>• 2.8 m |
| GEV162 | • Allows serial connection between GS10/GS15 (port 1) to a computer to stream NMEA or RTK data<br>• Allows serial connection between CS10/CS15 (with LEMO CBC01 connector module) and, for example, a hidden point device, ASCII input device, or computer.<br>• Allows serial connection between CS10/CS15 (with 9 pin serial CBC02 connector module) and GS10/GS15 (port 1). This connection is useful when using third-party software such as Carlson SurvCE on the CS10/CS15 and a cable connection is required to the GS10/GS15.<br>• LEMO-1, 8 pin, 135° / 9 pin, RS232 serial<br>• 2.8 m |
| GEV163 | • Allows serial connection between CS10/CS15 (with LEMO CBC01 connector module) and GS10/GS15 port 1. This connection is useful when using third-party software such as Carlson SurvCE on the CS10/CS15 (with LEMO CBC01 connector module) and a cable connection is required to the GS10/GS15.<br>• LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135°<br>• 1.8 m |

#### USB to serial converter cables

| Name | Description |
|---|---|
| GEV268 | • Allows GS10 (port 2 and 3) or GS15 (port 2) to be connected to a computer where a serial connection is required, but no 9 pin RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer to the CS10/CS15 or GS10/GS15 hardware.<br>• LEMO-1, 8 pin, 30° / USB type A<br>• 2.0 m |
| GEV269 | • Allows CS10/CS15 (with LEMO CBC01 connector module) and GS10/GS14/GS15 (port 1) to be connected to a computer where a serial connection is required, but no 9 pin RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer to the CS10/CS15 or GS10/GS14/GS15 hardware.<br>• LEMO-1, 8 pin, 135° / USB type A<br>• 2.0 m |

#### USB data transfer cables

| Name | Description |
|---|---|
| GEV223 | • Allows USB data transfer between CS10/CS15 (both connector modules) and a computer.<br>• USB Type A / Mini USB Type B<br>• 1.8 m |
| GEV234 | • Allows a CS10/CS15 (with 9 pin serial CBC02 connector module) to connect to a GS10/GS15 (port 1). This cable is for when a cable connection is needed between CS10/CS15 and GS10/GS15 when the CS10/CS15 is using the CBC02 connector module.<br>• Allows a USB connection between the USB port of a computer and the GS10/GS15 (port 1)<br>• Allows a USB connection between the USB port of a computer and the CS10/CS15 (with LEMO CBC01 connector module)<br>• LEMO-1, 8 pin, 135° / USB type A<br>• 1.65 m |
| GEV237 | • Allows a CS10/CS15 (with LEMO CBC01 connector module) to connect to a GS10/GS15 (port 1). This cable is for when a cable connection is needed between CS10/CS15 and GS10/GS15 when the CS10/CS15 is using the CBC01 connector module.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135°<br>• 1.65 m |

**Antenna cables**

| Name | Description |
|---|---|
| GEV108 | • TNC connector / TNC connector<br>• 30 m |
| GEV119 | • TNC connector / TNC connector<br>• 10 m |
| GEV120 | • TNC connector / TNC connector<br>• 2.8 m |
| GEV134 | • TNC connector / TNC connector<br>• 50 m |
| GEV141 | • TNC connector / TNC connector<br>• 1.2 m |
| GEV142 | • TNC connector / TNC connector (male)<br>• 1.6 m |
| - | • TNC connector / TNC connector<br>• 70 m |

## E.2 TPS Cables

**Power cables**

| Name | Description |
|---|---|
| GEV52 | • Allows TS11/TS12 Robotic/TS15 to be externally powered<br>• LEMO-0, 5 pin, 30° / LEMO-1, 5 pin<br>• 1.8 m |
| GEV219 | • Allows CS10/CS15 (with LEMO CBC01 connector module) to be externally powered via the LEMO port<br>• Allows GS10/GS15 (port 1) to be externally powered<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30°<br>• 1.8 m |

**Radio / Y cables**

| Name | Description |
|---|---|
| GEV186 | • Allows connections between TS11/TS12 Robotic/TS15, an external battery and TCPS27/TCPS28/TCPS29<br>• LEMO-0, 5 pin, 30° / LEMO-0, 8 pin,30° / LEMO-1, 5 pin<br>• 1.8 m |
| GEV220 | • Allows connections between MS50/TS50/TM50, external battery GEB171 and a PC with 9 pin D-Sub RS232.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin/USB/9pol D-Sub<br>• 1.8 m |
| GEV236 | • Allows connection between MS50/TS50/TM50, an external battery and TCPS27/TCPS28/TCPS29<br>• LEMO-1, 8 pin, 15/150° / LEMO-1, 5pin / LEMO-1, 8 pin, 30°<br>• 1.8 m |
| GEV261 | • Allows connections between MS50/TS50/TM50, external battery GEB171 and a PC with either USB or 9 pin D-Sub RS232.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 5 pin/USB/9pol D-Sub<br>• 1.8 m |

**Serial data transfer cables**

| Name | Description |
|---|---|
| GEV102 | • Allows serial connection between TS11/TS12 Robotic/TS15 and a computer<br>• Allows serial connection between TS11/TS12 Robotic/TS15 and CS10/CS15 (with 9 pin serial CBC02 connector module)<br>• LEMO-0, 5 pin, 30° / 9 pin, RS232 serial<br>• 2.0 m |
| GEV162 | • Allows serial connection between CS10/CS15 (with 9 pin serial CBC02 connector module) and a computer<br>• LEMO-1, 8 pin, 135° / 9 pin, RS232 serial<br>• 2.8 m |
| GEV163 | • Allows serial connection between CS10/CS15 (with LEMO CBC01 connector module) and GS10/GS15 port 1. This connection is useful when using third-party software such as Carlson SurvCE on the CS10/CS15 (with LEMO CBC01 connector module) and a cable connection is required to the GS10/GS15.<br>• LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135°<br>• 1.8 m |
| GEV187 | • Allows connections between TS11/TS12 Robotic/TS15, an external battery and a computer<br>• LEMO-0, 5 pin, 30° / 9 pin, RS232 serial / LEMO-1, 5 pin, 30°<br>• 2.0 m |
| GEV217 | • Allows serial connection between TS11/TS12 Robotic/TS15 and CS10/CS15 (with LEMO CBC01 connector module)<br>• LEMO-1, 8 pin, 135° / LEMO-0, 5 pin,30°<br>• 1.8 m |

**USB to serial converter cables**

| Name | Description |
|---|---|
| GEV267 | • Allows TS11/TS12 Robotic/TS15 to be connected to a computer where a serial connection is required, but no 9 pin RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer to the TS11/TS12 Robotic/TS15 or DNA hardware<br>• LEMO-0, 5 pin, 30° / USB type A<br>• 2.0 m |

**USB data transfer cables**

| Name | Description |
|---|---|
| GEV234 | • Allows a USB connection between the USB port of a computer and the CS10/CS15 (with LEMO CBC01 connector module)<br>• LEMO-1, 8 pin, 135° / USB type A<br>• 1.65 m |
| GEV237 | • Allows a CS10/CS15 (with LEMO CBC01 connector module) to connect to a GS10/GS15 (port 1). This cable is for when a cable connection is needed between CS10/CS15 and GS10/GS15 when the CS10/CS15 is using the CBC01 connector module.<br>• LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135°<br>• 1.65 m |

# Appendix F NMEA Message Formats GPS

## F.1 Overview

| | |
|---|---|
| **Description** | **N**ational **M**arine **E**lectronics **A**ssociation is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument. |
| **Access** | Select **Main Menu: Instrument\Instrument\All other connections\NMEA 1** or **NMEA 2**. Press **Mesgs**. |
| ☞ | A Talker ID appears at the beginning of the header of each NMEA message.<br>The Talker ID can be user defined or standard (based on the NMEA 3.0). The standard is normally GP for GPS but can be changed in **NMEA Output 1** or **NMEA Output 2**. |

## F.2 Symbols Used for Describing the NMEA Formats

**Description**

NMEA messages consist of various fields. The fields are:

- Header
- Special format fields
- Numeric value fields
- Information fields
- Null fields

Certain symbols are used as identifier for the field types.
These symbols are described in this section.

**Header**

| Symbol | Field | Description | Example |
|---|---|---|---|
| $ | - | Start of sentence | $ |
| --ccc | Address | • -- = alphanumeric characters identifying the talker<br>Options:<br>GN = **Gl**obal **N**avigation **S**atellite **S**ystem<br>GP = GPS only<br>GL = GLONASS<br>GA = Galileo<br>BD = BeiDou<br>• ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message. | <br><br>GNGGA<br>GPGGA<br>GLGGA<br>GAGGA<br>BDGGA |

**Special format fields**

| Symbol | Field | Description | Example |
|---|---|---|---|
| A | Status | • A = Yes, Data Valid, Warning Flag Clear<br>• V = No, Data Invalid, Warning Flag Set | V |
| llll.ll | Latitude | • Degreesminutes.decimal<br>• Two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes.<br>• Leading zeros are always included for degrees and minutes to maintain fixed length. | 4724.538950 |
| yyyyy.yy | Longitude | • Degreesminutes.decimal<br>• Three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes.<br>• Leading zeros are always included for degrees and minutes to maintain fixed length. | 00937.046785 |
| eeeeee.eee | Grid Easting | At the most six fixed digits for metres and three fixed digits for decimal fractions of metres. | 195233.507 |
| nnnnnn.nnn | Grid Northing | At the most six fixed digits for metres and three fixed digits for decimal fractions of metres. | 127223.793 |
| hhmmss.ss | Time | • hoursminutesseconds.decimal<br>• Two fixed digits of hours, two fixed digits of minutes, two fixed digits of seconds and a variable number of digits for decimal fraction of seconds.<br>• Leading zeros are always included for hours, minutes and seconds to maintain fixed length. | 115744.00 |
| mmddyy | Date | • Monthdayyear - two fixed digits of month, two fixed digits of day, two fixed digits of year.<br>• Leading zeros always included for month, day and year to maintain fixed length. | 093003 |
| No specific symbol | Defined field | • Some fields are specified to contain predefined constants, most often alpha characters.<br>• Such a field is indicated by the presence of one or more valid characters. Excluded from the list of valid characters are the following that are used to indicate other field types: A, a, c, x, hh, hhmmss.ss, llll.ll, yyyyy.yy. | M |

**Numeric value fields**

| Symbol | Field | Description | Example |
|---|---|---|---|
| x.x | Variable numbers | • Integer or floating numeric field<br>• Optional leading and trailing zeros. Decimal point and associated decimal-fraction are optional if full resolution is not required. | 73.10 = 73.1 = 073.1 = 73 |
| hh_ | Fixed HEX field | Fixed length HEX numbers | 3F |

**Information fields**

| Symbol | Field | Description | Example |
|---|---|---|---|
| c--c | Variable text | Variable length valid character field | A |
| aa_ | Fixed alpha field | Fixed length field of upper case or lower case alpha characters | N |
| xx_ | Fixed number field | Fixed length field of numeric characters | 1 |

**Null fields**

| Symbol | Field | Description | Example |
|---|---|---|---|
| No symbol | Information unavailable for output | Null fields do not contain any information. | ,, |

☞ Fields are always separated by a comma. Before the Checksum field there is never a comma.

