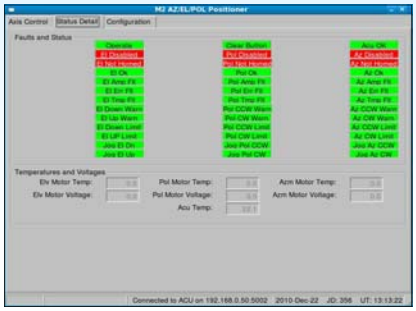
M2 Antenna Systems, Inc.
Model No: ACU-X2PFM(PB)-F115



SPECIFICATIONS:

MODEL NUMBER	ACU-X2PFM(PB)-F115
POWER REQUIREMENTS	115 VAC @ 15 A
ENCLOSURE SIZE	L=19.0" / W=14.5" / D=5.88"
ENCLOSURE RATING	PELICAN CASE 1550
COLOR	FLAT BLACK
POINTING ACCURACY	<0.03°
READOUT ACCURACY	<0.001°
MINIMUM COMMANDED MOTION	<0.001°
CONTROL SWITCHES	Elevation Jog Control (Up & Down Momentary) Azimuth Jog Control (CCW & CW Momentary) Reference Return (Momentary)
ELECTRONIC ENCLOSURE MODES	Run Mode Via GUI / Maintenance Mode
COOLING	300 Cubic Foot-Per-Minute Thermostatically Controlled Fan
STANDARD OUTPUT VOLTAGES	AZ / EL = 48 VDC @ 12.5 A
ONBOARD COMPUTER VOLTAGE	5 VDC @ 3 A
COMPUTER INTERFACE	(1) RS232 / (1) Ethernet-RJ45

FEATURES:

The M2 ACU-X 2PFM(PB)-F115 "Antenna Control Unit" is a Commercial grade computer controlled system designed for quick deployment and to control a series of our M2 multi axis pedestals including the AE1000S and AE1000SCB Housed in the Pelican Case 1550® is the main switching power supplies for the Pedestal, Computer controls and thermostat for simple cooling. The housing is a Pelican Case 1550® with rubber gaskets and screened ventilation ports. Jog controls for both Elevation, Azimuth and Reference Return can be run in the "Maintenance Mode" inside the enclosure. The M2 ACU-X2PFM (PB)-F115 controller has options for 110 VAC or 230 VAC. The ACU-X2PFM-(PB)F115 software system is designed around the open source LINUX based operating system. Developed for **M2** by (TCS) Telecommunication Systems, a world leader in highly reliability products for the Aerospace, Military, and Industrial markets.

M2 Antenna Systems, Inc. 4402 N. Selland Ave. Fresno, CA 93722
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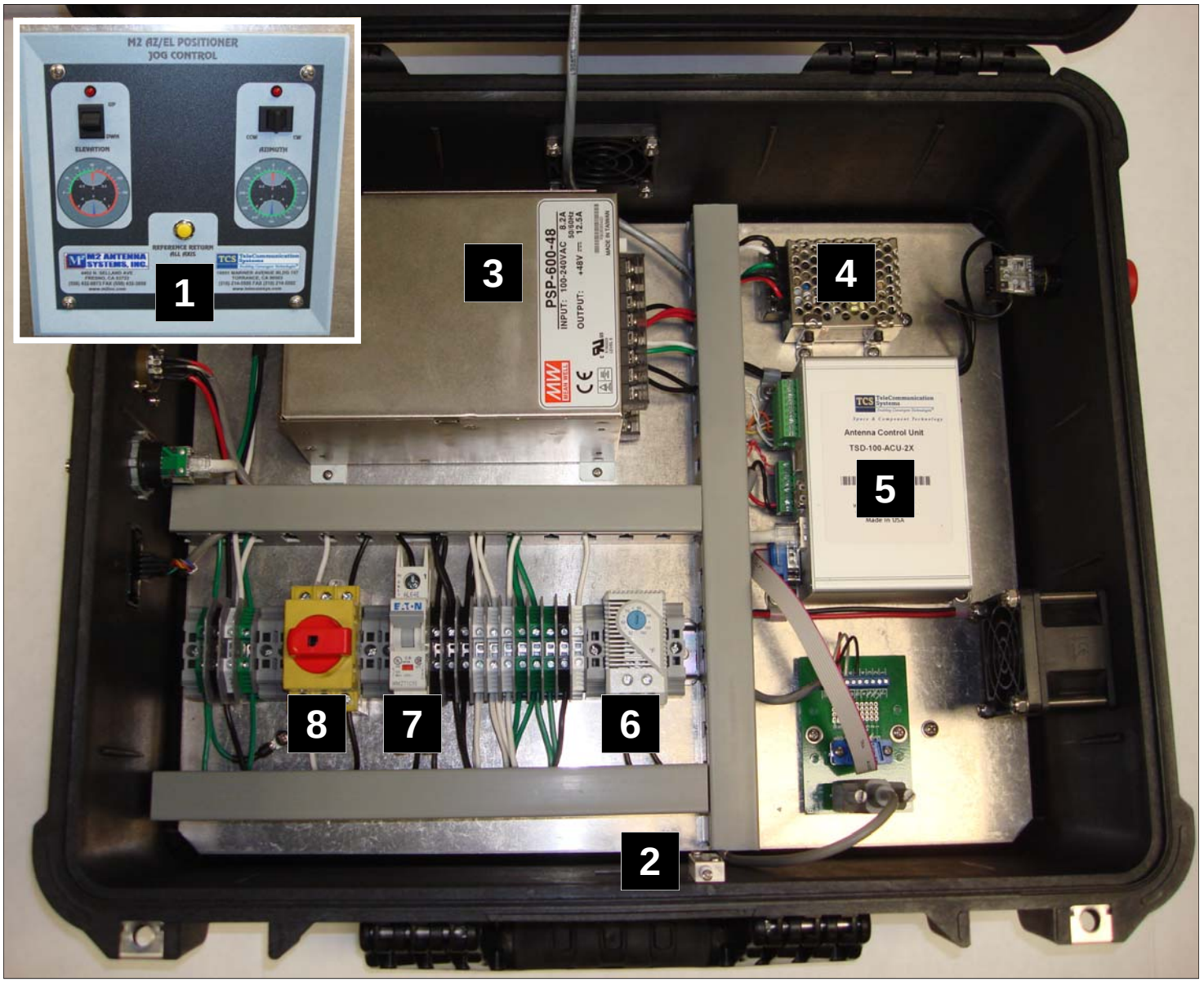
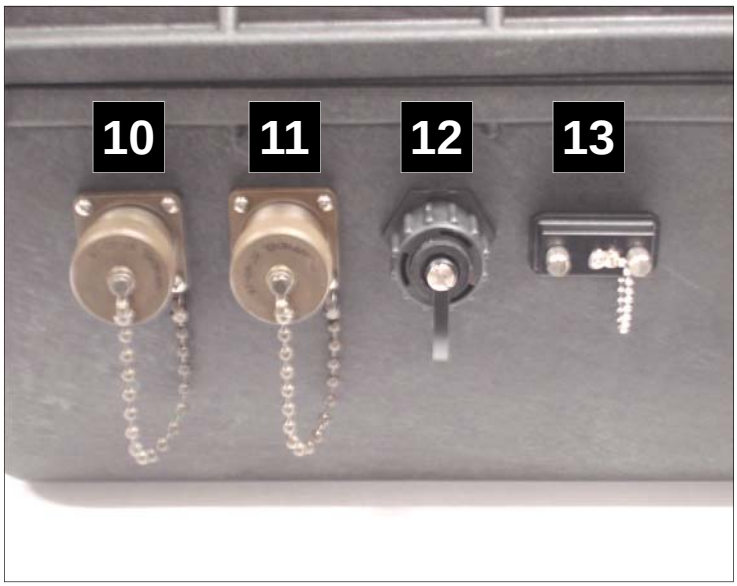
OVERVIEW ELECTRONICS ENCLOSURE



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	(Local) Jog Control and Reference Panel, used for local movement and homing of the antenna at the positioner.	6	Thermostat used to control fan, can be set degrees from 32-140F
2	Interlock Switch, when door is open the system goes into a maintenance mode which locks out any remote control and provides control to the Jog Control and Reference panel shown in item 1	7	AC circuit breaker, 16 amp
3	+48 VDC power supply for motor drive systems	8	Twist ON/OFF switch.
4	+5 VDC power supply for ACU (item 5)		
5	Antenna Control Unit (ACU)		

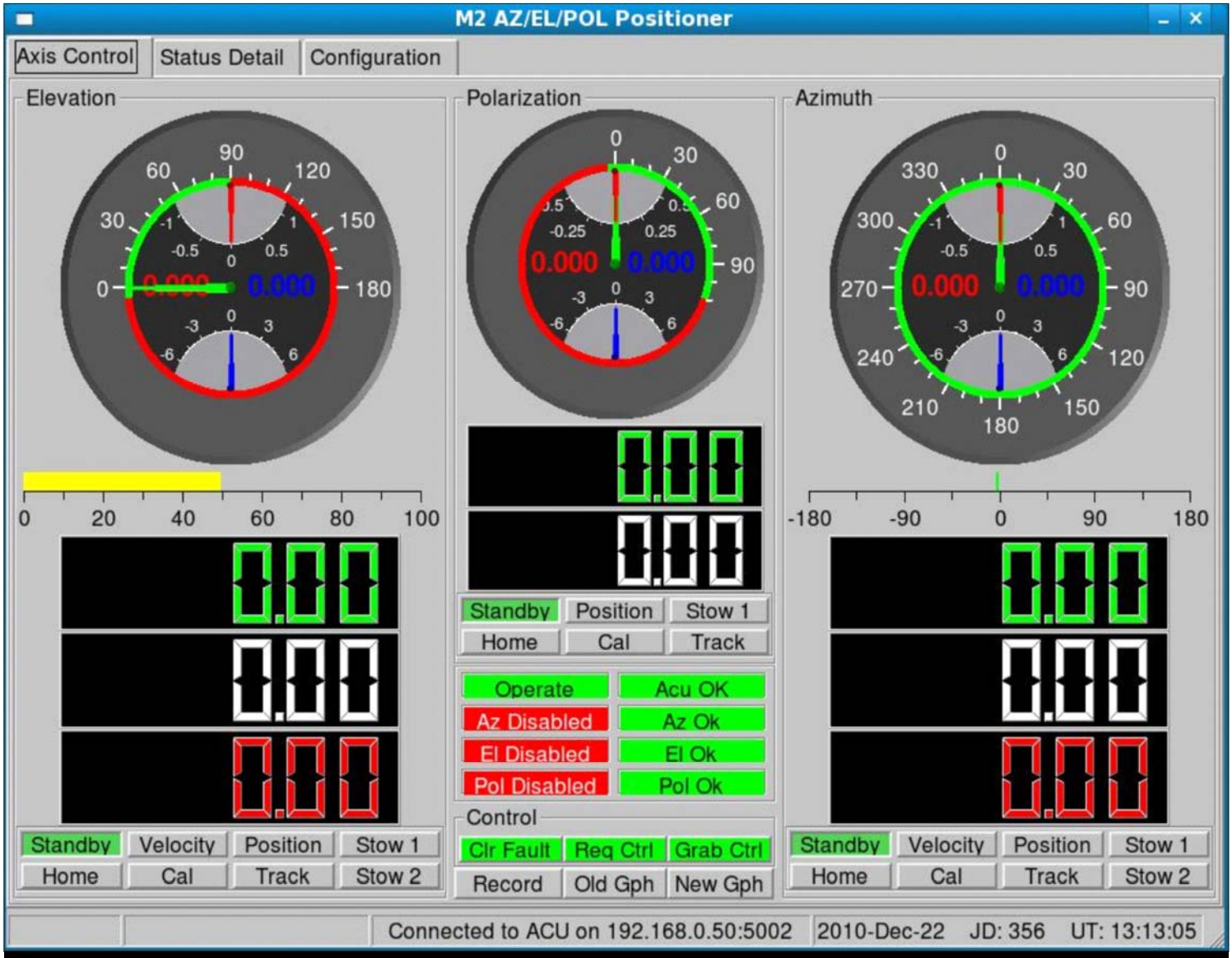
OVERVIEW ELECTRONICS ENCLOSURE CONTINUED



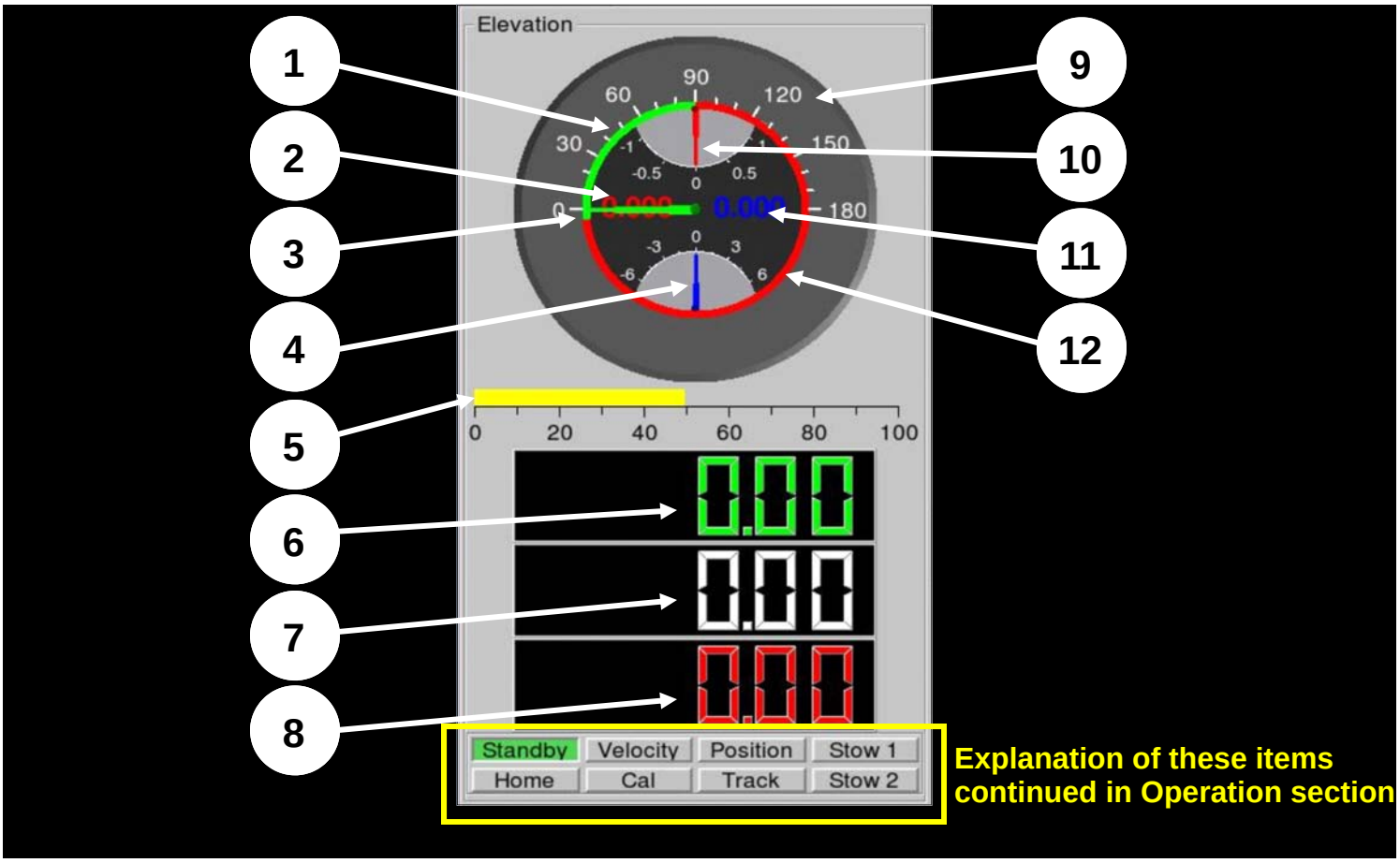
ITEM	DESCRIPTION
9	Emergency Stop button. Located on the right bottom side of the Pelican Case 1550®. Used during safety issues where the AZ/EL Pedestal assembly runs past a limit or is near an obstruction.
10	Main power input plug. 120VAC @ 15 amps. (5 Pin) A supplied AC cable assembly has been included.
11	AZ/EL Pedestal Motor Cable input. (7 Pin) A supplied 50’ cable assembly has been included.
12	Computer Interface (Ethernet Connection)
13	Computer Interface (RS232 Connection)

MAIN OVERVIEW GUI AXIS CONTROL

The main screen (GUI) display used for operator control. Operation of each of the controls is described further in the Operations section of the manual.

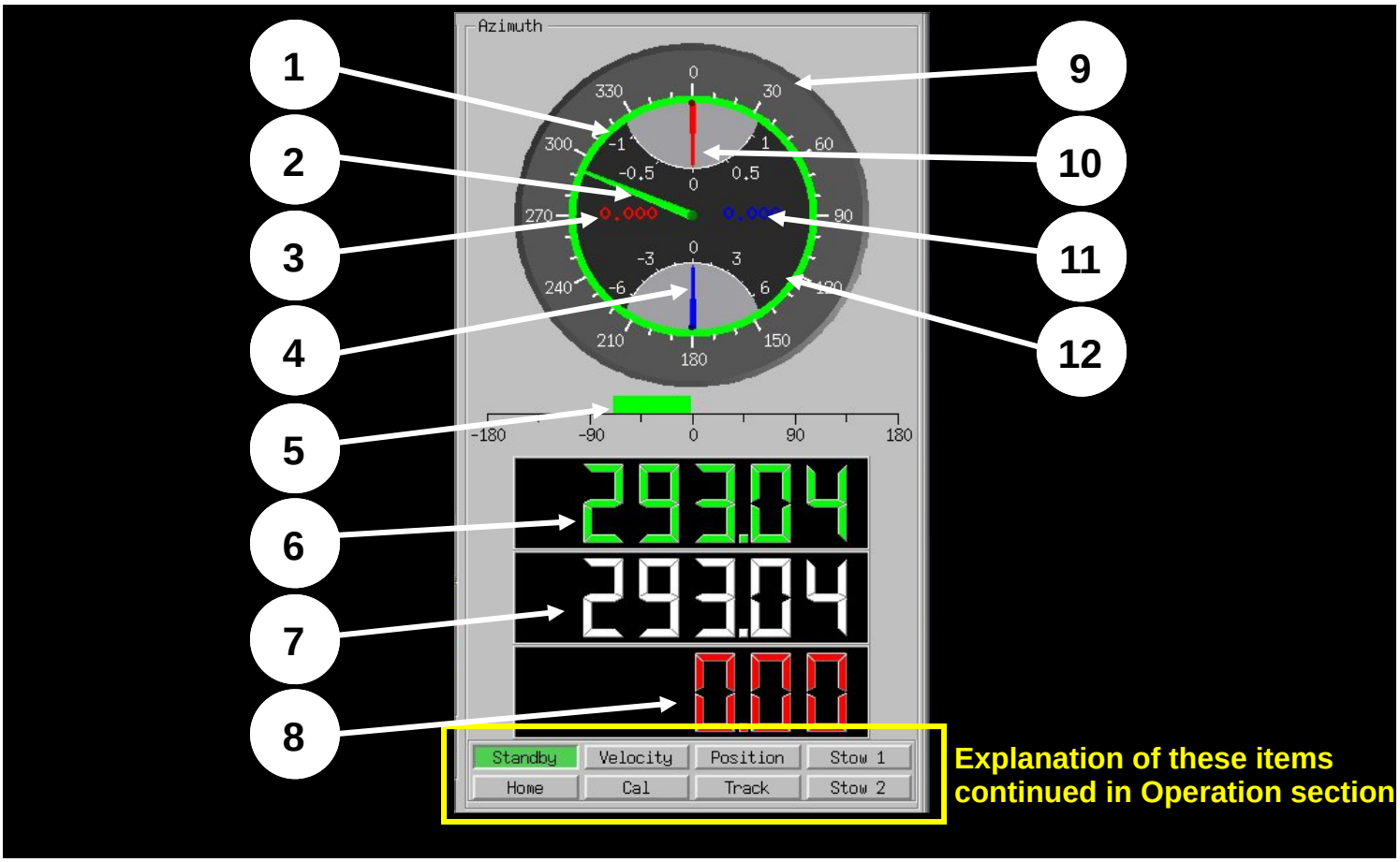


DESCRIPTIONS AND DEFINITIONS (ELEVATION)



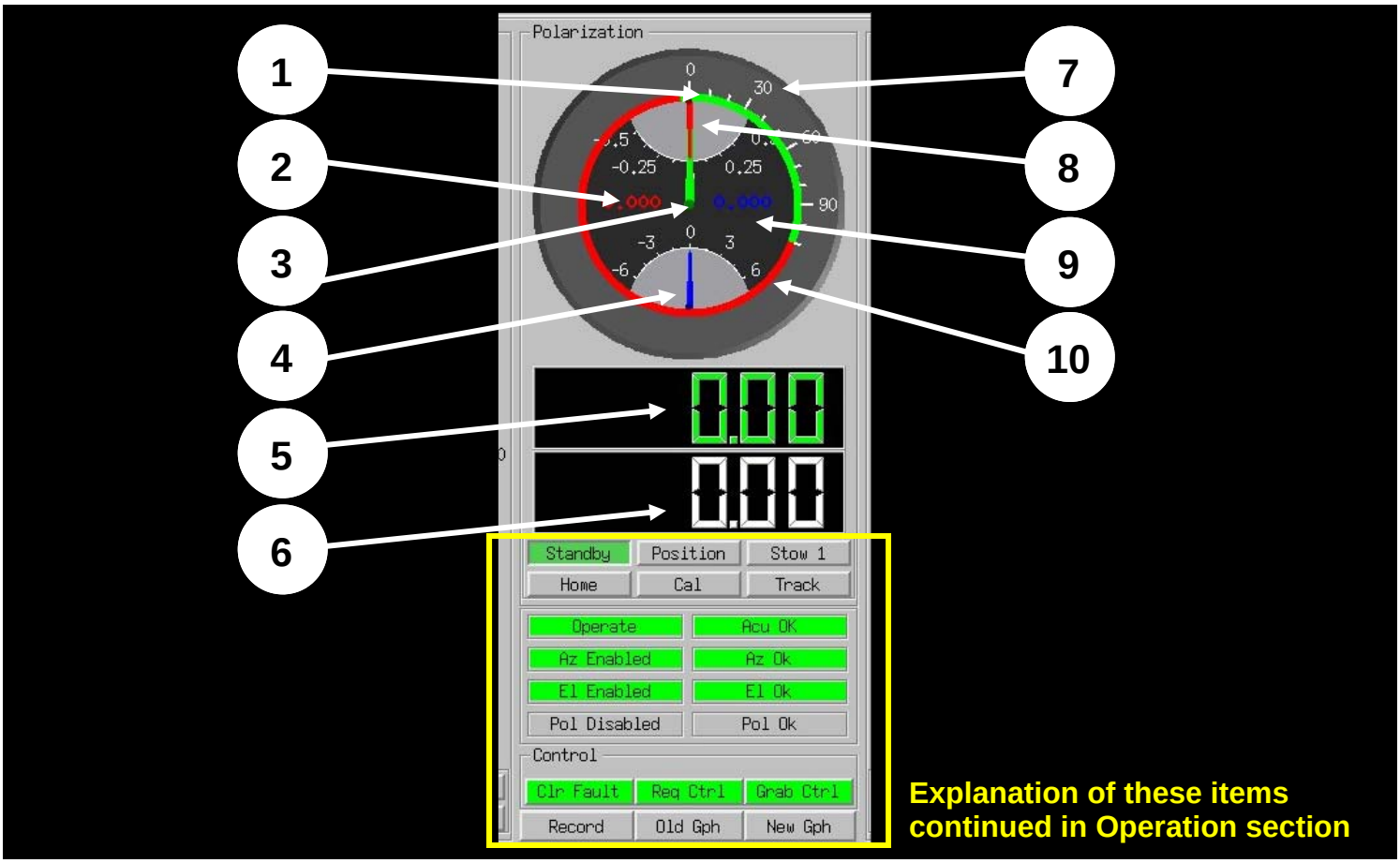
ITEM	DESCRIPTION OF INDICATORS AND CONTROL (ELEVATION)
1	Positioner operational area shown in Green.
2	Red numbers indicated antenna position error, compared to commanded position. This read out is applicable for Position and Track modes.
3	Green needle is analog representation of actual antenna position in degrees.
4	Blue needle is analog representation of antenna speed in degrees. Down speed shown as negative number and up speed shown as positive number.
5	Cable wrap indicator.
6	Green digital readout provides actual antenna position
7	White digital readout provides the antenna Commanded position in Position and Track modes; in Velocity mode it indicates the commanded degrees per second. Additional information for the antenna command position functions are described in the Antenna Operation section of the manual.
8	Red digital readout indicates position error, which is the difference between the actual position and the commanded position.
9	White numbers scale indicate antenna position in degrees.
10	Red needle is an analog representation of position error for the Position and Track modes.
11	Blue numbers indicate antenna speed in degrees. Elevation down speed shown as negative number and up speed shown as positive number.
12	Red zone indicates antenna non-operational area.

