# FL MC 10/100BASE-T/FO G1300

## FO converter for converting 10/100Base-T to multi-mode glass fibers (1300 nm)

## INTERFACE

Data sheet
101151_en_02

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## 1 Description

The **FL MC 10/100BASE-T/FO G1300** FO converter provides a high level of immunity to interference and a long transmission range in industrial applications by converting the 10/100Base-T(X) Ethernet interface to fiber optics (100 Mbps according to FX standard).

The supply voltage is 24 V DC. The connection is made either via plug-in screw terminal blocks or via a system power supply unit and T-BUS DIN rail connector. A higher level of availability can be achieved for both versions using a redundant supply.

The auto negotiation function via fiber optics ensures that the maximum possible transmission power is used. In "Transparent" mode, the FO converter behaves like a direct copper connection, which means that the connected devices can negotiate the operating mode automatically.

For easy startup, the FO converter also has an integrated MDI/MDIx changeover. The required line or crossover cable connections can thus be set locally.

The converter also has link monitoring, which separately signals/monitors the operability of the connected cable connection and devices for the twisted pair and fiber optic channels.

If longer distances are to be covered or if an existing glass fiber installation is used, the **FL MC 10/100BASE-T/FO G1300** converter covers distances of up to 10,000 m with 62.5/125 µm or 6400 m with 50/125 µm multi-mode glass fibers in full duplex mode. The connection conforms to the SC duplex standard.

The FO converter conforms to the specifications of standards IEEE 802.3 and ISO/IEC 68802.3.

**WARNING: Explosion hazard**

**The module is designed for use in zone 2, if the specific conditions are observed.**

Observe the safety regulations and installation notes on page 4.

If you have any technical problems, which you cannot resolve with the aid of this documentation, please contact us during the usual office hours at:

PSI hotline: +49 - 52 35 - 31 98 90
Fax: +49 - 52 35 - 33 09 99
E-mail: interface-service@phoenixcontact.com

Make sure you always use the latest documentation.
It can be downloaded at www.download.phoenixcontact.com.

A conversion table is available on the Internet at
www.download.phoenixcontact.com/general/7000_en_00.pdf.

This data sheet is valid for all products listed on the following page:

## 2 Ordering data

### FO converter

| Description | Type | Order No. | Pcs./Pkt. |
|---|---|---|---|
| FO converter for converting 10/100Base-T(X) to multi-mode glass fibers (1300 nm), DIN rail-mountable, 24 V DC supply | FL MC 10/100BASE-T/FO G1300 | 2708164 | 1 |

### Accessories

| Description | Type | Order No. | Pcs./Pkt. |
|---|---|---|---|
| Fiber optic glass fiber cable for indoor installation | PSM-LWL-GDM RUGGED-50/125 | 27 99 32 2 | 1 |
| Fiber optic glass fiber cable for outdoor installation | PSM-LWL-GDO-50/125 | 27 99 43 2 | 1 |
| Heavy CAT5 installation cable | FL CAT5 HEAVY | 27 44 81 4 | 1 |
| Light, flexible CAT5 installation cable | FL CAT5 FLEX | 27 44 83 0 | 1 |
| RJ45 connector, gray for straight cables (2 connectors in the set) | FL PLUG RJ45 GR/2 | 27 44 85 6 | 1 |
| RJ45 connector, green for crossed cables (2 connectors in the set) | FL PLUG RJ45 GN/2 | 27 44 57 1 | 1 |
| Crimping pliers for RJ45 connectors | FL CRIMPTOOL | 27 44 86 9 | 1 |
| CAT5 connection field, screw terminal block to RJ45 | FL CAT5 TERMINAL BOX | 27 44 61 0 | 1 |

## 3 Technical data

| Ethernet interface | | | | |
|---|---|---|---|---|
| Ethernet interface | 10/100Base-T(X) according to IEEE 802.3u | | | |
| Connection | RJ45 female connector, shielded | | | |
| Transmission speed | 10/100 Mbps | | | |
| Auto negotiation modes | Either transparent via TP and FO (default) or locally on TP | | | |
| Transmission length for TP | 100 m (twisted pair, shielded) | | | |
| Link through | Link down is automatically forwarded to the second connection | | | |
| MDI/MDIx changeover | Can be switched internally between line (1:1) and crossover connection | | | |
| Signal LEDs | Activity (yellow LED), link status (green LED), 100 Mbps (green LED) | | | |
| Cable impedance | 100 Ω | | | |
| Propagation delay (PEV), TP/FO | 146 BT (146 m), maximum | | | |