☞ When information for a field is not available, the position in the data string is empty.

## F.3 GGA - Global Positioning System Fix Data

**Syntax**

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GGA | Header including Talker ID |
| hhmmss.ss | UTC time of position |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| x | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Valid fix for GNSS**P**recise **P**ositioning **S**ervice mode, for example WAAS<br>4 = Real-time position, ambiguities fixed |
| xx | Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | HDOP |
| x.x | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| x.x | Geoidal separation in metres. The Geoidal separation is the difference between the WGS 1984 earth ellipsoid surface and mean sea level. |
| M | Units of geoidal separation as fixed text M |
| x.x | Age of differential GNSS data, empty when DGPS not used |
| xxxx | Differential base station ID, 0000 to 1023 |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**User-defined Talker ID = GN**

$GNGGA,113805.50,4724.5248541,N,00937.1063044,E,4,13,0.7,1171.281,M,-703.398,
M,0.26,0000*42

## F.4 GGK - Real-Time Position with DOP

**Syntax**

$--GGK,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,EHTx.x,M*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GGK | Header including Talker ID |
| hhmmss.ss | UTC time of position |
| mmddyy | UTC date |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| x | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx | Number of satellites in use. For $GNGGK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | GDOP |
| EHT | Ellipsoidal height |
| x.x | Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**Standard Talker ID**

$GNGGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.7,EHT1171.742,M*6D

**User-defined Talker ID = GN**

$GNGGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.4,EHT1171.746,M*66

## F.5 GGK(PT) - Real-Time Position with DOP, Trimble Proprietary

**Syntax**

$PTNL,GGK,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,EHTx.x,M*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $PTNL | $ = Start of sentence delimiter, talker ID fixed with PTNL |
| GGK | GGK sentence formatter |
| hhmmss.ss | UTC time of position |
| mmddyy | UTC date |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| x | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Not existing<br>3 = Real-time position, ambiguities fixed<br>4 = Real-time position, ambiguities not fixed |
| xx | Number of satellites in use, 00 to 26. |
| x.x | PDOP |
| EHT | Ellipsoidal height |
| x.x | Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**Standard Talker ID**

$PTNL,GGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.5,EHT1171.742,M*4C

**User-defined Talker ID = GN**

$PTNL,GGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.2,EHT1171.746,M*43

## F.6 GGQ - Real-Time Position with CQ

**Syntax**

$--GGQ,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GGQ | Header including talker ID |
| hhmmss.ss | UTC time of position |
| mmddyy | UTC date |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| x | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx | Number of satellites in use. For $GNGGQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | Coordinate quality in metres |
| x.x | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**For NMEA v4.0:**

**Standard Talker ID**

$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M*22
$GPGGQ,113615.50,041006,,,,08,,*67
$GLGGQ,113615.50,041006,,,,04,,*77

**User-defined Talker ID = GN**

$GNGGQ,113805.50,041006,4724.5248541,N,00937.1063044,E,3,13,0.010,1171.281,M*2E

**For NMEA v4.1:**

$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M*22

☞ Only the $GNGGQ is output when more than one GNSS is active.

## F.7 GLL - Geographic Position Latitude/Longitude

**Syntax**

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GLL | Header including talker ID |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| hhmmss.ss | UTC time of position |
| A | Status<br>A = Data valid<br>V = Data not valid |
| a | Mode indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

☞ The Mode indicator field supplements the Status field. The Status field is set to A for the Mode indicators A and D. The Status field is set to V for the Mode indicator N.

**Examples**

**Standard Talker ID**
$GNGLL,4724.5248556,N,00937.1063059,E,113615.50,A,D*7B
**User-defined Talker ID = GN**
$GNGLL,4724.5248541,N,00937.1063044,E,113805.50,A,D*7E

## F.8 GNS - GNSS Fix Data

**Syntax**

$--GNS,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,xxxx,h*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GNS | Header including talker ID |
| hhmmss.ss | UTC time of position |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, **N**orth or **S**outh |
| yyyyy.yy | Longitude (WGS 1984) |
| a | **E**ast or **W**est |
| c--c | For NMEA v4.1 in use. Four character mode indicator for each GNSS constellation used in the position where the<br>• First character is for GPS<br>• Second character is for GLONASS<br>• Third character is for Galileo<br>• Fourth character is for BeiDou<br>N = Satellite system not used in position fix or fix not valid<br>P = Precise, for example no deliberate degradation such as SA<br>A = Autonomous; navigation fix, no real-time fix<br>D = Differential; real-time position, ambiguities not fixed<br>R = Real-time kinematic; ambiguities fixed<br>F = Float real-time kinematic |
| xx | Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | HDOP |
| x.x | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported. |
| x.x | Geoidal separation in metres |
| x.x | Age of differential data |
| xxxx | Differential base station ID, 0000 to 1023 |
| h | For NMEA v4.1. Navigation Status Indicator<br>S = Safe<br>C = Caution<br>U = Unstable<br>V = Navigation status not valid |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**For NMEA v4.0:**

**Standard Talker ID**

$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-703.398,0.76,0000*6C

$GPGNS,113616.00,,,,,,08,,,,,*69

$GLGNS,113616.00,,,,,,04,,,,,*79

☞ Only the $GNGNS is output when more than one GNSS is active.

**User-defined Talker ID = GN**

$GNGNS,113806.00,4724.5248547,N,00937.1063032,E,R,13,0.7,1171.283,-703.398,0.76,0000*39

**For NMEA v4.1:**

$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-703.398,0.76,0000,V*6C

☞ Only the $GNGNS is output when more than one GNSS is active.

## F.9 GSA - GNSS DOP and Active Satellites

**Syntax**

$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,h*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--GSA | Header including talker ID |
| a | Mode<br>M = Manual, forced to operate in 2D or 3D mode<br>A = Automatic, allowed to change automatically between 2D and 3D |
| x | Mode<br>1 = Fix not available<br>2 = 2D<br>3 = 3D |
| xx | PRN numbers of the satellites used in the solution.<br>For NMEA v4.0: This field is repeated 12 times.<br>For NMEA v4.1: This field is repeated 16 times.<br>☞ A new GSA message is sent for each GNSS constellation tracked.<br>**For NMEA v4.0 and v4.1:**<br>GPS 1 to 32 GPS satellites<br>33 to 64 SBAS satellites<br>65 to 99 Undefined<br>GLONASS 1 to 32 Undefined<br>33 to 64 SBAS satellites<br>65 to 99 GLONASS satellites<br>**For NMEA v4.1 also:**<br>Galileo 1 to 36 Galileo satellites<br>37 to 64 Galileo SBAS<br>65 to 99 Undefined<br>BeiDou 1 to 37 BeiDou satellites<br>38 to 64 BeiDou SBAS<br>65 to 99 Undefined |
| x.x | PDOP |
| x.x | HDOP |
| x.x | VDOP |
| h | For NMEA v4.1. GNSS System ID<br>1 = GPS<br>2 = GLONASS<br>3 = Galileo<br>4 = BeiDou |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**For NMEA v4.0:**

**Standard Talker ID**

$GNGSA,A,3,01,11,14,17,19,20,24,28,,,,,1.5,0.9,1.2*26
$GNGSA,A,3,65,66,67,81,,,,,,,,,1.5,0.9,1.2*29

**User-defined Talker ID = GN**

$GNGSA,A,3,01,11,14,17,19,20,23,24,28,,,,65,66,67,81,,,,,,,,,1.2,0.7,1.0*27

**For NMEA v4.1:**

$GNGSA,A,3,01,04,10,11,13,20,23,31,,,,,,,,,1.1,0.6,0.9,1*39
$GNGSA,A,3,66,67,68,7,6,77,81,82,83,,,,,,,,,1.1,0.6,0.9,2*3B
$GNGSA,A,3,05,10,14,,,,,,,,,,,,,,1.1,0.6,0.9,4*3A

## F.10 GSV - GNSS Satellites in View

**Syntax**

$--GSV,x,x,xx,xx,xx,xxx,xx,.....,h*hh<CR><LF>

**Description of fields**

| Field | Description | | |
|---|---|---|---|
| $--GSV | Header including talker ID | | |
| x | Total number of messages, 1 to 9 | | |
| x | Message number, 1 to 9 | | |
| xx | Number of theoretically visible satellites according to the current almanac. | | |
| xx | PRN numbers of the satellites used in the solution. | | |
| | GPS | 1 to 32 | GPS satellites |
| | | 33 to 64 | SBAS satellites |
| | | 65 to 99 | Undefined |
| | GLONASS | 1 to 32 | Undefined |
| | | 33 to 64 | SBAS satellites |
| | | 65 to 99 | GLONASS satellites |
| | Galileo | 1 to 36 | Galileo satellites |
| | | 37 to 64 | Galileo SBAS |
| | | 65 to 99 | Undefined |
| | BeiDou | 1 to 37 | BeiDou satellites |
| | | 38 to 64 | BeiDou SBAS |
| | | 65 to 99 | Undefined |
| xx | Elevation in degrees, 90 maximum, empty when not tracking | | |
| xxx | Azimuth in degrees true north, 000 to 359, empty when not tracking | | |
| xx | **S**ignal to **N**oise **R**ation C/No in dB, 00 to 99 of L1 signal, null field when not tracking. | | |
| ... | Repeat set PRN / Slot number, elevation, azimuth and SNR up to four times | | |
| h | For NMEA v4.1. Signal ID | | |
| | GPS | 0 | All signals |
| | | 1 | L1 C/A |
| | | 2 | L1 P(Y) |
| | | 3 | L1M |
| | | 4 | L2 P(Y) |
| | | 5 | L2C-M |
| | | 6 | L2C-L |
| | | 7 | L5-I |
| | | 8 | L5-Q |
| | | 9-F | Reserved |
| | GLONASS | 0 | All signals |
| | | 1 | G1 C/A |
| | | 2 | G1 P |
| | | 3 | G2 C/A |
| | | 4 | GLONASS (M) G2 P |

| Field | Description | | |
|---|---|---|---|
| | | 5-F | Reserved |
| | Galileo | 0 | All signals |
| | | 1 | E5a |
| | | 2 | E5b |
| | | 3 | E5a+b |
| | | 4 | E6-A |
| | | 5 | E6-BC |
| | | 6 | L1-A |
| | | 7 | L1-BC |
| | | 8-F | Reserved |
| | BeiDou | 0 | All signals |
| | | 1-F | Reserved |
| *hh | Checksum | | |
| <CR> | **C**arriage **R**eturn | | |
| <LF> | **L**ine **F**eed | | |

☞ Satellite information can require the transmission of multiple messages, specified by the total number of messages and the message number.