DESCRIPTIONS AND DEFINITIONS (AZIMUTH)



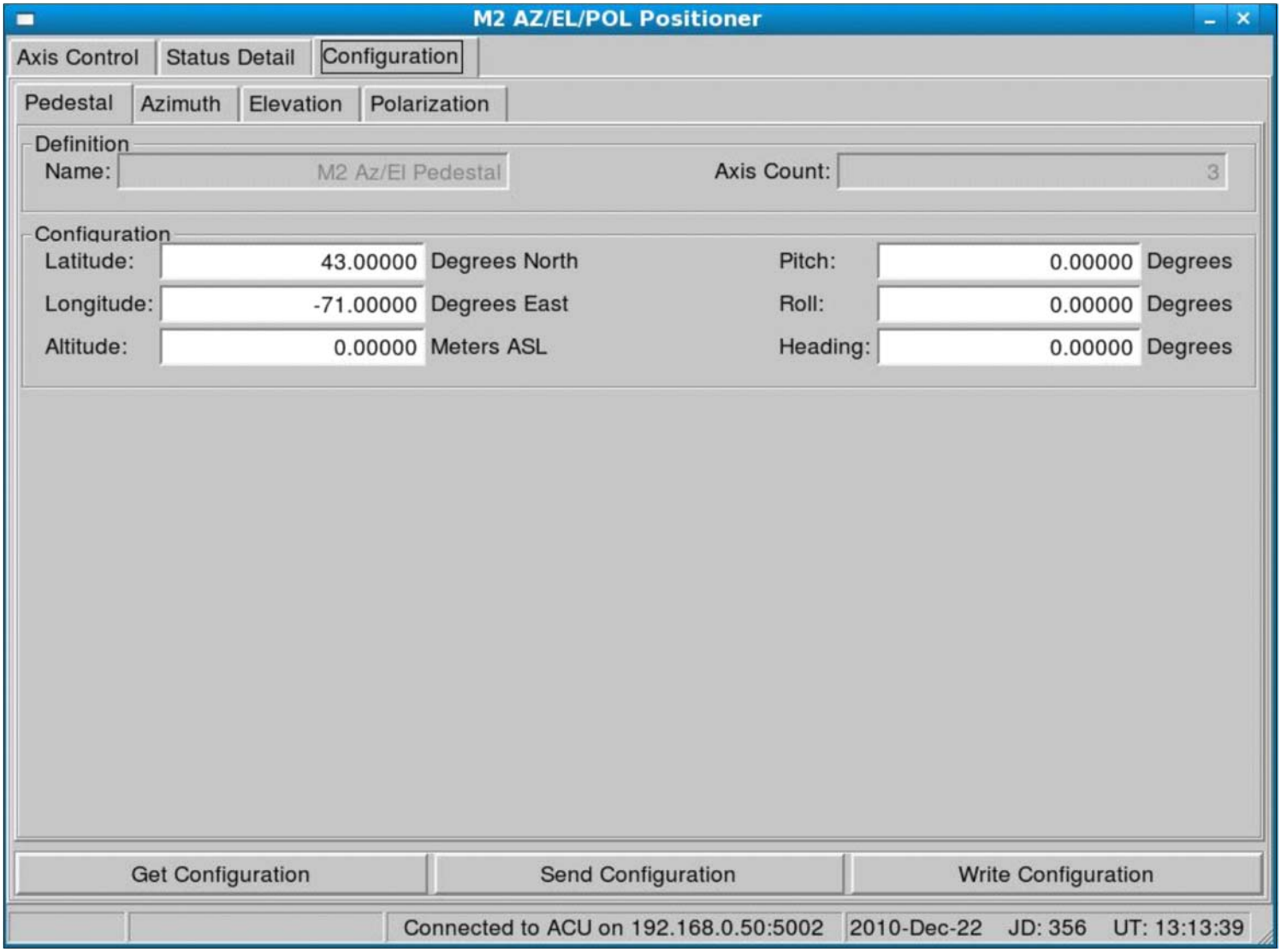
ITEM	DESCRIPTION OF INDICATORS AND CONTROL (AZIMUTH)
1	Positioner operational area shown in Green.
2	Red numbers indicated antenna position error, compared to commanded position. This read out is applicable for Position and Track modes.
3	Green needle is analog representation of actual antenna position in degrees.
4	Blue needle is analog representation of antenna speed in degrees. Down speed shown as negative number and up speed shown as positive number.
5	Cable wrap indicator.
6	Green digital readout provides actual antenna position
7	White digital readout provides the antenna Commanded position in Position and Track modes; in Velocity mode it indicates the commanded degrees per second. Additional information for the antenna command position functions are described in the Antenna Operation section of the manual.
8	Red digital readout indicates position error, which is the difference between the actual position and the commanded position.
9	White numbers scale indicate antenna position in degrees.
10	Red needle is an analog representation of position error for the Position and Track modes.
11	Blue numbers indicate antenna speed in degrees. Elevation down speed shown as negative number and up speed shown as positive number.
12	Red zone indicates antenna non-operational area.

DESCRIPTIONS AND DEFINITIONS (POLARIZATION)



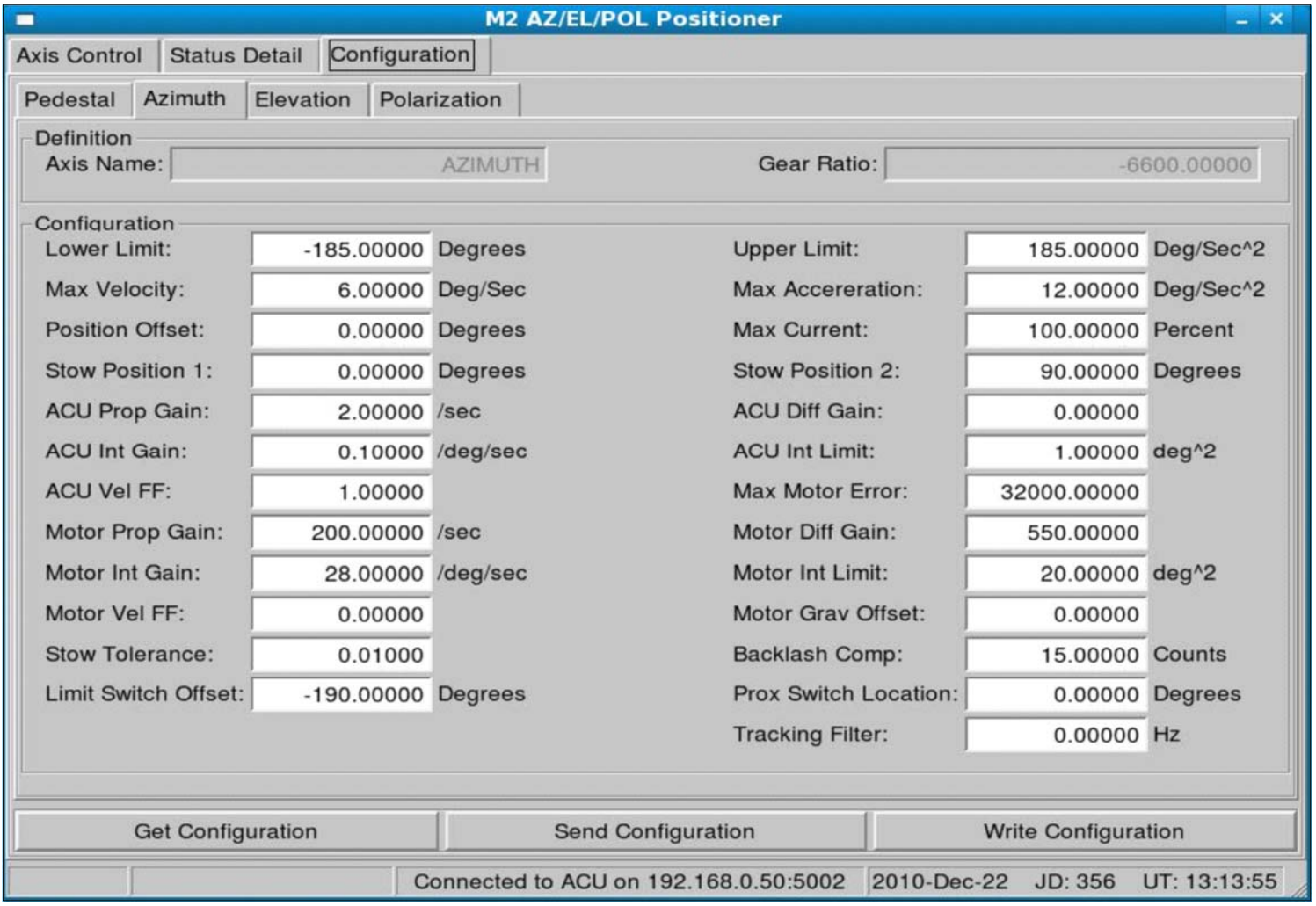
ITEM	DESCRIPTION OF INDICATORS AND CONTROL (POLARIZATION)
1	Positioner operational area shown in Green.
2	Red numbers indicated antenna position error, compared to commanded position. This read out is applicable for Position and Track modes.
3	Green needle is analog representation of actual antenna position in degrees.
4	Blue needle is analog representation of antenna speed in degrees. Down speed shown as negative number and up speed shown as positive number.
5	Green digital readout provides actual antenna position.
6	White digital readout provides the antenna Commanded position in Position and Track modes; in Velocity mode it indicates the commanded degrees per second. Additional information for the antenna command position functions are described in the Antenna Operation section of the manual.
7	White numbers scale indicate antenna position in degrees.
8	Red needle is an analog representation of position error for the Position and Track modes.
9	Blue numbers indicate antenna speed in degrees. Polarization down speed shown as negative number and up speed shown as positive number.
10	Red zone indicates antenna non-operational area.

PEDESTAL SETUP AND CONFIGURATION



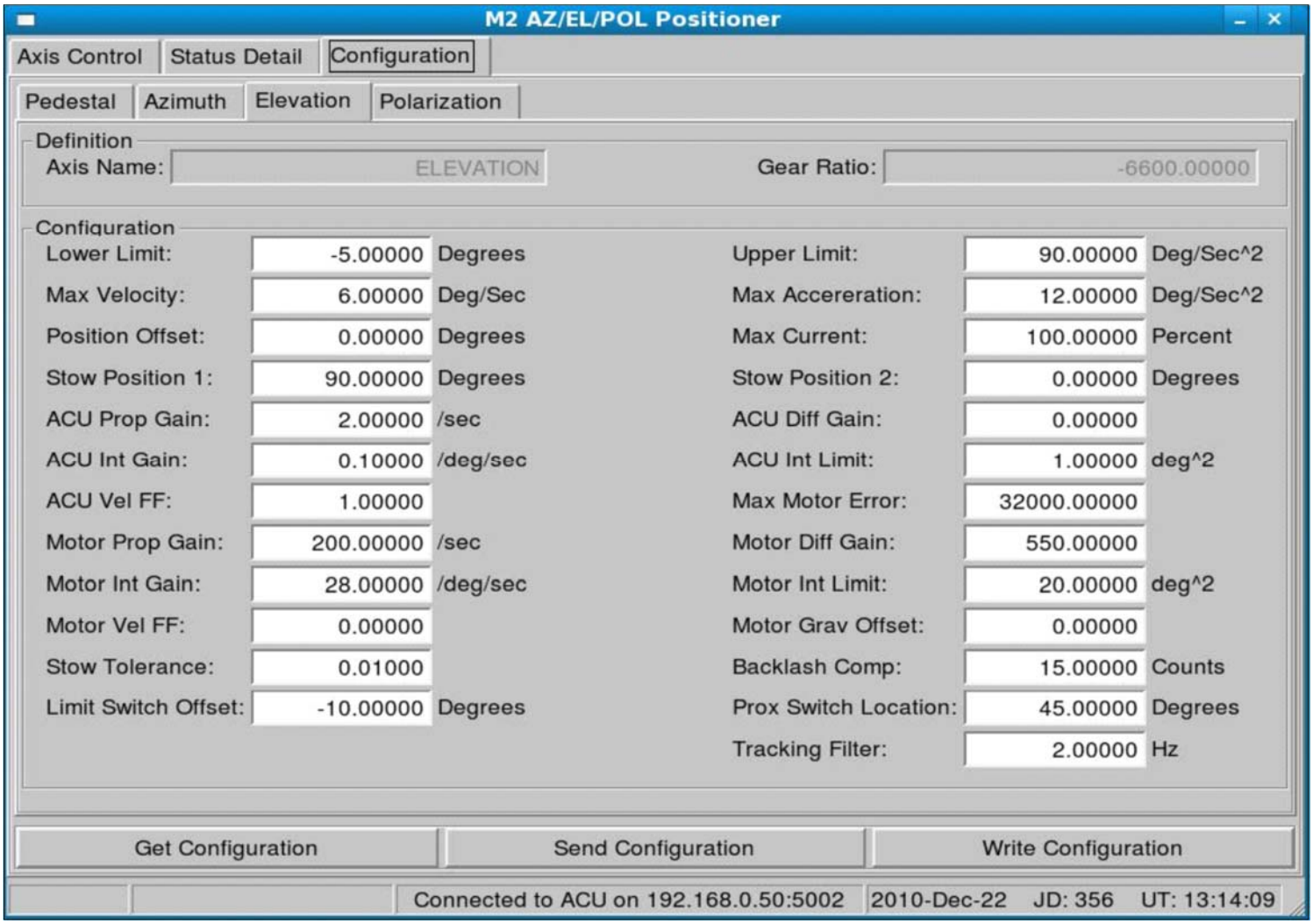
CONFIGURATION (PEDESTAL)			
LATITUDE	Enter location degrees NORTH	**PITCH**	0.00000 fix location
LONGITUDE	Enter location degrees EAST	**ROLL**	0.00000 fix location
ALTITUDE	0.00000 fix location	**HEADING**	0.00000 fix location

AZIMUTH AXIS SETUP AND CONFIGURATION



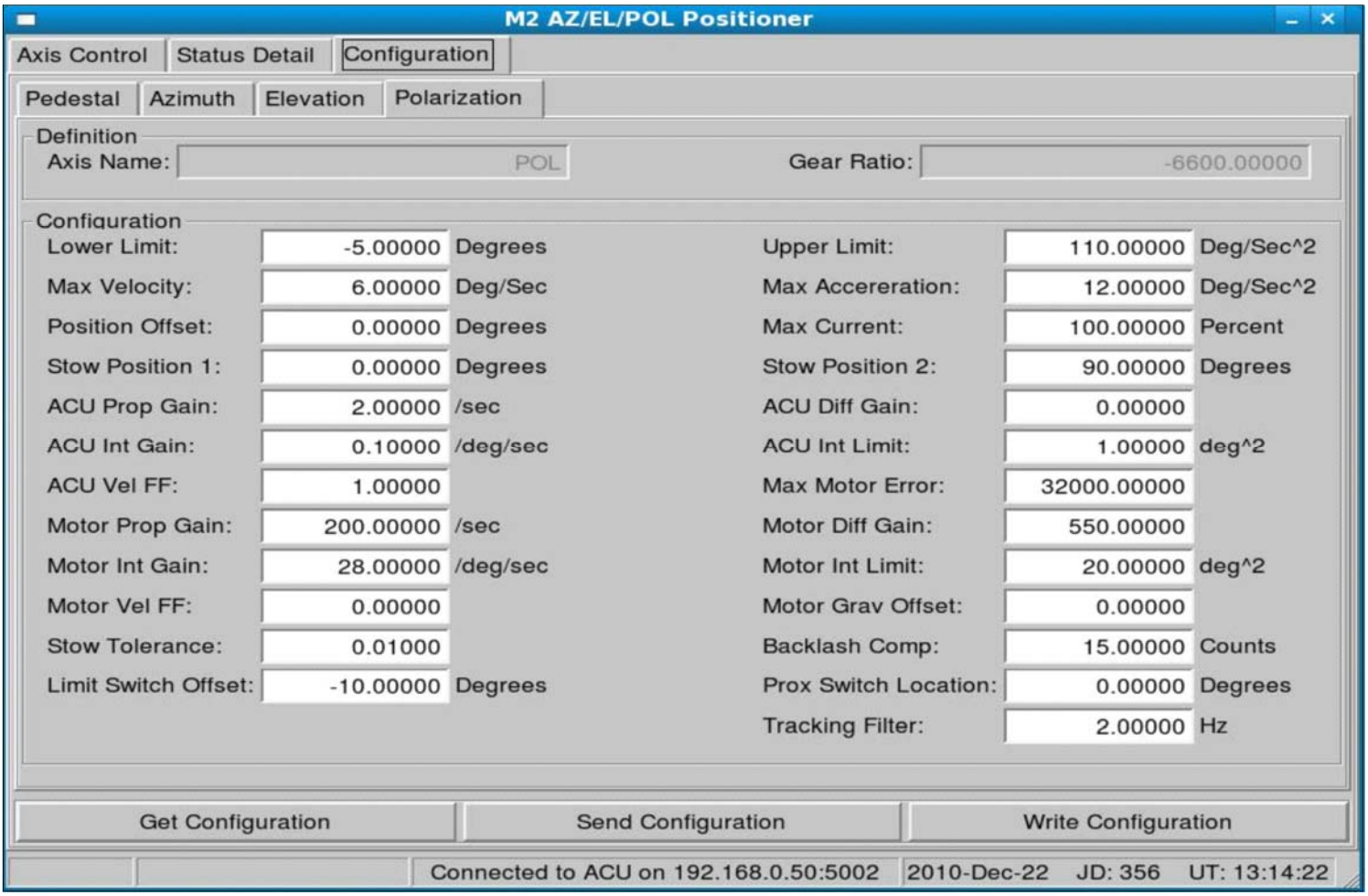
CONFIGURATION RANGES (AZIMUTH)			
DESCRIPTION	**RANGE**	**DESCRIPTION**	**RANGE**
Lower Limit	-360.0 to 360.0 degrees	Upper Limit	-360.0 to 360.0 degrees
Max Velocity	0.0 to 10 deg/sec	Max Acceleration	0.0 to 20 deg/sec^2
Position Offset	-360.0 to 360.0 degrees	Max Current	0.0 to 100 percent
Stow Position 1:	-360.0 to 360.0 degrees	Stow Position 2	-360.0 to 360.0 degrees
ACU Prop Gain	0.0 to 200.0	ACU Diff Gain	0.0 to 200.0
ACU Int Gain	0.0 to 200.0	ACU Int Limit	0.0 to 100.0
ACU Vel FF	0.0 to 200.0	Max Motor Error	0.0 to 32000.0
Motor Prop Gain	0.0 to 1000000.0	Motor Diff Gain	0.0 to 1000000.0
Motor Int Gain	0.0 to 1000000.0	Motor Int Limit	0.0 to 1000000.0
Motor Vel FF	0.0 to 1000000.0	Motor Grav Offset	0.0 to 200.0
Stow Tolerance	0.0 to 1.0 degrees	Backlash Comp	0.0 to 1000.0
Limit Switch Offset	-360.0 to 360.0 degrees	Prox Switch Location	-360.0 to 360.0 degrees
		Tracking Filter	0.0 to 100.0 Hz

