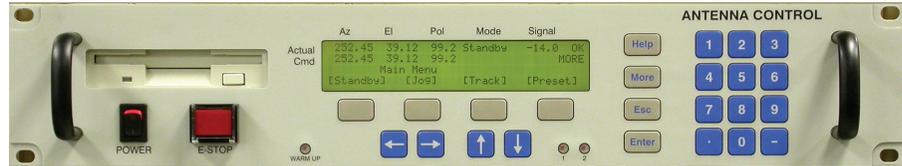


# GENERAL DYNAMICS

## C4 Systems



# Antenna Control System

**123T**  
Transportable  
Antenna Control

# Operations Manual

99-403-0100 Rev B  
Aug 2005



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## VertexRSI Contact Information

The following Contact Information is provided in the event that a problem has occurred or any additional information is required.

**Address:** VertexRSI Richardson Controls Facility

1219 Digital Drive

Richardson, TX 75081

**Phone:**      **24-Hour Help**              **888-Tripoint (888-874-7646)**

**Main Line:** 972-907-9599              (Hours M-F, 8am – 5pm, GMT –6)

**Fax Line:**    972-907-0027

## **Proprietary Notice**

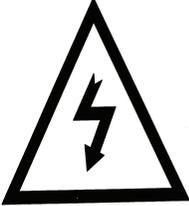
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## Acronyms and Abbreviations

°	Degrees
<b>ACU</b>	Antenna Control Unit
<b>AZ</b>	Azimuth
<b>BW</b>	3 dB Doublesided Receive Beamwidth of the Antenna
<b>EL</b>	Elevation
<b>PDU</b>	Power Drive Unit
<b>PMU</b>	Portable Maintenance Unit
<b>POL</b>	Polarization
<b>PWM</b>	Pulse Width Modulated

## Safety Symbol Definitions

	<b>SAFETY GROUND</b>	Indicates protective earth terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Any interruption of the protective (grounding) conductor, inside or outside the equipment, or disconnection of the protective earth terminal could result in personal injury.
	<b>WARNING</b>	Alerts users to a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	<b>CAUTION</b>	Directs attention to a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

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# ***SECTION 1 - SYSTEM***

## **1 SYSTEM DESCRIPTION**

### **1.1 OVERVIEW**

The Model 123T Control System described herein is designed to position a transportable antenna in all axes of movement for the purpose of locating and tracking the satellites of interest. Pointing and dynamic pointing to other targets is also supported. A single track DC motor per axis is used for this antenna pedestal configuration.

The Control System performs numerous functions to accomplish locating and maintaining contact with a satellite. The following list entails the major functions provided by the Control System.

- Stow and unstow sequences with Auto Search routine.
- Antenna calibration for tilt, heading and geographic location.
- Simultaneous positioning modes for each axis of movement.
- Manual modes for maintenance operations.
- Self test modes for control system calibration.
- Status monitoring for detailed events.
- Fault monitoring for detailed problems.
- Receive signal strength processing and display.
- Remote control and monitoring via third party computer.

### **1.2 OVERALL SYSTEM PERFORMANCE**

<b>ITEM</b>	<b>NOMENCLATURE</b>	<b>SPECIFICATION</b>
<b>1</b>	AZ/EL Axis Position Resolution, 1:1 Encoders	0.0055° Internal 0.01° Displayed
<b>2</b>	POL Axis Position Resolution, 1:1 Encoders	0.022° Internal 0.1° Displayed
<b>3</b>	AZ/EL Axis Position Accuracy (includes coupling, resolver electronics)	0.05° RMS Error
<b>4</b>	POL Axis Position Accuracy (includes coupling, resolver electronics)	0.3° RMS Error

## **1.3 TYPICAL COMPONENTS**

### **1.3.1 Block Diagram**

The “*Antenna Equipment Group Block Diagram (10762A)*”, Fig. 1-1 on page 1-4, depicts the following control system components.

#### ***Components Supplied by VertexRSI:***

- Power Drive Unit (PDU)
- Antenna Control Unit (ACU)
- Azimuth Position Transducer
- Elevation Position Transducer
- Portable Maintenance Control Unit (PMU)
- Tracking Receiver
- Clinometer
- Compass
- GPS Antenna and Receiver

#### ***Components Supplied by Others:***

- System Computer
- Utility and Technical Power
- Emergency Stop and Travel Limit Switches
- Servo Active Beacon
- DC Drive Motors
- Polarization Position Feedback

The primary man-machine interface is the Antenna Control Unit (ACU). The ACU is a rack-mounted computer with a LCD display and integral keypad. The unit provides significant monitoring and control capabilities with connections to the Power Drive Unit (PDU) via an EIA-422 data link. Over this link, the ACU gathers and reports system status and issues position commands for both axes. These commands are internally generated by the ACU's Steptrack and Pointing mode algorithms. The ACU has an emergency stop switch mounted on the front panel. The switch is microprocessor independent and interfaces directly with the PDU to command an immediate control and system disable.

An automated interface may be implemented through the use of a System Computer. An EIA 232/422 data link with the ACU allows control and monitoring to occur from this computer station. Other equipment interfaces with the ACU include the DC tracking voltage signal.

The hand-held Portable Maintenance Unit (PMU) has a pendant cable and connector that may be plugged into a dedicated port at the PDU. When interfaced to the PDU the PMU provides manual jog control of azimuth, elevation and polarization axes at the antenna.

The Power Drive Unit (PDU) is located at the antenna and contains the hardware and firmware to close the servo loops. The position commands are derived by Steptrack and Position modes in the ACU and then issued to the PDU via the EIA-422 link. The position loop closure electronics of the PDU reside in a dedicated microprocessor system called the Drive Board Assembly (DBA). The DBA compares the position commands with the position feedback from the on-axis transducers to generate position error terms. These position errors are frequency compensated and converted to directional commands.

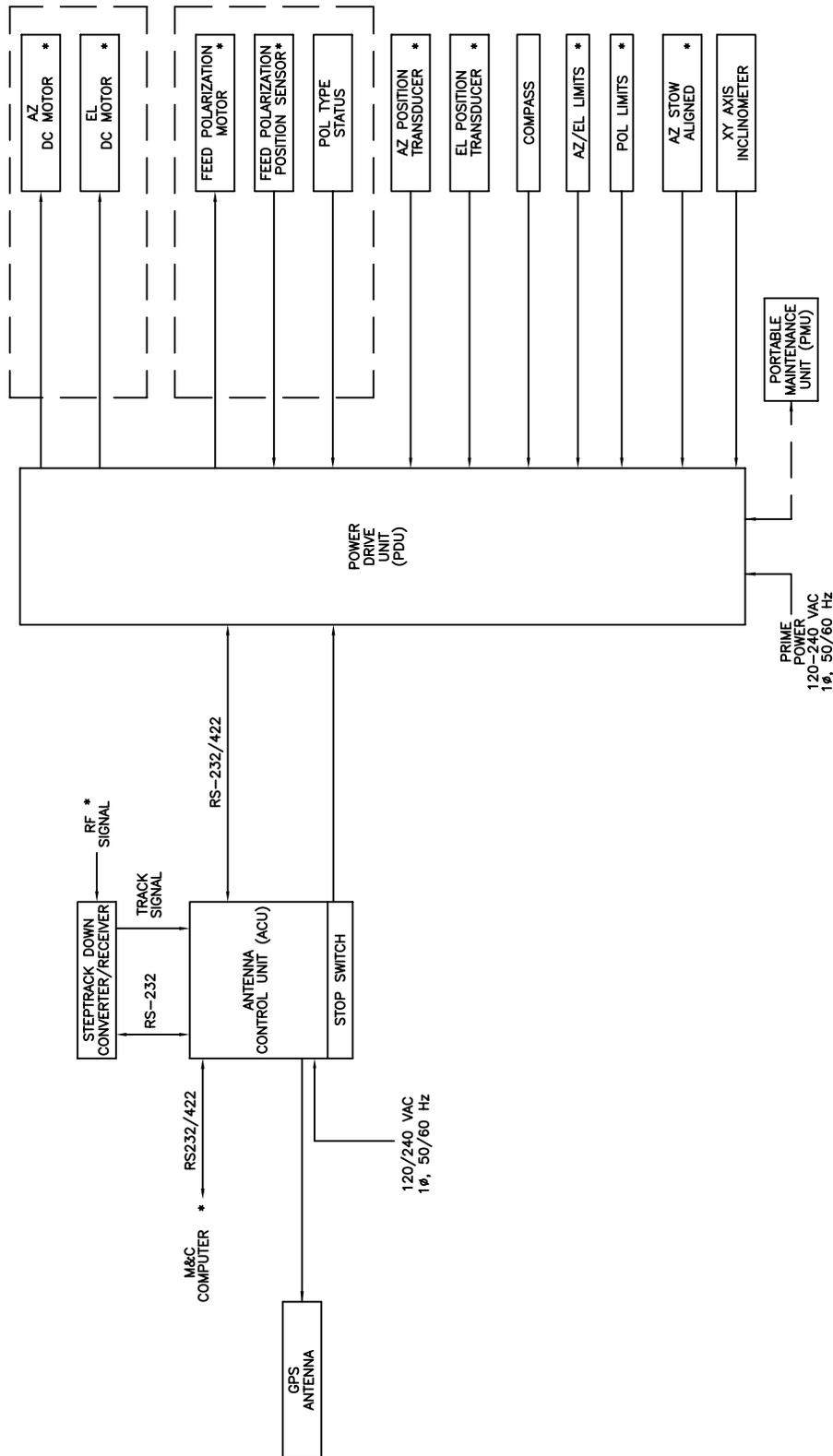
The PDU interfaces with the on-axis transducers to accept and process the signals to derive a digital representation of position.

Antenna mounted emergency stop and axis travel limit status switches are individually reported to the PDU. The PDU interlocks these switches with enable logic and reports their status to the ACU for display purposes.

#### **1.4 EQUIPMENT INTERFACE INFORMATION**

Interface Information is contained in a separate document entitled "*Hardware Interface Spec*" located in the 123T Maintenance manual. The document provides the detailed electrical and mechanical interfaces to the VertexRSI supplied equipment.

FIGURE 1-1 ANTENNA EQUIPMENT GROUP BLOCK DIAGRAM (10762A)



\* PROVIDED BY OTHERS

10762  
REV A

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## ***SECTION 2 - OPERATING***

### **2 OPERATING INSTRUCTIONS**

The ACU is the primary interface with site personnel or a Supervisory Computer for determining operational modes and fault/status reporting. The unit is a standard, 19-inch rack mounted assembly with a control keypad and LCD display.

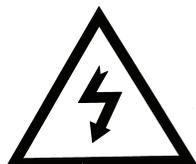
The normal operation of the unit consists of two decisions, namely the desired mode and the desired target. The operator simply selects the mode and the target name. To achieve this level of automation, previous Setup decisions need to be made and loaded into the unit. The Setup, Frequency, and Preset menus contain the majority of these decisions. For more detailed information on system setup parameters, see ***“SECTION 5 - Setup” on page 5-1.***

#### **2.1 START UP PROCEDURE**

The system requires AC power at the ACU and at the PDU for normal operation.

The ACU power switch is located at the left front corner of the chassis. This switch will power the entire ACU provided the power cord is plugged into the receptacle at the ACU rear panel.

The PDU requires a single-phase AC voltage source.



#### **WARNING**

***THE AC VOLTAGES SUPPLIED TO THIS SYSTEM ARE HARMFUL! PLEASE EXERCISE EXTREME CAUTION!***

After power has been applied to the ACU and PDU, check the status and fault windows at the ACU for verification of correct system power up.

## 2.1.1 Power Up Screens

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A TRIPPOINT GLOBAL COMPANY

Initializing Keypad

Initializing Database

Beginning Command Line Interpreter

Beginning Command Line Processing

Beginning OpTrack Task

## **2.2 NORMAL OPERATION**

The ACU, system computer and manual control unit listed below can provide control system monitoring to varying levels but, at any given time, only one may have control via the PDU.

- ACU
- System Computer
- Portable Maintenance Unit (PMU)

Upon initial power-up, the ACU communicates with the electronics in the PDU to determine if a PMU is in control. If control is not residing elsewhere, the ACU is given system control.

Control switching between the ACU and PMU automatically reverts the antenna to a Standby mode. The unit receiving and accepting control must then actively enter a mode to allow antenna operation.

The ACU may offer (or pass by default) control to the Portable Maintenance Unit (PMU). Selection of the Maintenance mode from the ACU will result in the PMU being offered control. If the PMU accepts, other units are precluded from taking control until control is released. The control functions of the PMU are intentionally designed to be independent of the ACU and position loop closure electronics are embedded in the PDU. Therefore, a power loss in either the ACU or position loop closure electronics in the PDU automatically defaults rate control to the PMU.

## **2.3 OPERATION UNDER EMERGENCY OR ADVERSE CONDITIONS**

The system design allows for continued operation under many equipment failure scenarios. For a complete listing of fault messages and troubleshooting instructions, see Section 8.

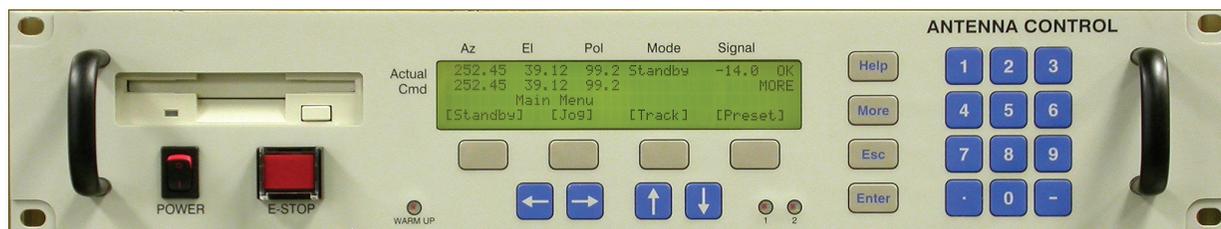
If the ACU ceases to exhibit control over the antenna, the PMU can manually control the axes. This hand-held unit employs a 50-foot control cable and optional connection points located on the antenna structure in addition to the dedicated port at the PDU. The PMU may control the antenna by executing the Maintenance Mode or by turning off power to the ACU.

## **2.4 POWER SHUT DOWN PROCEDURE**

The ACU ON/OFF switch is located at the front of the chassis. The single phase power cord may also be removed from the rear of the unit.

The PDU ON/OFF power switch mounted on the front of the enclosure provides means to turn off or on the power inside PDU.

## 2.5 ACU FRONT PANEL OPERATION



ACU front panel operation is detailed as follows.

When MORE appears on-screen, it means that the current screen contains more information than can be displayed in the 4-line LCD display. Pressing the MORE key brings up the remainder of the screen, line-by-line, into the display's 4th line.

When FLT appears on-screen, a fault exists. Fault messages can be viewed from the Messages/Faults screen. New faults trigger the fault buzzer. Any front-panel key press will disable the fault buzzer.

The physical buttons (a.k.a. keys) directly below the LCD display are assigned to the screen control directly above them on line 4 of the display. The two types of screen controls that can be assigned to these buttons are called “toggle buttons” and “pushbuttons”. These controls always appear in brackets. Toggle buttons are used to change an ACU parameter value by allowing the operator to cycle through a list of acceptable values by repeatedly pressing the associated button. Pushbuttons are used to either open a new screen or to perform some action. For push buttons that activate an action, the brackets will flash off for five seconds. If the brackets do not flash, then the action was not performed. Certain actions can only be performed under certain operational conditions.

Certain screen controls will “come and go” based on screen selections and/or operational conditions. For example, turning Polarization OFF in the Setup/General screen will cause the POL position display to vanish and the [POL] push button to vanish from the Setup menu. Likewise, changing the RF to a circular feed can cause the Polarization to go OFF.

