

**INTEGRATED ANTENNA
CONTROLLER
EXAMPLE HMI PROGRAM**

RTHMI V11.00

January 2010

BACKGROUND

- Observers generally write their own client interface to the Antenna Controller
- The simple HMI program that is supplied with the Controller was produced as a means to demonstrate the various functions. It is also used during the Site Acceptance Tests.

OVERVIEW

- Modbus TCP/IP is a Master/Slave Protocol (The Antenna is the Slave)
- Clients manipulate the antenna by writing values to the Controller's 32 bit registers (Long Integers)
- Clients can get status by reading registers
- The Controller makes available Status Words containing all Alarm and Status Bits. This provides a quicker method of monitoring status.

The screenshot displays a control interface with the following sections:

- POWER/STATUS** (Main Title)
- COMMS STATUS**: READ **OK**, WRITE
- REMOTE/LOCAL**: **REMOTE**
- POWER**: Drives ON (highlighted with a red arrow), Operate, Drives OFF, Standby
- DRIVES STATUS**:

AZ MASTER	AZ SLAVE	ELEVATION
ONLINE	ONLINE	ONLINE
E STOP	E-STOP	E STOP
TRIPPED	TRIPPED	TRIPPED
PERMIT	PERMIT	PERMIT
INACTIVE	INACTIVE	INACTIVE
BRAKE ON	BRAKE ON	MAIN BRAKE
		BRAKE ON
- 30 SECOND TIMEOUT**: Disable, Enable, Reset Timer
- RESETS**: Reset Drives, Reboot System, Reboot Central
- CURRENT POSITION**:

AZIMUTH	ELEVATION
-1.9997	85.0009
-0.0004	0.0005
- CURRENT VIRTUAL AXES VALUES**:

AZIMUTH	ELEVATION
0.0000	0.4831
- CURRENT TIME**:

MJD	Seconds
55225	74095.396

 CLOCK INITIALIZED, SNTP SERVER OK
- SOFT LIMITS**:

Axis	Limit
Azimuth	LOW
Elevation	LOW
Azimuth	HIGH
Elevation	HIGH
- DEMAND LIMITING**:

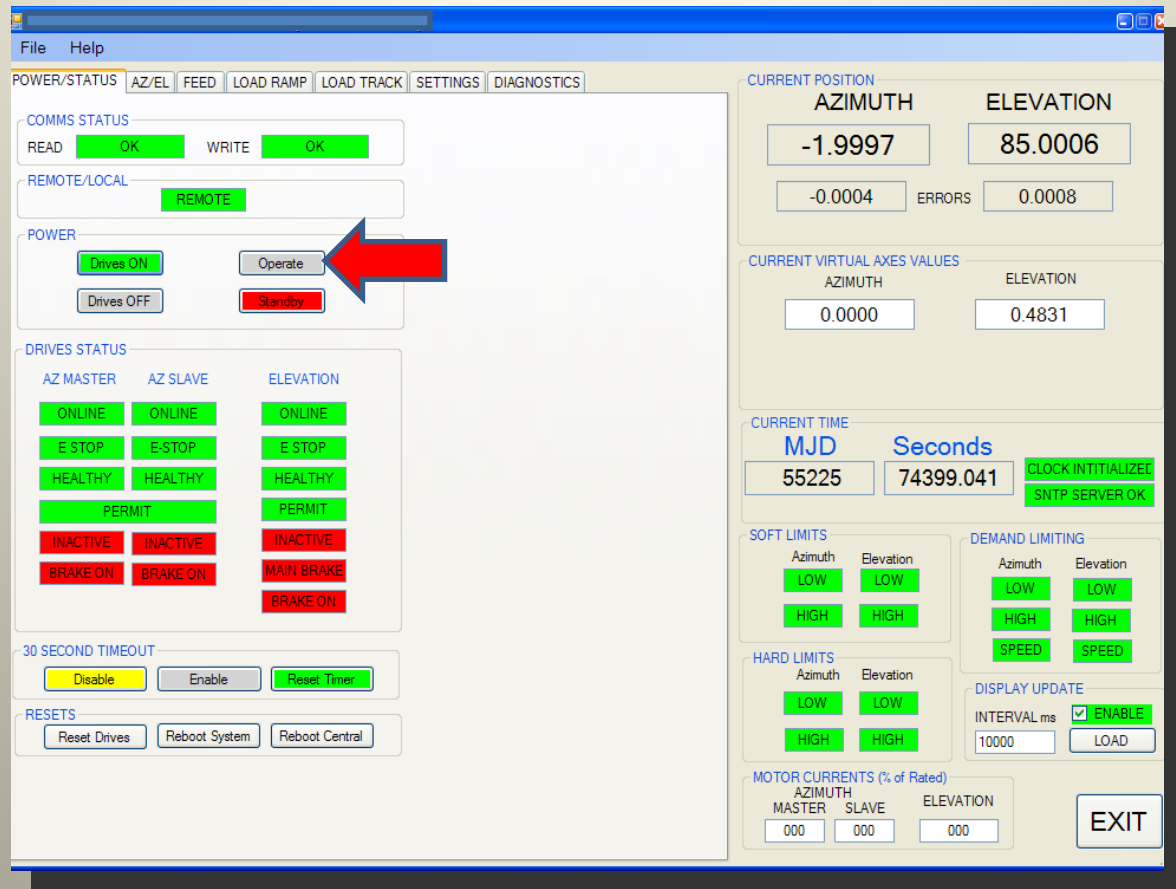
Axis	Limit
Azimuth	LOW
Elevation	LOW
Azimuth	HIGH
Elevation	HIGH
	SPEED
- HARD LIMITS**:

Axis	Limit
Azimuth	LOW
Elevation	LOW
Azimuth	HIGH
Elevation	HIGH
- DISPLAY UPDATE**: INTERVAL ms **ENABLE**
- MOTOR CURRENTS (% of Rated)**:

AZIMUTH	ELEVATION
MASTER: 000	SLAVE: 000
	000
- EXIT** button

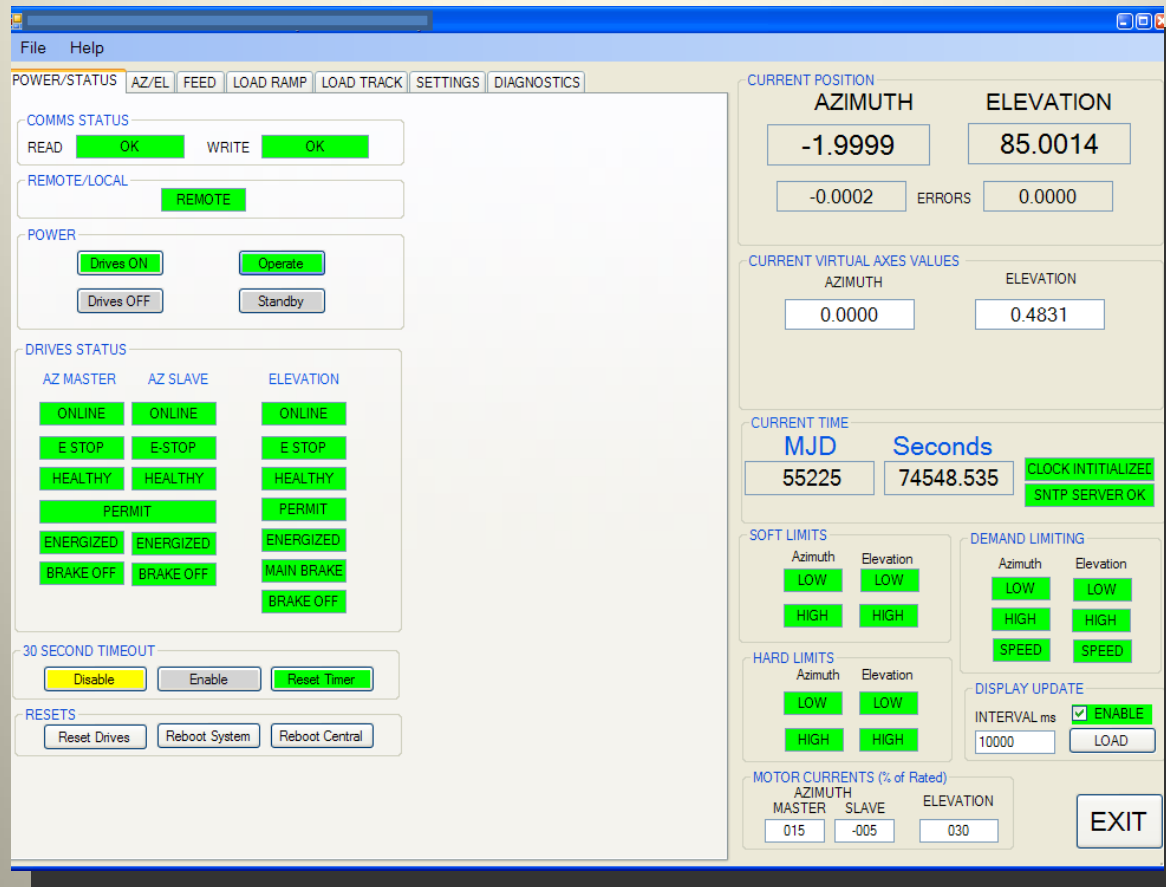
POWER/STATUS PAGE

- In Remote Control
- Drives are OFF
- In the POWER panel, Click DRIVES ON (PowerSwitch = ON).....



POWER/STATUS PAGE

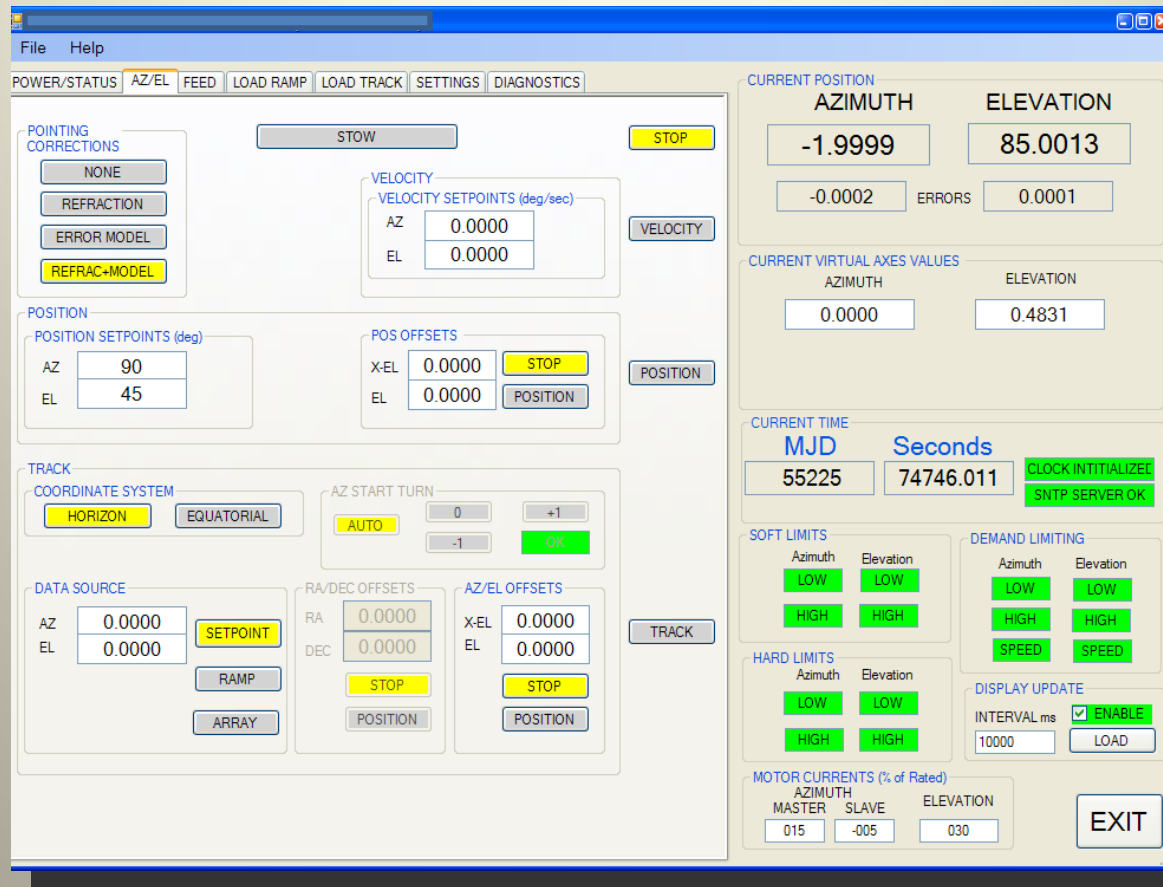
- Drives ON panel becomes green to confirm three phase contactor closed
- TRIPPED messages (Under Voltage trips) replaced by HEALTHY messages
- Click Operate button (**RunControl = OPERATE**).....