ELEVATION AXIS SETUP AND CONFIGURATION



CONFIGURATION RANGES (ELEVATION)			
DESCRIPTION	**RANGE**	**DESCRIPTION**	**RANGE**
Lower Limit	-5.00 to 0.00 degrees	Upper Limit	45.00 to 90.00 degrees
Max Velocity	0.0 to 10 deg/sec	Max Acceleration	0.0 to 20 deg/sec^2
Position Offset	-5.00 to 90.00 degrees	Max Current	0.0 to 100 percent
Stow Position 1:	0.00 to 90.00 degrees	Stow Position 2	0.00 to 90.00 degrees
ACU Prop Gain	0.0 to 200.0	ACU Diff Gain	0.0 to 200.0
ACU Int Gain	0.0 to 200.0	ACU Int Limit	0.0 to 100.0
ACU Vel FF	0.0 to 200.0	Max Motor Error	0.0 to 32000.0
Motor Prop Gain	0.0 to 1000000.0	Motor Diff Gain	0.0 to 1000000.0
Motor Int Gain	0.0 to 1000000.0	Motor Int Limit	0.0 to 1000000.0
Motor Vel FF	0.0 to 1000000.0	Motor Grav Offset	0.0 to 200.0
Stow Tolerance	0.0 to 1.0 degrees	Backlash Comp	0.0 to 1000.0
Limit Switch Offset	-5.00 to 0.00 degrees	Prox Switch Location	-5.00 to 100.00 degrees
		Tracking Filter	0.0 to 100.0 Hz

POLARIZATION AXIS SETUP AND CONFIGURATION



NOTE: THIS PAGE ONLY APPLICABLE FOR 3 AXIS SYSTEMS

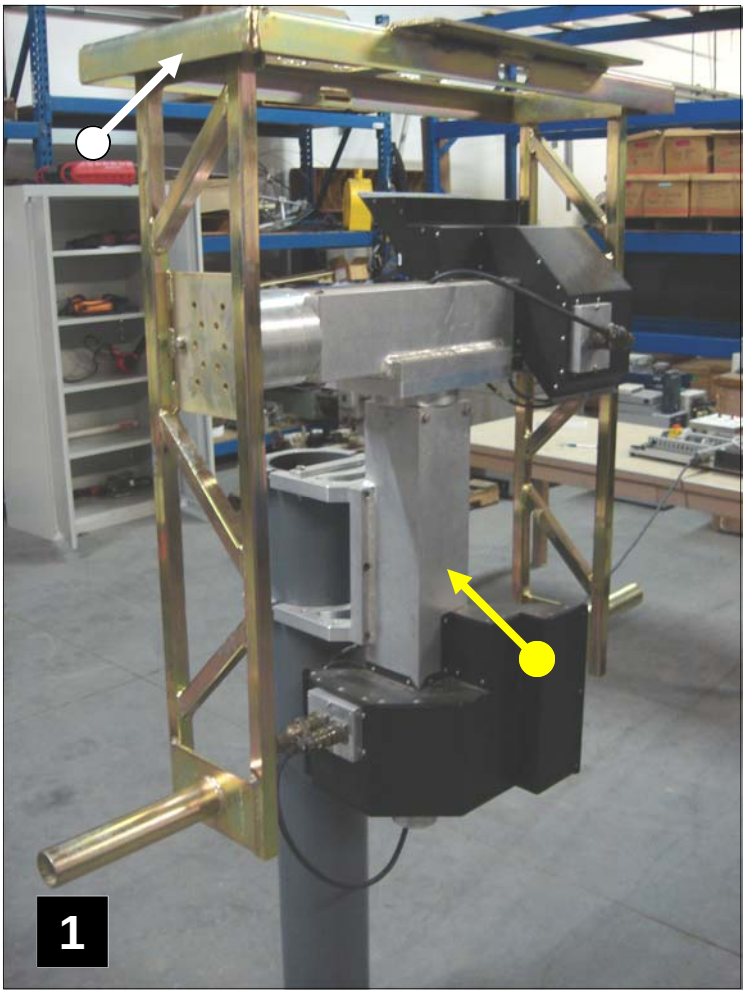
CONFIGURATION RANGES (POLARIZATION)			
DESCRIPTION	**RANGE**	**DESCRIPTION**	**RANGE**
Lower Limit	-5.00 to 0.00 degrees	Upper Limit	45.00 to 100.00 degrees
Max Velocity	0.0 to 10 deg/sec	Max Acceleration	0.0 to 20 deg/sec^2
Position Offset	-5.00 to 100.00 degrees	Max Current	0.0 to 100 percent
Stow Position 1:	0.00 to 100.00 degrees	Stow Position 2	0.00 to 90.00 degrees
ACU Prop Gain	0.0 to 200.0	ACU Diff Gain	0.0 to 200.0
ACU Int Gain	0.0 to 200.0	ACU Int Limit	0.0 to 100.0
ACU Vel FF	0.0 to 200.0	Max Motor Error	0.0 to 32000.0
Motor Prop Gain	0.0 to 1000000.0	Motor Diff Gain	0.0 to 1000000.0
Motor Int Gain	0.0 to 1000000.0	Motor Int Limit	0.0 to 1000000.0
Motor Vel FF	0.0 to 1000000.0	Motor Grav Offset	0.0 to 200.0
Stow Tolerance	0.0 to 1.0 degrees	Backlash Comp	0.0 to 1000.0
Limit Switch Offset	-5.00 to 100.00 degrees	Prox Switch Location	-5.00 to 100.00 degrees
		Tracking Filter	0.0 to 100.0 Hz

DEFINITION OF CONFIGURATION TERMS

DEFINITION OF CONFIGURATION TERMS	
PARAMETER	**DESCRIPTION**
Lower Limit	Minimum allowable position for axis. Software will not move the axis past this angle unless it is in the homing procedure. Typically this setting is the physical location of the limit switch (factory setting).
Max Velocity	The is the maximum speed in degrees/second that the ACU will move the axis.
Position Offset	This offset is added to the axis angle to provide a reported angle. This offset may be used to change the zero point of the axis if desired.
Stow Position 1:	Position that the axis moves to when a stow 1 command is received by the ACU.
ACU Prop Gain	The ACU implements a simple PID controller to attempt to smooth tracking commands. This is the proportional gain for the controller.
ACU Int Gain	The ACU implements a simple PID controller to attempt to smooth tracking commands. This is the integral gain for the controller.
ACU Vel FF	Velocity feed forward factor. It should be set to zero to disable ACU velocity feed forward and to 1 to enable it.
Motor Prop Gain	The motors themselves implement a PID controller when in motor move mode. This is the proportional gain for the controller.
Motor Int Gain	The motors themselves implement a PID controller when in motor move mode. This is the integral gain for the controller.
Motor Vel FF	Velocity feed forward factor. It should be set to zero to disable motor velocity feed forward and to 1 to enable it.
Stow Tolerance	When commanded to a stow position, the axis will be disabled once it is less than this distance from the desired stow position.
Limit Switch Offset	Offset from the CCW or down limit switch from the zero position of the axis, this is basically a software off set in degrees from the limit switch. This can be also used to adjust the “0” degree point.
Upper Limit	Maximum allowable position for axis. Software will not move axis above this angle.
Max Acceleration	This is the maximum acceleration at which the axis will be drive by the ACU.
Max Current	This is the maximum current command that will be given to the motor. It is in units of percent of maximum motor current capability.
Stow Position 2	Position that the axis moves to when a stow 2 command is received by the ACU.
ACU Diff Gain	The ACU implements a simple PID controller to attempt to smooth tracking commands. This is the differential gain for the controller.
ACU Int Limit	The ACU will not let the integrator of the PID controller exceed this amount. This prevents integrator windup and reduces axis overshoot.
Max Motor Error	The motor will fault if the error gets larger than this number.
Motor Diff Gain	The motors themselves implement a PID controller when in motor move mode. This is the differential gain for the controller.
Motor Int Limit	The motor will not let the integrator of the PID controller exceed this amount. This prevents integrator windup and reduces axis overshoot.
Motor Grav Offset	This is an offset in torque provided to an axis depending on direction. It is intended to be used to offset the effects off gravity in the elevation axis.
Backlash Comp	Not currently used.
Prox Switch Location	Not currently used.
Tracking Filter	This filter is applied to the position command during the tracking operation to smooth axis motion.

POSITIONER INSTALLATION/TRUE NORTH

SETTING UP THE AZEL1000 POSITIONER FOR NORTH STOP ORIENTATION



(Figure 1) shows the AZEL1000 Positioner in a North Stop Orientation. This is typically as close as possible to a True North heading. North Stop Orientation allows movement from –185° to + 185° through North. Once mounted onto the support pole, the Azimuth portion can be adjusted by loosening the two 3/8 bolts on the bottom clamp section (Figure 2).

Note in (Figure 1) that the Elevation portion is configured in the “Bird Bath” orientation. Nominally this is 90° for ease of assembling the dish to the box frame.

Note that both the Azimuth & Elevation assemblies can also be adjusted via the ACU GUI. Details on the minor adjustments are covered in the Operation, Home Position AZ and EL Offset pages in this manual.

CONNECTIONS AND STARTUP

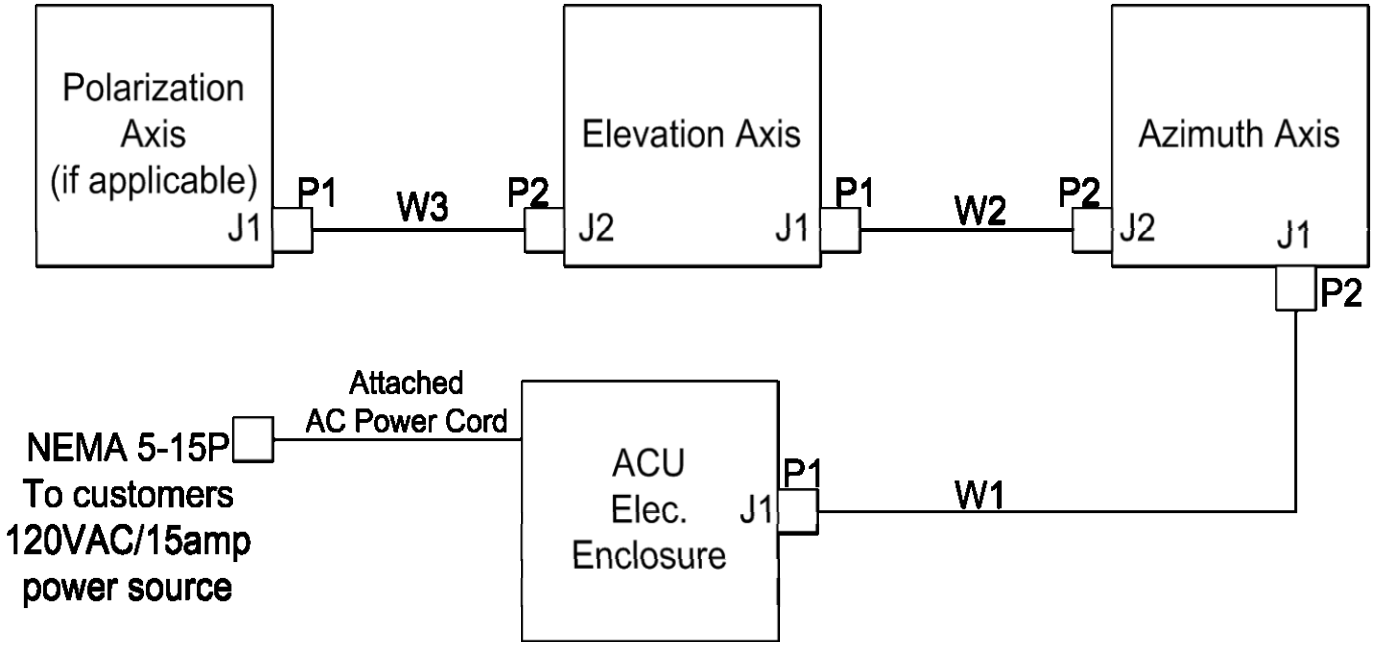
POSITIONER CONNECTIONS

This section covers the basic start up once the positioner is in place.

- Positioner Connections
- Positioner Reference (Home) the system position
- Remote ACU (computer) basic operation

Connect each of the cables as shown below in the diagram. In the case of cable W2, the straight connector end of the cable is routed through from the top of the Elevation/Azimuth housing as shown **(FIGURE 3 BELOW)**

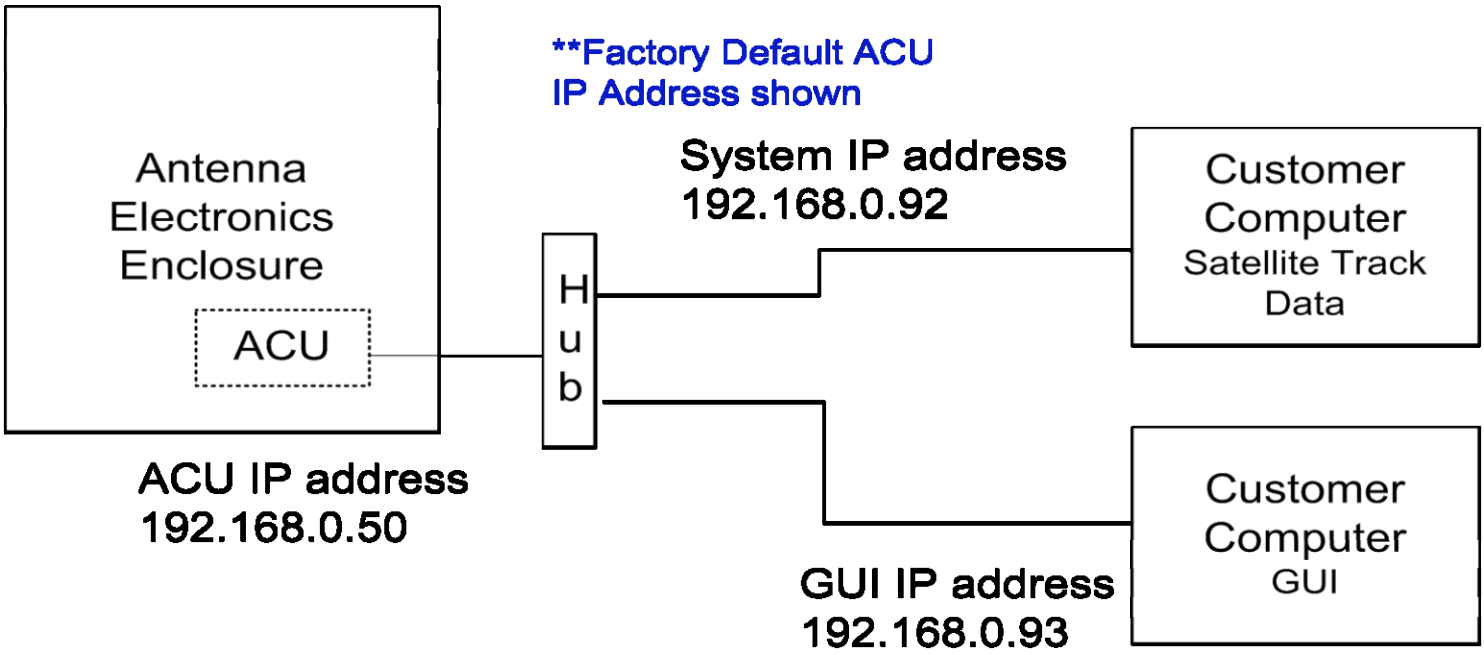
INTERCONNECTING CABLE DIAGRAM

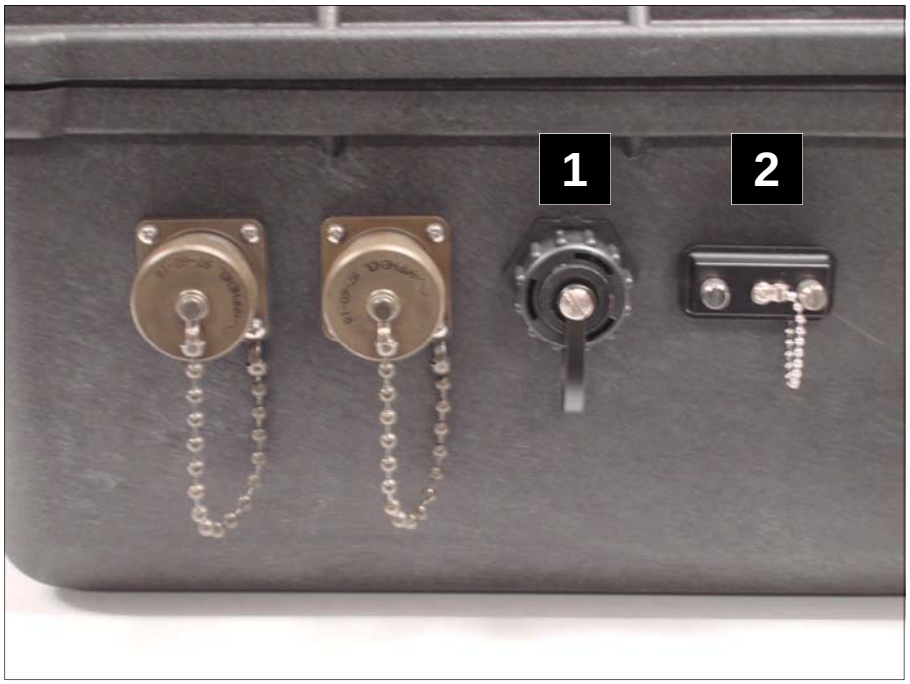


CUSTOMER COMMUNICATIONS INTERFACE

CUSTOMER CONNECTIONS:
Standard Ethernet RJ45 connectors, no cross over cable is required if a hub is not used. IP default addresses are shown in the drawing bellow. RS232 connections are also provided. Refer to Appendix A for the Interface Control Document (ICD)

TYPICAL ETHERNET CONNECTIONS SHOWN WITH DEFAULT IP ADDRESSES





ITEM	DESCRIPTION
1	Computer Interface (Ethernet Connection)
2	Computer Interface (RS232 Connection)

SETTING UP CONTROL COMPUTER

INTRODUCTION

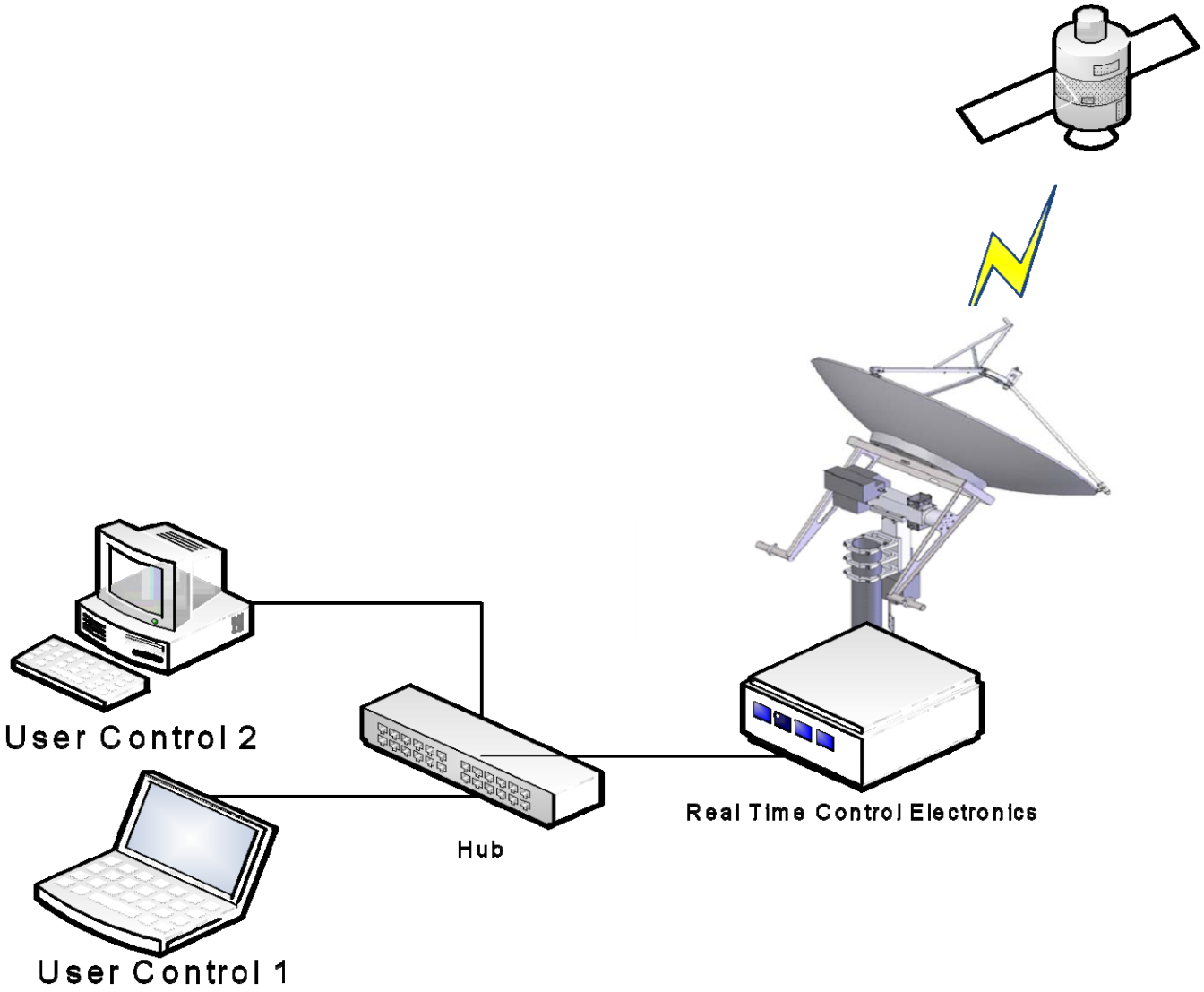
The M2 Antenna System is shipped preconfigured to require a minimal system to operate. As delivered the system requires no hard disk installation and will run completely out of RAM. The minimal system requirements are:

1) Laptop or desktop computer containing x86 or AMD processor with at least 512M of RAM
2) Built in CD player and / or USB 2.0 port.
3) BIOS that allows the setting of the USB drive or CD-ROM as the boot disk.