☞ The fields for the PRN / Slot number, Elevation, Azimuth and SNR form one set. A variable number of these sets are allowed up to a maximum of four sets per message.

**Examples**

**For NMEA v4.0:**

**Standard Talker ID**

$GPGSV,3,1,11,01,55,102,51,11,85,270,50,14,31,049,47,17,21,316,46*7A
$GPGSV,3,2,11,19,31,172,48,20,51,249,50,22,00,061,,23,11,190,42*7E
$GPGSV,3,3,11,24,11,292,43,25,08,114,,28,14,275,44,,,,*45
$GLGSV,2,1,06,65,16,055,42,66,64,025,48,67,46,262,42,68,01,245,*64
$GLGSV,2,2,06,81,52,197,47,83,07,335,,,,,,,,*68

**User-defined Talker ID = GN**

$GNGSV,3,1,10,01,55,100,51,11,86,263,50,14,31,049,47,17,22,316,46*65
$GNGSV,3,2,10,19,30,172,48,20,52,249,51,23,12,190,42,24,12,292,42*6C
$GNGSV,3,3,10,25,09,114,,28,14,274,44,,,,,,,*62

**For NMEA v4.1:**

$GPGSV,3,1,10,01,27,152,45,04,40,303,50,10,16,281,44,11,03,158,,0*62
$GPGSV,3,2,10,13,51,215,50,17,27,250,,20,59,089,51,23,84,143,52,0*63
$GPGSV,3,3,10,31,19,041,41,32,21,089,44,,,,,,,,0*6D
$GLGSV,3,1,10,66,28,068,47,67,68,359,48,68,31,280,43,75,07,011,,0*75
$GLGSV,3,2,10,76,33,061,45,77,26,123,42,81,03,189,33,82,02,188,,0*7F
$GLGSV,3,3,10,83,37,311,48,84,01,347,,,,,,,,,0*75
$BDGSV,2,1,05,02,05,104,,05,18,122,40,07,18,037,,10,37,059,41,0*7F
$BDGSV,2,2,05,14,60,076,46,,,,,,,,,,,,0*41

## F.11 LLK - Leica Local Position and GDOP

**Syntax**

$--LLK,hhmmss.ss,mmddyy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--LLK | Header including talker ID |
| hhmmss.ss | UTC time of position |
| mmddyy | UTC date |
| eeeeee.eee | Grid Easting in metres |
| M | Units of grid Easting as fixed text M |
| nnnnnn.nnn | Grid Northing in metres |
| M | Units of grid Northing as fixed text M |
| x | Position quality<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx | Number of satellites in use. For $GNLLK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | GDOP |
| x.x | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**For NMEA v4.0:**
**Standard Talker ID**
$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F
$GPLLK,113616.00,041006,,,,,,08,,,*57
$GLLLK,113616.00,041006,,,,,,04,,,*47
**User-defined Talker ID = GN**
$GNLLK,113806.00,041006,764413.021,M,252946.772,M,3,13,1.4,1171.283,M*04

**For NMEA v4.1:**
$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F

## F.12 LLQ - Leica Local Position and Quality

**Syntax**

$--LLQ,hhmmss.ss,mmddyy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--LLQ | Header including talker ID |
| hhmmss.ss | UTC time of position |
| mmddyy | UTC date |
| eeeeee.eee | Grid Easting in metres |
| M | Units of grid Easting as fixed text M |
| nnnnnn.nnn | Grid Northing in metres |
| M | Units of grid Northing as fixed text M |
| x | Position quality<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx | Number of satellites in use. For $GNLLQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position. |
| x.x | Coordinate quality in metres |
| x.x | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. |
| M | Units of altitude as fixed text M |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

**Examples**

**For NMEA v4.0:**

**Standard Talker ID**

$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*12
$GPLLQ,113616.00,041006,,,,,,08,,,*4D
$GLLLQ,113616.00,041006,,,,,,04,,,*5D

**User-defined Talker ID = GN**

$GNLLQ,113806.00,041006,764413.021,M,252946.772,M,3,13,0.010,1171.283,M*1A

**For NMEA v4.1:**

$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*12

## F.13 RMC - Recommended Minimum Specific GNSS Data

**Syntax**

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--RMC | Header including talker ID |
| hhmmss.ss | UTC time of position fix |
| A | Status<br>A = Data valid<br>V = Navigation instrument warning |
| llll.ll | Latitude (WGS 1984) |
| a | Hemisphere, North or South |
| yyyyy.yy | Longitude (WGS 1984) |
| a | East or West |
| x.x | Speed over ground in knots |
| x.x | Course over ground in degrees |
| xxxxxx | Date: ddmmyy |
| x.x | Magnetic variation in degrees |
| a | East or West |
| a*hh | Mode Indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| <CR> | Carriage Return |
| <LF> | Line Feed |

**Examples**

**Standard Talker ID**

$GNRMC,113616.00,A,4724.5248557,N,00937.1063064,E,0.01,11.43,100406,11.4 3,E,D*1C

**User-defined Talker ID = GN**

$GNRMC,113806.00,A,4724.5248547,N,00937.1063032,E,0.00,287.73,100406,287 .73,E,D*10

## F.14 VTG - Course Over Ground and Ground Speed

**Syntax**

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--VTG | Header including talker ID |
| x.x | Course over ground in degrees true north, 0.0 to 359.9 |
| T | Fixed text T for true north |
| x.x | Course over ground in degrees magnetic North, 0.0 to 359.9 |
| M | Fixed text M for magnetic North |
| x.x | Speed over ground in knots |
| N | Fixed text N for knots |
| x.x | Speed over ground in km/h |
| K | Fixed text K for km/h |
| a | Mode Indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

☞ The Magnetic declination is set in the instrument in **Regional Settings**, **Angle** page.

**Examples**

**Standard Talker ID**

$GNVTG,11.4285,T,11.4285,M,0.007,N,0.013,K,D*3D

**User-defined Talker ID = GN**

$GNVTG,287.7273,T,287.7273,M,0.002,N,0.004,K,D*3E

## F.15 ZDA - Time and Date

**Syntax**

$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>

**Description of fields**

| Field | Description |
|---|---|
| $--ZDA | Header including talker ID |
| hhmmss.ss | UTC time |
| xx | UTC day, 01 to 31 |
| xx | UTC month, 01 to 12 |
| xxxx | UTC year |
| xx | Local zone description in hours, 00 to ±13 |
| xx | Local zone description in minutes, 00 to +59 |
| *hh | Checksum |
| <CR> | **C**arriage **R**eturn |
| <LF> | **L**ine **F**eed |

☞ This message is given high priority and is output as soon as it is created. Latency is therefore reduced to a minimum.

**Examples**

**Standard Talker ID**

$GPZDA,091039.00,01,10,2003,-02,00*4B

**User-defined Talker ID = GN**

$GNZDA,113806.00,10,04,2006,02,00*76

**AT commands**

Hayes Microcomputer Products is a leading manufacturer of modems that has developed a language called the AT command set for controlling digital cellular phones and modems. This AT command set has become the de facto standard.

**List of selected AT commands**

The characters in this table are the most commonly used AT commands when configuring a digital cellular phone or modem. Refer to the manual of the used digital cellular phone or modem for information on which AT commands to use.

| AT command | Description |
|---|---|
| ~ | Inserts a delay of 1/4 second. |
| ^# | Inserts the phone number as defined in digital cellular phone connection. |
| ^^ | Inserts character ^. |
| ^C | Bearer Service: Connection Element. |
| ^M | Inserts a carriage return and send command. |
| ^S | Bearer Service: Speed including Protocol and NetDataRate. |
| AT | Starts a command line to be sent to phone. |
| AT&F[<value>] | Sets the configuration parameters to default values specified by manufacturer of phone.<br><value>:<br>• 0 = Factory default configuration profile |
| ATD<number> | Starts a call to the phone number given as parameter. If ";" is present, a voice call to the given number is performed. |
| AT+CBST=[<speed>[,<name>[,<ce>]]] | Sets the bearer service <name> with data rate <speed>, and the connection element <ce> . Refer to the manual of the used digital cellular phone or modem for a list of supported name, speed and connection element values. |
| AT+CREG=[<mode>] | Enables/disables network registration reports depending on the parameter <mode>. |
| AT+CREG? | Reports the <mode> and registration status <stat> of phone.<br><mode>:<br>• 0 = Disable network registration unsolicited result code<br>• 1 = Enable network registration unsolicited result code<br><stat>:<br>• 0 = Not registered, ME is not currently searching a new operator to register to<br>• 1 = Registered, home network<br>• 2 = Not registered, but ME is currently searching a new operator to register to<br>• 3 = Registration denied<br>• 4 = Unknown<br>• 5 = Registered, roaming |