POWER/STATUS PAGE

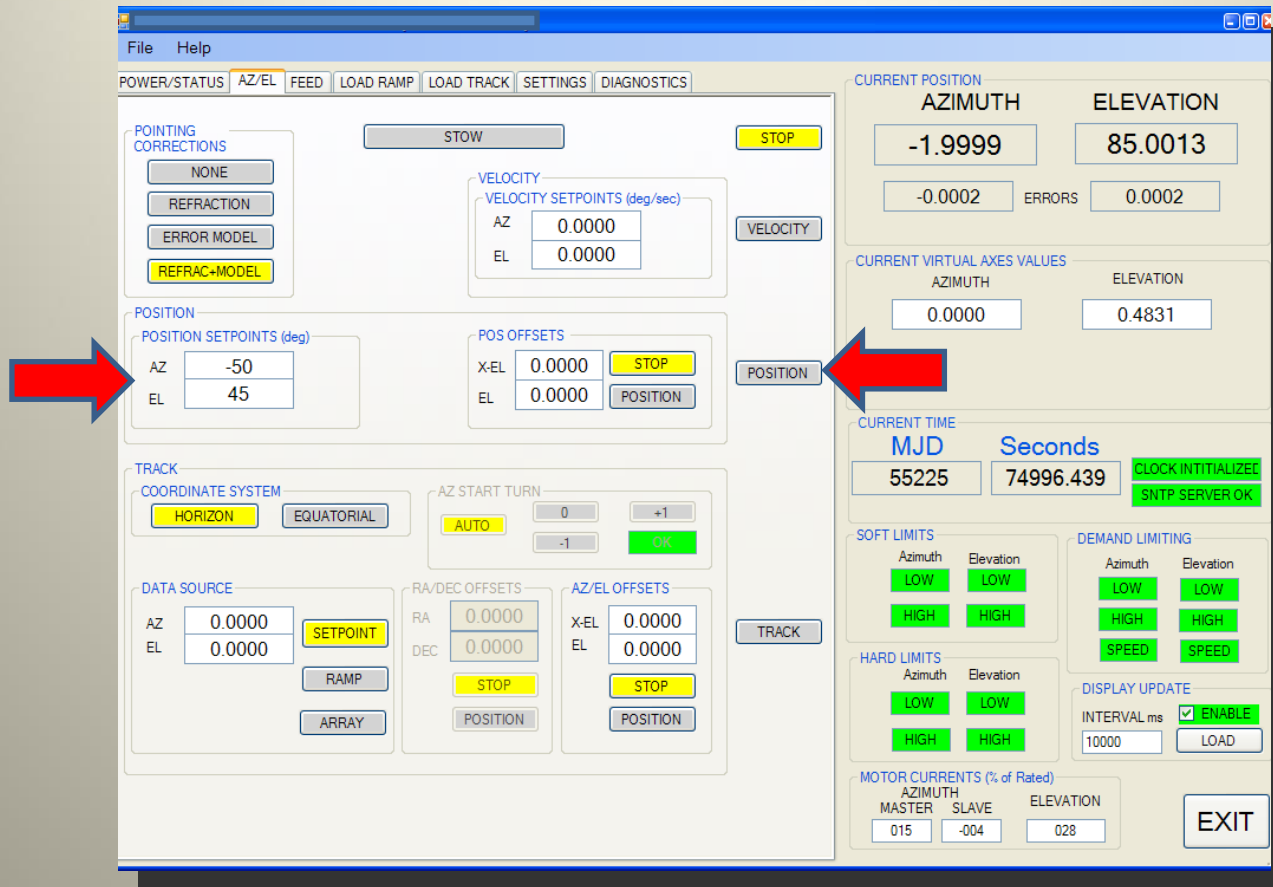
After a few seconds

- All drives are now ENERGIZED
- All BRAKES are now OFF



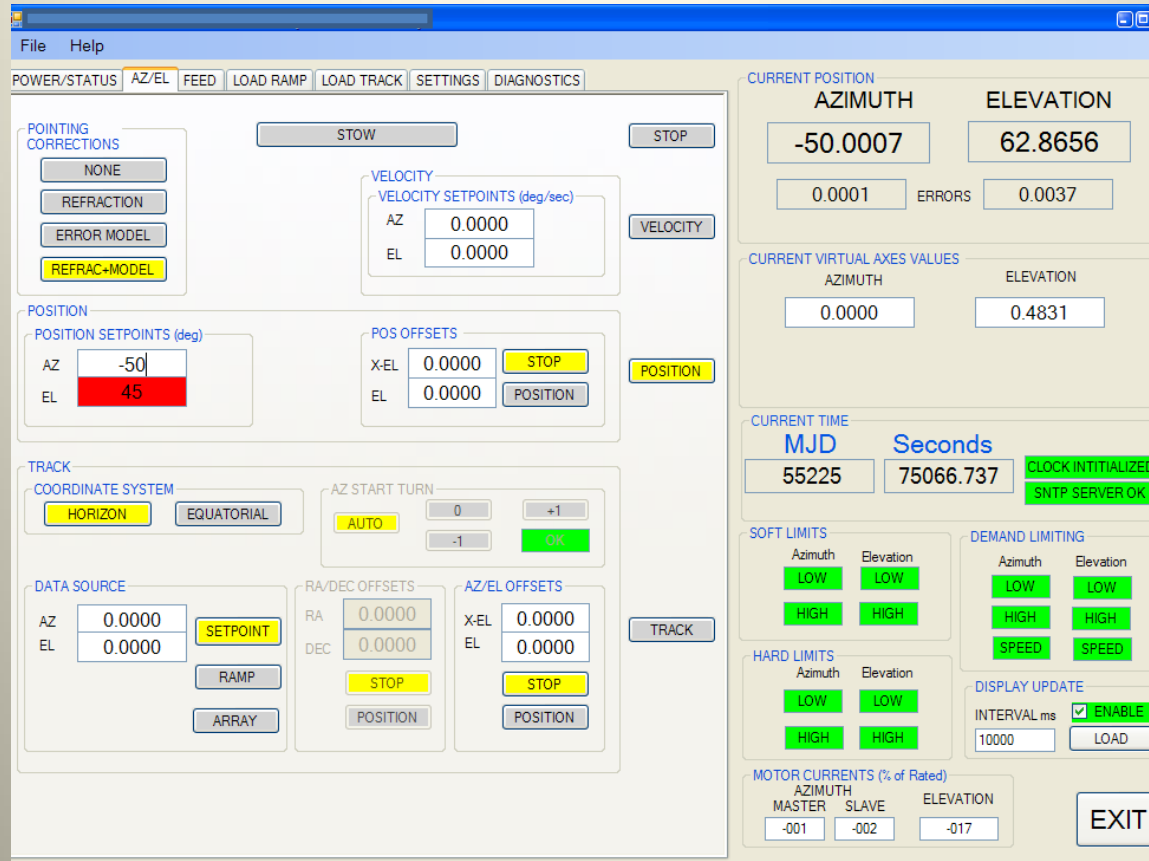
AZ/EL PAGE

- In STOP mode (Default on Power-up)
- Refraction and Pointing Model Corrections are Enabled
- TRACK mode is working in HORIZON coordinates