Installation to hard disk is optional, or the user can choose to integrate the software with an existing Linux based system. As delivered, the ACU image, the executable GUI, and non volatile storage resides on a 4 GB flash memory stick.

OVERVIEW

The M2 Tracking System is designed to be a mid-performance, low cost tracking system allowing direct control over the antenna through a variety of tracking modes. The software provides low level antenna operations and a user friendly GUI interface. This is split between the local real time (jog) controller at the pedestal and the user interface at the control computer. The control computer has the minimum requirements listed above.



DEFAULT OPERATING SYSTEM

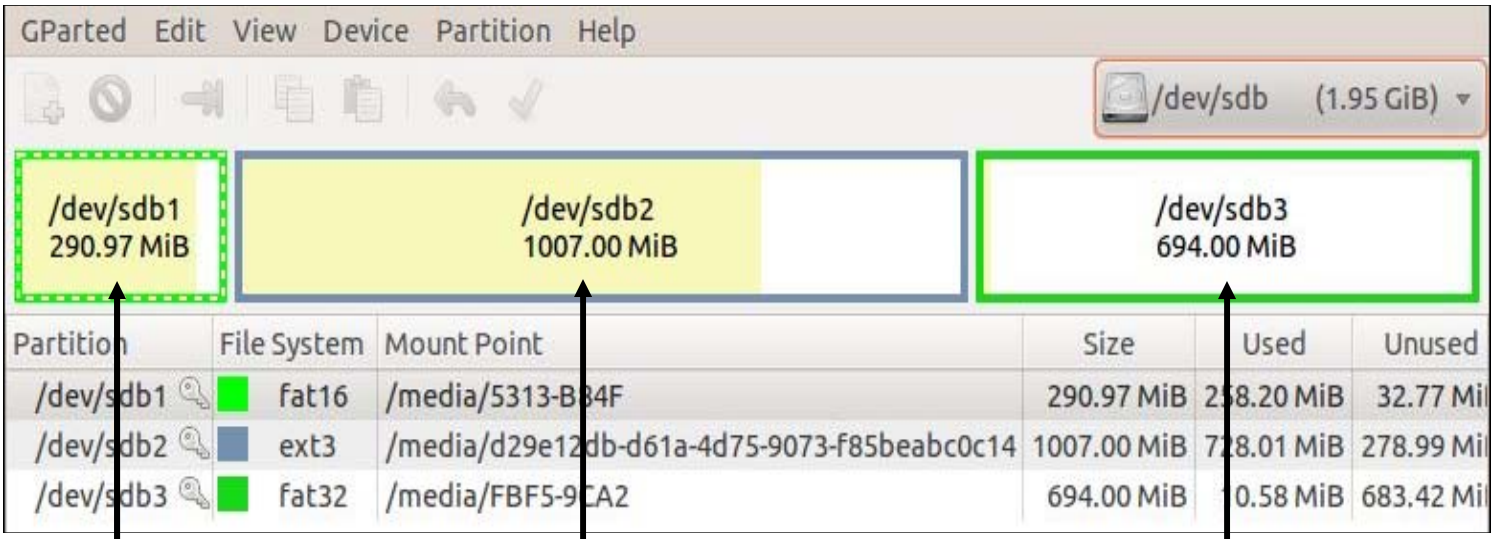
STARTUP

To validate the control computer system operation, you must perform the following steps:

STEP	OPERATION
1	Plug the flash memory stick into the computer's USB port and power up the system.
2	Power up the computer pressing F2 or <Delete> (depending on the system) to set the BIOS parameter allowing the system to boot from the inserted media. ** NOTE ** The flash stick will save updates locally on the stick only.
3	The boot screen should appear on the monitor.

DEFAULT OPERATION SYSTEM

The default operating system is a distribution of Linux called Puppy Linux. This was released by Barry Kaul in 2005 and has the unique feature of running in RAM. This makes the system very responsive, quick to boot, and uses a small footprint. This is configured to provide general purpose GPL tools as well as the M2 Control Program. The environment provides the user with documentation tools, screen capture tools, web browser and other useful utilities. After the previous section, it is necessary to configure the display and network for proper operation. The following diagram shows the layout of the memory stick:



ACU LOAD AREA

SYSTEM CONTROL OS AND OPERATIONAL ENVIRONMENT

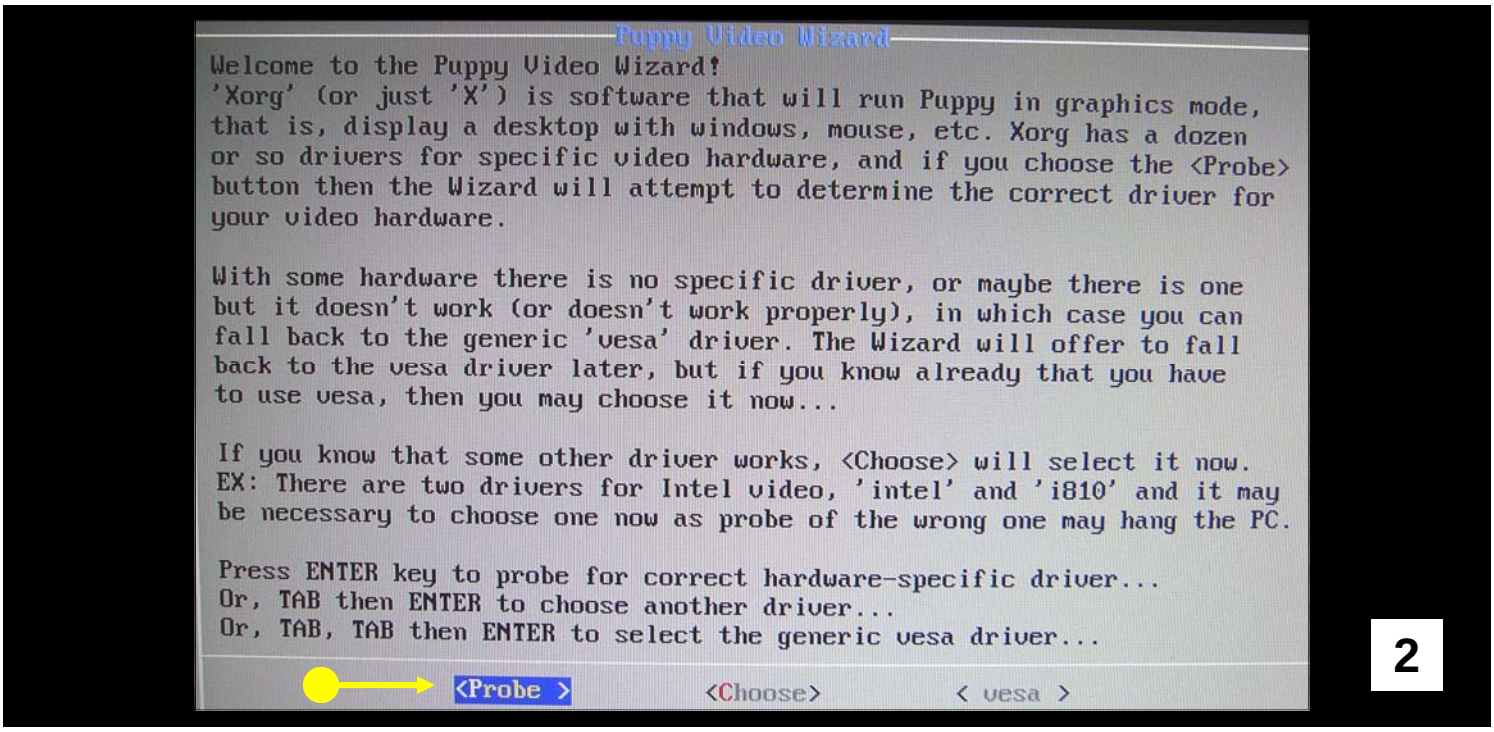
USER STORAGE AREA (WINDOWS AND LINUX)

COMPUTER DISPLAY SETUP

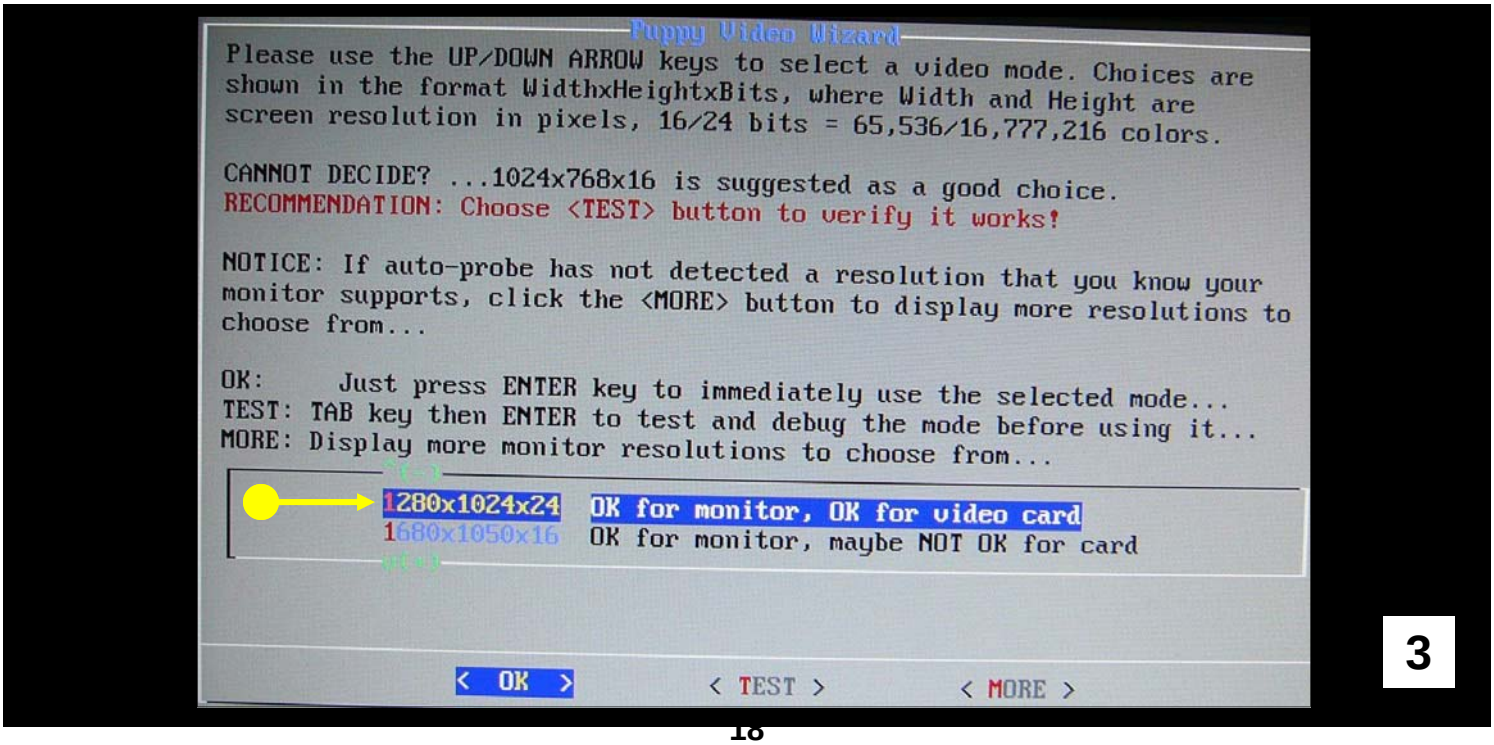
DISPLAY CONFIGURATION

The first step is to configure the display for the computer the software will be written on:

STEP	OPERATION
1	After boot, the video wizard is displayed (see Figure 2)
2	Select “Probe”



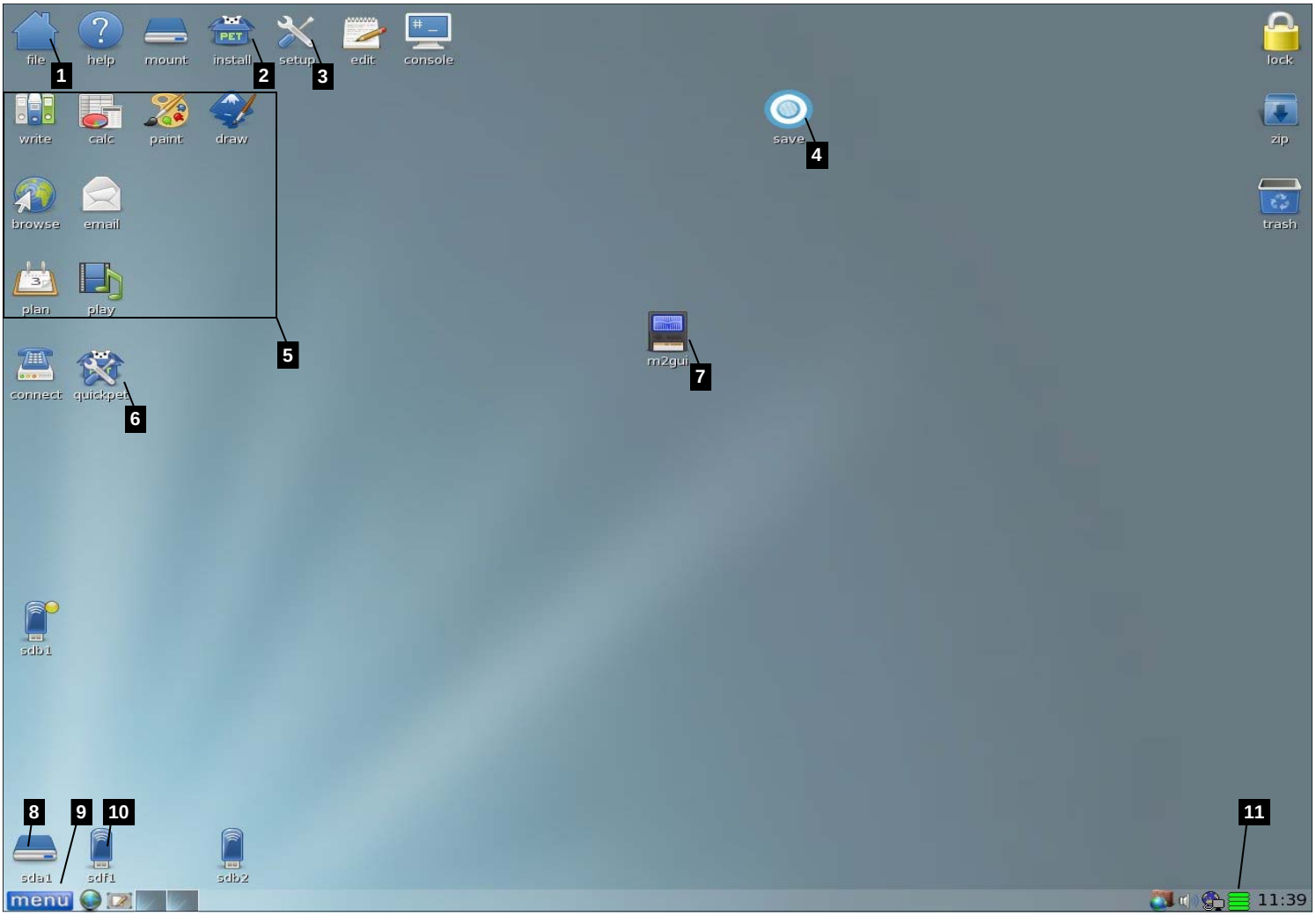
3	After probe, several selections will be shown. Choose the one that says OK for the Monitor and OK for the Video Card (see Figure 3)



COMPUTER DISPLAY SETUP

COMPUTER DISPLAY SETUP

After the display is configured correctly, the screen should look similar to the screen display below. (Resolution, icons, and background may vary).



ITEM	DESCRIPTION
1	File Browser
2	Install to disk partition
3	Basic Setup (display, network, etc)
4	Save Configuration
5	Standard Applications
6	Add Software from Network
7	M2 Control Launch Icon
8	Available disk partitions
9	Main Menu
10	Available removable disk partitions (LED is mounted status)
11	Status Area

ETHERNET CONFIGURATION

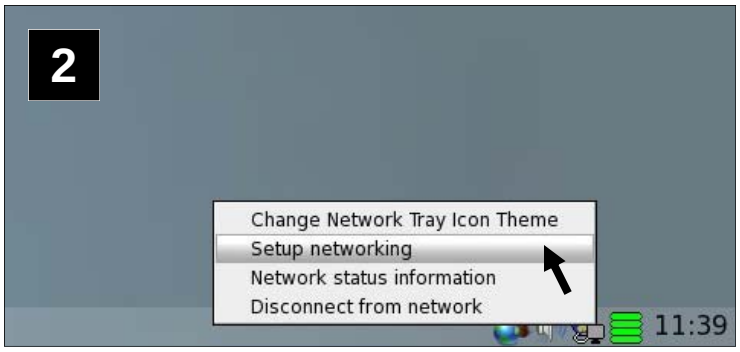
NETWORK CONFIGURATION

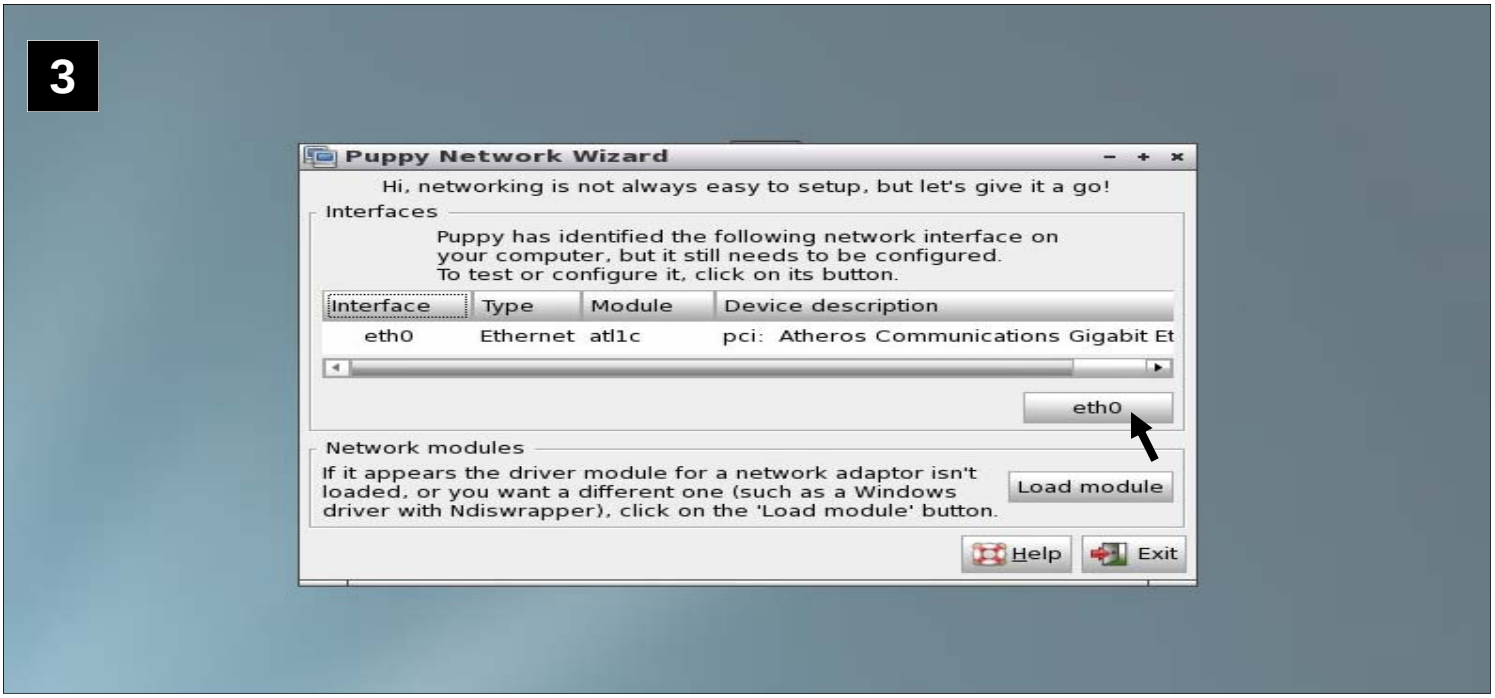
The next step is to configure the network to talk to the M2 System. By default the system is set for Static IP addressing according to the following table:

UNIT	IP ADDRESS	COMPUTER
M2 System Base	192.168.0.50	ACU (antenna control unit)
M2 Controller 1	192.168.0.92	Remote computer (s) such as GUI
M2 Controller 2	192.168.0.93	

LAUNCHING THE NETWORK WIZARD

STEP	OPERATION
1	To launch the “Puppy Network Wizard” right click on the Network Icon located on the right bottom corner of the main screen display. (Figure 1)
2	Next Click on the “Setup Networking” Icon. (Figure 2)
3	Click on the “ethO” Icon to continue to the “Configuration Network Interface ethO”.