| AT command | Description |
|---|---|
| AT+COPS=<br>[<mode><br>[,<format><br>[,<oper>>[,<br>< AcT>]]]] | Forces an attempt to select and register the GSM\UMTS network operator.<br><mode>:<br>• 0 = Automatic choice<br>• 1 = Manual choice<br><format>:<br>• 0 = Alphanumeric long form<br>• 1 = Short format alphanumeric<br>• 2 = Numeric, 5 digits<br><oper>:<br>• Network operator in format defined by <format><br><AcT>:<br>Access technology selected:<br>• 0 = GSM<br>• 2 = UTRAN |
| AT+COPS? | Returns the currently registered network operator. |
| AT+COPS=? | Returns a list of all available network operators in form of:<br><stat>, long alphanumeric <oper>, short alphanumeric <oper>, numeric <oper>,<AcT>:<br><stat>:<br>Operator availability:<br>• 0 = Unknown<br>• 1 = Available<br>• 2 = Current<br>• 3 = Forbidden<br><AcT>:<br>Access technology selected:<br>• 0 = GSM<br>• 1 = GSM Compact<br>• 2 = UTRAN |
| AT+CPIN=<pin>[,<newpin>] | Sends the PIN to the phone. |
| AT+CPIN? | Returns the status of the PIN request:<br>• READY = Phone can be used<br>• SIM PIN = PIN is not set, phone not ready for use.<br>• SIM PUK = PUK is required to use the device<br>• ERROR = No SIM card inserted |
| AT+CSQ | Reports received signal quality indicators in form of:<br><signal strength><bit error rate> |
| AT+CSQ=? | Returns the supported ranges. |
| AT+FLO=<type> | Selects the flow control behaviour of the serial port in both directions.<br>• 0 = Flow control None<br>• 1 = Flow control Software (XON-XOFF)<br>• 2 = Flow control Hardware (CTS-RTS) |

# Appendix H Event Input Notify Message Format GPS

**Description**

With GS25, a message can be created. This message provides information about
- the fact that an event was detected by the receiver
- the time when the event was detected.

The message can be in ASCII or in binary format. It is sent to a connected device, for example a PC.
Refer to "19.12 Event Input 1/Event Input 2" for configuring the event input interface.

**Example**

$PLEIR,HPT,134210000,1203*17

**Syntax in ASCII**

$PLEIR,EIX,sssssssss,tttttttt,nnnn,cccc,dddd*hh<CR><LF>

**Description of the fields**

| Field | Description |
|---|---|
| $PLEIR | Header |
| EIX | Message identifier.<br>X = 1 for port E1<br>X = 2 for port E2 |
| ssssssssss | GPS time of week of event in ms |
| tttttttt | GPS time of week of event in ns |
| nnnn | GPS week number |
| cccc | Event count |
| dddd | Event pulse count<br>This is the count of all pulses including those violating the specified accuracy limit boundary conditions set in **Event input 1**/**Event input 2**, **Event input** page. This allows determination of missed events. |
| *hh | Checksum |
| <CR> | Carriage return |
| <LF> | Line feed |

**Example**

$PLEIR,EI2,292412000,28932,1203,203,1*70

# Appendix I PPS Output Notify Message Format GPS

**Description**

With GS25, a message can be created. This message informs about the output of a PPS pulse. The message can be in ASCII or in binary format. It is sent to a connected device, for example a PC.
The message is sent at least 0.5 s before the next pulse. For this reason, notify messages are sent when the PPS output rate is greater than 1 s.
Refer to "19.11 PPS Output" for configuring the PPS output interface.

**Syntax in binary format**

In binary, the notification message format is Leica Binary v2. Documentation for LB2 is available on request from the Leica Geosystems representative.

**Syntax in ASCII**

$PLEIR,HPT,sssssssss,nnnn*hh<CR><LF>

**Description of the fields**

| Field | Description |
|---|---|
| $PLEIR | Header |
| HPT | Message identifier, **H**igh **P**riority **T**ime |
| sssssssss | GPS time of week of next PPS output in ms |
| nnnn | GPS week number |
| *hh | Checksum |
| <CR> | Carriage return |
| <LF> | Line feed |

**Example**

$PLEIR,HPT,134210000,1203*17

# Appendix J Glossary

## J.1 A

**A (parameter)**

For horizontal alignments:
$A^2 = R * L$
R = Radius of the connecting circular curve.
L = Length of the spiral.

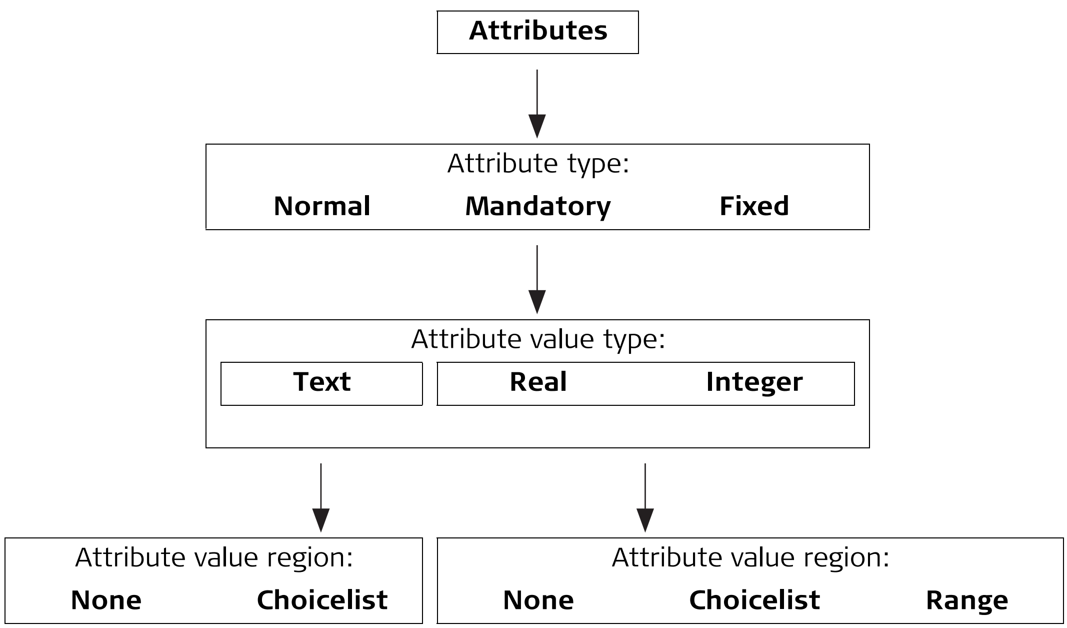
**Arc**

Refer to "Curve".

**Attribute**

**Description**
The use of attributes allows additional information to be stored with the code. Up to twenty attributes can be related to one code. Attributes are not compulsory.

**Structure of attributes**




**Example**

| Code | Attributes | Attribute value type | Attribute value region | Example for the attribute value region |
|---|---|---|---|---|
| Birch | Height | Real | Range | 0.5-3.0 |
| | Condition | Text | Selectable list | Good, Dead, Damaged |
| | Remark | Text | None | - |

**Attribute types**

The attribute type defines the input requirements for the attribute.

| | |
|---|---|
| Normal: | An input for the attribute is optional. The attribute value can be typed in the field. New attributes with this attribute type can be created in LGO or on the instrument. |
| Mandatory: | An input for the attribute is compulsory. The attribute value must be typed in the field. New attributes with this attribute type can be created in LGO. |
| Fixed: | The attribute value is a predefined default which is displayed but cannot be changed in the field. This attribute value is automatically attached to the code. New attributes with this attribute type can be created in LGO. |

**Attribute value regions**

The attribute value region defines if the attribute values must be selected from a predefined list.

| | |
|---|---|
| None: | An input for the attribute must be typed in. New attributes with this attribute value region can be created in LGO or on the instrument. |
| Range: | An input for the attribute must fall within a predefined range. New attributes with this attribute value region can be created in LGO. |
| Selectable list: | An input for the attribute is selected from a predefined list. New attributes with this attribute value region can be created in LGO. |

**Attribute value types**

The attribute value type defines which values are accepted as input.

| | |
|---|---|
| Text: | Any input for the attribute is interpreted as text. New attributes with this attribute value type can be created in LGO or on the instrument. |
| Real: | An input for the attribute must be a real number, for example 1.23. New attributes with this attribute value type can be created in LGO. |
| Integer: | An input for the attribute must be an integer number, for example 5. New attributes with this attribute value type can be created in LGO. |

**Averaging mode**

**Averaging Mode**

The averaging mode defines the checks which are performed when more than one set of measured coordinates are recorded for the same point. The selected averaging mode also affects the behaviour of the instrument when editing a point and calculating averages.

## J.2 B

## J.3 C

**Chainage equation**

Chainage equations define adjustments for the chainage values in the horizontal alignment. These adjustments can be necessary when a horizontal alignment is modified, by inserting or removing an element, and the chainage values in the horizontal alignment are not recomputed. This situation can occur when editing manually or editing with a program that does not automatically recompute. Chainage equations define leaving a gap or allowing an overlap at certain chainages.

The elements involved in the equations are:

- chainage back
- chainage ahead.

**Class**

The class describes the type of coordinate triplet.

**Description of classes**

The following table shows the classes in descending hierarchical order.