AZ/EL PAGE – POSITION MODE

- Type POSITION SETPOINTS AZ = -50.0, EL = 45.0
- Click POSITION (AzimuthPosition = -500000, ElevationPosition = 450000, RunMode = POSITION).....



AZ/EL PAGE – POSITION MODE

- Antenna is moving to target position
- Elevation SETPOINT textbox is red to indicate NOT AT POSITION
- Velocities – Azimuth 5 deg/sec Elevation 1.25 deg/sec (average)

The screenshot displays the 'AZ/EL' control interface. A red arrow points to the 'NONE' button in the 'POINTING CORRECTIONS' panel. The interface is divided into several sections:

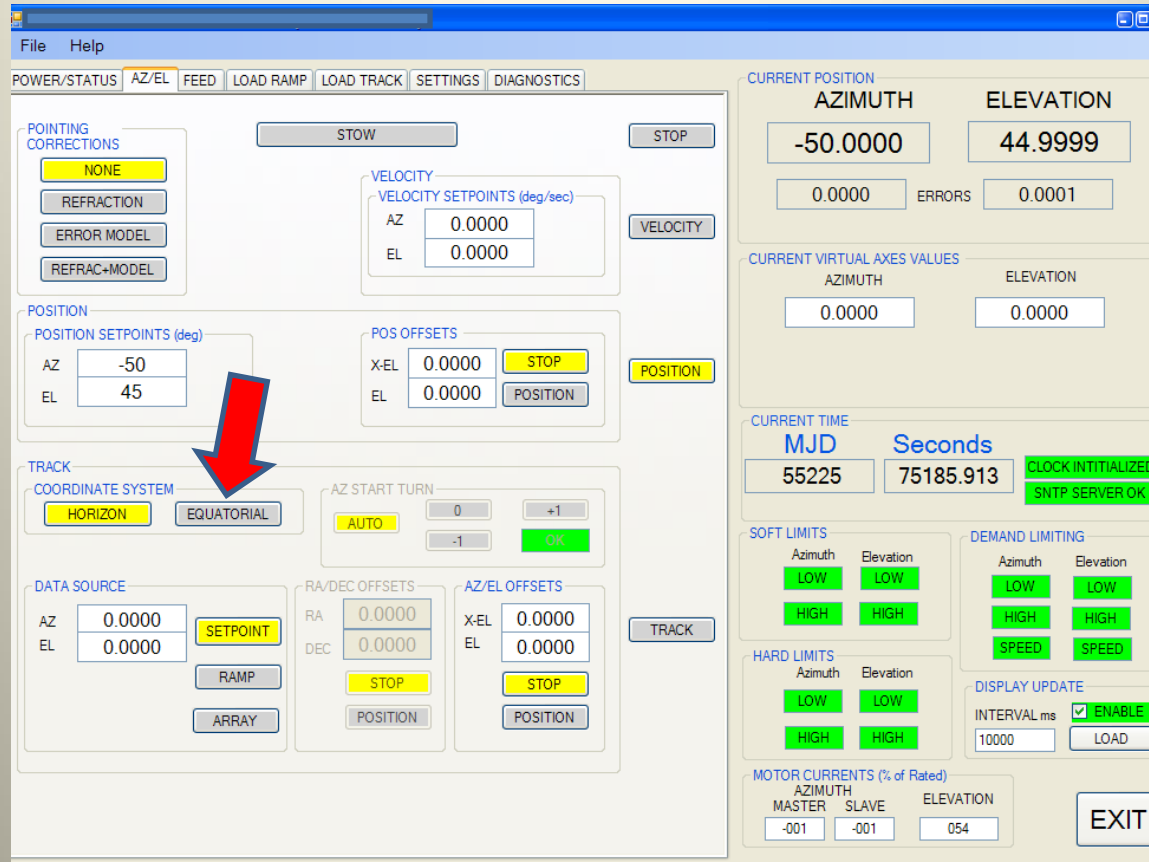
- POINTING CORRECTIONS:** Includes buttons for NONE, REFRACTION, ERROR MODEL, and REFRAC-MODEL. A red arrow points to the 'NONE' button.
- POSITION:** Shows 'POSITION SETPOINTS (deg)' with AZ at -50 and EL at 45. It also includes 'POS OFFSETS' for X-EL and EL, both at 0.0000.
- VELOCITY:** Shows 'VELOCITY SETPOINTS (deg/sec)' for AZ and EL, both at 0.0000.
- TRACK:** Includes 'COORDINATE SYSTEM' (HORIZON selected), 'AZ START TURN' (AUTO selected), and 'DATA SOURCE' (AZ and EL at 0.0000).
- RA/DEC OFFSETS:** RA and DEC at 0.0000.
- AZ/EL OFFSETS:** X-EL and EL at 0.0000.
- CURRENT POSITION:** AZIMUTH: -49.9998, ELEVATION: 45.0168.
- CURRENT VIRTUAL AXES VALUES:** AZIMUTH: 0.0000, ELEVATION: 0.4831.
- CURRENT TIME:** MJD: 55225, Seconds: 75115.645. Status: CLOCK INITIALIZED, SNTP SERVER OK.
- SOFT LIMITS:** Azimuth and Elevation LOW and HIGH indicators are green.
- DEMAND LIMITING:** Azimuth and Elevation LOW and HIGH indicators are green. SPEED indicators are also green.
- HARD LIMITS:** Azimuth and Elevation LOW and HIGH indicators are green.
- DISPLAY UPDATE:** INTERVAL ms: 10000, ENABLE checkbox checked.
- MOTOR CURRENTS (% of Rated):** AZIMUTH MASTER: 004, SLAVE: 002, ELEVATION: 055.