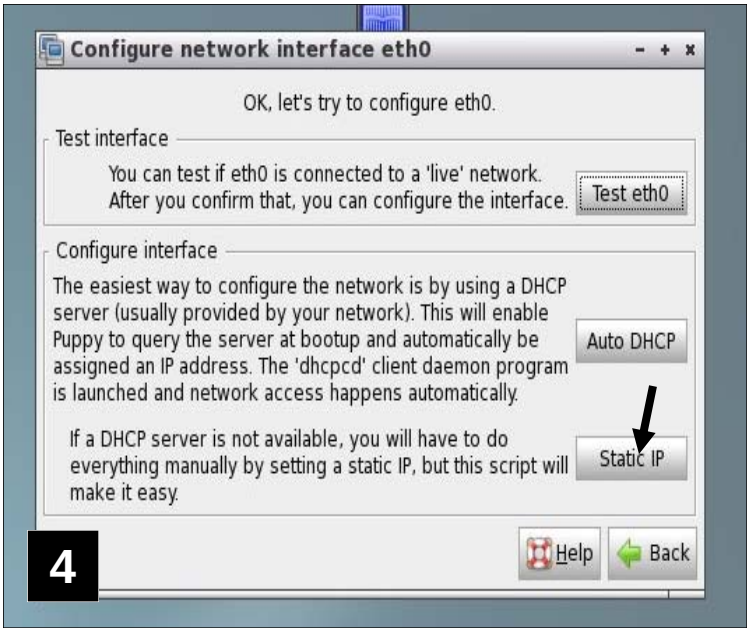


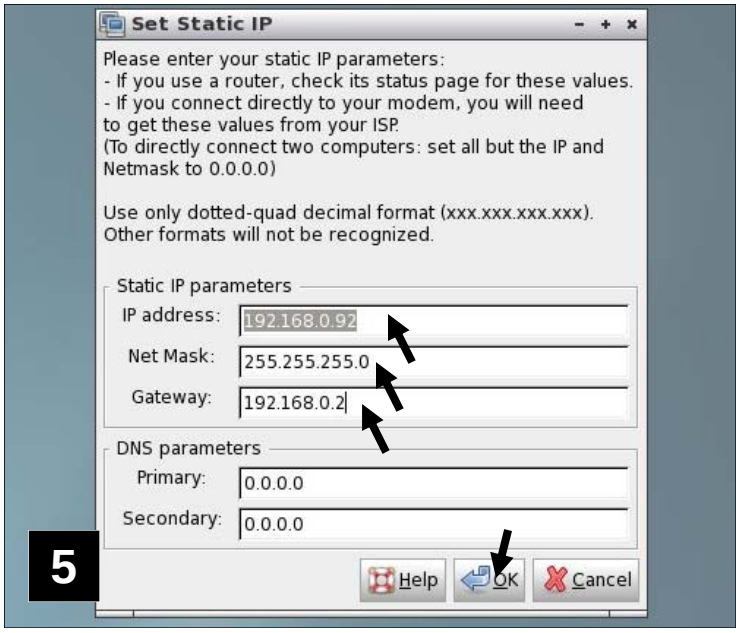


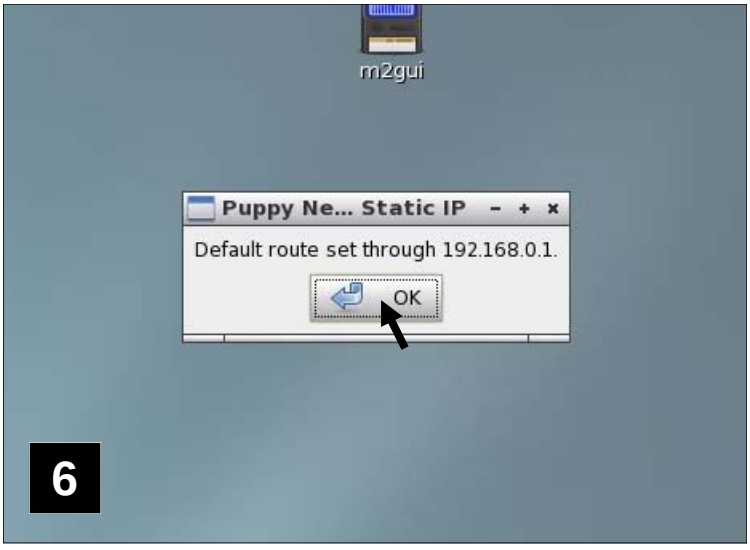
ETHERNET CONFIGURATION

CONFIGURE NETWORK INTERFACE

STEP	OPERATION
4	On the “Configure Network Interface ethO” click the “Static IP” icon to launch the “Set Static IP” screen. (Figure 3)
5	In the “Set Static IP” screen type in the IP Address, Net Mask & Gateway as shown. Then click “OK.” (Figure 5)
6	The next screen will appear as the “Default Route.” Click the “OK” button to proceed. (Figure 6)
7	On the “Network Configuration of ethO” screen, Click the “Yes” button to proceed. (Figure 7)



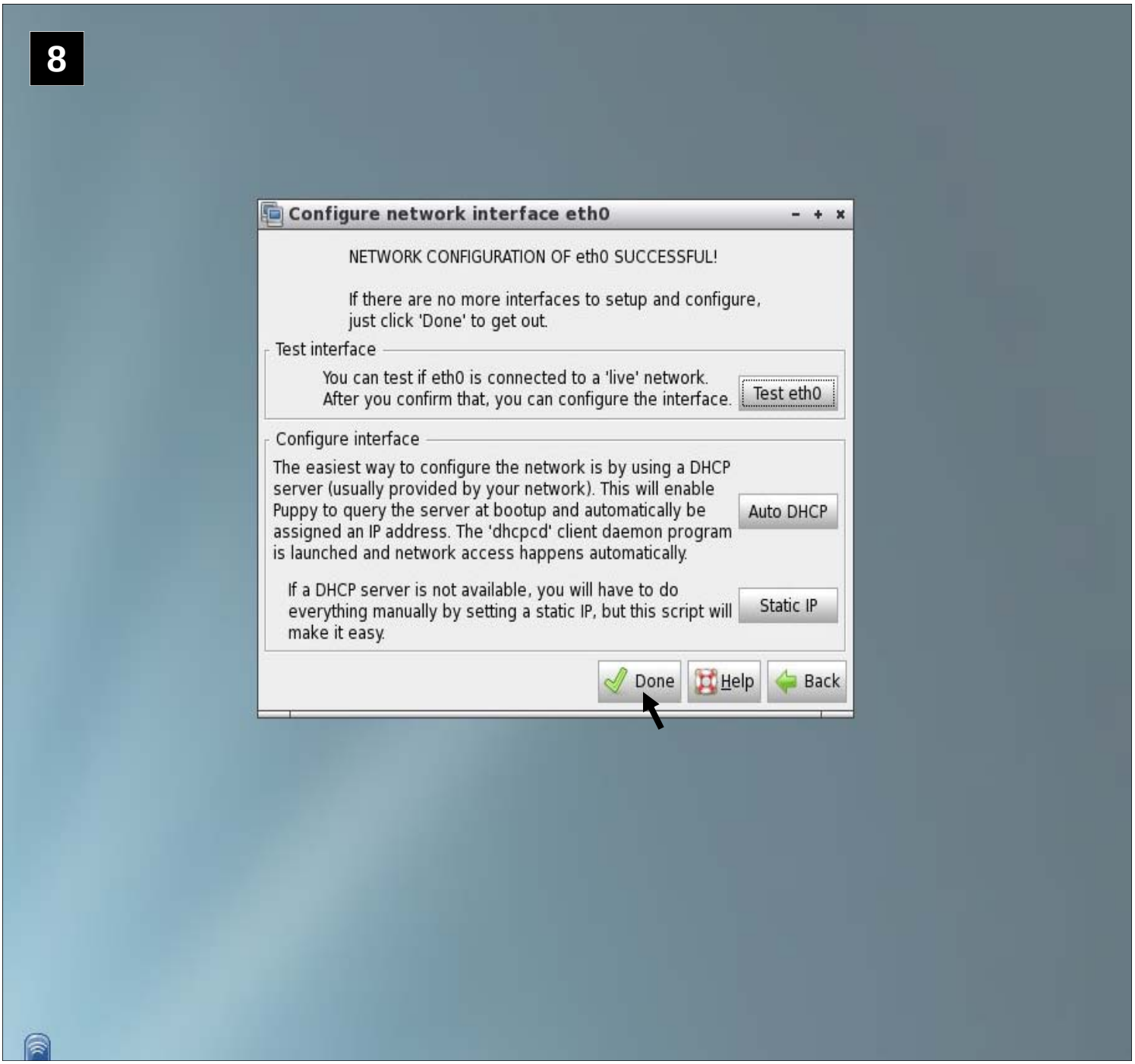




ETHERNET CONFIGURATION

CONFIGURE NETWORK INTERFACE (CONTINUED)

STEP	OPERATION
8	On the “Configure Network Interface ethO”, click the “Done” button to complete the Network Interface Procedure.



The system is now configured and the M2 GUI Control application can be launched. Please see the section of the user manual “Operations” for additional information.

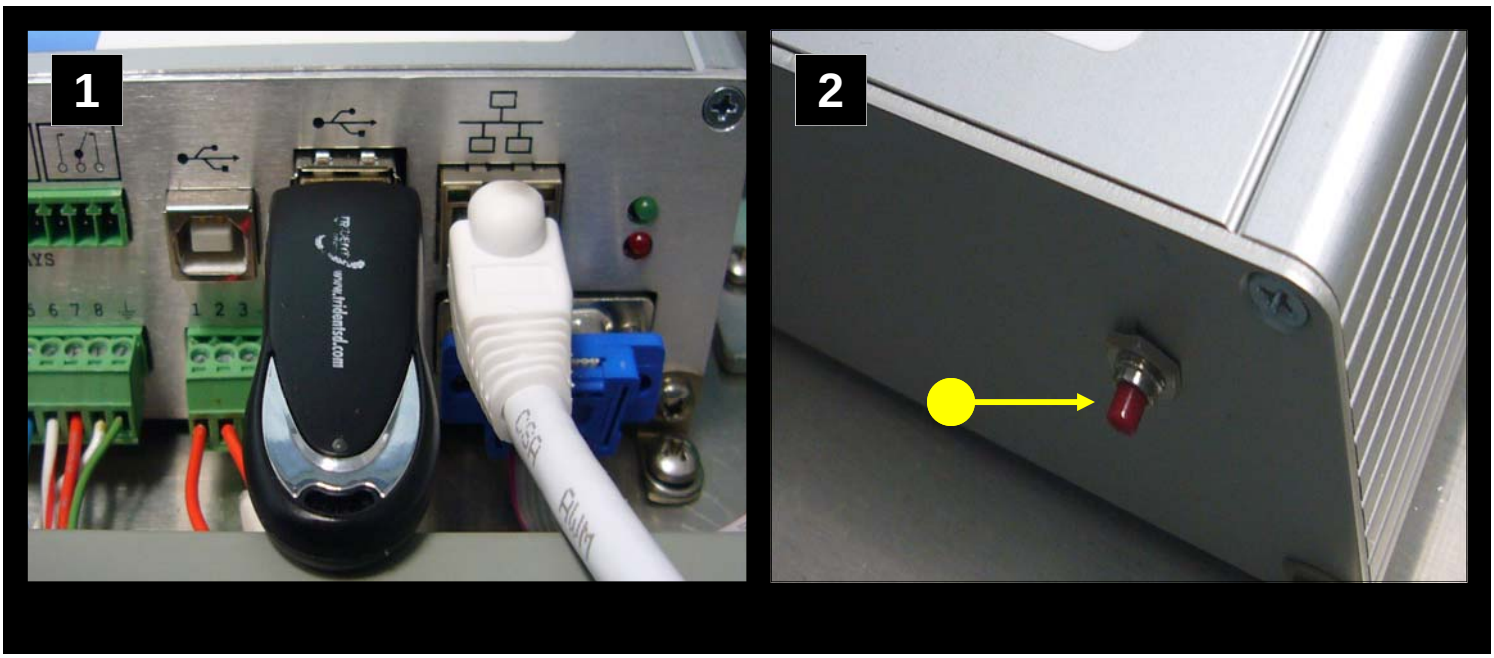
CHANGING ACU IP ADDRESS

CHANGING THE ACU DEFAULT IP ADDRESS

The IP Address of the base antenna system can be changed to any desired address by performing the following procedure:

```
1 #!/bin/sh
2
3 export IPADDRESS=192.168.0.50
4
5 export PATH=/bin:/sbin:/usr/bin:/usr/sbin:/mnt/root/bin:/mnt/root/sbin:/mnt/root
6 mount -t proc proc /proc
7 mount -t sysfs sysfs /sys
8 mount -t devpts devpts /dev/pts
9
```

STEP	OPERATION
1	Using a standard text editor such as Notepad or G-Edit, open the following file on the USB Drive: **/baseSystem/linuxrc-m2acu.**
2	Locate the above line in the file and change the IP address to the desired value. **(See line 3 above)**
3	Save the file.
4	Power down the ACU and control computer.
5	Insert the USB Drive in the ACU and power up while holding in the red button. Hold the button in until the red led goes on. Refer to detail procedure **ACU FIELD UPGRADES/PROGRAM RELOAD** located in Connection/Start UP section of this manual. (Reference Figure 1 & 2 below)
6	Wait approximately 13 minutes until the ACU is reloaded and the red LED goes out.
7	Power Cycle the ACU.
8	Boot up the control computer and follow the previous section to set the local IP address.
9	Verify the connection by launching m2acu and verify the connection message in the status bar.



SERIAL CONFIGURATION

STARTUP

To validate the control computer system operation, you must perform the following steps:

STEP	OPERATION
1	Install the supplied CD and power up your computer

DEFAULT OPERATION SYSTEM

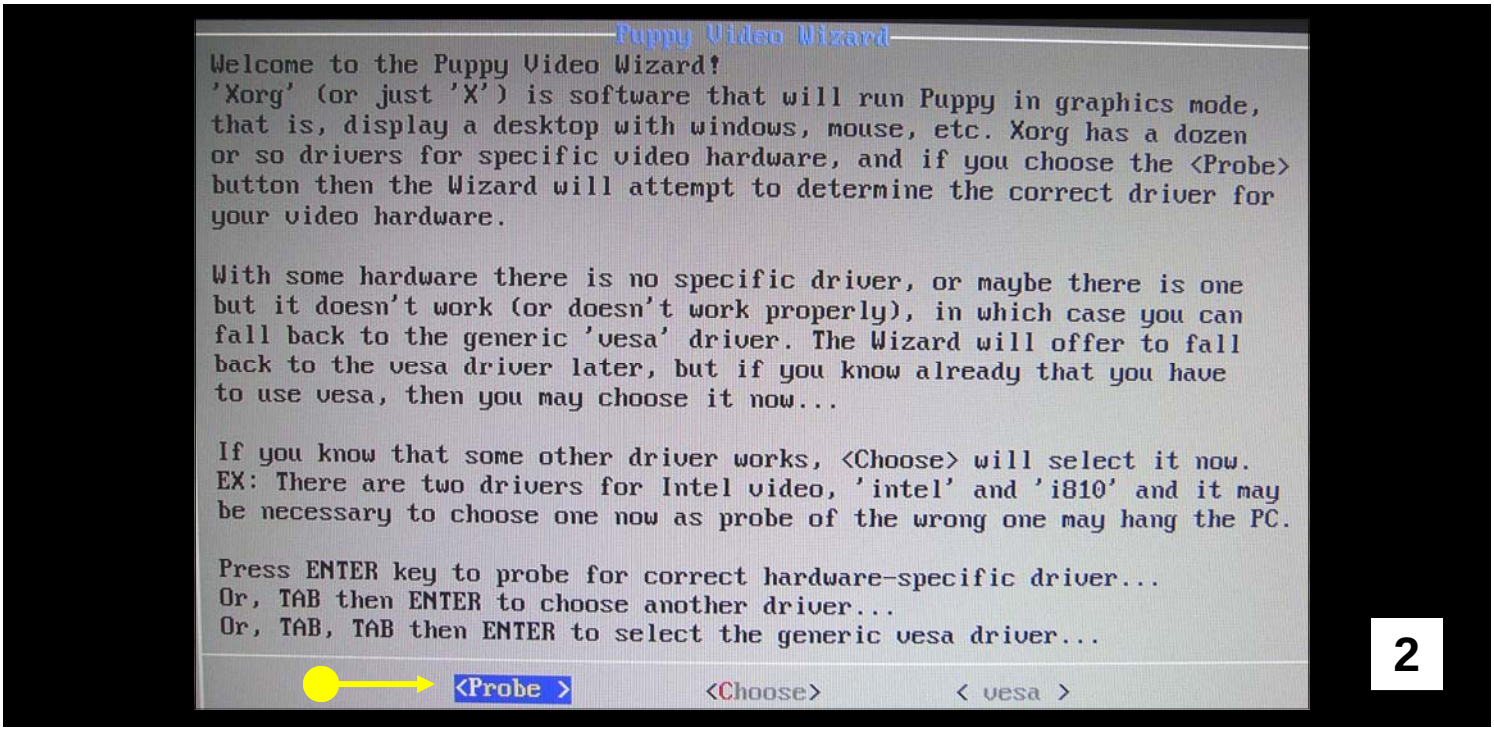
The default operating system is a distribution of Linux called Puppy Linux. This was released by Barry Kaul in 2005 and has the unique feature of running in RAM. This makes the system very responsive, quick to boot, and uses a small footprint. This is configured to provide general purpose GPL tools as well as the Minicom Serial Control. The environment provides the user with documentation tools, screen capture tools, web browser and other useful utilities. After the previous section, it is necessary to configure the display and serial configuration for proper operation.

COMPUTER DISPLAY SETUP

DISPLAY CONFIGURATION

The first step is to configure the display for the computer the software will be written on:

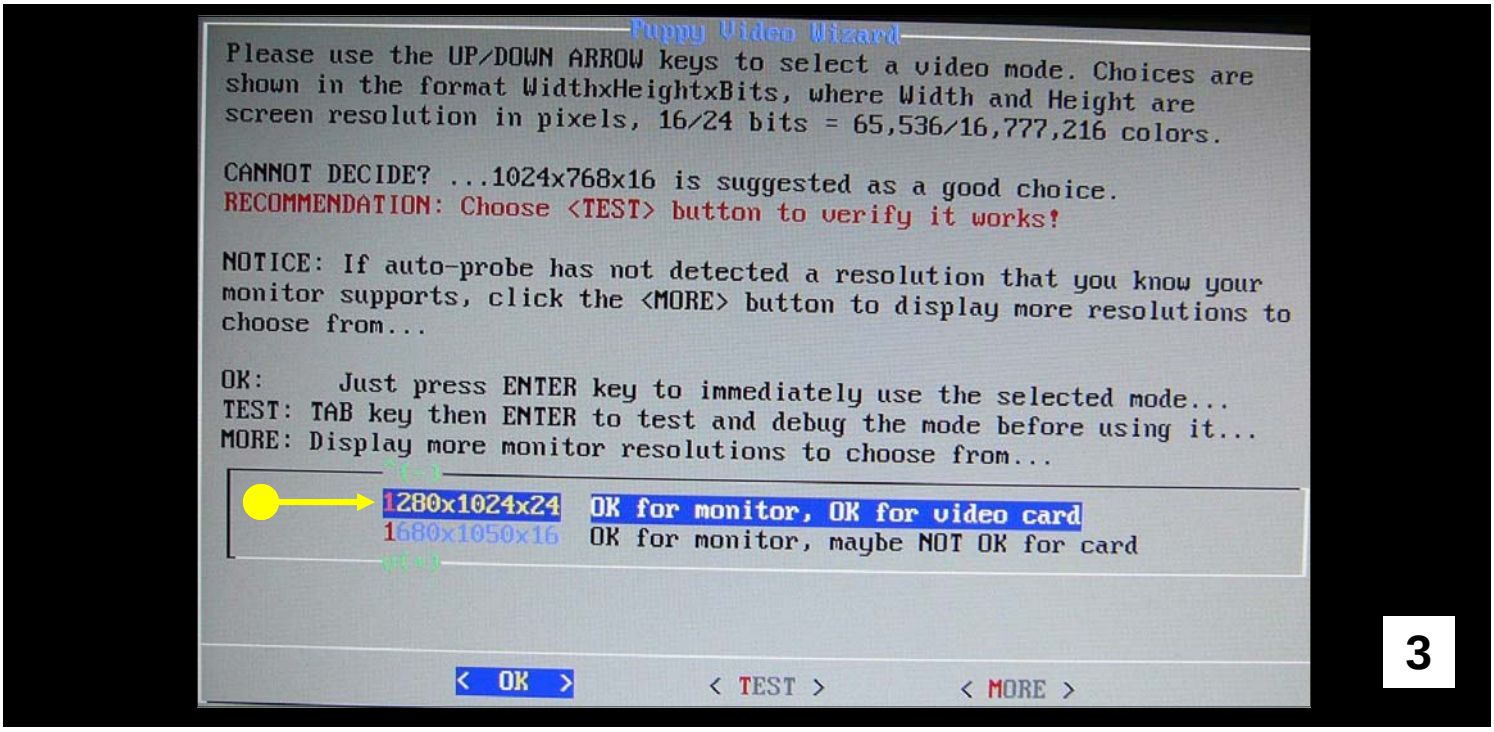
STEP	OPERATION
1	After boot, the video wizard is displayed (see Figure 2)
2	Select “Probe”



2

COMPUTER DISPLAY SETUP

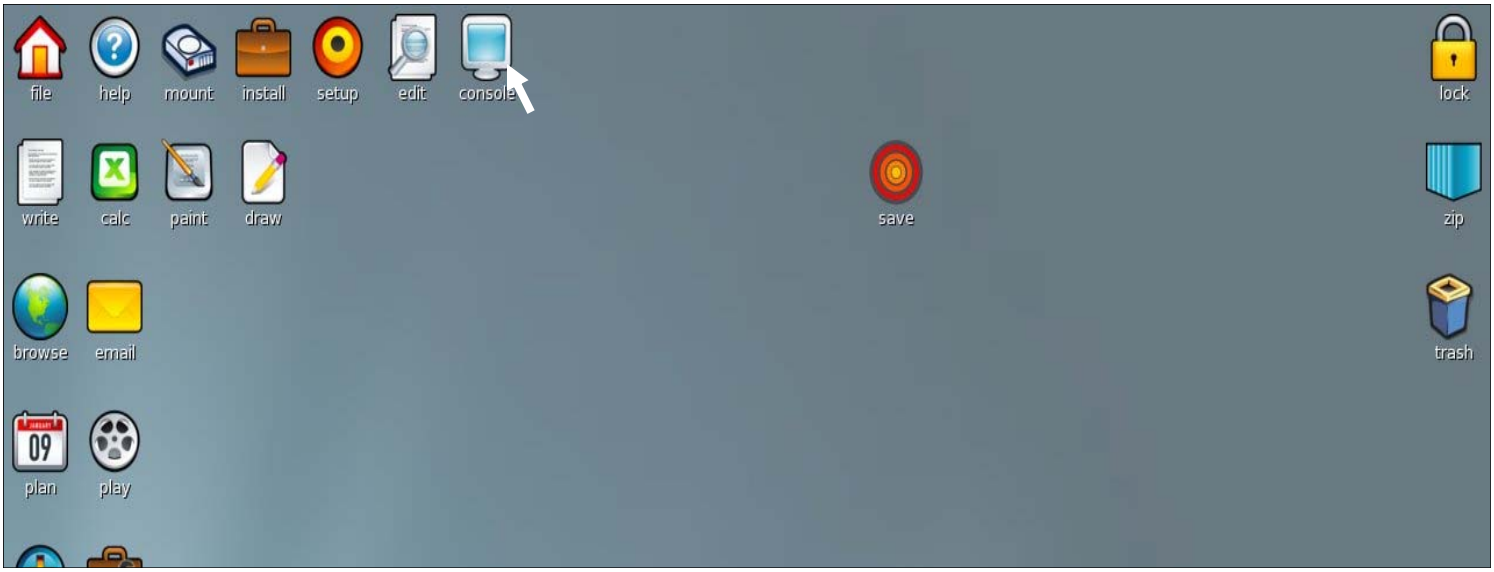
3	After probe, several selections will be shown. Choose the one that says OK for the Monitor and OK for the Video Card (see Figure 3)



SETTING UP THE MINICOM SERIAL TERMINAL

In order for the ACU to recognize the Minicom Serial Terminal, the Terminal must be configured to the correct computer port.

