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AUG 2010

OPERATION AND MAINTENANCE MANUAL FOR THE

7200 ANTENNA CONTROL SYSTEM



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VertexRSI
3750 W. Loop 281
Longview, Texas 75604

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NOTICES

WARNING

THE ELECTRICAL CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST OBSERVE SAFETY REGULATIONS AT ALL TIMES.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers of handling potentially hazardous electrical and electronic circuits. This manual is not intended to contain a complete statement of all safety precautions that should be observed by personnel in using this or other electronic equipment.

WARNING

IN CASE OF EMERGENCY BE SURE THAT POWER IS DISCONNECTED.

The manufacturer has attempted to detail in this manual all areas of possible danger to personnel in connection with the use of this equipment. Personnel should use caution when installing, operating, and servicing this equipment. Care should be taken to avoid electrical shock, whether the hazard is caused by design or malfunction.

WARNING

ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, ENCLOSURES, PANELS, OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS OR PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR FATIGUED.

The manufacturer is specifically not liable for any damage or injury arising from improper procedures or failure to follow the instructions contained in this manual or failure to exercise due care and caution in the installation, operation, and service of this equipment or use by improperly trained or inexperienced personnel performing such tasks. During installation and operation of this equipment, local building codes and fire protection standards must be observed.

PROPRIETARY NOTICE

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Declaration of Conformity

The **VertexRSI 7200 ACU Rack Mount Unit (201379)**

was tested to the following specifications and found to be in compliance with the required criteria on the indicated test date.

In accordance with the following directives:

72/23/EEC	**The Low Voltage Directive** and its amending directives.
89/336/EEC	**The Electromagnetic Compatibility Directive** and its amending directives.

It has been designed and manufactured to the following specifications:

EN 61010-1: 2001	
EN 300339: 1998	
EN 55022: 1998	Class B
EN 61000-4-2: 1995	(4/8kV)
EN 61000-4-3: 1995	(3V/m)
EN 61000-4-4: 1995	(2kV/1kV)
EN 61000-4-5: 1995	(2/1kV)
EN 61000-4-6: 1996	(3 Vrms)
EN 61000-4-11: 1994	>95%-0.5p, 30%-25p,>95%-250p

I hereby declare that the equipment named above, when installed according to manufacturer's instructions, complies with the above directives and standards.

Signed: James B. Hurlbut Date: February 18, 2003

General Dynamics SATCOM Technologies
3750 W. Loop 281
Longview, TX 75604
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1.0 INTRODUCTION

1.1 Purpose

This manual provides the user with the information necessary to install and operate the VertexRSI Model 7200 Antenna Control System (ACS). Failure to follow the instructions and all cautions and warnings provided in this manual may result in improper installation and/or operation of the 7200 ACS.

1.2 Scope

This manual primarily contains the information related to the 7200 ACS, and includes limited information about the antenna structure, the equipment used to develop the tracking signal, and other equipment peripheral to the 7200 ACS.

1.3 Organization of Included Contents

This manual is divided into the following sections:

- Section 1.0, Introduction, gives the purpose, scope, and organization of this manual. Information for obtaining technical support is also included in this section.
- Section 2.0, Overview of the 7200 ACS, provides a general overview of the system, including specifications, the functions of the system, and a description of the controls and indicators.
- Section 3.0, Theory of Operation, explains the theory of operation of the 7200 ACS.
- Section 4.0, Installation, provides instructions for installing the 7200 ACS, showing the connections of system cabling and explaining the setup and initial power-up of the system.
- Section 5.0, Operation, provides detailed information for configuring and operating the 7200 ACS.
- Section 6.0, Maintenance, provides information necessary for maintaining the 7200.
- Section 7.0, Engineering Drawings, contains the engineering drawings for the 7200 ACU and the drive cabinet.
- Appendix A, Acronyms and Abbreviations, lists the definitions of all acronyms and abbreviations used in this manual.
- Appendix B, 7200 ACU Password Protection, provides information to set, change, and clear user passwords from the 7200 ACS. It also provides information to disable password protection on the system.
- Appendix C, Two-Speed Resolver Calibration, provides instructions for calibrating the two-speed resolvers in the 7200 ACS.

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- Appendix D, Tracking Tutorial for Operators, provides instructions for quickly setting up tracking with the 7200 ACS, eliminating the need to read the step-by-step instructions in Section 5.0 of the manual.

- Appendix E, 7200 Troubleshooting Guide, contains probable causes and corrective action for troubleshooting the 7200 ACS.

- Appendix F, Site Acceptance Test Procedure, contains the final proof of acceptance procedure for the antenna control system.

- Appendix G, Graphical Menu Tree, contains a graphical menu tree that depicts all menus and parameters for the system.

1.4 Supplemental Literature on CD and Website

Related documentation that is highly specialized or infrequently used has been included on an enclosed Compact Disc. This information is also maintained on the General Dynamics SATCOM Technologies website at http://www.gdsatcom.com.

This manual and all its various appendices have also been included on the CD. In addition, documentation for prior generation (legacy) systems is included.

TABLE 1-1 SUPPLEMENTAL DOCUMENTATION

Directory	Contents
7200 O&M Manual	CG-1280 – All subdocuments (Including vendor literature)
Protocol Documents	CG-6042 – RC M&C protocol document CG-6045 – MT M&C protocol document CG-6041 – GPIB protocol document
Firmware Upgrade Procedures	CG-1281 – VCPU Flash Firmware Upgrade Procedure V4.x CG-1295 – 72XX ACU Parameter Download/ Upload V4.3+
Factory Test Procedures Reports	CG-0281 – Factory Test Proc. – 7200 (VCPU) CG-0282 – Factory Test Report – 7200 (VCPU) CG-0283 – Factory Test Proc. – VCPU CG-0284 – Factory Test Report – VCPU
7200 Legacy Product Documents	CG-1190 – 7200 w/7150 (NTAC 2000 Inverters) CG-1210 – 7200 w/7134 (NTAC 2000 Inverters) CG-1260 – 7200 w/7150 (GPD315 Inverters) (non-VCPU 7200) CG-5546 – Force CPU 30xxxx Firmware Upgrade Procedure V3.x

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1.4 Technical Support

The 7200 Antenna Control Unit (ACU) contains context-sensitive, on-line help that is easily accessible from any menu or submenu in the system by simply pressing the [HELP] key on the 7200 ACU's front panel. For operational problems, a troubleshooting guide is provided in Appendix E of this manual.

If any questions or problems arise that are not addressed by the manual or the online help (provided by pressing the [HELP] key), please contact our technical support team.

1. Email us at ***support@vcsd.com.***

2. Phone us at (903) 295-1480.

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2.0 OVERVIEW OF THE 7200 ACS

2.1 General Information About the 7200 ACS

The 7200 ACS is an antenna pointing system, controlled manually or automatically, that positions the antenna to receive the peak signal from one or more communications satellites. The 7200 ACS uses microprocessor technology to provide accurate antenna positioning, high reliability, and maximum system flexibility. The system has the capabilities for rapid multiple satellite access, highly sophisticated predictive tracking with inclined orbit satellites, and EIA/TIA-232E, EIA/TIA-422B, IEEE-488 (Optional) remote control communications, and 10BASE-T Ethernet.

In two-axis applications, azimuth (AZ) and elevation (EL) controls are used to position the antenna. The three-axis applications use AZ, EL, and polarization (POL) controls to position the antenna and feed assembly. The four-axis applications use AZ, EL, and two polarizations (POL & 4TH AXIS) to control the position of the antenna and feed assembly. Variable speed inverters provide two-speed operation for AZ and EL with continuously variable drive rates over a range of approximately 50 to 1. The 7150 Drive Cabinet houses the drive controls and interfacing equipment to the 7200 ACS. The 7150 Drive Cabinet is normally mounted on the antenna foundation.

A large 8-inch by 4-inch electro-luminescent display and a sensible, uncluttered keypad form a user interface which is fully menu-driven and includes context-sensitive help messages. With much detail paid to the man-machine interface, the 7200 ACU provides straightforward access to an extremely versatile ACS.

The 7200 offers a number of operational modes including manual jog control, several programmed positioning modes, "conventional" steptrack, and the revolutionary Orbit Prediction Track (OPT) mode. OPT provides tracking performance approaching that of monopulse control systems by combining efficient steptrack operation with advanced orbital propagation algorithms to produce a state-of-the-art, predictive tracking method. With OPT, the 7200 provides highly accurate tracking with minimal initial data (approximately 1.25 hours for initial model development).

Two-speed motor control is provided as standard equipment, not through the use of expensive clutched arrangements or dual-wound drive motors, but with standard three-phase induction motors, controlled by solid-state variable frequency inverters. This approach not only provides a reliable and cost-effective means of two-speed operation (with ratios of up to 50 to 1), but also allows for more precise positioning than conventional Alternating Current (AC) motor control systems which simply use contactors to switch motor power on and off. This is a result of the ability of the inverter to "ramp" the motor speed up or down in a controlled manner rather than simply removing motor power while at full speed. This can result in uncontrollable coasting and inevitable "overshoot" of the target.

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An optional cable allows the user to remotely control the antenna axes, using the Portable Maintenance Control Unit (PMCU) located in the 7150 drive cabinet.

2.2 System Specifications

As shown in Table 2-1, the 7200 ACS has specifications that reflect performance sufficient for virtually any communications system antenna, as well as Tracking, Telemetry, and Control (TT&C) applications. Tracking accuracy within 5 percent of the receive antenna beamwidth are achievable due to the advantages provided in the sophisticated OPT modeling. The overall tracking accuracy is related to the resolution of the angular position display system, which is configured according to individual system requirements.

TABLE 2-1 7200 ACS SPECIFICATIONS

FEATURE	DESCRIPTION
Tracking Accuracy	Nominally more than 10% of receive 3 dB beamwidth, RMS, in Steptrack mode. Nominally 5% of receive 3 dB beamwidth, RMS, with valid model in OPT mode (independent of orbit inclination).
Position Encoding	1) (Standard) Absolute, single-speed, brushless resolvers (size 11) and 16-bit monolithic LSI tracking resolver-to-digital conversion IC's with 0.02° RMS accuracy. 2) (Optional) Absolute, electrical two-speed, brushless resolvers (size 20) and paired LSI tracking resolver-to-digital conversion IC's with 0.01° peak accuracy. 3) (Optional) Absolute optical encoders w/accuracies to ±0.004° over 360° range.
Front Panel Position Display Resolution	0.01° Standard – Single speed resolvers 0.001° (Optional - Available only with two-speed resolvers or optical encoders.)
Position Encoding Repeatability	Typically 1 LSB of resolver-to-digital conversion resolution
Input Power Requirements	**Drive cabinet** (two factory configurations available): 1) 208-240 VAC, three-phase, 50-60 Hz, 5-wire WYE. 2) 380-415 VAC, three-phase, 50-60 Hz, 5-wire WYE. Drive Cabinet current requirements are determined by the motor horsepower. **Antenna Control Unit** (Rack Mount): 100-240 VAC, 50-60 Hz; 75 VA (Nominal)
Horsepower Range	1/2 to 20 HP; Others available per special order
ACU Tracking Receiver Interface	VertexRSI Model DTR - Serial Port (Standard) EIA/TIA-232E or EIA/TIA-422B. VertexRSI Model 253 - Analog: Single 0 to 10 VDC analog input; Contact closure outputs available for selection of up to four beacon signals for legacy fixed frequency receivers.
Remote Communications Interface	10BASE-T Ethernet Port (IEEE 802.3) for remote monitor and control. Or EIA/TIA-232E 115.2 kbps max. or EIA/TIA-422B (115.2 kbps max.) (Optional) IEEE-488 GPIB (General Purpose Interface Bus).
Summary Alarm Output	Normally closed dry contacts, ratings: Maximum Voltage 220 VDC or 125 VAC. Maximum Switched Current 1 Amp Maximum Switched Power 62.5 VA
System Interconnect Cabling	* ACU/drive cabinet interface (1) 25/C, #22 AWG * Resolver/ACU (2) three-shielded pair, #22 AWG (two-axis systems) * (3) three-shielded pair, #22 AWG (three-axis systems) * 100 feet of interconnect cabling * Additional cabling is available up to a maximum length of 1500 feet * Two-speed and optical encoding systems cabling requirements specified for each requirement

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TABLE 2-1 7200 ACS SPECIFICATIONS	
FEATURE	**DESCRIPTION**
Environmental	**Antenna Control Rack-mounted Unit:** Temperature - 0°C to + 50°C; Humidity - 90% non-condensing **Drive Cabinet:** Temperature (Standard) -10°C to +50°C Temperature (Optional) -40°C to +50°C (Low temperature package) Humidity - 100% condensing.

Specifications subject to change without notice.

2.3 System Configuration

Refer to Figure 2-1 for a typical overall block diagram of the integrated control system. Items shown with solid interconnection lines represent fundamental system components that provide automatic positioning for a two-axis system. Items connected with a dashed line represent typical system options such as a tracking receiver, POL motorization components, Customer-Furnished Equipment (CFE), and remote Monitor and Control (M&C) equipment.

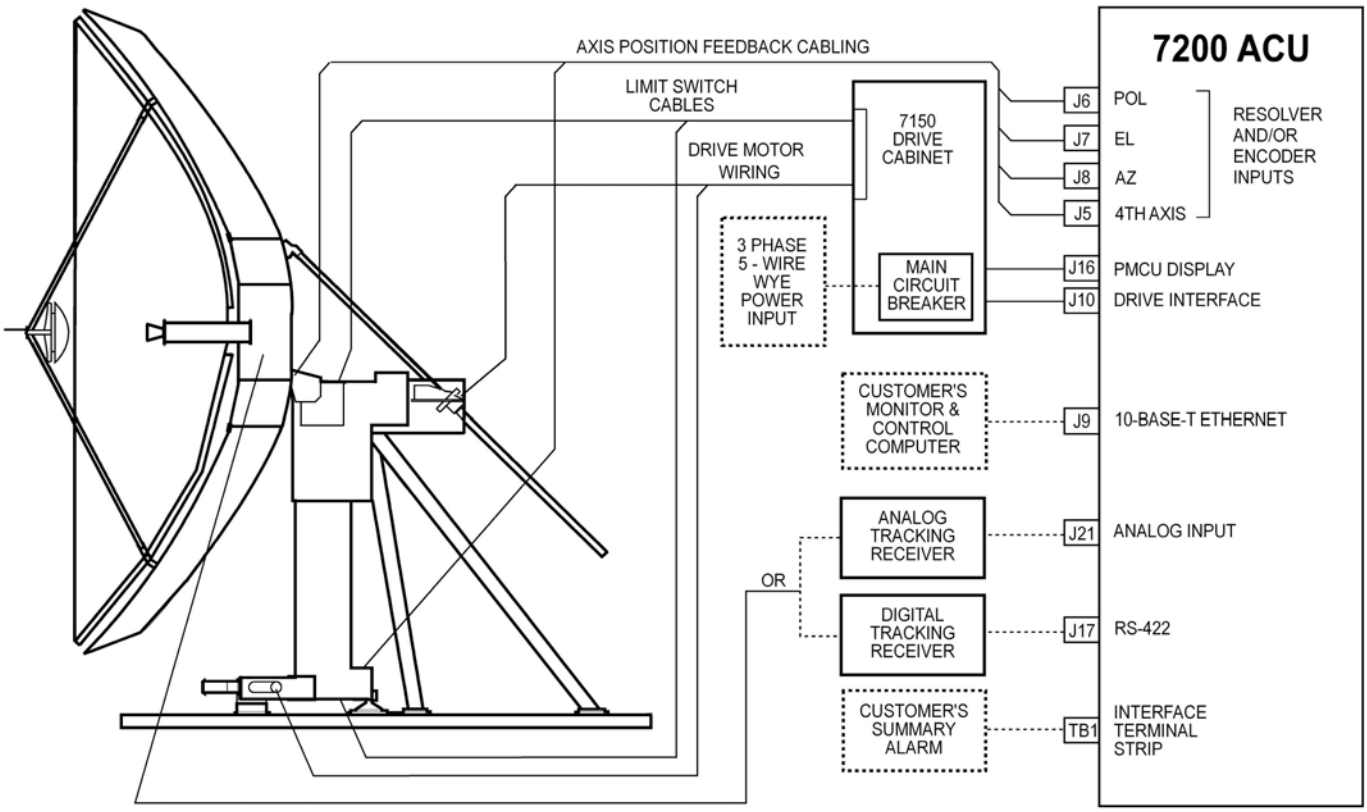


Figure 2-1 Typical 7200 ACS Block Diagram

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The standard main input voltage for the drive cabinet is either 208 VAC three-phase WYE, or 380 - 415 VAC three-phase WYE requiring a four-wire circuit plus a ground conductor. The actual current/power requirements for a given system are essentially established by the drive motor characteristics with only a small portion being used for control logic power. Other input voltages and frequencies are available as options, as is single-phase input power (the drive motors remain three-phase in this case as the inverter modules perform the required conversion). The input power wiring connects to pressure-type lug terminals on the main circuit breaker housing inside the drive cabinet.

> ***NOTE: In all cases, power wiring to the drive cabinet must be sized for the rated currents and voltage drop and installed by qualified personnel in accordance with local codes.***

Power for each of the drive motors is supplied from the drive cabinet through double insulated cables which are run through conduit and other enclosures serving as cable plenums and pull boxes. The motor power conductors connect to pressure-type lugs on terminals in the drive cabinet and in the motor junction boxes. Motor power wiring is sized for rated currents and voltage drops and is protected by overcurrent devices as defined by the regulations of the National Electrical Code (NEC), International Electrotechnical Commission (IEC), and Institute of Electrical and Electronic Engineers (IEEE).

Overtravel limit switches for each axis are interfaced with the drive cabinet via double insulated control cabling. In the drive cabinet, drive interlock logic is provided for each direction of travel and a summary limit alarm is developed and provided to the ACU for display. The limit switch cables connect to pressure-type terminals at each limit switch and in the drive cabinet.

Axis drive commands and drive cabinet status signals are passed between the ACU and drive cabinet through a 25 conductor, #22 AWG cable with a maximum length of 1500 feet. The cable connects to a pressure-type terminal strip in the drive cabinet and terminates into a 25-pin female D-connector at the rear of the ACU.

The AZ, EL, and POL (three-axis systems) and AZ, EL, POL and 4TH AXIS (four-axis systems) transducers interface directly with the ACU via a shielded multiconductor cable for each device. The standard configuration includes single-speed, brushless resolvers that require three twisted pair cables. The cables terminate to flying leads at the resolver via solder or positive crimp connections and terminate into male D-connectors at the ACU end (25-pin for AZ and EL; 9-pin for POL). Other types of position transducers, including high accuracy two-speed resolvers and absolute optical encoders, are available as options to accommodate critical antenna pointing accuracy requirements or to provide additional resolution for narrow beamwidths.

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In applications requiring closed-signal-loop tracking (Steptrack and OPT), a serial connection between the VertexRSI DTR tracking receiver and the 7200 ACU provides the ACU with the beacon signal level. Alternatively, an analog tracking signal is accepted through the ACU rear panel via J21 (a 9-pin D-connector). The nominal tracking voltage input is in the range of 0 to 10 VDC, with a slope of 0.2 V/decibels (dB) to 1.0 V/dB. Beacon select outputs are provided on a 7200 ACU rear panel terminal strip (TB1), allowing remote manual or automatic beacon selection with VertexRSI tracking receivers.

Full function remote control of the tracking system is facilitated through the 10BASE-T Ethernet port or one of the serial ports (both EIA/TIA-232E and EIA/TIA-422B are provided). An IEEE-488 (also known as GPIB), interface is also available as a factory option.

A summary alarm contact is provided on the ACU rear panel user interface terminal strip TB1. The contact can be wired to a warning light, buzzer or M&C interface to alert the station operators that the 7200 ACU has a summary fault condition.

2.4 System Hardware

The 7200 ACS consists of the following subsystems:

- Model 7200 ACU
- 7150 Drive cabinet
- Position Feedback Devices

The system interfaces with three-phase induction motors for AZ and EL positioning and a single-phase AC synchronous stepping motors for POL rotation. Limit interfaces are for normally closed switches that open upon engagement.

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2.4.1 7200 ACU Hardware

The Model 7200 ACU is a technically advanced, specially designed, multitasking embedded control computer that includes input and output circuitry sufficient for interfacing with all other related tracking system components. The ACU hardware is based upon the industrial Versa Module Europe (VME64 (VITA 1-1994)) bus architecture, providing extreme versatility and reliability far above many other hardware platforms. Several printed circuit cards and peripheral subassemblies, described in subsequent sections, are integrated in a custom chassis to comprise the ACU. The primary components of the 7200 ACU are:

- Front Panel Display Assembly
- Keyboard Controller PCB
- Digital I/O Daughter PCB
- Optical Encoder PCB (Optional)
- Optical Encoder I/O PCB (Optional)
- Rear Panel PCB
- One Power Supply
- VCPU PCB
- Single/Dual-Speed RDC PCB (Optional)

The 7200 ACU front panel is shown in Figure 2-2. The 7200 ACU functional block diagram is shown in Figure 2-3. Figures 2-4 and 2-5 show the top and side view of the ACU respectively. (Refer to the engineering drawings in Section 7.0)



Figure 2-2 7200 Antenna Control Unit Front Panel

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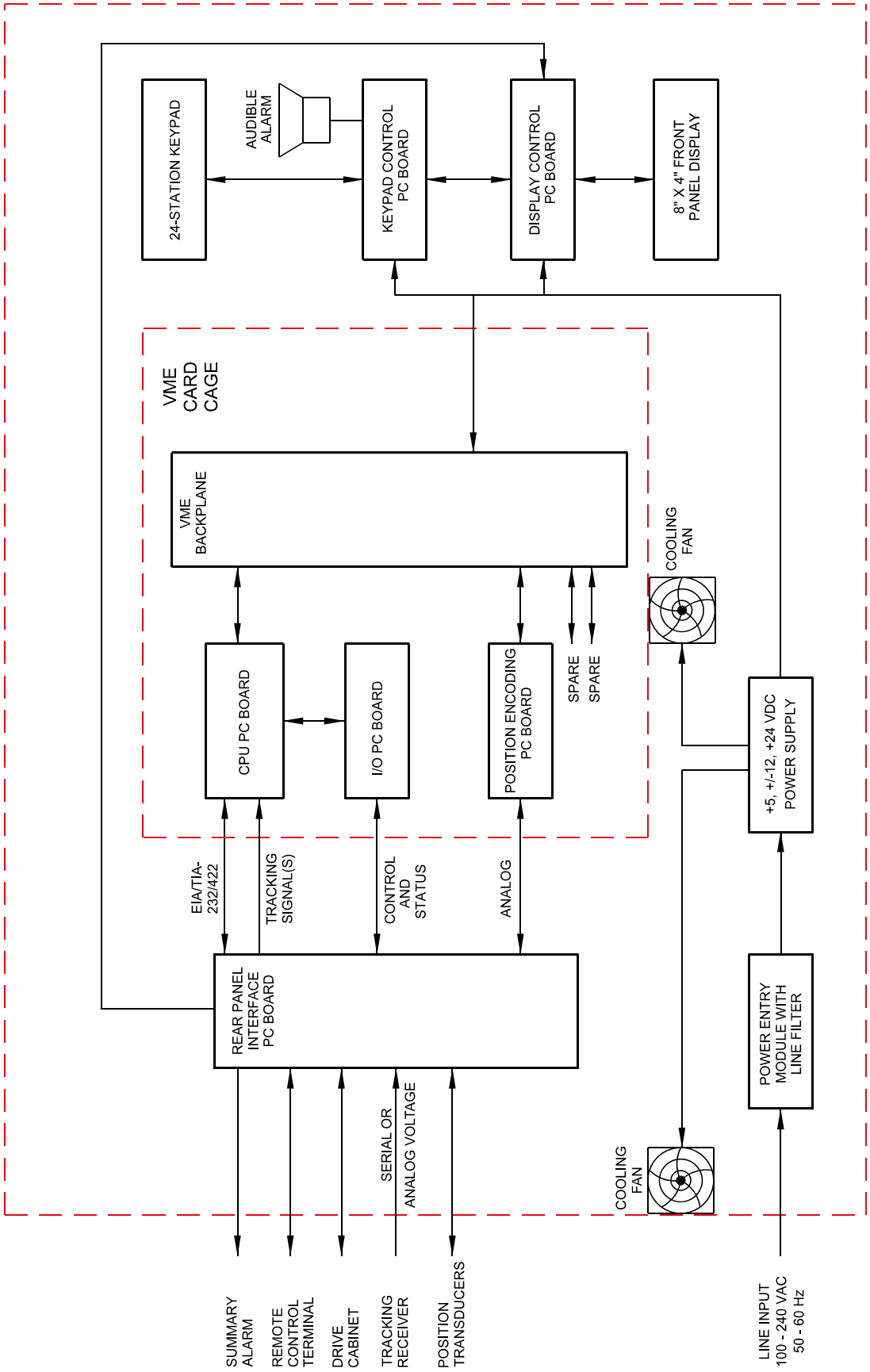


Figure 2-3 7200 ACU Functional Block Diagram

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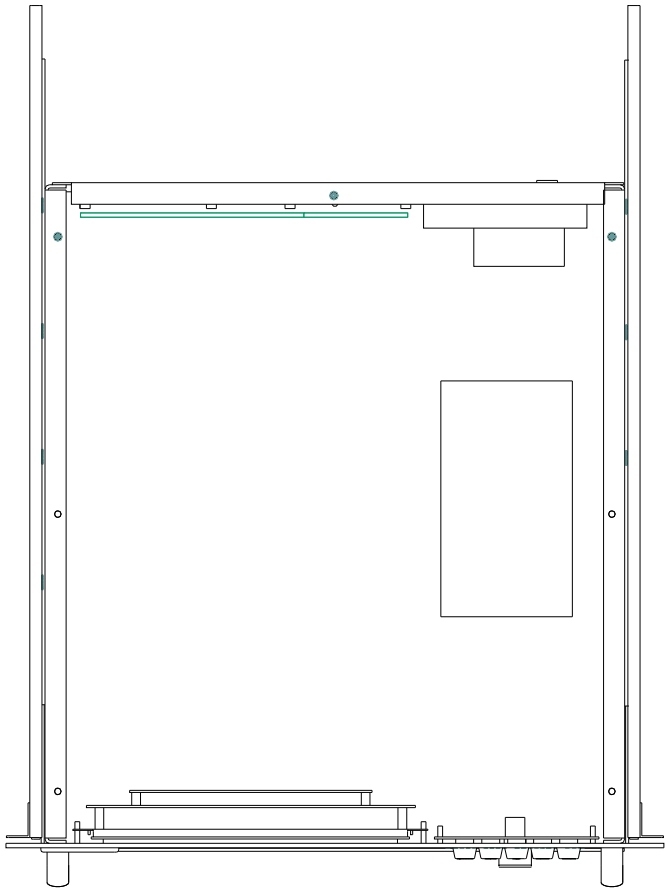


Figure 2-4 7200 Antenna Control Unit Top View

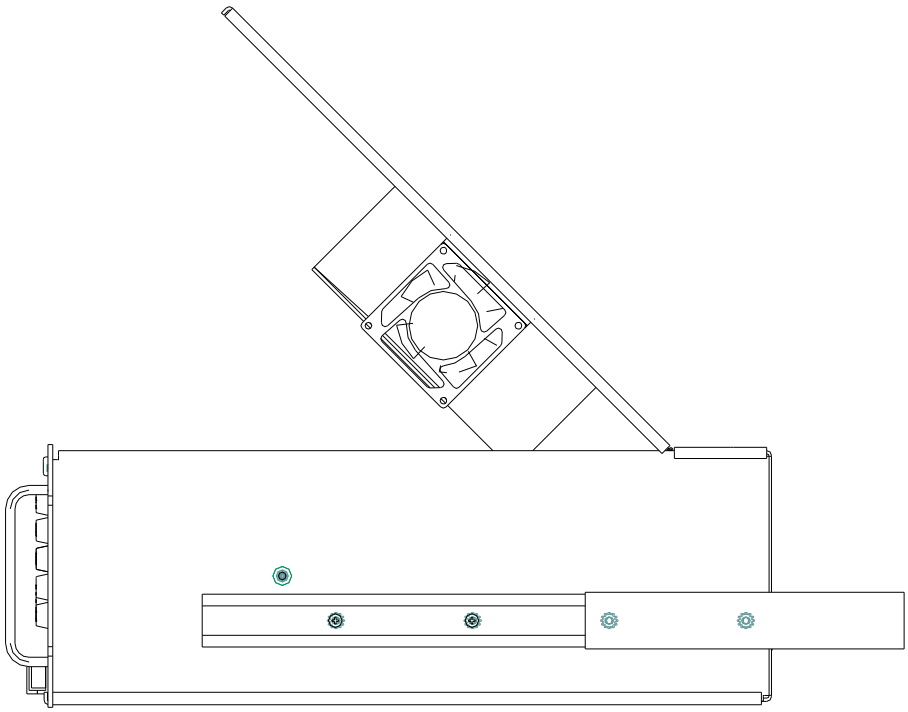


Figure 2-5 7200 Antenna Control Unit Side View

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2.4.1.1 VertexRSI Central Processing Unit (VCPU) PCB Assembly

The 7200 ACU uses the Motorola 68030 32-bit microprocessor as the Central Processing Unit (CPU), providing sufficient computing power for the sophisticated control and tracking algorithms used by the ACU. A dedicated VME CPU circuit card is provided, which includes the CPU, Read-Only Memory (ROM), Random Access Memory (RAM), bus control circuitry, and nonvolatile memory control circuitry, providing efficient and reliable system operation.

The VCPU card has several indicators and switches mounted on the VME front panel to provide the user with basic diagnostic information.

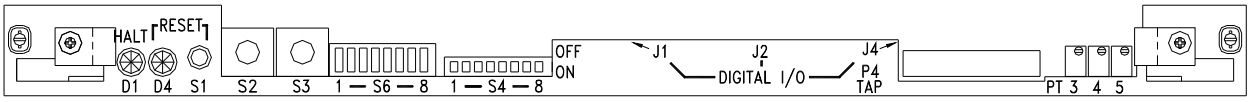


Figure 2-6 VCPU Card

D1 Halt LED – This bi-color green/red LED indicates the operational status of the 68030 CPU. If this LED is red the processor is halted and the system will not operate, consult the factory for assistance. This LED will always be illuminated green even when the board is held in reset.

D4 Reset LED – This bi-color green/red LED indicates the reset status of the board. If this LED is red it means the board is in reset. The following events can cause a reset condition to occur:

1) **2.5 VDC undervoltage fault** – If this is the cause then LED D2 (SMT LED located between the battery and the left hand side of the board) will be extinguished indicating that the 2.5V power supply source has fallen below 2.38VDC. Check the voltage to ensure it is above 2.38VDC. Potentiometer PT1 sets the threshold for this fault (Re-adjust per VertexRSI document CG-0283).
2) **3.3 VDC undervoltage fault** – If this is the cause the battery monitor IC (U1) has detected a voltage lower than 2.9 VDC. Check the 3.3V regulator output (VR1) to see if 3.3V is the output voltage.
3) **5.0 VDC undervoltage fault** – If this is the cause then LED D3 (SMT LED located between the battery and the left hand side of the board) will be extinguished indicating that the 5.0V power supply source has fallen below 4.75VDC. Check the voltage to ensure it is above 4.75VDC. Potentiometer PT2 sets the threshold for this fault (Re-adjust per VertexRSI document CG-0283).
4) **Dip Switch S6 pos 6 in the ON position** – Leaving this dip switch in the ON position holds the board in reset; change the position of the switch to the OFF position to allow the board to operate normally.

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5) **Momentary Pushbutton switch S1 is pressed** – This switch is spring loaded so it should not be able to remain pressed in (which will hold the board in reset); however, if it were to be held in place by something mechanically binding it, then the board would remain in reset; press the reset push button switch S1 several times to ensuring that it is springing back out with each release.

Reset Switch S1 - The momentary reset switch allows the user to reset the system CPU. Resetting the board is similar to cycling the power on the unit except the main RAM bank of memory on the board is not erased (as it is when the power is cycled). This reset switch is mainly used by VertexRSI software development personnel but can also be used by site operators when troubleshooting.

Hex Rotary Switch S2 – This rotary switch is used to determine which firmware to run when the system is powered on. The VCPU contains enough flash memory to hold four unique versions of application code (each of these four allocations in memory is referred to as a boot bank). This is useful when upgrading the 7200 ACU firmware because the new image can be uploaded to another boot bank, the rotary switch can be changed, and the ACU can be booted up with the new application firmware without erasing the original factory supplied application code. The rotary switch positions and their respective functions are defined in the table below:

TABLE 2-2 VCPU S2 HEX ROTARY SWITCH POSITIONS DEFINITION

S2 SWITCH POSITION	DESCRIPTION
0 (Factory Setting)	On power-up, run the application firmware contained in boot bank 0.
1	On power-up, run the application firmware contained in boot bank 1.
2	On power-up, run the application firmware contained in boot bank 2.
3	On power-up, run the application firmware contained in boot bank 3.
4 - D	Unused (currently these positions are treated like position E).
E	On power-up, run the MONDO Monitor program. MONDO is a low level monitor program used by VertexRSI to power-up, test and program a new 7200 ACU. MONDO uses an ASCII based protocol to interface with a PC via a terminal program via serial port 0 (front panel display or serial port 1 – J14 on the rear of the 7200).
F	On power-up, run the Swift X talker (Used by VertexRSI software developers only)

Hex Rotary Switch S3 – This rotary switch is used to determine which self-test the VCPU will run when powered up. The VCPU contains self test code which are divided into three categories:

1) **Destructive Tests** – These tests erase memory, which would cause the user to have to reload the parameters and application code.
2) **Independent Tests** – These tests can be run without the need for external test cables and other test hardware. The following circuits are functionally tested: floating point coprocessor, real time clock, serial ports (loopback internal to the UART), CPU interface to the Ethernet controller microcontroller, the rotary switches S2, S3 and the dip switch S4.
3) **Dependent Tests** – These tests require special test jigs and are run by factory personnel to verify operation of the system.

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This self-test code is only run if DIP switch S4 pos 8 is in the ON position. To prevent against "accidentally" running these tests, the tests are also interlocked with the Keyboard controller card. If the keyboard controller card is detected, the tests will be aborted. The serial port between the keyboard controller card and the display controller card should be unplugged to allow the tests to proceed.

TABLE 2-3 VCPU S3 HEX ROTARY SWITCH POSITIONS DEFINITION	
S3 SWITCH POSITION	**DESCRIPTION**
0 (Factory Setting)	On power-up, no self-test code is run.
1	On power-up, the destructive suite of tests is run.
2	On power-up, the independent suite of tests is run.
3	On power-up, the dependant suite of tests is run.
4 - E	Unused.
F	On power-up, run all tests sequentially.

DIP Switch S6 – This DIP switch directly controls various hardware related board functions as defined in the following table:

TABLE 2-4 VCPU S6 DIP SWITCH POSITIONS DEFINITION		
S6 SWITCH POSITION	**OFF POSITION (SWITCH OPEN)**	**ON POSITION (SWITCH CLOSED)**
1 - 4	Flash Write Disabled ♦♥	Flash Write Enabled
5	EEPROM Write Disabled♦	EEPROM Write Enabled
6	Normal Operation♦	Hold the VCPU board in Reset
7	CPU Watchdog Disable♦	CPU Watchdog Enable
8	Board Reset Disabled	Board Reset Enabled♦

♦ Denotes the normal operating position of the switch (factory setting).
♥To program the flash boot banks with new application code, S6 pos 1-4 must be in the ON position; after programming is complete, return these four switches to the OFF position.

DIP Switch S4 – This DIP switch controls various software functions as defined in the following table.

TABLE 2-5 VCPU S4 DIP SWITCH POSITIONS DEFINITION		
S4 SWITCH POSITION	**OFF POSITION (SWITCH OPEN)**	**ON POSITION (SWITCH CLOSED)**
1	Password Protection Enabled♦	Password Protection Disabled
2-6	Unused♦	Unused
7	Standard Boot Up ♦	Resets all params to factory defaults on Boot
8	Self Test Mode Disabled♦	Self Test Mode Enabled♠

♦ Denotes the normal operating position of the switch (factory setting).
♠ Enabling self-test mode should ONLY be performed when directed to do so by VertexRSI technical support. Some of the self-tests erase NVRAM (parameter storage space) and some erase all the flash banks (application firmware).

Potentiometer PT3 – The analog input circuit contains an AGC gain amplifier. The gain of this amplifier is adjusted by PT3. To use the AGC gain amplifier, the shunt plug on 201358-01 site J4 must be moved from the "Bypass" position (factory setting) to the "Gain" position. Refer to the A/D Calibration section of VertexRSI Document #CG-0283.

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Potentiometer PT4 – The analog input circuit contains a zero offset calibration potentiometer PT4. Refer to the A/D Calibration section of VertexRSI Document #CG-0283.

Potentiometer PT5 – The analog input circuit contains a gain calibration potentiometer PT5. Refer to the A/D Calibration section of VertexRSI Document #CG-0283.

Table 2-6 provides miscellaneous performance specifications that are inherent to the VCPU board.

TABLE 2-6 VCPU PERFORMANCE SPECIFICATIONS

Description	Typical	Calculated Worst Case
Real Time Clock Accuracy (A TCXO drives this clock)	+ / - 0.16 Seconds/Day	+ 0.26 to –0.42 Seconds/Day (@ 0-50 Degrees C)
NVRAM Battery Backup Shelf Life (external power source off)	24 Months	15 Months (@ 0 Degrees C)
NVRAM Battery Backup Normal Operation (external power source operational)	-	90% capacity after 10 years due to self discharge (@ 25 Degrees C)
Battery Change Period (without NVRAM corruption) *	> 45 Seconds	> 21 Seconds

* A capacitor keeps the NVRAM powered while the battery is being replaced. This row in the table defines the minimum amount of time that the discharging capacitor will keep the NVRAM powered without the battery present.