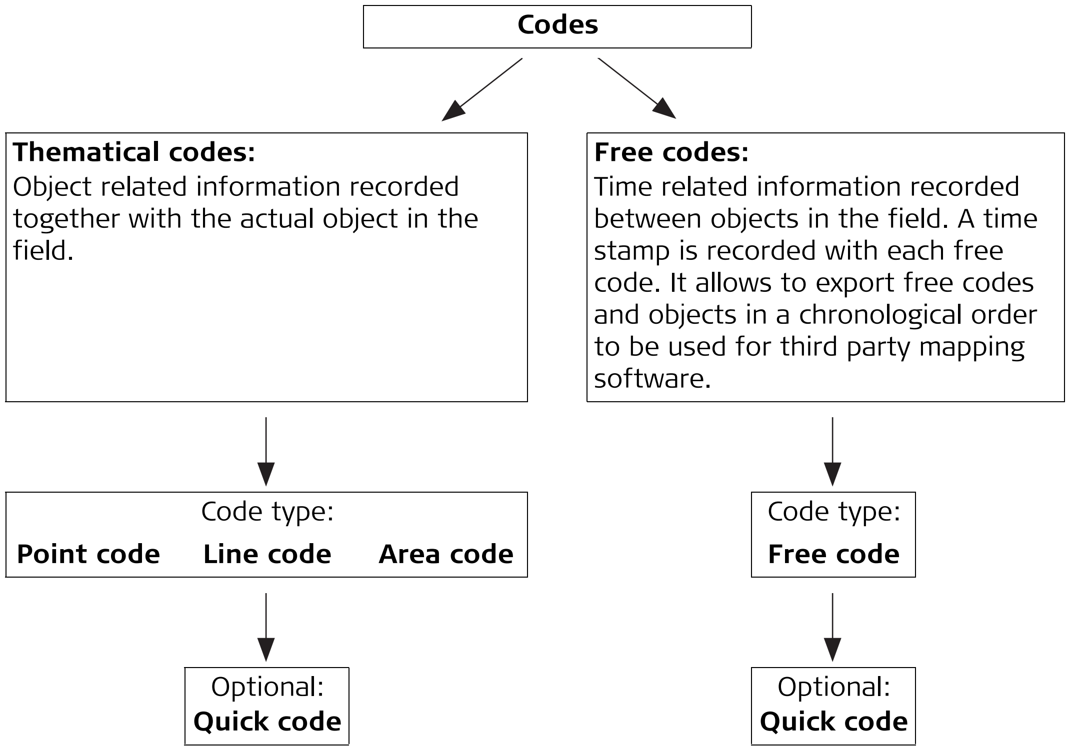
| Class | Characteristic | Description |
|---|---|---|
| **Ctrl** | Type | Control points. Automatically assigned to entered points or manually assigned to calculated points from COGO. |
| | Instrument source | GPS, TPS or LGO |
| | Number of triplets | One |
| **Adj** | Type | Adjusted points using the adjustment program. |
| | Instrument source | LGO |
| | Number of triplets | One |
| **Ref** | Type | • Reference point received by a real-time rover<br>• Station point set by Setup application. |
| | Instrument source | GPS, TPS or LGO |
| | Number of triplets | One |
| **Avge** | Type | Averaged point calculated when more than one coordinate triplet of class **MEAS** exist for the same point ID unless **Averaging Mode: Off**. |
| | Instrument source | GPS or TPS |
| | Number of triplets | One |
| **Meas** | Type | • Measured points differentially corrected using real-time phase, real-time code or post-processing.<br>• Measured points with angles and distances.<br>• Calculated from some applications. |
| | Instrument source | GPS, TPS or LGO |
| | Number of triplets | Multiple. With more than one measured coordinate triplet, the average for the position and the height can be computed. |
| **Nav** | Type | Navigated points using uncorrected code solutions of a single epoch or SPP positions. |
| | Instrument source | GPS |
| | Number of triplets | Multiple |
| **Est** | Type | Estimated points from LGO. |
| | Instrument source | LGO. |
| | Possible number of triplets | One |
| **None** | Type | Measured points with angles. |
| | Instrument source | TPS |
| | Possible number of triplets | Unlimited |

**Code**

**Description**

A code is a description which can be stored with an object or alone.

**Structure of codes**




**Code group**

A code group allows codes belonging to the same theme to be grouped. Individual groups can be activated or deactivated. The codes belonging to a deactivated code group cannot be selected from the selectable list for code selection.

**Code types**

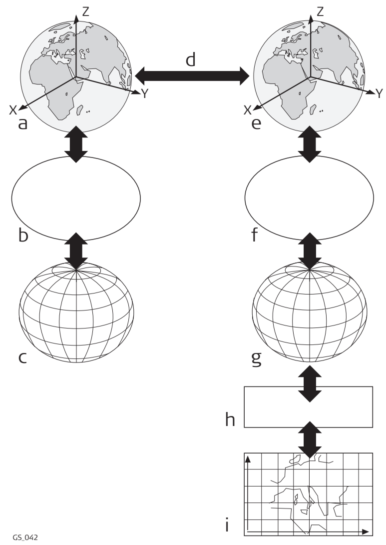
The code type defines how and for which objects a code can be used. It is possible to create a code of the same name but of different code types both on the instrument and in LGO. Example: The code Oak can exist with code type point code and with code type line code.

| | |
|---|---|
| Point code: | To record a code directly with a point. Thematical point coding. |
| Line code: | To record a code directly with a line. Thematical line coding. |
| Area code: | To record a code directly with an area. Thematical area coding. |
| Free code: | To record a code based on time in between objects. |
| Quick code: | To start a point occupation and store the code by typing in one, two or three predefined digits. |

**Coordinate system - elements**

The five elements which define a coordinate system are:

- a transformation
- a projection
- an ellipsoid
- a geoid model
- a **C**ountry **S**pecific **C**oordinate **S**ystem model




a) WGS 1984 cartesian: X, Y, Z
b) WGS 1984 ellipsoid
c) WGS 1984 geodetic: Latitude, longitude, ellipsoidal height
d) 7 parameter transformation: dX, dY, dZ, rx, ry, rz, scale
e) Local cartesian: X, Y, Z
f) Local ellipsoid
g) Local geodetic: Latitude, longitude, ellipsoidal height
h) Local projection
i) Local grid: Easting, Northing, orthometric height

All these elements can be specified when creating a coordinate system.

**Coordinate triplet**

A measured point consists of three coordinate components - two horizontal components and one vertical component. The generic term for the three coordinate components is coordinate triplet.

Depending on the class, a point ID can contain more than one coordinate triplet of the same and/or of different classes.

**CSCS field file**

CSCS field files can be used in the field to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.

| | |
|---|---|
| Creation: | In LGO with export onto a data storage device or the internal memory of the instrument. |
| Extension: | *.csc |

**CSCS model**

**Description**

**C**ountry **S**pecific **C**oordinate **S**ystem models

- are tables of correction values to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.
- take the distortions of the mapping system into account.
- are an addition to an already defined coordinate system.

**Types of CSCS models**

The correction values of a CSCS model can be applied at different stages in the coordinate conversion process. Depending on this stage, a CSCS model works differently. Three types of CSCS models are supported. Their conversion process is as explained in the following table. Any suitable geoid model can be combined with a geodetic CSCS model.

| Type | Description |
|---|---|
| **Grid** | 1 Determination of preliminary grid coordinates by applying the specified transformation, ellipsoid and map projection.<br>2 Determination of the final local grid coordinates by applying a shift in Easting and Northing interpolated in the grid file of the CSCS model. |
| **Cartesian** | 1 Performing the specified transformation.<br>2 Determination of local cartesian coordinates by applying a 3D shift interpolated in the grid file of the CSCS model.<br>3 Determination of the final local grid coordinates by applying the specified local ellipsoid and map projection. |
| **Geodetic** | 1 Determination of local geodetic coordinates by applying a correction in latitude and longitude interpolated from the file of the CSCS model.<br>2 Determination of the final local grid coordinates by applying the local map projection.<br>☞ Using a geodetic CSCS model excludes the use of a transformation in a coordinate system. |

## Coordinate quality for GPS

### Description

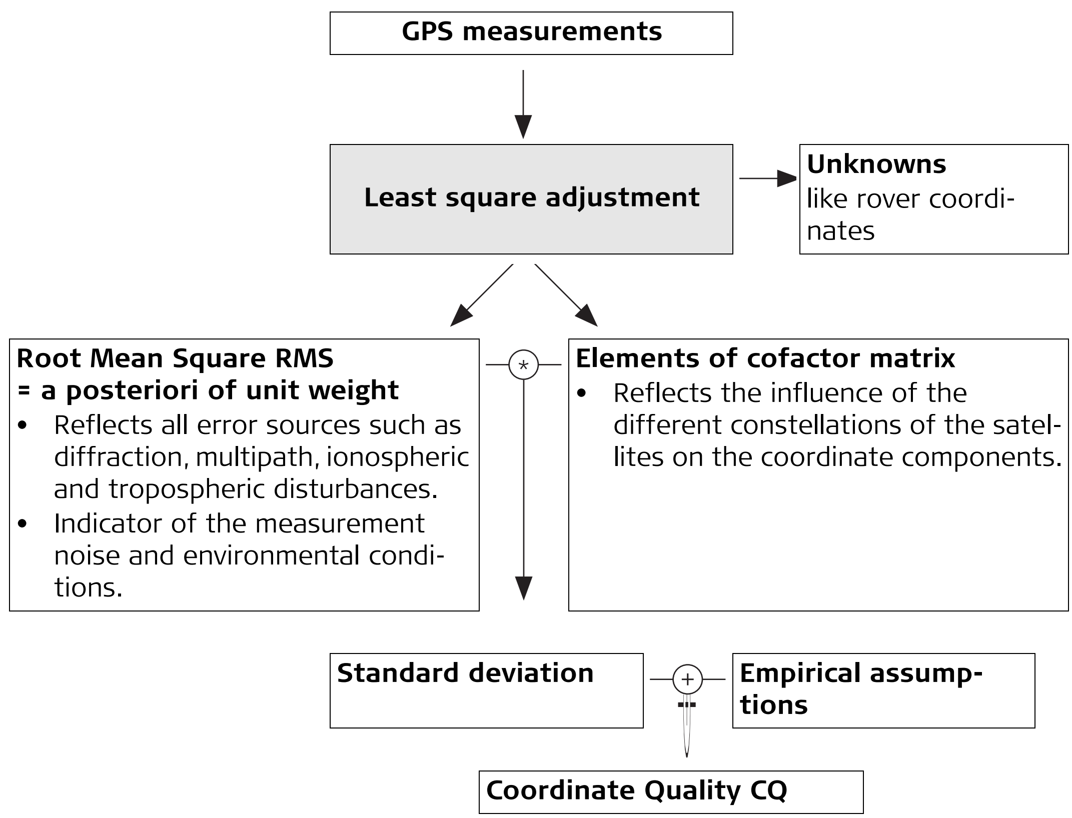
The **C**oordinate **Q**uality is

- computed on the rover for code solutions and phase fixed solutions.
- an indicator for the quality of the observations.
- an indicator for the current satellite constellation.
- an indicator for different environmental conditions.
- derived such that there is at least a two third probability that the computed position deviates from the true position by less than the CQ value.
- different from the standard deviation.