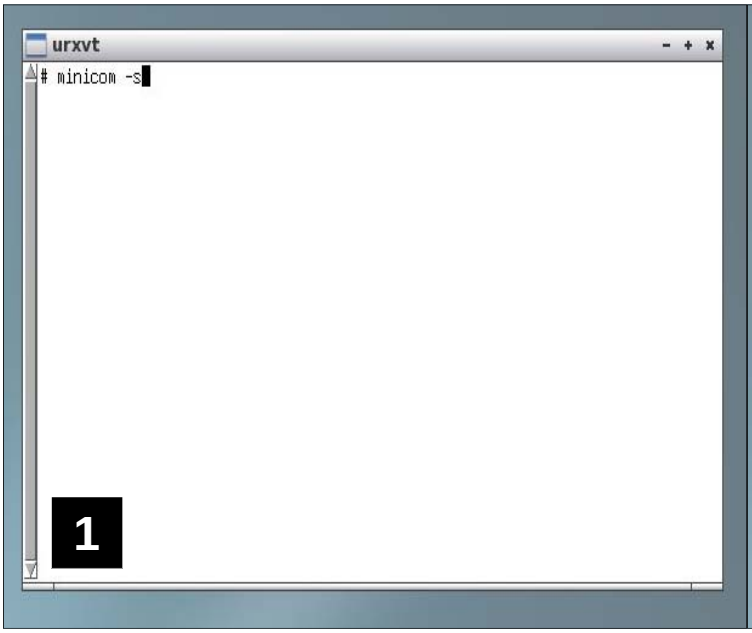
1	Click the “Console” logo on the top of the screen to enter into the Minicom Terminal.

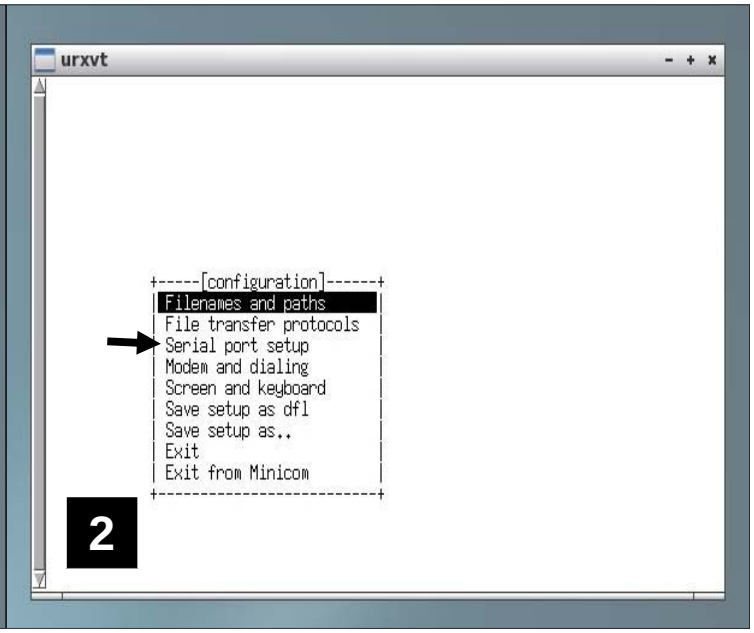


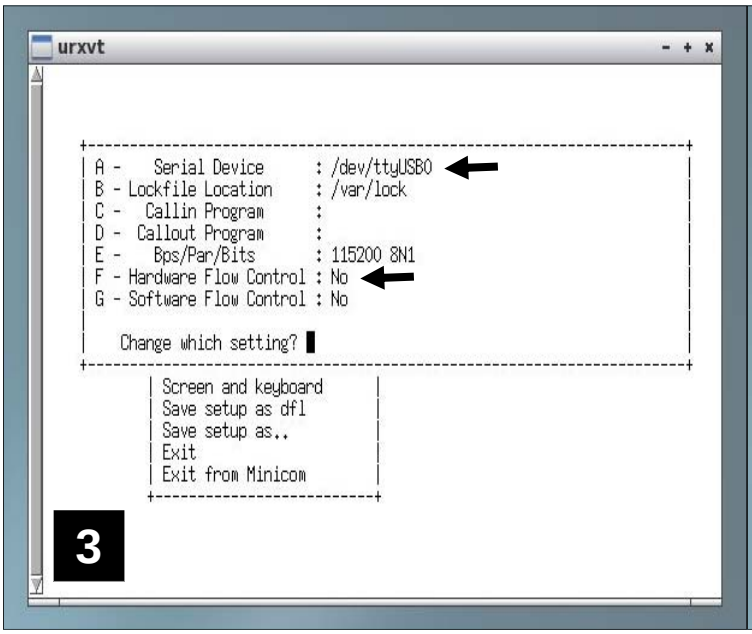
SERIAL CONFIGURATION

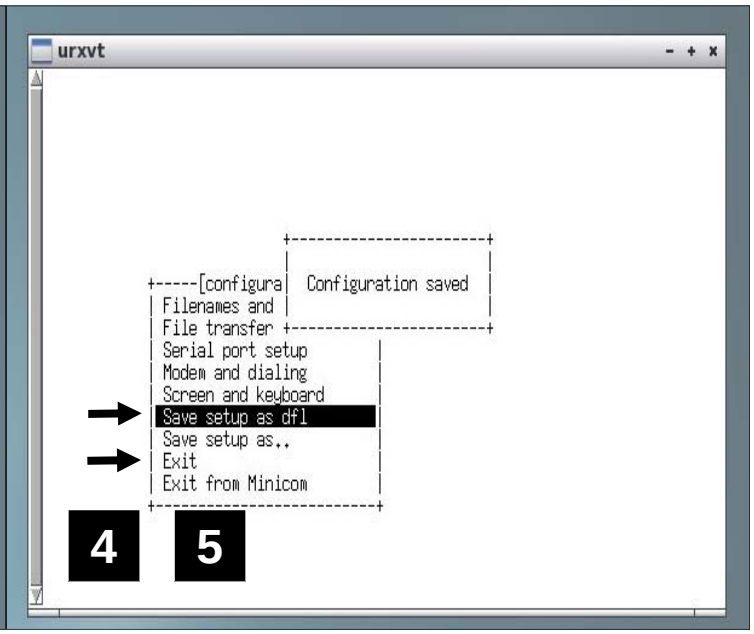
SERIAL CONFIGURATION

STEP	OPERATION
1	In the urxvt terminal screen, type minicom (space) -s and press enter.
2	The configuration screen appears. Scroll to the “Serial Port Setup” and press enter.
3	It is necessary to change the Serial Device to the correct port. Press the “A” key and this will allow you to enter the correct port. The correct location is: /dev/ttyUSB0. The “USB” must be capitalized. Now press the “F” key to change the “Hardware Flow Control:” from (Yes) to (No).
4	Press enter twice and scroll down to the “Save setup as dfl”. Press enter and the Serial Setup is saved.
5	Scroll to “Exit” to return to the terminal. The Serial Terminal is now ready for commands. Please refer to the ICD for proper command operation.









INSTALLATION INTO AN EXISTNG OS

INSTALLING ON A PRE-EXISTING OPERATING SYSTEM

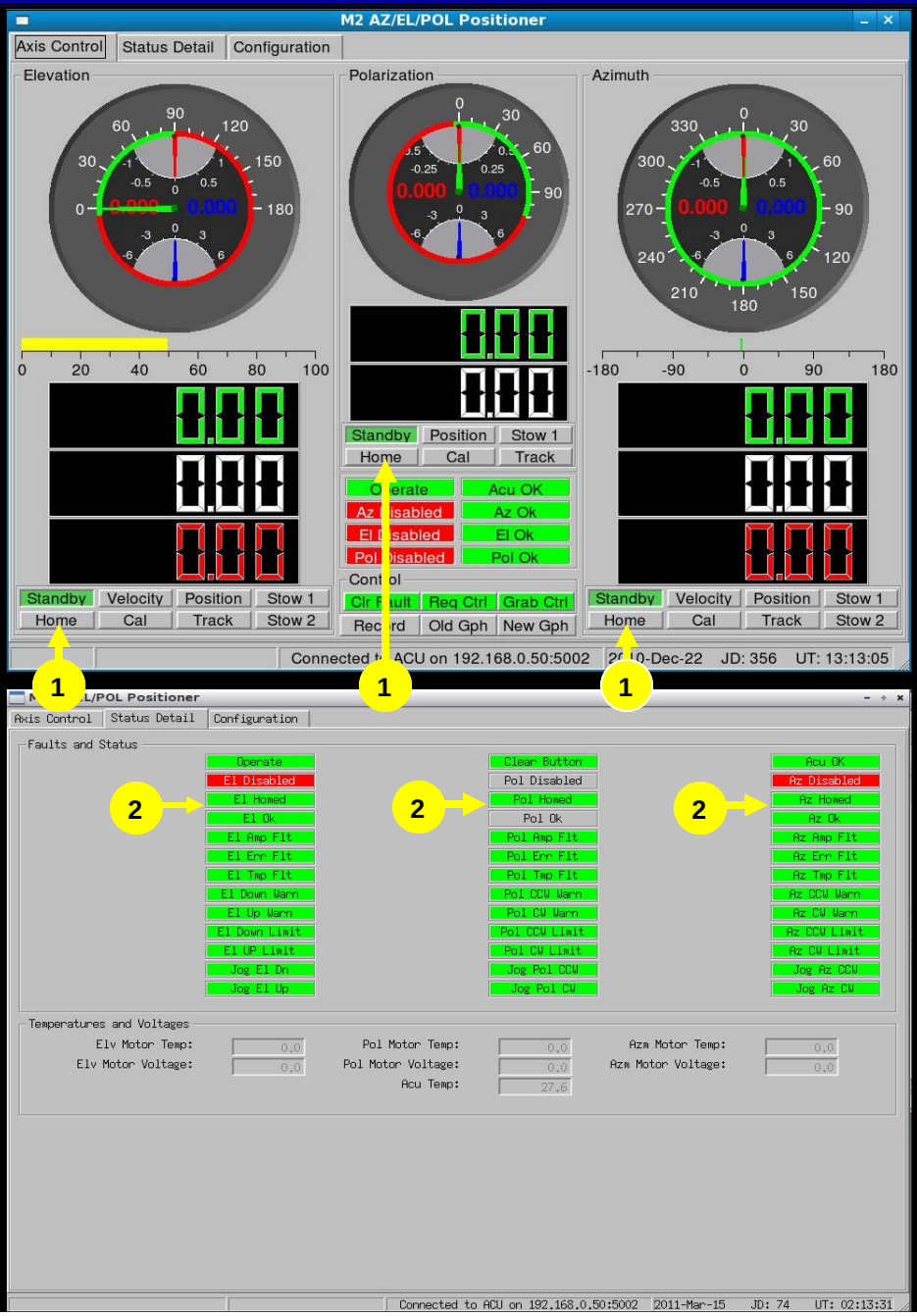
The M2 control application can be installed on systems currently running an existing Linux OS. M2Gui has been verified compatible with RedHat, Fedora, and Ubuntu Linux distributions. To install, put the memory stick in the target computer, launch a console terminal window and execute the M2GuiInstall.sh shell script. This will walk you through the process of installing the files. When complete, the files should be in the following locations:

/usr/local/bin	m2Gui	Executable application
	Bitmap	Bitmap images for cursors used in m2Gui
	m2Gui.cfg	
	Communications.cfg	

CUSTOMER NOTE SECTION

STANDARD CONTROL WIRING

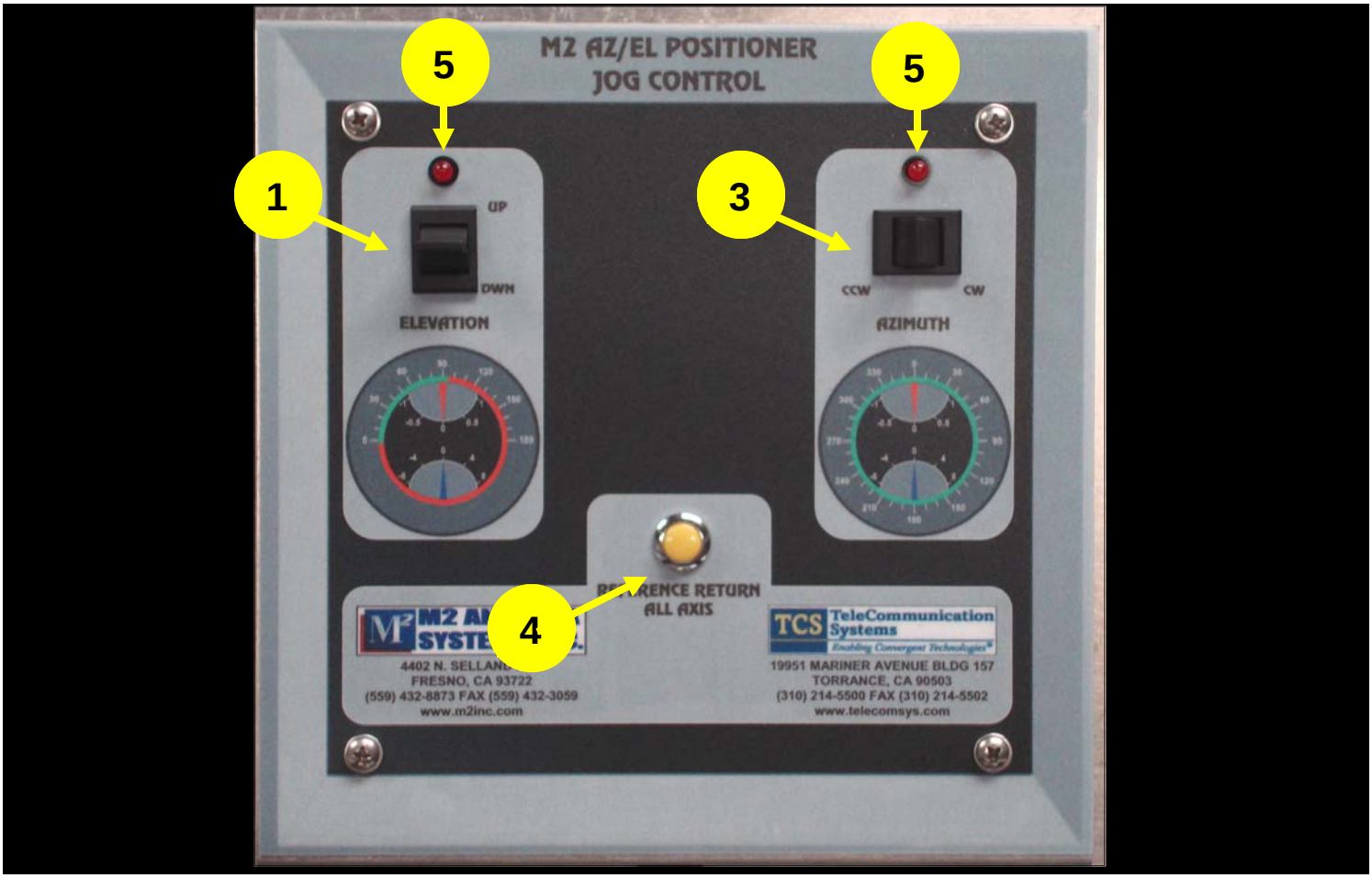
HOME OPERATION



ITEM	DESCRIPTION OF INDICATORS AND CONTROLS
1	Home function is required anytime the system (ACU) is initially powered up. The antenna positioner must locate its position on the mount by finding the limit switches in each axis. This is performed by pressing the HOME button for each of the axis. Once pressed the positioner will be activated and start moving. Azimuth will move CCW until it hits the factory physical limit approx 185 degrees, at this same time the Elevation and Polarization axis (if applicable) will move to their lower limits. Once complete the system will place all axis to their predefined STOW 1 positions. ***Home position (0 degrees) OFFSET are discussed on the next page.***
2	System status of "HOME" can be verified at the Status Detail page. If the indicator is Green the system is Homed and ready to go. If this indicator shows RED (Not Homed) the homing function has not been completed, and must be performed for correct operation.
	*Note: The system can also be homed from the Jog Panel at the ACU electronics enclosure by pressing and holding the Reference Return All Axis button. See Local Jog control for more details.

LOCAL JOG CONTROL OPERATION AND HOMING

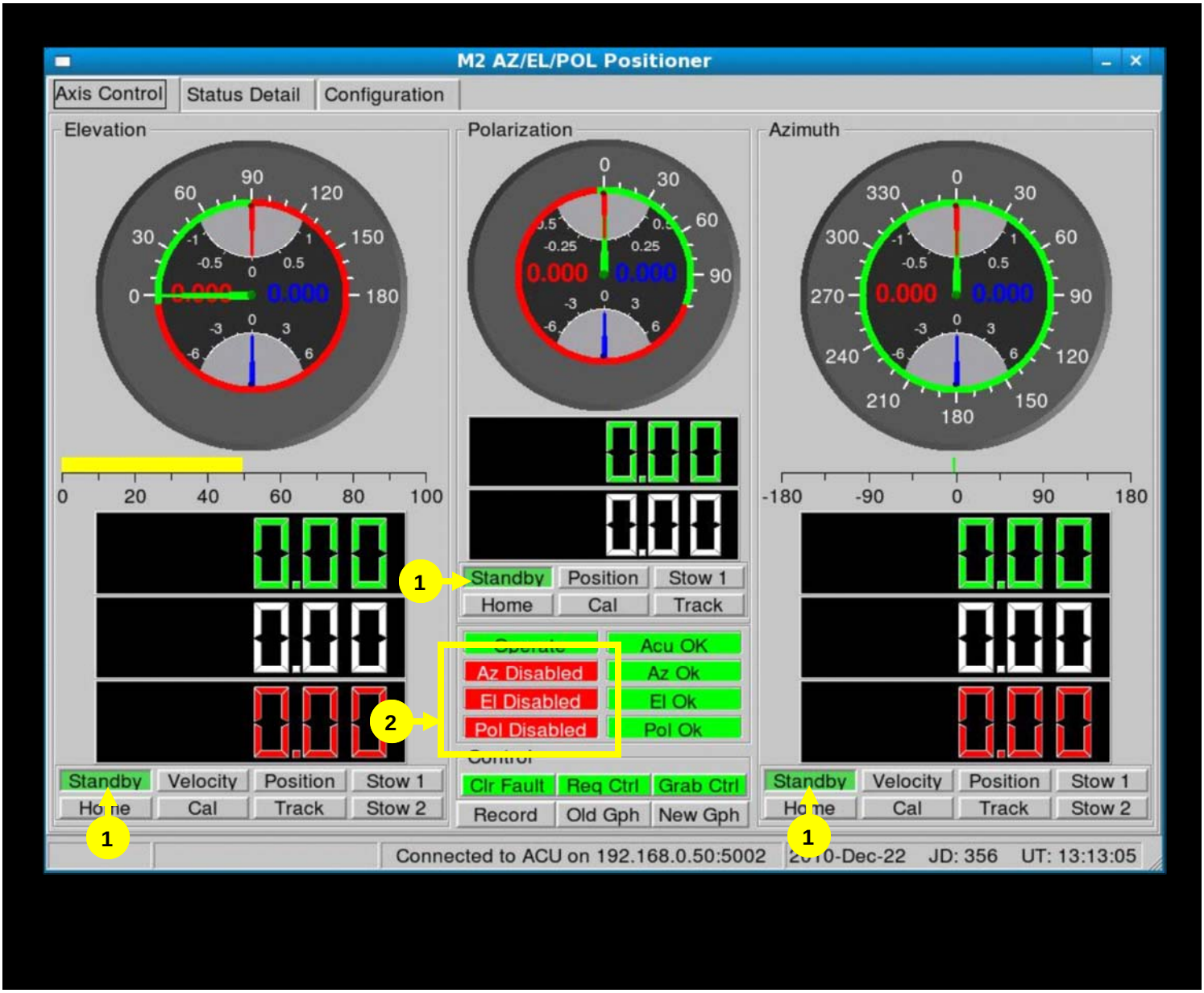
LOCAL JOG CONTROL OPERATIONS AND HOMING



ITEM	OPERATIONS
1	UP/Down control, when held in either the up or down position, the elevation axis at first will move slowly, but if continuously held for approximately 5 seconds the axis movement will increase to full speed. When released the antenna will stop.
2	N/A
3	CCW/CW control, when held in either position the azimuth axis at first will move slowly, but if continuously held for approximately 5 seconds the axis movement will increase to full speed. When released the antenna will stop.
4	Reference return button is used when the system is initially powered up. The button must be held for approximately 5 seconds to start the “homing process”. Once the homing process is completed the Red LED above each of the jog control switches will go OFF. This indicating the homing process is competed. NOTE: This function can also be performed from the ACU GUI by pressing the HOME button for each axis.
5	The LED’s are multi-function. When OFF the system is HOMED. When the LEDs are steady ON the axis is not homed and system must be homed before proceeding. If an LED is blinking slowly a limit most likely has been reached. This fault can be cleared locally at the ACU electronics enclosure by momentarily pressing the Reference Return (yellow) button. After pressing the button the LED indicating the fault will go off and system can now be moved out of the limit by moving the antenna in the opposite direction of the limit.