A block cursor indicates normal screen operation. An underline cursor indicates that the screen is currently in edit mode. The position of the cursor shows the data field that is currently being edited. Most screen operations cannot be performed while in edit mode. When in edit mode, use either the Enter key or the Escape key to return to normal operation. The Enter key will save any edit made to the data field. The Escape key will abandon the edit and return the data field to its prior value. If a screen has no editable data fields, then no cursor will display. In this case, screen operation is also considered normal.

During normal screen operation, the Arrow keys are used to move between all the edit fields currently displayed on-screen.

With normal operation, the Escape key causes a return to the prior screen.

Press the Help key to obtain on-screen help for the screen currently displayed.

### **2.5.1 ACU Internal Heater**

Some ACU Models incorporate internal heaters to extend the operational temperature range. Models with heaters will have a “warm-up” LED on the front panel. When this LED is lit the heater is operational and the controller is being held in reset. Once the internal chassis temperature has reached zero degrees celsius, the controller reset is removed and boot-up proceeds.

### **2.5.2 Multiple Pedestal Support**

Multiple pedestal support is a powerful feature that allows pre-configuration of one ACU+PDU for up to four unique antenna types. The detected antenna can be signaled by jumpers installed at the antenna or at the ACU rear panel. Type jumpers are necessary ONLY when multiple antennas are supported with a single ACU+PDU.

**NOTE:** *Location of the type jumper determines the ACU/PDU boot sequence. Consult your system integrator to determine if Multiple Antennas are supported and how each antenna type is detected.*

#### **2.5.2.1 Antenna Type Detect at the PDU**

- Verify all external antenna cabling has been connected at the PDU
- Apply power to the PDU either before or simultaneously with the ACU.
- During the ACU boot process, the antenna type information is transferred from the PDU to the ACU. The ACU then loads the matching software configuration.

#### **2.5.2.2 Antenna Type Detect at the ACU**

- Verify correct type jumper has been installed at ACU rear panel connector J7.
- Boot the ACU.
- The ACU must completely boot prior to applying power at the PDU.
- During the PDU boot process, the antenna type information is transferred from the ACU to the PDU. The PDU then loads the matching hardware configuration.

### 2.5.2.3 Antenna Detect Troubleshooting

Several fault conditions can occur that are specific to Multiple Antenna operation.

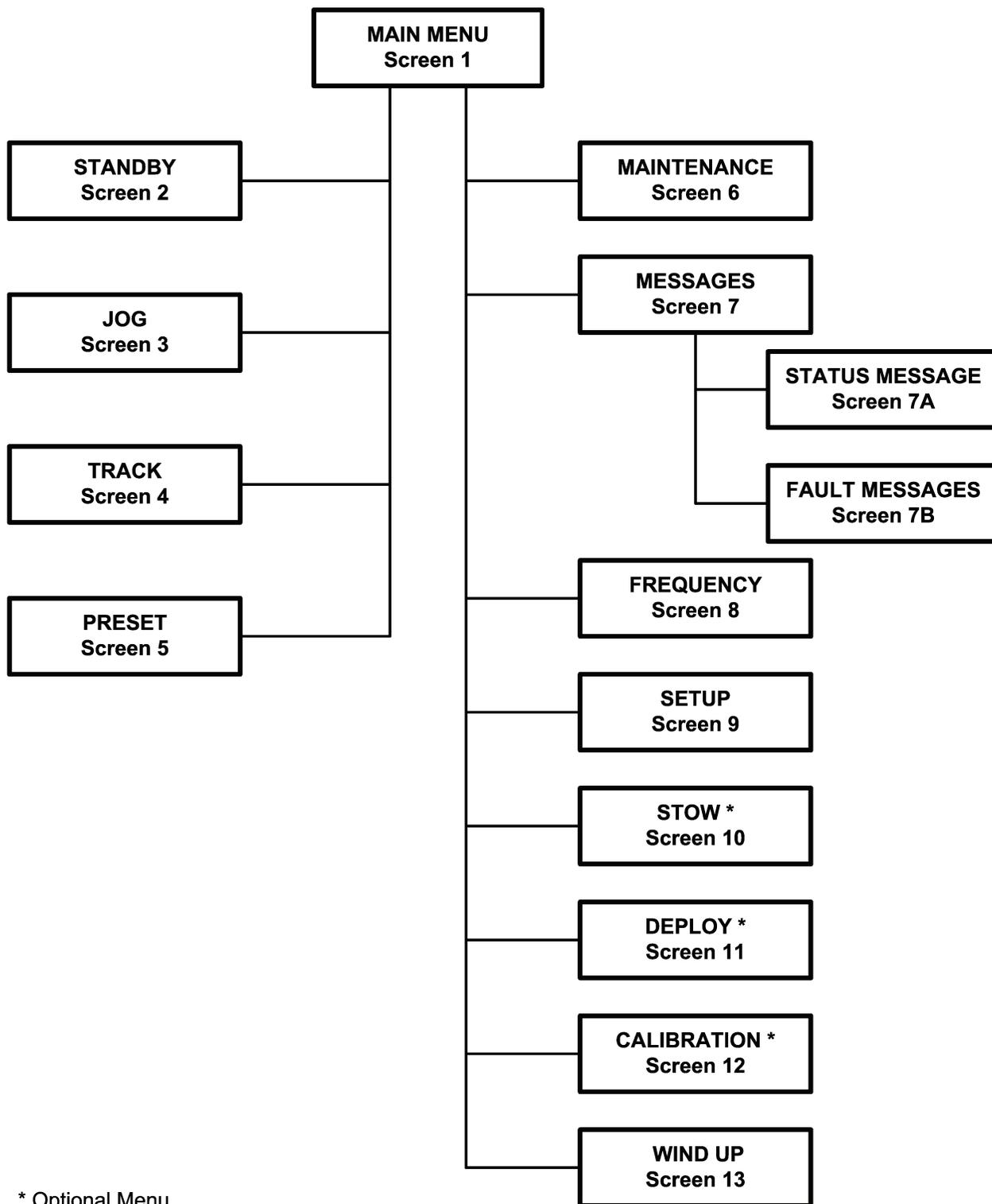
- Pedestal Select Invalid Fault. This fault occurs due to an incorrect boot sequence, or failure to re-boot after changing antenna type. Clear the fault by re-booting the system in the correct sequence as defined in 2.5.2.1 and 2.5.2.2 above.

## 2.6 ACU MENUS

See “**ACU Menus (V-1038)**”, **Fig. 2-1 on page 2-7** and “**Setup Menus (V-1039)**”, **Fig. 2-2 on page 2-8**. There are eleven primary sub-menus, each of which are accessible directly from the main menu. The sub-menus are:

MENU	DESCRIPTION
Track	Operations Mode
Preset	Operations Mode
Jog	Operations Mode
Maintenance	Operations Mode
Standby	Operations Mode
Messages	Fault and Status Information
Frequency	System Parameters
Stow	Operations Mode
Deploy	Operations Mode
Calibrate	Sensor Update
Setup	System Parameters
Wind-up	Encoder Test Mode

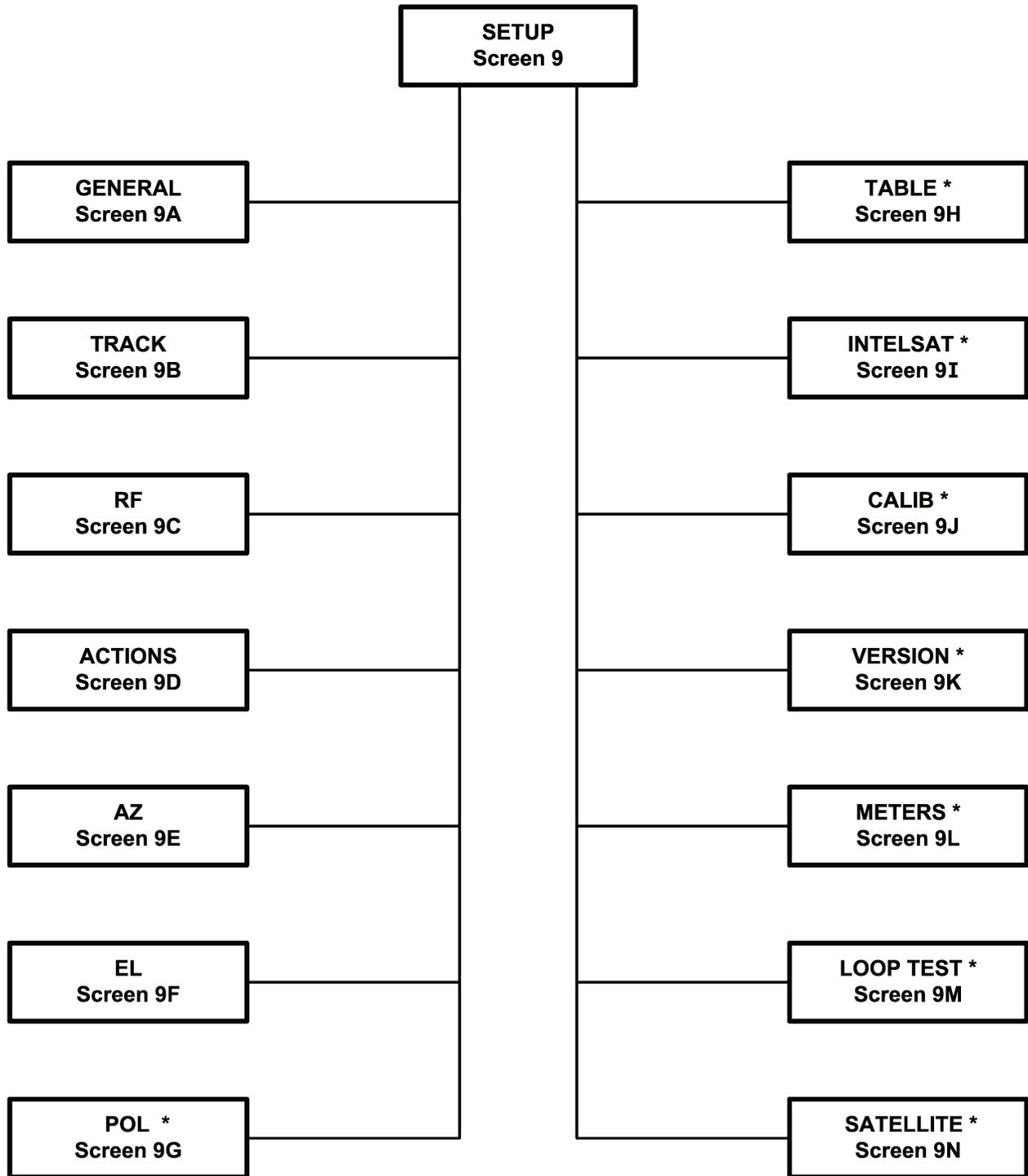
FIGURE 2-1 ACU MENUS (V-1038)



\* Optional Menu

V-1038

**FIGURE 2-2 SETUP MENUS (V-1039)**



\* Optional Menu

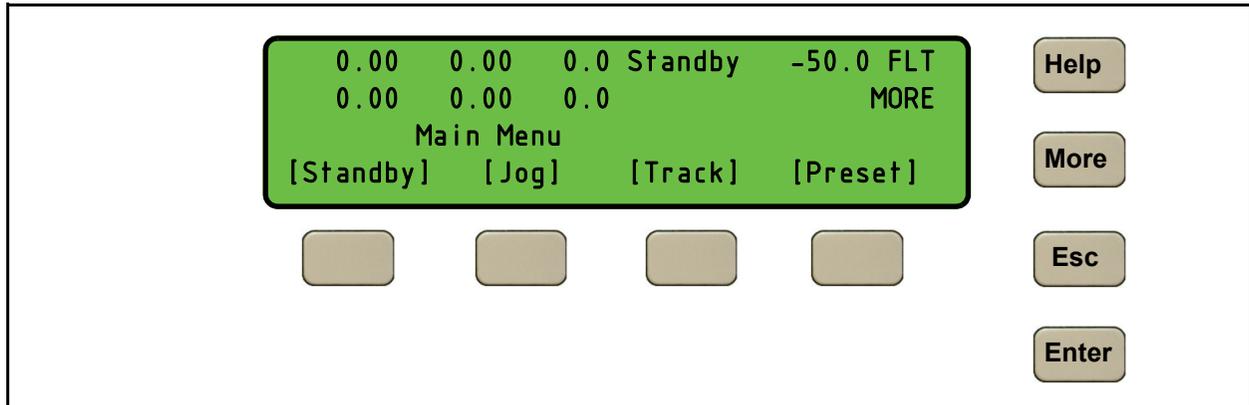
V-1039

**Table 2-1, “Primary ACU Menu Screens’ on page 2-9** shows the primary ACU menu screens. Additional information on each mode can be found in the paragraphs that follow.

**Table 2-1: Primary ACU Menu Screens**

<b>ACCESS SOURCE</b>				
<b>Menu</b>	<b>Computer</b>	<b>ACU</b>	<b>PMU</b>	<b>Comment</b>
Track	X	Track Menu		Orbit Determination and Pointing Algorithm
Preset Position	X	Preset Menu		Stored AZ/EL/POL Commands (50)
Jog		AZ/EL POL Jog Menu		Cursor Position Commands for AZ/EL/POL
Maintenance	X	Maintenance Menu	X	Portable Rate Control, AZ/EL/POL
Standby	X	Standby Menu		Disable Axis Drives
Messages	X	Messages Menu		Fault and Status Information
Frequency	X	Frequency Menu		Receiver Setup
Setup	X	Setup Menu		Operations Options
Stow	X	Stow Menu		Drive Antenna To It's Stow Location
Deploy	X	Deploy Menu		Drive Antenna Out Of It's Stow Location
Calibrate	X	Calibrate Menu		Read all Sensors and update AZ/EL angles
Windup		Windup Menu		Encoder Test Function

## 2.6.1 Main Menu



The Main Menu contains the following sub menus and are accessed by pressing  :

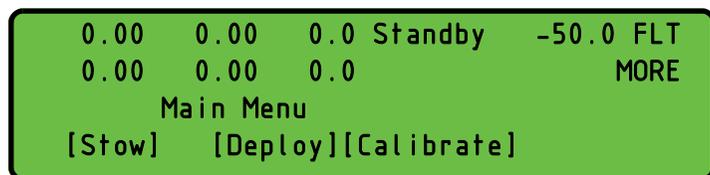
- *Standby*
- *Jog*
- *Track*
- *Preset*



- *Maintenance*
- *Messages*
- *Frequency*
- *Setup*



- *Stow*
- *Deploy*
- *Calibrate*



- *Windup*



## 2.7 STANDBY

The Standby window consists of an Execute field only. Standby mode disables all motion and clears all active modes. Some system parameters may only be changed when the ACU is in Standby mode.

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
                               Standby
[Execute]
    
```

## 2.8 JOG

This mode allows the operator to Jog the antenna using the ACU front panel's arrow keys. Manual Jog is selectable for AZ, EL and POL (if applicable).