### CQ versus standard deviation

The standard deviation as CQ would often be too optimistic, therefore the computation of the CQ is not based on the basic standard deviation algorithms. There is a 39.3% statistical probability in 2D, that the computed position deviates from the true position, by less than the standard deviation. This probability is not enough for a reliable quality indicator.
This unreliability is particularly true for low redundancy situations such as a constellation of four satellites. In such a case, the RMS converges to zero and the standard deviation would show an unrealistically small value.

### Computation

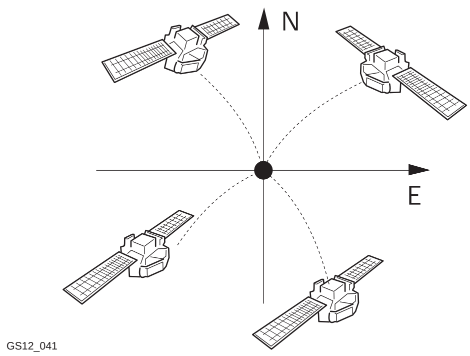



### Range

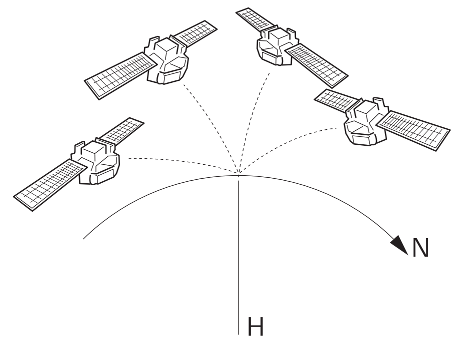
| | |
|---|---|
| For a phase fixed solution: | Centimetre level |
| For a code solution: | From 0.4 m to 5 m. |

**Position CQ versus height CQ**

All GPS computed positions are almost twice as accurate in plan than in height. For the position determination, satellites can appear in all four quadrants. For the height determination, satellites can appear in two quadrants. Fewer quadrants weakens the height position compared to the plan position.




Position determination with satellites appearing in all four quadrants.




Height determination with satellites appearing in two quadrants.

---

**Coordinate quality for TPS**

**Description**

The **C**oordinate **Q**uality is an indicator for the estimated quality of the point coordinates. The coordinate quality of the measurements is used in point averaging.

| Column | Description |
|---|---|
| **Est 3D CQ** | Estimated 3D coordinate quality of computed position. |
| **Est 2D CQ** | Estimated plan coordinate quality of computed position. |
| **Est 1D CQ** | Estimated height coordinate quality of computed position. |

Vertical angles are always assuming zenith angles and not elevation angles. Standard deviations of circle readings relate to one face measurements.

$$\rho = \frac{200}{\pi}$$

Standard deviation of circle reading

$$\sigma_{Hz,V}[rad] = \frac{\sigma_{Hz,V}[gon]}{\rho}$$

σHz,V Standard deviation of circle reading if σHz = σV.
σHz: Standard deviation of horizontal circle reading.
σV: Standard deviation of vertical circle reading.

Standard deviation of distance measurement

$$\sigma_D = c_D + ppm * D$$

σD Standard deviation of distance measurement.
cD Constant part of EDM accuracy.
ppm ppm part of EDM accuracy.
D Slope Distance.

1D estimated coordinate quality

$$1D\ CQ = \sqrt{\sigma^2_D * \cos^2 V + \sigma^2_{Hz,V} * D^2 * \sin^2 V}$$

1D CQ Estimated coordinate quality of the height.
V Zenith angle.

2D estimated coordinate quality

| | |
|---|---|
| $2D\ CQ = \sqrt{\sigma^2_D * \sin^2 V + \sigma^2_{Hz,V} * D^2}$ | 2D CQ Estimated horizontal coordinate quality. |

3D estimated coordinate quality

| | |
|---|---|
| $3D\ CQ = \sqrt{\sigma^2_D + \sigma^2_{Hz,V} * D^2 * (1 + \sin^2 V)}$ | 3D CQ Estimated spatial coordinate quality. |

**Working Example 1**

| | |
|---|---|
| Instrument: | TS15 |
| Angular accuracy: | 2" = 6.1728*10-4 gon => σHz,V = 2"*√2 |
| EDM accuracy: | 1 mm + 1.5 ppm for an IR measurement |
| Slope distance: | 150 m |
| Hz: | 210 gon |
| V: | 83 gon |

1D CQ = 0.00201 m ≘ 2.0 mm
2D CQ = 0.00237 m ≘ 2.4 mm
3D CQ = 0.00311 m ≘ 3.1 mm

**Working Example 2**

| | |
|---|---|
| Instrument: | TS15 |
| Angular accuracy: | 2" = 6.1728*10-4 gon => σHz,V = 2"*√2 |
| EDM accuracy: | 1 mm + 1.5 ppm for an IR measurement |
| Slope distance: | 7000 m |
| Hz: | 210 gon |
| V: | 83 gon |

1D CQ = 0.09263 m ≘ 92.6 mm
2D CQ = 0.09663 m ≘ 96.6 mm
3D CQ = 0.13386 m ≘ 133.9 mm

**Working Example 3**

| | |
|---|---|
| Instrument: | TM50 |
| Angular accuracy: | 0.5" = 1.5432*10-4 gon => σHz,V = 0.5"*√2 |
| EDM accuracy: | 1 mm + 1 ppm for standard mode |
| Slope distance: | 150 m |
| Hz: | 210 gon |
| V: | 83 gon |

1D CQ = 0.00058 m ≘ 0.6 mm
2D CQ = 0.00122 m ≘ 1.2 mm
3D CQ = 0.00135 m ≘ 1.3 mm

**Working Example 4**

| | |
|---|---|
| Instrument: | TM50 |
| Angular accuracy: | 0.5" = 1.5432*10-4 gon => σHz,V = 0.5"*$\sqrt{2}$ |
| EDM accuracy: | 1 mm + 1 ppm for standard mode |
| Slope distance: | 7000 m |
| Hz: | 210 gon |
| V: | 83 gon |

1D CQ = 0.02324 m ≙ 23.2 mm
2D CQ = 0.02521 m ≙ 25.3 mm
3D CQ = 0.03429 m ≙ 34.3 mm

**Cross section assignments**

One cross section is valid until a new one is defined at a chainage ahead. Cross section definition can be at any chainage. The chainages need not necessarily correspond to chainages where a design element starts or ends.

**Cross section template**

A Cross section gives a profile view. It requires vertical alignment or actual elevation on each chainage.

The elements involved are straight elements. The points are called vertices. You can optionally define slopes at the vertices most left and most right.

Points are defined by:

- DH and DV
- DH and slope in percentage
- DH and slope in ratio

**Curve**

For horizontal alignments: Circular curve with constant radius.

For vertical alignments: Circular vertical curve with constant radius.

## J.4 D

| | |
|---|---|
| **Data** | Data is a generic term for points, lines and areas. |
| **Device** | The hardware which is connected to the chosen port.<br>GPS Devices are used to transmit and receive real-time data and to communicate with the instrument, for example to download raw observations from a remote location.<br>TPS Devices are used to transmit and receive measurement data. |

## J.5 E

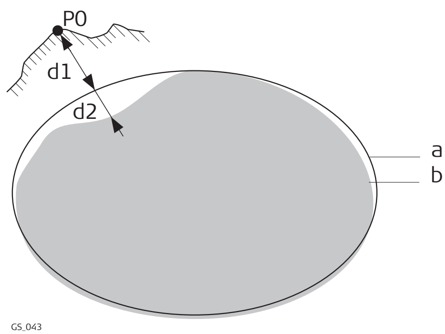
## J.6 F

**Geoid model**

**Description**

GPS operates on the WGS 1984 ellipsoid and all heights obtained by measuring baselines are ellipsoidal heights. Existing heights are usually orthometric heights, also called height above the geoid, height above mean sea level or levelled height. The mean sea level corresponds to a surface known as the geoid. The relation between ellipsoidal height and orthometric height is

**Orthometric Height = Ellipsoidal Height - Geoid Separation N**




a WGS 1984 ellipsoid
b Geoid

P0 Measured point
d1 Ellipsoidal height
d2 Geoid separation N, is negative when the geoid is below the ellipsoid

**N value and geoid model**

The geoid separation (N value) is the distance between the geoid and the reference ellipsoid. It can refer to the WGS 1984 or to the local ellipsoid. It is not a constant except over maybe small flat areas such as 5 km x 5 km. Therefore it is necessary to model the N value to obtain accurate orthometric heights. The modelled N values form a geoid model for an area. With a geoid model attached to a coordinate system, N values for the measured points can be determined. Ellipsoidal heights can be converted to orthometric heights and back.

Geoid models are an approximation of the N value. In terms of accuracy, they can vary considerably and global models in particular should be used with caution. If the accuracy of the geoid model is not known, it can be safer to use local control points with orthometric heights and apply a transformation to approximate the local geoid.

**Geoid field file**

The geoid separations in a geoid field file can be used in the field to change between ellipsoidal and orthometric heights.

| | |
|---|---|
| Creation: | In LGO with export onto a data storage device or the internal memory of the instrument. |
| Extension: | *.gem |

**GPS mode**

Current active instrument is GPS.

**GPS points**

The coordinates of GPS points are always stored in the WGS 1984 coordinates system. WGS 1984 is a three-dimensional Cartesian coordinate system with the origin at the centre of the Earth. WGS 1984 coordinates are given as X,Y,Z Cartesian coordinates, or latitude, longitude and height (above the WGS 1984 ellipsoid).

GPS points are stored as class **Meas** or class **Nav**:

- Class Meas: If there are 5 or more satellites, and the distance to the reference is not too great for the prevailing ionospheric conditions, SmartStation will compute a GPS real-time position. The CQ indicator for this type of point is about 0.01 m to 0.05 m.
- Class Nav: If the reference stops working, or if the communication link between the reference and SmartStation fails, SmartStation will only compute a navigation position. The CQ indicator for this type of point is about 3 m to 20 m.