AZ/EL PAGE – POSITION MODE

Both Axes now at Target Position (Textboxes have returned to white)

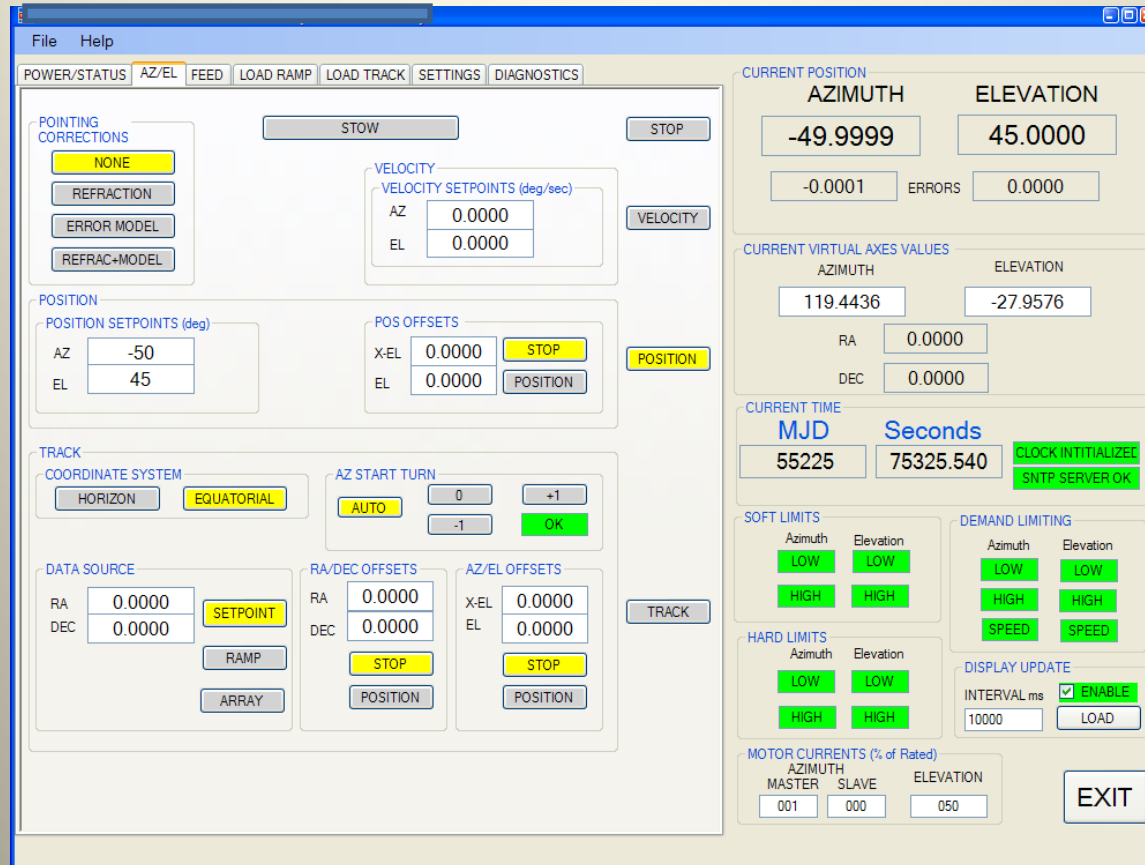
Elevation position slightly different from set-points

In POINTING CORRECTIONS panel, click NONE (CorrectionDisable = ALL)



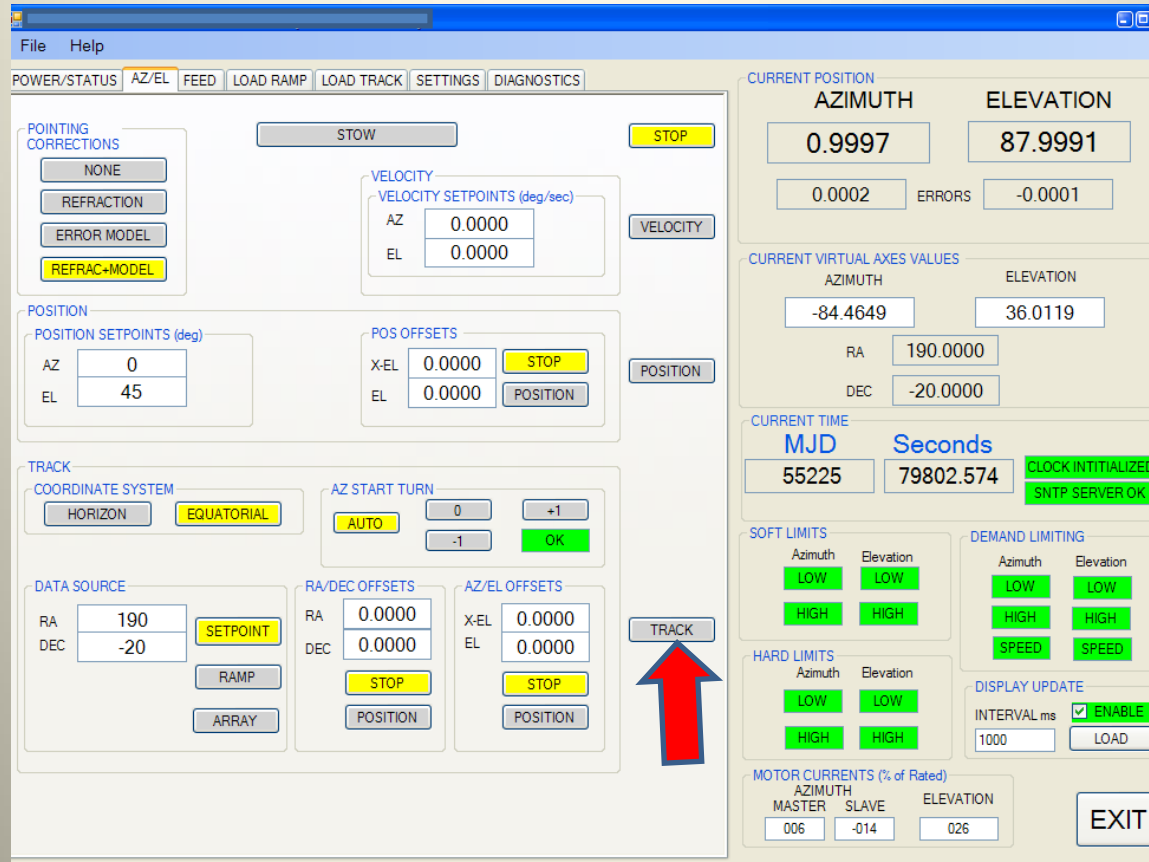
AZ/EL PAGE – POSITION MODE

- Corrections are removed so achieved position is now the same as the setpoint
- In TRACK panel coordinates are selected as HORIZON (Default)
- Click EQUATORILA (**DataMode = RADEC**).....