```

0.00  0.00  0.0 Jog Rate  -50.0 FLT
0.00  0.00  0.0
                               Jog          ARROW KEYS ACTIVE
[Slow]  [Execute] [Pol CW]  [Pol CCW]
    
```

### 2.8.1 Jog Setup

The Jog screen allows the operator the ability to execute and operate Manual Jog mode. The selectable fields are as follows:

**Execute** - This field will execute the mode. The ARROW KEYS ACTIVE message will display on this screen in response to indicate that the arrow keys can now be used to move the antenna. The right and left arrow keys move azimuth CW and CCW respectively. The up and down arrow keys move elevation up and down respectively.

**Slow/Fast** - This toggle field sets the antenna speed. For slow, the antenna speed is 1/10 full rate. For fast, the antenna speed is full rate.

**POL CW and POL CCW** - When polarization control is active, these pushbutton fields allow the operator to jog the polarization axis. Since all the cursor keys are used in driving the azimuth and elevation axes when Jog mode is active, the pushbuttons are used to jog the remaining axis, .

## 2.9 TRACK

The Track Menu contains the following options:

**NOTE:** All tracking types may not be available on some systems.

- *Optrack*
- *Position Track*
- *Geo Track*
- *Steptrack*
- *INTELSAT*
- *Table Track*
- *Memory Track*
- *Norad Track*
- *Satellite Track*

The presence of a question mark at the start of the AZ, EL or POL field indicates that the field is not editable. Track type selected at this screen determines which fields are editable. refer to **“SECTION 4 - Tracking” on page 4-1**

## 2.10 PRESET

The Preset Position menu contains 50 selectable AZ/EL/POL positions.

Execution of the Preset Position mode relocates the antenna to a position defined by the stored positions. Upon mode execution, the

ACU performs a range check of the data set to verify it is within the travel range of the antenna. The antenna is then driven at slew velocity in both axes simultaneously to the commanded coordinates. Each Preset Position can be assigned to any configuration set (1, 50). Enter is used to execute the displayed data set.

0.00	0.00	0.0	Preset	-50.0	FLT
0.00	0.00	0.0			
Preset 1	Az	180.00	El	10.00	Pol 1.0
[Execute]	[Pol ON]				[Store]

### 2.10.1 Preset Position Setup

The Preset screen allows positions to be defined, stored and assigned a number.

The selectable fields are as follows:

**Preset #** - This recalls Azimuth, Elevation and optional POL angles for the displayed set number. Up/Down arrow keys can be used to access sequential preset numbers.

**Store** - This field assigns the window's currently displayed parameters to any Preset number desired (1, 50).

**Execute** - This field will execute the mode.

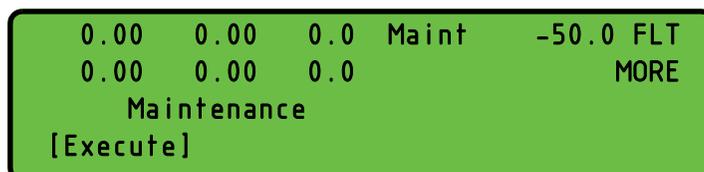
**Azimuth Data** - This field allows the azimuth angle value to be entered.

**Elevation Data** - This field allows the elevation angle value to be entered.

**Polarization Data** - This field allows the Polarization angle value to be entered.

**Polarization** - This toggle field allows the polarization mode to be entered (for polarization systems). Valid options are ON,OFF.

### 2.11 MAINTENANCE



The Maintenance window consists of an Execute field only. The keystroke Enter will allow transfer of control to the Portable Maintenance Unit (PMU).

## 2.12 MESSAGES

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0
      Messages
[Status] [Faults]

```

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0
      Status
LOW SIGNAL  PMU AVAILABLE

```

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Faults
LOAD SITE LOCATION  COMPASS LINK DOWN
                        [Ack Faults]

```

The Message Menu allows the operator to view all current Fault and Status messages. For a complete listing of Standard Status Messages, see **Section 6, "Standard Status Messages" on page 6-1**. For a complete listing of Standard Fault Messages, see **Section 8.5, "Fault Messages" on page 8-5**. Fault and Status messages may be latched to capture short duration or intermittent events. Fault latching can be toggled ON/OFF from the Setup/General Setup menu. To remove a latched fault message, select Acknowledge Fault.

### 2.12.1 Fault Latching

Fault Latching is located at the Setup/General Setup menu. This parameter, when set ON, causes the fault messages to be continually displayed until acknowledged by the operator. If the fault is axis disabling,

```

0.00  0.00  0.0 Standby  -50.0 FLT
      General Setup      17:59:17 MORE
                        Time 17:59:13 H:M:S
Fault latching      [ ON]

```

the axes will remain disabled until the fault is acknowledged. Fault Latching is set to ON to allow the operator to record intermittent or short duration faults. In un-manned situations, Fault Latching can be set to OFF to allow quick recovery from a fault condition. Latched faults may be acknowledged at the front panel of the ACU or remotely via the host computer.

## 2.13 FREQUENCY

```

0.00  0.00  0.0 Standby  -50.0 FLT
Frequency  3.40000 GHz
Offset    0.0 dB  Low Signal -10.0dB
[Pol A]
    
```

```

0.00  0.00  0.0 Standby  -50.0 FLT
Frequency  3.40000 GHz
Offset    0.0 dB  Low Signal -10.0dB
[Pol B]
    
```

The Frequency Screen is used to select the RF Parameters for the current target of interest. See **Section 5.3, "RF Setup" on page 5-4** for additional Tracking Receiver parameters.

### 2.13.1 Low Signal Threshold

Low Signal Threshold – This is entered in dB. If the received signal strength falls below this parameter, a LOW SIGNAL alarm is issued. If the ACU is in Steptrack mode and the Low Signal Threshold is reached, Steptrack will stop and the system will revert to STANDBY mode. If the ACU is in Optrack mode and the Low Signal Threshold is reached, Optrack will continue to operate only if sufficient valid tracking data has been previously gathered. Refer to **Section 4.1, "Optrack" on page 4-1** for a description of Optrack operation with signal loss. "Pointing Only" tracking modes such as Intelsat or Table Track are not affected by the Low Signal alarm.

### 2.13.2 Signal Offset

Used to shift the displayed signal strength. Value is in dB.

### 2.13.3 Frequency Parameter

**Frequency** - Set this parameter to match the beacon signal used for tracking. Value is in GHz.

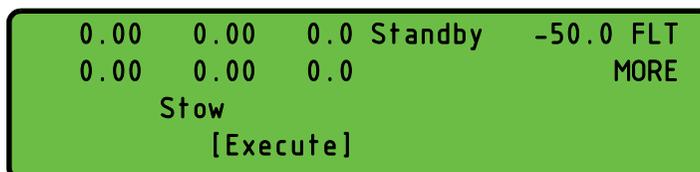
**NOTE:** For systems with Feed Status Switches: Failure to enter a frequency matching the installed feed will result in a Band Conflict Fault.

### 2.13.4 Receiver –1 / Receiver – 2 Select

This parameter is valid for ACU's containing dual internal L-Band or 70 MHz receiver modules. A toggle function selects either RCVR-1 or RCVR-2. If RCVR-1 is selected, then the displayed signal strength is generated from the A2 receiver card. If RCVR-2 is selected, then the displayed signal strength is generated from the A7 receiver card. All RF parameters found in the Frequency and Setup/RF Setup menus apply to each receiver card.

### 2.14 STOW

Stow mode is optional and is not present on all antennas. The Stow screen allows execution of Stow mode. Once executed, Stow goes through a specific sequence of antenna movement. Text on the Stow screen shows the progress of the Stow sequence. There are two available types of Stow, Position and 240MVO. Each Stow type is described in the following text.



#### 2.14.1 240MVO Stow

The 240MVO antenna stows in a “clamshell” configuration for transport. Not all antennas support this method of stowing. 240MVO Stow is accomplished by the following sequence. First, azimuth is driven to the center of the azimuth travel range. The screen displays “AZ Stow” during this portion of the Stow sequence. If the RF feed in place has a polarization drive, the POL axis is commanded to the CCW travel limit. The elevation axis is held disabled.

Once the desired AZ position is reached, as indicated by the occurrence of the AZ STOW ALIGNED status message, and the POL position is reached, as indicated by the presence of the POL STOWED status message, (if applicable based on the RF feed) then these axes are disabled and the elevation axis is driven down. The screen displays “EL Stow” during this portion of the Stow sequence. The stow relays in the PDU bypass the elevation lower limit when Azimuth and POL are in the stow position. Once the antenna is below the Elevation limit, the Azimuth axis is disabled via the travel limits. The fault messages associated with the limits are masked in software during the stow sequence.

As the antenna descends and gets near the trailer platform, the EL VELOCITY LIMIT status indication should occur. In response, the elevation drive slows to 1/10 speed and the elevation torque limit is automatically reduced. The antenna will continue to drive downward in elevation until the dish is firmly seated onto the trailer. The screen displays “EL Stowing” during this portion of the Stow sequence.

As the antenna is depressed into the stow pad, the drive torque increases to the reduced limit, which trips the stowed status. The ANTENNA STOWED status message is displayed. In response, the elevation drive is disabled. From that point on, the screen displays “Stowed”.

The Stow algorithm monitors each stage in the sequence. If it detects an error, it triggers an appropriate fault message and aborts the Stow sequence. The screen displays “Stow Fail” under this circumstance. The possible fault messages related to Stow operation are as follows. See **Section 8.5, “Fault Messages” on page 8-5** for a detailed description.

- PREMATURE STOW
- STOWED OFF TARGET
- EL VEL LIMIT ERR
- STOW INCOMPLETE

Executing Stow mode commands the antenna to factory-defined stow encoder positions.

### **2.14.2 TSM305 STOW**

The TSM305 antenna stows in a “clamshell” configuration for transport. TSM305 Stow executes the following sequence. First, Elevation is commanded to 45 degrees. If the RF feed has a polarization drive, POL is commanded to the CCW travel limit causing a “POL STOWED” status message. Once EL and POL have reached their positions, AZ is driven CW. When AZ reaches 180 degrees (mechanical) the “AZ STOW ALIGNED” status message occurs. Stow relay logic in the PDU bypasses the EL DN Limit when Azimuth Stow Align and POL Stowed occur, allowing EL to be driven down to approximately –50 degrees where the auto-stowed switch activates. The status message “Auto Stow Complete” signals the end of the stow sequence. The antenna can then be re-deployed or handcranked into the transport position.

### **2.14.3 4.6M DMC STOW**

The 4.6M DMC antenna stows in a “clamshell” configuration for transport. 4.6M DMC Stow executes the following sequence. First, POL is commanded to the CCW travel limit causing a “POL STOWED” status message. Once POL reaches it’s stow position, AZ is driven to the trailer centerline. The ACU screen displays “AZ Stow” during this portion of the stow sequence. Once AZ centerline is reached, “AZ STOW ALIGNED” status message occurs and Elevation automatically drives to 22.5 degrees.

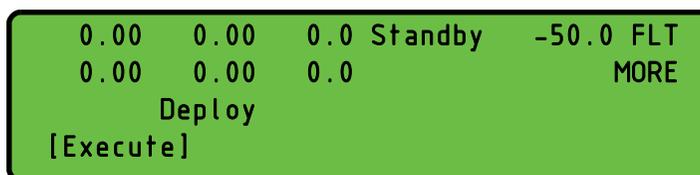
When 22.5 degrees is reached, EL pauses, allowing the operator time to remove the main reflector “wings”. The ACU then allows “Proceed” to be executed, causing EL to continue driving down to –45 degrees. Stow relay logic in the PDU bypasses the EL DN Limit when Azimuth Stow Align and POL Stowed occur. When –45 degrees is reached, EL stow pauses again, allowing the operator time to affix the antenna upper wing locks and raise the feed boom support bracket. The ACU then allows “Proceed” to be executed, causing EL to continue driving down to the stowed position. “EL Velocity Limit” message is displayed as the velocity limit switch is passed, causing the antenna to slow to 1/10 speed. The status message “Stowed” signals the end of the stow sequence.

### 2.14.4 Position Stow

Position Stow drives the antenna to factory defined AZ, EL, and POL stow positions. Each axis is disabled once it reaches the stow position.

## 2.15 DEPLOY

Deploy mode is optional and is not present on all antennas. Deploy mode is used with 240MVO type antennas.



The Deploy screen allows execution of Deploy mode. Once executed, Deploy mode drives the antenna up into the operational region of the antenna to a point 5 degrees above the lower elevation limit. Text displays on the Deploy screen showing the progress of the deployment sequence. “Off Target” will display when Deploy mode is driving to position. “Deployed” will display when it has reached its final position.

Immediately upon Deploy mode execution, the ACU performs auto-calibration using the auto-calibration sensors (GPS, compass and clinometer). If any sensor is not operational, the auto-calibration procedure will be aborted and the CALIBRATION FAIL fault message will display. This does not affect deployment but merely acts to inform the operator that auto-calibration did not occur. Once deployed, execution of any other mode will cause this fault message to clear. See **Section 8.5, "Fault Messages" on page 8-5** for a detailed description.

## 2.16 CALIBRATE

```
0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
      Main Menu
[Stow]  [Deploy] [Calibrate]
```

Calibrate mode updates AZ and EL encoder offsets so that the displayed AZ and EL angles are true for the current antenna location.

Executing Calibrate mode causes the ACU to read all installed Auto-Calibration sensors (GPS, Compass, and Tilt). Calibrate mode also applies any additional operator provided data such as Site Location, Compass Heading, Compass Mark Angle, EL Encoder Offset, and Magnetic Variance. See **Section 3.3, "Manual Calibration" on page 3-5**.