2.4.1.2 User Interface

One of the most striking and advanced features of the 7200 ACU is the user interface, which combines an 8-inch by 4-inch electroluminescent display with a custom 24-station keypad to provide the most straightforward, powerful, and user-friendly operating platform in the industry. As shown in Figure 2-2, the 7200 ACU front panel layout is uncluttered and offers a logical format for the display of information. For more information on the user interface refer to Section 2.5.1.

2.4.1.3 Digital Input/Output Printed-Circuit Board Assembly

The I/O PCB provides the electrical interface between the ACU and the drive cabinet. In addition, the I/O card serves as the interface between the CPU and the ACU rear panel status inputs and control outputs. There are a total of 24 digital inputs (some inputs are used internally so all 24 are not available through the rear panel connectors). See table 2-7 for the digital inputs specifications.

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TABLE 2-7 7200 DIGITAL I/O SPECIFICATIONS	
DIGITAL INPUTS	**DESCRIPTION**
Voltage Levels	Logic Level High Voltage Range: (+4.5 to +26.7 VDC) Logic Level Low Voltage Range: (0 to +1 VDC)
Input Impedance	10 K Ohms (Nominal)
Transient Voltage Suppression	Electrostatic discharge (ESD) as defined in IEC 1000-4-2, Electrical fast transients (EFT) per IEC 1000-4-4
DIGITAL OUTPUTS CONNECTOR TB1 ONLY	**DESCRIPTION**
Output Type	Relay Contact Closure
Maximum Input Voltage	220 VDC or 125 VAC RMS
Maximum Load Current	1 Amp
Maximum Switched Power	62.5 VA
DIGITAL I/O CONNECTORS J10 & J11	**DESCRIPTION**
Output Type	Open Collector Transistor
Maximum Input Voltage	26.7 VDC
Maximum Load Current	500 mA
Transient Voltage Suppression	Electrostatic discharge (ESD) as defined in IEC 1000-4-2, Electrical fast transients (EFT) per IEC 1000-4-4

Specifications subject to change without notice.

2.4.1.4 Resolver-to-Digital Converter Printed-Circuit Board Assembly

The Resolver-to-Digital Converter (RDC) PCB accepts analog inputs from the antenna-mounted AZ, EL, and/or POL resolvers (via the rear panel termination circuit card) and provides a binary digital encoded representation of the pointing angles for each axis to the CPU. VME bus interface circuitry is included, based upon CPU and RDC timing requirements. The standard configuration is for single-speed resolvers and 16-bit encoding; however, the RDC PCB can be configured to accept dual-speed resolver inputs and provide higher resolution as required. Alternate means of position encoding are available, including high accuracy absolute optical encoders, in which case an alternate position interface circuit card is provided.

2.4.1.5 Optical Encoder Daughter Board (Optional - AZ and EL)

The OE daughter card is mounted on its own VME card. This card takes the EIA-422A serial encoder data and converts it to 24 bits for use by the CPU. Two Complex Programmable Logic Devices (CPLDs) are employed to convert the buffered serial data to parallel data for use by the CPU. The card reads each encoder about 4000 times per second. The bits of position resolution are dependant on the actual optical encoder used, however, most optical encoder systems have 18 bits of resolution.

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2.4.1.6 Dual Channel Resolver-to-Digital Converter PCB Assembly (Optional POL and 4TH AXIS)

The Resolver-to-Digital Converter (RDC) PCB accepts analog inputs from the antenna-mounted resolvers (via the rear panel termination circuit card) and provides a binary digital encoded representation of the pointing angles for the POL and 4TH AXIS to the CPU. VME bus interface circuitry is included, based upon CPU and RDC timing requirements. The standard configuration is for single-speed resolvers and 16-bit encoding.

2.4.1.7 IEEE-488 Interface (Optional)

The IEEE-488 bus has been optionally incorporated into the 7200 ACU to accommodate users wishing to utilize this type of interface. The IEEE-488 bus allows connectivity between different programmable devices with a standard interface for communications between each instrument. The IEEE-488 interface is also known as GPIB (General Purpose Interface Bus) or HPIB (Hewlett Packard Interface Bus), and is electrically similar to IEC-625. Please refer to document CG-6041 for M&C protocol for this interface.

2.4.1.8 Time and Frequency Processor Board (Optional)

The 7200 ACU clock accuracy can be precisely maintained by utilizing the optional Time and Frequency Processor Board. This VME board is used in conjunction with an external (CFE) time source to synchronize the 7200 ACU clock to the accurate time source. The external time source sends an IRIG-B compliant signal to the J3 BNC connector on the rear of the 7200 ACU. This signal is routed to the Time and Frequency Processor Board (TFP). The VCPU board acquires only the year from the on-board real-time clock while the rest of the time/date information is taken directly from the TFP board. If the TFP board becomes disconnected from its source, a message will be displayed on the ACU “External Timing Source Lost”.

2.4.1.9 ACU Chassis Assembly

The ACU is housed in a custom chassis assembly which mounts in a standard 19-inch Electronics Industry Association (EIA) rack, requiring 7-inches of vertical rack space (4 Rack Units per EIA 310). The nominal overall dimensions of the ACU chassis are: 7-inches tall by 19-inches wide by 20-inches deep. The 7200 ACU’s weight is approximately 27 Lbs. A four-slot VME card cage, which houses the VCPU, I/O, and RDC PCB’s, is mounted to the inside of the chassis top plate. The top plate is hinged at the rear of the chassis and includes a locking support arm to facilitate convenient front-side access to the card cage. Studs connected to the front panel support the front panel display and keypad and their respective control circuit cards.

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A VME backpanel PCB serves as the bus interface and DC power supply distribution system for the CPU and RDC PCB's. Two of the four slots are available for future expansion and/or customized features and factory options.

A PCB mounted to the ACU rear panel accepts all external wiring and connectors (with the exception of the line cord) and serves as a "break-out" device with connections to each of the circuit boards in the card cage.

Two cooling fans are provided to ensure operation of the ACU internal components remain well within device ratings. The fans are powered from the +24 V output of the power supply.

2.4.1.10 Power Supply, EMI Filter and Fuse

Power for all ACU components is provided by one power supply assembly, which is mounted to the bottom plate of the chassis. This power supply is a quad output, switched mode type, providing output voltages of +5, ±12 and +24 VDC for all logic and control circuits. Nominal power requirements for the ACU are 75 VA at 100 to 240 VAC, 50 or 60 Hertz (Hz).

The power supply used in the 7200 ACU has an automatic shutdown feature in case over-current conditions occur. The system also has a line fuse on the rear power entry module in case of a ground fault. An input line-conditioning filter provides Electromagnetic Interference (EMI) suppression.

TABLE 2-8 7200 POWER INPUT SPECIFICATIONS

AC POWER INPUT	DESCRIPTION
Input Voltage Range	100 to 240 VAC Nominal
Input Power Requirements	75 VA Typical
Input Surge Current	25 Amps Max. @ 25 degrees C
Input Power Factor	0.98 Typical (Active Power Factor Corrected Supply)
Input Frequency Range	50 to 60 Hz Nominal (47-63 Hz Max.)
Fuse Current Rating	2 Amps
Fuse Type	5 x 20 mm Time Lag Fuse (Slo-Blo Type Fuse) per IEC 60127-2 Sheet 3

Specifications subject to change without notice.

2.4.2 Antenna Drive Cabinet Hardware

The standard motor drive cabinet is a freestanding, foot-mounted aluminum NEMA-4X enclosure with overall dimensions of approximately 36-inches tall by 30-inches wide by 10-inches deep. The aluminum cabinet provides outstanding corrosion protection even in the harshest of environments.

A functional block diagram of the drive cabinet is shown in Figure 2-7.

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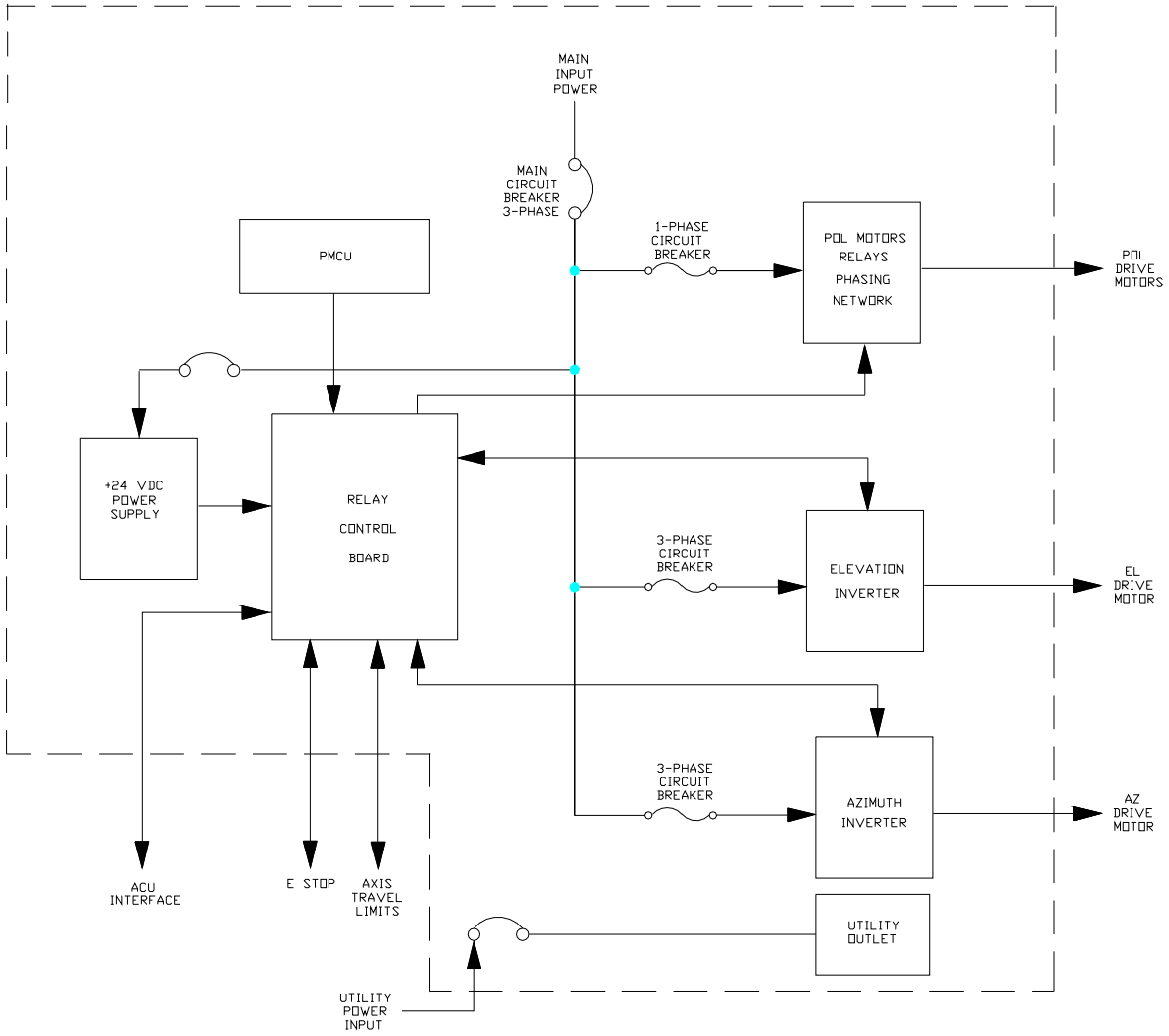


Figure 2-7 Drive Cabinet Block Diagram

The drive cabinet consists of the following major components:

- Portable Maintenance Control Unit
- Main and Inverter Drive Circuit Breakers
- EMERGENCY STOP SWITCH
- AZ Variable Speed AC Drive Unit (Inverter)
- EL Variable Speed AC Drive Unit (Inverter)
- 24 VDC Power Supply
- Control Circuitry for the POL Motors (In Three-Axis and Four-Axis Systems)

Figure 2-8 shows the major components of the drive cabinet. Refer to the engineering drawings in Section 7.0.

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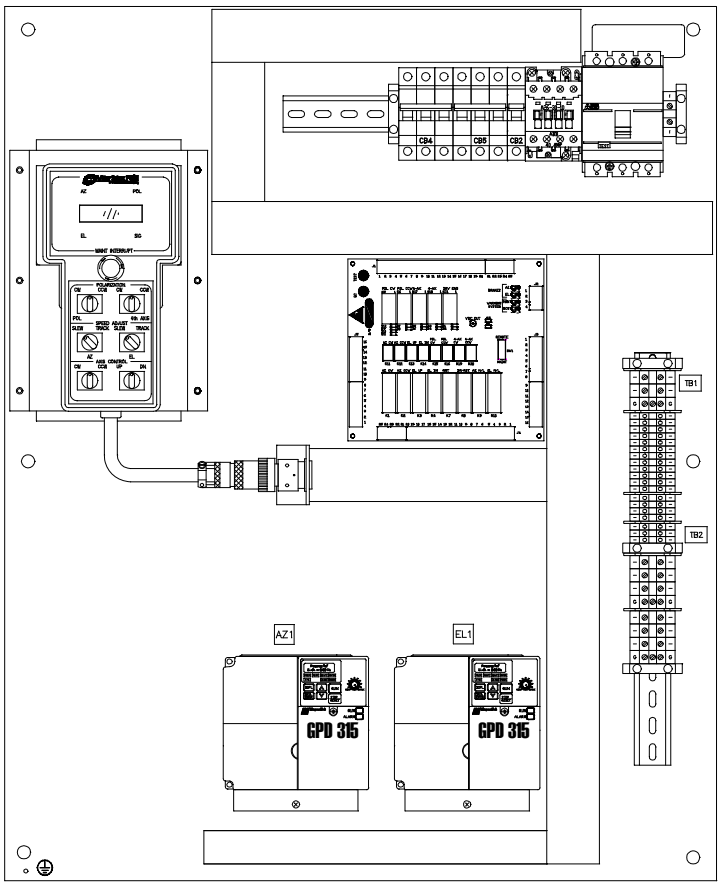


Figure 2-8 Drive Cabinet Assembly

The Portable Maintenance Control Unit (PMCU) located inside the 7150 Drive Cabinet allows the operator to control antenna movement from the proximity of the antenna.

The MAIN CIRCUIT BREAKER controls the main power to the drive motors, the limit switches, and the drive cabinet, but does not provide power to the 7200 ACU. Each inverter has an individual circuit breaker for protection.

The EMERGENCY STOP switch (on the outside of the drive cabinet), when pressed, removes power from the drive motors by opening the drive enable contactor.

The AZ and EL inverters provide pulse-width-modulated motor current, allowing continuously variable drive rates over a range of up to 50 to 1.

The 24 VDC power supply provides operating voltage to the drive cabinet relay circuit board.

Relay PCB accepts all limit switch status inputs and controls the commands to the inverter drives and the POL motors.

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2.4.2.1 AZ and EL Drive Inverters

One of the critical advantages of the 7200 ACS over many other systems is the use of variable frequency drive inverters to control the speed of standard three-phase induction motors for AZ and EL antenna motion. This approach has several distinct advantages over the commonly used and simplistic on/off contactor control of motor power. First, inverters allow VertexRSI to offer two-speed control in a standard configuration without the problems associated with special dual-wound motors or clumsy clutching arrangements. Secondly, the inverters offer precision motor control by ramping motor speeds up and down in a controlled manner rather than simply switching full motor power on and off and having to contend with inertial coasting of the motor rotor and the related axis overshoot. In addition to these two distinct advantages, the inverter drives offer superior motor protection through sophisticated electronic motor overcurrent protection. Motor current is continuously monitored and compared against allowable levels for different conditions. Should the actual measured current exceed the allowable levels, the inverter trips and the drive is disabled. The inverter then has the capability to automatically reset and continue operation, provided the current remains within allowable limits.

2.4.2.2 Polarization Motor Control (POL and 4th Axis)

A three-axis system uses a single-speed AC synchronous stepping motor for feed assembly rotation (**POL**). In the four-axis system a pair of single-speed AC synchronous stepping motors are used for feed assembly rotation. Both POL motors are controlled and powered from the 7150 drive cabinet. Drive power to the POL motor(s) is switched, according to the required direction of rotation, by relays located on the Relay PCB. A resistance-capacitance (RC) network in the drive cabinet provides the proper phase relationship to each motor.

2.4.2.3 Drive Cabinet Control Logic

Motor drive commands and interlock functions in the drive cabinet are performed with relay logic operating at +24 VDC, which is derived from a regulated power supply. Commands can be received from the ACU, or PMCU, for motor speed and direction. The **Drive Reset** is controlled from the Relay PC board and the **Emergency Stop** is located on the right side of the enclosure. The drive cabinet relay logic then commands the axis drives accordingly. Likewise, limit switches mounted on the structure activate relays in the drive cabinet upon engagement to form axis interlocks and provide the appropriate fault reporting to the ACU.

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2.4.2.4 Local Control

Local (Maintenance) control of the antenna drives is facilitated through a set of switches on the PMCU in the drive cabinet. A MAINT/REMOTE switch located on the Relay PCB allows the operator to select between ACU control and local drive cabinet control. With the select switch set to the MAINT position, ACU control is disabled; however, all status reporting remains fully operational at the ACU.

2.4.2.5 Drive Cabinet Overcurrent Protection

As described in Section 2.4.2.1, "intelligent" electronic overcurrent protection is provided for AZ and EL drive motors by the variable frequency inverters. In addition, there are several other protection devices integral to the drive cabinet. The inverter inputs are individually protected by circuit breakers, offering short-circuit protection in the event of a drive inverter catastrophic failure. The +24 VDC logic power supply has a line input circuit breaker for short circuit protection. In three-axis and four-axis systems, the POL motor circuit(s) is individually protected by a circuit breaker. A main input power circuit breaker is also provided, which serves as an internal disconnect for the entire cabinet.

2.4.2.6 AZ and EL Drive Motors

Three-phase induction gearmotor assemblies are utilized for actuation of the AZ and EL axes. The motors are sized based upon deadweight, frictional, and wind-loading requirements, as well as the required axis velocities. The standard motors can be connected for either 208 or 380 - 415 VAC three-phase input, based upon the line voltage available to the drive cabinet. The motors have sealed, permanent, synthetic grease lubricated bearings and the gearboxes are lubricated with synthetic gear oil, minimizing maintenance requirements.

2.4.2.7 Absolute Position Transducers

Angular position feedback is provided by absolute position transducers (resolvers) for each axis. The standard configuration includes size 11 single-speed, brushless resolvers which, combined with the position encoding circuitry in the ACU, yield an accuracy of 0.02 degrees, root mean square (RMS). The resolver reference voltage for the standard devices is 4.6 V RMS, at 2500 Hz.

Encoding system options include electrically wound two-speed resolvers or absolute optical encoders to provide increased resolution and accuracy. With the two-speed option, an overall control system accuracy of 0.01-degree peak error is achieved. In this configuration, dual monolithic resolver-to-digital conversion IC's are used in the ACU with bit rotation techniques incorporated to significantly increase binary resolution. Various optical encoder configurations allow for resolution and accuracy levels commensurate with the most demanding system applications.

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2.4.2.8 Axis Overtravel Limit Switches

Overtravel is prevented in each direction for each axis of rotation by electrical limit switches with normally closed (open upon limit engagement) contacts. The switches are designed with double break contacts such that movement of the switch actuator in either direction opens a corresponding set of discrete contacts. In this manner, only one limit switch assembly is required for each axis. Each switch is mounted with brackets, including adjustable strikers for each direction of travel.

2.4.2.9 Drive Cabinet Low-Temperature Option

The standard 7200 ACS drive cabinet is rated to operate in an outside ambient temperature range of 14° F (-10 °C) to 122° F (+ 50 °C). For sys tems where the ambient temperature will fall below 14° F (-10 °C), an optional low -temperature package is available for the drive cabinet.

For the low-temperature option package, a 200 watt forced air convection heater with integrated fan and wall insulation are installed inside the drive cabinet. Over current protection is provided by an individual circuit breaker sized to the wattage and input voltage of the heater. When the thermostat inside the drive cabinet registers a temperature below 41°F (5°C), the heater is activated and heats the air inside the drive cabinet. An external thermostat shuts the heater off when outside air exceeds 41°F (5°C). The heated air maintains the internal te mperature of the drive cabinet to within the standard operating temperature range.

2.5 Controls and Indicators

The controls and indicators for the 7200 ACS are located on the ACU and inside the drive cabinet. The EMERGENCY STOP button is located on the outside of the drive cabinet and additional optional emergency stop switches may be provided at other locations.

2.5.1 7200 ACU Controls and Indicators

The controls and indicators for the ACU are located on the front panel and on the rear panel. The following sections describe the functions of the ACU controls and indicators.

2.5.1.1 The Power On/Off Switch

The power on/off switch is located on the rear of the 7200 ACU in the power entry module. When the switch is set to the on position, power is applied to the power supply in the ACU.

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2.5.1.2 The Alphanumeric Display

The 7200 ACU user interface combines an 8-inch by 4-inch electroluminescent display with a custom 24-station keypad to provide the most straightforward, powerful, and user-friendly operating platform in the industry. Figure 2-8 shows each section of the 7200 ACU display, and each section is described in detail in the following sections.

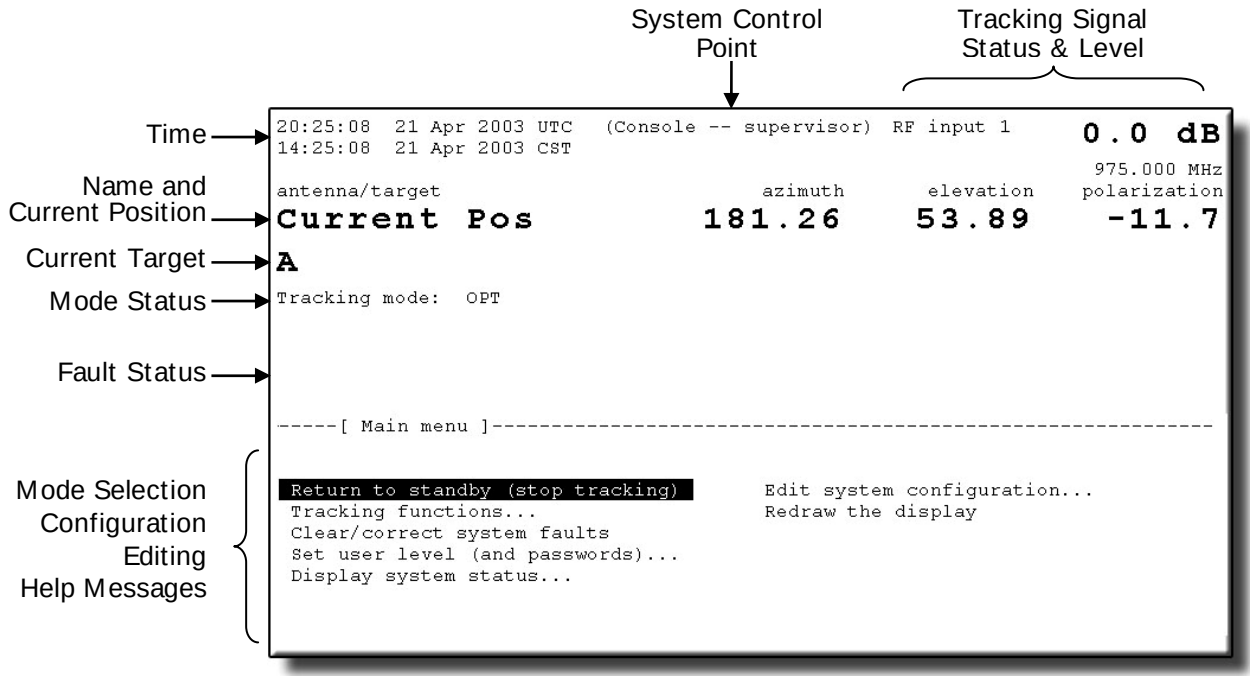


Figure 2-9 7200 Antenna Control Unit Display

The display is divided into upper and lower sections: the upper section (approximately 60 percent) is dedicated to real-time information display, and the lower section is used for interactive mode selection, configuration, editing, and help messages. In the real-time display section, "current pos" AZ and EL angles are displayed in double-size characters. A user-configurable alphanumeric field to the left of the current position angles allows for labeling (naming) the display, primarily to aid identification in multiple-antenna stations. The line of information directly below the current position information (also double-size characters) identifies the target currently being accessed by the system. If the system is in the process of moving from one target to another, or in a program tracking mode of operation, the target (or next position) angles are also displayed directly below the current position angles.

Immediately below the target name field is a line of information that displays the current mode of operation and pending modes. The current target shown in Figure 2-9 is "A" and the mode status line shows that the current tracking mode is **OPT**. Shown at the top of the display are current time (Coordinated Universal Time (UTC) and/or local), user level (**Monitor**, **Operator**, or **Supervisor**) and tracking signal source and level. Each of these items may be blanked out by the user if not required in a particular application (refer to Section 5.8.6.14 for information on user interface options).

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System fault status is reported in inverse, double-size characters in the field below the **Tracking mode** status line. In the event of multiple fault conditions, the fault messages are scrolled continuously at approximately one-second intervals. An audible alarm (if the alarm option is turned on) accompanies any major fault and may be silenced from the front panel keypad (refer to Section 5.8.6.14 for information on user interface options). To the right of "UTC", an asterisk "*" will appear if an optional time and frequency processor board (IRIG-B) is installed and has locked onto an external signal at least once (refer to Section 2.4.1.8).

The lower portion of the display allows fully menu-driven selection of control modes, parameter editing, etc. A logical tree structure provides for easy and efficient system operation with minimal reliance upon system operation manuals. One item in each menu is always highlighted by an inverse-video cursor, which is controlled by keypad direction keys. The [ENTER] key then selects the highlighted item either for activation or editing. A dedicated [HELP] key and context-sensitive help messages serve to remind the operator of operational functions.

The display control PCB receives commands from the CPU through a serial link and provides appropriate decoding and driver functions for illumination of the display.

2.5.1.3 The Keypad

Commands from the keypad are decoded and serialized through a dedicated keypad control PCB and sent to the CPU through a serial link shared with the display control serial link. A speaker located on the keypad control circuit board provides an audible alarm for fault conditions. Refer to Table 2-9 for explanations of the function of each key.

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TABLE 2-9 7200 ACU KEYPAD CONTROLS	
CONTROL	**FUNCTION**
↑	Moves the selection cursor up. In one-screen menus, the up arrow moves the cursor from the bottom item in the right column to the top of the left column, but does not wrap from the top of the left column to the bottom of the right column. In menus filling more than one screen, it will return to previous screens. Also used to toggle between preprogrammed choices for tracking modes, naming targets, etc. (refer to Section 5.0 of this manual).
↓	Moves the selection cursor down. In one-screen menus, the down arrow moves the cursor from the top item in the left column of a menu to the bottom of the right column one item at a time, but does not wrap from the bottom of the right column to the top of preceding left column. In menus filling more than one screen, the down arrow will reveal additional screens of information when it is pressed from the bottom right position. Also used to toggle between preprogrammed choices for tracking modes, naming targets, etc. (refer to Section 5.0 of this manual).
→	Moves the selection cursor to the right. In one-screen menus, the right arrow moves the selection cursor from the left column to the right column, but does not wrap the selection cursor from the right column to the left column. In multi-screen menus, it will reveal additional screens of information.
←	Moves the selection cursor to the left. In one-screen menus, the left arrow moves the selection cursor from the right column to the left column, but does not wrap the selection cursor from the left column to the right column. In multi-screen menus, it will return to previous screens of information.
PG DN	When pressed simultaneously with [SHIFT] key, changes display to the next page for multiscreen menus. Has no effect on single-screen menus.
PG UP	When pressed simultaneously with [SHIFT] key, changes display to the previous page for multiscreen menus. Has no effect on single-screen menus.
ENTER	Selects the currently highlighted item.
PRIOR	Returns to the last screen viewed before the user pressed [ENTER] or [HELP]. During in-line editing, restores data to the value it had before [ENTER] was last pressed.
MAIN	When pressed simultaneously with the [SHIFT] key, returns to the **Main menu**. **NOTE: If the [MAIN] key is pressed while editing data, all changes that have been made are lost.**
STOP	Stops movement of the antenna when pressed. Keyboard Stop flashes on the screen in double-size letters. If the audible alarm is turned on, the alarm sounds until the [SHIFT] and [RESUME] keys are simultaneously pressed (or **Clear/correct system faults** is selected).
RESUME	When pressed simultaneously with the [SHIFT] key, resumes tracking when a tracking mode is interrupted by keyboard stop.
HELP	Provides access to the context sensitive help screens from anywhere in the menu system.
SHIFT	Allows the use of the shift functions shown in white letters on the keypad.
+ / -	Used when entering numerical parameters if the range includes negative numbers. Also used to toggle between **Momentary** and **Sticky** keypad mode for the ACU keypad.
YES/NO	Toggles between YES and NO when setting parameters or when changing operating modes for the system.
A/B	Toggles the display between POL only, 4TH AXIS only, and POL and 4TH AXIS (In Four-axis systems only)
•	The period is used to enter floating-point numbers or to choose between POL and 4TH AXIS in four-axis systems.
EXP	Used for entering exponents into numeric data fields.
	In **Manual antenna control** mode, moves POL clockwise (CW). Has no other use.
	In **Manual antenna control** mode, moves POL counterclockwise (CCW). Has no other use.
0 - 9	The numeric keys are used for entering numerical data. Hexadecimal digits A - F may be entered by pressing the [SHIFT] key and 0 - 5, respectively.

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2.5.1.4 Drive Enable Switch

When the DRIVE ENABLE switch is in the out position, it is illuminated, and the drive motors are enabled through the drive enable contactor. When the DRIVE ENABLE switch is engaged, and not illuminated, the drive motors are disabled, and a message is displayed on the screen of the 7200 ACU.

2.5.2 Drive Cabinet Controls and Indicators

The drive cabinet contains the following controls and indicators located on the PMCU and the Relay PCB. The function of each control is described in Table 2-10.

TABLE 2-10 DRIVE CABINET PMCU AND RELAY PCB CONTROLS

CONTROL	FUNCTION
MAINT/REMOTE	The MAINT/REMOTE switch is located on the Relay PCB. When set to the REMOTE position, transfers control to the 7200 ACU. When set to MAINT> the PMCU has control of the system. The remote mode is selected when the switch is in the UP position. Maintenance mode is selected when the switch is in the DOWN position.
AZIMUTH SPEED ADJUST	Located on the PMCU. SLEW SPEED/TRACKING SPEED select switch - Selects the AZ drive speed (functional in MAINT mode only). SLEW SPEED - This speed is programmed in to the AZ drive and sets the AZ high-speed drive rate. TRACKING SPEED - This speed is programmed in to the AZ drive and sets the AZ low speed drive rate.
AZIMUTH CW & CCW SWITCH	Located on the PMCU, when this switch is turned to CW and held it rotates the Azimuth in the CW direction at the speed determined by the AZIMUTH SPEED ADJUST Switch until the switch is released. When the switch is released it returns to center and the motion ceases. This switch when turned to CCW and held rotates the Azimuth in the CCW direction at the speed determined by the AZIMUTH SPEED ADJUST Switch until the switch is released. When released the switch returns to center and the motion ceases.
ELEVATION SPEED ADJUST	Located on the PMCU. SLEW SPEED/TRACKING SPEED select switch - Selects the EL drive speed (functional in MAINT mode only). SLEW SPEED - This speed is programmed in to the EL drive and sets the EL high-speed drive rate. TRACKING SPEED - This speed is programmed in to the EL drive and sets the EL low speed drive rate.
ELEVATION UP & DN SWITCH	Located on the PMCU. This switch when turned to UP and held rotates the Elevation in the UP direction at the speed determined by the AZIMUTH SPEED ADJUST Switch until the switch is released. When the switch is released it returns to center and the motion ceases. This switch when turned to DN and held rotates the Elevation in the DN direction at the speed determined by the AZIMUTH SPEED ADJUST Switch until the switch is released. When released the switch returns to center and the motion ceases.
CONTROL POWER CIRCUIT BREAKER	Provides circuit protection for the DC power supply that provides 24 VDC for control circuits.
CONTROL POWER LED	The Light-Emitting Diode (LED) is located on the Relay PCB and illuminates green when power is ON.
MAIN CIRCUIT BREAKER	Provides circuit protection for entire drive cabinet power circuits.
DRIVE(S) CIRCUIT BREAKER	Provides individual circuit protection for each drive.
RECEPTACLE CIRCUIT BREAKER (if installed)	Provides circuit protection for the duplex utility outlet on the leg of the drive cabinet.

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2.6 System Functions

The 7200 ACS offers a full complement of standard antenna position control modes as well as a number of advanced tracking modes. For automatic tracking, the 7200 ACS incorporates a new approach to control system operation with a unique target-oriented environment, which provides for the establishment of unique system characteristics for multiple targets (satellites). In this manner, each target to be accessed is user-configured with tracking mode, tracking signal frequency and slope, etc. A target-specific data base is established for any predictive or programmed tracking data relative to the target. Once configured, tracking for a target is initiated and maintained in a fully automatic manner simply by invoking the "name" of the target. This greatly enhances normal operation of the system by reducing the level of required operator expertise and intervention.

Configuring a target includes the establishment of an operational mode to be used for accessing that target. The following sections describe the available control modes for the system in some detail. It should be noted that configuration of a new target or editing of an existing target configuration is a relatively simple matter, with the ACU user interface presenting information in logical order. As a result, the system essentially allows for direct mode entry with the target configuration being accomplished in real time. For more information on configuring targets, refer to Section 5.8.2.6.

2.7 Standby

In **Standby** mode, the ACU does not command the antenna to move in any axis. The AZ and EL inverters are powered-up but are not enabled, and brakes are set on systems equipped with brakes. Real-time status, time, signal level, and position information is being displayed on the ACU front panel along with any current fault information. In **Standby** mode, the ACU is in an active wait state for instructions from the front panel or computer interface.

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2.8 Manual Control Via Portable Maintenance Control Unit (PMCU)

Manual control of antenna position is provided from the drive cabinet PMCU or the ACU user interface. Figure 2-10 shows the PMCU without and with the optional display.

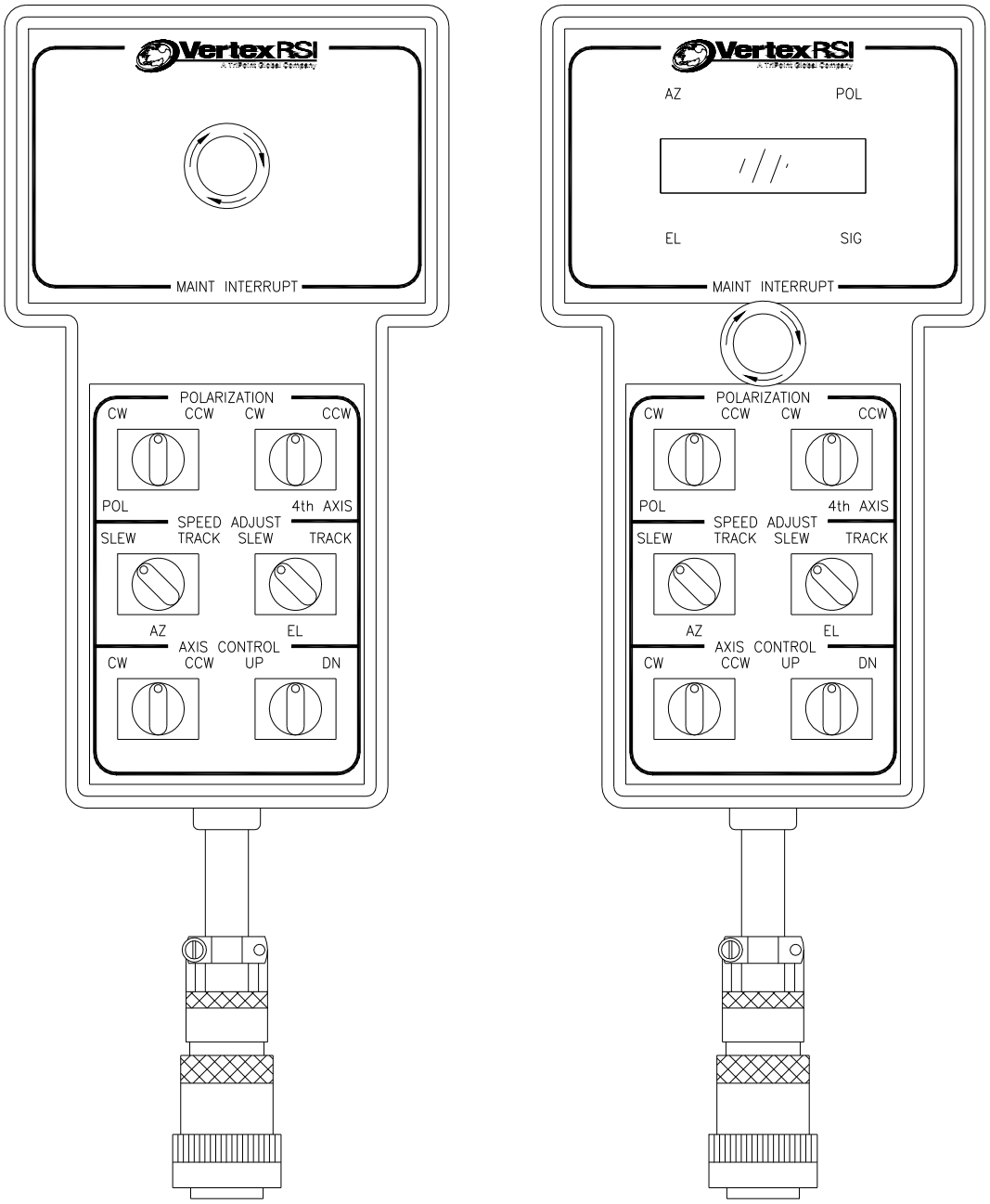


Figure 2-10 Portable Maintenance Control Units

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2.8.1 Manual Antenna Control from the Drive Cabinet

Manual control of each axis is provided at the drive cabinet using the PMCU, primarily to facilitate antenna maintenance. Setting the MAINT/REMOTE switch located on the Relay PCB panel to MAINT mode transfers control of the system to the PMCU, allowing maintenance to be performed on the system.