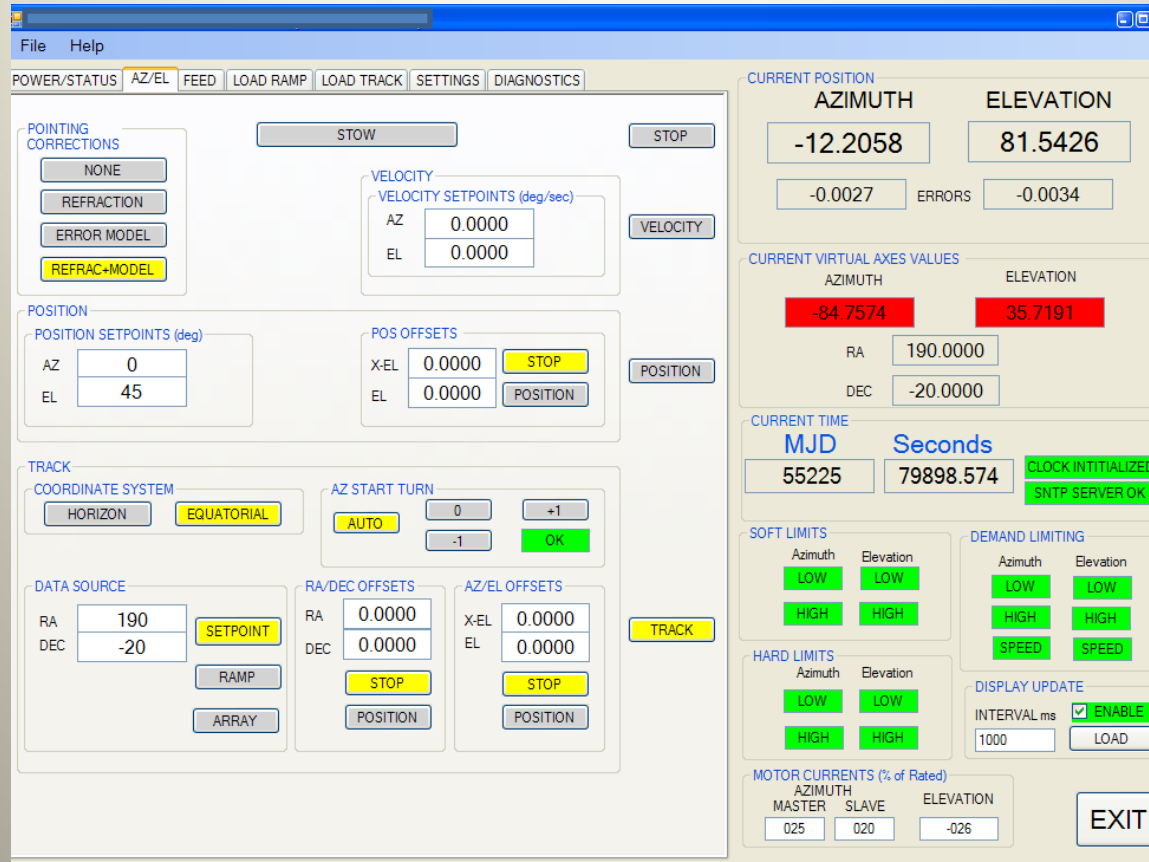
AZ/EL PAGE – TRACK MODE

- Track Coordinates change form AZ/EL to RA/Dec
- Selected DATA SOURCE is SETPOINT (Default)
- VIRTUAL AXES panel shows position antenna will move to when TRACK mode is selected