## 2.17 WINDUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0
Windup test
[Execute] Windup Az 0.000 El 0.000
```

Windup is a special Encoder Test mode. See **Section 8.6, "Wind-Up Test" on page 8-11** for more information on this function.

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## ***SECTION 3 - SITE SETUP***

### **3 SITE-TO-SITE SETUP PROCEDURE**

When the antenna is moved to a new operational location, the Control System must be initialized for proper operation. The following discussion details system setup and auto-calibration sensor operation. Refer to *Appendix B - 123T/240MVO* for the 240MVO antenna “quick setup” procedure and *Appendix C - 123T/LHGXA* for the LHGXA Antenna Setup procedure.

#### **3.1 AUTO-CALIBRATION WITH GPS, COMPASS, AND TILT SENSORS**

Auto-calibration orients the antenna at its new location. ***Deploy or Calibrate mode must be executed to complete the auto-calibrate sequence.***

Upon arrival at the new site, the system should be powered ON and all auto-calibration sensors should be verified. These sensors can be monitored via the Messages/Status, Messages/Faults and Setup/Calib screen.

##### **3.1.1 GPS Operation**

Communication between the ACU and GPS Receiver should be verified by observing the absence of the ACU-GPS LINK DOWN fault message in the Messages/Faults screen.

The GPS sensor can take up to 20 minutes to acquire a valid site location. Until the acquisition process is complete, the GPS DATA UNAVAIL message will appear on the Messages/Status screen. Do not attempt to deploy or calibrate the antenna until this message clears.

The GPS antenna must have a clear view of the sky. Obstructions rising higher than 20 degrees from the GPS antenna may interfere with the GPS signal, causing the GPS DATA UNAVAIL message. GPS data is not required after Deploy/Calibrate has been executed.

GPS signal acquisition should be observed a few times so that the operator becomes familiar with the process. GPS Status and Quality feedback can be observed at the Setup/Calib screen, allowing the operator to monitor GPS activity. When the GPS quality value climbs to an acceptable value, the GPS DATA UNAVAIL message will automatically clear.

The Magnetic Variance offsets are applied to the AZ encoder during auto-calibration. Magnetic Variance is calculated by the ACU from site location information generated by the GPS receiver.

If the GPS signal is unavailable for auto-calibration, manually enter your site location and current GMT time as described in ***Section 3.3, "Manual Calibration" on page 3-5.***

The [GPS RESET] pushbutton at the Setup/Calib screen can be used to software-reset the GPS Receiver.

### **3.1.2 Clinometer Operation**

Clinometer operation can be observed at the Setup/Calib menu. “Tilt Fwd/Back” and “Tilt R/L” display the current antenna attitude. If these values are non-zero and they intuitively match the observable slant of the trailer platform, then the clinometer is operating correctly.

**NOTE:** *Pedestal tilts greater than 10 degrees in the X or Y axes may result in degraded system performance.*

Adjust the antenna leveling or stabilizing jacks to achieve tilt within +/- 5 degrees if possible.

### **3.1.3 Compass Operation**

Antenna orientation can be determined using a manual or electronic compass. The compass heading is assumed to be coincident with either the RF line of sight, or more commonly with the main axis of the antenna trailer, depending upon the specific system design.

Compass readings are used by the 123T control system to calculate the antenna's azimuth look angle.

The ultimate accuracy of any compass depends upon several factors including:

1. Magnetic field disturbances (Static, Induced, and Time Varying)
2. Tilt errors (compass tilt that exceeds specification).

Static magnetic field disturbances are caused by proximity to permanent magnets or conductors carrying DC current. Induced magnetic field disturbances are caused by proximity to soft iron or common steel. Time varying magnetic field disturbances can result from any unshielded electrical device. Isolating the compass from these sources reduces their effect on compass accuracy.

Tilt errors occur when the compass is not level with respect to the earth's surface.

The 123T Antenna Control System supports the following compass options:

- KVH-C100
- True North
- Manual
- None

Consult your system documentation to determine the installed compass type.

### 3.1.4 KVH-C100 Compass Overview

The KVH-C100 Compass has a tilt specification of +/- 16 degrees. Compass accuracy is reduced when compass tilt exceeds 16 degrees from level. The KVH-C100 compass is typically mounted in (or on) the antenna main reflector and the compass is nominally level at the main reflector STOW position. This allows for simultaneous compass reading and system calibration upon execution of DEPLOY mode. The magnetic angle returned by the compass is assumed to be coincident with the trailer centerline. Compass information generated after DEPLOY cannot be used by the control system.

#### 3.1.4.1 KVH-C100 Compass Operation

Verify PDU-Compass communication, as indicated by the absence of the COMPASS LINK DOWN fault message. Open the Setup/Calib screen and observe the Compass Heading feedback. Verify Compass operation by cross-checking the Heading feedback against a Hand-Held compass (if available). Compass Noise Score and Environment Count are available at the Setup/Calib screen for KVH-C100 Compass option. Desired values here are 7, 8 or 9. Compass Noise Score and Environment Count indicate the quality of the compass heading value.

**Table 3-1: Compass Noise Score**

NOISE SCORE	HEADING ACCURACY
9	+/- 0.5 degrees
8	+/- 1.0 degrees
7	+/- 2.0 degrees
6	+/- 4.0 degrees
5	+/- 8.0 degrees

If the Compass sensor is installed but has failed, then the Compass Mark angle parameter should be updated to produce a heading that matches measurements taken with a hand-held magnetic compass.

### 3.1.5 True North Compass Overview

The True North Compass has a tilt specification of +/- 40 degrees. Compass accuracy is reduced when compass tilt exceeds 40 degrees from level. The True North compass is typically mounted in (or on) the antenna main reflector and the compass is nominally level at an Elevation look angle of 45 degrees. This allows accurate readings and system calibration to occur at any Elevation angle from 5 to 85 degrees. Systems containing the True North compass option have a separate "Calibrate" mode. Executing "Calibrate" captures the current compass reading and updates the Azimuth look angle calculation.

Compass heading feedback is displayed at the Setup/Calibrate menu. Compass operation can be verified by cross-checking the heading feedback against a hand-held compass (if available). The compass heading is always coincident with the RF line of sight.

If the Compass sensor is installed but has failed, then the Compass Mark angle parameter should be updated to produce a heading that matches measurements taken with a hand-held magnetic compass.

### 3.1.6 Manual Compass Heading

If no compass sensor is installed, then the Compass Heading can be manually input at the Setup/Calibrate menu. The compass heading is typically taken along a line-of-sight that is coincident with the trailer centerline using a hand-held "needle" type unit.

## 3.2 AUTO-CALIBRATION EXECUTION

After GPS, Compass, and Tilt sensor operation has been verified, Deploy or Calibrate mode can be executed. Azimuth and Elevation encoder offsets are calculated by the control system based upon the calibration sensors. The Azimuth and Elevation positions (displayed at the ACU front panel) are calculated as follows:

Displayed AZ Pos. = Raw AZ Encoder Pos. + AZ Encoder Offset.

Where: AZ Encoder Offset = (Compass Angle + Compass Mark Angle + Magnetic Variance + AZ Tilt compensation)

**NOTE:** For level platforms, AZ Tilt compensation is zero. AZ Encoder Offset is recalculated each time Deploy/Calibrate mode is executed.

Displayed EL Pos. = Raw EL Encoder Pos. + EL Encoder Offset + EL Tilt compensation.

**NOTE:** The EL Encoder Offset is static, only the EL Tilt compensation changes upon Deploy/Calibrate.

### **3.3 MANUAL CALIBRATION**

Manual Calibration is the process of manually entering Site Location and/or compass data. Manual Calibration is required on any system not containing a full suite of sensors (GPS, Compass, and Tilt). Manual Calibration is also required if any auto-calibration sensor fails. Executing Deploy or Calibrate mode completes the calibration process.

#### **3.3.1 Site Location**

If GPS is not installed, or GPS failure has occurred, Site LAT and LON will need to be manually input by the operator at the Setup/General Setup menu. LON must be entered in degrees East. After entering Lat/Lon, execute "Set Site" to accept the input. Site location can only be updated when the system is in Standby mode.

#### **3.3.2 Date and Time**

Date and Time are automatically set by the GPS. If GPS is not installed, or GPS failure has occurred, Date and Time may be manually input by the operator at the Setup/General Setup menu. Date and Time are based upon Greenwich Mean Time (GMT). After entering Date and Time, execute "Set Time" to accept the input. Date and Time can only be set when the system is in Standby mode.

Operational note: Intelsat, Norad, Memory, and Table Track require accurate Date and Time. Optrack, Steptrack, GEO, and Position Track do not require accurate Date and Time.

#### **3.3.3 Tilt**

Manual entry of antenna tilt is not available. Recovery from tilt sensor failure is as follows:

1. Disconnect the tilt sensors at PDU connector J4. This will drive the tilt readings to zero.
2. Level the antenna as closely as possible using a bubble level.
3. Replace the tilt sensors when available.

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## ***SECTION 4 - TRACKING***

### **4 TRACKING OVERVIEW**

The 123T antenna control system provides several tracking modes designed to support a wide variety of missions and antenna hardware. Generally, Optrack provides the best tracking performance and has the easiest operator setup. Optrack is the 123T's "Primary" tracking mode. Antennas with poor position feedback should use Steptrack or Memory Track.

Tracking modes can be categorized as "Active signal peaking" or "Position only tracking". Active signal peaking modes (Optrack, Steptrack, and Memory Track) use algorithms to actively maximize receive signal strength, typically by commanding small antenna movements and recording the corresponding signal change. Position Only tracking modes (Norad, Intelsat, and Table Track) drive the antenna to calculated Azimuth and Elevation positions generated from equations and operator input data. Norad, Intelsat, and Table Track do not require RF signal input for operation.

There are two "hybrid" tracking modes, GEO and Position. GEO Track allows input of the satellite LON as a tracking start position, automatically performs a search scan, then executes either Optrack (if enabled) or Steptrack.

Position Track is the same as GEO, except Position allows input of satellite AZ and EL predict angles for the tracking start position.

"Satellite" Track allows choice of 1 to 10 pre-configured satellite targets from a satellite database listing. Any tracking mode (Optrack, Steptrack, Memory Track, Norad, Intelsat, Table Track, Position or GEO) can be preset into the satellite database.

#### **4.1 OPTRACK**

Optrack is the Model 123T ACU's primary tracking mode. It provides for AZ, EL, and POL tracking of geosynchronous targets. Tracking data is gathered, normally via Steptrack, and stored. This data is used to form an ephemeris model. The combination of active tracking data and ephemeris model is used to optimally position the antenna in the presence of wind, fade and other disturbances.

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[Optrack ]           [Pos Pol][Execute]
    
```

The standard Optrack sequence is as follows. Optrack begins (step) tracking on a new satellite. Continuous tracking occurs for approximately 10 minutes. Steptrack then continues tracking at periodic intervals of not greater than 10 minutes for the first one or two hours. The frequency of tracking during this period is primarily determined by the satellite dynamics, with higher dynamics requiring more frequent tracking. After this period, Optrack has sufficient information to begin dynamically estimating the satellite position, resulting in greatly improved tracking stability and accuracy. Loss of signal at this time causes Optrack to continue to estimate the trajectory for 30 minutes. As data gathering continues, the accuracy and longevity of the predictions increase with significant improvements occurring at 12 and 24 hours. After 24 hours of data, ephemeris extrapolation is valid for 72 hours without further data.

Optrack status messages (OPTRACK 12HRS GOOD and OPTRACK 24HRS GOOD) will display to indicate when the Optrack process has stored 12+ hours and 24+ hours of tracking data respectively. The typical scenario is for Optrack to start with a "clean slate" and thus these messages should occur at the 12 and 24 hour mark. Atypical scenarios will occur when Optrack mode is exited and reentered. The time space between Optrack mode actions creates "holes" in the internal Optrack tracking data table. The algorithm has logic to deal with the non-continuous data table created by these "holes" and the 12HRS GOOD and 24HRS GOOD status will still occur if sufficient data exists to offset these "data holes". The operator should be aware of the fact that even though Optrack has been used for 24+hours, the 24HRS GOOD message may not occur until some time later if an operational action has caused "holes" in the data table.

There are three conditions that will cause automatic clearing of stored optrack data. First, if Optrack is executed after entering a new AZ/EL position coordinate that is greater than 2 beam widths away from the last stored optrack data point, then any Optrack data previously gathered will be automatically cleared by the control. Second, if Optrack is executed and the 24 Hours Valid Data message has not occurred, then existing optrack data will be automatically cleared if more than one hour has elapsed from the last stored data point. Third, if more than 14 days have elapsed from the last stored data point, the Optrack data will automatically be cleared.

Unusual tracking conditions may require the operator to manually clear the Optrack data set before the Optrack mode can be made active. To clear the existing Optrack data set, select Setup/Track and execute "Clear".

It is good practice to manually clear Optrack data upon satellite changeover when using Optrack on multiple satellites.

Certain Optrack fault and status messages may highlight the need to clear the Optrack data. The OPTRACK DATA OLD message indicates that it has been a long time since Optrack has been used to track the satellite whose tracking data Optrack currently has stored. The time period associated with this message is a function of how much tracking data exists. The maximum tracking data stored covers a 3 day period and under this scenario would take 9 days of being idle for this message to appear. The basic rule is 3 days for every 1 day of tracking data. The OPTRACK TBL ERR and OPTRACK DATA ERR faults indicate that unexpected data points have been found in the tracking table. These faults should not occur under normal circumstances. Certain events like time changes made by the operator, unstable position feedback or Optrack operation on multiple satellites are typically checked first to troubleshoot these fault messages.

All messages in the prior paragraph will clear once the Optrack data set has been manually cleared.

#### 4.1.1 Backup Track Mode

This parameter is not active on all systems. If active, it can be found at the Setup/General Setup menu. Backup Tracking modes are operator selectable, and command the control to Optrack, Memtrack, or Standby in the event AZ or EL axis velocities exceed 50% of slew speed during a Optrack or Memtrack operation.

#### 4.1.2 Optrack Execution

Stand-alone Optrack mode can be executed from the Track menu. Optrack mode (by itself) does not have an automatic search Scan if the satellite beacon signal is not present. When executing Optrack, the assumption is made that the antenna has been pre-positioned close enough to the satellite beam center so that the received signal is above the Low Signal Threshold. Satellite acquisition by search Scan can be achieved by executing GEO or POSITION Track. Each of these tracking modes executes a search scan if the satellite beacon signal is below the Low Signal Threshold setting.

### 4.2 POSITION TRACK

Position Track is a hybrid tracking mode which allows entry of AZ, EL, and (optional) POL starting Coordinates. Upon execution, the antenna will drive to the starting coordinates. When the antenna

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[Position ]           [Pos Pol][Execute]
    
```

arrives at the start coordinates, the control enters Optrack if a signal is found that is above the low signal threshold. If the signal is not above low signal threshold, then the control will enter BOX SCAN mode. See **Section 4.10.1, "Box Scan" on page 4-9** for a description. Position Track is executed by selecting "Position" at the Track menu.

### 4.3 GEO TRACK

Geo Track is a second hybrid tracking mode which is identical to Position Track with two exceptions. First, Satellite Longitude is entered instead of Satellite AZ/EL (The LON parameter only exists when GEO

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[Geo   ]                [Pos Pol][Execute]
    
```

Track is selected). The control automatically computes AZ/EL starting coordinates based upon this longitude. Second, additional POL options are available. If POL is commanded to ON, then three POL choices exist. They are "POS POL", "VERT POL" and "HORZ POL". If POS POL is selected, then the POL angle field becomes editable and the operator can specify a starting POL angle. If VERT POL or HORZ POL is selected, then the starting POL position is determined using the satellite longitude and polarization type (Horizontal or Vertical).

Upon execution of GEO Track, the antenna moves to the starting position and enters either Optrack or Box Scan as described in **Section 4.2, "Position Track" on page 4-3**. Geo Track is executed by selecting "Geo" at the Track menu.

### 4.4 STEPTRACK

Steptrack is one of the Model 123T ACU's secondary tracking modes. It is normally used only as part of Optrack's data gathering sequence. It can, however, be executed as a stand-alone tracking mode when there is a problem with the encoder pickoffs which prohibit optrack from developing an accurate model of the satellite ephemeris.

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[Steptrac ]            [Pos Pol][Execute]
    
```

### 4.5 INTELSAT

The INTELSAT mode provides selection of the desired target via Operator Input INTELSAT II data set. The INTELSAT data may be changed in the Setup/INTELSAT menu. INTELSAT mode requires accurate Latitude and Longitude site location parameters for proper operation. INTELSAT data can be further adjusted to compensate for low look angle effects by setting Refract ON in the Setup/General Setup menu (see **Section 4.5.2, "Refract Correction" on page 4-5**).

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[Intelsat ]            [Pos Pol][Execute]
    
```

### 4.5.1 INTELSAT Setup

The INTELSAT Setup window allows selection and entry of the INTELSAT parameters. The selectable fields follow.

**Store** - This saves the current INTELSAT data. (Unlike most ACU parameters, the Intelsat values are not loaded immediately upon operator entry. This is because they must be loaded as a set and verified against a LAT and LON “check values”).

**Erase** - This field clears all of the INTELSAT parameters.

**INTELSAT Parameters** - LM0, LM1, LM2, LONC, LONC1, LONS LONS1, LATC, LATC1, LATS, and LATS1 are the parameters provided by INTELSAT to describe the orbital ephemeris.

**Epoch** - This field lists the time used to compute the reference INTELSAT answer used to verify the INTELSAT data set.

**Check LAT and LON** - These fields represent the INTELSAT reference answer at the time Hours After Epoch. Correct values are required to enter an INTELSAT set.

### 4.5.2 Refract Correction

This parameter enables the Refraction Correction algorithm, which adjusts the antenna look angle to correct for atmospheric refraction of the RF path at low look angles. This is useful when using Table Track or INTELSAT Track modes. When enabled, the displayed elevation angle will include the refraction corrections. Refract Correction is found in the Setup/General Setup menu.

### 4.6 TABLE TRACK

Table Track mode exists primarily to allow an operator to manually input time-tagged AZ/EL position angle data points. The table is capable of storing up to 144 points per axis.