| Fiber optic interface | | | | |
|---|---|---|---|---|
| Fiber optic interface | 10/100 Mbps (100 Mbps according to FX standard) | | | |
| Connection | SC duplex | | | |
| Wavelength | 1300 nm | | | |
| Laser protection | Class 1 according to DIN EN 60825-1 | | | |
| Transmission length including 3 dB system reserve | 6400 m glass fiber with F-G 50/125 0.7 dB/km F1200, minimum<br>2800 m glass fiber with F-G 50/125 1.6 dB/km F800, minimum<br>10,000 m glass fiber with F-G 62.5/125 0.7 dB/km F1000, minimum<br>3000 m glass fiber with F-G 62.5/125 2.6 dB/km F600, minimum | | | |
| Signal LEDs | Data transmission (yellow LED), link status (green LED) | | | |
| Optical output power | **Dynamic (average) in link mode** | | **Static** | |
| Fiber type 50/125 µm | -23.5 dBm, minimum | -14 dBm, maximum | -20.5 dBm, minimum | -11 dBm, maximum |
| Fiber type 62.5/125 µm | -20 dBm, minimum | -14 dBm, maximum | -17 dBm, minimum | -11 dBm, maximum |
| Optical receiver sensitivity | -31 dBm, minimum | | -28 dBm, minimum | |
| Overrange | -14 dBm, maximum | | -11 dBm, maximum | |
| MTBF (Mean Time Between Failures) according to Telcordia standard (100% duty cycle) | | | | |
| At 25°C | 500,000 h | | | |
| At 40°C | 330,000 h | | | |

## General data

| | |
|---|---|
| Supply voltage | 24 V DC ±20% |
| Nominal current consumption | 95 mA, maximum |
| Protection against polarity reversal | Serial diodes |
| Indicators | UL (green LED) |
| Connection | Plug-in screw terminal block (COMBICON), redundancy possible |
| Electrical isolation | 10/100Base-T//supply |
| Test voltage | 1500 $V_{rms}$, 50 Hz, 1 min. |
| Housing material | PA V0, green |
| Connection data for screw terminal blocks | 0.2 $mm^2$ ... 2.5 $mm^2$ |
| Dimensions (W x H x D) | 22.5 mm x 99 mm x 114.5 mm |
| Weight | 120 g |
| Ambient temperature | |
| Operation | 0°C … +55°C |
| Permissible humidity | |
| Operation | 30% ... 95% (no condensation) |
| Storage/transport | 30% ... 95% (no condensation) |
| Air pressure | |
| Operation | 860 hPa ... 1080 hPa |
| Storage/transport | 660 hPa ... 1080 hPa |

## Tests/approvals

| | |
|---|---|
| Ambient compatibility | Free from substances that would hinder coating with paint or varnish according to central standard P-VW-3.10.757 650 of VW, Audi, and Seat |
| Vibration resistance | EN 60068-2-6, 5g, 1.5 h in xyz direction |
| Shock test | EN 60068-2-27, storage/transport: 50g, operation: 15g, 11 ms period, half-sine shock pulse |
| Free fall | 1 m |
| Air and creepage distances | EN 60950 |
| ATEX | II 3G Ex nAC IIC T4 X |
| Approval | File E 140324; Vol. 2, Sec. 3 |
| | File E 199827; Vol. 3, Sec. 4 Cl. 1, Div. 2, Grp. A - D, Temp Code T4A |

## Conformance with EMC Directive 89/336/EEC and 2004/108/EC and Low Voltage Directive 2006/95/EC

### Noise immunity test according to EN 61000-6-2 *

| | | |
|---|---|---|
| Electrostatic discharge (ESD) | EN 61000-4-2 | 8 kV air discharge †<br>6 kV contact discharge† |
| Electromagnetic HF field | EN 61000-4-3 | |
| Amplitude modulation | | 10 V/m ‡ |
| Pulse modulation | | 10 V/m‡ |
| Fast transients (burst) | EN 61000-4-4 | |
| Signal | | 2 kV/5 kHz† |
| Supply | | 4 kV/5 kHz† |
| Surge current loads (surge) | EN 61000-4-5 | |
| Signal | | 2 kV/12 Ω† |
| Supply | | 0.5 kV/2 Ω† |
| Conducted interference | EN 61000-4-6 | 10 V‡ |

### Noise emission test according to EN 61000-6-4

| | | |
|---|---|---|
| Noise emission of housing | EN 55011 + | Class A ~ |

* EN 61000 corresponds to IEC 1000

† Criterion B: Temporary adverse effects on the operating behavior, which the device corrects automatically.