Therefore, with this switch in the MAINT position, the ACU cannot assume control. With the switch in the REMOTE position, the ACU has control of the system and the PMCU is inoperative.

2.8.2 Manual Antenna Control from the Antenna Control Unit

Real-time manual jog control is provided at the ACU by dedicated keys on the keypad (one key for each direction of travel), which are activated by selecting **Manual antenna control** from the ACU **Tracking Functions menu** (refer to Section 5.8.2.5). For the AZ and EL axes, pressing the jog keys results in corresponding low-speed motion of the antenna. Pressing the jog keys while pressing the [SHIFT] key results in high-speed antenna motion. POL jog control (3-axis systems) is single-speed only. 4TH AXIS jog control (optional 4-axis systems) is also single-speed.

2.9 Immediate Tracking

Immediate tracking is the quickest method to begin tracking. Since it requires very little configuration, this method of tracking is useful for testing and moving the antenna to seldom used locations. The 7200 ACU provides immediate tracking modes as described in the following sections. These tracking modes are accessed from the **Main menu** by selecting **Tracking functions..., Immediate tracking...**. For more information on these tracking modes, refer to Section 5.8.2.4.

2.9.1 Move to Longitude

This mode is identical to **Move to look angles**, except that the user enters a longitude on the geostationary arc instead of AZ and EL coordinates. The ACU computes the AZ and EL coordinates from the given longitude. (Refer to Section 5.8.2.6.3.4.)

2.9.2 Move to Look Angles

In this mode of operation, the system moves the antenna to a preprogrammed set of AZ, EL, and POL(s) coordinates (look angles), then actively maintains the antenna at that position. During the operation, the antenna is moved at slew (fast) speed until relatively close to the target, and then automatically switches to track (slow) speed for precise positioning. Positioning is complete when the axis position feedback reflects antenna positioning to within a user-definable deadband around the target angles. (Refer to Section 5.8.2.6.3.5.)

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2.9.3 Steptrack

Steptrack mode provides automatic periodic positioning of the antenna for maximum receive signal strength as measured at the ACU tracking signal input. The 7200 ACU utilizes the VertexRSI Adaptive Steptrack (AST) algorithm to perform the function of conventional steptrack peak signal optimization, eliminating the random "guessing" errors associated with predetermined fixed scan patterns. AST employs alternate AZ and EL peaking operations based upon a mathematical relationship between the changes in receive signal level and angular antenna position. For each axis, an initial fixed-size step is taken; signal strength levels before and after the step are used to determine the magnitude and direction of the corrective (peaking) step required. Once the peak position is determined, flags are set, indicating the direction of travel of the satellite so that the initial step for the next peaking operation will tend to move the antenna along the satellite ephemeris. This feature greatly reduces the errors introduced by the "wrong" guess made during significant portions of the daily satellite drift by algorithms that consistently make initial steps in a given direction.

Steptrack peaking operations are performed at user-definable time intervals, or when the receive signal level falls below a user-settable threshold. Steptracking parameters, including tracking signal frequency, cycle time, track threshold, etc., are established for each target, allowing maximum versatility for the system. (Refer to Section 5.8.2.4.1)

2.9.4 Star Tracking

Automatic **Star tracking** is provided as an aid in performing antenna gain calculations by the radio star method. Such measurements require consistent, accurate positioning along the path of a star with relatively high velocity. This can be done by manual positioning, but automatic pointing yields more accurate tests, performed in less time. Based upon site location coordinates, automatic pointing for stars including Cassiopeia A, Taurus, and Orion is supported.

2.9.5 Intelsat 11-element Track

In this IESS-412 mode, the antenna is moved according to pointing data generated using the Intelsat Eleven Parameter Model. The ACU accepts element sets as distributed by Intelsat, as well as local site data, and calculates the corresponding predicted AZ and EL positions along the ephemeris. The antenna is then moved to the predicted positions with sufficient frequency to maintain pointing within a user-selectable deadband around the theoretical values. The data for a given target is maintained in a dedicated database for that target and is continually updated to provide appropriate positioning anytime the target is accessed (within time of validity constraints).

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2.9.6 Orbital Element Track (Optional)

The Orbital Element Tracking (OET) mode allows the user to input a Cartesian orbital element set to be used in an open loop pointing of the antenna over time. This tracking mode is available as a target and can be set up from the front panel or the M&C interface. To use the OET mode the operator first creates an OET target by inputting Cartesian orbital elements at a specific epoch in the True Earth Mean Equinox (TEME) reference system. This element set has the general format of Date/Time, X position, Y position, and Z position, X velocity, Y velocity and Z velocity.

Built in sanity checking is available in the form of expected means with acceptable tolerances. The user can enable or disable individually checks on the following characteristics: Semi-major axis, Eccentricity, Inclination, Right Ascension of the ascending node, and Argument of Perigee. If the input orbital elements differ from the enabled check by more than a preset tolerance, an error is issued and the orbital element set is not used.

When the tracking mode is executed the ACU uses built in propagators and the real time clock to calculate look angles for antenna pointing in real time. Two built in propagators are available in the 7200 series controllers. The first is a two-body propagator based on Keplarian motion. The second is a multi-body propagator that includes the effects of Moon and Sun gravitational forces and a 4x4 Geopotential model. The system uses the Two-Body for all start up look angle calculations and switches to the Multi-Body when the element set has been brought up to real time. New look angles can be calculated as frequently as every ½ second out to every 120 seconds.

For proper operation of the OET mode it is important that the site information stored in the ACU be as accurate as possible. This means it should be acquired from site survey information or averaged from a GPS receiver. The built in clock must be set to UTC time and updated once each day. Note: The internal real time clock can only be set to the second and at worst case could drift 1 second per day. The ACU read outs should be carefully calibrated to the local azimuth/elevation reference system. The frequency at which new element sets should be input to the ACU will depend greatly on the type of orbit represented. At minimum new elements must be provided each time a satellite maneuver takes place. The propagators will also deviate from real life over a period of time. This could be days, weeks or months depending on the orbit in question.

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2.10 Tracking Functions

The 7200 ACU allows a user to configure up to 50 targets for establishment of target-specific databases (refer to Section 5.8.2.6). The following tracking modes are available:

- **Move to longitude** (refer to Section 2.9.1)
- **Move to look angles** (refer to Section 2.9.2)
- **Orbit Prediction Tracking (OPT)**
- **Star tracking** (refer to Section 2.9.4)
- **Intelsat 11-element (IESS-412)** (refer to Section 2.9.5)
- **Orbital Element Track (Optional)** (refer to Section 2.9.6)

2.10.1 Orbit Prediction Tracking

The OPT system provides exceptional short-term and long-term pointing capabilities by combining orbital mechanics with modern modeling and error analysis techniques. Orbital mechanics are used to provide a model of the satellite and earth's surface motion. The modeling and error analysis takes pointing data collected in **Steptrack** operations and finds the satellite orbital parameters and systematic errors caused by the mechanical structure which provide the best least squares solution. The orbital parameters and systematic errors are then fed back through the orbital mechanics models to determine antenna look angles at any future point in time. The models accurately match the "real world" and provide excellent real world results. (Refer to Section 3.1).

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3.0 THEORY

This section provides in-depth information on **OPT** and **Orbit scan**, two of the more advanced features of the 7200 ACS.

3.1 OPT

3.1.1 Orbit Prediction

OPT is the algorithm used by the 7200 ACS to predict the position of a spacecraft based upon its previous motion. The basic principle proposes that if the spacecraft's position, velocity, and the forces acting upon it are known, its position can be predicted at any time in the future.

An "OPT model" is what is referred to in orbital mechanics as an orbital element set. An orbital element set describes the position and velocity of an orbiting body at some particular time (the epoch time, or simply, the epoch). **OPT**'s position predictions are made by taking the orbital element set and using the data it provides, along with the computed forces acting on the spacecraft, to predict the position of the spacecraft at the desired time.

The prediction is performed using an algorithm called a propagator. A propagator takes an orbital element set at some epoch and produces an orbital element set at a later epoch. **OPT** uses two different propagators in its operations:

- Two-body propagator: where only the earth's force on the spacecraft is considered and earth is modeled as a sphere with uniform mass.
- Multibody propagator: where the following effects on the spacecraft are considered:
  - Earth's gravity, including a geopotential model (accounting for the nonuniformity of the earth's gravitational field).
  - Sun's gravity.
  - Moon's gravity.
  - Solar radiation pressure on the spacecraft.

The two-body propagator is the simplest and fastest, and provides quick solutions while accounting for the most significant factor affecting the spacecraft's motion. The more complex multibody propagator provides a more accurate model of the spacecraft's actual motion.

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3.1.2 Orbit Determination

An orbital element set is composed by making an initial guess of the orbit and then generating positions from this guess using the propagators described previously. These positions are compared with the positions gathered by AST. The differences between AST data and propagator-generated data are used to determine a correction to the orbit. The process is repeated until the RMS error between the AST data and the propagator-generated data is minimized. The algorithm used to perform this is referred to as the solver.

The orbit must be periodically re-solved in order to remain accurate. Theoretically, if all of the forces acting upon the spacecraft are known at any time, the orbital element set can be predicted forward to any desired time. However, all of the forces are not known at all times. The largest unknown force comes from the station-keeping maneuvers performed in order to keep the spacecraft in the desired orbit. Station-keeping is only performed periodically (typically once every few days). The validity of an orbit solution determined from data after a maneuver has taken place is not adversely affected by station-keeping until a new station-keeping maneuver is performed.

The two-body propagator does not take into account any forces except those generated by the Earth's gravity, and even then, a simplified model is used. A position prediction from a two-body propagator has an error that grows with time due to the omission of these forces in the orbit determination.

Neither propagator can account for varying effects on the ground. The primary ground errors affecting the system are:

- Wind loading of the antenna.
- Thermal distortion of the antenna, caused by non-uniform solar heating.

Both of these factors affect the data collected by AST. However, **OPT** is able to separate ground errors from the orbital solution because the spacecraft's motion must follow Newton's laws. This information is retained as two error terms, one per axis. These error terms are used to correct future position predictions.

3.1.2.1 Short-term and Long-term OPT Solutions

OPT generates three distinct types of orbital solutions:

- Short-term solution using two-body propagator (ST)
- Long-term solution using two-body propagator (LT2b)
- Long-term solution using multibody propagator (LTmb)

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All of these solutions are generated using the method described previously. The differences in the solutions are due to the time span of AST data used, and the propagator used. The ST will use up to the last 10 hours of data available, while the LT (2b and mb) will use up to the last 73 hours of data available.

Assuming that tracking is started on a target with no stored AST data, the first ST solution will be available for use approximately 90 minutes after tracking begins. The first LT2b solution will be available 18 hours after tracking begins. The first LTmb solution will be available 35 hours after tracking begins.

The choice of which solution to use for tracking is made after each steptrack cycle by comparing the peak position with the predicted positions from all available models. The solution that produces a position closest to the steptrack peak is used.

3.2 Orbit Scan

The 7200 ACU has a satellite-locating algorithm referred to as **Orbit scan**. The purpose of **Orbit scan** is to locate satellites in inclined operation. This method is superior to other scanning methods such as Box Scan, Spiral Scan, or Raster Scan. Orbit scan will only search the most probable path of the satellite and not waste time in empty sky.

The **Orbit scan** mode is a user-selectable option on the **OPT** tracking. If enabled, **Orbit scan** will be used when no **OPT** solutions exist, and no signal is available at current pointing or at box center for the designated target.

3.2.1 Orbit Scan Theory

This scan method will only be effective for geosynchronous satellites in inclined operation. It is assumed that the satellite owners are attempting to hold nominal longitude and a near circular orbit.

The 7200 ACS creates a set of orbital parameters that place the ascending node at nominal longitude and provide the estimated inclination. The resulting trajectory will follow the most likely path for a satellite in this type of operation. From the site point of view, this produces a figure 8 (approximately) which is followed from box center. The system always starts by traveling north from box center, all the way around the figure 8 and back to box center (refer to Figure 3-1). This will work correctly regardless of site to satellite orientation. (Note: Figure 3-1 shows the scan in terms of latitude/longitude. The trajectory will look different in terms of AZ/EL based on site position and satellite position.)

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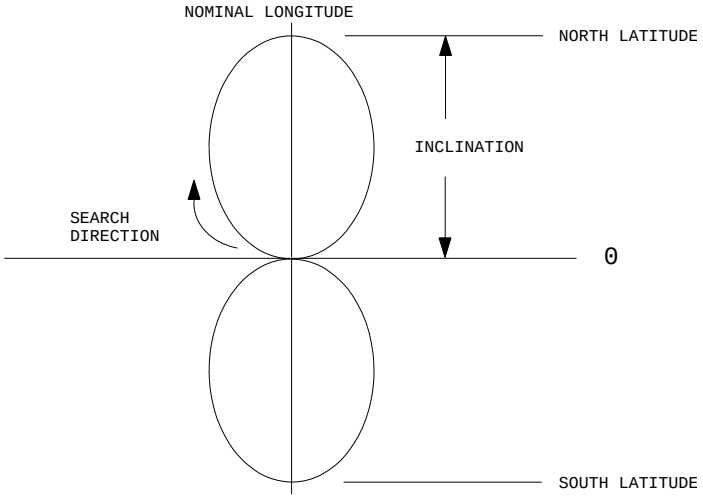


Figure 3-1 Orbit Scan Theory

3.2.2 Orbit Scan Operation

To use **Orbit scan** it is necessary to have correct site information loaded in the site parameters. When an **OPT** target is built, the user must provide the nominal longitude (degrees east) and an estimated inclination. Then the **Orbit scan** parameter must be enabled. (Note: The longitude range is NOT used by **Orbit scan** but is used to set up **Box limits** for the target's operation.)

If no solutions are available when the target is selected for tracking the system will follow this sequence. If **Box limits** are enabled, then **OPT** will check to see if the system is currently inside the box. If not, the system will go to box center. Then it will check for a signal. If no signal is received, and **Orbit scan** is enabled, **OPT** will calculate a satellite trajectory which places the ascending node at the nominal longitude and provides an inclination equal to the estimated inclination provided.

The trajectory is assumed to be a circular orbit with a sidereal period. This trajectory is then followed in steps equal to a 5 dB signal change based on the 3 dB beamwidth of the antenna. The signal level is monitored throughout the operation. The satellite is assumed to be acquired if the level rises 0.5 dB above the **Low signal level** set for the target. If no satellite acquisition occurs after one pass, the system will stop at box center and issue an **OPT cannot track** alarm.

It should be noted that the **Orbit scan** is only used when no **OPT** solutions exist for a given target. Once a solution exists, no matter how old it may be, the scan will NOT be used, even if there is no signal at the solution's position.

At acquisition, the system enters steptrack to peak the antenna and then begins standard **OPT** operation.

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4.0 INSTALLATION AND INITIAL SETUP OF SYSTEM

WARNING

Always disconnect power before opening covers, doors, enclosures, gates, panels, or shields. Never make internal adjustments or perform maintenance or service when alone or fatigued. Qualified personnel should perform main power connections and grounding. Keep away from live circuits; be familiar with the equipment and don't take chances. In case of emergency, be sure to disconnect power before touching equipment or personnel in contact with the equipment.

4.1 Overview

This section of the manual provides the information necessary for the installation and initial setup of the 7200/7150 ACS for all modes of operation, including connection details for the remote serial interface.

The system installation and setup instructions are presented in the following general order.

- Mechanical Installation
- System Cabling
- Power-Up and Setup

4.2 Mechanical Installation

4.2.1 Antenna-Mounted Components

Mechanical interfaces for the antenna and motors vary with the specific equipment provided and are detailed in the drawing package supplied with each antenna. Proper and complete installation of the motors, resolvers, and limit switches is imperative for safe and accurate system operation. Refer to the mechanical drawings supplied in the appropriate drawing package separate from this manual for mechanical interface details and complete this phase of installation first.

4.2.2 Installing the Drive Cabinet

Refer to VertexRSI foundation and conduit layout drawings for recommended locations of the drive cabinet. Use the following procedures to install the drive cabinet.

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1. Locate the drive cabinet as close as possible to the antenna without obstructing the full range of antenna movements.

2. Center the drive cabinet over any conduit stub-ups to facilitate conduit termination and wire pulling.

3. Attach the drive cabinet to the foundation using at least two 1/2-inch concrete anchors on each leg.

4. Using a set of knockout punches, punch conduit holes in the bottom of the drive cabinet to facilitate conduit entry. Install conduits.

4.2.3 Installing the 7200 ACU

Determine the location of the 7200 ACU in the rack. Refer to Figure 4-1 for details of rack mounting.

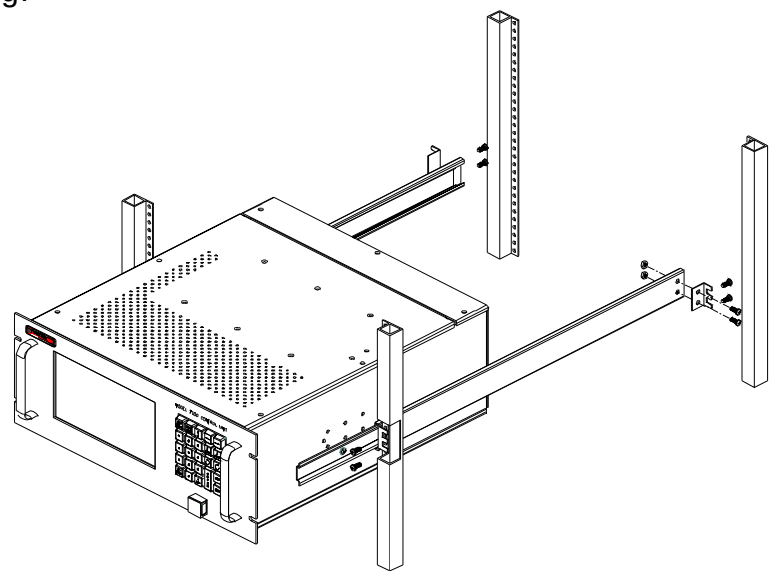


Figure 4-1 Mounting the 7200 ACU

1. Separate individual slides into two pieces by removing the outer portion. **Note:** Part of the slide should be left bolted to the ACU.

2. Mount the small angle brackets to the portions of slides removed in step 1 as shown.

3. Mount the slide assembly from step 2 into the rack. **Note:** Be sure to use the provided flathead screws for the front slide mount. Do not fully tighten any bolts yet.

4. Be sure both slides are mounted at the same height and are level.

5. Slide the 7200 ACU into the rack-mounted slides.

6. Adjust the rack-mounted slides as necessary until the ACU slides smoothly in and out of the rack.

7. Fully tighten all hardware.

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4.3 System Cabling

The following sections describe the cabling and list the connections for the 7200 ACS. Cables must be connected from the antenna to the drive cabinet, from the drive cabinet to the 7200 ACU, and from the antenna directly to the 7200 ACU. Power must also be provided from CFE power distribution points to the drive cabinet and ACU. Be sure the cables are connected correctly and securely because proper functioning of the system during power-up is important for the protection of the equipment and for timely completion of the installation. Refer to Figure 4-2.

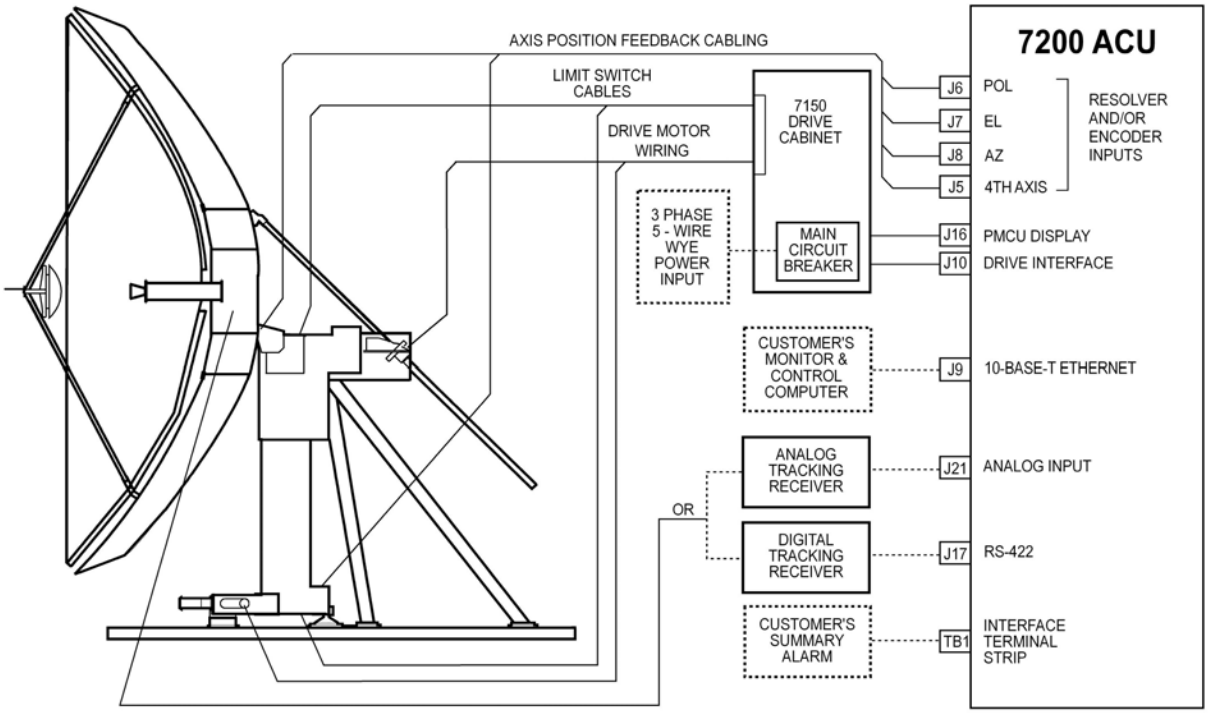


Figure 4-2 7200 Antenna Control System Cabling Diagram

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4.3.1 Drive Cabinet Main Power Connection

Always follow applicable local electrical safety codes when installing wire and cables.

1. If conduit is not installed, use chase nipples with bushings or other suitable means to protect the wire and cables.

2. Check the main breaker size in the drive cabinet to determine required power conductor size for this installation.

3. If the wire from the distribution panel to the drive cabinet is long, increase wire size to keep the voltage drop to less than 5 percent of nominal.

> ***NOTE:*** ***The prime power required for the standard drive system is 3 phase WYE, 5-wire with ground. Other prime power configurations are available by special order. The neutral wire of the power system must be installed for proper operation.***

4. Connect the three-phase line leads to the line side (top) of the main circuit breaker in the upper right corner of the drive cabinet. Refer to Figure 4-3 for a drawing of the drive cabinet.



Figure 4-3 Drive Cabinet Assembly

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5. Tag the neutral wire with white electrical tape and connect the wire to one of the large terminals marked N on TB1 in the lower right corner of the drive cabinet.

6. Tag the ground wire with green and yellow electrical tape and connect the wire to one of the large green terminal blocks labeled with a G or a ground symbol on TB1.

4.3.2 Connecting the Drive Motors to the Drive Cabinet

To connect the drive motors to the drive cabinet, refer to Table 4-1 and use the following procedures.

NOTE: The AZ and EL motors require 3-phase conductors and a ground conductor.

TABLE 4-1 MOTOR CONNECTIONS TO THE DRIVE CABINET

DRIVE CABINET TB1	DEVICE	FUNCTION
Az-U	Az Motor	Phase 1
Az-V	Az Motor	Phase 2
Az-W	Az Motor	Phase 3
EL-U	EL Motor	Phase 1
EL-V	EL Motor	Phase 2
EL-W	EL Motor	Phase 3
POL CW	POL Motor	POL Motor CW
POL CCW	POL Motor	POL Motor CCW
N	POL Motor	POL Motor Common
4TH AXIS CW	POL Motor	4TH AXIS Motor CW
4TH AXIS CCW	POL Motor	4TH AXIS Motor CCW
N	POL Motor	4TH AXIS Motor Common

1. Wire the AZ and EL motors for the appropriate system voltage by following the motor wiring diagrams inside the motor terminal box or on the motor nameplate.

2. Connect the AZ motor leads to TB1 terminals labeled Az-U, Az-V, and Az-W.

3. Connect the motor ground wire to the ground terminal.

4. Connect the EL motor leads to TB1 terminals labeled EL-U, EL-V, and EL-W.

5. Connect the motor ground wire to the ground terminal.

If 2-axis system, perform steps 1-5.
If 3-axis system, perform steps 1-9.
If 4-axis system, perform steps 1-13.

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6. Connect the wire from terminal 1 of the POL motor to the TB1 terminal labeled POL CW in the drive cabinet.

7. Connect the wire from terminal 3 of the POL motor to the TB1 terminal labeled POL CCW in the drive cabinet.

8. Connect the wire from terminal 2 of POL motor to TB1 terminal labeled N.

9. Connect the POL AXIS motor case ground to the ground terminal on TB1 in the drive cabinet.

10. Connect the wire from terminal 1 of the 4TH AXIS motor to the TB1 terminal labeled POL CW in the drive cabinet.

11. Connect the wire from terminal 3 of the 4TH AXIS motor to the TB1 terminal labeled POL CCW in the drive cabinet.

12. Connect the wire from terminal 2 of 4TH AXIS motor to TB1 terminal labeled N.

13. Connect the 4TH AXIS motor case ground to the ground terminal on TB1 in the drive cabinet.

4.3.3 Limit Switch Connections

Connect the limit switches to TB1-1 through TB1-9 on the drive cabinet as shown in Table 4-2. Note that normally closed (open upon limit) contacts are required.

TABLE 4-2 LIMIT SWITCH CONNECTIONS TO THE DRIVE CABINET

DRIVE CABINET TB1	DEVICE	FUNCTION
1	Az Limit Switch	Az CW Limit
2	Az Limit Switch	Az Limit Common
3	Az Limit Switch	Az CCW Limit
4	EL Limit Switch	EL Up Limit
5	EL Limit Switch	EL Limit Common
6	EL Limit Switch	EL Down Limit
7	POL Limit Switch	POL CW Limit
8	POL Limit Switch	POL Limit Common
9	POL Limit Switch	POL CCW Limit
10	4TH AXIS Limit Switch	4TH AXIS CW Limit
11	4TH AXIS Limit Switch	4TH AXIS Limit Common
12	4TH AXIS Limit Switch	4TH AXIS CCW Limit

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4.3.4 Installing the 7200 ACU Control Cable

The procedures for installing the 7200 ACU control cable are different for the standard product and a system with the optional low-temperature package. For standard system installation, refer to Section 4.3.4.1; for systems with EIA/TIA-422B cable installation refer to Section 4.3.4.2.

4.3.4.1 Standard System 7200 ACU Control Cable Installation

1. Connect one end of the 25-conductor control cable (Belden 8459 or equivalent) to the 25-pin connector labeled DRIVE INTERFACE (J10) on the back of the 7200 ACU (refer to Figure 4-4). Refer to Table 4-4A for a pin-out and the function of each conductor.

2. Connect the other end of the 25-conductor cable to J1 on the relay board inside the drive cabinet (refer to Table 4-4A).

TABLE 4-3 REAR PANEL CONNECTORS

REF DESIG	TYPE	GENDER
J2 (Optional)	24-pin IEEE-488	SOCKET (female)
J3 (Optional)	BNC	SOCKET
J5, J6	DB-9	SOCKET
J7, J8	DB-25	SOCKET
J9	RJ-45	SOCKET
J10	DB-25	PLUG
J11	DB-37	SOCKET
J14, J15	DB-25	SOCKET
J16, J17	DB-25	PLUG
J18, J19, J20	DB-9	PLUG
J21	DB-9	PLUG
TB1	20 PIN	PLUGGABLE TERMINAL STRIP



Figure 4-4 7200 Antenna Control Unit Rear Panel

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TABLE 4-4A CONTROL CABLE CONNECTIONS		
DRIVE CABINET J1	**7200 ACU J10**	**FUNCTION**
1	1	AZ CW Command
2	2	AZ Common
3	3	AZ CCW Command
4	4	EL Up Command
5	5	EL Common
6	6	EL Down Command
7	7	POL CW Command
8	8	POL Drives Enable Command
9	9	POL CCW Command
10	10	Summary Limit
11	11	4TH AXIS CW Command
12	12	4TH AXIS Drives Enable Command
13	13	4TH AXIS CCW Command
14	14	AZ Fault
15	15	EL Fault
16	16	E Stop Return
17	17	Sum Limit, Az Fault, EL Fault Common
18	18	Sum Limit, Az Fault, EL Fault Common
19	19	E Stop Command
20	20	No Connection
21	21	AZ High Speed Command
22	22	EL High Speed Command
23	23	Drives Enable
24	24	Local Maint Status
25	25	Local Maint Status Return

TABLE 4-4B CONTROL CABLE CONNECTIONS		
DRV CAB TB1	**7200 ACU J16**	**FUNCTION**
Rx(+)	19	EIA/TIA-422B Receive
Rx(-)	6	EIA/TIA-422B Receive Not
SHLD	20	Shield

4.3.4.2 Standard System 7200 ACU EIA/TIA-422B Cable Installation

1. Connect one pair of the two twisted pair control cable (Belden 8162 or equivalent) to the 25-Pin connector labeled (J16) EIA/TIA422 on the back of the 7200 ACU (refer to Figure 4-4). Refer to Table 4-4B for a pin-out and function of each conductor.

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2. Connect the other end of the same pair of the two-twisted pair cable to terminal strip TB1 inside the drive cabinet (Refer to Table 4-4B).

4.3.4.3 Portable Maintenance Control Unit (PMCU) With Position Display Option Installation

The PMCU with Optional Position Display is provided for local control at the antenna. It is located inside the 7150 drive cabinet.

4.3.4.3.1 PMCU Connections

The following table gives the terminal numbers and a description of the terminals of the PMCU terminal strip (J5) on the relay Printed Circuit Board (PCB) and the MS connector located on the back plate of the 7150 drive cabinet. The connections on TB1 are for the EIA/TIA-422B that is used on the optional PMCU display. This information is for reference only.

TABLE 4-5 PMCU CONNECTIONS

RELAY PCB "J" CONNECTORS	DESCRIPTION	MS CONNECTOR PIN OUT
J5-1	INTERRUPT RTN	B
J5-2	MAINT. INTERRUPT	A
J5-3	AZ CW	N
J5-4	AZ/EL COMMON	E
J5-5	AZ CCW	P
J5-6	AZ SLEW	J
J5-7	EL UP	L
J5-8	EL DN	M
J5-9	EL SLEW	K
J5-10	POL CW	G
J5-11	POL COMMON	F
J5-12	POL CCW	H
J5-13	4TH AXIS CW	C
J5-14	4TH AXIS CCW	D
J5-15	NC	
J5-16	NC	
J4-13	+24 VDC	W
J4-11	VDC COMMON	X
TB1 TERMINAL STRIP		
EIA/TIA-422B Rx	EIA/TIA-422B RECEIVE	R
EIA/TIA-422B $\overline{Rx}$	EIA/TIA-422B RECEIVE NOT	S
SHLD	SHLD	T
	NC	U
	NC	V
	NC	Y
	NC	Z

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4.3.4.3.2 PMCU Display Setup

In order for the PMCU display to operate, the serial link connections must be in place between the ACU and drive cabinet, and the EIA/TIA422 (J16 or Port 3) serial port must be setup properly in the ACU. Failure to perform the following steps will result in a **LINK LOSS** fault on the PMCU display. The PMCU will still be able to control the antenna locally.

1. Complete the serial link connections between J16 (EIA/TIA422) on the ACU and TB1 in the drive cabinet. Refer to Table 4-4B for connection description. Refer to Table 4-12 for a complete EIA/TIA422 pin-out of port J16.
2. From the 7200 ACU Main Menu, select **Edit System Configuration..., Remote Port Configuration**. Setup the following parameters. Please be aware that these port configuration changes must be saved before the new settings become valid.

   - Port = 3
   - Baud (bps) = 9600
   - Parity = None
   - Data bits = 8
   - Stop bits = 1
   - Shell = PMCU
   - Handshake = None

4.3.5 Resolver and Encoder Connections

Single-speed, size-11 resolvers are standard for azimuth, elevation, polarization, and 4th axis (optional). Two-speed (size-20 resolvers) and optical encoders are options available for azimuth and elevation.

4.3.5.1 Resolver Connections

The connections for size-11 resolvers are provided in Table 4-6A. Connect each connector to the appropriate connector on the rear of the ACU. J6 & J5 are 9-pin D connectors, and J7 and J8 are 25-pin D connectors. Refer to Figure 4-4 for location of the connectors on the ACU. **See Appendix H for using CTB055 to attach the resolver wires to the resolver control cable.**

NOTE: Connect shield leads at the ACU connector end only. Do not allow the shield leads to come into contact with one another or with the resolver case. At the antenna end, tape each lead separately. Connecting shields at both ends creates a current path (ground loop) which may cause erratic position readings.

TABLE 4-6A RESOLVER CONNECTIONS—SINGLE SPEED, SIZE-11

7200 – J6, J7, J8, J5	FUNCTION*	RESOLVER LEAD COLOR
2	R1	Red/White
8	R2	Yellow/White
9	S1	Red
5	S2	Yellow
4	S3	Black
3	S4	Blue
1,6,7	Shield	Not Connected at Resolver

* Shielding pairs: R1-R2, S1-S3, S2-S4.

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The connections for two-speed, size-20 resolvers are provided in Table 4-6B. Connect each connector to the appropriate connector on the rear of the ACU. J7 and J8 are 25-pin D connectors. Refer to Figure 4-4 for location of the connectors on the ACU.

TABLE 4-6B RESOLVER CONNECTIONS—TWO-SPEED, SIZE-20			
7200 –J7, J8	FUNCTION*	RESOLVER PIGTAIL LEAD COLOR AND CIRCULAR CONNECTOR PIN NUMBER	
2	R1	Red/White	6
8	R2	Black/White	7
9	S1	Red	1
5	S2	Yellow	4
4	S3	Black	2
3	S4	Blue	5
10	S11	Red/Green	8
13	S12	Yellow/Green	11
11	S13	Black/Green	9
14	S14	Blue/Green	12
1,6,7,12,15	Shield	Not Connected at Resolver	
No Connection	Reserved	3	
No Connection	Reserved	10	

* Shielding pairs: R1-R2, S1-S3, S2-S4, S11-S13, S12-S14.

If position readouts bobble or do not track to antenna motion, refer to Section 5.0 in Appendix E, Troubleshooting Guide, of this manual.

4.3.5.2 Optical Encoder Connections

This section applies only if optical encoders are used for the azimuth and elevation transducers. Model 800499-01 is the optical encoder J-box assembly. Model 800499-02 is the assembly with optional Position Display Unit (PDU), which shows position feedback even without an ACU. 18-bit encoders connect directly to the ACU and do not use a J-box. See Table 4-8C.

TABLE 4-7 OPTICAL ENCODER CONNECTIONS			
7200 – J7, J8	FUNCTION	800499-02	800499-01
15	CLK	1	1
16	CLKN	2	2
17	SHLD (CLK)	NC	NC
18	CLK2	7	NC
19	CLK2N	8	NC
20	SHLD (CLK2)	10	NC
21	DAT	3	3
22	DATN	4	4
23	SHLD (DAT)	9	NC
24	+ 24V	5	5
25	+ 24V RTN	6	6

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TABLE 4-8A 17/19-BIT OPTICAL ENCODER CONNECTIONS TABLE			
OPTICAL ENCODER COLOR	**FUNCTION**	**800499-02**	**800499-01**
PUR	CLK	1	1
YEL	CLKN	2	2
GRY	DAT	3	3
PNK	DATN	4	4
BRN/GRN	+ 5V	7	7
BLU	+ 5V	7	7
WHT/GRN	GND	8	8
WHT	GND	8	8
BRN	N/A	9	5
GRN	N/A	10	6
RED	N/A	11	9
BLK	N/A	12	10

TABLE 4-8B 26-BIT OPTICAL ENCODER CONNECTIONS TABLE		
OPTICAL ENCODER COLOR	**FUNCTION**	**800499-01**
PUR	CLK	1
YEL	CLKN	2
GRY	DAT	3
PNK	DATN	4
BRN/GRN	+ 5V	7
BLU	+ 5V	7
WHT/GRN	GND	8
WHT	GND	8
GRN/BLK	N/A	5
YEL/BLK	N/A	6
BLU/BLK	N/A	9
RED/BLK	N/A	10

TABLE 4-8C 18-BIT OPTICAL ENCODER CONNECTIONS TABLE		
OPTICAL ENCODER COLOR	**FUNCTION**	**7200 PIN OUT**
YELLOW	CLK	15
GREEN	CLKN	16
PINK	DAT	21
GRAY	DATN	22
WHITE (Large)	+ 24V	24
BROWN (Large)	0V	25
BLK	N/A	N/A
VIOLET	N/A	N/A
BLUE	N/A	N/A
RED	N/A	N/A

Note: Shield must be terminated on pins 17 & 23 for CLK and DATA respectively on the 7200 side for noise reduction purposes.

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NOTE: The table below **only** applies to 800499-02.

TABLE 4-9 POSITION DISPLAY UNIT TABLE

PDU – J1, J2	FUNCTION	AZIMUTH & ELEVATION OPTICAL ENCODER J-BOXES J3
15	CLK	1
16	CLKN	2
17	SHLD (CLK)	NC
18	CLK2	7
19	CLK2N	8
20	SHLD (CLK2)	10
21	DAT	3
22	DATN	4
23	SHLD (DAT)	9
24	+24V	5
25	24V RTN	6

4.3.6 Analog Input Connections

One analog input port is provided on the 7200 ACU via J21 on the rear panel (refer to Figure 4-4). Internally, the analog input connects to an A/D converter circuit that provides tracking signal inputs to the main processor.

The analog input has (+), (-), and GND terminals to facilitate devices with isolated or differential outputs. In most cases, the (+) output of the tracking receiver connects to the (+) analog input, and the common or (-) output of the tracking receiver connects to the (-) analog input with no further connections required. The analog input voltage range is 0 to 10 VDC. The voltage per dB slope range is 0.1 to 1.0 V/dB.