STANDBY COMMAND

STANDBY COMMAND



ITEM	DESCRIPTION OF INDICATORS & CONTROL
1	Standby (GREEN) mode is used when the antenna is not in use. No movement is possible locally on that access when antenna is placed into this mode. NOTE: At anytime a remote computer can command the system into motion, this removing the system from Standby. If the Standby indication goes to (Yellow), connection to the ACU most likely has been lost. This must be resolved before the system can be operated. NOTE: ACU (electronic enclosure) must be powered on for at least 10 seconds prior to starting the GUI in order for a successful connection.
2	When in Standby the system axis status will show RED and indicate “Disabled”. When the system is removed from Standby, these status will change to Green “Enabled”

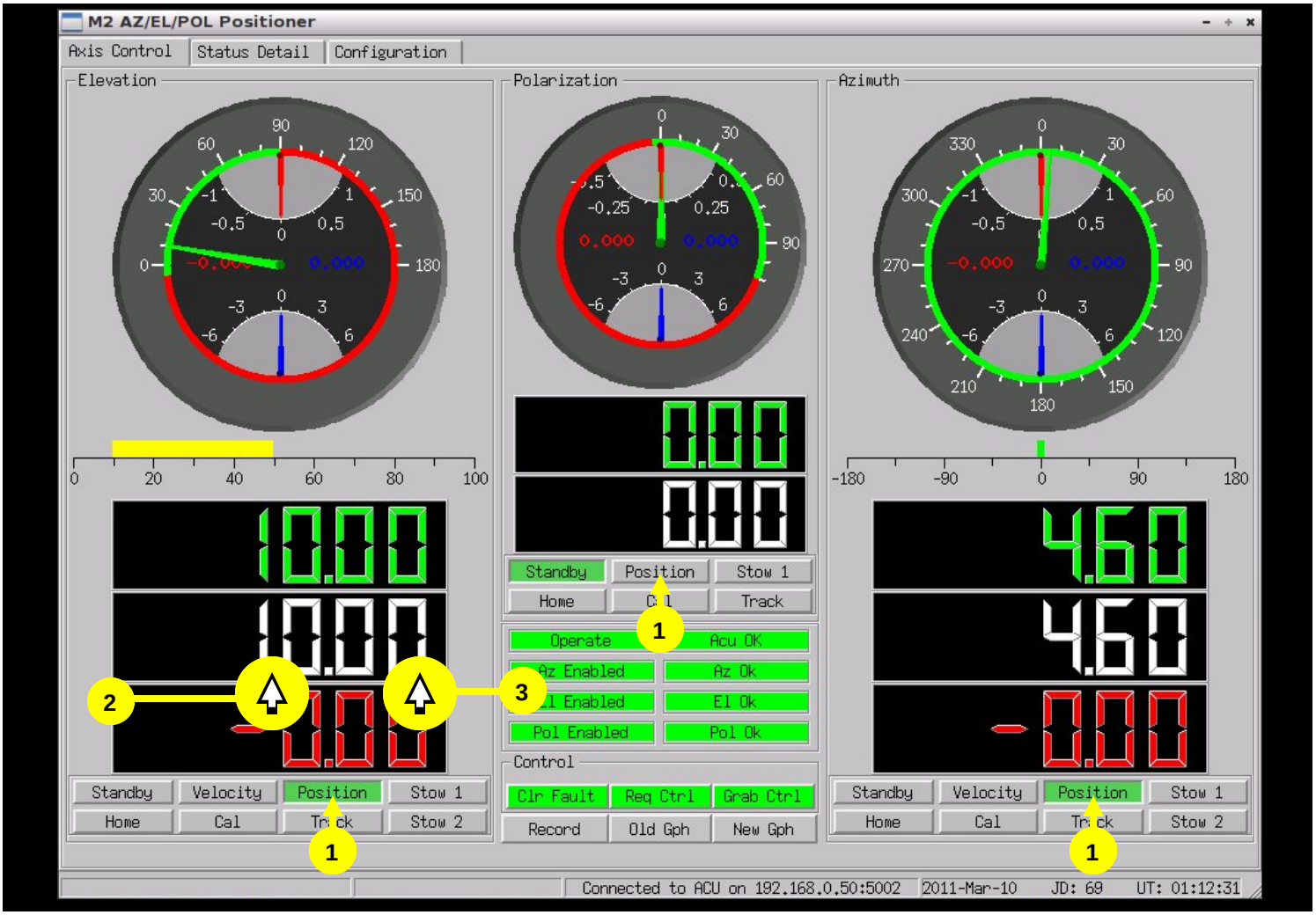
VELOCITY COMMAND

VELOCITY COMMAND

ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Velocity mode is used to drive the antenna at a specified rate. This rate can be adjusted from max speed to minimal speed in 0.01 degree increments if required.
2	Operation of Velocity mode: Once the system has been placed into Velocity mode, the mouse curser can moved either to the upper side or lower side of the white digits (Commanded Angle display) , an up or down arrow will appear. From this position, each time the left mouse button is pressed the angle will either increment (up arrow for positive angle) or decrement (down arrow for negative angle) one count. This action can be performed on any of the three axis.

POSITION COMMAND

VELOCITY COMMAND



ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Position mode is used to drive the antenna to a designated position. All of the axis positions can be commanded (set) to any position within the axis range, to a resolution of 0.01 degrees.
2	Operation of Position mode: Once the system has been placed into Position mode, the mouse curser can be moved either to the upper side or lower side of the white digits (Commanded Angle display) , an up or down arrow will appear. From this position, each time the left mouse button is pressed the angle will either increment (up arrow for positive angle) or decrement (down arrow for negative angle) one count. This action can be performed on any of the three axis.
3	Direct Angle Input: With the antenna in the Position mode, the user can place the mouse curser over the Command Angle display window and right click the mouse. The Command Angle will go blank, at this time the user can enter the desired angle directly from the key board and press “enter”. The antenna will then move to the specified angle.
	NOTE: While in Position mode, if the curser is positioned anywhere within the position dial, the antenna can be quickly repositioned by holding either the right or left mouse button and dragging the needle to the desired position.

STOW COMMAND

STOW COMMAND

ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Stow mode 1 and 2 are used to position the antenna to predefined locations. This is useful for storing the antenna when not in use or positioning the antenna to a known target such as a bore sight location. Two separate stow locations are provided for Elevation and Azimuth axis and one is provided for the Polarization axis. To operate the Stow mode, go to the Axis Control (Main Menu). Select either Stow 1 or Stow 2 for the desired axis to stow. The system will slew directly to the predefined angle(s).
2	To Configure Stow mode: To enter stow angles into the antenna control unit, go to the Configuration page tab. From this tab the axis to be set can be selected. Azimuth and Elevations examples are provided above.
3	Note:If the configuration shows blank, press the “Get Configuration” tab at the bottom of the page. This will provide the systems current configuration for all parameters.
4	Go to either Stow 1 or Stow 2 and enter in the desired position. Note: the entered angle must be within the operation range of the selected axis.
5	Once the angle is entered, push the Send Configuration tab at the bottom of the page.
6	If you want any angle to permanently remain in the configuration file, press the Write Configuration tab and confirm with a Yes.

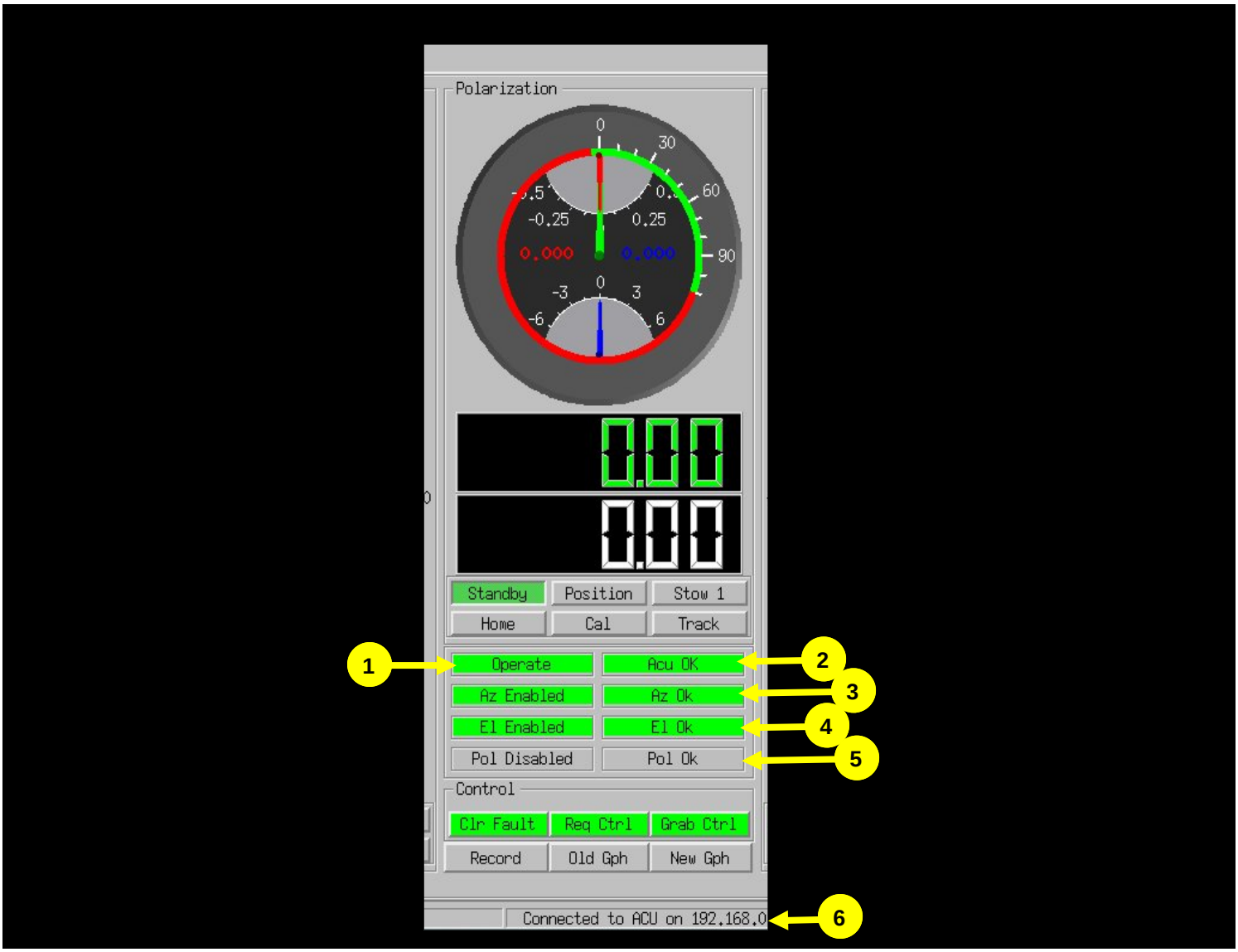
CALIBRATION AND TRACK MODE

CALIBRATION AND TRACK MODE

ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Cal Mode is currently not used and disabled.
2	Track mode is not used with the GUI. It is used when the ACU is controlled remotely. The Track function processes the points received from the interface into a smooth trajectory. Commands for this function are provided in the Interface Control Document (ICD).

DESCRIPTIONS AND OPERATONS STATUS

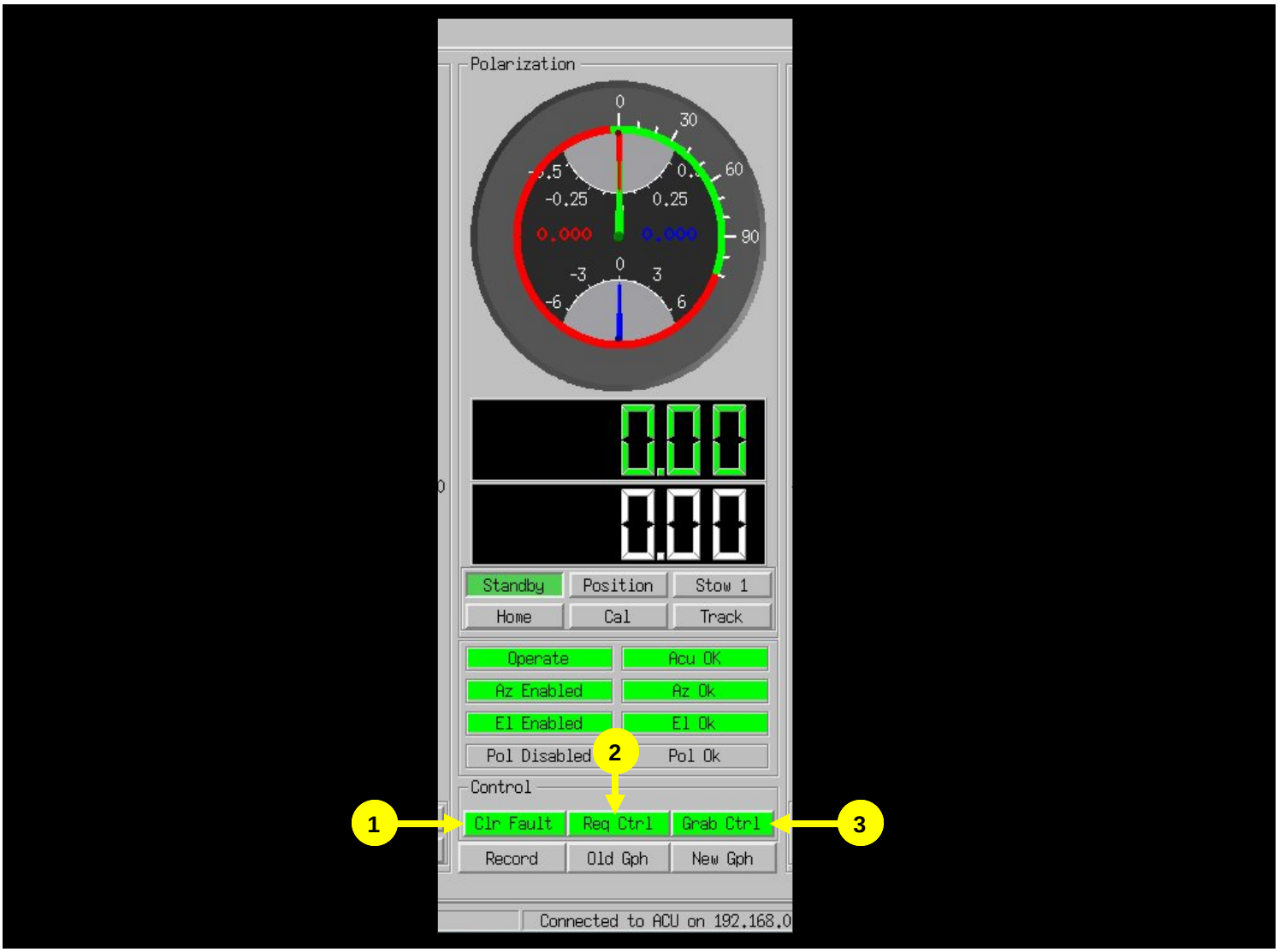
CALIBRATION AND TRACK MODE



ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Operate: Green indicator shows the system as ready, if the antenna electronics enclosure door is open, the Operate indicator will turn BLUE indicating Maintenance mode and the system will not operate. Operation (Green) will be restored once the door is closed.
2	Acu Ok: Indicates the antenna control unit is communicating with the GUI. When RED communication with the ACU has been lost.
3	Az Ok: This indicator shows the axis as operational, if there is a failure (fault) the indicator will show Az Fault in RED. For details of the fault, go the Status Detail tab
4	Ez Ok: This indicator shows the axis as operational, if there is a failure (fault) the indicator will show El Fault in RED. For details of the fault, go the Status Detail tab
5	Pol Ok: The indicate this axis is operational, there is a failure it will indicate Pol Fault in RED. For details of the fault, go the Status Detail tab
6	This status shows the IP address connected to the ACU.

DESCRIPTIONS AND OPERATONS CONTROL

CALIBRATION AND TRACK MODE



ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	**CLR FAULT:** When an axis motor encounters an error such as a motion fault or a limit switch, the motor enters a fault condition and will not move until the error is cleared. This fault is indicated on the GUI by changing the Az, El, Pol Ok, Green indicator to RED. Once the error is cleared, the motor will respond to motion commands until another fault condition is encountered. A specific example of this behavior is the physical limit switches. If one of these switches is encountered, all motion will stop and the ACU will report a fault condition. These limit switches are direction sensitive. Once the error condition is cleared, the ACU can be commanded to move the axis in the direction away from the limit switch. The motor will only allow motion out of the limit condition. If commands are presented to the ACU which continue to try to move the axis in the direction of the limit switch, the motor will immediately fault again.
2	**REG CTRL:** This command is not truly required but is included for completeness. Issuing this command will attempt to capture control of the pedestal. If control is available (if not already being controlled another computer), control will be resumed locally at the GUI.
3	**GRAB CTRL:** This is similar to the request control command except that it will take control of the pedestal whether or not the pedestal is being controlled by another connection. Obviously, this command should be used with care and is included because it is envisioned that the ACU is being used in a “friendly” environment.

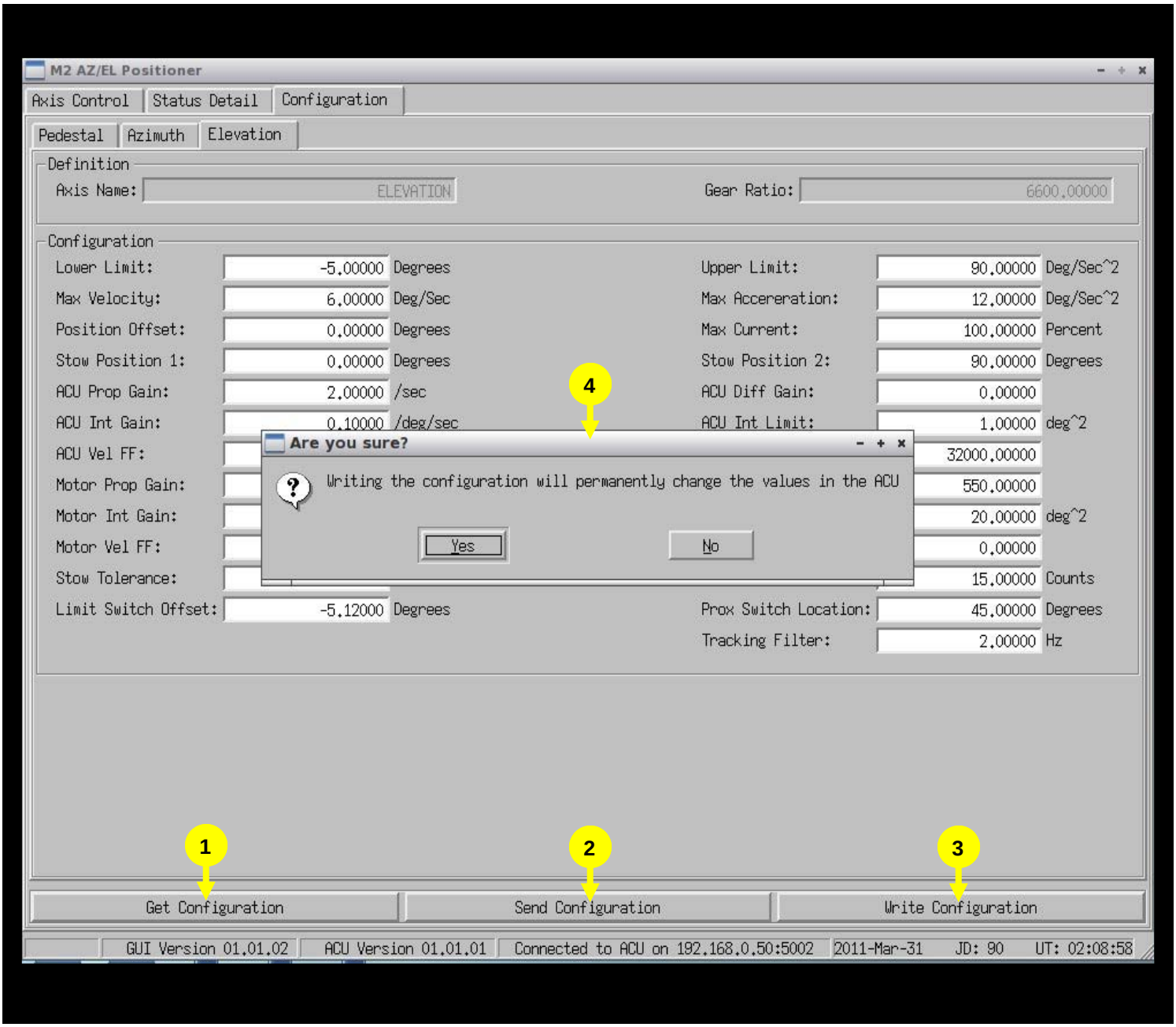
SYSTEM STATUS DETAIL (FAULTS AND STATUS)

SYSTEM STATUS DETAIL (FAULTS AND STATUS)

ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	Indicates if the system is operational or in maintenance mode (electronics assembly door open)
2	Axis enable shows the system is ready for operation, when RED this will indicated disabled which typically means the axis has been placed into Standby.
3	Homed in GREEN indicate the system was completed its homing procedure, when RED the indicator will show Not Homed. The system must be homed when the positioner is initially powered up.
4	These indicators are basically the Sum of the alarm status. Any system fault.
5	**"AMP FLT"**, GREEN indicates the amplifier is OK, RED indicates the servo amp on the motor has faulted.
6	This indicator will go from GREEN to RED if there is a motor fault. Faults can be cleared from the main page, by pressing the **"CLR FLT"** button
7	This indicator will go from GREEN to RED if the motor temperature exceeds the pre-set limits.
8	This indicator will go from GREEN to YELLOW when a software limit is reached.
9	This indicator will go from GREEN to RED when a physical limit is reached.
10	These indicators are active when the job controls are in use at the antenna control unit electronics enclosure.
11	Not used.
12	This indicator is GREEN when connection to the ACU is good and will be RED when a connection is lost or not established.