‡ Criterion A: Normal operating behavior within the specified limits.

\+ EN 55011 corresponds to CISPR11

~ Class A: Industrial application, without special installation measures.

# 4 Safety regulations and installation notes

## 4.1 Installation and operation

Follow the installation instructions.

**NOTE:** Installation, operation, and maintenance may only be carried out by qualified specialist personnel.

When installing and operating the device, the applicable safety directives (including national safety directives), accident prevention regulations, as well as general technical regulations must be observed.

**NOTE:** The circuits inside the device must not be accessed.

Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer.

**NOTE:** The device is designed to meet IP20 protection when:

- It is installed outside potentially explosive areas.
- The environment is clean and dry.

In order to provide protection against mechanical or electrical damage, install the device in appropriate housing with a suitable degree of protection according to IEC 60529.

**NOTE:** Operation of the device is only permitted if accessories available from Phoenix Contact are used. The use of other additional components may invalidate the device approval status.

## 4.2 Safety regulations for installation in potentially explosive areas

For the safety data, please refer to the operating instructions and certificates (EC-type examination certificate, other approvals, if necessary).

### Installation in zone 2

**WARNING: Explosion hazard**

The device is designed for installation in zone 2.

**WARNING: Explosion hazard**

Devices that are installed in zone 1 must **not** be connected to the fiber optic interface.

Observe the specified conditions for use in potentially explosive areas.

**WARNING: Explosion hazard**

Install the device in suitable **housing that meets IP54 protection, minimum**.
Observe the requirements of IEC 60079-14/ EN 60079-14, e.g., steel housing with a wall thickness of 3 mm.

**WARNING: Explosion hazard**

Disconnect the block power supply **before** snapping it on or connecting it.

**WARNING: Explosion hazard**

Only use category 3G modules (ATEX 94/9/EC).

**WARNING: Explosion hazard**

Temporary malfunctions (transients) must not exceed the rated voltage by more than 40%.

### Installation in areas with a danger of dust explosions

**WARNING: Explosion hazard**

The device is **not** designed for installation in areas with a danger of dust explosions.