These data points can represent an ephemeris and the filled table then could be used for Stand-alone tracking. The data points can also be used as an easy way to program multiple satellite locations for automatic positioning requirements. The operator may command the mode to derive linearly interpolated position commands between table values to continuously position the antenna.

```

0.00  0.00  0.0 Standby  -50.0 FLT
      Track
AZ=?  0.00  El=?  0.00  Pol=?  0.00
[TabTrack ]           [Pos Pol][Execute]
    
```

### 4.6.1 Table Track Setup

The Table Track Setup window (Setup/Table) allows selection and entry of the time-tagged data points. The selectable fields are defined as follows.

**Erase** - This field deletes the entire contents of the Table Track data table set currently displayed.

**Interp On** - This field toggles the interpolate function ON/OFF. If the interpolate is ON, the movement between time-tagged data points is linear. If the interpolate is OFF, the ACU holds the position of the last time-tagged data point until such time that a new time-tagged data point is reached.

**POL Axis** - This field toggles the POL axis tracking ON/OFF.

**Pt#** - The table associated with table track has 144 possible points. Any of these points can be made to display on-screen by entering its value in this field. In addition, the arrow keys can be used, when the cursor is positioned on this field, to scroll through the table.

**Table Day/H/M/S** - This field selects the Julian Day (1 to 365 or 1 to 366 on leap year), Hour, Minute, and Second of the data point. The format is DD/HH/MM/SS.

**Table AZ** - This field allows input of the AZ angle data point. Angle positions of 0 to 359.999 may be entered.

**Table EL** - This field allows input of the EL angle data point. Angle position of 0 to 359.999 may be entered.

**Table POL** - This field allows input of the POL angle data point. Angle positions of 0 to 359.9 may be entered.

## 4.7 MEMORY TRACK

Memory Track mode is used for actively tracking geosynchronous satellites. It works on the principle that a geosynchronous satellite's trajectory does not differ significantly from day to day. While tracking, the satellite's position is stored over time. Enough position data is always maintained so that Memory Track mode knows where the satellite traveled over the course of the previous day. Memory Track mode then merely repeats yesterday's trajectory (sidereally corrected) today.

AZ/EL tracking data is stored in the Memory Track data table. Tracking data is loaded when the ACU is in Memory Track mode. Memory Track uses Steptrack to gather data points. New data points are loaded into the table each time an active steptrack cycle completes. This "time-tagged" tracking data is used to determine the commanded position.

The Memory Track table is free form. This means that the points are placed in the table in order, but the points are not spaced in equal time intervals. An average of three days of tracking data storage is provided. The operator has the ability to clear the Memory Track table from the ACU console. Executing calibrate mode will also clear the memory track table. Cycling power at the ACU does not affect the Memory Track Data. There is only one Memory Track table. The operator should manually clear the Memory Track table when switching from one satellite to another.

A check is performed on all points in this data table. The basis of the check is to perform a fit to the data and then observe the “quality of fit”.

When the Memory Track table check finds poor data, it causes a fault indication. The Memory Track data collection and table check processes only when in Memory Track mode and so this message will only appear then. The indication will not clear until the data table is cleared using /Setup/Track Setup/Clear. If this fault indication exists and Memory Track mode is entered, both axes will be disabled.

The typical Memory Track operational sequence is as follows. The Memory Track table is cleared and the antenna is positioned on the satellite to be tracked. Memory Track mode is entered and maintains position on the satellite using Steptrack for a 24 hour period. After 24 hours, enough data points have been gathered by Memory Track to begin predicting the satellite. The appearance of the MEMTRACK AVAILABLE status message indicates that Memory Track has enough data in the table to make valid predictions. At the point, tracking performance improves since steptracking is required less frequently; only enough to continue to gather some data to maintain the prediction capability.

#### 4.8 NORAD TRACK

This mode generates pointing angles that dynamically command the trajectory of a NORAD object as defined by a NORAD two-line element set. NORAD mode requires accurate Latitude and Longitude site location parameters for proper operation. The 123T ACU can store up to ten NORAD data sets. Due to the complexity of the NORAD elements, each data set must be loaded from a supervisory computer. There are no provisions for hand entry of NORAD data from the ACU front panel keypad. NORAD data sets can be selected from the TRACK menu by soft-key toggle function.

#### 4.9 SATELLITE TRACK

“Sat” tracking mode can be executed from the Track menu. Sat tracking allows the choice of 1 to 10 pre-configured satellite targets from a satellite database listing.

```

0.00 0.00 0.0 Standby -50.0 FLT
Track
AZ=? 0.00 El=? 0.00 Pol=? 0.00
[Sat ][SATNAME 1][Pos Pol][Execute]

```

Refer to **Section 5.11, "Satellite Database" on page 5-8** for more information.

## 4.10 SATELLITE ACQUISITION

Geo Track mode is recommended for first-time satellite acquisition. Geo Track requires input of the satellite LON, Beacon Frequency, and Low Signal Threshold. Automatic SCAN mode occurs if the satellite is not at the initial prediction point.

A word of caution concerning the Low Signal Threshold found at the Freq screen. This value must be set properly in order for the satellite acquisition logic that is a part of Geo Track to work. It must be set so that when the antenna is positioned on the noise floor, a LOW SIGNAL status message occurs, and when the antenna is positioned on a satellite signal rising above the noise floor, the LOW SIGNAL message is not displayed. If the noise floor changes from site-to-site, this parameter may need to be adjusted.

Geo track mode drives to the AZ/EL position associated with the entered LON. If a signal is found that is above Low Signal Threshold, Optrack begins. If a signal is not found that is above Low Signal Threshold, then the system automatically performs a box scan. It covers the full area of the box and returns to the highest signal level that it encounters, unless that signal level is less than the Low Signal Threshold. At that point, and from then on, the system begins actively tracking this satellite.

The size of the scan box is set via the Box Scan Size parameter located on the Setup/Track Setup screen. This value is the side-to-side box size in degrees. Setting this value too large can mean a long wait for satellite acquisition while the box scan takes place. Setting this value too small can mean not finding the satellite at all. A number of factors come into play in determining what the box size should be including satellite inclination, compass inaccuracy and axis velocities. Experience is likely to be the best determiner of which size box you prefer to use.

Once you are positioned on a satellite, you can use that satellite to “tweak” the Azimuth and Elevation encoder offsets. This will improve pointing accuracy and make it easier to move between satellites. Refer to **Section 4.10.2, “EL Encoder Offset and Compass Mark Angle” on page 4-9** for a detailed description of this procedure.

### 4.10.1 Box Scan

Box Scan is a target acquisition mode that is automatically called by either Position Track or Geo Track. Box Scan parameters are automatically calculated by the ACU, and are based upon the antenna's beamwidth. One user-defined Box Scan parameter is available, Box Scan Size. The Box Scan Size parameter is located at the Setup/Track Setup screen. This value is the final side-to-side box size in degrees (1-20). Setting this value too large can mean a long wait for satellite acquisition while the box scan takes place. Setting this value too small can mean not finding the satellite at all. A number of factors come into play in determining what the box size should be including satellite inclination, compass inaccuracy and axis velocities. Experience is likely to be the best determiner of which size box you prefer to use.

If a signal above the low signal threshold is detected during Box Scan, then the control will return to the highest detected signal after the scan is completed and enter Optrack. If no signal (above Low Signal Threshold) is detected by the scan, then the scan will end by returning the antenna to the starting point and holding position.

### 4.10.2 EL Encoder Offset and Compass Mark Angle

The Antenna Control Unit applies pointing adjustments automatically each time the antenna is deployed or "Calibrate" mode is executed. (Refer to **Section 2.15, "Deploy" on page 2-18** and **Section 2.16, "Calibrate" on page 2-19**.) The automatic adjustments are offsets generated to compensate for platform tilt (x,y), platform direction (North/South/East/West), and platform location (LAT, LON). Tilt sensors mounted to the antenna platform measure the platform's x-y tilt, a Heading sensor is used to measure the platform's direction, and a GPS receiver is used to measure the platform's location. Due to inaccuracies in each sensor, (Tilt, Heading, and GPS), additional AZ/EL offsets can be manually applied to refine the antenna's pointing angle, resulting in faster satellite acquisitions. The adjustments are typically applied through the Elevation Encoder Offset parameter (Setup/EL Setup menu, and the Compass Mark Angle parameter (Setup/Calib menu).

**NOTE:** *The EL encoder offset and Azimuth mark angle adjustments are held in non-volatile memory. These parameters will modify the antenna's pointing angle at each deployment or Calibration.*

Adjustment of these parameters should be attempted ONLY after all other antenna installation steps have been completed and all RF equipment has been installed. The adjustment procedure is as follows:

Find a satellite with known AZ and EL look angle for your site location. The satellite should be greater than 10 degrees above the horizon to avoid effects from atmospheric refraction. Peak the signal, then compare the known position with the displayed Azimuth and Elevation coordinates. Apply an Elevation Encoder Offset to make the displayed Elevation angle match the known Elevation position. Calculate a Compass Mark angle adjustment that will make the displayed Azimuth angle match the known Azimuth position.

**NOTE:** *The ACU must be in Standby Mode before a mark angle change will be accepted.*

Enter, then store the mark angle. The displayed Azimuth angle will not change until the antenna has been re-Calibrated. Calibration can be executed in two different ways, dependant upon the antenna type being used.

- For 240MVO antennas, re-Calibration occurs when Deploy mode is executed. Stow the antenna, then re-deploy to the satellite of interest.
- For non-240MVO antennas, Execute Calibrate mode.

The control system should now rapidly peak the signal. Refer to your Site Acceptance test procedure for more information on this procedure.

Azimuth and Elevation encoder adjustments have greatest utility if they are recalculated each time the antenna is moved.

## SECTION 5 - SETUP

### 5 SETUP

The Setup Menu contains the following options:

**NOTE:** Some menus may not be available dependent upon the system configuration.

- General Setup
- Track Setup
- RF Setup
- Actions

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
          Setup
[General] [Track]   [RF]   [Actions]
    
```

- AZ Setup
- EL Setup
- Table

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
          Setup
[AZ]      [El]                               [Table]
    
```

- Intelsat Menu
- Calibration
- Version Screen

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
          Setup
[Intelsat] [Calib] [Version]
    
```

- Satellite Database

```

0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0                               MORE
          Setup
                               [Satellite]
    
```

## 5.1 GENERAL SETUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
General Setup      17:59:17 MORE
Time 17:59:13 H:M:S
[Set Time]       Date 01:09:2000 M:D:Y
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
General Setup      17:59:17 MORE
Time 17:59:13 H:M:S
Fault latching    [OFF]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
General Setup      17:59:17 MORE
Time 17:59:13 H:M:S
Fault latching    [ ON]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
General Setup      17:59:17 MORE
Time 17:59:13 H:M:S
[Set Site] Lon 88.00 [W] Lat 48.00 [N]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
General Setup      17:59:17 MORE
Time 17:59:13 H:M:S
[Set Site] Lon 88.00 [E] Lat 48.00 [S]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
      General Setup      18:00:00 MORE
                        Time 17:59:13 H:M:S
Refract Correct      [OFF]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
      General Setup      18:00:00 MORE
                        Time 17:59:13 H:M:S
Refract Correct      [ON ]
```

This menu allows the following actions:

- Set Site Location and Time  
(Refer to **Section 3.3, "Manual Calibration" on page 3-5**).
- Turn Fault Latching On/Off  
(Refer to **Section 2.12.1, "Fault Latching" on page 2-14**).
- Turn Refract Correction On/Off  
(Refer to **Section 4.5.2, "Refract Correction" on page 4-5**).

## 5.2 TRACK SETUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
Track Setup
Box Scan Size  6.0
[Clear]
```

This menu allows the following actions:

- Set the Box Scan Size  
(Refer to **Section 4.10.1, "Box Scan" on page 4-9**).
- Clear existing Optrack data  
(Refer to **Section 4.1, "Optrack" on page 4-1**).

## 5.3 RF SETUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
RF Setup                                     MORE
RF Bandwidth           [4.0 kHz]
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
RF Setup                                     MORE
Band 1 Range  3.400 GHz to 4.200 GHz
```

```
0.00  0.00  0.0 Standby  -50.0 FLT
RF Setup                                     MORE
Band 1 BDC Freq           2.450 GHz
```

This menu allows the following actions:

- Set the L.O. Frequency  
(Refer to **Section 5.12, "LO Frequency" on page 5-9**).

- Band 1 BDC Freq 2.450 GHz
- Band 2 BDC Freq 6.300 GHz
- Band 3 BDC Freq 10.000 GHz
- Band 4 BDC Freq 10.500 GHz
- Band 5 BDC Freq 10.750 GHz
- Band 6 BDC Freq 11.250 GHz
- Band 7 BDC Freq 19.250 GHz
- Band 8 BDC Freq 19.750 GHz
- Set the RF Bandwidth  
(Refer to **Section 5.13, "RF Bandwidth" on page 5-10**).
  - 4.0 kHz
  - 280 kHz
  - 2.5 kHz
  - Band 1 Range 3.4 GHz to 4.200 GHz
  - Band 2 Range 7.250 GHz to 7.750 GHz
  - Band 3 Range 10.950 GHz to 11.450 GHz
  - Band 4 Range 11.450 to 11.700 GHz
  - Band 5 Range 11.700 GHz to 12.200 GHz
  - Band 6 Range 12.200 GHz to 12.750 GHz
  - Band 7 Range 20.200 GHz to 20.700 GHz
  - Band 8 Range 20.700 GHz to 21.200 GHz

#### 5.4 ACTIONS



This menu controls system parameter backup to floppy disk. See **Section 8.3.1, "ACU Parameter Back-up To 3.5" Floppy Disk" on page 8-2** for instructions on this function.