NOTE: When connecting a VertexRSI TRL or DTR Tracking Receiver via serial link, the analog input is not used. However, when connecting a Model 253 Tracking Receiver via serial link, the analog input is required to return the signal level back to the 7200.

Refer to Table 4-10 and connect the analog input to J21 (9-pin D-connector) on the rear panel of the 7200 ACU.

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TABLE 4-10 ANALOG INPUT CONNECTIONS		
J21	**DESIGNATION**	**FUNCTION**
1	GND	Chassis Ground
2	AD1+	Channel 1(+) *
3	AD1 GND	Chassis Ground
4	AD2-	No Connection
5	SPARE	No Connection
6	GND	Chassis Ground
7	AD1-	Channel 1(-) *
8	AD2+	No Connection
9	AD2 GND	Chassis Ground

* Standard connection scheme.

4.3.6.1 A/D Circuit Calibration

A calibration procedure is performed at the factory as part of the normal product configuration, therefore a field calibration is only performed if operational problems due to drift are encountered at a later date or if different video receivers are used in the AGC mode. Should field calibration be necessary, refer to VertexRSI Document #CG-0283

4.3.7 Digital Inputs

The input pairs for the Digital Input, J11, are shown in Table 4-11.

TABLE 4-11 DIGITAL INPUTS – J11	
7200 ACU – J11	**INPUTS**
1	24 -
2	24+
3	23 -
4	23 +
5	22 –
6	22 +
7	21 -
8	21 +
9	20 -
10	20 +
11	19 -
12	19 +
13	18 -
14	18 +
15	17 -
16	17 +

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17	15 -
18	15 +
19	NC
20	14 -
21	14 +
22	11 -
23	11 +
24	10 -
25	10 +
26	9 -
27	9 +
28	8 -
29	8 +
30	7 -
31	7 +
32	6 -
33	6 +
34	NC
35	NC
36	NC
37	NC

4.3.8 Remote Communications Connections

Tables 4-12 and 4-13 provide the connections for the remote communication ports to the 7200 ACU. Two independent Monitor and Control (M&C) protocols are provided with the 7200 ACU:

1) **Reqest/Command (RC) M&C Protocol** – This protocol format is ASCII based; the protocol is concise, yet includes all the commonly used commands for operation. See VertexRSI Document # CG-6042.

2) **Menu Tree M&C protocol** – This protocol format is also ASCII based but is more comprehensive. It includes all setup and operational commands as well as some diagnostics. See VertexRSI Document # CG-6045.

Refer to Section 5.8.6.12, Remote Port Configuration, for additional interfaces. The standard 7200 ACU is capable of EIA/TIA-232E, EIA/TIA-422B, and Ethernet communications.

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TABLE 4-12 STANDARD COMMUNICATION PORT CONNECTIONS (EIA/TIA-232E)		
J14, J15	**DESIGNATION**	**FUNCTION**
1	PROT GND	Protective Gnd
2	EIA/TIA-232 XDATA	Transmit
3	EIA/TIA-232 RDATA	Receive
7	SIG GND	Signal Gnd
9 * (see below)	+12V (off by default)	Fiber Optic Modem Power (Enabled by SW1 on rear panel)

A RS-232 cable run longer than approximately 50 feet requires fiber optic cables with a fiber optic modem at each end. The modem can be powered by +12V supplied by pin 9 of each RS-232 port (J14 and J15). Each connector is individually switched by a DIP switch, SW1 Modem Power, located on the rear panel (see Figure 4-4). The top switch controls J14, and the bottom switch controls J15. Both switches are in the left position (off) by default.

VertexRSI offers the following fiber optic modems (optional):

BFM001 - 25 pin D (powered by pin 9)
BFM002 - 25 pin D (externally powered)
BFM020 - External Power source for BFM002

TABLE 4-13 COMMUNICATION PORT CONNECTIONS (EIA/TIA-422B)		
J16, J17	**DESIGNATION**	**FUNCTION**
1	GND	Ground
2		
6	XDATA-	Transmit (-) *
9	RDATA-	Receive (-) *
15		
16		
19	XDATA+	Transmit (+) *
20	XDATA SHLD	Transmit Shield *
22	RDATA+	Receive (+) *
23	RDATA SHLD	Receive Shield *

* Standard connection scheme for EIA/TIA-422B port.

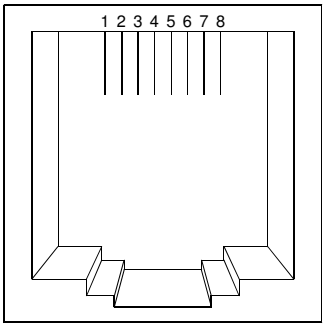
NOTE: If a PMCU with Position Display is connected as specified in Section 4.3.4.3.2, J16 is not available for use with an M&C system.

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TABLE 4-14 COMMUNICATION PORT CONNECTIONS (EIA/TIA-422B)		
J18, J19, J20	**DESIG**	**FUNCTION**
1	XDATA+	Transmit (+) *
2,3	NC	No Connect
4	RDATA+	Receive (+) *
5	GND	Shield (Chassis Gnd)
6	XDATA-	Transmit (-) *
7,8	NC	No Connect
9	RDATA-	Receive (-) *

* Standard connection scheme for EIA/TIA-422B port.

The Ethernet port, J9, is available for use with an M&C system. The pin connections are detailed in Table 4-15.

TABLE 4-15 10BASE-T ETHERNET CONNECTIONS (IEEE 802.3)		
PIN	LABEL	PIN ORIENTATION
1	TX+	
2	TX-	
3	RX+	
4	NC	
5	NC	
6	RX-	
7	NC	
8	NC	

4.3.9 Remote Beacon Select and Summary Fault Connections

TB1 on the 7200 ACU rear panel provides a summary fault output (normally closed dry contacts) and four contact closures for remote beacon selection. The fault contacts have continuity between them under normal conditions but provide an open circuit under fault conditions. The terminals for remote beacon select are open circuits for the respective beacon 1 through 4 unless that beacon is selected through the 7200 ACU front panel. Thus, the customer interface beacon contacts for any selected beacon provide a closed circuit, allowing the flexibility of switching beacon channels and/or sources on compatible equipment. The remaining IN and OUT terminals are reserved for future use.

Refer to Table 4-16 and make the appropriate connections to TB1 on the 7200 ACU rear panel.

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TABLE 4-16 REMOTE BEACON SELECT AND SUMMARY FAULT TERMINAL STRIP		
TERMINAL (TB1)	**FUNCTION**	**INPUT/OUTPUT**
1	Summary Alarm Out	OUTPUTS
2	Summary Alarm Return	
3	Beacon 1 Out	
4	Beacon 1 Common	
5	Beacon 2 Out	
6	Beacon 2 Common	
7	Beacon 3 Out	
8	Beacon 3 Common	
9	Beacon 4 Out	
10	Beacon 4 Common	
11	Output 22 +	
12	Output 22 Common	
13 *	CP Command Common (+)	
14 *	CP Command +	
15 *	LP Command Common (+)	
16 *	LP Command +	
17 *	CP Position Common (+)	INPUTS
18 *	CP Position Ind (Return)	
19 *	LP Position Common (+)	
20 *	LP Position Ind (Return)	

* Optional CP/LP switching firmware must be installed in the 7200 ACU for TB1 pins 13 to 20 to have these assigned functions.

Pins 4, 6, 8, and 10 are tied together and connect to the COM terminal on the VertexRSI tracking receivers. Pins 3, 5, 7, and 9 connect to the appropriate Bn terminal on the tracking receiver. Pin 1 is on the left end of TB1 with the user facing the rear of the 7200 ACU. The summary alarm output (TB1 pins 1 and 2) is provided for customers who wish to receive an indication anytime a fault occurs on the 7200 ACU. This is typically connected to an indicator light or buzzer in the main control room of an earth station, or may be tied as an input to a monitor and control computer system. The electrical specifications for this output are provided in Table 2-7 (Section 2.4.1.3).

4.4 Initial Power-Up and System Setup

Before proceeding with system power-up, check all system cabling and termination for correctness and integrity. Then proceed with the following items in the order presented. Because the antenna may be moved from the control panel of the drive cabinet, independent of the ACU, system start-up will be initiated at the drive cabinet before the ACU.

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4.4.1 Drive Cabinet Power-Up and Initialization

The inverters have no internal adjustments; therefore, before power-up the covers of the inverters should be in place.

4.4.1.1 Initial Power-Up

1. Verify that the following conditions exist at the respective drive cabinet controls:

   a. CONTROL switch set to the MAINT position
   b. CONTROL POWER switch set to ON
   c. EMERGENCY STOP button pulled out

2. Apply power to the drive cabinet by setting the MAIN CIRCUIT BREAKER to ON. Turn on all other breakers. The green indicator LED in the center of the CONTROL POWER circuit breaker should illuminate at this time. Also, the displays on the inverters should become active.

4.4.1.2 Inverter Drive Setup (AZ/EL Drv Modules)

The intelligent, variable speed motor control modules incorporated in the drive cabinet for AZ and EL require correct setting for a number of operational parameters. All parameters should be set correctly from the factory, but the procedures in Section 4.4.1.2.1 should be followed to ensure that the correct settings have been retained. Additionally, some codes may have to be altered during system installation to fine-tune system performance.

4.4.1.2.1 Inverter Drive Operation

All functions of the inverter drives are accessed using the Digital Operator. In addition to controlling the motor operation, the operator can enter information into the inverter's memory to configure its operation. See the Vendor Manual on the product CD for more detailed information.

GPD315 INVERTER DRIVE OPERATION

The following figures and tables summarize the operation of the GPD315 Inverter Drive. For more information, refer to the drive's manuals.

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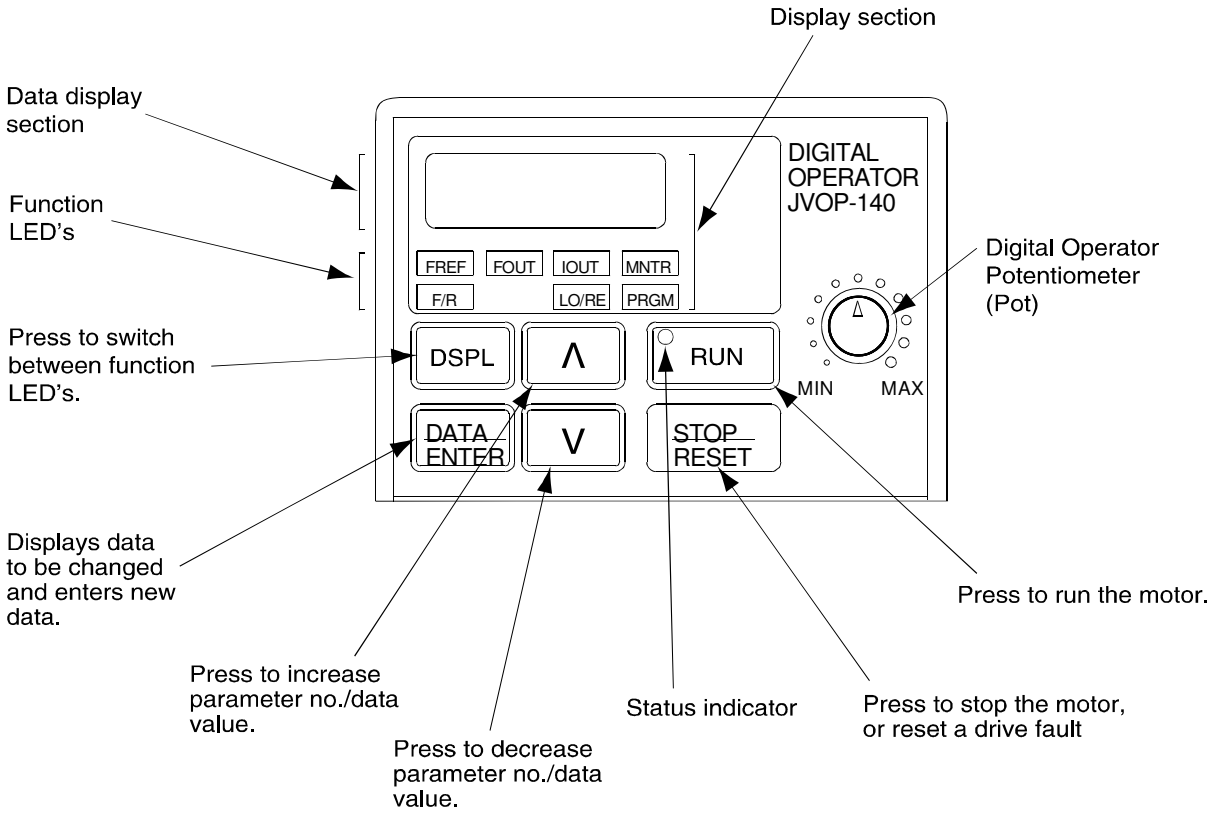


Figure 4-5 GPD315 Digital Operator Indicator and Key Description

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By pressing the DSPL key on the Digital Operator, the operator can step to each of the seven Function LEDS and its associated display/setting function:

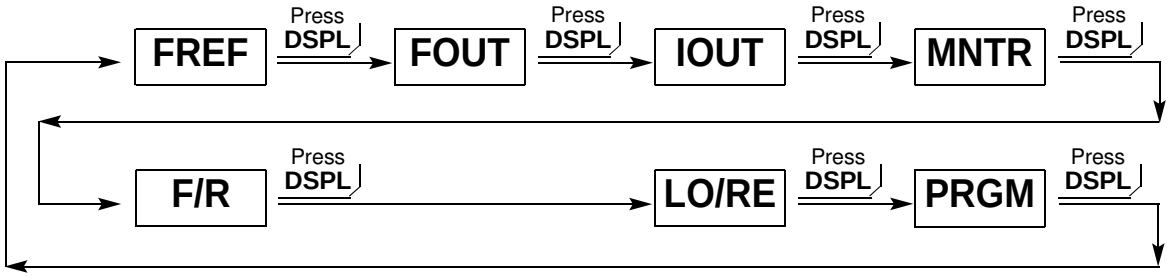


Figure 4-6 Digital Operator Indicator and Key Description

TABLE 4-17 DIGITAL OPERATOR LED FUNCTION DESCRIPTIONS

Key	Description
FREF	**Frequency Reference Setting** Sets/Displays the GPD 315 operation speed (Hz).
FOUT	**Output Frequency Monitor** Displays the output frequency (Hz) at which the GPD 315 is currently operating. This is a **monitor only** function; the operator cannot change the displayed value by use of the keypad.
IOUT	**Output Current Monitor** Displays the level of the output current (Amps) that the GPD 315 is currently producing. This is a **monitor only** function; the operator cannot change the displayed value by use of the keypad.
MNTR	**Monitor Selection** Pressing **ENTER** allows access to the various Monitor parameters, ***U-01*** through ***U-10***. These are monitor only functions; the operator cannot change the displayed value. Accessible during run command. See vendor literature for complete listing of all monitor parameters.
F/R	**FWD/REV Run Selection** Sets the rotation direction of the motor when a Run command is given by the Digital Operator keypad. Display of ***For*** = forward run, ***rEu*** = reverse run.
LO/RE	**Local/Remote Selection** This toggles between the Local (Digital Operator) and Remote (set by parameters n003 & n004) modes of operation. This affects both the start/stop functions, as well as the frequency reference. Local/Remote status cannot be changed using this LED when a multi-function input terminal is set for Local/Remote (n050 through n056 set for "17").
PRGM	**Parameter Programming** Selects or reads data using parameter number (***nXXX***). Data is displayed by pressing the **ENTER** key, and can be changed by pressing the "up arrow" or "down arrow" keys. Any changes can be saved by again pressing the **ENTER** key. Pressing the **DSPL** key exits the Programming mode.

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V1000 INVERTER DRIVE OPERATION

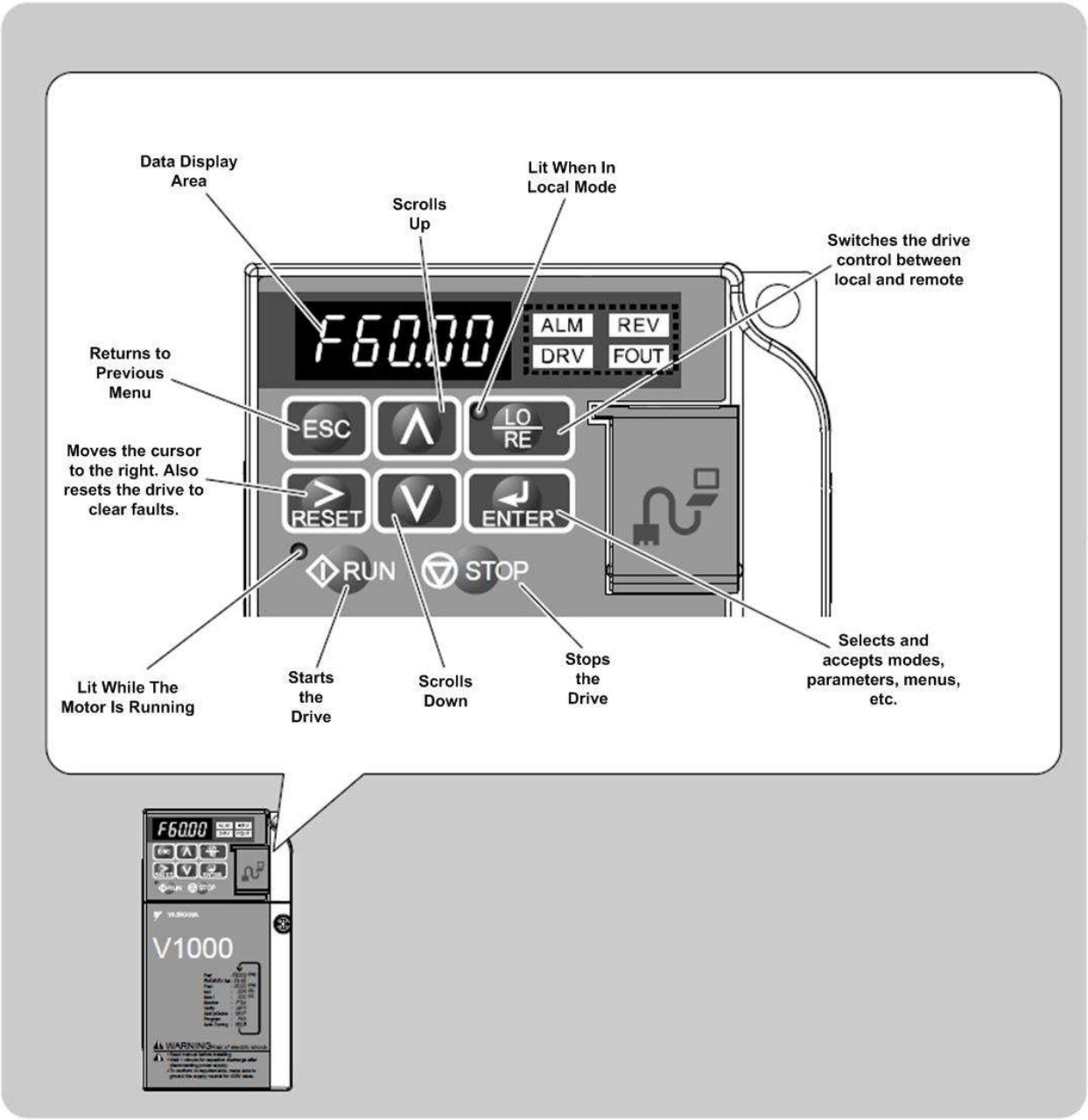
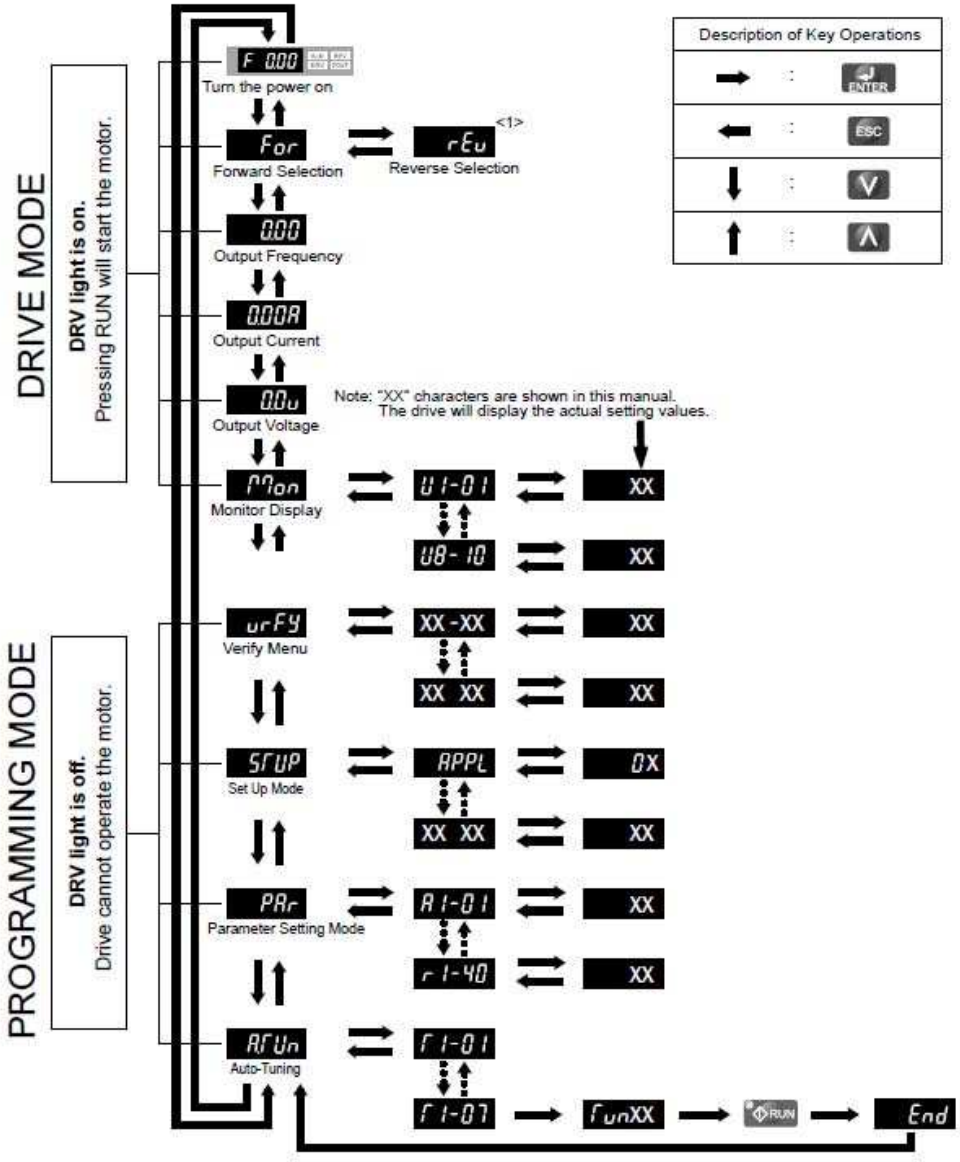


Figure 4-7 V1000 Keys, Displays, and LEDs

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Menu Structure for Digital LED Operator



<1> Reverse can only be selected when LOCAL is set.

Figure 4-8 V1000 Digital LED Operator Screen Structure

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Changing Parameter Settings or Values on V1000 Drives

This example explains changing C1-01 (Acceleration Time 1) from 10.0 seconds (default) to 20.0 seconds.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Press the ∧ key until the Setup Mode Screen appears.	→	
3.	Press the ENTER key to view the parameter setting display.	→	
4.	Scroll through parameters by pressing the ∧ key until C1-01 appears.	→	
5.	Press ENTER to view the current setting value (10.0). (Number farthest to the left flashes)	→	
6.	Press RESET until the desired number is selected. ("1" flashes)	→	
7.	Press the ∧ key and enter 0020.0.	→	
8.	Press ENTER and the drive will confirm the change.	→	
9.	The display automatically returns to the screen shown in Step 4.	→	
10.	Press the ESC key until back at the initial display.	→	

Figure 4-9 V1000 Drive Parameter Settings or Values

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4.4.1.2.2 Inverter Drive Setup (Function Parameters)

All parameters are set at the factory. GDST has modified some of these parameters.

TABLE 4-18 GPD315 DRIVE PARAMETERS

PARAM.	DESCRIPTION	SETTING	HELP	AZ	EL
n002	Control Method	1	This parameter must be set to 1.		
n003	Operation Mode	1	This parameter must be set to 1.		
n004	Reference Select	1	This parameter must be set to 1.		
n008	Reference-Digital Operator	1	This parameter must be set to 1.		
n011	Frequency-Max	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
n012	Motor Operating Voltage	208V 230 – 240V 380 – 415V	This parameter must match the motor nameplate data for Volts. If the motor is rated for dual voltage, verify which voltage the motor has been strapped for and make this parameter match.		
n013	Maximum Frequency at Motor Operating Voltage	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
n019*	Acceleration Time	0.8 seconds	This parameter must be set to 0.8.		
n020*	Deceleration Time	0.8 seconds	This parameter must be set to 0.8.		
n025*	Frequency Reference #1	5 or 6	If the motor is rated for 50Hz, this parameter should be set at 5. If the motor is rated for 60Hz, this parameter should be set at 6.		
n026*	Frequency Reference #2	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
n036	Motor Rated Current	0.1 to 49.5	This parameter must match the motor nameplate information for current. This information can be found on the motor nameplate under the column of FLA (Full Load Amps), or A (Amps).		

* Parameters can be changed while the inverter is running.

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TABLE 4-19 V1000 DRIVE PARAMETERS

PARAM.	DESCRIPTION	SETTING	HELP	AZ	EL
A1-02	Control Method	2	This parameter must be set to 2.		
B1-02	Operation Mode	1	This parameter must be set to 1.		
B1-01	Reference Select	1	This parameter must be set to 1.		
E1-04	Frequency-Max	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
E1-05	Motor Operating Voltage	208V 230 – 240V 380 – 415V	This parameter must match the motor nameplate data for Volts. If the motor is rated for dual voltage, verify which voltage the motor has been strapped for and make this parameter match.		
E1-06	Maximum Frequency at Motor Operating Voltage	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
C1-01*	Acceleration Time	0.8 seconds	This parameter must be set to 0.8.		
C1-02*	Deceleration Time	0.8 seconds	This parameter must be set to 0.8.		
D1-02*	Frequency Reference #1	5 or 6	If the motor is rated for 50Hz, this parameter should be set at 5. If the motor is rated for 60Hz, this parameter should be set at 6.		
D1-03*	Frequency Reference #2	50 Hz or 60 Hz	Most motors are rated for either 50 or 60 Hz operation. The specific rating can be found on the motor nameplate under the Hz column. If the motor is rated at 50 Hz, this parameter should be set to 50. If the motor is rated for 60 Hz, this parameter should be set to 60.		
E2-01	Motor Rated Current	0.1 to 49.5	This parameter must match the motor nameplate information for current. This information can be found on the motor nameplate under the column of FLA (Full Load Amps), or A (Amps).		

* Parameters can be changed while the inverter is running.

NOTE: ***Do not make changes to the program function codes before contacting General Dynamics SATCOM Technologies. Changing these parameters could cause drive malfunctions, incorrect tracking of the antenna, and/or physical damage to the system.***

All other parameters are set to the factory default or are not user configurable.

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4.4.1.3 Drive Motor Phasing

Because all axis drives are bi-directional, the actual direction of antenna axis rotation should correspond to the direction commanded by the control system. The following procedures should be followed to ensure this correspondence (make all control commands at the PMCU; refer to Figure 2-10).

NOTE: Prior to performing these procedures, ensure that the antenna is clear of electrical and mechanical stop limits in all axes, preferably with each axis near the center of travel.

WARNING
IF ANY AXIS DRIVE MOTOR IS PHASED INCORRECTLY, THE CORRESPONDING ELECTRICAL LIMIT SWITCH WILL NOT PREVENT OVERTRAVEL OF THE ANTENNA.

4.4.1.3.1 AZ Motor Phasing

1. Using the PMCU set the AZ SPEED ADJUST switch to the TRACK position.

2. Hold the AZ AXIS CONTROL switch to CW for a few seconds and then to CCW for a few seconds, while observing the direction of rotation of the antenna.

3. If the direction of antenna rotation agrees with the control commands, proceed to Section 4.4.1.3.2.

4. If the direction of antenna rotation is reversed from the commanded direction, remove power from the drive cabinet and switch the AZ motor leads connected to terminals Az-U and Az-W.

5. Restore power to the drive cabinet and recheck for proper AZ rotation.

4.4.1.3.2 EL Motor Phasing

1. Using the PMCU set the EL SPEED ADJUST switch to the TRACK position.

2. Hold the EL AXIS CONTROL switch to UP for a few seconds and then to DOWN for a few seconds, while observing the direction of rotation of the antenna.

3. If the antenna movement correlates with the commanded direction, proceed to Section 4.4.1.3.3.

4. If the direction of antenna rotation is reversed from the commanded direction, remove power to the drive cabinet, and switch the EL motor leads connected to terminals EL-U and EL-V.

5. Restore power to the drive cabinet and recheck for proper EL rotation.

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4.4.1.3.3 POL Motor and 4th Axis Motor Phasing

1. Hold the POL switch to CW for a few seconds and then to CCW for a few seconds. The CW drive command should result in clockwise rotation of the feed assembly as viewed from the rear of the antenna structure; the CCW drive command should result in counterclockwise rotation of the feed assembly as viewed from the **rear** of the antenna structure.

2. If the drive command and axis rotation are correct, proceed to Section 4.4.1.4.

3. If the drive command and axis rotation are reversed, remove power from the drive cabinet and switch the POL motor leads connected to terminals POL CW and POL CCW located on TB1.

4. Restore power to the drive cabinet and recheck for proper POL rotation.

5. The 4-axis systems have a 4th Axis that is part of the feed assembly. Since many different versions of the feed arrangement exist, additional information will be supplied as needed.

4.4.1.4 Electrical Limit Switch Tests and Preliminary Settings

CAUTION

In the following steps, jog the antenna slowly as it nears each limit to prevent possible damage to the antenna structure because of a malfunctioning or improperly adjusted limit switch. This caution is necessary only during installation in order to verify that the limit switches are functioning correctly.

1. Using the PMCU hold the AZ AXIS CONTROL switch to the CW position. As the antenna approaches the AZ CW limit, set the AZ SPEED ADJUST switch to TRACK and drive the antenna into the AZ CW limit. Verify that the CW movement of the antenna stops and that CCW motion is allowed. If CW and CCW limits are operating backward, switch wires on TB1-1 and TB1-3.

2. Using the PMCU hold the AZ AXIS CONTROL switch in the CCW position and drive the antenna into the AZ CCW limit. Verify that the CCW movement of the antenna stops and that CW motion is allowed.

3. Using the PMCU hold the EL AXIS CONTROL switch in the UP position and drive the antenna into the EL UP limit. Verify that the upward movement of the antenna stops and that downward motion is allowed.

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4. Using the PMCU hold the EL AXIS CONTROL switch in the DOWN position and drive the antenna into the EL DOWN limit. Verify that the downward movement of the antenna stops and that upward motion is allowed. If UP and DOWN limits are operating backward, switch wires on TB1-4 and TB1-6.

5. Using the PMCU hold the POL switch in the CW position and drive the feed tube into the CW limit. Verify that the CW movement of the feed tube stops and that CCW motion is allowed. If CW and CCW limits are operating backward, switch wires on TB1-7 and TB1-9.

6. Using the PMCU hold the POL switch in the CCW position and drive the feed tube into the CCW limit. Verify that the CCW movement of the feed tube stops and that CW motion is allowed.

7. The 4-axis Systems have a 4th Axis that is part of the feed assembly. Since many different versions of the feed arrangement exist, additional information will be supplied as needed.

If any of the limit switches do not operate in the manner described above in steps 1 through 4, discontinue operation of the system until the problem is corrected. Limit circuit problems can usually be traced to a wiring error between the switch and drive cabinet.

After ensuring proper operation of all limits, set the limit stops for each axis to ensure clearance of all obstructions while allowing only the necessary total antenna travel in each axis.

4.4.1.5 AZ and EL Speed Adjustments

Low and high-speed drive rates for the AZ and EL axes are preset parameters inside each drive.

4.4.2 ACU Power-Up and Initialization

The procedures that follow prepare the system for site acceptance tests.

Set the drive cabinet MAINT/REMOTE switch to REMOTE to transfer control to the 7200 ACU.

Refer to Section 5.0 of this manual for operation of the 7200 ACS, especially Section 5.6, Power-Up Procedures.

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4.4.2.1 Setting Position Parameters

See Section 5.8 for the location of applicable parameters. Appendix D, Tracking Tutorial for Operators, may also be useful.

1. From the 7200 ACU command the antenna CW, UP, and POL CW.

2. Observe the Current Position display for increasing angles on each axis (refer to Figure 2-9). If not, set the corresponding angular transducer parameter to "REV".

3. Enter the station location parameters (refer to Section 5.8.6.9).

4. Steer the antenna to a satellite with known current position data. Accurately position the antenna for maximum signal and set the position parameters to agree with the known satellite look angles (refer to Section 5.8.6.4).

4.4.2.2 Setting Beacon Signal Level and Slope

See Table 5-8, Calibrate Tracking Signal, for additional details.

1. Adjust the antenna for maximum beacon signal level.

2. Select menu item Calibrate Tracking Signal

3. Set the 0 dB point.

3. Move the antenna off the target 3 dB and set the -3 dB point.

The system should now be ready for site acceptance tests; see Appendix F, Site Test Procedure, for complete test information.

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5.0 OPERATION

5.1 Introduction

This section of the manual provides the procedures for operation of the 7200 ACS. The 7200 ACS contains on-line help that is accessible by simply pressing the [HELP] key on the front panel keypad (refer to Section 5.3 for information on the 7200 help system).

This section begins by giving the user an introduction to the 7200 ACS menu and help systems. For clarity, all menu items (and system messages and prompts) that appear in text will be in boldface type and shown in text exactly as they appear on the display. All key names are presented in square brackets ([]).

The 7200 ACU has a Simulation mode that can be used for training purposes or for becoming familiar with the system before beginning system operation. For more information on the ACU simulator, refer to Section 5.8.6.7.

Manual antenna control, instructions on how to use the tracking functions of the system, and procedures for editing the tracking data and system configuration are included in this section.

5.2 The 7200 ACS Menu System

The menu system provides access to all of the capabilities of the 7200 ACS and is structured according to system functions. The menu system is displayed in the lower portion of the display on the front panel of the ACU and each "screen" is titled for convenience. Items displayed that are followed by "..." are menus. The arrow keys on the 7200 keypad may be used to place the cursor on any menu item. If [ENTER] is then pressed, the relevant screen for the item chosen will be displayed and depending on the item chosen, the new screen may contain one, or a combination, of the following items:

- a function [e.g., "**Return to standby (stop tracking)**"]
- a parameter (e.g., "**Target name**")
- a menu (e.g., "**Edit schedule...**")

Alternatively, a user may pick an item from a visible list by entering the number of its position in that list; (for example: to select the **Tracking Functions...** menu, press [1] then [ENTER]). The menu items are numbered 0-9, starting at the top, left column first.

On-line help is available for all menus, functions, and parameters. The help system for the 7200 ACS is described in detail in Section 5.3. Pressing [HELP] will display either help for the entire system, or help related to the item that is highlighted.

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Figure 5-1 shows a representation of the (Main Menu) screen as it appears on the 7200 ACU display. See Appendix G for 7200 Menu Tree software flow charts.

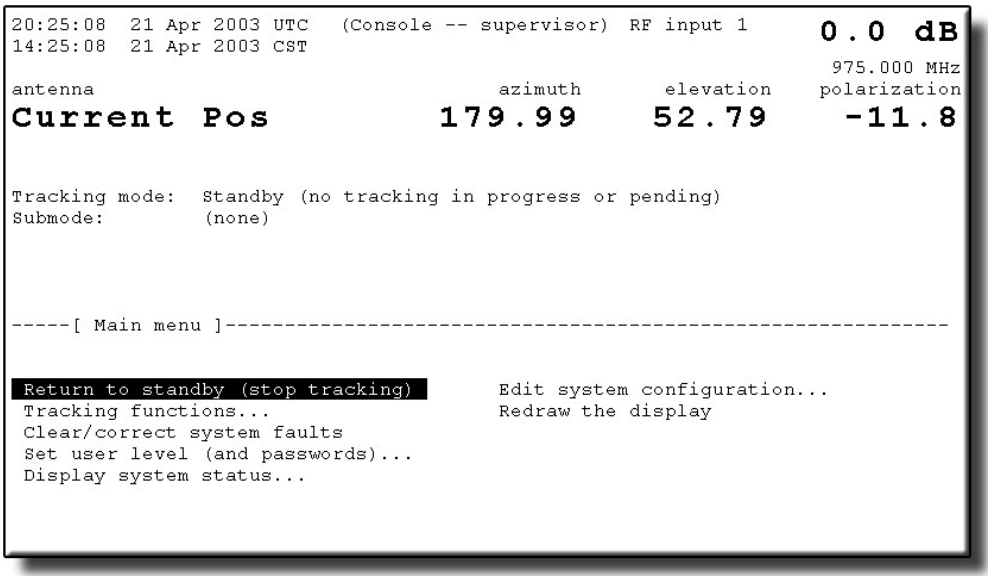


Figure 5-1 7200 ACS Basic Menu System

5.2.1 Multiscreen Menus

Each screen can display up to 5 lines of text or 10 menu items (5 per column). If more information than can fit on one screen needs to be displayed, there will be a message in the screen title as shown in Figure 5-2. To view the next screen of a multiscreen menu, simultaneously press [SHIFT] and [↓]. To view the previous screen of a multiscreen menu, simultaneously press [SHIFT] and [↑]. Note that pressing [PRIOR] will return the system to the previous menu, moving up a menu tree level. It will not necessarily return to the previous screen.