# 5 Structure

## 5.1 Example topology

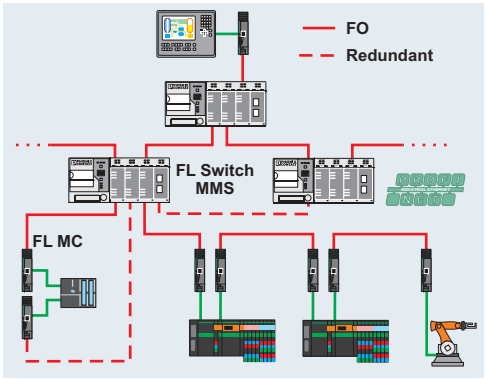


Figure 1 Example topology

## 5.2 Block diagram

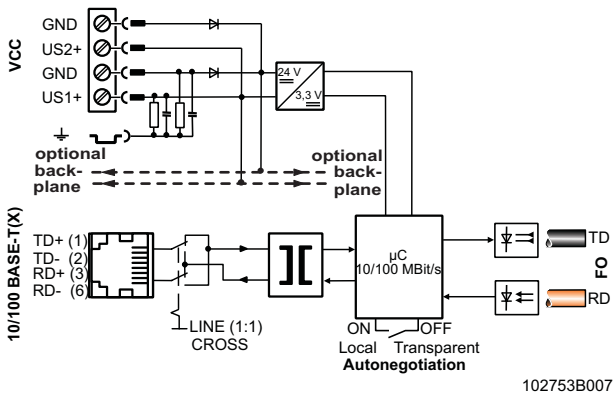


Figure 2 Block diagram

## 5.3 Function elements

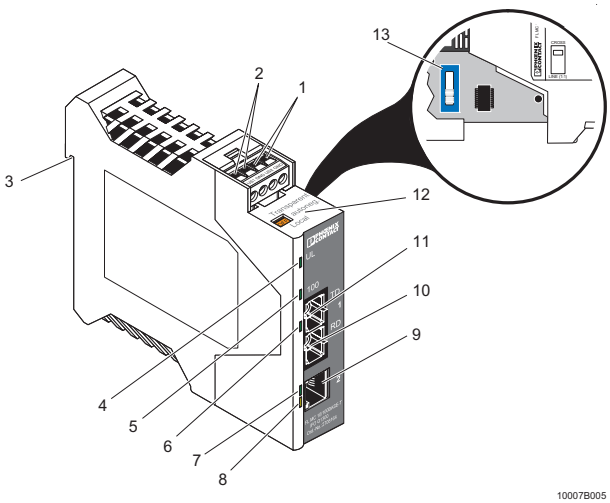


Figure 3 Function elements

1 Redundancy power supply 2 (24 V DC)
2 Power supply 1 (24 V DC)
3 Connection for functional earth ground
4 "UL" LED: Power supply (green)
5 "100" LED: 100 Mbps transmission speed (green)
6 "FO link" LED: Link status of FO port (green)
7 "TP link" LED: Link status of TP port (green)
8 "Activity" LED: Data transmission of TP and FO port (yellow)
9 10/100Base-T(X) connection (TP port)
10 Fiber optic connection, receiver
11 Fiber optic connection, transmitter
12 Local/transparent auto negotiation
13 MDI/MDIx changeover

### Housing dimensions

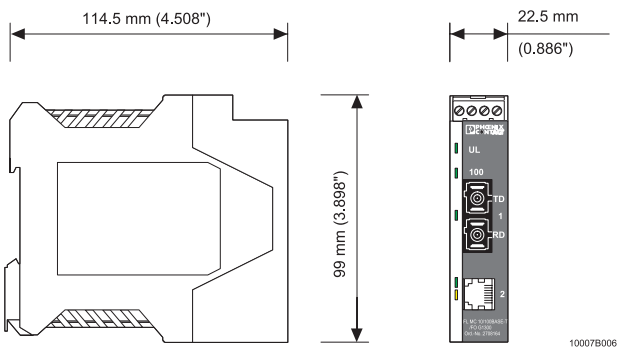


Figure 4 Housing dimensions (in mm)

# 6 Assembly

## 6.1 Connection notes

**WARNING: Risk of injury and damage to equipment**

Only mount and remove modules when the power supply is disconnected.

**WARNING: Only suitable for SELV operation**

The FL MC 10/100BASE-T/FO G1300 is designed exclusively for SELV operation according to IEC 60950/EN 60950/VDE 0805.

**NOTE: Electrostatic discharge**

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-2.

**Assembly in potentially explosive areas**

**WARNING: Explosion hazard**

Observe the safety notes on page 4.

## 6.2 Mounting on the DIN rail

- Install the FL MC 10/100BASE-T/FO G1300 on a 35 mm DIN rail according to DIN EN 60715.

To avoid contact resistance only use clean, corrosion-free DIN rails. End clamps can be mounted on both sides of the module to stop the modules from slipping on the DIN rail.

**WARNING: Ground the module properly**

Connect the DIN rail to protective earth ground using a grounding terminal block. The modules are grounded when they are snapped onto the DIN rail. This ensures that the shield is effective. Connect protective earth ground with low impedance.

## 6.3 Combined assembly with a system power supply unit

1. Connect together the required number of DIN rail connectors for the connection station. One ME 22,5 TBUS 1,5/ 5-ST-3,81 GN DIN rail connector is required for each device (Order No. 2707437, see A in Figure 5).
2. Push the connected DIN rail connectors onto the DIN rail (B and C).

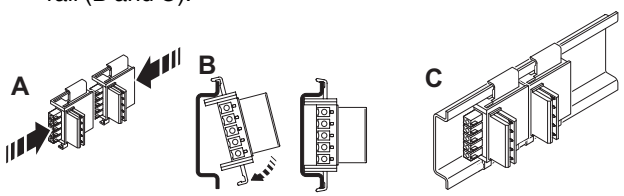


Figure 5 Combined assembly

## 6.4 Assembly in the control cabinet

1. Install an end clamp next to the left-hand module to prevent the modules from slipping.
2. Place the module onto the DIN rail from above. The upper holding keyway must be hooked onto the top edge of the DIN rail (Figure 6).
3. Push the module from the front towards the mounting surface.
4. Once the module has been snapped on properly, check that it is fixed securely on the DIN rail.
5. Snap the other modules that are to be contacted onto the DIN rail next to one another.