## 5.5 AZ SETUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
      Az Setup
Encoder Position  0.000 Degs
```

## 5.6 EL SETUP

```
0.00  0.00  0.0 Standby  -50.0 FLT
      El Setup
Encoder Position  0.000 Degs
Encoder Offset    0.000 Degs
```

These menus display the current AZ and EL raw encoder feedback, and allow manual offset of the Elevation Encoder position.

## 5.7 TABLE

```
0.00  0.00  0.0 Standby  -50.0 FLT
Table Pt# Day.h.m.s          Pol
1
[Execute][Interp ON ][Pol OFF]
```

This menu allows optional Table Track data to be input. See **Section 4.6.1, "Table Track Setup"** on page 4-6 for more information on the Table Track function.

## 5.8 INTELSAT MENU

```
0.00  0.00  0.0 Standby  -50.0 FLT
      Intelsat 11 Parameter Set      MORE
Lm0  201.0000      Lm1  0.0000
Lm2   0.00000
```

This menu supports the optional INTELSAT tracking mode. See **Section 4.5, "INTELSAT" on page 4-4** for more information on these parameters.

## 5.9 CALIBRATION

```
0.00  0.00  0.0 Standby  -50.0 FLT
0.00  0.00  0.0      MORE
Calibration
Tilt Fw/Back 0.00  Tilt R/L 0.00
```

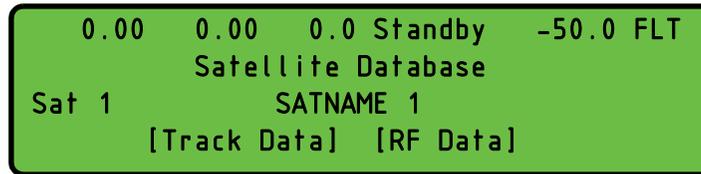
This screen supports monitor and control of the sensors used to auto-calibrate the antenna system. The auto-calibration sensors include the GPS receiver, the compass, and the dual-axis clinometers. See **Section 3, "Site-To-Site Setup Procedure" on page 3-1** for more information on these parameters.

## 5.10 VERSION SCREEN