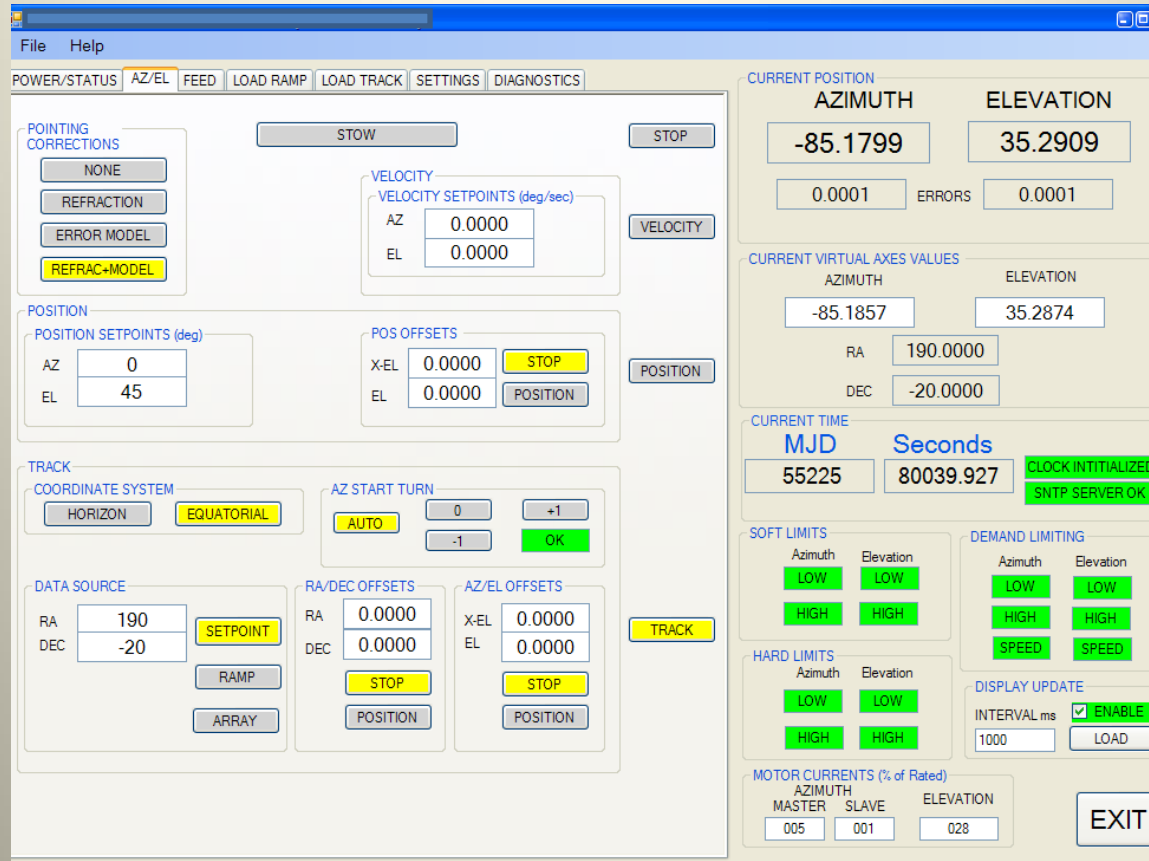
AZ/EL PAGE – TRACK MODE

- Type RA and DEC Setpoint values in textboxes
- Virtual Axis is tracking the source (Source is above the horizon)
- Click TRACK button (**RunMode = TRACK**)



AZ/EL PAGE – TRACK MODE

- Antenna is synchronizing to the source trajectory (using maximum speed and acceleration)
- Virtual Axes panels are red to indicate NOT LOCKED (yet)



AZ/EL PAGE – TRACK MODE

- Virtual Axes textboxes are white again to show antenna has synchronized to the source trajectory
- SIDEREAL TRACKING
- RA/DEC and AZ/EL OFFSETS can be superimposed on to the track

TRACK DATA SOURCES

- POSITION SETPOINT

 - AZ/EL Position or RA/DEC Position (Sidereal Track)

- RAMP (LINEAR POSITION/TIME)

 - Position at Epoch, Time of Epoch, and Velocities (to 8 dp)

- ARRAY

 - Virtual Axes obtained by Interpolation between Time Tagged coordinates (1000 points standards, optional 4000 points)

AVAILABLE OFFSETS IN TRACK MODE

- In HORIZON COORDINATE mode
 - Azimuth and Cross-Elevation Position Offsets
 - In EQUATORIAL COORDINATE mode
 - Right Ascension and Declination Position Offsets
- AND
- Azimuth and Cross-Elevation Position Offsets

File Help

POWER/STATUS AZ/EL FEED **LOAD RAMP** LOAD TRACK SETTINGS DIAGNOSTICS

LOAD RAMP

	POSITION AT EPOCH deg	RAMP RATE deg/sec
RA	0.0000	0.00000000
DEC	0.0000	0.00000000

(Ramp rates can be specified to 8 decimal places)

SPECIFY EPOCH

Day	0	MJD
Time	0.000	sec

OR

CONTROLLER SETS EPOCH ON RECEIPT

LOAD

CURRENT POSITION

AZIMUTH	ELEVATION
-85.8142	34.6485
0.0001	ERRORS
	0.0001

CURRENT VIRTUAL AXES VALUES

AZIMUTH	ELEVATION
-85.9675	34.4929
RA	190.0000
DEC	-20.0000

CURRENT TIME

MJD	Seconds	CLOCK INITIALIZED
55225	80300.171	SNTP SERVER OK

SOFT LIMITS

Azimuth	Elevation
LOW	LOW
HIGH	HIGH

DEMAND LIMITING

Azimuth	Elevation
LOW	LOW
HIGH	HIGH
SPEED	SPEED

HARD LIMITS

Azimuth	Elevation
LOW	LOW
HIGH	HIGH

DISPLAY UPDATE

INTERVAL ms ENABLE

1000 LOAD

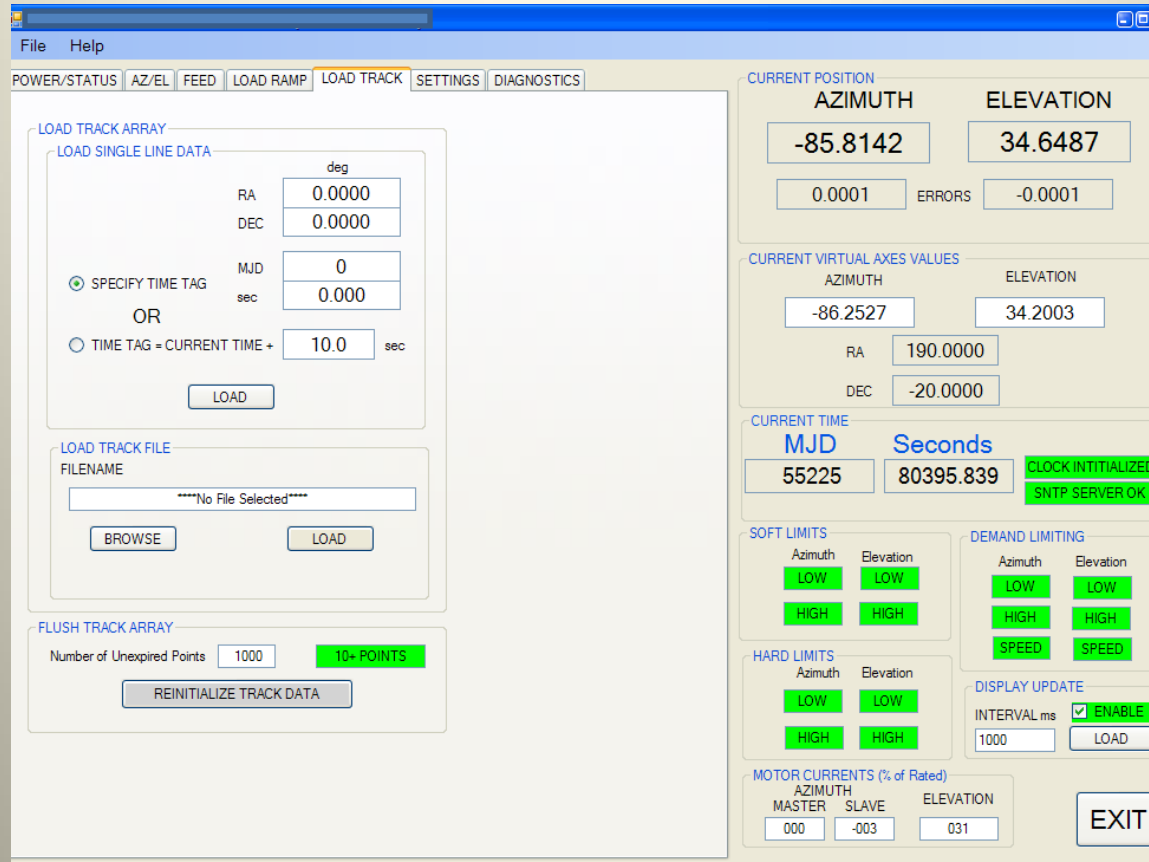
MOTOR CURRENTS (% of Rated)