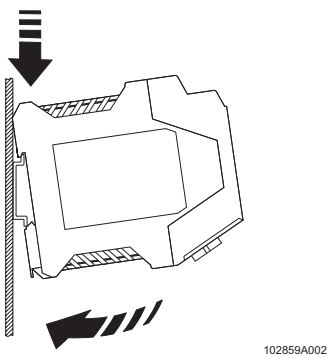


Figure 6 Assembly in the control cabinet

## 6.5 Removal

1. Pull the locking latch down using a screwdriver, needle-nose pliers or similar.
2. Pull the bottom edge of the module away from the mounting surface.
3. Pull the module diagonally upwards away from the DIN rail.

# 7 Mode selector switch

Modern Ethernet devices support the auto negotiation mechanism. The devices request the operating mode from one another (half or full duplex mode). If the partner device does not respond to the request, then the requesting device selects half duplex mode. This considerably reduces the maximum achievable distance. If the mode is not the same – half duplex (HD) on one side, full duplex (FD) on the other side – the communication is aborted by a transmission error.

This behavior often occurs when media converters are used, because in the past the auto negotiation signals could not be transmitted via the fiber optic path. As a result, auto negotiation devices select half duplex mode for safety reasons, even if the partner device operates in full duplex mode.

The FL MC 10/100BASE-T/FO G1300 offers a remedy in the form of a mechanism, which either transmits the auto negotiation signals via the fiber optic path (transparent) or responds to the requesting device (local) and thus forces full duplex mode.

The mode selector switch is located next to the power supply connection.

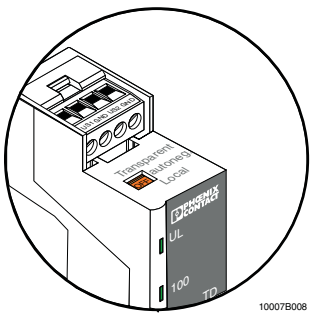


Figure 7 Mode selector switch

The operating mode must be selected before connecting the supply voltage. The changeover only takes effect after power up.

– **Transparent auto negotiation** (default)
  The connected termination devices negotiate the transmission speed (10/100 Mbps) and transmission mode (half/full duplex) directly.
– **Local**
  The transmission speed (10/100 Mbps) is set to the maximum possible value and the transmission mode (half/full duplex) is negotiated separately after each subsection. This mode enables paths, which have a device without auto negotiation on one side, to operate in full duplex mode.

Ensure that the same transmission mode/speed has been selected for all the connected devices.

## 7.1 Selecting local/transparent auto negotiation

The following settings arise from the possible device combinations:

| Termination device 1 | Media converter | | Termination device 2 |
|---|---|---|---|
| | 1 | 2 | |
| Auto negotiation | Transparent (default) | | Auto negotiation |
| 100 Mbps full duplex | Transparent (default) | | 100 Mbps full duplex |
| 100 Mbps half duplex | Transparent (default) | | 100 Mbps half duplex |
| 10 Mbps full duplex | Transparent (default) | | 10 Mbps full duplex |
| 10 Mbps half duplex | Transparent (default) | | 10 Mbps half duplex |
| 100 Mbps half duplex | Transparent (default) | | Auto negotiation |
| 10 Mbps half duplex | Transparent (default) | | Auto negotiation |
| 100 Mbps full duplex | Local | Local | Auto negotiation |
| 10 Mbps full duplex | Local | Local | Auto negotiation |
| Integrated FO port with FX standard (100 Mbps full duplex) | – | Local | Auto negotiation |
| Integrated FO port with FL standard (10 Mbps full duplex) | – | Local | Auto negotiation |
| 100 Mbps full duplex | Not permitted (Full and half duplex mode must not be combined) | | 100 Mbps half duplex |
| 10 Mbps full duplex | | | 10 Mbps half duplex |
| 100 Mbps full duplex | Not permitted (Different transmission speeds) | | 10 Mbps full duplex |
| 100 Mbps full duplex | | | 10 Mbps half duplex |
| 100 Mbps half duplex | | | 10 Mbps full duplex |
| 100 Mbps half duplex | | | 10 Mbps half duplex |

# 8 Supply voltage

The module is operated with a +24 V DC SELV.