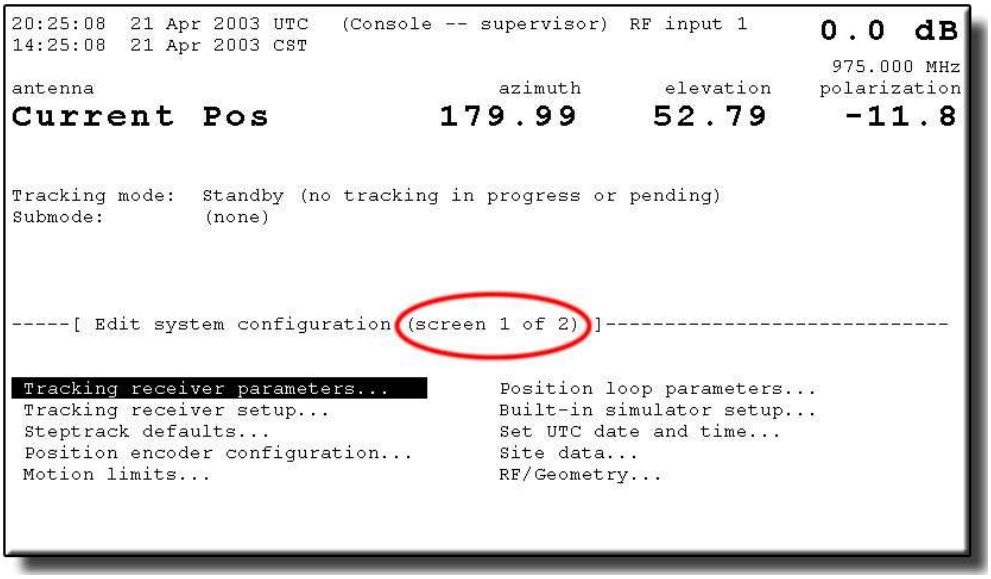


Figure 5-2 Multiscreen Menu

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5.2.2 Menu Items

Some of the menus (e.g., "**Edit target parameters...**") will have parameters appear on the screen that only appear under certain conditions. As an example, when the tracking mode for a certain target is set to **Move to look angles...**, **Edit target parameters...** will have only the following two items displayed:

- **Look angles [deg]**
- **Bias angles [deg]**

However, when the tracking mode for a target is set to **Intelsat 11-element**, 22 different parameters will be displayed.

Figure 5-3 shows an example of the menu that appears when **Tracking functions...** is selected from the **Main menu**. If **Immediate tracking...** is chosen from that menu, the **Immediate tracking** screen appears with additional items displayed. If the user then chooses **Edit immediate target...**, the **Edit selected target** screen appears with the relevant functions/parameters displayed.

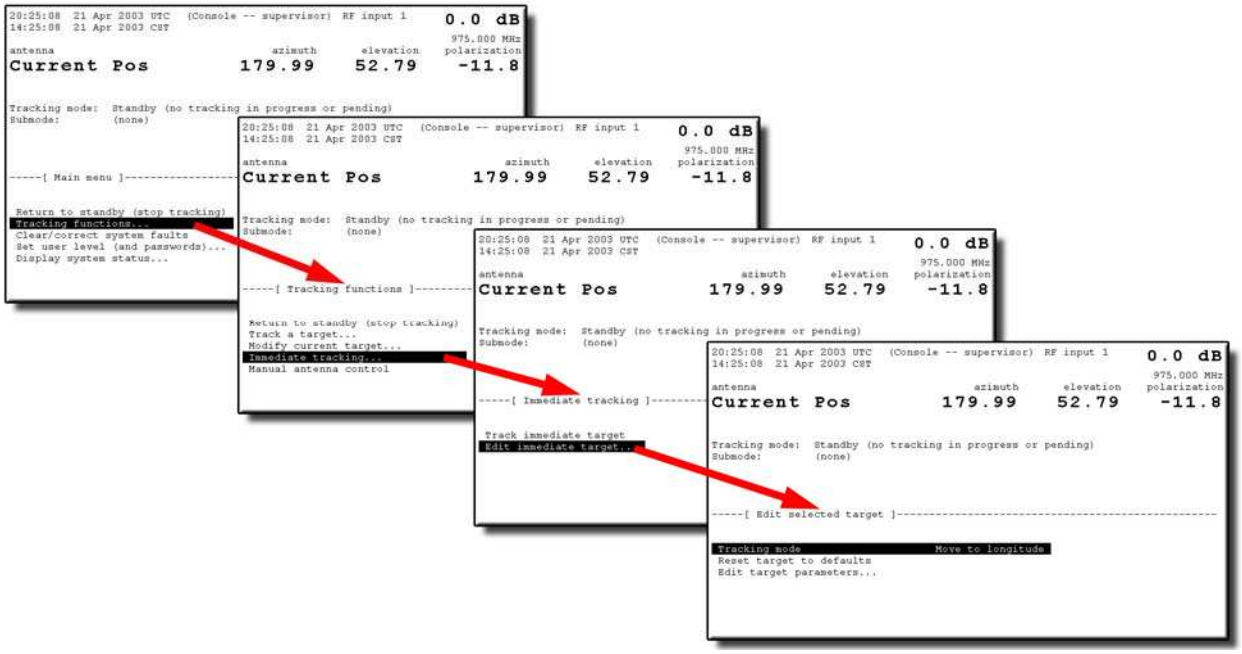


Figure 5-3 Tracking Functions Menu System

5.3 The Help System

The 7200 ACU provides easy-to-use, on-line help. Pressing [HELP] will provide assistance for whatever parameter or menu is highlighted. When in a menu, pressing [HELP] twice enters the Introductory Help, which explains general system navigation. Press the [PRIOR] key to exit any help screen.

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Figure 5-4 is an example of a help screen that describes the parameter **E. Longitude of site [deg]** which is in the **Edit System Configuration Menu...** in the **Site data...** menu. Notice the highlighted portion, "Press [HELP] for introductory help." This function is available in all help screens.

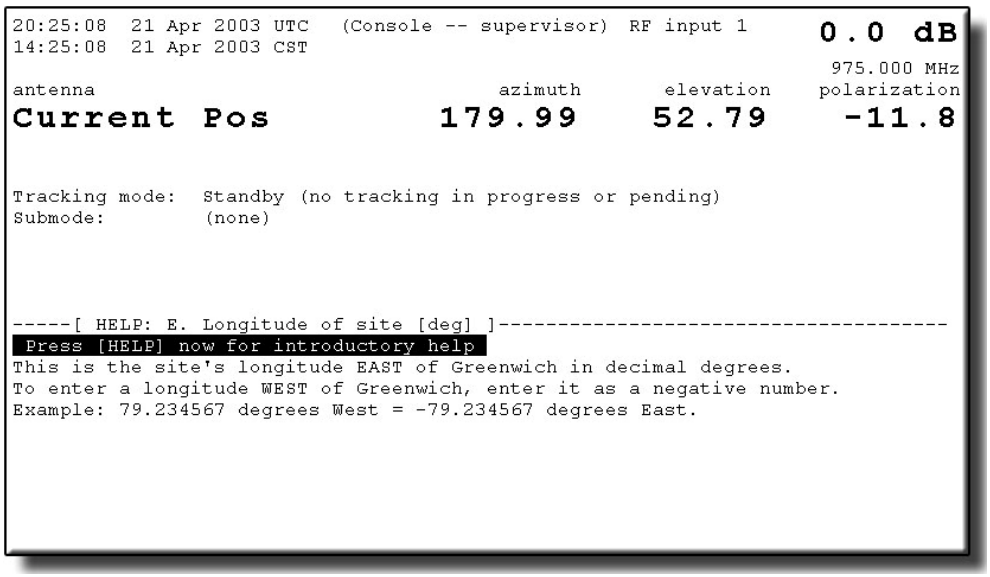


Figure 5-4 ACS Help Screen (Parameter Help Screen)

The 7200 help system includes information on all system functions, parameters, and menus. Help screens may contain explanations of a parameter or a function and any requirements for executing that function (e.g., the user level necessary to execute the function). Figure 5-5 shows a help screen containing information on the overall system help (Introductory help).

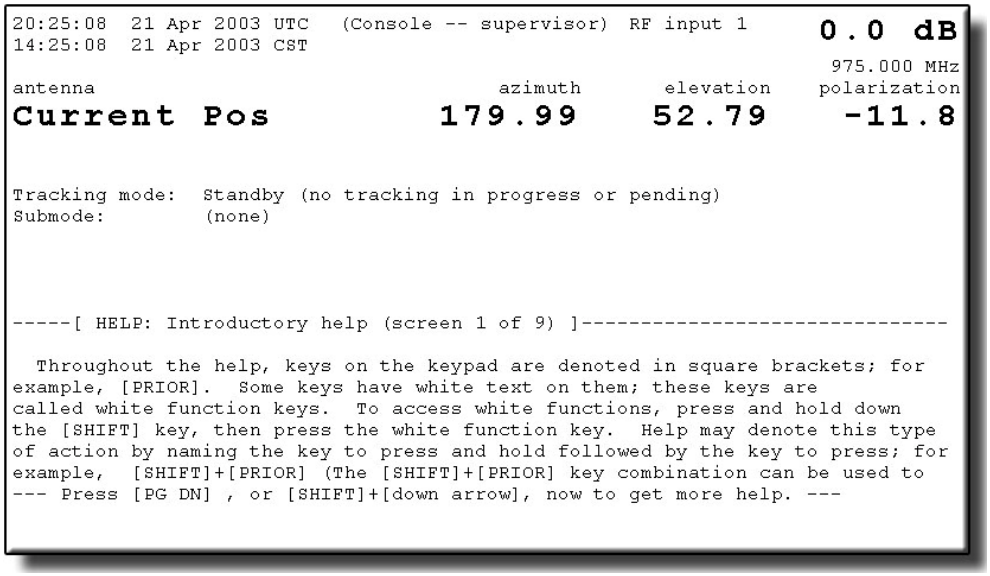


Figure 5-5 7200 ACS Help Screen (Introductory Help)

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5.4 System Prompts

Executing functions and changing parameters on the 7200 ACS are made simple with the use of system prompts. For example, if a user wishes to change the parameter **E. Longitude of site [deg]** shown in Figure 5-4 above, the system will prompt the user with the allowable range of values when this parameter is selected to be edited. Figure 5-6 shows the screen that will appear when the cursor is placed over the parameter and the [ENTER] key is pressed.

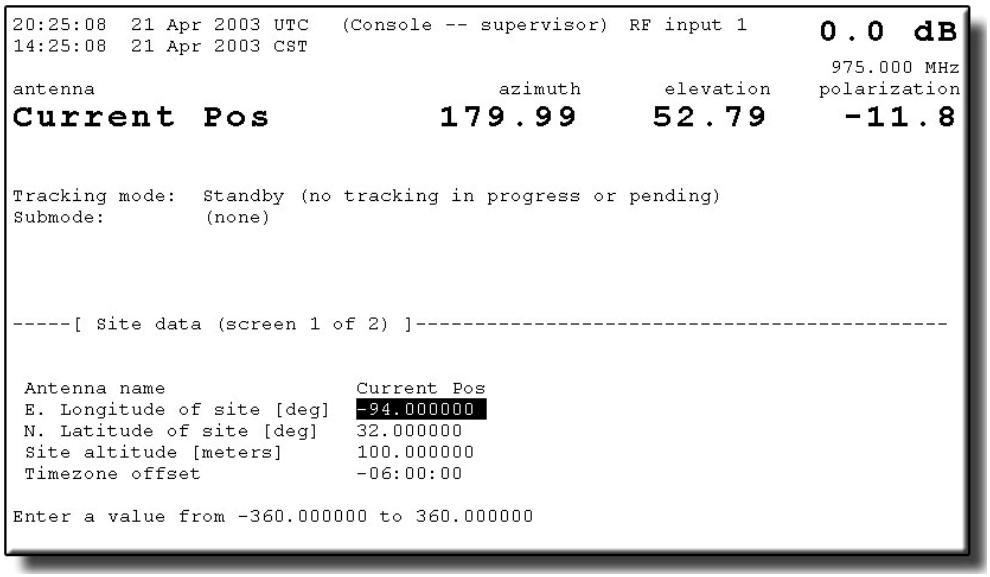


Figure 5-6 Parameter Edit Screen

5.4.1 Error Messages for Incorrect Entries

The 7200 ACS not only provides value ranges in system prompts when the user is editing parameters, but it also provides error messages when an out-of-range value is entered. For example, if the user is editing the parameter shown in Figure 5-6 above and enters a value of 365.000000, the following system prompt will appear:

Your entry 365.000000 is too high.
Enter a real number between -360.000000 and 360.000000.

Press [ENTER] to continue.

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5.4.2 Confirmation Messages

Depending on the setting of the user interface options parameters (refer to Section 5.8.6.14), the system will display tracking and editing confirmation messages, and a warning bell may be operational to alert the user that a confirmation message awaits a response. The bell will also sound when an invalid key is pressed.

> ***NOTE:*** ***The defaults for the confirmation messages are set so that the messages appear. For all operating procedures in this manual, it is assumed that the defaults are unchanged and all confirmation messages will appear.***

The following is an example of a tracking confirmation message:

Stop tracking and return to standby?(yes/no) YES

[YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

5.5 Parameter and Data Storage

All parameters (target-specific and system) are stored in battery-backed nonvolatile RAM on the CPU board. This includes all accumulated steptrack data.

In addition, when the ACU is powered up, it automatically resumes tracking the target that it was tracking at the time the system was powered down. If the ACU was in Standby at that time, it remains in Standby. There is a five-second delay from the time the ACU completes power-up and is ready to be commanded and when tracking resumes on the target that was being tracked at power-down time. This gives the user the opportunity to return the unit to Standby before antenna movement starts.

5.6 Power-Up Procedures

Before proceeding with these power-up procedures, be sure that Section 4.0, Installation and Initial Setup of System, has been followed to install, set up, and configure the system.

To power up the 7200 ACS, use the following procedures.

1. On the 7150 Drive Cabinet, pull the EMERGENCY STOP switch to the out position.

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2. On the 7150 Drive Cabinet, set the following controls as indicated:

   a. Set the Main Circuit Breaker to ON
   b. Set all remaining Circuit Breakers to ON
   c. Set MAINT/REMOTE switch to MAINT

3. On the 7200 ACU back panel, set the on/off switch to the on position.

5.7 Manual Movement of the Antenna

5.7.1 Manual Movement From the Drive Cabinet (PMCU)

Manual control of each axis is provided at the drive cabinet by using the PMCU, primarily to facilitate antenna maintenance. A MAINT/REMOTE switch (CONTROL) located on the Relay PCB. It is the only selection point for maintenance mode. Therefore, with this switch in the MAINT position, the ACU cannot assume control. With the switch in the REMOTE position, the ACU has control of the system and the drive cabinet switches are inoperative.

To operate the antenna from the drive cabinet, use the following procedures.

1. On the drive cabinet, set the CONTROL switch to MAINT to enable the controls on the PMCU.

2. Set the AZ SPEED ADJUST to TRACK. The slew and tracking speed parameters are set in the drives. (SLEW is a fast speed. TRACK is a slow speed.)

3. Hold the momentary AZ AXIS CONTROL to the CW or CCW position. Holding the switch at CW results in clockwise motion of the antenna as observed from the **rear** of the antenna. Holding the switch at CCW results in counterclockwise motion of the antenna. When released, the switch automatically returns to the center (off) position.

4. Set the EL SPEED ADJUST to TRACK. The slew and tracking speed parameters are set in the drives.

5. Hold the momentary EL AXIS CONTROL switch to the UP or DOWN position. Holding the switch at UP results in upward motion of the antenna and holding the switch at DOWN results in downward motion of the antenna. When released, the switch automatically returns to the center (off) position.

6. Hold the momentary POL switch to the CW or CCW position. Holding the switch at CW causes the feed assembly to rotate CW as observed from the **rear** of the antenna and holding the switch at CCW causes the feed assembly to rotate CCW. When released, the switch automatically returns to the center (off) position.

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7. The 4-axis system has a 4TH AXIS that is part of the Feed Assembly. Since many different versions of the feed arrangement exist, additional information will be supplied as needed.

8. Press the RESET button located on the Digital Operator console to clear any faults detected by the motor controllers (inverters). Refer to Section 4.4.1.2.1.

9. Return MAINT/REMOTE switch to REMOTE.

5.7.2 Manual Movement From the ACU

Refer to Section 5.8.2.5 for instructions on manually controlling the antenna from the ACU.

5.8 The 7200 ACS Main Menu

All operation of the 7200 ACU is through the Main Menu. See Appendix G for 7200 menu tree flow charts. The Main Menu gives the operator a choice to select a function for the 7200 ACU to perform or to select another menu where more functions are available or where parameters can be changed.

For example, the **Main menu** has three functions: **Return to standby (stop tracking)**, **Clear/correct system faults** and **Redraw the display.** It also has four menus:

- **Tracking functions...**
- **Set user level (and passwords)...**
- **Display system status...**
- **Edit system configuration...**

Figure 5-7 shows a representation of the **Main menu** screen as it appears on the 7200 ACU display.

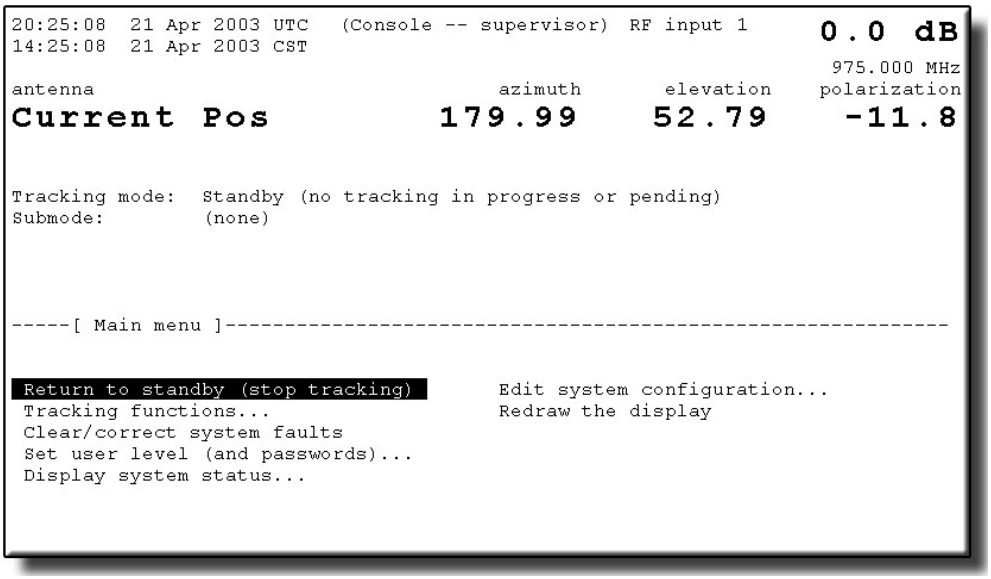


Figure 5-7 7200 ACU Main Menu Screen

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NOTE: To return to the Main menu from any screen, press the [Shift] key and hold it while pressing the [PRIOR] key.

The following sections describe each of these functions and menus.

5.8.1 Return to Standby (Stop Tracking) Function

Selecting **Return to standby (stop tracking)** places the system in Standby mode. In Standby mode the antenna is not being commanded to move by the ACU. Real-time status, signal level, and position information is still displayed on the ACU front panel. Any current fault information is also displayed.

The AZ and EL inverters are powered up but are not enabled, and on systems equipped with brakes, the brakes are set. In Standby mode, the ACU is in an active wait state for instructions from the front panel and computer interface(s).

During tracking, the ACU may be commanded to stop tracking and return to the **Standby** mode by selecting the **Return to standby (stop tracking)** function. For convenience, the function is included in two menus: **Main menu** and **Tracking functions** menu.

5.8.2 Tracking Functions Menu

All antenna control, including manual antenna control, is accessed from the **Main menu**. The **Tracking functions...** menu includes the following functions and menus:

- **Return to standby (stop tracking)**
- **Track a target...**
- **Modify current target...**
- **Immediate tracking...**
- **Manual antenna control**
- **Edit a new or existing target...**
- **Target scheduler...**

The following sections will describe each of these functions and menus.

5.8.2.1 Return to Standby (Stop Tracking) Function

Return to standby (stop tracking) is the function that appears under the **Main menu** and it is also available under the **Tracking functions...** menu for convenience.

When this function is selected, the system will prompt the user to ensure that the user wishes to stop tracking and return the ACU to Standby mode. In Standby mode, the status line of the ACU will indicate **Standby (no tracking in progress or pending).**

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5.8.2.2 Track a Target Menu

The **Track a target** menu allows selection of a preconfigured target to track. When this menu is selected, if there are no previously configured targets, the screen will appear as shown in Figure 5-8. For instructions on entering targets into the target selection menu, refer to Section 5.8.2.6.

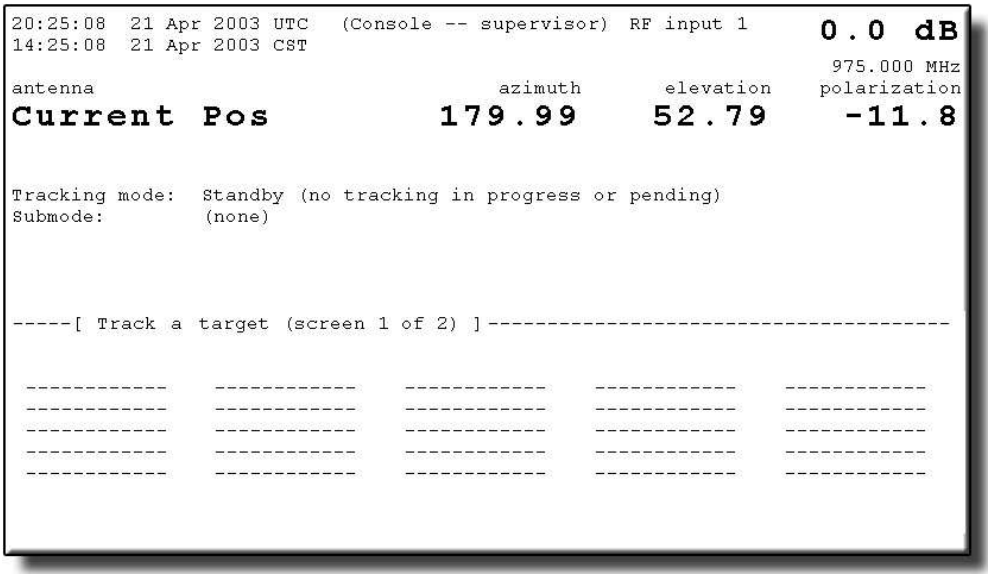


Figure 5-8 Track a Target Screen

Although individual tracking modes are directly accessible through the **Immediate tracking...** menu, primary 7200 ACS operation is through the **Track a target...** menu. This target-oriented environment consists of preconfigured targets that include the desired tracking mode. Multiple, unique data bases are simultaneously maintained for all targets. The user simply selects the name associated with the desired target and the ACU automatically invokes the mode, or series of modes, and the predictive tracking data base(s) established for that target.

To track a target in the target selection menu, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, and **Track a target...**.

2. Using the arrow keys on the 7200 ACU keypad, move the cursor to the desired target and press [ENTER].

3. A prompt will appear to confirm that tracking should begin at the preconfigured position. To begin tracking the target, toggle the [YES/NO] key to [YES]. To cancel the tracking function, answer [NO], and the ACU will return to the **Track a target...** screen.

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When commanded to begin tracking the target, the system will move the antenna to the target's position and maintain that position. The name of the target remains on the display under the antenna name.

5.8.2.3 Modify Current Target Menu

From this menu, the user can modify the target currently being tracked. The items under this menu vary according to the tracking mode of the current target.

- **Tracking receiver parameters...** is available in all tracking modes and is the only item displayed when the system is in **Standby**.
- **Manually bias target** is available in all tracking modes, but not in **Standby.**
- **Edit current target...** is available for all tracking modes, allowing the user to edit the **Target name**, **Tracking mode**, and target parameters.
- **Reset OPT target** is only available when a target's tracking mode is **OPT.**
- **Set star time bias...** is only available for targets configured for the **Star tracking** mode.

5.8.2.3.1 Manually Bias Target Function

NOTE: The Manually bias target function is not available when the system is in Standby mode.

The **Manually bias target** function allows the user to create a bias for a target preconfigured with any tracking mode (except OPT); the functionality varies according to the selected tracking mode of the target. This function is used to peak polarization on targets with OPT tracking modes -- i.e., OPT's polarization predictions are "calibrated" by adjusting polarization as the target moves along its orbit. Figure 5-9 is an example of how the front panel display looks when manual biasing is being performed on a target preconfigured for the **OPT** mode.

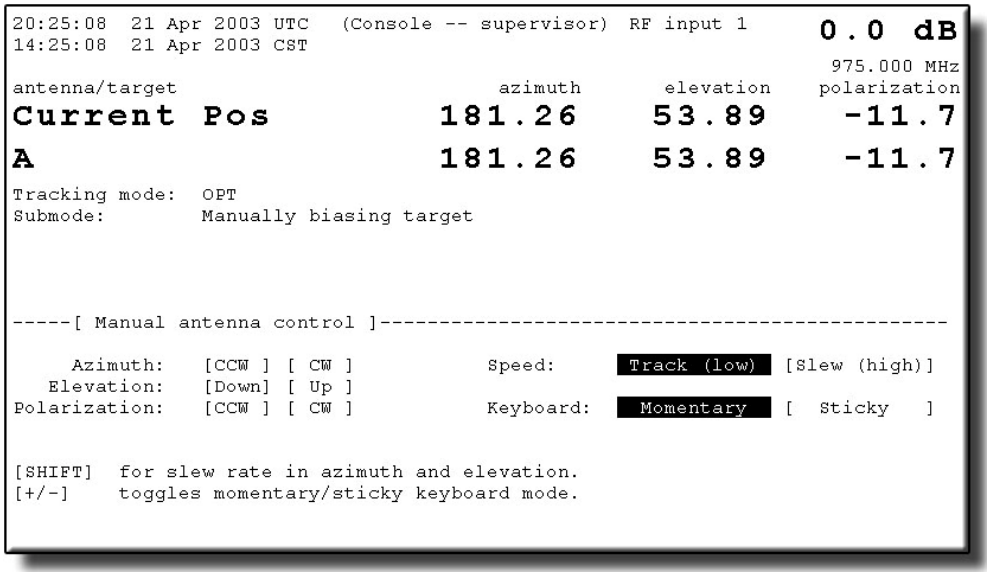


Figure 5-9 Manually Bias Target Screen

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Although the screen in Figure 5-9 is titled **Manual antenna control**, only biasing can be performed from this screen. Paragraph 5.8.2.5 explains how to manually control the antenna from the ACU.

For a target with a tracking mode of **Move to look angles**, **Move to longitude**, **Intelsat-11 element,** and **Star tracking**, the bias can be thought of as a "target-specific offset". Targets with these tracking modes have a parameter, **Bias angles**, which has a value in degrees for each axis. When the ACU is tracking a target, the command position is computed using the appropriate technique for the tracking mode, and then the bias angles are added to create the final command position to which the ACU drives the antenna.

Use the following procedures to perform manual biasing:

1. From the **Main menu**, select **Tracking functions...**; then select **Modify current target...**, and **Manually bias target**. The following prompt appears:

   Enter manual antenna control to bias the current target? (yes/no)

   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

2. Answer YES. Peak the antenna using the appropriate arrow keys.

3. Press [PRIOR]. The following prompt appears:

   Set bias for the current target from current look angles? (yes/no)

   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

4. If the user answers yes, the command position is subtracted from the current position on each axis and stored as the target's bias. If the user responds no, the ACU will move the antenna to the position computed for the target, effectively "undoing" the manual antenna movement.

Because the **Immediate tracking...** modes are used for immediate tracking only (i.e., the antenna is commanded to move to a position and is held there), none of these modes have bias angles. For more information on **Immediate tracking...**, refer to Section 5.8.2.4.

5.8.2.3.2 Tracking Receiver Parameters

The parameters for the **Tracking receiver parameters...** menu vary according to the setting of **Shell** under the **Remote port configuration...** menu (refer to Section 5.8.6.12).

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If **Shell** is set to **DTR**, the parameters in Table 5-1 will appear. If the **Shell** is set to **253_REC** the parameters in Table 5-2 will appear. If **Shell** is set to **TRL**, the parameters in Table 5-3 will appear. For all other **Shell** settings (**Disabled**, **Printer**, **M&C**, **Visual,** etc.), the parameters in Table 5-4 will appear.

TABLE 5-1 DTR PARAMETERS

PARAMETER	DESCRIPTION
Frequency [MHz]	Frequency for the tracking receiver.
RF input	Selects RF (polarization) input to the tracking receiver.
FFT Sample Averaging	FFT sample averaging controls this same function on the DTR. Increasing this value will improve the stability of the signal. Decreasing the value improves response time.
Filter Bandwidth	This index value selects the DTR bandpass filter bandwidth.
DTR Detection Type	This selects the detection type used by the DTR. This is only available on DTR receivers with "wideband" option; on standard DTRs, this will be ignored. The default is "FFT signal", which is the only detection type available on non-wideband DTRs. Consult the DTR Operations and Maintenance Manual for further information.

TABLE 5-2 253 PARAMETERS

PARAMETER	DESCRIPTION
Frequency [MHz]	Frequency for the tracking receiver.
A/D channel	The ACU A/D channel is connected to the analog signal output from the receiver.
Bandwidth	Selects narrow IF Bandwidth of the 253 Receiver

TABLE 5-3 TRL PARAMETERS

PARAMETER	DESCRIPTION
Frequency [MHz]	Frequency for the tracking receiver.
Attenuation [dB]	Attenuation setting for the tracking receiver.
RF input	Selects RF (polarization) input to the tracking receiver.

TABLE 5-4 ANALOG TRACKING PARAMETERS

PARAMETER	DESCRIPTION
A/D channel	The ACU A/D channel is connected to the analog signal.
Beacon	One of four available beacon signals.

Tracking signal input is only used for signal-based tracking (i.e., **Steptrack** and **OPT**). If the system is performing other types of tracking, the operator may want to see what the tracking receiver "sees" for a particular beacon frequency.

For targets tracking in OPT, changes to these parameters remain in effect until the target is restarted (or power is cycled). To permanently change a tracking signal source, the system must be at **Supervisor** level and the changes must be made by accessing the **Edit a new or existing target...** menu (refer to Section 5.8.2.6).
To edit any of the parameters under this menu, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**; then select **Modify current**

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target... and **Tracking signal parameters...**.

2. Using the arrow keys, move the cursor to the parameter to be edited and press [ENTER]. Using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].
3. Press the [PRIOR] key and the following prompt appears:
   Save changes to menu "Tracking signal parameters"? (yes/no)

   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.
4. To save the changes, toggle the YES/NO key to YES and press [ENTER].

5.8.2.3.3 Reset OPT Target Function

The **Reset OPT target** function is only available when an **OPT** target is being tracked. If this function is selected, the user is prompted to verify that the user wants to erase all stored steptrack data and orbital models for the current target. This is not required for normal operation. If the ACU is tracking poorly under OPT, it may be necessary to use this function to cause OPT to discard poor steptrack data and/or orbital solutions it has generated and stored.

Executing this function does not change any of the target's **Steptrack** or **OPT** configuration parameters.

5.8.2.3.4 Set Star Time Bias Function

The **Set star time bias...** function is only available when a star target is being tracked. The bias is a time value that is added to the current time to determine the point in the star's trajectory to which the ACU will point.

By default, the star time bias is 00:00:00, which means that the ACU is tracking the star in real time. If the bias is changed to a nonzero number, the ACU will "run ahead" of the star by that amount of time. For example, if the star time bias is 00:01:00, the ACU will run 1 minute ahead of the star.

To edit the **Set star time bias...**, select the function, select **Time bias**, and enter the desired numeric values (within the range of values specified in the system prompt).

5.8.2.3.5 Edit Current Target Menu

The function of this menu is identical to the function of the **Edit a new or existing target...** menu (refer to Section 5.8.2.6), and is placed under **Modify current target...** for convenience when modifying the current target.

5.8.2.4 Immediate Tracking Menu

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Immediate tracking allows the user to begin tracking without first configuring a target. This method of tracking is useful for testing purposes and moving the antenna to odd locations. To track a satellite for operational use, a target should be configured for that satellite -- refer to Section 5.8.2.6 for details on configuring targets.

This menu contains the following menus:

- **Track Immediate Target…**
- **Edit Immediate Target…**

Some tracking modes are target-specific. For example, OPT is not available through **Immediate tracking** and Steptrack is not available through **Edit a new or existing target**. For that reason, Steptrack mode is explained in this section while others are explained in Section 5.8.2.6.2.

5.8.2.4.1 Steptrack Parameters

Table 5-5 describes the steptracking parameters and lists the default settings for each parameter.

NOTE: Before changing any of the steptrack parameters, read the information about that parameter in Table 5-5.

TABLE 5-5 STEPTRACK PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
Cycle time	00:02:00	Sets time between the end of one **Steptrack** cycle and the beginning of the next cycle when no OPT solution is available. For immediate Steptrack, this is the only cycle time used. In addition, this time is used when excessive discrepancies exist between the OPT models and the steptrack pointing.
Receive -3 dB beamwidth [deg]	0.450°	The receive -3 dB of the antenna. Used by Steptrack and OPT to determine deflection from beam center. The value is normally supplied with the antenna's specs.
Step size [deg]	0.040	Sets the size of each step that the antenna makes as the steptrack algorithm approximates a curve and samples points along that curve. This step is also used for steptrack operations in OPT tracking. The value should be set to approximately 8% of the -3 dB receive beamwidth of the given antenna, but no less than 0.02 with standard encoders.
Position deadband [deg]	0.040	Steptrack moves the antenna closer to the peak signal until the difference between the previous estimated peak position and the current peak position is less than the deadband. This difference is measured radially between the AZ/EL pairs. As in system configuration parameters, this deadband setting affects AZ and EL only. When the antenna moves to within this deadband of the peak signal, steptracking stops for that cycle and peaking is complete. The value should be less than 10% of the -3 dB receive beamwidth, but greater than 0.01° for systems with standard encoders.
Maximum no. of cycles	5	Limits the number of AZ and EL cycles (attempts) that the steptrack algorithm makes in finding the peak signal. Nominal value is 5, but the value should be decreased for a very fast target as steptrack assumes target is fixed for duration of steptrack operations.

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TABLE 5-5 STEPTRACK PARAMETERS		
PARAMETER	**DEFAULT**	**DESCRIPTION**
Cycle to start rate estimates	3	Sets the cycle at which rate estimates will be made during steptrack operations. The rate estimates are only made when no OPT solution exists for the target being tracked. If an OPT solution is available, the rates used by steptrack are obtained from OPT. The nominal value is 3, but should be decreased to 2 for a very fast target. For a stationary target, the value should be set to 5.
Peaking correction limit (%BW)	30	Sets the maximum beam radial distance steptrack will adjust the antenna pointing in one cycle. The value is given in percent of -3 dB beamwidth. Nominal value is 30% -- this can be lowered to 10% to limit the steptrack working area but will inhibit the ability of steptrack to peak on a highly inclined satellite.
Weight adjustment value	1.00	The steptrack algorithm combines data together by a weighting system which is determined automatically. This parameter can be used to magnify the internal weighting under special situations. The nominal value is 1.0 and should not be changed unless directed by VertexRSI personnel. Increasing this value decreases the responsiveness of steptrack.
Low tracking signal level [dB]	-10.00 dB	Defines the lowest signal level that steptrack can work with to perform its operations. If the signal falls below this level while steptracking, the ACU will display a Low tracking signal level message and wait until the signal rises above this level before attempting another steptrack cycle. ***NOTE: Setting this value too close to 0 dB will interfere with proper steptrack operation.***
Signal threshold [dB]	15.00 dB	This parameter is used in both standalone steptrack and OPT to initiate steptrack operation if the signal drops by this many dB between steptrack operations. In a noisy environment, a small value will cause excessive steptrack operations. Setting this value larger than the "Low tracking signal level" will effectively disable this parameter. The default value, 15.00 dB, is less than the default "Low tracking signal level, and for most applications (and all OPT tracking), it should remain so. While the ACU is waiting for the cycle time to expire (to begin a new steptrack cycle), if the signal falls by this many dB below the most recently acquired peak, it will do a steptrack cycle immediately. If the signal threshold is set below the Low tracking signal level [dB], it will only do steptrack cycles at intervals given by Cycle time.
Axis to peak first	Elevation	Allows selection of which axis is peaked first during steptrack cycle. Normally, the axis for which the satellite has the greatest apparent motion is peaked first. Select AZ only if the required motion for following the satellite is more AZ than EL. Otherwise, set this parameter to EL. Unless the spacecraft's inclination is high (greater than approximately 5 degrees), this parameter has no noticeable effect, and may be left at the default.
# of samples	10	This sets the number of signal readings taken at each position during steptrack. The default is 10, which is good for virtually all applications. The value should be between 3 and 70.
Sun outage protection	Enabled	Sun outage protection works by inhibiting steptrack whenever the current look angles are within a specific angle from the center of the sun. The angle used is the -3 dB beamwidth plus the radius of the sun's disk. A delay of up to 10 minutes may result. The ACU must contain the correct site and time information for this parameter to function.

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5.8.2.4.2 Edit Steptrack Parameters... Menu

This menu contains the steptrack parameters. For a description of the parameters and the default settings, refer to Section 5.8.2.4.1.

The following parameters are included in this menu:

- **Cycle time**
- **Receive -3 dB beamwidth [deg]**
- **Step size [deg]**
- **Position deadband [deg]**
- **Maximum no. of cycles**
- **Cycle to start rate estimates**
- **Peaking correction limit (%BW)**
- **Weight adjustment value**
- **Low tracking signal level [dB]**
- **Signal threshold [dB]**
- **Axis to peak first**
- **# of samples**
- **Sun outage protection**

To edit the steptrack parameters, use the following procedures:

1. From the Main menu, select **Tracking functions...**, then **Immediate tracking...**, **Steptrack...**, and **Edit steptrack parameters....**

2. Using the arrow keys, move the cursor to the parameter to be changed and press [ENTER].

3. A prompt will appear at the bottom of the screen. If the parameter is a numeric value, the prompt will give the acceptable range of values to be entered. Using the numeric keys, enter the desired value and press [ENTER]. If the parameter is a non-numeric value (e.g., **Axis to peak first),** the prompt will instruct the user to change the value using the up and down arrow keys. Pressing either the up or down arrow key will "toggle" through the choices for the parameter. When the desired choice appears next to the parameter, press [ENTER].