**GPS surveying techniques** GPS

Depending on the surveying task and the instruments being used, certain GPS surveying techniques are possible. The three existing types of GPS surveying techniques are:

| GPS surveying technique | Characteristic | Description |
|---|---|---|
| **Static** | Way of working | • Base set up over a point with accurately known coordinates.<br>• Rover set up over a point with known or unknown coordinates.<br>• Data recorded at both instruments simultaneously at the same data rate, typically 15 s, 30 s or 60 s.<br>• Post-processing is compulsory. |
| | Use | For long baselines, geodetic networks, tectonic plate studies. |
| | Accuracy | High over long and very long baselines. |
| | Working speed | Slow |
| **Post-processed kinematic** | Way of working | • Base set up as static over a point with accurately known coordinates.<br>• Rover moves from one point to another. The instrument remains turned on while moving.<br>• Static and moving raw observations are collected.<br>• Post-processing is compulsory. |
| | Use | For detail surveys and measuring many points in quick succession. |
| | Accuracy | High for baselines up to 30 km. |
| | Working speed | Efficient for surveying many points that are close together. |
| **Real-time, base and rover** | Way of working | • Base set up as static over a point with accurately known coordinates in WGS 1984.<br>• Rover equipment is set up on a pole and moves from one unknown point to another.<br>• A data link, for example a radio or digital cellular phone, transmits satellite data from the base to the rover.<br>• Data coming from the base and GNSS signals received on the rover are processed together on the rover as the survey is carried out in real-time.<br>• Ambiguities are solved, coordinates of the surveyed points are calculated and displayed.<br>• applications as on conventional instruments like stakeout or COGO can be performed.<br>• Post-processing is optional. |
| | Use | For surveying detail with many points in one area. |
| | Accuracy | High for baselines up to 30 km. |
| | Working speed | Efficient as the results are generated in the field. |

Refer to standard surveying literature for more details on GNSS surveying techniques.

**Horizontal Alignment**

The horizontal alignment defines the road axis of a project. Horizontal alignments are comprised of the elements:

- straights (tangents)
- curves (arcs)
- spirals (clothoid or cubic parabola)
- bloss curves (element type used for railway track design)

Each element involved is defined by individual horizontal design elements such as chainage, Easting, Northing, radius and parameter A.

**Initialisation**

For cm positioning with GNSS, the ambiguities must be fixed. The process of fixing ambiguities is called initialisation. In order to carry out an initialisation, the active working style must be a real-time rover configuration allowing for phase fixed solutions. A minimum of five satellites on L1 and L2 is required.

The three existing types of initialisation methods are:

| Initialisation method | Characteristic | Description |
|---|---|---|
| **Moving** | Principle | The rover instrument is moved from the beginning of the GNSS operation on, recording data. The trajectory of the moving rover is recorded. Ambiguities are fixed while moving. A new initialisation starts automatically when, after losing the minimum number of required satellites, enough satellites are tracked again. |
| | Antenna setup | On a pole. |
| | Beginning of initialisation | Immediately. |
| | Use | For fast initialisations over distances up to 30 km. |
| **Static** | Principle | The rover instrument is kept stationary at the beginning of the GNSS operation. |
| | Antenna setup | On a pole with a quickstand. |
| | Beginning of initialisation | Immediately. |
| | Use | If it is proving difficult to initialise while moving and no known point is available. |
| **Known point** | Principle | The rover instrument is kept stationary over a point with known coordinates at the beginning of the GNSS operation. |
| | Antenna setup | On a pole with a quickstand. |
| | Beginning of initialisation | After selecting the known point. |
| | Use | If it is proving difficult to initialise while moving and to speed up an initialisation while static. |

**Instrument source**

The instrument source describes where the coordinate triplet was measured or entered. The options are GPS, TPS, LGO or **Level**.

**Interface**

The procedures, codes and protocols that enable two entities to interact for an exchange of data. Each interface is given a meaningful display name which enables easy distinction between interfaces.

## J.10 J

## J.11 K

## J.12 L

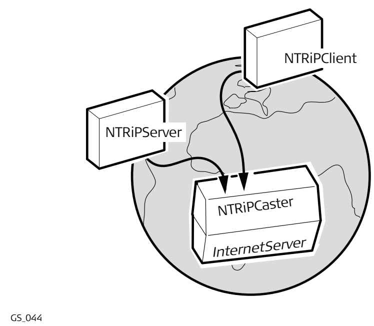
## J.13 M

**Ntrip**

**N**etworked **T**ransport of **R**TCM via **I**nternet **P**rotocol

- is a protocol streaming real-time corrections over the Internet.
- is a generic protocol based on the Hypertext Transfer Protocol HTTP/1.1.
- is used to send differential correction data or other kinds of streaming data to stationary or mobile users over the Internet. This process allows simultaneous computer, laptop, PDA, or instrument connections to a broadcasting host.
- supports wireless Internet access through mobile IP networks like digital cellular phones or modems.

The Ntrip Server could be the GPS instrument itself. This setup means the GPS instrument is both the Ntrip Source generating the real-time data and also the NTRIP Server transferring this data to the Ntrip Caster.




Ntrip and its role in the Internet

**Ntrip Caster**

The Ntrip Caster

- is an Internet server handling various data streams to and from the Ntrip Servers and Ntrip Clients.
- checks the requests from Ntrip Clients and Ntrip Servers to see if they are registered to receive or provide real-time corrections.
- decides whether there is streaming data to be sent or to be received.

**Ntrip Client**

The Ntrip Client receives data streams. This setup could be, for example a real-time rover receiving real-time corrections.

In order to receive real-time corrections, the Ntrip Client must first send

- a user ID
- a password
- an identification name, the so-called Mountpoint, from which real-time corrections are to be received

to the Ntrip Caster.

**Ntrip Server**

The Ntrip Server transfers data streams.

In order to send real-time corrections, the Ntrip Server must first send

- a password
- an identification name, the so-called Mountpoint, where the real-time corrections come from

to the Ntrip Caster.

Before sending real-time corrections to the Ntrip Caster for the first time, a registration form must be completed. This form is available from the Ntrip Caster administration centre. Refer to the website of the Ntrip Caster administration centre.

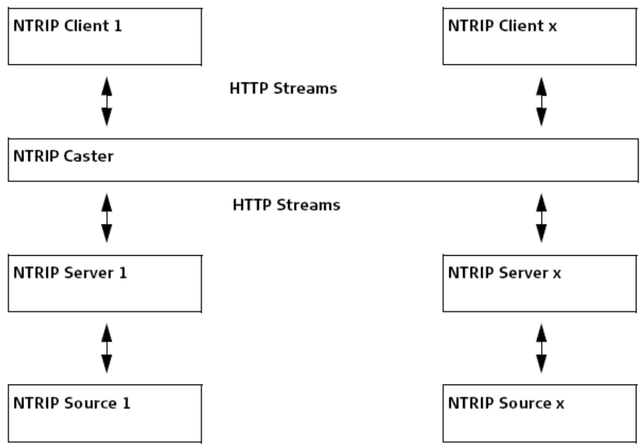
**Ntrip Source**

The Ntrip Source generates data streams. This setup could be base sending out real-time corrections.

**Ntrip system components**

Ntrip consists of three system components:

- Ntrip Clients
- Ntrip Servers
- Ntrip Caster



## J.15 O

**Objects**

Objects
- are points, lines and areas.
- have a unique identification ID. This ID is the point ID, the line ID and the area ID.
- can have a code attached. This code is either a point code, a line code or an area code depending on the type of object.

## J.16 P

**Parabola**

Parabolic vertical curve with constant rate of grade change.
An asymmetrical parabola uses inconstant rates of change.

**Parameter A**

Refer to "A (parameter)".

**Port**

A connection through which a separate device can communicate with the instrument.

## J.17 Q

## J.18 R

**Source**

The source describes the application or functionality that generated a coordinate triplet and the method with which it was created.

| Source | Originated from application/functionality | Instrument source |
|---|---|---|
| **ASCII file** | Convert Data, Import ASCII/GSI Data to Job | GPS or TPS |
| **Arc base pt** | COGO, Arc Calculation - Base Point | GPS or TPS |
| **Arc centre pt** | COGO, Arc Calculation - Centre Point | GPS or TPS |
| **Arc offset pt** | COGO, Arc Calculation - Offset Point | GPS or TPS |
| **Arc segment pt** | COGO, Arc Calculation - Segmentation | GPS or TPS |
| **Backward brg-dst** | Hidden point measurements, Backward Bearing and Distance | GPS |
| **Bearing-Distance** | Hidden point measurements, Bearing and Distance | GPS |
| **Chainage & offset** | Hidden point measurements, Chainage and Offset | GPS |
| **COGO Area Div** | COGO Area Division | GPS or TPS |
| **COGO Shift/Rtn** | COGO, Shift, Rotate & Scale (Manual)<br>COGO, Shift, Rotate & Scale (Match Pts) | GPS or TPS |
| **COGO Traverse** | COGO, Traverse | GPS or TPS |
| **Copied Point** | Convert Data, Copy points between jobs | GPS or TPS |
| **Cross Section** | Survey Cross Section | GPS or TPS |
| **Using 2 bearings** | Hidden point measurements, Double Bearing | GPS |
| **Using 2 distances** | Hidden point measurements, Double Distance | GPS |
| **GSI file** | Convert Data, Import ASCII/GSI Data to Job | GPS or TPS |
| **Hidden Point** | Hidden Point, auxiliary points | TPS |
| **Intsct (Brg Brg)** | COGO, Intersection - Bearing - Bearing | GPS or TPS |
| **Intsct (Brg Dst)** | COGO, Intersection - Bearing - Distance | GPS or TPS |
| **Intsct (Dst Dst)** | COGO, Intersection - Distance - Distance | GPS or TPS |
| **Intsct (4 Pts)** | COGO, Intersection - By points | GPS or TPS |
| **LandXML** | Design to Field in LGO converting data from LandXML software to be used in the field | LGO |
| **Line Base Pt** | COGO, Line Calculation - Base Point | GPS or TPS |
| **Line Offset Pt** | COGO, Line Calculation - Offset Point | GPS or TPS |
| **Line Segmt Pt** | COGO, Line Calculation - Segmentation | GPS or TPS |
| **None** | No information on the source is available | GPS or TPS |
| **RefLine (Grid)** | Reference Line, staked out in a defined grid | GPS or TPS |
| **RefLine (Meas)** | Reference Line, measured | GPS or TPS |
| **RefLine (Seg)** | Reference Line, segmented | GPS or TPS |
| **RefLine (Stake)** | Reference Line, staked out | GPS or TPS |
| **Ref Plane (Meas)** | Reference Plane, measured | GPS or TPS |
| **Ref Plane (Scan)** | Reference Plane, scan | TPS |
| **Road** | Road Runner | GPS or TPS |
| **Sets of angles** | Sets of Angles | TPS |