## 8.1 Operation as an individual device

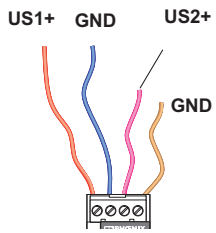


Figure 8 Connecting the power supply

- Provide the supply voltage for the module via terminal blocks US1 and GND.
- As an option, an additional power supply unit can be connected to terminal blocks US2 and GND to provide a redundant voltage supply.

## 8.2 Combined operation with system power supply unit

As an alternative, the devices can be supplied using the MINI-SYS-PS-100-240AC/24DC/1.5 system power supply unit (Order No. 2866983). This is connected via two ME 17,5 TBUS 1,5/ 5-ST-3,81 DIN rail connectors (Order No. 2709561).

Usually the system power supply unit is mounted as the first device in a topology. A second power supply unit can be used to create a redundant supply concept.

# 9 Twisted pair interface (TP port)

## 9.1 10/100Base-T interface

The FL MC 10/100BASE-T/FO G1300 has an Ethernet interface on the front in RJ45 format, to which only twisted pair cables with an impedance of 100 Ω can be connected. The data transmission speed is 10/100 Mbps.

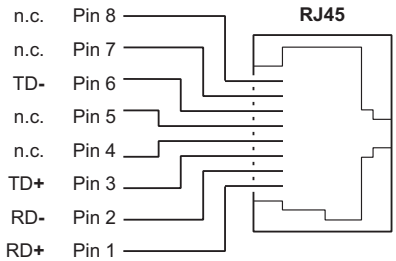


Figure 9 Pin assignment in RJ45 format

### Connection

- Push the Ethernet cable with the crimped RJ45 connector into the interface until it engages with a click. Please observe the keying of the connector.

**NOTE: Use shielded cables/connectors**

Only use shielded twisted pair cables and corresponding shielded RJ45 connectors.

### 9.2 MDI/MDIx changeover

In general, line cables (1:1) are required between structure components and termination devices. Crossover cables, on the other hand, are used to connect two devices of the same type.
The integrated crossover switch on the FL MC 10/100BASE-T/FO G1300 makes cable selection easier, which means that the device can always be connected using line cables (1:1). For crossed cable assignment, simply set the switch to the "Cross" position.

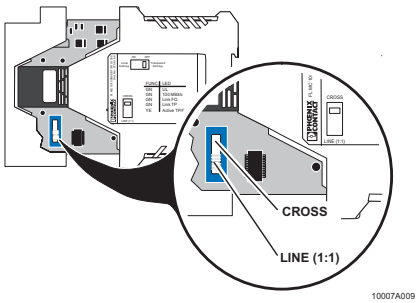


Figure 10 MDI/MDIx changeover

The correct switch position can be selected using the following table.

| | PC/RFC | IBS gateway | I/O bus terminal | Switch | Hub | FO converter |
|---|---|---|---|---|---|---|
| **PC/RFC** | Cross | Cross | Cross | Line | Line | Line |
| **IBS gateway** | Cross | Cross | Cross | Line | Line | Line |
| **I/O bus terminal module** | Cross | Cross | Cross | Line | Line | Line |
| **Switch** | Line | Line | Line | Cross | Cross | Cross |
| **Hub** | Line | Line | Line | Cross | Cross | Cross |
| **FO converter** | Line | Line | Line | Cross | Cross | Cross |

**Pin assignment of line cable (1:1)**

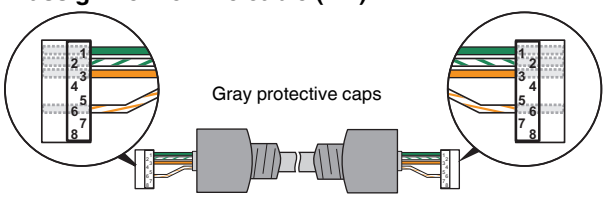


Figure 11 Line connection

## 10 Diagnostic indicators

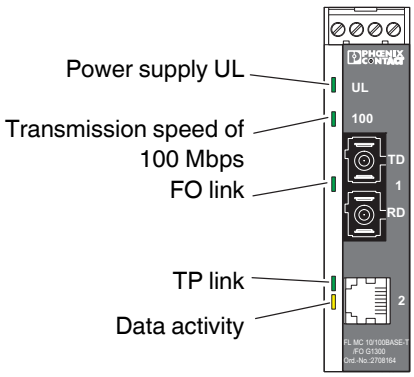


Figure 12 Diagnostic indicators

**Power supply UL**

The green "UL" LED lights up when the module is supplied with power.