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5.8.2.5 Manual Antenna Control Function

Figure 5-10 shows a representation of the **Manual antenna control** screen.

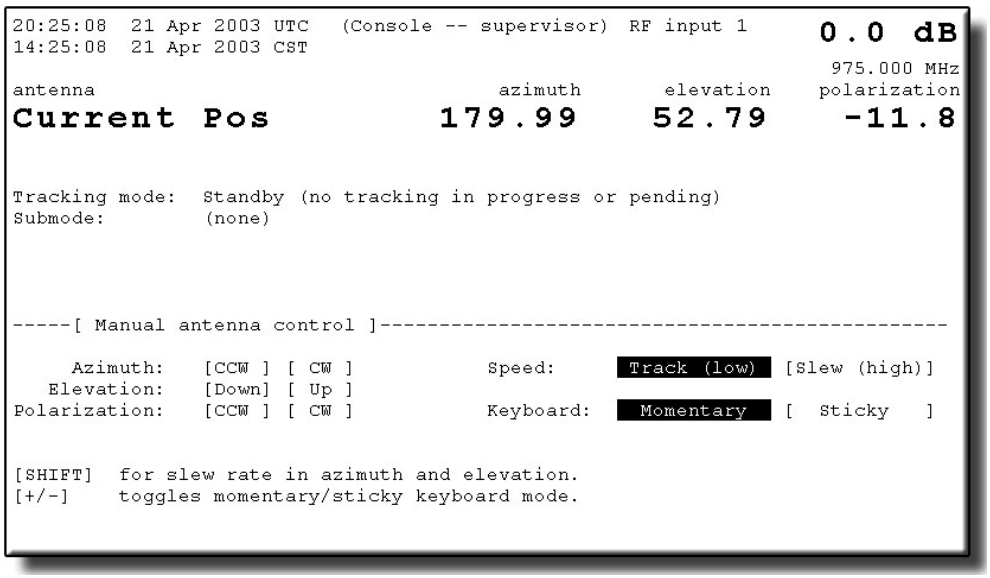


Figure 5-10 Manual Antenna Control Screen

5.8.2.5.1 7200 ACU Keypad Momentary and Sticky Modes

There are two modes for use of the keypad in the **Manual antenna control** function: **Momentary** mode and **Sticky** mode.

In **Momentary** mode, the axis is driven only as long as a direction key (arrow key) is pressed. Therefore, **Momentary** mode is the "normal" mode of operation for the keypad.

Sticky mode is used to drive the antenna for extended periods of time, such as doing test patterns. To move the antenna in Sticky Mode hold the [+/-] key with the desired directional key; release both keys and the antenna will continue to move in the selected direction until one of the following conditions exists.

- the directional key is pressed again
- the opposite directional key is pressed
- the soft limit is reached (refer to Section 5.8.6.5.1)
- the keypad is returned to **Momentary** mode (the [+/-] key is pressed again)

To use the **Sticky** mode at slew rate, hold the [+/-] key with the desired directional key; then release the keys and press [SHIFT]. Pressing [SHIFT] again will stop the slew rate, but the keypad remains in **Sticky** mode.

As an added safety feature, the ACU will return the keypad to the **Momentary** mode when the antenna is not being moved.

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5.8.2.5.2 Antenna Speed Selection Control from the ACU

The [SHIFT] key toggles between track (low) speed and slew (high). POL is one speed and therefore the [SHIFT] key has no effect on its speed.

To operate the antenna manually, use the following procedures:

1. From the **Main menu**, select **Tracking functions...** and then **Manual antenna control**.

   NOTE: In the following steps, the respective field is highlighted to indicate commanded speed and direction.

2. To move the AZ axis at track speed, press the left arrow key to move the axis CCW and the right arrow key to move it CW. To move the axis at slew speed, hold down the [SHIFT] key and the left arrow key to move the antenna CCW, and the right arrow key to move it CW.

3. To move the EL axis at track speed, press the up arrow key to move the axis upward and the down arrow key to move it downward. To move the axis at slew speed, hold down the [SHIFT] key and the up arrow key to move the antenna upward, and the down arrow key to move it downward.

4. To rotate the POL axis, press the CCW arrow key or the CW arrow key

5.8.2.6 Edit a New or Existing Target Menu

The **Edit a new or existing target...** menu allows the user to configure up to 50 targets for the target-oriented environment to establish a target-specific data base for any predictive or programmed tracking data relative to the target.

This menu contains the target selection menu and the following parameters and menu:

- **Target name**
- **Erase target name**
- **Tracking mode**
- **Edit target parameters...**

The target selection menu appears as either 25 blank lines (to denote the capability to configure targets -- this menu contains two screens, each with 25 initialized or non-initialized targets), names of any preconfigured targets, or a combination of blank lines and named targets. Refer to the following sections to name a target, erase a target name, change the tracking mode of a target, or to edit a target's parameters.

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Once configured, tracking for a target is initiated by selecting the name of the target under the menu **Track a target...**. The target name will also be displayed when the target is being tracked. Refer to Section 5.8.2.2 for information on tracking a target in the target-oriented environment.

5.8.2.6.1 Target Name Parameter

As mentioned in the previous section, when the **Edit a new or existing target...** menu is accessed, the target selection menu will appear. The user can name a new target or edit an existing target's name. The target name may be up to 12 characters in length. The following section explains how to name a target.

5.8.2.6.1.1 Creating a Target Name

To create a new target name, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**; then select **Edit a new or existing target...**.

2. The **Edit a new or existing target...** screen appears where a target may be selected.

3. Select a non-initialized item (represented as "----------") on the target selection menu and press [ENTER].

4. The **Edit selected target** screen will appear. This screen contains **Target name, Erase target name** and **Tracking mode** parameters, and the menu **Edit target parameters...**.

5. Select **Target name**. The following prompt appears: **Up and down arrows change character, left and right arrows change position. A/B resets character to 'A'; '+/-' = space; Shift '+/-' = backspace.**

6. To create a target name use the up and down arrow keys to scroll through the character set, which consists of the following:

    - A blank space
    - Uppercase alphabet letters
    - Lowercase alphabet letters
    - Digits 0 through 9
    - Special characters:! "#$%&'()* + , -./:; < = > ? @[\]^_`{|}~

7. When the desired character is highlighted, press the right arrow key to move to the next space to create a target name of more than one letter. The left arrow key may be used to correct a mistake. Blank spaces may be included as part of the target's name. When completed, press [ENTER] to set the target name as selected.

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5.8.2.6.1.2 Editing a Target Name

To edit an existing target name, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**; then select **Edit a new or existing target...**.

2. On the target selection menu, move the cursor to the target to be edited and press [ENTER]. The **Edit selected target** screen will appear. This screen contains **Target name, Erase target name** and **Tracking mode** parameters, and the menu **Edit target parameters...**.

3. Select **Target name**. The same editor that allowed creating a target name now allows the user to edit that name. See step 5 in Section 5.8.6.1.1.

4. The cursor highlights the first character of the target name. Use the right arrow key to move to the character to be edited, and using the up and down arrow keys, scroll through the character set to the desired character. When all characters have been edited as desired, press [ENTER].

5.8.2.6.1.3 Erasing a Target Name

To delete an existing target name, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**; then select **Edit a new or existing target...**.

2. Move the cursor to the target name to be erased and press [ENTER]. The **Edit selected target** screen will appear. This screen contains **Target name, Erase target name** and **Tracking mode** parameters, and the menu **Edit target parameters...**.

3. Select **Erase target name**, Exit the menu, and save the changes to the menu.

   NOTE: **Erase target name** only erases the text name for that target, leaving all associated data intact. To erase a target completely (allowing a new target to be set up from defaults in its place) the tracking mode must be set to **Unused**. Refer to Section 5.8.2.6.2 for more information on tracking modes.

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5.8.2.6.2 Tracking Mode Parameter

NOTE: All noninitialized targets (shown as "----------") have a tracking mode of "Unused".

Use the following procedures to change the tracking mode of a target:

1. From the **Main menu**, select **Tracking functions…**; then select **Edit a new or existing target…**.

2. Move the cursor to the target to be edited (a noninitialized or named target) and press [ENTER]. The **Edit selected target** screen will appear. This screen contains **Target name** and **Tracking mode** parameters, and the menu **Edit target parameters…**.

3. Select **Tracking mode**. Using the up and down arrow keys, the user can scroll through the following choices for the tracking mode:

    - Unused
    - Star tracking Track a star. This is commonly used as a point of reference during installation.)
    - OPT (Calculates an OPT orbital element set and follows the calculated position.)
    - Intelsat 11-element -IESS-412 (Calculates an orbit by using figures from Intelsat, and moves to the current calculated position.)
    - Move to longitude (moves to longitude and holds position).
    - Move to look angles (Moves to look angles.)

    NOTE: When the Tracking mode for a target is set to Star tracking, the system will automatically "blank" or erase any user-defined Target name. If one of the preprogrammed stars is chosen for the Star parameter under the Edit target parameters… menu, the name of the selected star becomes the Target name. If User-defined is selected, the Target name can be edited by following procedures listed in Section 5.8.2.6.1.1.

The following additional option will be available on the system if configured with the following OPTIONAL tracking mode.

- Orbital Element Tracking (OPTIONAL)

4. When the desired tracking mode is highlighted, press [ENTER].

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5.8.2.6.3 Edit Target Parameters Menu

The items in the **Edit target parameters...** menu vary according to the tracking mode of the target (refer to the previous Section 5.8.2.6.2 for the tracking modes). The following Sections describe the parameters for each available tracking mode.

To edit a target's parameters, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**; then select **Edit a new or existing target...**.

2. Select **Edit target parameters...**.

3. Using the arrow keys, select the parameter to be edited and press [ENTER].

4. For parameters requiring numeric values, use the numeric keys on the keypad to enter the desired value (within the specified range), and press [ENTER]. If the parameter has a predefined list of choices, use the up and down arrow keys to toggle through the preset choices.

5.8.2.6.3.1 Star Tracking Mode Parameters

Table 5-6 describes the parameters for **Star tracking**.

TABLE 5-6 STAR TRACKING PARAMETERS

SELECTION	DESCRIPTION
Star	Five preset stars and one user-definable entry are programmed for this parameter. For the user-definable star, the user may enter any right ascension of the star in degrees, declination of the star in degrees, and the epoch set, which is the Julian date representing the epoch for the right ascension and declination values. Common values are: B1950 = 2433282.423; J2000 = 2451545.0. (The data for the predefined stars is from the U. S. Naval Observatory.)
Right ascension [deg]	The right ascension (in degrees) of the star
Declination [deg]	The declination (in degrees) of the star
Epoch [Julian date]	Epoch for the right ascension and declination. Common values are R1950 = 2433282.423; J2000 = 2451545.0.
Time bias	Used to cause star tracking to run ahead of where the star is in real time.
Polarization [deg]	The polarization angle of the antenna. (Only available when the POL axis is enabled.)
Bias angle [deg]	Bias angles for the star. Refer to Section 5.8.2.3.1, Manually bias target, for a description of the function of bias angles.

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5.8.2.6.3.2 OPT Tracking Mode Parameters

The **Edit target parameters...** screen for targets with tracking modes set to **OPT** contains three menus and one function:

- **Spacecraft parameters...**
- **Steptrack parameters...**
- **OPT parameters...**
- **Reset OPT target**

Table 5-5 describes the **Steptrack** parameters, while Tables 5-7, 5-8, 5-9, and 5-10 describe **Spacecraft parameters...** and **OPT parameters...**. Refer to Section 5.8.2.3.3 for information on the **Reset OPT target** function.

TABLE 5-7 SPACECRAFT PARAMETERS

PARAMETER	DESCRIPTION
Box center longitude [deg.East]	East longitude where the spacecraft is at its box center.
Longitude range [deg]	Used for the box limit and orbit scan. This sets the longitude range of motion from the box center longitude. Nominal value is 0.1°, which means the spacecraft is constrained to box center longitude ±0.1°.
Estimated inclination [deg]	Inclination is the measure of how much an orbit is inclined, or tilted, with respect to the equatorial plane. 0 degree inclined orbits travel directly over the equator. 90 degree inclined orbits travel directly over the north and south poles and are perpendicular to the equator. This is used for the box limit to specify north and south limits, and should be set to a value marginally greater than the actual inclination of the spacecraft orbit. It is also used for the orbit scan.
Box limit	The ACU's box limit generates a latitude/longitude box using the box center longitude, longitude range, and estimated inclination. The box limit should usually be ENABLED, as it provides OPT with information about the spacecraft's range of motion, which helps prevent tracking the wrong spacecraft. When box limit is ENABLED and a new or erased OPT target is started, it first checks to see if the antenna is within the box limit. If not, OPT will move to the target's box center longitude before doing anything else, even if it is seeing a usable tracking signal (from the wrong spacecraft) at the starting point. If box limit is disabled, OPT cannot detect that it is on the wrong target. While OPT is tracking, if it ever moves the antenna outside of the box, a "Box limit" error occurs, and OPT will not track until the error is cleared.
Orbit scan	Used if OPT has no signal and no orbit model with which to work. A circular geosynchronous orbit is generated passing through the box center longitude with an inclination given by the **Estimated inclination** parameter. The scan then runs the antenna around this trajectory looking for a signal that is at least 0.5 dB above the **Low tracking signal level**. If it finds such a signal, OPT begins at that point. If one orbit is swept without finding a signal, OPT stops. If disabled, OPT stops without trying a scan first.

The **Spacecraft parameters...** menu contains two menus: **Tracking signal parameters...** (refer to Section 5.8.2.3.2) and **Calibrate tracking signal...**. The **Calibrate tracking signal...** menu contains the parameters listed in Table 5-7, and it also contains the **Manual antenna control** function described in Section 5.8.2.5.

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TABLE 5-8 CALIBRATE TRACKING SIGNAL	
PARAMETER	**DESCRIPTION**
Set 0 dB point	Pressing [ENTER] on this item will cause the 0 dB point to be set at the current signal level. The new value is displayed in "0 dB setting" below. To set this value, peak up the antenna on all axes, adjust the signal level appropriately (see next paragraph) then press [ENTER]. This parameter affects both the dB display on the front panel, and all tracking modes which use tracking signal. For "analog receivers" (that is, a tracking receiver that feeds an analog signal into the ACU's A/D inputs,) as well as a VertexRSI TRL receiver, adjust the receiver's output voltage to 6-8 VDC when peaked on the spacecraft. Once this is done, proceed to "Set -3 dB point." For a DTR receiver, no change to the receiver is required. The DTR reports signal in dBm; this setting merely offsets the receiver output such that "0 dB" on the ACU is the peak signal level. Also, when a DTR is configured as the tracking receiver, "Set -3 dB point" and "A/D slope" have no effect, although they are visible for backwards compatibility.
Set -3 dB point	Pressing [ENTER] on this item will set the -3 dB point at the current signal level. Once this step is done, and changes are saved, the tracking signal calibration is complete. First set the 0 dB point, then run the antenna off of the target by 3 dB and press [ENTER] on this item. This is the most accurate and preferred method. The alternative is to insert a -3 dB attenuator at the tracking receiver input. However, this is less accurate, especially at lower C/N values. This has no effect when using a DTR receiver; it is included only for backwards compatibility.
0 dB setting	The "0 dB setting" value is generated by executing "Set 0 dB point"; the "A/D slope" is generated by executing "Set -3 dB point". Once the 0 and -3 dB points have been computed once for this ACU/tracking receiver combination, the "0 dB setting" and "A/D slope" should be recorded. In the event of non-volatile RAM loss, these values may be re-entered into the ACU: the ACU will then have the same 0 and -3 dB points as before. **NOTE**: A/D slope is ignored when a DTR receiver is being used.
A/D slope	**NOTE**: A/D slope is ignored when a DTR receiver is being used (also see 0 dB setting).

The parameters listed in Table 5-9 should only be modified by VertexRSI personnel or experienced technicians who thoroughly understand these parameters

TABLE 5-9 OPT PARAMETERS		
PARAMETER	**DEFAULT**	**DESCRIPTION**
Cycle time with ST solution	00:10:00	Sets the cycle time between steptrack operations when a short-term solution is in use.
Cycle time with LT solution	00:20:00	Sets the cycle time between steptrack operations when a long-term solution is in use.
Signal fluctuation limit [dB]	0.20	This value sets the point at which steptrack, under OPT operation, will go to a fixed scan pattern. This will only happen when an OPT model is available and the Std. Dev. On the "OPT Statistics" screen is greater than this parameter. A fixed scan will minimize tracking errors in a noisy environment. The nominal value is set to 0.20 dB, but can be decreased to cause the OPT to use a fixed pattern more frequently.
Min. ST solution time span	1.25	Sets the minimum window of data used to create a short-term solution. The smallest allowable value is 1.25 hours. The value may be increased if performance of the early solutions is less than desirable.
Min. LT solution time span	18	Sets the minimum window of data used to create a long-term solution. The smallest allowable value is 18 hours. The value may be increased if performance of the early solutions is less than desirable.

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CAUTION

Improper modification of the parameters listed in Table 5-9 will severely degrade OPT performance.

TABLE 5-10 ADVANCED OPT PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
ST discard point	0.10	Represents the fraction of the -3 dB beamwidth at which OPT will start the process to invalidate the current short-term solution. Setting this value larger will allow more error growth, but setting it too small will cause excessive steptrack operations.
LT discard point	0.09	Represents the fraction of the -3 dB beamwidth at which OPT will start the process to invalidate the current long-term solution. Setting this value larger will allow more error growth, but setting it too small will cause excessive steptrack operations.
dB collect cycle time [ms]	500 ms (0.5 sec)	Controls the frequency at which new points are read from the current A/D. A window of 40 points is held to determine the mean dB and standard deviation of the signal inside OPT. The nominal value is 500 ms (0.5 sec) which will cover the last 20 seconds in time. Increasing this value will stretch the time the window covers but only 40 points are maintained.
Propagator cycle time [ms]	1000 ms (1 sec)	Controls the frequency at which new look angles are calculated from an existing OPT solution. The value can be increased to lower the workload on the CPU.
Max solution RMS	0.10 (10% bandwidth)	***WARNING: Setting this value too low will cause OPT to malfunction.*** Represents the fraction of the receive -3 dB beamwidth at which OPT will no longer consider an orbital element set valid. Setting this value too high could allow OPT to use a bad solution.
Max steptrack fit [db]	N/A	One of two values used to determine if a steptrack operation should be accepted by OPT. **SP_FIT** (seen in **Steptrack statistics**) is the comparison data. This parameter should only be changed on the advice of VertexRSI personnel.
Max steptrack std [db]	N/A	One of two values used to determine if a steptrack operation should be accepted by OPT. **SP_STD** (seen in **Steptrack statistics**) is the comparison data. This parameter should only be changed on the advice of VertexRSI personnel.
Use solutions	Enabled	In normal operation, OPT will follow its solutions between steptrack operations. This parameter must be enabled for this to happen. Disabling this parameter will stop OPT from using its solutions, but OPT will continue to collect data and generate solutions. OPT will always use its solutions to initially acquire the target.

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The non-geosynchronous parameters listed in Table 5-11 provide OPT with the capability to support tracking a satellite in non-geosynchronous orbits under certain circumstances. Improper use of these parameters will severely degrade OPT performance. VertexRSI recommends that the user contact a Control Systems Division engineer before attempting to modify these parameters.

TABLE 5-11 NON-GEOSYNCHRONOUS SUPPORT PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
Non-geosynchronous tracking	Disabled	Allows the ACU to track satellites that are not in geosynchronous orbit. In this system, a geosynchronous orbit is defined to have a period very close to 1 sidereal day (86164 seconds) and an eccentricity near zero (circular orbit). Inclined orbits with these characteristics are still geosynchronous. For most applications, this parameter should be disabled. Unless an operator is ***certain*** that this parameter needs to be enabled, it should be Disabled. This is typically used for drift orbit support (repositioning a satellite to a new orbital assignment on the geostationary arc), limited transfer orbit tracking, and Molniya-type orbit tracking. If this parameter is enabled, ***all*** other items in this menu ***must*** be set properly to begin tracking. The values should be as accurate as possible. When OPT gathers sufficient steptrack data, it will compute its own values for these parameters, and the values in this menu will be dropped from use.
Orbital period [seconds]	86164 seconds	Used in conjunction with the steptrack data to build OPT solutions. The orbital period is the time in which the satellite makes one complete revolution around the Earth. Units are seconds.
Orbital eccentricity	0.00000	Used in conjunction with the steptrack data to build OPT solutions. The orbital eccentricity defines the shape of the orbit. The value is non-dimensional.
Orbit argument of perigee [deg]	0.000	Used in conjunction with the steptrack data to build OPT solutions if the eccentricity is set greater than zero. The argument of perigee is the angular measurement, in the plane of the satellite's orbit, between the ascending node and the periapsis point. Units are degrees. ***NOTE: If the orbital inclination is very near zero, this angle is measured from the mean vernal equinox vector to the periapsis point.***

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5.8.2.6.3.3 Intelsat 11-Element Tracking Mode Parameters

Table 5-12 describes the **Intelsat 11-element** (IESS412) parameters.

TABLE 5-12 INTELSAT 11-ELEMENT PARAMETERS

PARAMETER	DESCRIPTION
Year	Year portion of the epoch time on which the ephemeris is based; value must be a four-digit number (1990; 2001).
Month	Month portion of the epoch time on which the ephemeris is based; input is a two-digit integer value (01 - 12).
Day	Day portion of the epoch time on which the ephemeris is based; input is a two-digit integer value (01 - 31).
Hour	Hour portion of the epoch time on which the ephemeris is based; input is a two-digit integer value (00 -23).
Minute	Minute portion of the epoch time on which the ephemeris is based; input is a two-digit integer value (00 - 59).
Second	Second portion of the epoch time on which the ephemeris is based; input is a two-digit integer value (00 - 59).
LM0 [deg. E]	Mean longitude (degrees east of Greenwich). Labeled LM0 on the 11-parameter ephemeris from Intelsat.
LM1 [deg/day]	Mean longitude drift rate (degrees east per day).
LM2 [deg/day/day]	Mean longitude drift acceleration (degrees east per day).
LONC [deg. E]	Amplitude of the cosine component of the longitude oscillation (degrees east).
LONC1 [deg/day]	Rate of change in LONC (degrees east per day).
LONS [deg. E]	Amplitude of the sine component of the longitude oscillation (degrees east).
LONS1 [deg/day]	Rate of change in LONS (degrees east per day).
LATC [deg. N]	Amplitude of the cosine component of the latitude oscillation (degrees north).
LATC1 [deg/day]	Rate of change in LATC (degrees north per day).
LATS [deg. N]	Amplitude of the sine component of the latitude oscillation (degrees north).
LATS1 [deg/day]	Rate of change in LATS (degrees north per day).
Longitude at 170 hours [deg. E]	Satellite longitude at epoch plus 170 hours (degrees east).
Latitude at 170 hours [deg. N]	Satellite latitude at epoch plus 170 hours (degrees north).
Polarization angle [deg]	POL angle used with Intelsat tracking if POL is enabled. If the ACU does not control POL, this value is irrelevant.
Bias angles [deg]	Angles added to the look angles to determine the target position. These exist because the look angles can only be edited at Supervisor level, but the bias angles can be edited at Operator level, allowing periodic repeaking of the target without losing the base position.
Pointing update time [ms]	Controls the frequency at which new look angles are calculated from the Intelsat parameters. The nominal value is 1000 milliseconds (ms) (1 second). The value can be increased to lower the workload on the CPU.

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5.8.2.6.3.4 Move to Longitude Tracking Mode Parameters

The **Move to longitude** parameters are described in Table 5-13.

TABLE 5-13 MOVE TO LONGITUDE PARAMETERS		
PARAMETER	**DEFAULT**	**DESCRIPTION**
E. Longitude of target [deg]	N/A	E. longitude of target to which antenna will move
(Look angles [deg])	N/A	Read-only item that shows look angles corresponding to the **E. Longitude of target [deg]**
Polarization [deg]	N/A	POL look angle for target
Bias angles [deg]	N/A	Added to **Look angles [deg])** to compute target position; these exist because look angles can be edited only at Supervisor level; Operator level can edit the **Bias angles [deg]**

5.8.2.6.3.5 Move to Look Angles Tracking Mode Parameters

Table 5-14 describes the **Move to look angles** parameters.

TABLE 5-14 MOVE TO LOOK ANGLES PARAMETERS		
PARAMETER	**DEFAULT**	**DESCRIPTION**
Look angles [deg]	N/A	Look angles to which the antenna will move when selected target is tracked.
Bias angles [deg]	N/A	These angles are added to the look angles to determine the target position. These exist because the look angles can only be edited at Supervisor level, but the bias angles can be edited at Operator level, allowing periodic repeaking of the target without losing the base position.

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5.8.2.6.3.6 Orbital Element Tracking (OPTIONAL)

Table 5-15 describes the **Orbital Element Tracking** parameters.

TABLE 5-15 ORBITAL ELEMENT TRACKING PARAMETERS

PARAMETER	FORMAT	DESCRIPTION
Test element set		This command tests the Orbital element set for validity. This test is run automatically in the visual shell when this menu is exited. Run from the M&C shell, returns the following code: 0: ok 1: > = 1 invalid terms (test couldn't be more specific.)
Year	YYYY	This is the year portion of the Epoch time on which the element set is based. Note that the input value MUST be a 4 digit number. E.g.: 1990 is OK but 90 is not. 2001 is OK but 01 is not.
Month	MM	Month is the month portion of the Epoch time on which the element set is based. Note that the input is a 2 digit value.
Day	DD	Day is the day portion of the Epoch time on which the element set is based. Note that the input is a 2 digit integer value.
Hour	HH	Hour is the hour portion of the Epoch time on which the element set is based. Note that the input is a 2 digit integer value.
Minute	MM	Minute is the minute portion of the Epoch time on which the element set is based. Note that the input is a 2 digit integer.
Second	SS.SSS	Second is the second portion of the Epoch time on which the element set is based. Note that the input is a 2 digit real with 3 digit fractional part.
X Position [km]	XXXXXX.XXXX	Earth Centered Inertial X Position in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: km
Y Position [km]	XXXXXX.XXXX	Earth Centered Inertial Y Position in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: km
Z Position [km]	XXXXXX.XXXX	Earth Centered Inertial Z Position in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: km
X Velocity [m/sec]	XXXXXX.XXXX	Earth Centered Inertial X Velocity in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: m/sec
Y Velocity [m/sec]	XXXXXX.XXXX	Earth Centered Inertial Y Velocity in a True Earth Mean Equinox (TME) reference fixed at the time of Epoch. Units: m/sec
Z Velocity [m/sec]	XXXXXX.XXXX	Earth Centered Inertial Z Velocity in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: m/sec
Polarization Angle [deg]		Polarization angle used with Orbital Element tracking, if polarization is enabled. If the ACU doesn't control polarization, this value is irrelevant. Range: -180 to 180.0
Bias Angles [deg]		These angles are added to the look angles to come up with the target position. These exist because the look angles can only be edited by supervisor, whereas the bias angles can be edited by an operator. This allows periodic re-peaking of the target without worrying about losing the base position. Range: -180 to 180.0
Pointing Update Time [ms]		This value controls the frequency at which new look angles are calculated from the OE Set. Nominal value is 2000 ms (2 seconds) and can be increased to lower work load on CPU. Pointing update time range: 500-120000.

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5.8.2.7 Target Scheduler Menu

The **Target scheduler...** menu allows the user to program up to 200 targets with corresponding dates and times at which tracking begins for each target. This allows fully automatic tracking of a number of targets, each with its own preconfigured mode of tracking.

When the target scheduler is running and a target is being tracked, the display will show the target name under the **Current pos**, **Moving to target** or **Awaiting next scheduled target time (no tracking in progress)** will be displayed at the **Tracking mode:** prompt, and **Next target** will show the name, date, and time of the next target to be tracked.

The **Target scheduler...** menu contains the **Start target scheduler** and **Edit schedule...** menu.

5.8.2.7.1 Start Target Scheduler

When this function is selected, if there are entries in the schedule, a prompt appears asking the user if tracking is to begin at the first target in the schedule -- the target's name and parameters are displayed in the prompt. The following sections provide procedures for viewing and editing this track schedule.

5.8.2.7.2 Edit Schedule Menu

Edit Schedule Menu allows viewing and editing of the schedule. Items under this menu include the following when a schedule exists. Before a schedule is created, only **Add a new entry...** is visible.

- **View/edit existing entries...**
- **Add a new entry...**
- **Delete one entry...**
- **Delete ALL entries**

The user must be at **Operator** or **Supervisor** level to make changes to the schedule; however, the schedule may be viewed at **Monitor** level. Also note that any changes made in this menu do not take effect until the user presses [PRIOR] to leave the menu and saves the changes.

> ***NOTE: All entries displayed or entered are in UTC time, not local time.***

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5.8.2.7.2.1 View/Edit Existing Entries Menu

View/Edit Existing Entries Menu displays all entries in the schedule. There is one entry displayed per line, in the following format:

date: dd Mmm yyyy time: hh:mm:ss target: target_name

To view entries in the schedule, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, **Target scheduler...**, and **Edit schedule...**.

2. Select **View/edit existing entries...** and the entries will be displayed. To edit an entry, use the following procedures:

To edit entries in the schedule, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, **Target scheduler...**, and **Edit schedule...**.

2. Select **View/edit existing entries...** and place the cursor on the target to be edited and press [ENTER].

3. For parameters requiring numeric values, use the numeric keys on the keypad to enter the desired value and press [ENTER]. If the parameter has a predefined list of choices, (e.g., the date), use the up and down arrow keys to toggle through the preset choices. To edit (change) the target name selected, when the **Select a target** screen is displayed, use the arrow keys to highlight the desired target and press [ENTER].

5.8.2.7.2.2 Add a New Entry Menu

Add a New Entry Menu allows the user to enter the name (from the **Select a target** screen), date, and time of up to 50 targets to be added to the schedule. If a new entry has the same date and time as an existing entry, the existing entry will be replaced with the new entry. New entries are inserted into the schedule in chronological order, moving entries with a later date and time down in the schedule. When the schedule is full, the user must delete an entry before adding a new one (refer to Section 5.8.2.7.2.3 for procedures to delete an entry).

To add a new entry, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, **Target scheduler...**, and **Edit schedule...**.

2. Select **Add a new entry...** and press [ENTER].

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3. For parameters requiring numeric values, use the numeric keys on the keypad to enter the desired value and press [ENTER]. If the parameter has a predefined list of choices, (e.g., the date), use the up and down arrow keys to toggle through the preset choices. To select a target to be added, when the **Select a target** screen is displayed, use the arrow keys to highlight the desired target and press [ENTER].

4. To enter (add) an entry, press [ENTER] when **Add the entry above to the schedule** is highlighted. Notice that the number of entries in the schedule is updated on the display.

5.8.2.7.2.3 Delete One Entry Menu

Delete One Entry Menu allows the user to delete one entry at a time. As mentioned in Section 5.8.2.7.2.2, when the schedule is full, the user must delete an entry before adding a new one.

To delete an entry, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, **Target scheduler...**, and **Edit schedule...**.

2. Select **Delete a new entry...** and press [ENTER].

3. Select the entry to be deleted and press [ENTER]. A confirmation message will appear before the deletion is processed.

5.8.2.7.2.4 Delete All Entries Function

Delete All Entries Function allows the user to delete all entries in the schedule. A confirmation message will appear to verify that the user intends to delete all entries from the schedule.

To delete all entries from the schedule, use the following procedures:

1. From the **Main menu**, select **Tracking functions...**, **Target scheduler...**, and **Edit schedule...**.

2. Select **Delete ALL entries** and press [ENTER].

3. A confirmation message will appear to verify that this will delete all entries in the schedule.

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5.8.3 Clear/Correct System Faults Function

Clear/correct system faults clears all faults that can be cleared, and acknowledges faults that the ACU cannot correct. If there are unacknowledged faults:

- All faults are displayed in reverse video (even if some faults had been previously acknowledged). If all faults displayed have been acknowledged, they are displayed in normal video.
- If the audible alarms are on (refer to Section 5.8.6.14), the ACU will emit a steady tone -- acknowledging the faults will deactivate the alarms.
- The summary alarm contact closure is opened. When all faults are cleared and/or acknowledged, this contact will close.

Some faults can only be acknowledged by the ACU; action external to the ACU is required to clear the fault (e.g., if the EMERGENCY STOP button on the drive cabinet is engaged, the button must be disengaged at the drive cabinet before the fault can be cleared.)

Some faults are "latching"; that is, even though the fault condition has been cleared, the user must acknowledge that the fault occurred before the fault message will disappear from the ACU display. An example of a latching fault is the "Tracking signal input saturated" fault message, indicating that the tracking signal input exceeded 10 VDC. The ACU cannot track properly with that voltage. This latches because this error often occurs intermittently. Since this can cause intermittent tracking problems, it is important to be aware of such a fault so that it can be corrected.

To clear system faults, return to the **Main menu** and select **Clear/correct system faults**.

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Table 5-16 describes the faults that may be displayed on the ACU.

TABLE 5-16 CLEAR/CORRECT SYSTEM FAULTS

FAULT	DESCRIPTION
Axis immobile	Indicates that the antenna has been commanded to move in a particular axis, but the antenna has not moved or the resolver has not moved.
Axis soft limits	Indicates that the antenna has moved beyond the limits set by the software in the ACU.
Axis reversed	Indicates that the antenna is moving in the direction opposite to the commanded direction. Can also be a result of the antenna "whipping".
Axis runaway	Indicates that the antenna has not been commanded to move, but the antenna is moving. Can also be a result of the antenna "whipping".
Azimuth drive fault	Indicates that the AZ speed controller is tripped or has lost power.
East box limit violation	Indicates that the antenna has jogged beyond the limit set by the east box limit in the steptracking configuration of a target.
Elevation drive fault	Indicates that the EL speed controller is tripped or has lost power.
Emergency stop at drive cabinet	Indicates that the EMERGENCY STOP switch at the drive cabinet is pushed in.
Keyboard stop	Indicates that tracking has been stopped from the ACU keypad.
Low tracking signal level	Indicates if the signal is below the threshold necessary for steptracking functions.
Maintenance override at drive cabinet	Indicates that the CONTROL switch in the drive cabinet is set to MAINT. The 7150 drive cabinet switch has a remote position and maintenance position.
No power at drive cabinet	Indicates that the drive cabinet is without power.
Non-volatile RAM corrupted	Indicates that one or more parameter tables failed power-up test and was loaded with default values. All data in the RAM is lost and must be re-entered.
OPT cannot track	OPT has no valid orbital models and a low tracking signal level condition exists. OPT will maintain the antenna at the current position until the low tracking signal level condition is gone.
South box limit violation	Indicates that the antenna has jogged beyond the limit set by the south box limit in the steptracking configuration of a target.
Travel limit switch (summary)	Indicates that the antenna has tripped one of the mechanical limit switches.
West box limit violation	Indicates that the antenna has jogged beyond the limit set by the west box limit in the steptracking configuration of a target.
System error: unused fault	A firmware error has occurred; call VertexRSI upon the indication of this fault.

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5.8.4 Set User Level (and Passwords) Menu

Set User Level (and Passwords) Menu contains the following functions:

- **Go to monitor level**
- **Go to operator level**
- **Go to supervisor level**
- **Change operator password**
- **Change supervisor password**

5.8.4.1 7200 ACS User Levels

The 7200 ACS has three user levels:

- **Monitor** level: At Monitor level, the user can examine all system parameters but cannot edit the parameters or command the antenna.

- **Operator** level: At Operator level, the user can command the antenna to a new target or use manual mode, but cannot edit system parameters.

- **Supervisor** level: At Supervisor level, there are no restrictions on the user -- the user may modify any system parameters or target configurations.

To change the user level of the system, use the following procedures:

1. From the **Main menu**, select **Set user level (and passwords)...**.

2. Select the desired level and press [ENTER].

5.8.4.2 7200 ACS Passwords

No password is required to change the user level of the system to Monitor, but passwords are required to change to either the Operator or Supervisor level.

Passwords are one to nine digits (0 through 9). Setting a password to 0 disables password protection for that level. Supervisor level is required to change passwords at Operator or Supervisor levels.

If password protection is not desired, disable passwords (set the password to 0), and set the user level to Supervisor. The user level is stored in battery-backed memory and will be retained by the ACU until it is changed.

For instructions on disabling or changing passwords through the system hardware, refer to Appendix B.

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To change an Operator password, use the following procedures:

1. From the **Main menu**, select **Set user level (and passwords)...**.

2. Select **Change operator password** and press [ENTER]. If the system is not at Supervisor level, a prompt will appear to notify the user to go to Supervisor level (refer to Section 5.8.4.1).

3. The following prompt will appear:
   Enter new password to go to operator level: _____

4. Enter the desired password (one to nine digits, 0 to 9) and press [ENTER].

5. The following prompt will appear: **Re-enter password:**

6. Re-enter the password exactly as it was originally entered. If the password is incorrectly entered, the following prompt will appear: **Password entered differently; try again**

7. If the password is entered incorrectly again, the system will return to the **Change user level** screen.

To change a Supervisor password, select **Change supervisor password**, and follow steps 3 through 7 above.

5.8.5 Display System Status Menu

This menu contains the following parameters:

- **Hardware Diagnostics**
- **Position loop diagnostics**
- **Steptrack statistics**
- **OPT statistics**
- **Orbit data**
- **Box limits**
- **Background tasks**
- **Simulated target**
- **Star viewing windows**
- **View message buffer**
- **Serial DTR Diagnostics**
- **Serial TRL diagnostics**
- **253 Diagnostics**
- **Power-up test report**
- **Firmware version information**
- **Network Diagnostics**

These functions are not normally used in everyday operation, but are useful in debugging the 7200 ACS, especially during installation.