| Source | Originated from application/functionality | Instrument source |
|---|---|---|
| **Setup (Known BS)** | Setup, Known Backsight Point | TPS |
| **Setup (LocCoord)** | Setup, Local Coordinates | TPS |
| **Setup (Loc Rsct)** | Setup, Local Resection | TPS |
| **Setup (Ori&Ht)** | Setup, Orientation and Height Transfer | TPS |
| **Setup (Resect)** | Setup, Resection | TPS |
| **Setup (Resect H)** | Setup, Resection Helmert | TPS |
| **Setup (Set Az)** | Setup, Set Azimuth | TPS |
| **Srvy Auto Offset** | Survey Auto Points, automatically recorded with offsets | GPS or TPS |
| **Stakeout** | Stakeout | GPS or TPS |
| **Survey** | Survey, measured | TPS |
| **Survey (Auto)** | Survey Auto Points, automatically recorded | TPS |
| **Survey (Event)** | Survey, Event input | GPS |
| **Survey (Instant)** | Survey, measured with **Pt Occupation: Instantaneous** in **CONFIGURE Point Occupation Settings** | GPS |
| **Survey (Rem Pt)** | Survey, Remote Point | TPS |
| **Survey (Static)** | Survey, measured with **Pt Occupation: Normal** in **CONFIGURE Point Occupation Settings** | GPS |
| **Traverse** | Traverse | TPS |
| **Unknown** | - | GPS or TPS |
| **User Application** | Customised applications | GPS or TPS |
| **User entered** | Manually entered point | GPS or TPS |

**Spiral**

For horizontal alignments:
Spirals are used to connect straights and curves. A full spiral has an infinite radius at its start or end point whereas a partial has a finite radius at its start and end point.
**In**. Radius at the start point is bigger than at the end point.
**Out**. Radius at the start point is smaller than at the end point.

**Straight**

Straight line between two points. Its end point is identical with the beginning of a curve or spiral. The tangent is perpendicular to the radius of the curve.

**Sub class**

The sub class describes certain classes in detail. It indicates the status of the position when a coordinate triplet was measured and how the coordinates were determined.

| Sub class | Description | Instrument source |
|---|---|---|
| **COGO** | Indirect coordinate determination with application COGO. | GPS or TPS |
| **None** | Direction is available but no coordinates. | TPS |
| | Height is available but no position coordinates. | **Level** |
| **TPS** | Measured with distances and angles. | TPS |
| **Fixed (Height)** | Manually entered and fixed in height. | GPS or TPS |
| **Fixed (Position)** | Manually entered and fixed in position. | GPS or TPS |
| **Fixed (Pos & Ht)** | Manually entered and fixed in position and height. | GPS or TPS |
| **GNSS Code Only** | Direct coordinate determination with code solution. | GPS |
| **GNSS Fixed** | Direct coordinate determination with phase fixed solution. | GPS |
| **GNSS Float** | Direct coordinate determination using GPS and GNSS or with autonomous solution coming from LGO. | GPS |
| **Hidden Point** | Indirect coordinate determination with hidden point measurements. | GPS or TPS |

**Tangent**

Refer to straight.

**TPS mode**

Current active instrument is TPS.

**Transformations**

A transformation is the process of converting coordinates from one geodetic datum to another.

**Requirements**
- Transformation parameters.
- In some cases a local ellipsoid.
- In some cases a map projection.
- In some cases a geoid model.

**Transformation parameters**

A transformation consists of shifts, rotations and scale factors, depending on the type of transformation used. Not all these parameters are always required. These parameters can already be known, or can be computed.

**Description of transformations**
- Classic 3D, also called Helmert transformation
- Onestep
- Twostep

| Transformation | Characteristic | Description |
|---|---|---|
| **Classic 3D** | Principle | Transforms coordinates from WGS 1984 cartesian to local cartesian coordinates and vice versa. A map projection can then be applied to obtain grid coordinates. As a similarity transformation, it is the most rigorous transformation type and keeps the full geometrical information. |
| | Positions and heights | Positions and heights are linked. The accuracy is fully maintained and does not distort the measurements. |
| | Use | When measurements are to be kept homogenous. |
| | Requirements | • The positions and heights are known in WGS 1984 and in the local system for at least three points. Four points or more are recommended to obtain higher redundancy.<br>• Parameters of the local ellipsoid.<br>• Parameters of the local map projection, to convert between grid coordinates and geodetic coordinates.<br>• Parameters of the local geoid model, to convert between orthometric and ellipsoidal heights. This information is not compulsory. |
| | Area | Especially wide networks with large height differences. Local grid coordinates must be accurate. |
| | Advantage | • Accuracy of the measurements is maintained. |

| Transformation | Characteristic | Description |
|---|---|---|
| | | • It can be used over any area as long as the local coordinates, including heights, are accurate. |
| | Disadvantage | • The local ellipsoid and map projection must be known for the local grid coordinates.<br>• In order to obtain accurate ellipsoidal heights, the geoid separation at the measured points must be known. This information can be determined from a geoid model. |
| **Onestep** | Principle | Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure:<br>1) The WGS 1984 coordinates are projected onto a temporary Transverse Mercator Projection. The central meridian of this projection passes through the centre of gravity of the common control points.<br>2) The results of 1. are preliminary grid coordinates for the WGS 1984 points.<br>3) These preliminary grid coordinates are matched with the local grid control points. The Easting and Northing shifts, the rotation and scale factor between these two sets of points can then be computed. This process is known as a classic 2D transformation.<br>4) The height transformation is a single dimension height approximation. |
| | Positions and heights | The position and height transformations are separated. |
| | Use | When measurements are to be forced to tie in with local existing control. For example:<br>A site where the coordinates of the control points are based on a purely local grid. The coordinate values within this grid are arbitrary and are in no way connected with any ellipsoid or map projection. Obviously a Classic 3D transformation cannot be used here, as cartesian coordinates cannot be calculated from such a grid. |
| | Requirements | • The position is known in WGS 1984 and in the local system for at least one point. Three or more points are recommended to obtain redundancy.<br>• Additional height information for one point enables the transformation of heights.<br>• Parameters of the local geoid model. This information is not compulsory.<br>• No parameters of the local ellipsoid.<br>• No parameters of the local map projection. |

| Transformation | Characteristic | Description |
|---|---|---|
| | Area | • Limited to about 10 x 10 km as no projection scale factor is applied and a standard Transverse Mercator Projection is used to compute the preliminary WGS 1984 grid coordinates.<br>• For areas without large height differences. |
| | Points and transformation parameters | The transformation parameters determined depend on the number of available points with position information.<br>• One point: Classic 2D with shift in X and Y.<br>• Two points: Classic 2D with shift in X and Y, rotation about Z and scale.<br>• More than two points: Classic 2D with shift in X and Y, rotation about Z, scale and residuals. |
| | Points and height transformation | The type of height transformation performed depends on the number of available points with height information.<br>• No point: No height transformation.<br>• One point: Heights are shifted to fit to the height control point.<br>• Two points: Average height shift between the two height control points.<br>• Three points: Tilted plane through the three height control points to approximate the local heights.<br>• More than three points: Best fitting average plane. |
| | Advantage | • Errors in height do not propagate into errors in position since the height and position transformations are separated.<br>• If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa.<br>• The height points and position points do not have to be the same points.<br>• No parameters of the local ellipsoid and map projection is required.<br>• Parameters can be computed with a minimum of points. Care must be taken when computing parameters using just one or two local points, as the parameters calculated are valid in the vicinity of the points used for the transformation. |
| | Disadvantage | • Restriction in the area over which the transformation can be applied. This restriction is because there is no provision for scale factor in the projection.<br>• The accuracy in height depends on the undulation of the geoid. The bigger the geoid variations the less accurate the results are. |

| Transforma-tion | Characteristic | Description |
|---|---|---|
| **Twostep** | Principle | Combines the advantages of the Onestep and the Classic 3D transformation. It allows treating position and height separately, but is not restricted to smaller areas. Procedure:<br>1) The WGS 1984 coordinates of the common control points are shifted closely to the local datum using a given Classic 3D pre-transformation. This Classic 3D pre-transformation is typically a rough transformation valid for the country of the local datum.<br>2) The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points.<br>3) A 2D transformation is applied, exactly as with the Onestep transformation. |
| | Positions and heights | The position and height transformations are separated. |
| | Use | When measurements are to be forced to tie in with local existing control in areas larger than 10 x 10 km. |
| | Requirements | • The position is known in WGS 1984 and in the local system for at least one point. Four points or more are recommended to obtain higher redundancy.<br>• Parameters of the local ellipsoid.<br>• Parameters of the local map projection.<br>• Parameters of a pre-transformation. |
| | Area | Virtually any area as long as the local coordinates are accurate. |
| | Points and transformation parameters | Identical with the Onestep transformation. |
| | Points and height transformation | Identical with the Onestep transformation. |
| | Advantage | • Errors in height do not propagate into errors in position since the height and position transformations are separated.<br>• If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa.<br>• The height points and position points do not have to be the same points.<br>• Fits much better over larger areas than a Onestep transformation. Reason: |

| Transforma-tion | Characteristic | Description |
|---|---|---|
| | | The first step of a Twostep transformation avoids any distortions because the preliminary grid coordinates are built on a different ellipsoid than the local points. The second step ensures that the influence of the map projection scale factor is taken into account before the final 2D transformation is computed. |
| | Disadvantage | • The local ellipsoid must be known.<br>• The map projection must be known.<br>• A pre-transformation must be known. A null transformation can be used.<br>• In order to obtain accurate ellipsoidal heights, the geoid separation at the measured points must be known. This information can be determined from a geoid model. |

## J.21 U

## J.22 V

**Vertical alignment**

The vertical alignment gives information about the pattern of heights of the road axis as it is defined in the horizontal alignment.
A vertical alignment is comprised of the elements:
- tangents (straight segments)
- curves
- parabolas.

Each element involved is defined by individual vertical design elements such as chainage, Easting, Northing, radius and parameter P.

## J.23 W

**WGS 1984**

**WGS 1984** is the global geocentric datum to which all GPS positioning information is referred to.

## J.24 X

## J.25 Y

## J.26 Z

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- when it has to be **right**