**Transmission speed of 100 Mbps**

The green diagnostic LED lights up when both interfaces are operating at a transmission speed of 100 Mbps.

When one or both interfaces transmits data at 10 Mbps, the LED goes out.

**FO link (link control fiber optic path (FO))**

The line monitoring function checks the connected cable segment for an interrupt. The partner must transmit link or data signals.

The green LED lights up if no error has occurred. An interface that is not being used or a termination device that is switched off is indicated as an error and the LED goes out.

**TP link (link control TP path (RJ45))**

The line monitoring function checks the connected cable segment for a short circuit or an interrupt. The partner must transmit link or data signals.

The green LED lights up if no error has occurred. An interface that is not being used or a termination device that is switched off is indicated as an error and the LED goes out.

**Data activity**

The yellow "Activity" LED flashes according to the amount of data that is being transmitted or received by the TP/FO interfaces.

The LED remains permanently lit when only one auto negotiation signal is present at the FO converter and the second connection is not connected.
Faulty cables or device failures can thus be detected easily.

# 11 Fiber optic interface (FO port)

## Connection notes

**WARNING: Damage to eyes**

During operation, do not look directly into transmitter diodes, or use visual aids to look into the glass fibers.

The infrared light is not visible.

**NOTE: Do not remove dust protection caps too soon**

Dust protection caps should only be removed just before the connectors are connected. They prevent contamination of the transmit and receive elements.

The same applies for the protective caps on the connectors.

**NOTE: Install fiber optics correctly**

Observe the cable manufacturer's technical data when handling the various fiber optic cables.

In order for the communication path to be protected against interference, the permissible values for the bending radii, tensile force, and pressure force must not be exceeded.

## 11.1 Fiber optic (FO) connection

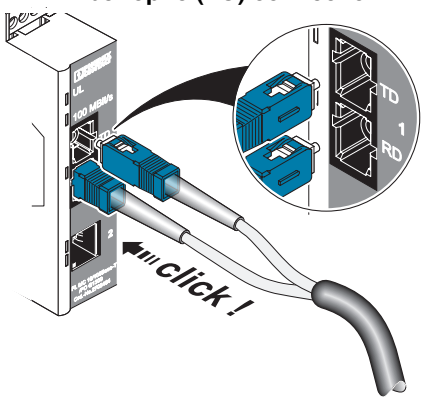


Figure 13 Connecting the SC duplex connector

- Connect the fiber optic cable to the SC duplex connector for the transmit and receive channel. Make sure that the keying is in the correct position.
- Ensure the connector is secure by gently pulling it.

## Connecting two FO converters

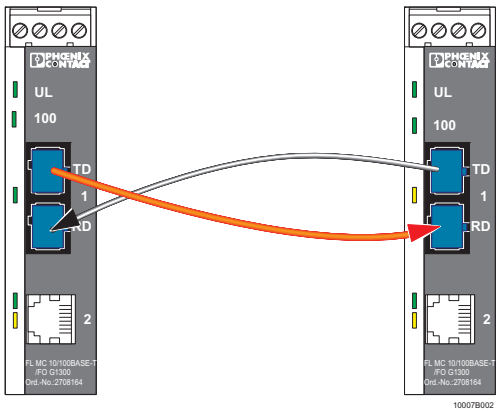


Figure 14 Signal direction for the fiber connection

**NOTE: Connecting two FO converters**

When connecting two FO converters, note the signal direction of the fiber optics.

Module 1 fiber connection "TD" (transmitter) to module 2 fiber connection "RD" (receiver).

## 11.2 Optical power measurement after initial installation

After the installation of a fiber optic link, the optical power can be checked before the receiving device using a fiber optic measuring device.

The transmitting device must be operated at an ambient temperature of 20°C ... 30°C. Temperature-related fluctuations are already taken into account in the limit values.

### Measuring the optical power

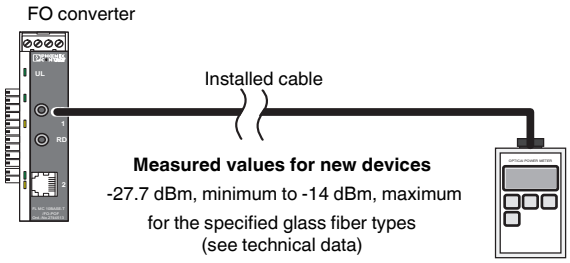


Figure 15 Measuring the optical power

The dBm values indicated already take into account the 3 dB system reserve, temperature influences, and aging of the transmitter/receiver.