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5.8.5.1 Hardware Diagnostics

5.8.5.1.1 Input States

When **Input States** is selected from the menu, the input states of the I/O board are displayed. The logic is negative true; therefore a 0 indicates that an input is engaged and a 1 indicates that an input is disengaged. The only inputs supported by the drive cabinet are the first five (EM STOP, MAINT, SUM LIM, AZ DRIVE FLT, AND EL DRIVE FLT). If all five inputs are in the 1 state, the 7200 ACU interprets this condition as a no-power condition at the drive cabinet.

5.8.5.1.2 Output States

If **Output States** is selected from the menu, the screen shows the current output states from the I/O board. Outputs are negative true; therefore, 0 for one of the drive lines (AZ CW, EL UP) indicates movement in that direction. DRIVE ENABLE is 0 if the drive cabinet is enabled (powered). For beacons (B1 - B4), the one showing 0 is the beacon selected. SUM ALM is 0 for OK and 1 for fault.

5.8.5.1.3 A/D states

A/D States provide the status of the A/D states for each channel. The display shows raw data, the 12-bit data from the A/D board (in hexadecimal and binary), and the status of three flags as follows:

- If the flags are off, the display shows "---"
- An **O** indicates that the A/D is overrange (saturated)
- An **S** indicates sign, which is true if a positive voltage is present; negative voltage readings are unusable
- An **N** indicates that a new value is ready (**N** will normally be flashing on and off)

5.8.5.1.4 Optical Encoders

Optical Encoders shows, in real time, the errors occurring on the serial link from the optical encoders and the CPU. This screen can only be accessed if **Encoder type** is set to an optical encoder type in the **Position configuration...** menu.

This information is most useful during the installation of the system. There are no "acceptable" limits, but for proper operation, the values must remain five percent or less.

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5.8.5.1.5 RDC States

The information shown in Figure 5-11 shows the state of the RDC card. This data is primarily used for debugging systems with standard resolvers. On single-speed systems, AZ and EL fine data, states, and mode will show all bits as **F** (hexadecimal).

The information is displayed in hexadecimal by default, but can be changed to binary display by pressing [ENTER] to toggle between hexadecimal and binary.

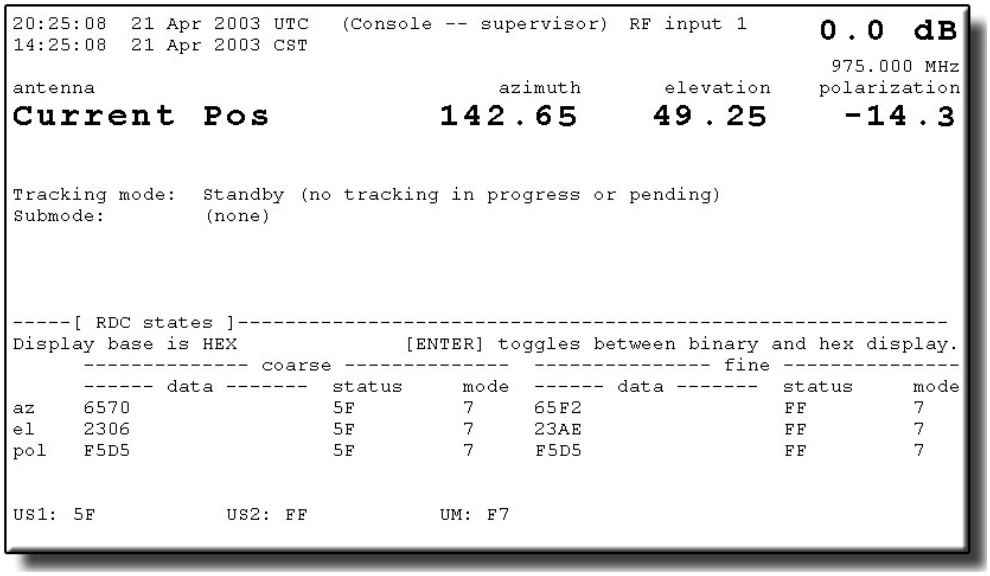


Figure 5-11 RDC States Display

On systems with two-speed resolvers, this information is also used to determine the internal alignment of the resolver (i.e., the fine resolver value when the coarse resolver value is 0). Even though it is unused on two-speed resolver systems, POL fine bits will always show all bits as **1**'s. On systems without two-speed resolvers, the fine data fields should show **FFFF** in hexadecimal (or **1111 1111 1111 1111** in binary).

US1 and **US2** are unused states 1 and 2, and **UM** is unused mode, but all should show **1**'s. The status and mode information are not useful to the user; they are provided for VertexRSI engineers' use only and are not documented here.

5.8.5.1.6 VCPU Hardware Diagnostics

This diagnostic is fully functional even in simulation mode. The CPU board temperature is displayed at the top of the window. Fault status indicators are shown in [brackets] when that fault is clear, and in reverse video when that fault is sensed. Raw status is shown at the bottom, for use by technical support. This is
done only for a sanity check; all the data encoded there is displayed above in human-readable format. The functions are outlined below.

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- A **temperature sensor** is located on the VCPU board site U29.

- **A/D Power Supply Fault** - This fault means the power source to the A/D converter has failed and thus the A/D converter results are unreliable. If the RF tracking signal is an analog input then immediate attention should be given to correct this failure. If the RF tracking signal is supplied over the serial port then this alarm should not affect the operation of the ACU.

- **±12 Volt Source Faults** - This fault means the +12 (or -12) volt power source has fallen below 10.95 volts. The ACU power supply sources this voltage which feeds the resolver reference oscillator circuits, the keypad speaker, and the display controller card. This fault is a latching fault that causes the system to return to the standby mode.

- **+24 Volt Source Fault** - This fault means the +24 volt power source has fallen below 22.24 Volts. The ACU power supply sources this voltage which feeds the optical encoder (optional feedback device) and the 7200 ACU cooling fans.

- **Low Battery Warning** - The warning means the battery voltage has fallen below 2.7 Volts. Replace the battery soon or the parameters and the real time clock may be erased when the ACU is powered down.

- **RTC Power Source Fault** - The fault means the charge pump which supplies +3.3V to the real time clock circuit has fallen below 2.97 Volts. The failure will cause the ACU clock to stop counting.

5.8.5.1.7 ACE DUART Diagnostics

This display shows the number of serial port interrupts processed and number of characters processed by the receive queue handler. Pressing [ENTER] resets the counters.

- **Receive queue characters** - Total number of characters processed by the receive queue handler.

- **Summed DUART interrupts** - All DUART interrupts share a common interrupt handler. This is the number of times this interrupt handler has been called.

- **Receive queue interrupts** - Number of interrupts per serial port. Port 0 is the display. Total may differ from "Summed DUART interrupts" if port does not have receive queue attached to it.

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5.8.5.2 Position Loop Diagnostics

Position Loop Diagnostics shows the states of the position loop task in real time. The status (awake or asleep) of the position loop is displayed. If the loop is awake, the antenna is being actively commanded to a position (or the system is actively holding the current position). If the system is in **Standby** or **Manual** mode, the loop is asleep and is not commanding the antenna.

The **FSM state** provides the current status of position loop Finite State Machine (FSM) for each axis. Table 5-17 describes the possible states of the FSM.

TABLE 5-17 FINITE STATE MACHINE STATES

STATE	DESCRIPTION
Slew drive	Indicates that the antenna is driving at slew (fast) speed toward the target.
Slew coast	Indicates that the antenna is now within the slew->track transition point, waiting for the antenna to coast to a stop before proceeding.
Track drive	Indicates that the antenna is driving at track (slow) speed toward the target.
Track coast	Indicates that the position loop has come within the deadband and is waiting for the antenna to come to a stop.
Inch coast	Indicates that the position loop either overshot the positioning deadband on the way to the target, or the antenna has drifted outside the positioning deadband and the antenna is inching back to the deadband.
On target	Indicates that the antenna is within positioning deadband of the target.
Unknown	Indicates that the FSM has not been used since power-up of the ACU.
Outputs	Shows (in the form rate, direction), the rate and direction in which the antenna is being driven. For example, slew CCW indicates that the antenna is moving CCW at slew rate. If the antenna is not being commanded, this line indicates **Track Stop**.
Distance to target	Shows how far the antenna has to move to get to the commanded position. Positive value means move up/CW to get to the target.

5.8.5.3 Steptrack Statistics

The **Steptrack statistics** provide real-time information when the **Steptrack active** field is true. When **Steptrack inactive** is true, the final values at completion of the last steptrack operation are displayed. Table 5-18 describes the steptrack statistics.

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TABLE 5-18 STEPTRACK STATISTICS	
FIELD	**DESCRIPTION**
no. of cycles	Indicates the number of complete steptrack cycles (both AZ and EL peaking) performed to achieve peaking constraints.
SP_LOOP	Indicates the number of loops required by the fitting algorithm.
SOL-MAX DIFF	Indicates the calculated radial difference in percentage of beamwidth between the position where maximum signal was recorded and the adjusted peak position.
SP_FIT	Minimized least squared error between internal beam model and collected data.
SP_STD	Maximum standard deviation of original recorded during stepping operations.
SP_WT	Weight value used for filtering steptrack peak estimates.
CAL STEP	Estimated step to peak antenna (in percentage of beamwidth).

5.8.5.4 OPT Statistics

OPT statistics provides useful information only when OPT is in operation. The statistics are described in Table 5-19. Information on this screen is intended for use by VertexRSI personnel.

TABLE 5-19 OPT STATISTICS	
FIELD	**DESCRIPTION**
STvsAST delta	The short-term versus AST delta is the calculated radial error in percentage of beamwidth between the last steptrack solution and the short-term solution at that time.
LTvsAST delta	The long-term versus AST delta is the calculated radial error in percentage of beamwidth between the last steptrack solution and the long-term solution at that time.
LTvsST delta	The difference between the LT solution and the ST solution at the last steptrack operation.
Sol. in use	Displays, in real time, the OPT model being followed.
Mean	The mean signal level being used in OPT (real time).
Std. Dev.	The standard deviation of the signal used to determine when the signal is too noisy to steptrack (real time).
ST Sol	The RMS of the deviations for the last short-term solution created.
LT2b Sol	The RMS of the deviations for the last long-term solution created using the two-body propagator.
LTmb Sol	The RMS of the deviations for the last long-term solution created using the multibody propagator.
ST SOLVER	Indicates if the short-term solver task is awake or asleep.
LT SOLVER	Indicates if the long-term solver task is awake or asleep.

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5.8.5.5 Orbit Data

Orbit data provides information from the current target OPT solutions. This information can be useful in setting up or checking **Box limit**s. Three solutions may exist for each OPT target: Short-term, Long-term (2b), and Long-term (mb). If data is not available for a given solution, **Not available** will be displayed.

Under each solution, the user will see the data listed in Table 5-20 calculated at the solution epoch.

TABLE 5-20 ORBIT DATA CALCULATIONS

FIELD	DESCRIPTION
Longitude (E)	Estimated east longitude of the satellite.
Inclination	Estimated orbital inclination, in degrees.
Axis 1 delta	Estimated delta, in degrees, applied to the first axis. For most systems, axis 1 is AZ.
Axis 2 delta	Estimated delta, in degrees, applied to the second axis. For most systems, axis 2 is EL.

5.8.5.6 Box Limits

The **Box limits** information provides the limits in use and the current pointing location inside the box. The limits are only active when the current target is an OPT target and Box limits are enabled. This information is provided to assist in troubleshooting Box limit errors. The longitude/latitude values displayed are estimates determined from the current look angles. The estimates are independent of the OPT solutions and will function with or without OPT solutions, and the estimates do not affect the solutions.

The north/south limits are determined by the **Estimated inclination** input for the target under OPT parameters. The east/west limits are determined by using three values: the **Longitude range**, a longitude spread calculated from the **Estimated inclination**, and the **Box center longitude**. These values are input for the target under OPT parameters.

When a north/south limit is intersected and no other problem exists, open the limits by increasing the **Estimated inclination** for that target. The **Orbit data** screen can assist in determining the target's inclination. The **Estimated inclination** must be set to a value greater than that displayed on the **Orbit data** screen.

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When an east/west limit is intersected and no other problem exists, open limits by increasing the **Estimated inclination** and/or the **Longitude range** value. The box center longitude should be verified to be at the normal longitude for the satellite. This nominal longitude can be obtained from the satellite operator or may be estimated on the **Orbit data** screen if the axis is very small.

5.8.5.7 Background Tasks

Background tasks indicates whether the background tasks or awake or asleep. Table 5-21 describes each of the tasks.

TABLE 5-21 BACKGROUND TASKS

TASK	DESCRIPTION
POSITIONER*	POSITIONER controls the position loop. This task drives the antenna to a target and holds it there. **POSITIONER** will be asleep when in **Standby** and awake when tracking. **Steptrack** will momentarily put **POSITIONER** to sleep while it is gathering data and then wake it up again. **POSITIONER** will also be asleep during manual antenna control.
OUINTF	(Outside Unit Interface) Reads the position transducers (resolvers) and does fault monitoring. OUINTF should always be awake.
ST_SOLVER*	Used by OPT to build orbit solutions. These tasks will be awake occasionally when a new solution is being built. Builds OPT short-term solutions.
LT_SOLVER*	Used by OPT to build orbit solutions. These tasks will be awake occasionally when a new solution is being built. Builds OPT long-term solutions.
SIMULATOR	This task will be AWAKE when the ACU is in SIMULATION mode and asleep otherwise.
TARGETER*	Drives the current target. For **Move to look angles** and **Move to longitude** targets, **TARGETER** will be awake only long enough to set **POSITIONER** to the correct look angles, then it will go to sleep and remain asleep until a new target is tracked or the ACU is returned to standby. For steptrack, OPT, Intelsat, star, and (optional) NORAD tracking, TARGETER should be awake at all times.
SCHEDULER	This task drives the **Target scheduler**. This task should be awake when **Target scheduler** is operating, and asleep when the scheduler is not being used.
Multitasker Frequency	The multitasker frequency shows how fast the multitasker is completing service of all system tasks. This gives an indication of how busy the system is: a lower frequency means that the system is more heavily loaded. [ENTER] resets the statistics.

* These are ASLEEP except when building new solutions for a target. When awake, they show the target name and number that they are solving, which is not necessarily the target currently being tracked. The target number is the target's position in the **Tracking functions**, **Track a target** or **Edit a new or existing target** menus. When looking at these menus, target 1 is in the upper left hand corner of the menu, target 2 is beneath target 1, etc. Target 6 is at the top of the second column. Target 26 is first on screen 2.

NOTE: When the ST_SOLVER and LT_SOLVER tasks are shown, the target name is also displayed because the task(s) may not necessarily be building solutions for the target currently being tracked.

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5.8.5.8 Simulated Target

Simulated Target is useful only in SIMULATION mode. When in SIMULATION, this shows the simulated target's current position and error and basic orbit information.

5.8.5.9 Star Viewing Windows

The **Star Viewing Windows** screen shows the windows of visibility (when the star is within the software travel limits of the antenna) for a star. This is used primarily for G/T testing of antennas by radio stars. This screen shows at what times of the day the star will be visible for use by the tester.

Table 5-22 describes the parameters for **Star viewing windows**.

TABLE 5-22 STAR VIEWING WINDOWS

PARAMETER	DESCRIPTION
Star	This is the star for which information is to be displayed. When selected, a screen similar to the target selection screen will appear, showing only the targets with **Tracking mode** set to **Star tracking**.
Date	Reference date for the viewing windows. The star's position at 0 hours UTC on this date is analyzed. If the star is in view at that time, the window in which the star is will be displayed. If the star is not in view, the next window in time will be displayed.

Selecting **Display viewing windows...** will display the viewing windows for the star selected corresponding to the date entered in the **Date** parameter. If **Soft limits** are enabled, then the Acquisition of Star (AOS) and Loss of Star (LOS) are bounded by the soft limits (i.e., the star is within the soft limits between AOS and LOS). If **Soft limits** are disabled, then AOS and LOS values are only bounded by the horizon (0 degrees elevation).

To use this utility, a target for the star must be established. To view a window for an existing target with a tracking mode set to **Star tracking**, use the following procedures:

1. From the **Main menu**, select **Display system status...** and then **Star viewing windows**.

2. Place the cursor on **Star** and press [ENTER]. A screen similar to the target selection screen will appear, listing only those stars with a tracking mode set to **Star tracking**.

3. Select the star to be viewed and press [ENTER]. The target name will be displayed in the **Star** parameter, and the star's reference date will be displayed in the **Date** parameter.

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4. To display the "viewing windows" for the selected star, select **Display viewing windows...**. The dates and times (in UTC) at which the star will be visible to the antenna are listed. The up and down arrow keys may be used to scroll forward or backward through the visibility dates.

To set a target with a **Tracking mode** of **Star tracking**, use the following procedures.

1. From the **Main menu**, select **Tracking functions...**, and **Edit a new or existing target...** (refer to Section 5.8.2.6).

2. Select a noninitialized target, and set the **Tracking mode** to **Star tracking** (refer to Section 5.8.2.6.2). If the star is a user-defined star, "name" the target.

3. Select **Edit target parameters...**. To select one of the preprogrammed stars, select **Star**, and using the up and down arrow keys, scroll through the list of stars. To select one of the stars, when the name of the star is highlighted, simply press [ENTER] and the values for **Right ascension [deg]**, **Declination [deg]**, and **Epoch [Julian date]** will automatically be assigned to those parameters. To define another star, select the choice "User-defined" for **Star**, and assign the values for these parameters by selecting each parameter and entering values within the specified range.

5.8.5.10 View Message Buffer

This utility allows viewing the message printer buffer. When this is first entered, it is in "View most recent messages" mode. The most recent messages are displayed on the screen.

Events that have scrolled off the screen may be viewed as well. The message buffer holds up to 400 lines of text. Pressing the up arrow key scrolls back one line in the buffer. **[PG UP]** (shift + up arrow key) scrolls back one screen-full. If there aren't enough messages to fill a screen, pressing arrow keys will scroll through blank lines.

NOTE: once an arrow key is pressed, the display will no longer show new events as they occur. To see most recent events again, simply press [PRIOR] to return to the **Display system status...** menu and press [ENTER] to return to the **View most recent messages** screen.

If the tilde character, '~', appears in the text, then the message buffer contains corruption or is un-initialized; nonprintable characters are replaced with the tilde character.

In the **Edit system configuration** menu in the **Factory tests** menu, the item **Clear message buffer** can be used to erase a corrupted or un-initialized message buffer.

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5.8.5.11 Serial Diagnostics Menus

One of the following menus will appear in the **Display System Status** menu if that respective type of tracking receiver is selected in the **Shell** parameter under **Remote port configuration…**

- Serial DTR Diagnostics
- Serial 253 Diagnostics
- Serial TRL Diagnostics

The screens show "raw" status values being transmitted by the respective tracking receiver to the ACU. It is normally only of interest to VertexRSI engineers troubleshooting the serial link. While this screen is still available for viewing in simulation mode, the respective tracking receiver interface is not active, and the selected tracking receiver is not being queried or commanded while in simulation mode. The Link fields show values since power-up or last reset. [ENTER] resets the link counters to 0. Details for each type of receiver can be seen in Tables 5-23, 5-24 and 5-25.

5.8.5.11.1 Serial DTR Diagnostics

TABLE 5-23 SERIAL DTR DIAGNOSTIC FIELDS

FIELD		DESCRIPTION
Link	# ok	Number of successful transactions with the DTR.
	# aborted	Number of aborted transactions with the DTR.
	# timeouts	Number of timeouts with DTR (# aborted may also increment).
Data	Power	Received signal power in dBm
	Frequency	DTR's currently selected frequency. If the ACU is in remote control of the DTR, this should match the value on the real-time display.
	DTR port	Which serial port on the DTR the ACU is connected to.
	Control	Which serial port on the DTR is currently in control of the DTR. Control = 5 indicates DTR is in local control.
	Pol select	Which pol input is in use on the DTR [1-2].
	FFT sample avg	FFT sample averaging [1-2000]
	Filter BW	(Bandpass) Filter bandwidth [0-3] ([0-11] with wideband DTR option)
	Detection type	-1 indicates this is not a wideband DTR, so this is not user-selectable (which means FFT signal is in effect.) 0=FFT signal; 1=FFT noise; 2=RMS power; 3=RMS density.

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5.8.5.11.2 Serial 253 Diagnostics

TABLE 5-24 SERIAL 253 DIAGNOSTIC FIELDS		
FIELD		**DESCRIPTION**
Link	# good reads	# of successful transactions with the 253.
	# aborts	# of bad/partial responses from receiver
	# cksum fail	# of incorrect checksums in packets from receiver
	# timeouts	# of timeouts with 253 (no response from receiver)
Data	Frequency	Value returned from the 253 receiver in kHz
	Bandwidth	Selected IF returned from 253 receiver [1-3], refer to documentation for RF Board for specific filter values used
	Status bytes	Read status bits right to left where furthest right is bit 0 See "Request System Status" in 253 Tracking Receiver Software Interface for detailed description.

5.8.5.11.3 Serial TRL Diagnostics

TABLE 5-25 SERIAL TRL DIAGNOSTIC FIELDS		
FIELD		**DESCRIPTION**
Link	# ok	Number of successful transactions with the TRL.
	# aborted	Number of aborted transactions with the TRL.
	# timeouts	Number of timeouts with TRL (# aborted may also increment).
Data	Beacon	Beacon currently selected on TRL. [0-16]
	TRL port	TRL serial port ACU is connected to. [1-2]
	Control	TRL control point. ["Local", "Serial 1|2", "Parallel"]
	Attenuation	Attenuation value in dB*10. [0-500]
	Errors	Bit mapped hex: [00h-3Fh] b0=out of band; b1=AIB failure; b2=1st LO failure; b3=2nd LO failure; b4=PLL/AFC failure; b5=beacon error; b6-b7=unused.
	Voltage	Value in VDC*1000. [0-9999]

5.8.5.12 Power-up Test Report

The **Power-up test report** option provides the time that the ACU was last powered up, and any unlikely problems with the I/O cards. If any errors were detected on these cards at power-up, errors will be displayed. This screen can occasionally be useful for debugging.

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5.8.5.13 Firmware Version Information

Firmware version information shows the ACU firmware version information. This allows VertexRSI personnel to determine which versions of firmware are being used in the ACU. The information includes the ACU version, factory configuration options, build time, printed circuit board (PCB) revision, complex programmable logic device (CPLD) version, bootloader EEPROM version, and network controller version. The 7200 ACU firmware has both a version number and a configuration. The configuration is displayed on the line below the version information as a 32 bit HEX coded label called " ACU-CONFIG" . The center column defines the firmware configuration that is included when its respective bit is set to a one. The third column lists what the HEX coded value would be assuming that only one optional configuration was added to the standard factory 7200 ACU firmware. It is possible to have multiple configurations combined together in the same 7200 ACU firmware release.

TABLE 5-26 ACU-CONFIG Firmware Options

Configuration Bit	Optional Firmware Configurations	Single Option HEX ACU-CONFIG Code w/ VCPU Board
0 LSB	Norad Tracking	$80000001
1	Remove Star Tracking	$80000002
2	GPIB (IEEE-488) Port	$80000004
3	Moon Tracking	$80000008
4	Table Tracking	$80000010
5	Circular Pol/Linear Pol Switching	$80000020
6	Fourth Axis	$80000040
7	Dual Polarization Axis	$80000080
8	Ka-Band Frequency Limit	$80000100
9	Intelsat with Low Signal Alarm	$80000200
10	Delay to Standby	$80000400
11	Orbit Element Tracking	$80000800
12	Sun Tracking	$80001000
13	With Transmit CP_LP Control	$80002000
14	With DMK_Stow Mode	$80004000
15	With Redundant ACU	$80008000
16	With 7200 Aux Drive Cabinet	$80010000
17	With 7200 ACU Parameter Sync	$80020000
18 - 30	Reserved for future configurations	N/A
31 MSB	With VCPU Board	$80000000 ♦

♦ Denotes the standard firmware configuration for the 7200 Antenna Control Units.

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DTR firmware version information appears if the DTR shell is enabled and shows the firmware version information obtained from the DTR. If the DTR is disconnected or powered off, this screen will show "Version information not available."

This information is read at start-up, then re-read once each time communication is lost and restored with the DTR. This screen will not display anything until the version information has been completely read. To refresh this screen, simply press [PRIOR], then [ENTER].

5.8.5.14 Network Diagnostics

This menu Displays the Media Access Control (MAC) address, real-time values of Rabbit Slave Port registers SPSR, SPD1R, and SPD2R, then network controller boot progress.

SPSR bit descriptions are below.

SPD1R: FF booting, 00 booted, 1? socket error, 2? port error, toggling bit 0 waiting for connection, otherwise echoing SPD0R out.

SPD2R: MAC 6-bytes, IP 4-bytes, Subnet Mask 4-bytes, Gateway Address 4-bytes, TCP Port 2-bytes, Ver 5-bytes, 00 7-bytes, repeating.

SPSR Bit 0: 1 slave wrote SPD0R, 0 master read SPD0R
Bit 1: 1 slave wrote SPD1R, 0 master read SPD1R
Bit 2: 1 slave wrote SPD2R, 0 master read SPD2R
Bit 3: 1 slave wrote SPD0R, 0 master wrote SPSR
Bit 4: 1 master wrote SPD0R, 0 slave read SPD0R
Bit 5: 1 master wrote SPD1R, 0 slave read SPD1R
Bit 6: 1 master wrote SPD2R, 0 slave read SPD2R
Bit 7: 1 master wrote SPD0R, 0 slave wrote SPSR

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While the network subsystem is being loaded, a message of "Booting n of N" will be displayed at the bottom of the screen, where n is the current byte, and N is the total bytes to be loaded. When the network subsystem has finished booting, the message will change to display the time and date the boot upload completed. If the "Boot completed" message is not displayed and the "n of N" message remains such that n is 0 or some number less than N, then the subsystem is either disabled or malfunctioning. If malfunctioning, n may either move very slowly or stop before reaching N.

From the M&C, the diagnostic consists of one line containing MAC, SPSR, SPD1R, SPD2R and "n", respectively. H is hexadecimal; B is binary; D is decimal:

```
HH-HH-HH-HH-HH-HH  HH  BBBBBBBB  HH  BBBBBBBB  HH  BBBBBBBB  DDDDD
```

Example of the network being disabled:

```
00-00-00-00-00-01  FF  11111111  FF  11111111  FF  11111111      0
```

Example at 2,678 bytes into booting the network controller:

```
00-00-00-00-00-01  80  10000000  FF  11111111  FF  11111111   2678
```

Example of boot completed at UTC time 12:55:57 10 Jan 2003, now waiting for a connection :

```
00-00-00-00-00-01   06   00000110   01   00000001   00   00000000   12:55:57
01/10/2003
```


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5.8.6 Edit System Configuration Menu

> ***WARNING***
> ***Any of the system configuration parameters may be viewed at any time, but modifying these parameters after installation may cause the ACU to malfunction.***

The **Edit system configuration...** menu contains the following menus and function:

- **Tracking Receiver Parameters...**
- **Tracking receiver setup...**
- **Steptrack defaults...**
- **Position encoder configuration...**
- **Motion limits...**
- **Position loop parameters...**
- **Built-in simulator setup...**
- **Set UTC date and time...**
- **Site data...**
- **RF/geometry**
- **Network configuration...**
- **Remote port configuration...**
- **ACU sync configuration**
- **User interface options...**
- **Tracking restoration options...**
- **Factory tests...**
- **Message printer options...**

5.8.6.1 Tracking Receiver Parameters Menu

The parameters for the **Tracking receiver parameters...** menu will vary according to the type of tracking being performed. Refer to Section 5.8.2.3.2 for a complete listing and description of these parameters and procedures for changing them. If a tracking receiver with serial link is being used, one of the following **Remote port configuration** shells should be selected. If a Model 253 Receiver shell is selected, **Frequency [MHz]**, **A/D Channel**, and **Bandwidth** will be displayed. If a **TRL** shell is selected, **Frequency [MHz]**, **RF input**, and **Attenuation [db]** parameters will be displayed. If a DTR **Shell** is selected, **Frequency [MHz], RF Input, FFT Sample Averaging, Filter Bandwidth and DTR Detection Type** will be displayed under this menu.

If none of these shell selections is made, an analog signal input is used. **A/D channel** and **Beacon** parameters will be displayed.

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5.8.6.2 Tracking Receiver Setup Menu

The **Tracking receiver setup...** menu is used at system installation time to configure the tracking receiver. This must be done before invoking Steptrack or OPT. Setting the volts/dB slope under this menu is necessary for proper Steptrack and OPT operation.

This menu contains the following parameters, sub-menu, and function.

- **Receiver controller**
- **Set 0 dB point**
- **Set -3 dB point**
- **0 dB setting**
- **A/D slope**

5.8.6.2.1 Receiver Controller Parameter

The setting of the Receiver Controller Parameter selects how the tracking receiver is controlled. This only affects the "serial" tracking receiver input (i.e., a receiver with serial link); if an analog signal input is used, this parameter has no effect.

The default, and normal, setting for this parameter is **ACU**. This setting signals the system to assume the receiver to be in remote control, and receiver commands (frequency, attenuation, and RF input) are sent from the 7200 to the receiver. If the receiver is in local control, a **Tracking receiver in local control** alarm is issued. The 7200 will continue to track with the signal sent from the receiver even when this alarm is in effect.

Receiver is selected to allow control of the tracking receiver from the receiver's front panel, or to allow the receiver to be controlled by another computer (M&C). Tracking receiver commands will not be sent from the 7200 to the receiver, even if it is in remote control mode.

To set this parameter, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...**. Then select **Tracking receiver setup...** and **Receiver controller**.

2. Use the up and down arrow keys to toggle between the preprogrammed choices of **ACU** and **Receiver**. When the desired choice is highlighted, press [ENTER].

5.8.6.2.2 Calibrating the Tracking Signal

The parameters listed in Table 5-8 are used to set the volts/dB slope of the A/D channels.

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5.8.6.3 Steptrack Defaults Menu

This **Steptrack defaults...** menu has the same steptrack parameters that are found in the **Edit steptrack parameters...** menu under **Immediate tracking...**. Refer to Table 5-5 for a listing and description of the parameters.

Whenever a new OPT target is created, the initial parameter values for the target are obtained from Table 5-5. The values of these parameters only affect the creation of new OPT targets; once a target is created, it has its own set of steptrack parameters. Changes made to the defaults will not affect targets created before the defaults were changed. In addition, **Immediate steptrack** gets its default steptrack parameters from this table.

5.8.6.4 Position Encoder Configuration Menu

The **Position encoder configuration...** menu allows the user to set the position encoder offsets. The offset for an axis is the difference between the actual axis position and the angle returned by the encoder. When the encoder bracketry is properly aligned, this difference (the offset) is a constant throughout the range of motion of the antenna.

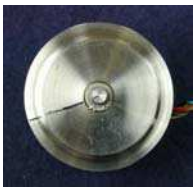
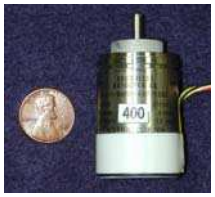
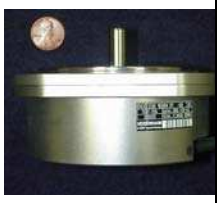
In addition, the 7200 ACU has the ability (in software) to reverse the direction in which the encoders count; that is, when the encoder indicates movement in the CW direction of its shaft but the ACU reports CCW direction, and vice versa.

Table 5-27 describes the **Position encoder configuration...** parameters.

TABLE 5-27 POSITION ENCODER CONFIGURATION PARAMETERS

PARAMETER	DESCRIPTION
Encoder direction	This sets the counting direction, or "sense" of the encoders (resolvers). If antenna movement in one direction causes the resolvers to indicate motion in the opposite direction, the direction may either be reversed by changing the phasing of the resolvers, or by changing the direction for that axis from Fwd (forward) to Rev (reversed). **NOTE: For absolute optical encoders, this is the only way to change the counting direction.**
Current position [deg]	For each axis, the current position is the "raw position" returned from the encoder plus the offsets.
Offsets [deg]	Value added to the raw position to determine the current position, or the difference between the actual axis position and the angle returned by the encoder.
Encoder type	This selects the type of encoders (resolvers) used by the ACU. This is determined by the hardware installed at the factory; changing this item from the proper value will leave the ACU inoperative. See the following table for supported encoder types (position feedback devices).
2-speed internal alignment	This option will appear on the menu only in systems with Encoder type set to 2-speed resolvers. These values are used to correct the internal alignment of the two-speed resolvers. The correction value is determined from the RDC diagnostics screen. To determine the value, rotate the resolver shaft until the coarse reading is 0000 (hex) and refer to Appendix C.

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TABLE 5-28 SUPPORTED ENCODER TYPES (POSITIION FEEDBACK DEVICES)			
ENCODER TYPE PARAMETER SETTING	VertexRSI Part #	SIDE VIEW	TOP VIEW
Resolver AZ/EL Size 11 (Standard accuracy – 2500 Hz)	DRE003 (EL) DRE005 (AZ)		
Resolver AZ/EL 2-speed (2-speed resolvers)	DRE008		
Resolver AZ/EL High accuracy (400 Hz) (High accuracy – 400 Hz)	DRE009		
Optical AZ/EL ROC-226 SSI Gray	DRE029		
Optical AZ/EL RCN-619 SSI Gray **(Absolute optical encoders)**	DRE227 (18-bit) Model: AI250018X2G2X08 DRE228 (19-bit) Model: AI250019X2G2X08		
Optical AZ/EL RCN-619 SSI Gray (Absolute optical encoders – 19-bit)	DRE010 DRE019		
Optical AZ/EL BEI 20-bit (BEI (20-bit) Optical)	DRE014		
Optical AZ/EL ROC-417 SSI Grey (Absolute optical encoders – 17-bit)	DRE017	Obsolete	Obsolete

*Note: A U.S. Penny is shown as a relative size reference.
BOLD items are standard factory configurations

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The following additional parameters appear under **Position Encoder Configuration...** as **Encoder Type** parameter options. These settings are only used for field repair situations.

- Optical AZ ROC-417 SSI Binary EL ROC-417 SSI Gray
- Optical AZ ROC-417 SSI Gary EL ROC-417 SSI Binary
- Optical AZ/EL ROC-417 SSI Binary
- Optical AZ ROC-226 SSI Gray EL RCN-619 SSI Gray
- Optical AZ RCN-619 SSI Gray EL ROC-226 SSI Gray

There are two ways to set the encoder offsets:

1. Enter the current position of the antenna into the **Current position [deg]** field. At installation time the antenna is normally peaked on a target (satellite or boresight tower) with a known look angle. When the current position is entered, the offsets are automatically computed.

2. Enter the offsets directly by selecting **Offsets [deg]** and entering the desired value. This is normally done only when a firmware upgrade requires re-entry of parameters, or if the nonvolatile memory should fail.

For systems with two-speed resolver option, refer to Appendix C for procedures to calibrate the two-speed resolvers.

5.8.6.5 Motion Limits Menu

There are two types of motion limits:

- Software travel limits ("soft limits"): The ACU will not drive the antenna beyond the soft limits if the option is enabled. The limits function as a "prelimit", stopping motion of the antenna before it reaches the electrical travel limit switches. The soft limits should be set such that when the antenna is moving at its fastest rate and hits the soft limit, it stops just short of tripping the limit switch.

- Motion errors: The motion errors prevent motion of an axis in the event that antenna motion as reported by the position encoders does not correspond with predicted motion due to ACU motor commands.

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Table 5-29 describes the **Motion limits...** parameters.

TABLE 5-29 MOTION LIMITS PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
Soft limits	Enabled	These are normally enabled. If the antenna needs to be moved to its limit switches (from the ACU) for maintenance purposes, the soft limits should be temporarily disabled.
Lower/CCW soft limits [deg]	AZ: 100.00 EL: 15.00 POL: -90.00	This position vector (along with Upper/CW soft limits [deg]) defines the range of motion that the ACU will allow. For each axis, if the antenna is at the lower/CCW limit, it may be moved up/CW to the upper/CW limit.
Upper/CW soft limits [deg]	AZ: 260.00 EL: 90.00 POL: 90.00 4thAxis: 90.00	This position vector (along with Lower/CCW soft limits [deg]) defines the range of motion that the ACU will allow. For each axis, if the antenna is at the lower/CCW limit, it may be moved up/CW to the upper/CW limit.
Motion errors	Enabled	Normally enabled, but may be disabled for testing purposes.
Immobile/reversed timeout [ms]	AZ: 2000 EL: 2000 POL: 2000 4thAxis 2000	Whenever the antenna is put into motion, the downcounter is loaded with this parameter and the current position is recorded. When that downcounter expires, the current position is compared against the previously recorded position. If, for each axis, encoders do not show a value of at least Immobile/reversed tolerance [deg] of motion, an "axis" immobile error is displayed (where "axis" is AZ, EL, or POL). Selecting Clear/correct system faults from the Main menu may clear the error. If the encoders show movement greater than the tolerance on an axis, but in the opposite direction in which the ACU commanded the antenna, an axis reversed error is displayed. If the test is passed for all three axes, the downcounter is reset with the Immobile/reversed timeout [ms] and the process is repeated continuously.
Immobile/reversed tolerance [deg]	AZ: 0.02 EL: 0.02 POL: 0.20 4thAxis: 0.20	If the encoders show movement greater than the tolerance on an axis, but in the opposite direction in which the ACU commanded the antenna, an axis reversed error is displayed. Selecting Clear/correct system faults from the Main menu may clear the error. If the test is passed for all three axes, the downcounter is reset with the Immobile/reversed timeout [ms] and the process is repeated continuously. When the antenna is commanded to stop, the ACU waits for it to come to rest, then records the position. If, any at point in the future, the current position is different from the recorded position more than the value of the Runaway angle on an axis when the ACU is not commanding the antenna to move, an axis runaway error is displayed and all drives are disabled. Selecting Clear/correct system faults from the Main menu... resets the drives and clears the error.
Runaway angle [deg]	AZ: 0.1 EL: 0.1 POL 0.2 4thAxis: 0.2	When the antenna is commanded to stop, the ACU waits for it to come to rest, then records the position. If, at any point in the future, the current position differs from the recorded position by more than the value of this parameter on an axis when the ACU is not commanding the antenna to move, an axis runaway error is displayed and all drives are disabled. Selecting Clear/correct system faults from the Main menu resets the drives and clears the error.