```
Vertex RSI
Controls and Structures Division
Version: 1.305.1.55  2004/11/23 17:55:37
PDU Rev: 1.23      2005/01/04 12:03:22
```

This screen displays the installed ACU software version.

## 5.11 SATELLITE DATABASE



The Satellite Database allows the operator to pre-configure up to 10 satellite targets to store for later execution. Satellite configurations can be edited in the Setup/Satellite menu. Targets are designated 1 thru 10, and have both Track and RF Data components.

### 5.11.1 Satellite Database – Track Data

The Satellite Database - Track Data menu allows the operator to associate a particular tracking type with each satellite preset. Any available tracking mode can be selected.

Common tracking options include Position Track, Geo Track, Intelsat, Norad Track and Table Track.

- If Position Track is selected, the initial AZ/EL/POL pointing angle to the target can be stored and automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack, Memtrack, or Steptrack (depending upon system configuration) after a successful SCAN.
- If Geo Track is selected, the initial target LON can be stored and automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack, Memtrack, or Steptrack (depending upon system configuration) after a successful SCAN.
- If Intelsat Track is selected, the initial AZ and EL pointing angle is calculated from the stored Intelsat data set. Automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack, Memtrack, or Steptrack (depending upon system configuration) after a successful SCAN.
- If NORAD Track is selected, the initial AZ and EL pointing angle is calculated from the stored NORAD data set. Automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack, Memtrack, or Steptrack (depending upon system configuration) after a successful SCAN. Any one of up to ten NORAD data sets can be selected.
- If Table Track is selected, the initial AZ/EL/POL pointing angle is calculated from the stored Table Track data set. Automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack, Memtrack, or Steptrack (depending upon system configuration) after a successful SCAN.

Other Tracking modes can also be attached to a Satellite preset. However, the remaining modes are less useful to the operator because they do not have the ability to specify initial pointing angles to the target.

- If MemTrack is selected, the initial AZ/EL/POL pointing angle is the current AZ/EL/POL position. Automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Memtrack after a successful SCAN.
- If Optrack is selected, the initial AZ/EL/POL pointing angle is the current AZ/EL/POL position. Automatic SCAN will occur if the beacon signal is not acquired. Tracking will default to Optrack after a successful SCAN.

### **5.11.2 Satellite Database – RF Data**

The Satellite Database - RF Data menu allows RF parameters to be stored with each satellite preset. Each RF Data set allows the operator to specify the following:

- Satellite Beacon Frequency,
- Down Converter Local Oscillator Frequency, (Applies to Internal L-Band Receivers only)
- Low Signal Threshold,
- Signal Offset,
- Receiver Bandwidth.

### **5.12 LO FREQUENCY**

This parameter is valid for ACU's containing the Model 250 internal L-Band Receiver card. The LO Frequency parameter should be set to match the antenna's BDC Local Oscillator frequency (in MHz). Consult your BDC documentation for actual LO frequency used.

The ACU uses the LO Frequency to calculate the tracking signal frequency (in L-Band).

For ACU's with an internal 70 MHz card or external tracking receiver, this parameter is not applicable.

Up to eight LO frequencies (and associated receive band) can be predefined in a down-converter table. This feature is primarily used with multi-band antennas that contain several down-converters.

When the FREQUENCY parameter changes, the associated LO parameter automatically loads from the down-converter table, eliminating the need to hand enter the LO parameter each time a band change occurs.

Refer to Section 7, RF Options, for more information on the tracking receiver function.

### **5.13 RF BANDWIDTH**

This parameter allows selection of the predetection receiver bandwidth. Parameter toggles between 2.5, 4.0, and 280 kHz. Valid for VertexRSI receiver types only. Narrower bandwidths will increase the receiver's S/N ratio. The 4.0 KHz bandwidth allows the system to track modulated beacons. The 280 KHz bandwidth allows the system to track on carriers.

## ***SECTION 6 - STATUS MESSAGES***

### **6 STANDARD STATUS MESSAGES**

The following lists the status messages displayed by the ACU and reported to the System Computer.

<b>ACU-PDU Link Reset</b>	The ACU-PDU communications were disrupted and the link was restarted. Normal operation is available. This message is normal upon power up of either unit, but is an indication of a communications problem if it occurs frequently.
<b>Antenna Stowed</b>	The antenna is fully stowed. The final stow condition is achieved by driving the antenna into the resting pads with adequate force to prevent it from moving during transportation. When the current command (torque) exceeds the stow threshold, the drives are disabled and the antenna stowed message is displayed.
<b>AZ Disabled, EL Disabled</b>	The AZ or EL axis is not active and the axis brake, if available, is set.
<b>AZ Stow Aligned</b>	The azimuth axis is positioned in its stow region. At this point, the elevation axis can be driven down below the elevation travel limits and into its stow position flush with the trailer.
<b>Battery Test Fail</b>	This ACU hardware test is performed upon power up. One or more of the power supply voltages is out of tolerance if this message appears. Return to Depot for replacement of the ACU battery.
<b>EL Velocity Limit</b>	This message indicates that a switch has closed to inform the system that the elevation axis is at a position very near its final stow position, level with the trailer. In this region, the elevation drive scales back on its velocity so that the antenna completes the stow process by "clamshelling" snugly to the pads on the trailer.
<b>GPS Data Unavailable</b>	The message indicates that the GPS Antenna and Receiver are not at present providing a valid site latitude and longitude. Depending on where the GPS antenna is mounted, this status message can occur during normal operation since the deployed antenna often blocks the antenna's view of the sky. However, while stowed, this message should not exist as then the antenna must have a clear view of the sky. The exception being that for a few minutes after the system is powered ON, the GPS antenna has not yet had time to acquire the GPS constellation and this message will display until it has completed acquisition. Wait for this status message to clear before deploying the antenna.
<b>INTELSAT Data Dated</b>	This indicates that the INTELSAT data in use is more than seven days old. INTELSAT parameters are normally updated at least weekly, and the parameters should be loaded as often as available to maintain optimum performance.
<b>INTELSAT Data Early</b>	The present time is before the epoch time of the INTELSAT data in use. Thus, the data is not yet valid. Better performance is available with data valid for the current time.

<b>Low Signal</b>	This message indicates that the signal strength is below the tracking threshold. Tracking is inhibited until the signal returns to the valid range. This may be an error if the Low Signal Threshold has not been set properly or if the tracking signal that has not been properly scaled. The signal is scaled using the Scale Offset parameters found in the Freq screen. The Low Signal Threshold exists on this screen also. Other possible causes of this message include sources such as loss of signal strength through the RF path (LNA failure, etc.), satellite beacon or transponder turned off. This message will naturally occur during target switching since no signal will be available while between targets. If this fault does not clear when the new target position is reached, corrective actions include manual scanning to find the target, rechecking the predicted position, and verifying that the frequency is correct.
<b>No Feed Detected</b>	This message occurs if the Feed Status option is active and no valid feed type indicators are detected by the PDU.
<b>Optrack 24 Hours Good</b>	This indicates that 24 hours of valid Optrack data is available. Extended tracking outages will not prevent continued ephemeris prediction. Full Optrack performance is now in effect.
<b>Optrack 12 Hours Good</b>	This message indicates that 12 hours of Optrack data is available. Optrack can now predict the ephemeris for up to 24 hours with sufficient accuracy to provide immediate reacquisition.
<b>Optrack Coeffs Available</b>	This message indicates that valid Optrack data table exists for the data set in use by Optrack. An ephemeris is available for immediate tracking. Optrack will continue pointing for extended time periods should an RF outage occur.
<b>Optrack Data Old</b>	This message indicates that the Optrack data set does not have recent tracking data. The meaning of 'recent' data changes depending on the amount of data in the Optrack table, but the minimum time before this message occurs is two days. Typically the data must be closer to one week old. The accuracy of the predictions degrades rapidly after this time, so full performance is not available until more tracking data can be gathered.
<b>PMU Available</b>	The Portable Maintenance Unit is plugged in.
<b>PMU in Control</b>	The Portable Maintenance Unit has control of the axes. When this status message is present, control from the ACU is not possible until control is released by the PMU.
<b>Power Supply Test Fail</b>	This test is performed upon ACU power up. One or more of the ACU power supply voltages is out of tolerance if this message appears.
<b>Unacquirable Signal</b>	The received signal strength is not strong enough to allow Steptrack operation. This can be set in units of dB by the Low Signal Threshold parameter found in the Setup→Track Setup window.

## 6.1 LINEAR POLARIZATION MESSAGES

<b>POL Disabled</b>	The POL axis is not active and the axis brake, if available, is set.
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## 6.2 CIRCULAR POLARIZATION MESSAGES (OPTIONAL)

<b>Left Circular POL</b>	The Polarization mechanism has been commanded to the Left Circular configuration.
<b>Right Circular POL</b>	The Polarization mechanism has been commanded to the Right Circular configuration.

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## SECTION 7 - CONTROL SYSTEM

### 7 CONTROL SYSTEM COMPONENTS

The following paragraphs provide information on other system components supplied with the servo system.

#### 7.1 PORTABLE MAINTENANCE UNIT

The Portable Maintenance Unit (PMU) is a microprocessor independent unit with the controls and status indicators to execute manual motion control for azimuth, elevation, and POL. The unit has a 25 or 50 ft. pendent cable and connector that may be interfaced at the Power Drive Unit (PDU). The PMU is capable of performing these operations as an autonomous, hand-held unit and is functionally and physically independent of the Antenna Control Unit (ACU) and microprocessor position loop closure electronics of the PDU. The PMU is offered control when the ACU enters the Maintenance mode. Also, the PMU is automatically offered control by default when the ACU or PDU position loop electronics are powered down.

The front panel of the hand held PMU is shown in the “**Portable Maintenance Unit (10988-)**”, **Fig. 7-1 on page 7-2.**

The PMU is a maintenance tool and is not designed for extensive usage. The unit is water resistant and may be used in outdoor conditions, but should not be stored outdoors.

##### 7.1.1 Controls and Indicators

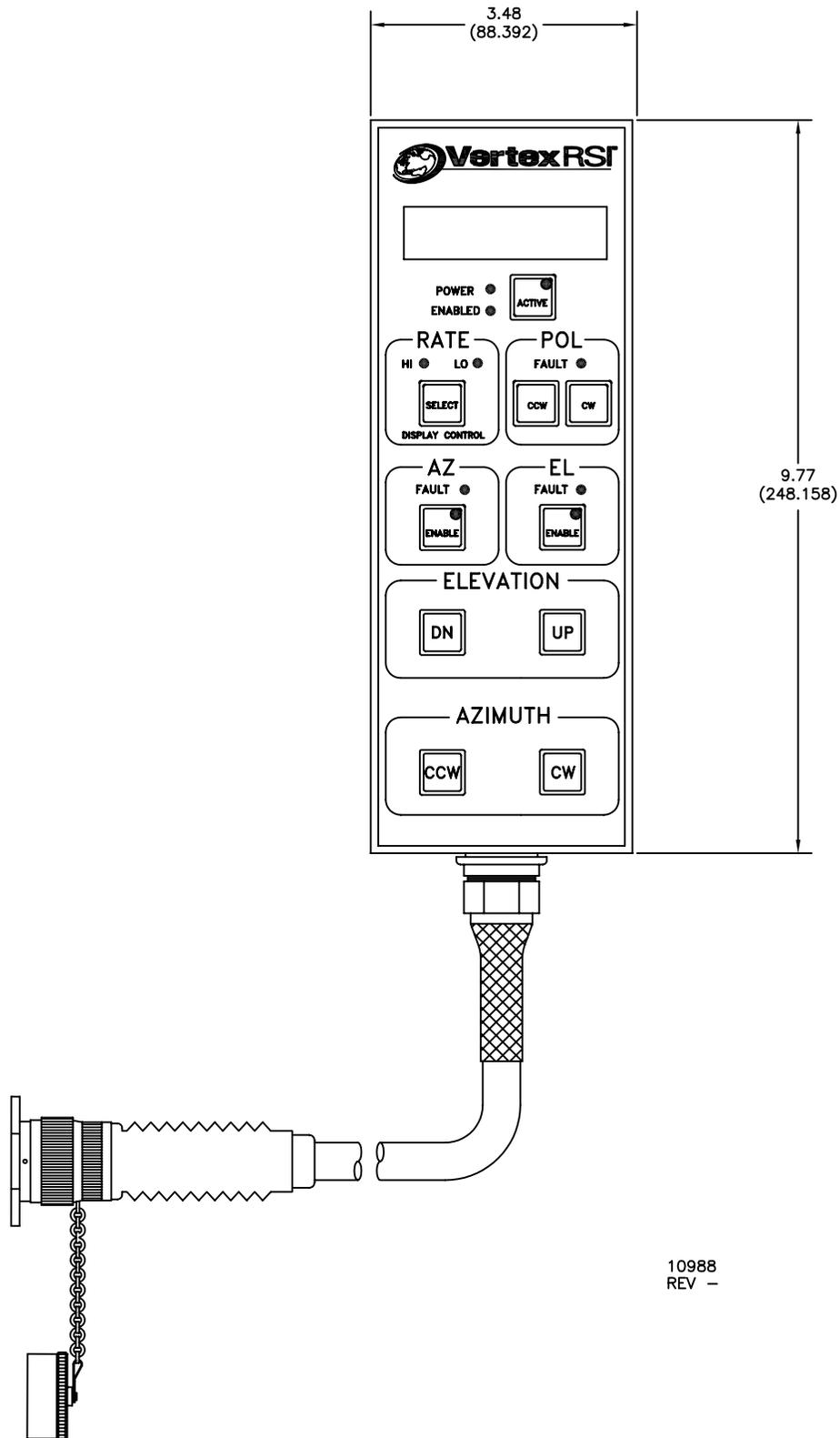
The following describes the controls and indicators on the unit.

**POWER Indicator** - This indicator illuminates green whenever the PMU cable is terminated to the Power Drive Unit (PDU) or dedicated motor vicinity junction box and power to the rate loop electronics is available.

**ENABLE Indicator** - This indicator illuminates green whenever the panel is offered control.

**ACTIVE Indicator/Switch** - The actuation of this alternate action switch when the PMU is capable of controlling the antenna, or is in Maintenance mode or ACU is off. The green illumination of the ENABLE indicator, will *accept* control and preclude other units from taking control away. To indicate the panel is in control, the ACTIVE indicator is illuminated green. Once control has been accepted by the PMU, other units may not take it away until it is offered by the PMU. Offering control requires another actuation of the momentary action switch.

FIGURE 7-1 PORTABLE MAINTENANCE UNIT (10988-)



10988  
REV -

The remainder of the PMU has the controls and indicators that are used when the unit is active. The azimuth and elevation sections are identical and are discussed together below.

**Azimuth (Elevation) FAULT Indicator** - This indicator illuminates red whenever an axis or system fault is reported by the PDU. This condition will inhibit control of the axis from the PMU. The fault message prohibiting movement is displayed at the ACU.

**Azimuth (Elevation) ENABLE Indicator/Switch** - The actuation of this alternate action switch allows the disabling and enabling of each axis without affecting the operation of the other axis. To indicate the axis is enabled, the ENABLE indicator is illuminated green.

**AZ CCW-CW/EL DN-UP Rate Switch** - When the PMU is activated and the axis is enabled, AZ/EL rate switches generate directional speed commands.

**Polarization FAULT Indicator** - This indicator illuminates red whenever a POL fault or system fault is reported by the PDU. This condition will inhibit control of the axis from the PMU.

**Polarization Rate Switch** - The polarization switch controls the CW/OFF/CCW state of the POL drive motors.

**HI/LO Switch and Indicators** - For the main drive system, the momentary action of the RATE switch allows the speed selection of HI (full speed) or LO (10% full speed) for azimuth and elevation axes.

The LCD Display (optional) continuously displays AZ/EL position and signal strength. Fault and Status message display mode is activated by depressing the RATE switch for at least 2 seconds. Return to the AZ/EL display mode is activated in the same way.

All of the safety interlocking functions such as emergency stops and travel limits are monitored and interlocked by microprocessor independent hardware logic in the PDU.

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## SECTION 8 - SERVICE

### 8 SERVICING INSTRUCTIONS

#### 8.1 GENERAL

##### 8.1.1 Tools And Test Equipment Required

Standard tools and test equipment are all that are necessary for servicing the 123T Antenna Control System.

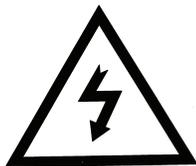
##### 8.1.2 Inspection, Cleaning And Lubricating

All components in this system were designed to provide trouble-free operation with a minimum of maintenance. Indoor equipment should be kept clean and well vented. The PDU should be kept free of debris and dirt build-up which could cause excessive heat.

The antenna manufacturer should provide a maintenance and lubrication schedule for the structure, motors and accessories. Follow this schedule for proper operation and to maintain initial performance levels.

##### 8.1.3 Safety Precautions To Be Taken

Follow the following safety precautions when maintaining or inspecting the equipment.



#### **WARNING**

**ONLY AUTHORIZED PERSONNEL SHOULD BE PERMITTED TO PERFORM MAINTENANCE, INSPECTIONS OR PARTS REPLACEMENT. [REMOVE ALL METAL OBJECTS (WATCHES, RINGS, ETC.) BEFORE OPERATION.] [USE TOOLS WHICH ARE INSULATED AGAINST ELECTRICAL SHOCK.] FAILURE TO OBSERVE THIS WARNING CAN RESULT IN AN ELECTRICAL SHOCK.**



#### **CAUTION**

**DANGER OF EXPLOSION IF LITHIUM BATTERY LOCATED INSIDE ACU IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME TYPE RECOMMENDED BY THE MANUFACTURER. DISPOSE OF USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.**

## **8.2 PERFORMANCE VERIFICATION**

System Performance testing should be done upon installation of control system hardware or after any maintenance is done on the antenna structure. Performance testing should include testing limit switch operation before moving the structure through its full travel range. The Site Acceptance Test Procedure provides specific tests used to verify system performance.

## **8.3 ACU SOFTWARE MAINTENANCE AND RESTORATION**

ACU software maintenance and restoration encompasses two procedures. The first is system parameter backup to 3.5" floppy disk, and the second is re-load of system software.

### **8.3.1 ACU Parameter Back-up To 3.5" Floppy Disk**

To save system parameters on 3.5" floppy disk.

Place a preformatted 3.5" disk in the FDD. Go to the Setup/Actions menu and execute "Backup". All system specific parameters will now be stored on the 3.5" disk.

The saved parameters can later be re-loaded on the ACU by following the same procedure above, inserting a previous backup in the FDD and executing "Restore" at the Setup/Actions menu.

### **8.3.2 ACU System Software Reload From Floppy Disk**

**NOTE:** *This procedure requires system software disks on 3.5 FDD media, provided by VRSI.*

To re-load system software from 3.5" floppy disks, first cycle power off at the ACU.

Place build disk #1 in the FDD. Power the ACU back on. The ACU front panel display will prompt for System disk, 1, 2, 3, 4, and Build Disk 2, in that order. After Build Disk 2 has loaded, the front panel display will prompt "Remove Build Disk 2 and cycle power". Remove the Floppy disk, power the ACU down. If system parameters had previously been saved, they can be restored now by following the procedure in 8.3.1.

## **8.4 SYSTEM LEVEL TROUBLESHOOTING**

There are three types of faults, SYSTEM, AXIS and NON-DISABLING. A system fault disables all AZ, EL and POL motors. An axis level fault disables only the affected axis. A non-disabling fault warns of a serious condition that may degrade operational efficiency, but does not require any motors to be disabled. The ACU provides reporting of numerous fault conditions. Each point monitored is assigned a specific fault message.

The standard list of each message with corresponding corrective action as follows:

**Table 8-1: AZ and EL Faults**

<b>AZ &amp; EL FAULTS</b>	<b>SYSTEM LEVEL DISABLE</b>	<b>AXIS LEVEL DISABLE</b>	<b>NON DISABLING</b>
ACU Emergency Stop	X		
ACU Software Error	X		
ACU-PDU Link Down	X		
Antenna Safe	X		
Antenna Emergency	X		
Real Time Clock Error	X		
AZ CW/CCW Limit		X	
AZ CW/CCW Prelimit		X	
AZ,EL Handcrank Engaged		X	
AZ/EL Drive Fault		X	
Command > Region AZ/EL ±		X	
EL Up/Dn Limit		X	
EL Up/Dn Prelimit		X	
Enter Standby Mode		X	
ACU-Computer Link Down			X
Axis Difference			X
AZ/EL ± Software Limit			X
Bad Track Point			X
Optrack AZ/EL POL, Data Error			X
Optrack Table Error			X
Receiver Fault			X
Receiver IF Synthesizer			X
Receiver Link Down			X
Receiver RF Synthesizer			X

The following fault messages are for systems with polarization option:

**Table 8-2: POL Faults**

<b>POL FAULTS</b>	<b>SYSTEM LEVEL DISABLE</b>	<b>AXIS LEVEL DISABLE</b>	<b>NON DISABLING</b>
Command > Region POL ±		X	
POL Drive Fault		X	
POL CW/CCW Limit		X	
POL Encoder Fault		X	
POL ± Software Limit			X

To capture transient or short duration fault events, toggle the fault latching function ON at the Setup/General Setup menu. See **Section 2.12.1, "Fault Latching" on page 2-14** for more information on this parameter.

## 8.5 FAULT MESSAGES

<b>ACU – Computer Link Down</b>	This fault will not disable any motors. The serial link connecting the ACU to the System Computer is not responding. The ACU assumes control and all previous position commands issued by the System Computer are cancelled. To clear this fault, reestablish ACU-computer communications by restarting the System Computer, repairing the ACU-computer cable, or restarting the ACU. Note that incorrectly set serial link parameters can also cause this problem.
<b>ACU – PDU Link Down</b>	This fault will disable all motors. This link is EIA-422 connecting the ACU to the PDU. The antenna will remain controllable with the PMU, but position feedback and faults/status information will not be available at the ACU.
<b>ACU Emergency Stop</b>	This fault will disable all motors. The switch is located on the ACU front panel activates this fault. Once the reason for the emergency action is cleared, this fault is cleared by depressing the switch again.
<b>ACU Software Error</b>	This fault will disable all motors. Please call RSI-PC (972-907-9599) for on-line help to correct this fault. If immediate rectification is necessary, cycle power on both the ACU and the PDU.
<b>ACU-GPS Link Down</b>	The GPS Receiver Board located internal to the ACU communicates via a Serial Data Link. This message will appear if the communication link is broken.
<b>Antenna Connect Fail</b>	This fault results from incorrect external antenna cabling. This fault will normally trigger the system disabling Antenna E-Stop condition, even if the Antenna E-Stop switch has not been installed. Correct any external antenna cabling problems to clear both faults.
<b>Antenna E-Stop</b>	This fault will disable all motors. The switch is typically located at the antenna pedestal. Once the reason for the emergency action is cleared, this fault is cleared by depressing the switch again. On some antennas, the antenna connect foil fault may simultaneously trigger the Antenna E-Stop. See Antenna Connect Fail for more information.
<b>Antenna Safe Fault</b>	This fault will disable all motors. The switch is typically located at the antenna pedestal. Once the reason for the emergency action is cleared, this fault is cleared by depressing the switch again.
<b>Axis Difference</b>	This fault will not disable any motors, but usually will appear with a fault that does disable motors. There are redundant interlock circuits on the PDU Drive board. If these redundant circuits ever disagree, then the fault message is issued. Replace the PDU Drive board at Depot level. Replace the PDU in the field.

<p><b>AZ ± Software Limit, EL ± Software Limit</b></p>	<p>This fault does not disable any axis motor. Axis travel limit parameters, as stored in the Site Setup window, can be crossed when the antenna is controlled by the PMU. When the antenna crosses the stored value, this fault is issued. For a related fault see “Command &gt; Region AZ (EL)”. To clear this fault, issue a position command within the travel limits. Once the antenna is again within the travel limits the fault will clear.</p>
<p><b>AZ CW/CCW Limit</b></p>	<p>The axis has traveled in the CW or CCW direction far enough to encounter a hardware switch. The brakes will be set and the axis disabled. This fault should never occur on antennas that use only AZ/EL Prelimits.</p>
<p><b>AZ CW/CCW Prelimit, EL UP/DN Prelimit</b></p>	<p>The axis has traveled far enough to encounter a hardware switch.</p> <p>If the system is configured for <b>automatic prelimit backout</b>, then the axis will reverse direction and slowly drive until the hardware switch reverts to the normal (closed) state. The axis will now respond to whatever command is present, therefore, if the command that drove the axis into prelimit is still present, then the axis will drive back into prelimit.</p> <p>If the system is configured for <b>manual prelimit backout</b> (all AC systems), then the axis will apply the brakes and disable. Manual backout is accomplished by depressing and holding the axis enable button on the PMU.</p>