CONFIGURATION CHANGES

CONFIGURATION CHANGES



ITEM	DESCRIPTION OF INDICATORS AND CONTROL
1	This function gets the configuration if not present at start up
2	This function sends any new entered value to the ACU without saving. When the ACU is powered off this information will be lost.
3	This function will send and save any new entered value to the ACU.
4	The computer will ask if the configuration is to be permanently changed, Yes or No. The Yes answer will place the information into non-volatile memory and will be retained when power is removed from the ACU.

PARAMETER GRAPH DISPLAYS

PARAMETER GRAPH DISPLAY

ITEM	FUNCTION DESCRIPTION
1	**RECORD** function is used to create a .CSV file of the displayed graph.
2	**OLD GPH**, loads previously recorded .CSV files for display.
3	**NEW GPH,** allows the operator setup the new graph with the desired parameters as shown in the example above. Various adjustments for the Time Scale and Value Scale will need to be made in order to obtain the desired graph display. Up to 8 channels can be displayed, which can included Elevation, Azimuth or Polarity parameters.

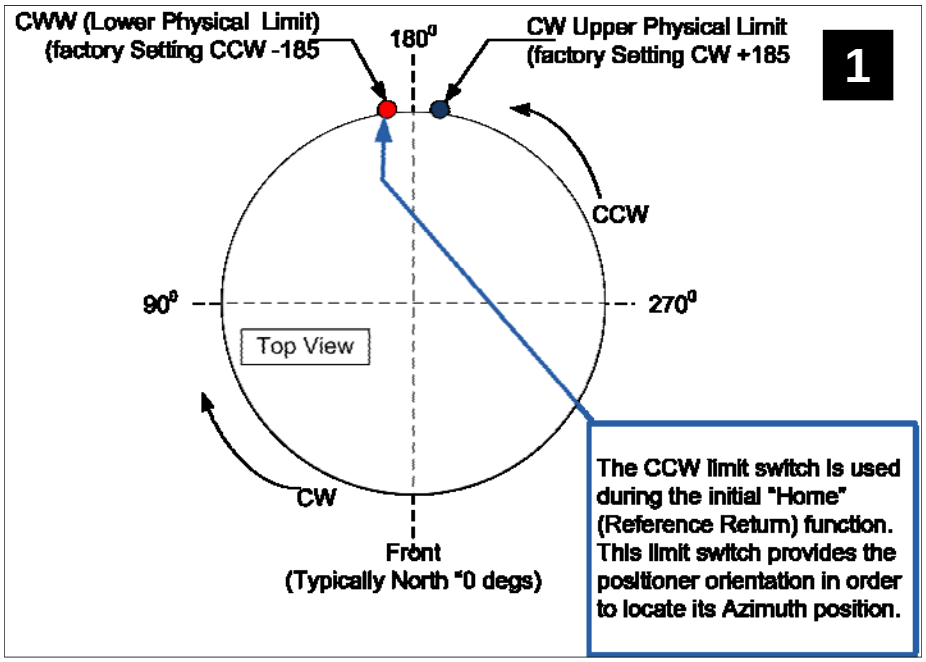
HOME POSITION AZIMUTH OFFSET

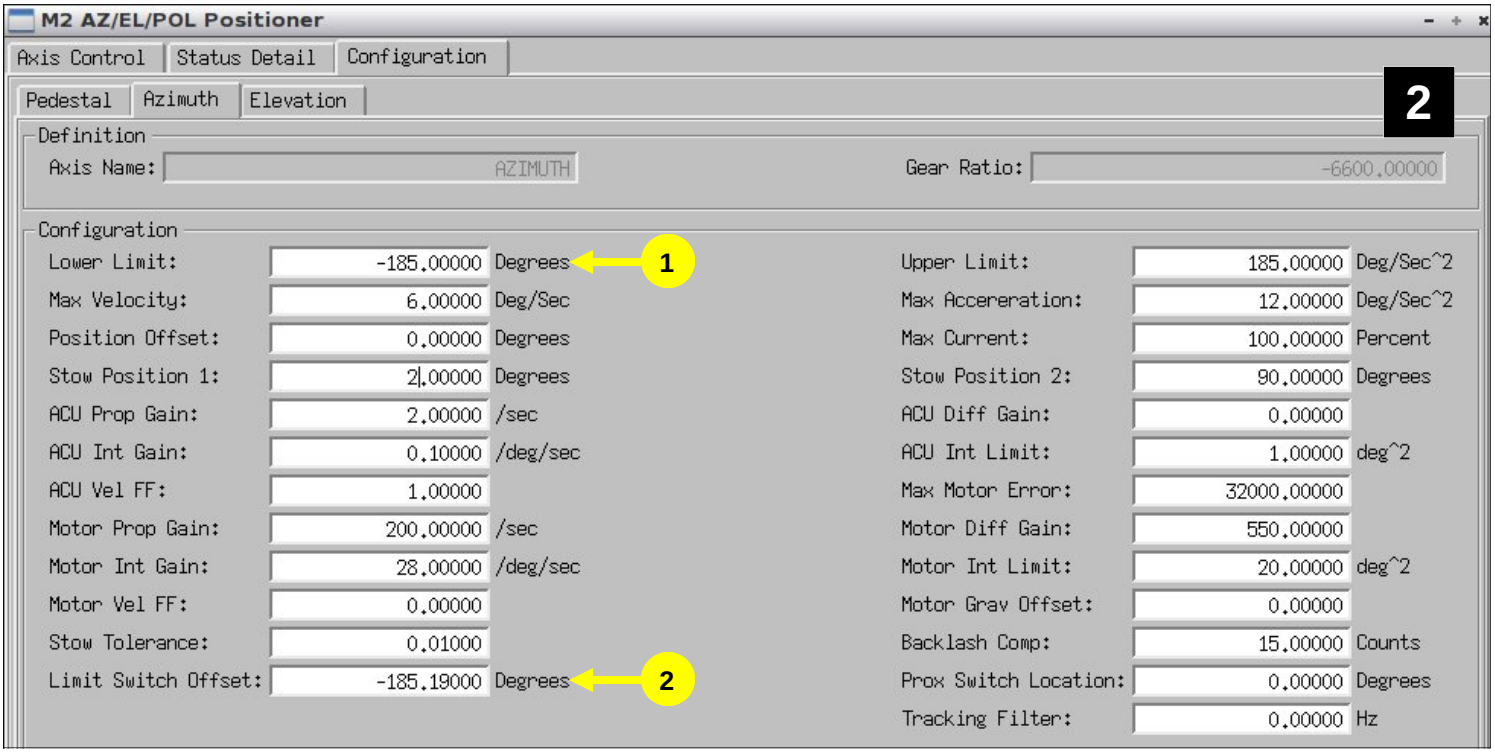
HOME POSITION AZIMUTH OFFSET

At the initial installation of the system, an offset adjustment may be necessary in Azimuth to find “True North.” A limit switch offset can be entered to offset the Azimuth position on it’s mount. An example is shown in Figure 2 below. A reference such as the Sun’s shadow or fixed location RF Source may be necessary to provide a true position reference.

Once the desired offset is in place, it can be saved permanently in the ACU. Each time the ACU is powered up, a Home function will need to be performed, but no further adjustments of the offset should be required.

Note: Each time the limit switch offset is adjusted the system will need to be homed. See Operations sections for details regarding the Home function and changing configurations.





ITEM	FUNCTION DESCRIPTION
1	Software limit, can be set as required. This setting has no effect on the home function.
2	**Setup Example to achieve a True Azimuth “0.0” degree angle using the offset function.** -185.0 degrees Physical Limit - (factory set) Subtract Limit Switch Offset Value -185.1900 degrees =0.1900 degree CW Angle Offset

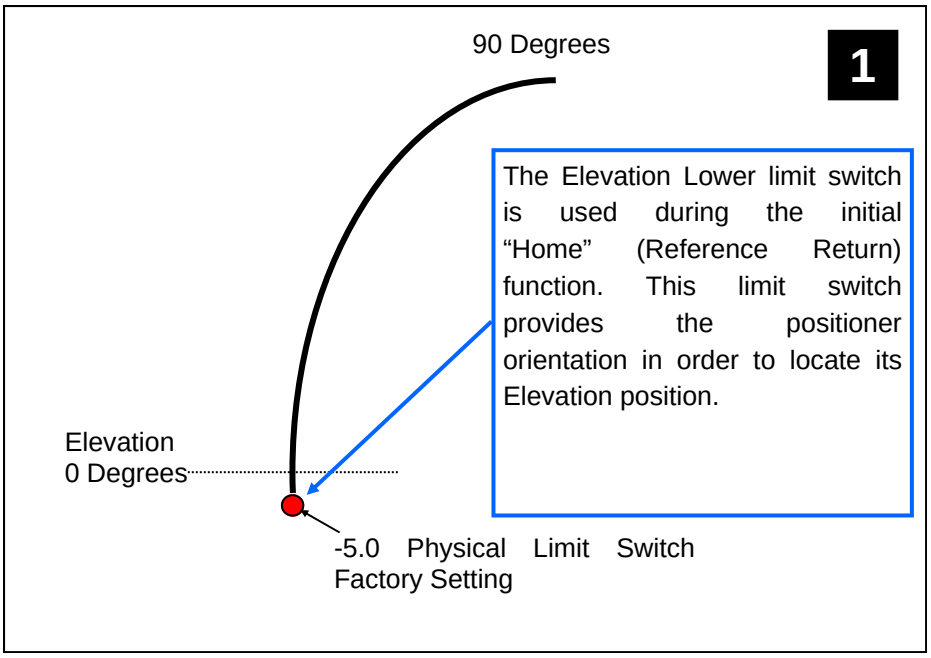
HOME POSITION ELEVATION OFFSET

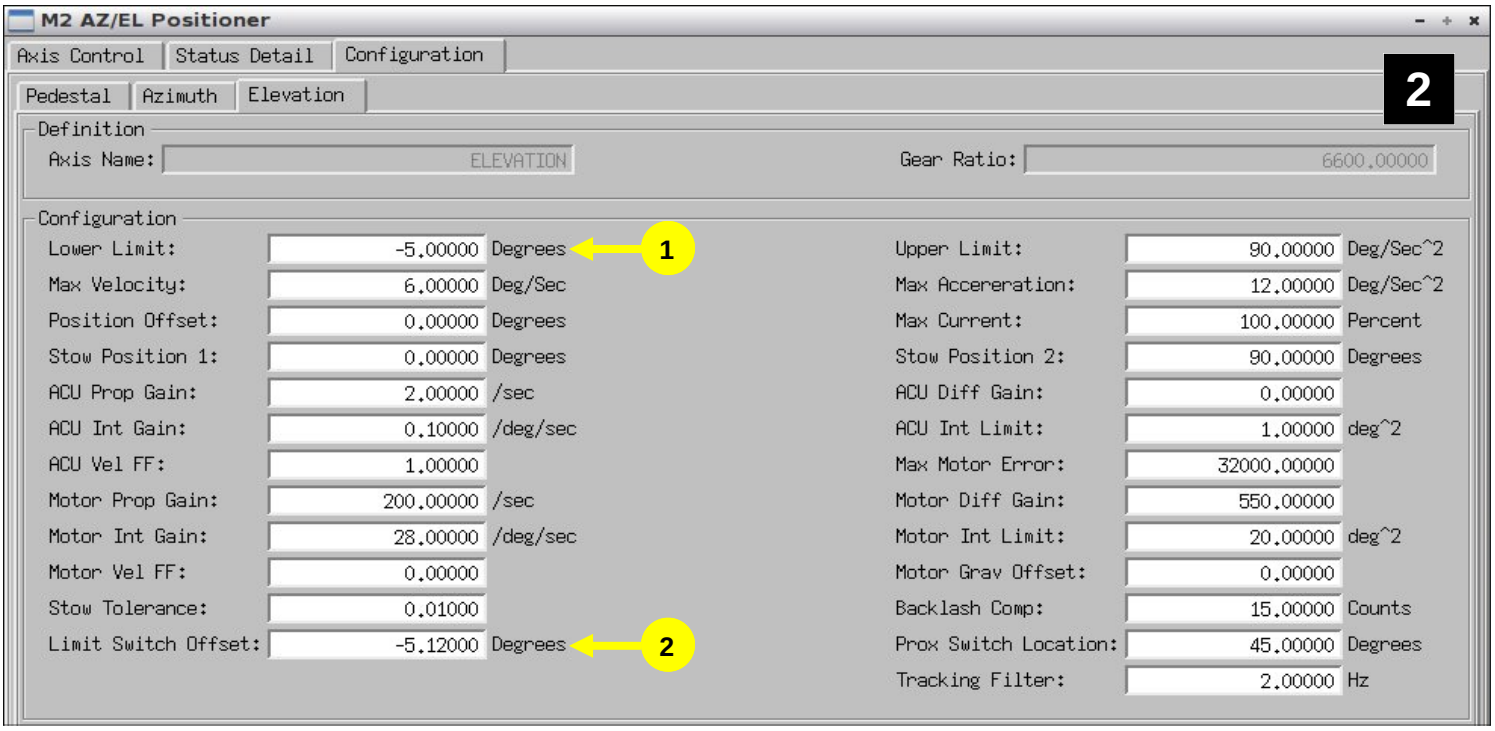
HOME POSITION AZIMUTH OFFSET

At the initial installation of the system, an offset adjustment may be necessary in Azimuth to find “True North.” A limit switch offset can be entered to offset the Azimuth position on it’s mount. An example is shown in Figure 2 below. A reference such as the Sun’s shadow or fixed location RF Source may be necessary to provide a true position reference.

Once the desired offset is in place, it can be saved permanently in the ACU. Each time the ACU is powered up, a Home function will need to be performed, but no further adjustments of the offset should be required.

Note: Each time the limit switch offset is adjusted the system will need to be homed. See Operations sections for details regarding the Home function and changing configurations.





ITEM	FUNCTION DESCRIPTION
1	Software limit, can be set as required. This setting has no effect on the home function.
2	**Setup Example to achieve the Elevation “0.0” degree angle using the offset function.** -5.0 degrees Physical Limit - (factory set) Subtract Limit Switch Offset Value -5.1200 degrees =0.1200 degree UP Angle Offset

AXIS POSITION OFFSET ADJUSTMENT

AXIS POSITION OFFSET ADJUSTMENT

It may be necessary to offset the Positioner to peak up on a track or to compensate for error in the trajectory data. In this case the function of Position Offset is useful, for example when in Track mode or if any operator was attempting to signal peak on a target to try and determine position error.

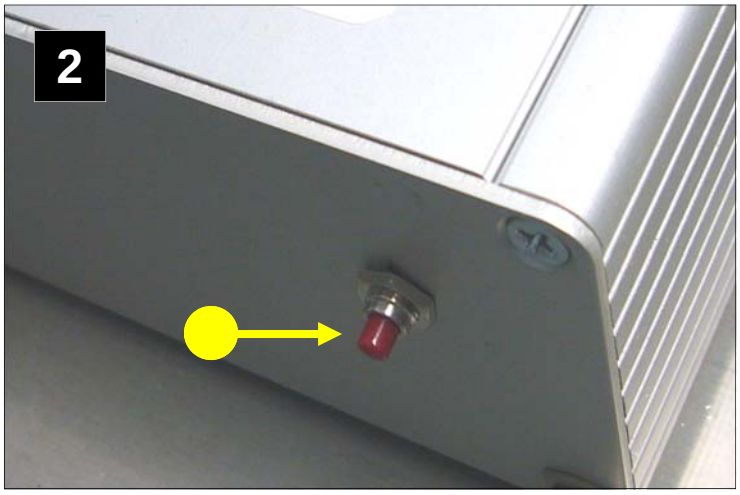
Each axis can be independently advanced or retarded from the Positioners actual position as necessary. The following are example setups of the Position Offset function.

ITEM	FUNCTION DESCRIPTION
1	Example of Position Offset in Azimuth
2	Example of Position Offset in Elevation
3	Note: When each axis is placed into the Position Mode, the difference between the commanded position (shown in white) and the actual position (shown in green) equals the amount of position error (shown in red)

ACU FIELD UPGRADES / PROGRAM RELOAD

ACU FIELD UPGRADES / PROGRAM RELOAD

The ACU has the capability to be upgraded in the field. If this ever becomes necessary, the following steps can be performed. **THE FOLLOWING STEPS MUST BE FOLLOWED EXACTLY AS WRITTEN.**



STEP	FUNCTION DESCRIPTION
1	With the power OFF, install the provided USB drive with the latest software for reload or upgrade, into the ACU.
2	Press and HOLD the RED button on the back of the ACU, while turning on the power.
3	Continue to HOLD the button until the RED LED is on steady. Once the LED is on the button can be released.
4	After about 13 minutes the RED LED will go OFF, signaling the completion of the software load. At this time power off the ACU and remove USB drive.
5	After removing the USB drive, turn on the ACU power and restart the GUI software.

See Appendix A Interface Control Document (ICD)

For remote computer control

TROUBLE SHOOTING

SYMPTOM:
No RF receive signal present or system does not appear to be in the right orientation.

POSSIBLE CAUSES:
1) Antenna Position incorrect; verify positioner offsets are correctly entered into the configuration file.
2) RF Feed does not have LNA/LNB power.
3) Home function not performed, verify the system has been homed by viewing the status page, also the Red LED's at the ACU electronics enclosure Jog Panel should be OFF if the system is properly homed.

SYMPTOM:
No communication with ACU, Red ACU fault light is on.

POSSIBLE CAUSES:
ACU fault red light indicates the ACU is not communicating with the control computer.
1) Verify ACU power ON,
2) Verify the communications cable connection between the control computer are good.
3) Verify the correct IP address at the control computer
4) If necessary restart both the ACU (power down) and the control computer.

NOTE: If the ACU communications with the control computer were disconnected for an extended period of time, it maybe necessary to restart (power cycle) the ACU.

SYMPTOM:
System configuration seems not to be holding the information.

POSSIBLE CAUSES:
Re-enter the values and ensure the Write Configuration button is selected and press Yes to confirm the write function.

SYMPTOM:
Standby indication goes to (Yellow)

POSSIBLE CAUSES:
1) ACU has lost communications with the computer. Restart the ACU (power cycle), then restart the GUI.
2) Command was not legal, send a legal command to the ACU and the status should return to Green when Standby is reselected.

SYMPTOM:
The antenna positioner will not move in one direction, but no fault is showing on main GUI page

POSSIBLE CAUSES:
The antenna positioner has most likely hit a software limit. This can be verified on the Status Detail page which will show a Yellow Warning indicator for which ever axis is not moving. To correct this, the software limit listed under the configuration page will need to be adjusted to a position outside of the required operational area of the positioner.

TROUBLE SHOOTING

SYMPTOM:
Limit switch fault at GUI, display shows RED Fault

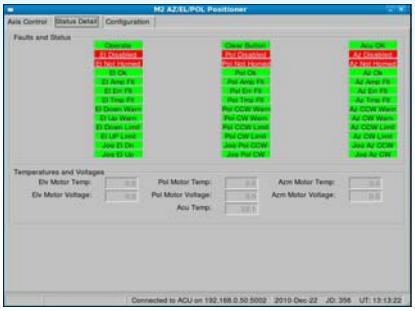
POSSIBLE CAUSES:
1) The positioner may have been driven into a mechanical limit. The fault can be cleared by pressing the Flt Clr button on the main display page. The positioner can now be backed out by driving the antenna in the opposite direction of the limit. It may be necessary to clear the fault more then once in order to back out of a limit.
2) Antenna reflector is unbalanced, counter weight maybe incorrect or not installed.
3) The antenna may have hit something obstructing its movement. Check the antenna path before proceeding.
4) High winds may have inhibited smooth antenna movement. Verify the winds are within the operational parameters of the positioner. The larger the dish, the more the system could be effected to high wind. In most cases, once the fault is cleared (Flt Clr), they system operation will be restored to normal.

SYMPTOM:
Jog Control will not move the antenna, Red LED blinking slowly at panel.

POSSIBLE CAUSES:
The positioner most likely has been driven into a limit . The fault can be cleared locally at the ACU electronics enclosure by momentarily pressing the Reference Return (yellow) button. After pressing the button the system can be moved out of the limit by moving the antenna in the opposite direction of the limit.

The fault can also be cleared at the GUI as described above under Symptom: Limit switch fault at GUI.

12 MONTH LIMITED WARRANTY



This warranty gives you specific legal rights. You may also have other rights which will vary from state to state or province to province.

M2 warrants against defects in material and workmanship for a **period of 12 months** from date of purchase. During the warranty period, **M2** will, at its option, either repair or replace products or components which prove to be defective. The warranty shall not apply to defects or damage resulting from:

- Improper or inadequate maintenance by user
- Improperly prepared installation site
- Unauthorized modifications or misuse
- Accident, abuse, or misapplication
- Normal wear

M2 specifically does not warrant this product for any direct, indirect, consequential, or incidental damages arising from the use or inability to use the product. Some states or provinces do not allow the exclusion or limitation of liability for consequential or incidental damages so the above limitation may not apply.

In the event repair or replacement are necessary, purchaser shall contact M2 for return authorization. In many cases this contact can simplify and expedite the repair / replacement process and help reduce costs and downtime.

The purchaser shall be responsible for packing the product properly for return and for charges to ship the product to **M2**. Always include with the shipment, a statement detailing the problem / failure and any other pertinent observations. Insuring the product for shipment is recommended. Use the original packing materials whenever possible. **M2** is responsible for charges **(in the United States)** to return the repaired / replacement product only where warranty service is involved.

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