This system reserve must be maintained in each fiber optic system to reduce physical aging of the optical transmitter.

The values are valid for new devices. In the first year, aging may amount to 1 dB and to 0.2 dB in subsequent years.

- For glass fibers, set the measuring device to 1300 nm and the power measuring range to dBm.
- Remove the RJ45 connector to interrupt the data communication.
- Apply the operating voltage at the module (the green UL indicator lights up).
- The converter now transmits LINK pulses via the FO interface.
- Take measurements for the forward and return line. The specified measured values must be attained.

# 12 Configuration notes

### Full duplex mode

In full duplex mode, the ranges specified in the technical data of the fiber optic interface apply.

### Half duplex mode

In half duplex mode (10 Mbps), configuration must take into account the expansion rules for collision domains. This can lead to considerable reductions in the range.

In order to reach maximum transmission distances and maximum transmission performance, the connected devices must be set permanently to 100 Mbps and full duplex transmission.

The transmission mode (half/full duplex) can be optimized using the mode selector switch (see "Mode selector switch" on page 7).

## 12.1 Expansion of collision domains

In order to determine the limits of the system configuration, a study must be performed. The result of the study must be positive, otherwise transmission errors may occur. We recommend compiling a plan of the network and proceeding systematically to find and study all possible signal paths and collision domains.

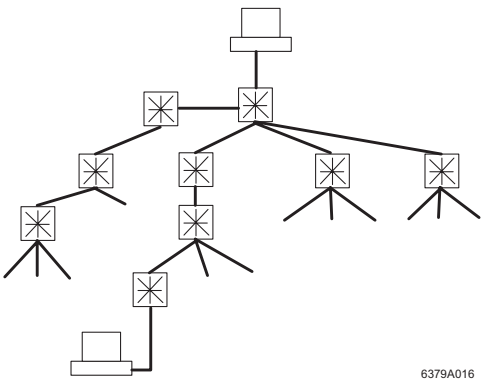


Figure 16 Network plan

## 12.2 Considering the PEV (Path Equivalent Value)

The PEV describes the signal delay of an Ethernet packet as a result of a network component. It is specified in meters. For reliable data transmission, the sum of all the signal delays including the total length of the installed cables must not exceed 4520 m between any two network devices within a collision domain.

The study must include network cards (NIC), hubs, FO converters, and copper and fiber optic cables in the calculation.

| | | | |
|---|---|---|---|
| **Example** | 2 x network cards | at 140 m | 280 m |
| | 2 x hubs | at 420 m | 840 m |
| | 2 x FO converters | at 146 m | 292 m |
| | 1 x FO cable | at 1000 m | 1000 m |
| | 2 x TP cables | at 100 m | 200 m |
| | | | Total 2612 m |

Maximum length permitted (4520 m) - total (2612 m) =
Reserve for system expansion (1908 m)

## 12.3 Considering the PVV (Path Variability Value)

The PVV describes the sum of all the signal runtime fluctuations of an Ethernet packet through the network components of a signal path. It is specified in bit times (BT). For reliable data transmission, a maximum delay time of 40 BT is permitted between any two network devices within a collision domain.

The study must only include hubs, FO converters, and transceivers in the calculation.

| | | | |
|---|---|---|---|
| **Example** | 2 x network cards (already taken into account) | at 0 BT | 0 BT |
| | 2 x hubs | at 2 BT | 4 BT |
| | 2 x FO converters | at 1 BT | 2 BT |
| | 1 x FO cable (does not cause runtime fluctuation) | at 0 BT | 0 BT |
| | 2 x TP cables (do not cause runtime fluctuation) | at 0 BT | 0 BT |
| | | | Total 6 BT |

Maximum permitted bit time (40 BT) - total (6 BT) =
Reserve for system expansion (34 BT)

If both studies are positive, the system has been correctly configured.

### Overview of PEV and PVV values for Factory Line products from Phoenix Contact

| Component | PEV [m] | PVV [BT] |
|---|---|---|
| Network cards (NIC) | 140 | 0 |
| Hub/hub agent | 420 | 2 |
| Switch | 140 | 0 |
| FO converter (TP <-> FO) | 146 | 1 |
| Twisted pair cable/FO cable | 1 per m | 0 |