AZIMUTH		ELEVATION
MASTER	SLAVE	
000	-003	054

EXIT

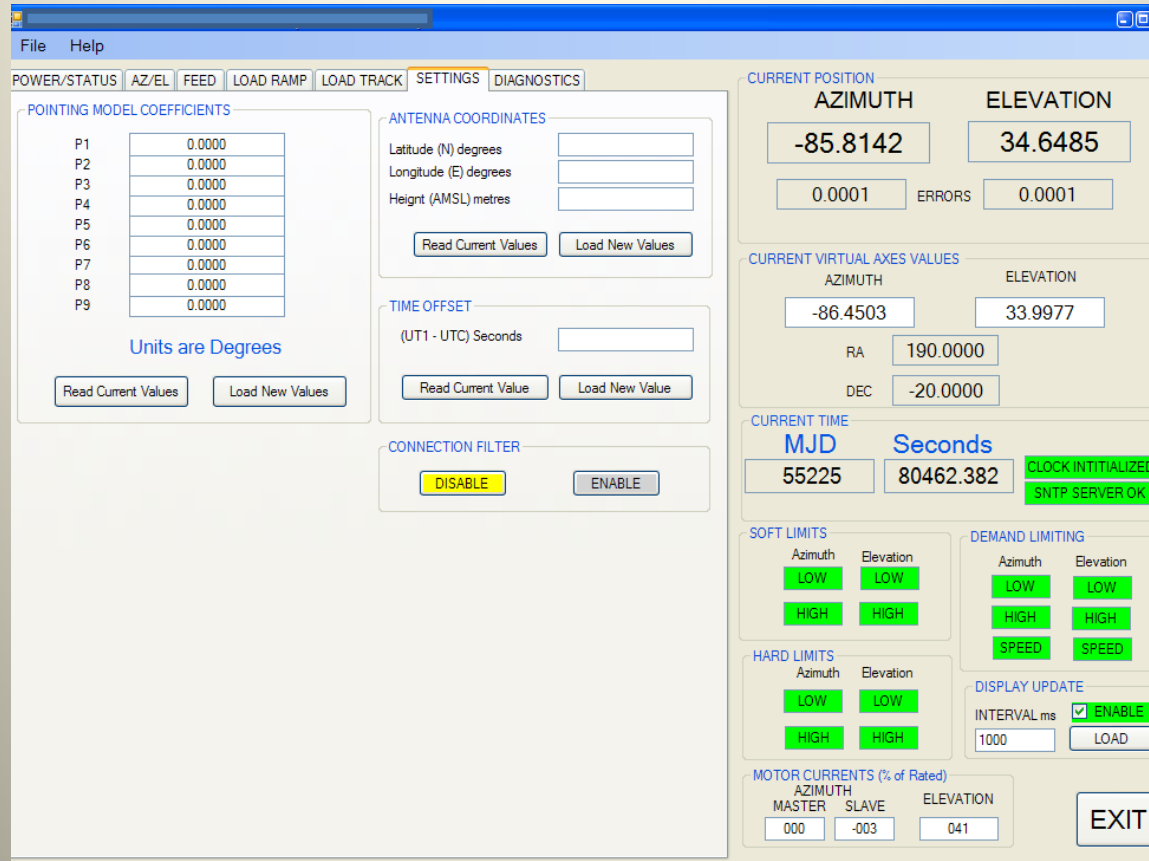
LOAD RAMP PAGE

➤ Ramp Rate Resolution = 10^{-8} deg/sec. Rounding Error < 0.02 millidegrees/Hour



LOAD TRACK PAGE

- HMI Program can be used to load a single line of data
- HMI Program can load a track file (tab delimited, .txt file)



SETTINGS PAGE

➤ The HMI program can be used to change some of the Controller's Settings

File Help

POWER/STATUS AZ/EL FEED LOAD RAMP LOAD TRACK SETTINGS **DIAGNOSTICS**

ELEVATION DIAGNOSTICS

Trip 0	6
Trip 1	6
Trip 2	6
Drive Overload	0
Drive Overtemp	0
Drive Summary	47
Apps Module Error	0
Program Status	2
Task in Error	0
DPL Line in Error	0
CTNet Diagnostics	1250
Encoder Status	0
IO Module Status	0

AZIMUTH DIAGNOSTICS

	Master	Slave
Trip 0	6	6
Trip 1	6	6
Trip 2	6	6
Drive Overload	0	0
Drive Overtemp	0	0
Drive Summary	47	47
Apps Module Error	0	0
Program Status	2	2
Task in Error	0	0
DPL Line in Error	0	0
CTNet Diagnostics	1503	1000
Encoder Status	0	0
IO Module Status	0	0

CENTRAL DIAGNOSTICS

Apps Module Error	0
Program Status	2
Task in Error	0
DPL Line in Error	0
CTNet Diagnostics	2000
Ethernet Status	0
Ethernet Frames/s	920

PARAMETER READ

NODE

MENU

PARAMETER #

VALUE

Elevation = Node #1
Azimuth Master = Node #3
Azimuth Slave = Node #4
Central = Node #10

CURRENT POSITION

AZIMUTH	ELEVATION
-85.8140	34.6486
-0.0001	ERRORS 0.0000

CURRENT VIRTUAL AXES VALUES

AZIMUTH	ELEVATION
-86.7488	33.6892
RA	190.0000
DEC	-20.0000

CURRENT TIME

MJD	Seconds
55225	80563.201

SOFT LIMITS

Azimuth	Elevation
LOW	LOW
HIGH	HIGH

DEMAND LIMITING

Azimuth	Elevation
LOW	LOW
HIGH	HIGH
SPEED	SPEED

HARD LIMITS

Azimuth	Elevation
LOW	LOW
HIGH	HIGH

DISPLAY UPDATE

INTERVAL ms ENABLE

MOTOR CURRENTS (% of Rated)

AZIMUTH		ELEVATION
MASTER	SLAVE	056
004	000	

DIAGNOSTICS PAGE

➤ Diagnostic information is available to assist with troubleshooting in the even of a fault.