<p><b>AZ, EL Handcrank Engaged</b></p>	<p>This fault will disable all AZ or EL motors. A switch is connected to the handcrank access plate of each motor. During the removal of the access plate, this switch will issue the fault message. To clear this fault, close the handcrank access. If this does not clear the problem, replace the switch at the handcrank access.</p>
<p><b>AZ/EL Drive Fault</b></p>	<p>This indicates that the PWM Drive has lost its enables and is unable to reset. If the condition occurs repeatedly, investigate the motor or cabling for failure. This may indicate a loss of power to the drive.</p>
<p><b>Bad Track Data Point</b></p>	<p>This fault occurs only during Optrack mode. If any estimate of target position is poor due to high scintillation (noisy signal), this fault occurs. This fault can be used as an indication of poor tracking conditions. This fault clears upon the next valid target position estimate. If this fault continues to occur, change the tracking node to Steptrack.</p>

<p><b>Band Conflict</b></p>	<p>This fault indicates that an active mode was attempted without the selected operational frequency matching the RF feed currently in place on the antenna. To clear the fault condition, either put the correct feed on the antenna or change the tracking frequency on the Freq screen to match the feed. For example, if a C-Band feed is mounted on the antenna, then the operational frequency must be between 2 and 6 GHz.</p> <table border="0"> <thead> <tr> <th data-bbox="636 449 743 478">RF Feed</th> <th data-bbox="922 449 1149 478">Frequency Range</th> </tr> </thead> <tbody> <tr> <td data-bbox="636 537 818 567">C BAND FEED</td> <td data-bbox="922 537 1110 567">2.0 TO 6.0 GHz</td> </tr> <tr> <td data-bbox="636 596 818 625">X BAND FEED</td> <td data-bbox="922 596 1127 625">6.0 TO 10.0 GHz</td> </tr> <tr> <td data-bbox="636 655 834 684">KU BAND FEED</td> <td data-bbox="922 655 1143 684">10.0 TO 17.7 GHz</td> </tr> <tr> <td data-bbox="636 714 834 743">KA BAND FEED</td> <td data-bbox="922 714 1143 743">17.7 TO 30.0 GHz</td> </tr> </tbody> </table> <p><b>Check for BAND CONFLICT</b></p> <p>Another potential source for this fault would be if the RF feed status circuits were not reporting properly. To look for the cause, verify that the status message indicating which feed is in place is a correct indication of the actual feed in use. Status messages can be viewed on the Messages/Status screen.</p> <p>This fault never occurs when the system is in Standby mode. This allows for feed changes to be made, in Standby mode, without triggering this fault.</p>	RF Feed	Frequency Range	C BAND FEED	2.0 TO 6.0 GHz	X BAND FEED	6.0 TO 10.0 GHz	KU BAND FEED	10.0 TO 17.7 GHz	KA BAND FEED	17.7 TO 30.0 GHz
RF Feed	Frequency Range										
C BAND FEED	2.0 TO 6.0 GHz										
X BAND FEED	6.0 TO 10.0 GHz										
KU BAND FEED	10.0 TO 17.7 GHz										
KA BAND FEED	17.7 TO 30.0 GHz										
<p><b>Calibration Fail</b></p>	<p>This fault indicates that the automatic calibration that occurs upon antenna deployment could not be performed. The typical cause would be the absence of one of the calibration sensors which includes the GPS, compass and clinometer. The presence of either ACU-GPS LINK DOWN, COMPASS LINK DOWN or GPS DATA UNAVAIL would indicate that a sensor is out. (Deployment is not recommended unless these fault and status conditions are cleared.) A possible, though less likely cause would be that the Deploy mode was commanded with elevation in a position which causes the compass to not be level. The compass only works properly at a level position which occurs at the antenna's stow position.</p> <p>All calibration sensor monitor and control is done via the Setup/Calib screen.</p> <p>If a sensor is out and a calibration is required, the operator must manually enter all information that the automatic calibration normally does. See <b>Section 3.3, "Manual Calibration"</b> on page 3-5 for details.</p>										

<p><b>Command &gt; Region AZ ±, Command&gt; Region EL ±</b></p>	<p>This fault disables all AZ (or EL) motors the moment the illegal position command (outside of the travel region) is entered. This fault is issued whenever a position is commanded that lies beyond a software limit. The software limit can be crossed when using the PMU to control the antenna. The software limit parameters are accessed through the site setup window to the Travel Limit Parameters window. To clear this fault, issue a legal position command.</p>
<p><b>Command &gt; Region POL ±</b></p>	<p>This fault disables the POL axis the moment the illegal position command (outside of the travel region) is entered. This fault is issued whenever a position is commanded that lies beyond the software limit. The software limit can be crossed when using the PMU to control the antenna. The software limit parameters are accessed through the site setup window to the Travel Limit Parameters window. To clear this fault, issue a legal position command.</p>
<p><b>Compass Link Down</b></p>	<p>An RS232 Serial Data Link runs between the heading sensor and the PDU. This message will appear if the communication link is broken. Refer to the system schematic and verify all connections between the PDU and heading sensor.</p>
<p><b>EL UP/DN Limit</b></p>	<p>The axis has traveled in the UP or DOWN direction far enough to encounter a hardware limit switch. The brakes will be set and the axis disabled. This fault should never occur due to the fact that prelimit is set to occur before this limit. To clear this fault use the handcrank (if available) to move the antenna out of limit. Alternately, the limit may be bypassed using hardware jumpers to deliberately defeat the limit. <b>EXERCISE EXTREME CAUTION</b> to avoid personnel injury or damage to the antenna. This limit is often not connected on ACLM systems and the prelimit is used in place of the final limit.</p>
<p><b>EI Vel Limit Err</b></p>	<p>This fault occurs only during Stow mode. It will clear on exit of Stow mode. It occurs because the EL VELOCITY LIMIT condition is not staying constantly ON for the full time from when it first occurs until when the ANTENNA STOWED condition occurs. The typical course of action is to investigate the hardware circuits that report the stow status switches.</p> <p>The trailer should never be moved without the antenna stowed. And the antenna should not be considered stowed unless the stow process completes without any stow faults. Stow faults include PREMATURE STOW, STOWED OFF TARGET, EL VEL LIMIT ERR and STOW INCOMPLETE.</p>
<p><b>Enter Standby Mode</b></p>	<p>This fault message will occur after a disabling fault latches the enables in the OFF state. By entering the STANDBY mode and then an active mode, the enables are cycled and control is once again available to the ACU.</p>

<b>Optrack AZ/EL, POL Data Error</b>	This error occurs if Optrack is unable to compute an accurate ephemeris, even though sufficient data is available. This is normally caused by a change in time or the site location. If the time or site is significantly changed, the Optrack table should be cleared. This error will eventually clear itself, but the (strongly) recommended action is to clear the Optrack data and restart Optrack. To clear Optrack data, go to Setup/Track Setup/Optrack Clear.
<b>Optrack Table Error</b>	This indicates that a bad data point was rejected by the Optrack table. This fault will clear upon the next store of a valid data point into the Optrack table. This is normally caused by a change in time. If the time is significantly changed, the Optrack data should be cleared. To clear Optrack data, go to Setup/Track Setup/Optrack Clear.
<b>Pedestal Select Invalid</b>	This fault is specific to Dual Antenna systems. The fault occurs whenever the detected antenna type and the loaded ACU software configuration fail to match. Cycling power at the ACU (with the PDU powered) will load the correct software configuration and clear this fault.
<b>POL ± Software Limit</b>	This fault does not disable the POL motors. The POL travel limit parameter as stored in the Setup/POL Setup menu can be crossed when the antenna is controlled by the PMU. When the antenna crosses the stored value, this fault is issued. For a related fault see "Command > Region POL ±." To clear this fault, issue a position command inside the travel limits. Once the antenna is again within the travel limits, the fault will clear.
<b>POL CW/CCW Limit</b>	The axis has traveled far enough to encounter a hardware switch. The axis is disabled. The limit may be cleared by issuing a command out of limit.
<b>POL Drive Fault</b>	This indicates that the Motor Drive has lost its enables and is unable to reset. If the condition occurs repeatedly, investigate the motor or cabling for failure.
<b>Premature Stow</b>	<p>This fault occurs only during Stow mode. It will clear on exit of Stow mode. It occurs because the stow process stopped at its elevation command stow position without either the EL VELOCITY LIMIT or the ANTENNA STOWED status messages occurring. This indicates that elevation is not being driven far enough down to securely stow the antenna. The typical fix is to enter the correct stow position on the Setup/General screen.</p> <p>The trailer should never be moved without the antenna stowed. And the antenna should not be considered stowed unless the stow process completes without any stow faults. Stow faults include PREMATURE STOW, STOWED OFF TARGET, EL VEL LIMIT ERR AND STOW INCOMPLETE.</p>
<b>Real Time Clock Error</b>	This fault will disable all motors. The real time clock circuit on the ACU Interface Board has failed. Time is not lost because the higher priority XCO clock is still functioning.

<b>Receiver Fault</b>	This fault will not disable any motors. The tracking receiver is reporting a fault to the ACU.
<b>Receiver IF Synthesizer Unlock</b>	This fault is generated if the programmed frequency is out of range, the ACU to RF module interconnect has failed, or the RF module frequency synthesizer circuit has failed.
<b>Receiver Link Down</b>	This fault will not disable any motors. The serial link connecting the ACU to an external tracking receiver is not responding. To clear this fault, reestablish ACU - receiver communications by restarting the receiver, repairing the ACU – receiver serial cable, or restarting the ACU. Note that incorrectly set serial link parameters can also cause this problem.
<b>Receiver RF Synthesizer Unlock</b>	This fault is generated if the programmed frequency is out of range, the ACU to RF module interconnect has failed, or the RF module frequency synthesizer circuit has failed.
<b>Stow Incomplete</b>	<p>This fault occurs only during Stow mode. It will clear on exit of Stow mode. It occurs because the EL VELOCITY LIMIT indication has occurred for over 60 seconds without the expected, subsequent ANTENNA STOWED indication occurring. Environmental conditions like ice and snow may be the root cause for this fault and should be ruled out before checking the stow status reporting circuitry for correct operation.</p> <p>The trailer should never be moved without the antenna stowed. And the antenna should not be considered stowed unless the stow process completes without any stow faults. Stow faults include PREMATURE STOW, STOWED OFF TARGET, EL VEL LIMIT ERR and STOW INCOMPLETE.</p>
<b>Stowed Off Target</b>	<p>This fault occurs only during Stow mode. It will clear on exit of Stow mode. It occurs because of two possible conditions: first, if the ANTENNA STOWED indication is occurring without the EL VELOCITY LIMIT indication first occurring and secondly, if the full stow sequence occurs but the final stow position achieved is not within five degrees of the commanded stow position (in Elevation). The typical course of action for the first cause is to investigate the hardware circuits that report the stow status switches. The typical course of action for the second cause is to correctly set the stow position on the Setup/General screen.</p> <p>The trailer should never be moved without the antenna stowed. And the antenna should not be considered stowed unless the stow process completes without any stow faults. Stow faults include PREMATURE STOW, STOWED OFF TARGET, EL VEL LIMIT ERR and STOW INCOMPLETE.</p>

## 8.6 WIND-UP TEST

The Wind-Up test is a diagnostic program found in the top-level menu tree. This test is used to characterize position feedback operation. Mechanical damage to the axis encoders, or axes drive trains, can produce antenna conditions that degrade or prohibit satellite tracking. The Wind-Up test mode outputs data useful in diagnosing potential encoder and drive train problems.

The Wind-Up test program assumes the antenna is pointed at a stationary satellite, and a valid tracking signal is being received. Under these conditions, offset movement in AZ or EL axes should always return a peak satellite signal at exactly the same AZ and EL position. If offset movement does not return a peak signal at the same AZ (EL) position, this indicates a position repeatability problem, the magnitude of which is displayed as the AZ (EL) windup. This test is also affected by the receive signal stability. Noisy conditions may degrade the test accuracy.

### Procedure:

Place the antenna pointed at a stationary satellite. Manually Peak the signal. Execute Wind-Up test. The control system will now automatically drive off peak, then reverse direction and drive through the peak, then reverse direction again and drive back through peak. The control monitors axis position and signal level while each pass occurs, calculating the peak angle. After the test is complete, the Windup is calculated as the difference in measured peak angle when driving CW (UP) into the peak versus driving CCW (DN) into the peak.

Run the Wind-Up test three times and verify that the results are similar for all runs.

Typical Wind-Up values should be less than 1% of the 3dB Beamwidth. If Wind-up greater than 3% is measured, then Optrack performance may be degraded. A minimum Wind-Up of 0.0055 degree, (with 1:1 resolver type encoders), is considered typical, and is due to the resolution with which these encoders are measured. The 3dB Beamwidth (BW) is calculated as follows:

$$BW = 21 / (\text{freq} \times \text{dia})$$

Where freq = beacon frequency in GHz, and dia = dish aperture, in meters.

Example: For a 2.4 meter dish operating at 4.2 Ghz, the BW = 2.083 deg.

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# ***SECTION 9 - APPENDICES***

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## Appendix A - Parameters

The following table lists each parameter, the default value, type, screen location, and dependency. Some parameters will be eliminated if their function is not needed. For example, if the system does not have polarization control, the POL position parameter on the track menu. The table lists parameters grouped by screen.

Type	Parameter	Screen	Range	Dependency	Notes	Default	Se ct.
Mode	Jog Speed	Jog	Fast/Slow	None	Fast = Full Rate Slow = 1/10 Rate	Slow	3
Mode	Lon	Track	0-359.9 Degs East	GEO (Appears only when [Geo] is the Track Type)			3
Mode	AZ	Track	0-359.999 Degs	None	Sometimes this field is not editable (i.e. it is automatically calculated for certain Track types). A question mark appears when this is the case.	Current AZ POS	3
Mode	EL	Track	-9.999-89.999 Degs	None	Sometimes this field is not editable (i.e. it is automatically Calculated for certain Track types). A Question mark Appears when this is the case.	Current EL POS	3
Mode	POL	Track	0-359.999 degs	POL (When the Polarization parameter in the Setup/General screen is ON)	Sometimes this field is not editable (i.e. it is automatically Calculated for certain Track types). A Question mark Appears when this is the case.	Current POL POS	3
Mode	Track Type	Track	Optrack/ Position/ Tab Track/ Step Track/ Geo	None	The INTELSAT selection does not appear Unless INTELSAT is set ON in the Setup/General screen. Likewise, for Table Track	Optrack	3
Mode	POL On/Off	Track	Pol On/ Pol Off	POL		On	3
Mode	POL Choice	Track	Pos POL/ Horz POL/ Vert POL	POL and GEO		POS POL	3
Mode	Preset Number	Preset	1-50	None	In addition to being editable, this field can be incremented Decrementated using the UP and DOWN ARROW keys.	1	3
Mode	AZ	Preset	0-359.999 Degs	None			3
Mode	EL	Preset	-9.999-89.999 Degs	None			3
Mode	POL	Preset	0-359.9 Degs	POL			3

Mode	POL On/Off	Preset	POL On/ POL Off	POL		On	3
Site	Center Frequency	Freq	0.1-100.0 GHz		The frequency in use must be supported by the RF feed in place. Entry of a frequency mismatched to the feed will cause a BAND MISMATCH fault to occur.	3.625	3
Site	Low Signal Threshold	Freq	-99.0 dBm	None		-10	3
Site	Tracking Signal Offset	Freq	100-100 dB	None		0.1	3
Site	Time	Setup/ General	Standard HH:MM:SS		The [Set Time] Pushbutton is used In conjunction with This field.		3
Site	Date	Setup/ General	Standard MM:DD:YY		The [Set Time] Pushbutton is used In conjunction with This field.		3
Operational	Fault Latching	Setup/ General	On/Off	None		Off	3
Site	Site Longitude	Setup/ General	0.359.999 Degs East	None	The [Set Time] Pushbutton is used In conjunction with his field.	272	3
Site	Site Latitude	Setup/ General	-90-90 Degs North	None	The [Set Time] Pushbutton is used In conjunction with This field.	48	3
Operational	Refraction Correction	Setup/ General	On/Off	None		Off	3
Mode	Box Scan Box Size	Setup/ Track	1-20 Degs	None		8.0	3
Hardware	Local Oscillator Frequency	Setup/RF	0-99.999999 GHz	None		5/15	3
Site	RF Bandwidth	Setup/RF	2.5 kHz/ 4.0 kHz/ 280kHz	None		2.5	3
Mode	Table Track Point Number	Setup/ Table	1-144	None	In addition to Being Editable, this field can be incremented and Decrementated using the UP and DOWN ARROW keys Respectively.	13	
Mode	Time	Setup/ Table	Standard DDD:HH:MM:SS				3
Mode	AZ	Setup/ Table	0-359.999 Degs	None			3
Mode	EL	Setup/ Table	-5-95	None			3
Mode	POL	Setup/ Table	0-359.999 Degs	POL			3

Mode	Interpolation	Setup/ Table	On/Off	None		On	3
Site	Forward & Backward Tilt	Setup/ Calib		None	Display Only		3
Site	GPS Status	Setup/ Calib		None	Display Only		3
Site	GPS Quality	Setup/ Calib		None	Display Only		3
Site	GPS Longitude	Setup/ Calib		None	Display Only		3
Site	GPS Latitude	Setup/ Calib		None	Display Only		3
Site	GPS Altitude	Setup/ Calib		None	Display Only		3
Site	GPS Time	Setup/ Calib		None	Display Only		3
Site	Compass Heading	Setup/ Calib		None	Display Only		3
Site	Magnetic Variance	Setup/ Calib		None	Display Only		3
Site	Compass Noise Score	Setup/ Calib		None	Display Only		3
Site	Compass Environment Quality	Setup/ Calib		None	Display Only		3
Integration	Compass Mark Angle	Setup/ Calib	-180-180 Degs	None	The [Store] Pushbutton is Used in conjunction with this field.	0.0	3

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## Appendix B - 123T/240MVO

### ***Typical Antenna Setup And Deployment***

The following procedure applies to 240 MVO antennas.

1. Park the truck facing North (Antenna to the South for Northern Hemisphere Operation).
2. Lower the stabilizing jacks.
3. Power up the ACU and PDU.
4. Check for Front/Back and Left/Right tilt in the Setup/Calibrate menu. The antenna must be level within  $\pm 10$  degrees. Adjust the stabilizing jacks, if necessary.
5. Check the GPS status in the Setup/Calibrate menu. The level should be 9 before deploying. The GPS may take up to 20 minutes to locate the required number of satellites for accurate position calculation. If the GPS cannot find the required number of satellites for accurate position calculation, the site LAT and LON can be entered manually (if known) at the SETUP/General Setup menu.
6. Check the compass status in the Setup/Calibrate menu. The noise and environment scores should be 7, 8, or 9. Operation may be possible at lower scores with degraded initial pointing angle performance.
7. DEPLOY the antenna.
8. Execute STANDBY mode.
9. Go to the TRACK menu. If you have the satellite LON, select GEO TRACK. Enter the satellite Longitude. EXECUTE GEO TRACK.
10. The control will calculate the initial satellite pointing angle using the GPS, Compass, and Tilt sensors as inputs.

The control will then move the antenna to the initial satellite pointing angle. If a signal (above the low signal threshold parameter) is found at the initial pointing angle, then the control will begin peaking the signal with OPTRACK.

If a signal (below the low signal threshold parameter) is found at the initial pointing angle, then the control will begin a BOX SCAN. The Box Scan size is determined by the Box Scan parameter found in the Setup/Track Setup menu.

At the end of the BOX Scan, the control will position the antenna to highest signal found within the scan. If no signal above the Low Signal Threshold is found, then the control will position the antenna back to the initial satellite pointing angle.

## **Appendix C - 123T/LHGXA**

### ***Typical Antenna Setup And Deployment***

The following procedure applies to LHGXA antennas.

1. Using a hand-held compass, locate the LHGXA so that the center of travel points towards the satellite. Record center of travel compass measurement for later use.
2. Lower the stabilizing jacks and level the LHGXA using the trailer bubbles.
3. Connect all units (ACU, PDU, etc.)
4. Power the PDU. The PDU will read the antenna type hardware jumpers.
5. Power the ACU. The antenna type will be sent from the PDU to the ACU. The ACU will then load the operating parameters for the LHGXA.
6. Verify the Status message "LHGXA" is displayed at the ACU Messages>Status menu.
7. Verify all faults have cleared except "Load Site Location".
8. Check the GPS status in the Setup/Calibrate menu. The level should be 9 before deploying. The GPS may take up to 20 minutes to locate the required number of satellites for accurate position calculation. If the GPS cannot find the required number of satellites for accurate position calculation, the site LAT and LON can be entered manually (if known) at the SETUP/General Setup menu.
9. At the Setup/Calibrate menu, enter the compass measurement from 1) above as the manual compass heading.
10. Go to the top level menu and execute "Calibrate" mode. This will update the displayed AZ/EL angles.
11. DEPLOY the antenna.
12. Execute STANDBY mode.
13. Go to the TRACK menu. Select GEO TRACK. Enter the satellite Longitude.  
EXECUTE GEO TRACK.
14. The control will calculate the initial satellite pointing.

The control will then move the antenna to the initial satellite pointing angle. If a signal (above the low signal threshold parameter) is found at the initial pointing angle, then the control will begin peaking the signal with STEPTRACK.

If a signal (below the low signal threshold parameter) is found at the initial pointing angle, then the control will begin a BOX SCAN. The Box Scan size is determined by the Box Scan parameter found in the Setup/Track Setup menu.

At the end of the BOX Scan, the control will position the antenna to highest signal found within the scan. If no signal above the Low Signal Threshold is found, then the control will position the antenna back to the initial satellite pointing angle.

## **Appendix D - 123T Maintenance Manual on CD**

The 123T Maintenance Manual is project specific. The manual is on CD and contains the following:

- Operations Manual
- Maintenance Manual
- Vendor Data
- Drawings and Parts List
- Cage Codes

To view the PDF files you will need Adobe Reader which can be downloaded for free from [www.Adobe.com](http://www.Adobe.com).

To request a replacement CD, refer to the **VertexRSI Contact Information** located in the front section of the Operations manual.

**NOTE:** *When requesting a replacement CD, you will need to provide the project configuration number. This number can be found on the rear panel of the 123T ACU or PDU. The configuration number is typically the letter "C" followed by 4 digits (ex: C1234).*