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To edit any of the parameters under this menu, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...** and then select **Motion limits...**.

2. To change **Soft limits** or **Motion errors**, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the up and down arrow keys, toggle through the preprogrammed choices. When the desired choice is highlighted, press the [ENTER] key.

3. To change any of the remaining parameters, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].

4. Press the [PRIOR] key and the following prompt appears:

   Save changes to menu "Motion limits"? (yes/no)

   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

5. To save the changes, toggle the YES/NO key to YES and press [ENTER].

5.8.6.5.1 Soft Limits

Soft limits are normally enabled, but they are disabled during site acceptance testing to allow the antenna to reach the travel limit switches.

The **Lower/CCW soft limits [deg]** and **Upper/CW soft limits [deg]** define the range of motion of the antenna. These limits are normally set such that when the soft limit is reached while traveling at slew speed, the limit switches are not yet engaged.

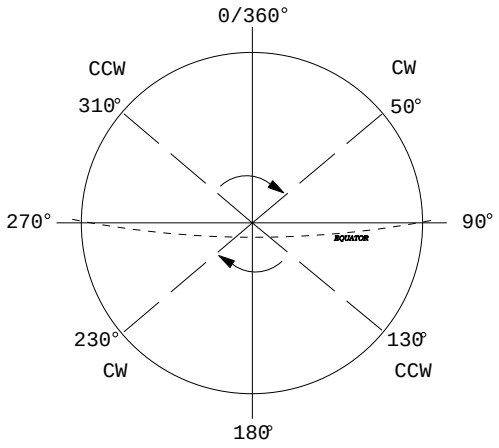


Figure 5-12 Soft Limits

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Motion is allowed, moving up/CW, from the lower/CCW limit to the upper/CCW limit. For the defaults shown in Table 5-29, the antenna may move CW in AZ starting from 130.00 to 230.00 degrees. This is a typical setting in the Northern Hemisphere for an antenna with ±50.00 degrees of motion in AZ from a centerline of due south (180.00 degrees). The corresponding values in the Southern Hemisphere would be a CCW limit of 310.00 degrees and a CW limit of 50.00 degrees (refer to Figure 5-12). This allows movement CW from 310.00 degrees through 0 degrees to 50.00 degrees. If the values were reversed (i.e., CCW = 50.00 degrees and CW = 310.00 degrees), the ACU would recognize that the antenna could not move through 0 degrees and the system would not function properly.

The POL values also illustrate this: the range of motion is from -90.00 degrees (270.00) to 90.00 degrees. Since the negative value is the CCW limit, the feed can move through 0 degrees.

5.8.6.5.2 Motion Errors

The parameter **Motion errors** must be enabled for the three types of motion errors listed in Table 5-30 to be detected.

TABLE 5-30 MOTION ERRORS

ERROR	DESCRIPTION
Immobile Error	ACU is commanded to move, but does not move.
Reversed Error	ACU moves in the direction opposite to the commanded direction.
Runaway Error	ACU moves even though no command for movement was given.

The user must clear all motion errors manually by either executing **Clear/correct system faults** from the **Main menu** or via the M&C interface by issuing the C3 command.

5.8.6.5.3 Immobile and Reversed Errors

Both immobile and reversed errors are governed by the parameters **Immobile/reversed timeout [ms]** and **Immobile/reversed tolerance [deg]** (refer to Table 5-29 for a description of these parameters).

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When the antenna is commanded to move on an axis, the current position is recorded and a timer is set to the value given by **Immobile/reversed timeout [ms]** for that axis. When the timer expires, the new current position is compared against the recorded position. If the antenna does not move in the correct direction at least the distance given by the **Immobile/reversed tolerance [deg]**, an error will occur. If no error is detected, the timer is reset and the process repeats for as long as the antenna is being commanded to move.

If the antenna has not moved the minimum distance, an axis immobile error is reported and displayed. If the antenna has moved a distance equal to or greater than the **Immobile/reversed tolerance [deg]** and in the direction opposite to the direction commanded by the ACU, an axis reversed error is reported and displayed.

The most common cause of an immobile error is that larger, slower antennas do not move fast enough to cover the required distance in 2000 ms (2 seconds). To prevent immobile errors in such systems, the value of the **Immobile/reversed timeout [ms]** should be increased, after verifying that the antenna is moving properly.

The **Immobile/reversed tolerance [deg]** parameter is not normally changed, except on small, mobile antennas, where the antenna may move 0.02 degrees due to wind motion, etc. The value of the parameter may be increased to provide better immobile and reversed protection to the system. Reversed errors rarely occur once proper encoder and motor direction have been established.

5.8.6.5.4 Runaway Errors

An axis runaway error is declared by the ACU whenever the antenna is not being commanded to move, but the encoders report a motion greater than that given by the **Runaway angle** parameter. If this error is detected, the drive enable line to the ACU is opened, which inhibits motion on **all** axes (the 7200 ACU does not have individual axis enable lines for each axis).

Executing **Clear/correct system faults** will clear the error and re-enable the drive cabinet.

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5.8.6.6 Position Loop Parameters

The parameters listed in Table 5-31 control how the antenna is moved to the target position and the precision of the antenna's position.

TABLE 5-31 POSITION LOOP PARAMETERS

PARAMETER	DESCRIPTION
Positioning deadband [deg]	This parameter determines the accuracy of the position loop. The position loop will continue to move the antenna from the current position to the target until the antenna is within the positioning deadband for this axis.
Slew rate	Under normal operation of the ACS, the slew rate (high speed) is enabled; however, for testing, it is sometimes disabled so that the antenna will use only its track speed to reach the target.
Slew -> track transition [deg]	These angles determine whether the antenna moves at slew (high) speed or track (slow) speed to reach the target position. For each axis, if the distance from the current position to the target position is greater than the slew -> track transition angle for that axis, the antenna moves at slew speed. If the distance is less than this value, the antenna moves at track speed. If these angles are set too low, the antenna will overshoot the target, and if they are set too high, the antenna will take longer than necessary to reach the target.
Slew -> stop coast time [ms]	This is the time, in milliseconds, that the ACU waits for the axes to come to a stop after the motors are stopped from slew speed.
Track -> stop coast time [ms]	This is the time, in milliseconds, that the ACU waits for the axes to come to a stop after the motors are stopped from track speed.
Inching on time [ms]	Inching on time is used in the event of target overshoot. The motors are turned on for a period of time equal to the value of this parameter and then turned off for a period of time equal to the value of Track -> stop coast time [ms]. This "inching" is repeated until the antenna comes within the deadband set for the axis. Inching on time [ms] should be set just high enough to get the antenna to move -- oscillation can occur if the value of the parameter is set too high.

To edit any of the parameters under this menu, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...** and then select **Position loop parameters...**.
2. To change Slew rate, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the up and down arrow keys, toggle through the preprogrammed choices. When the desired choice is highlighted, press the [ENTER] key.
3. To change any of the remaining parameters, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].

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4. Press the [PRIOR] key and the following prompt appears:

   Save changes to menu "Position loop parameters"? (yes/no)
   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

5. To save the changes, toggle the YES/NO key to YES and press [ENTER].

5.8.6.7 Built-in Simulator Setup

The ACU has a simulation program that can be used for training purposes or to become familiar with the system before beginning operation of the system. The simulation program can also be used for testing an M&C interface. For normal operational purposes, the **Operation mode** under this menu should be set to **Live**.

To edit the **Operation mode**, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...** and then select **Built-in simulator setup...**.

2. To change **Operation mode** use the arrow keys to move the cursor to the parameter and press [ENTER]. Using the up and down arrow keys, toggle through the preprogrammed choices. When the desired choice is highlighted, press the [ENTER] key.

3. Press the [PRIOR] key and the following prompt appears:

   Save changes to menu "Built-in simulator setup" and reboot the ACU? (yes/no)
   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

5.8.6.7.1 Antenna Simulator Setup

When in **Simulation** mode, the ACU reads a simulated set of inputs and writes output to the simulator. The simulator provides change in resolver feedback based on the outputs, at a rate determined by the parameters listed in Table 5-32. Note that these rates are unrealistically high -- they are set high to verify that the commands are transmitted properly during testing of an M&C interface. The high rates allow the ACU to move to a new target rapidly. For training purposes, VertexRSI advises that the rates be set to more realistic values.

> ***NOTE: The resolver excitation signals are active in Simulation mode (i.e., the resolvers are powered).***

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TABLE 5-32 ANTENNA SIMULATOR PARAMETERS		
PARAMETER	**DEFAULT**	**DESCRIPTION**
Antenna slew rate [deg/s]	AZ = 8.00 EL = 4.00 POL = 0.00	Determines how fast the simulator drives the simulated antenna in slew (high) speed.
Antenna track rate [deg/s]	AZ = 0.20 EL = 0.20 POL = 0.40	Determines how fast the simulator drives the simulated antenna in track (slow) speed.

To edit the parameters under this menu, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...**, **Built-in simulator setup**, and then select **Antenna simulator setup...**.

2. Use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].

5.8.6.7.2 Spacecraft Simulator Setup

Spacecraft simulation setup menu allows the user to set up a simulated spacecraft (satellite). The user can set nominal longitude, orbital inclination, and other simulated characteristics of the desired target. The parameters under this menu are listed in Table 5-33.

TABLE 5-33 SPACECRAFT SIMULATOR PARAMETERS	
PARAMETER	**DESCRIPTION**
Box center date	Gives the date on which the simulated spacecraft is at its box center.
Box center time	Gives the time at which the simulated spacecraft is at its box center.
Box center longitude [deg. E]	Box center longitude, in degrees east, of the simulated spacecraft.
Inclination [deg]	Inclination of the simulated spacecraft.
Receive -3 dB beamwidth [deg]	Receive -3 dB beamwidth used to simulate a signal for the simulated spacecraft. This value should be set to represent a specific antenna size.
Signal noise [dB]	Represents the magnitude of simulated signal noise to be injected into the simulated signal.

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To edit the parameters under this menu, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...**, **Built-in simulator setup**, and then select **Spacecraft simulator setup...**.

2. Use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. To change the month portion of the **Box center date**, use the arrow keys to toggle through the preprogrammed choices. When the desired choice is highlighted, press [ENTER].

3. To change any of the remaining parameters, select the parameter, and using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].

5.8.6.8 Set UTC Date and Time

> ***NOTE: The system clock MUST be set to UTC (Coordinated Universal Time – the international time standard). The date and time must be correct for OPT, Intelsat 11-element set tracking, and the Target Scheduler to perform properly. See Table 5-38 for complete date and time formatting information.***

This function contains the following parameters and menu:

- **Date**
- **Time**
- **Await mark...**

The date and time are set on the ACU by using the following procedures.

1. From the **Main menu...**, select **Edit system configuration...** and **Set UTC date and time**.

2. Select **Date** and enter the correct day of the year. Press [ENTER] and the month is highlighted.

3. Using the up and down arrow keys, select the correct month. Press [ENTER] and the year is highlighted.

4. Enter a year within the range specified in the prompt and press [ENTER].

5. Set the time in the same manner as the date and press [ENTER].

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6. To enter the date and time into the system, select **Await mark...** and the following message appears:

   System UTC date and time will be set to hh:mm:ss dd Mmmm yyyy (the date and time entered above will be displayed) **when [ENTER] is hit. Press [PRIOR] to cancel.**

7. Press [ENTER] to enter the date and time into the system.

5.8.6.9 Site Data

The parameters in the **Site data...** menu provide the following information to the ACU:

- The antenna's name, which is displayed, along with the current position, on the ACU front panel
- The position of the antenna: latitude, longitude, and altitude
- The difference between the local time and UTC (**Timezone offset**)
- Local timezone (displayed for the user's convenience only -- it is not used by the ACU for any functions)

> ***NOTE: The E. Longitude of site [deg] and N. Latitude of site [deg] position inputs must be in decimal degrees.***

To convert **E. Longitude of site [deg]** and **N. Latitude of site [deg]** to decimal degrees, use the following formula:

Decimal Degrees = Whole Degrees + [(Minutes * 60) + seconds]/3600

For example, to convert 67 degrees, 38 minutes, 15 seconds to decimal degrees using the formula above, the equation would be:

67 + {[(38 * 60) + 15]/3600} = 67.6375 degrees

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Table 5-34 describes each of the parameters of the **Site data...** menu.

TABLE 5-34 SITE DATA PARAMETERS	
PARAMETER	**DESCRIPTION**
Antenna name	This is the name displayed in the Current pos field of the 7200 ACU display. The antenna name may be up to 12 characters in length and may be changed by the user. In a rack with multiple ACU's, antenna names are commonly used to distinguish between systems. Also, the M&C link can read the antenna name and determine to which ACU it is connected.
E. Longitude of site [deg]	Site longitude in decimal degrees East. West longitudes may be entered by including a "-" sign before the longitude value.
N. Latitude of site [deg]	Site latitude in decimal degrees North. Southern latitudes may be entered by including a "-" sign before the latitude value.
Site altitude [meters]	Altitude of the antenna, in meters, above the mean sea level.
Timezone offset	Time difference between local site time and UTC. A "+" sign in front of the local time indicates that the local time is ahead of UTC; a "-" sign indicates that local time is behind UTC. Eastern Standard Time is the default.
Timezone abbreviation	Abbreviation used to indicate local time zone.

To change the antenna name, use the following procedures:

1. From the **Main menu...**, select **Edit system configuration...**, **Site data...**, and **Antenna name**.

2. Using the arrow keys (up and down arrow keys toggle through the ASCII character set; left and right arrow keys move cursor left and right), change the antenna name as desired.

3. Press [ENTER] to enter the new antenna name into the system.

To change the **Timezone offset**, use the following procedures:

1. From the **Main menu...**, select **Edit system configuration...**, **Site data...**, and **Timezone offset**.

2. Use the up and down arrow keys to toggle between + and -, select the appropriate sign, enter the numeric value of the offset, and press [ENTER].

With the exception of **Timezone abbreviation**, the other parameters are all numeric entries and may be changed by selecting the parameter and entering a value within the range specified by the system prompt. To change the **Timezone abbreviation**, use the arrow keys to toggle through the ASCII character set as described above in the procedures for changing the **Antenna name**.

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5.8.6.10 RF/Geometry...

The **RF/Geometry...** enables/disables POL control and contains the parameters described in Table 5-35. If POL is controlled by the ACU, set this parameter to enabled. If this parameter is disabled (for 2-axis systems), POL will not appear on the real-time display or in any menus.

TABLE 5-35 RF/GEOMETRY PARAMETERS

PARAMETER	DESCRIPTION
Polarization axis	Set this to Enabled if the POL axis is controlled by the ACU.
Antenna droop correction	Set this to Enabled if the POL axis is controlled by the ACU.
Amplitude droop corr. [deg]	The amplitude of the droop correction is used to adjust the EL look angle for mechanical droop. This value is determined from structural analysis of the dish.
Elevation alignment [deg]	The EL alignment angle is the EL angle at which the dish was balanced and focused. This value is used in the droop correction.
XEL correction	This parameter enables software correction of xel error. That is the elevation axis is moving orthogonal to azimuth but the RF beam is tilted creating a xel error. If DISABLED the correction is not used. This correction can be used independent of Droop correction.

To edit any of the parameters under this menu, use the following procedures.

1. From the **Main menu**, select **Edit system configuration...** and then select **RF/geometry...**.

2. To change **Polarization axis** or **Antenna droop correction**, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the up and down arrow keys, toggle through the preprogrammed choices. When the desired choice is highlighted, press the [ENTER] key.

3. To change any of the remaining parameters, use the arrow keys to move the cursor to the parameter to be edited and press [ENTER]. Using the numeric keys, enter a value within the range specified in the system prompt and press [ENTER].

4. Press the [PRIOR] key and the following prompt appears:

   Save changes to menu "RF/geometry"? (yes/no)

   [YES/NO] changes YES/NO response. [ENTER] accepts displayed YES/NO response.

5. To save the changes, toggle the YES/NO key to YES and press [ENTER].

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5.8.6.11 Network Configuration

This menu is used to set the communications and protocol parameters for the network ports on the unit.

5.8.6.11.1 Test configuration Parameter

This command tests the network configuration for validity. This test is run automatically in the visual shell when this menu is exited. Run from the M&C shell, it returns a hexadecimal code. If 00, all parameters passed; otherwise, the code consists of one or more of the following bits (see examples below):

BIT HEX BINARY DESCRIPTION
- 0 01 00001 IP address is 0.0.0.0 (LAN disabled)
- 1 02 00010 Gateway address is 0.0.0.0 (WAN disabled)
- 2 04 00100 Subnet mask failure
- 3 08 01000 Subnet/IP address failure
- 4 10 10000 IP/Gateway address failure

Examples of M&C return codes:
- 03 Neither local nor Wide Area Network is configured.
- 0A WAN is disabled. Either the subnet mask or the IP address is invalid.
- 10 The gateway address is invalid or incompatible with the IP address.

5.8.6.11.2 IP Address

The IP address is a 32-bit number that uniquely identifies each computer on an Internet Protocol (IP) network. It is commonly presented as a four-part string consisting of four period-separated numbers called octets. The first octet may be an integer in the range 0 through 223, but not 127. The remaining three octets may be set with values in the range 0 to 255.

NOTE: IP address change will not take effect until the ACU is rebooted.

Every device on an Internet-style network must be identified by a unique IP address. An improperly selected IP address can disrupt operation of the ACU network interface and may also seriously affect the operation of other devices on the network.

Consult a network administrator before attaching the ACU to an existing network.

The network port cannot be expected to work with other network clients if the IP address setting does not comply with the network design. An appropriate IP address cannot be chosen without knowing how client devices are configured.

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The IP address specified must be supplied to M&C clients that will interface with this ACU by way of the network.

When the IP Address is configured, the subnet mask must also be configured.

In general, neither the network portion nor the host portions of the IP address (defined by the subnet mask) are allowed to be made up entirely of one or zero bits. For example, with a subnet mask of 255.255.255.0, IP addresses 0.0.0.*, *.*.*.0, and *.*.*.255 are disallowed.

An IP address setting of 0.0.0.0 disables the network interface on the ACU. This is the recommended setting if the network port will not be used.

Examples:	Invalid settings:
192.168.0.1	127.0.0.1
10.0.0.254	254.0.1.10

5.8.6.11.3 Subnet Mask

A subnet mask is a 32-bit binary mask that is used in conjunction with the IP address to determine whether the ACU may send network data directly to another device or whether the data must be routed through a gateway device. It is commonly expressed as a four-part string consisting of four period-separated numbers (octets) that range from 0 to 255.

NOTE: Subnet mask change will not take effect until the ACU is rebooted.

The subnet mask setting must comply with the design of the network to which this ACU is attached. If it does not, the network port cannot be expected to function. Always consult the network administrator before attaching this ACU to an existing network. An appropriate subnet mask cannot be adequately specified without knowledge of the network design.

In general, the subnet mask should be equivalent to the subnet mask that is configured on M&C clients that use the network to communicate with this ACU. If a network is designed according to normal addressing conventions, it may be possible to pick a subnet mask based on the IP address:

For IP addresses in the form:

a.b.c.d	Subnet mask	Network Class
$0 \geq a \leq 127$	255.0.0.0	A
$128 \geq a \leq 191$	255.255.0.0	B
$192 \geq a \geq 192$	255.255.255.0	C

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If the ACU is to communicate with any device that is not on the same subnet, the gateway address parameter must be set to the IP address of a router.

Consider a setup where IP address=192.168.0.1 & Subnet mask=255.255.255.0

This means that the ACU is a member of the 192.168.0.0 network and that the network infrastructure allows the ACU to communicate directly with any client that has an IP address in the range 192.168.0.1 through 192.168.0.254.

Examples:	Invalid settings:
255.255.255.0	255.255.255.255
255.0.0.0	0.0.0.0 (unless IP address is also 0.0.0.0)

5.8.6.11.4 Gateway Address

The Gateway address is the IP address of a router on the local IP network. It is commonly presented as a string consisting of four period-separated numbers called octets. The first octet may be an integer in the range 0 through 223 and the remaining three octets may be set with values in the range 0 to 254.

SECURITY NOTE: Leave this parameter set to 0.0.0.0 unless the ACU needs to be accessed by M&C clients that are not on the local network.

NOTE: Gateway address change will not take effect until the ACU is rebooted.

Consult the network administrator in order to obtain the router address. The network port cannot be expected to interface with non-local network clients when the Gateway address setting does not point to a valid router.

A Gateway address setting of 0.0.0.0 prevents the ACU from being accessed by non-local network-attached devices. This is the recommended setting when the network port will not be used, and when non-local access is to be prevented.

The Subnet mask determines which IP addresses are local or non-local. An IP address is local if equivalent results are obtained when the mask is applied to the IP address of the ACU and to the M&C client IP address. The IP address is non-local if the results are not identical.

Example: With the IP address set to 192.168.0.1, and with the subnet mask set to 255.255.255.0, all IP addresses in the range 192.168.0.1 through 192.168.0.254 are local. All others are non-local.

The Gateway address must conform to all rules that apply to IP addresses.

Examples: 192.168.0.254
10.0.0.1

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5.8.6.11.5 TCP Port

TCP port numbers are used to allow clients to attach to specific services that are offered by a host with a given IP address. Conceptually, this allows the host to offer a variety of different services over a single network connection. The TCP port number is an integer that ranges from 0 to 65535.

NOTE: TCP port change will not go into effect until the ACU is rebooted. Both the IP address and the TCP port number are required in order for any network connection to be established.

The default TCP port setting of 23 was chosen to facilitate connections made with telnet clients. These clients also default to the use of TCP port 23. A telnet client can also be used to communicate with TCP ports other than port 23. An example command to contact an ACU with an IP address of 10.0.0.1 and
a TCP port of 1024 is:

telnet 10.0.0.1 1024

It is important to note that a TCP port number should be chosen that can be supported by the client application. Some telnet clients have been observed to not communicate with the ACU when port numbers 0, 1, or 65535 have been specified. If an alternate TCP port number is selected, be sure to test it.

5.8.6.11.6 Shell

This menu specifies the user interface, or "shell", for this port. See the Remote Port Configuration in Section 5.8.6.12 for descriptions of the shells.

5.8.6.11.7 Echo

This option is only visible when one of the M&C shells is active. If Enabled, the ACU echoes back all characters typed in. This is the usual setting if typing data directly into the port using a terminal. If Disabled, the ACU does not echo characters. This is the usual setting for a computer interface.

5.8.6.11.8 Newline

This option is only visible when one of the M&C shells is active. This controls how the ACU terminates its output lines. If set to CR, the line is terminated only with a carriage return. If set to CRLF, the line is terminated with carriage return line feed. Note that this only controls the ACU's output. The input line is expected to be terminated with CR only--LFs are not tolerated in the input.

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5.8.6.11.9 Checksums

This option is only visible when the Request/Command M&C shell is active. If enabled, then the beginning of each line to and from the ACU has a 2-character checksum which is the one's complement of the sum, modulo 256, of the characters on the line. This does not include the first space after the checksum, nor does it include the carriage return at the end of the line.

5.8.6.11.10 Screen lines

This option is only visible when the Menu Tree M&C shell is active. It limits the number of lines output when HELP is requested across the MT M&C. The user will then be prompted for MORE help. If set to 0 (zero), the MORE function is disabled.

5.8.6.12 Remote Port Configuration

The parameters in the **Remote port configuration...** menu control remote communications with the 7200 ACU via its serial port(s). The standard ACU has seven ports: two EIA/TIA-232E ports; (J4 and J15) and five EIA/TIA-422B ports (J16-J20).

The 7200 ACU supports several distinct "shells", or command interfaces:

- Disabled – This means the port is unused. If a port is set to Disabled, it will not respond to any input, nor will it generate any output.
- RC M&C - The Request/Command M&C is a command-line monitor and control interface to the ACU, typically used for computer control applications.
- MT M&C - The Menu Tree M&C is a command line monitor and control interface to the ACU, typically used for remote control applications. The MT M&C is more operator friendly than the RC M&C.
- Visual - This is the menu-driven user interface as shown on the front panel of the ACU. This is only functional with an optional 7200 Remote Control Unit.
- DTR – Interfaces to a Digital Tracking Receiver.
- TRL – Interfaces to a TRL Tracking Receiver.
- 253_REC – The serial interface allows the ACU to control frequency and bandwidth of the Model 253 Receiver.

NOTE: Only one port may be set to any of the following at any given time: TRL, DTR, or 253_REC. The editor will not allow a tracking receiver to be selected if another port is already using one.

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- PMCU - This is for the 7150 PMCU (optional) display. It is used on the EIA/TIA-422B Interface. Its use is not supported with any other device.

- ACU2ACU – This is an optional shell used to connect a VertexRSI 7200 ACU to another VertexRSI 7200 ACU to have Targets stay in sync.

- Printer - This is used to connect a serial printer for system logging purposes.

The seven ports are factory set to the parameters shown in Table 5-36.

TABLE 5-36 LOGICAL PORT TO PHYSICAL PORT CONVERSION TABLE

LOGICAL PORT	INTERFACE	PHYSICAL PORT
Port 0	RS-232	Front Display
Port 1	RS-232	J14
Port 2	RS-232	J15
Port 3	RS-422	J16
Port 4	RS-422	J17
Port 5	RS-422	J18
Port 6	RS-422	J19
Port 7	RS-422	J20

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Table 5-37 describes each of the **Remote port configuration...** parameters.

TABLE 5-37 REMOTE PORT CONFIGURATION PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
Port	1	Selects the port for which the configuration is being edited. The allowable values are 1 to the number of remote ports available. Port 0 is the console and may not be edited. Each port has its own remote port configuration. Changing the port number changes all other fields in this menu to reflect the settings for the selected port.
Bps (baud)	19200	This sets the data rate in bits per second for the specified port. Options are: 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200.
Parity	None	This sets the parity for the specified port. Options are: None, Even, or Odd.
Data bits	8	This sets the number of data bits for the specified port. Options are 7 or 8.
Stop bits	1	This sets the number of stop bits for the specified port. Options are 1 or 2.
Shell See Section 5.8.2.3.2, Tracking Receiver Parameters, to see how the shell selection affects which parameters will display.	Disabled	This specifies the user interface for the specified port. If a port is not being used, this parameter should be set to disabled**. Options are: • M&C - command line interface • Visual - menu-driven user interface used by the console; requires a 7200 Remote Control Unit • Disabled - port is unused • DTR – For interfacing with a Digital Tracking Receiver. • TRL - For interfacing with a TRL Tracking Receiver. • 253_REC – The serial interface allows the ACU to control frequency and bandwidth of the Model 253 Receiver. ***[NOTE: Use Even or Odd Parity. DO NOT use Parity = None]*** • PMCU - Uses the EIA/TIA-422B port for connection to the 7150 PMCU (Optional) Display • Printer - optional setting; used for printing system messages. • ACU2ACU – (Optional) For the optional ACU to ACU Synchronization. **MT M&C for port 1 and 2.
Echo*	Disabled	This sets the echo mode for the specified port. If Enabled, the ACU echoes all input.
Newline*	CR	This affects how the ACU terminates lines sent from the ACU to the remote computer. Input to the ACU is expected to be terminated by CR only. Options are: CR (carriage return) or CRLF (carriage return/line feed).
Checksums*	Disabled	If enabled, beginning of each line to and from the ACU has a two-character checksum that is the one's complement of the sum, module 256, of the characters on the line (this does not include first space after the checksum; nor does it include the CR at the end of the line).
Screen lines*	Disabled	This option is only visible when the Menu Tree M&C shell is active. It limits the number of lines output when HELP is requested across the MT M&C. The user will then be prompted for MORE help. If set to 0 (zero), the MORE function is disabled.
Handshake	None	This option affects all shells. Select handshaking mode: XON/XOFF, RTS/CTS, or None. WARNING: be sure that the device supports the handshaking mode selected. VCSD products such as PMCUs, TRL receivers, and 7200/7210 Remote Control Panels use XON/XOFF exclusively.

Note: Only available if Shell is set to RC M&C or MT M&C.

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The following parameters may be changed by selecting the parameter, and using the up and down arrow keys to toggle between preprogrammed choices:

- **bps (baud)**
- **Parity**
- **Shell**
- **Echo**
- **Checksums**
- **Newline**
- **Handshake**

To change the other parameters, **Port**, **Data bits**, **Stop bits**, and **Screen lines** select a parameter and enter the desired value within the range specified in the system prompt.

5.8.6.13 ACU Sync Configuration (OPTIONAL)

The **ACU Sync Configuration** menu contains parameters to control the synchronization behavior of a system with redundant ACUs. In redundant ACU systems it is advantageous for each ACU to have access to the tracking tables the other ACU has built. When the ACUs sync, all target data and OPT pointing data is exchanged. No system configuration parameters are passed since each ACU may have unique data.

To sync, each ACU must select the "ACU2ACU" shell parameter and must be connected serially via a null modem cable.

The following parameters control the synchronization behavior:

Unit Number – This parameter is used to indicate which unit this ACU is. The same number can't be used on both ACUs. The #1 ACU is using straight logic, while the #2 ACU is using reverse logic on the online/offline bits.

ACU Auto Synchronization – This parameter is used to indicate if the ACU to ACU link auto-synchronizes the offline unit. It can be set to Enabled or Disabled.

Resync Interval – This parameter controls the interval at which the ACUs sync and can be set from 1 to 1440 minutes (1 day).

Indicate Synchronization – When Enabled, the status of synchronization in progress will be shown.

Force Immediate ACU Synchronization – This is used to force a synchronization of the offline ACU with the online ACU rather than waiting for the next scheduled sync. **NOTE**: This command must be initiated from the online unit.

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5.8.6.14 User Interface Options Menu

The user can configure the ACU's display, enable or disable audible alarms, and control some system security features by setting the user interface options described in Table 5-38.

TABLE 5-38 USER INTERFACE OPTIONS SETTINGS

OPTION	DEFAULT	DESCRIPTION
UTC display	Enabled	Setting this to "Enabled" puts the system's UTC time on the upper left-hand corner of the display. Setting it to "Disabled" suppresses this display.
Local time display	Enabled	Setting this to "Enabled" puts the ACU's local time on the upper left-hand corner of the display, just below the UTC time. If UTC display is Disabled, then the local time will go in the upper left-hand corner of the display.
UTC date format	dd Mmm	The UTC and local dates may be displayed either as "dd Mmm" (day and month) or "DOY" (day of year). dd Mmm example: 19 Jul 1992 DOY example: Day 199 1992
Local date format	dd Mmm	This controls how the local date is displayed. Options are the same as UTC date format.
Tracking signal display	Enabled	Normally left "Enabled". When Enabled, the current A/D channel, beacon, and signal level is displayed. Setting it to "Disabled" suppresses the signal display.
Signal units	dB	The tracking signal level can either be displayed in volts (V) or dB. The signal is normally displayed in dB; displaying in V is sometimes useful when troubleshooting the tracking signal, although the same information (and more) is displayed under the **Display system status**, **A/D states** menu. If a DTR tracking receiver is in use, this setting will be ignored, as the DTR provides signal directly in dB.
User level display	Enabled	If using the ACU with multiple control ports, or using the security functions, this should be "Enabled". When enabled, the center of the top line of the display shows which port is in control of the system, and which user level it's at. if nobody's in control (all ports at monitor level), then it will show "Console -- monitor". If not using security, and there is no remote control capability at the site, disable this.
Confirm tracking	Enabled	If this field is set to "Enabled", then the ACU will ask for confirmation whenever the tracking mode or current target is changed. This includes starting to track when in standby, or returning to standby. The ACU will display the position to which it is about to drive the antenna when the user selects a new target to track. If this field is "Disabled", the ACU proceeds without confirmation. VertexRSI recommends leaving this option Enabled.
Confirm edits	Enabled	If this field is set to "Enabled", then the ACU will ask for confirmation whenever the user leaves an edit menu after making changes to any of the data. If the user selects "NO", the changes are undone. If this field is "Disabled", the ACU saves changes without confirmation when the menu is exited. VertexRSI recommends this stay enabled, because if disabled, the ability to undo mistakes without editing is lost. If [PRIOR] is pressed while editing, all changes are lost -- this is true of all editing menus, regardless of the setting of this parameter.
Warning bell	Disabled	If this field is set to "Enabled", then the ACU will sound the bell whenever confirmation for an action is needed, such as "Keep these changes?" or "Begin tracking?". The bell is also sounded for minor errors, such as hitting [PRIOR] when in the main menu (where there is no place to [PRIOR] to).

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TABLE 5-38 USER INTERFACE OPTIONS SETTINGS		
OPTION	**DEFAULT**	**DESCRIPTION**
Audible alarm	Disabled	The audible alarm is a tone (different from the warning bell tone) which is continuously sounded whenever the ACU has a fault condition that has not been acknowledged. Normally, this is left on, as it will alert an operator that a fault condition is in effect, even if the operator cannot see the display. This is often turned Off during installation until all connections are in place. It may also be turned Off if the SUM ALM contact is wired to a station alarm which provides an alternative audible/visual alarm source. The SUM ALM will be open if and only if the audible alarm would be sounding if turned On; if an alternative alarm source is available, the audible alarm is redundant.
Monitor can [STOP]/ [RESUME]	Enabled	A control port in monitor mode cannot command the antenna. However, it may be desirable for safety purposes to allow the monitor to [STOP] (keyboard stop) the antenna. If this is enabled, then any control port can stop tracking by hitting the [STOP] key (or sending the M&C command to do this). The monitor port can also resume tracking using [RESUME] (or via M&C). This setting does not affect the DRIVE ENABLE button on the ACU front panel, which bypasses the CPU and is not under software control.
Monitor can clear defaults	Enabled	If this is Enabled, then a port at monitor user level can execute "Clear/correct system faults". If Disabled, ports must be at operator level to execute this command. The user also cannot successfully execute the RC M&C C3 command.
YES/NO default answer	Enabled	Whenever the user is asked a yes/no question which will change the condition of the ACU, this will be the default answer; i.e.: the answer given by simply pressing [ENTER]. Most people prefer to set this to YES. If set to NO, then each time the parameter is changed, tracking is stopped or started, etc.; the user will need to hit the [YES/NO] key to change the "NO" to "YES" on the display before hitting [ENTER]. Some critical commands, such as resetting an OPT target or resetting the system to ROM defaults, have a default answer of NO regardless of the setting of this parameter.
Always show target position	Disabled	When "Disabled," the target (command) position is shown on the line underneath the current antenna position only when repositioning the antenna to a new target. Once the target is acquired, the target position is removed from the display. At this point, it doesn't convey any useful information in normal operation; also, the user can quickly glance at the ACU display and tell if it is on target. If the target position is no longer displayed, the ACU is on target. Turning this ON causes the ACU to always show the target position when tracking a target. This includes all Immediate tracking... modes. Regardless of this setting, the target position is never shown in Standby or Manual antenna control, as it is meaningless in these modes. It is, however, shown when manually biasing a target (see Section 5.8.2.3.1).
Command angle display	Position	When set to "Position", the command position is displayed beneath the current position. When set to "Error", the command error (actual position - command position) is displayed instead. Display of these angles is also governed by the "Always show target position" parameter; see its help for more information.
Auto-advance when editing	Enabled	When editing data, the cursor will automatically advance to the next parameter when [ENTER] is pressed to complete editing a parameter. This makes it more convenient when entering multiple parameters. If the current item isn't editable, then this has no effect. If Disabled, then the cursor remains on the current menu item, and the user must use the arrow keys to advance to the next item.
Alarm on standby	Disabled	If enabled, an alarm condition is triggered when the ACU goes to standby. When the ACU leaves standby mode, the standby alarm condition is reset.

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The parameters under this menu may be changed by selecting the desired parameter, and using the up and down arrow keys, toggling through the preprogrammed choices. When the desired setting is highlighted, press the [ENTER] key.

To save the changes, press [PRIOR] and answer yes when prompted to save the changes.

5.8.6.15 Tracking Restoration Options Menu

This menu controls how the ACU restores tracking after an interruption such as power loss or a fault (e.g., emergency stop). By default, the ACU attempts to return to tracking the last target it was tracking as soon as the fault condition(s) clears. Some users may wish to inhibit this restoration action under certain fault conditions and can accomplish this by changing the parameters in this menu. Table 5-39 lists the parameters, their defaults, and a description of each of the parameters under this menu.

TABLE 5-39 TRACKING RESTORATION OPTIONS PARAMETERS

PARAMETER	DEFAULT	DESCRIPTION
Standby after boot	Disabled	If this parameter is Disabled, when the ACU is powered up, it attempts to resume tracking the target it was tracking when power was lost. If the system was in Standby or manual, the ACU powers up in Standby mode, and if the Target scheduler was running, it will be restarted. If this parameter is Enabled, the ACU will return to Standby when powered up and automatic tracking will not resume.
Standby on emergency stop	Disabled	Regardless of the setting of this parameter, the ACU cannot command the antenna unless all emergency stops are disengaged. If this parameter is Disabled, when emergency stops are cleared, the ACU resumes tracking the target. If this is Enabled, the ACU returns to Standby mode immediately upon detection of an emergency stop.
Standby on motor controller fault	Disabled	If this parameter is Disabled, the ACU waits for the motor controller fault to clear and then resumes tracking the target. If this parameter is set to YES, the ACU returns to Standby immediately upon detection of the fault. **NOTE:** Clear/correct system faults resets the drive cabinet if a motor controller fault exists, which normally clears the fault. If one motor controller fails and the other continues to operate, the ACU continues tracking on the axis that is still operable.
Standby on maintenance override	Disabled	The setting of this parameter determines what the ACU does when the user flips the CONTROL switch at the drive cabinet from REMOTE to MAINT to allow local control of the antenna at the drive cabinet. If this parameter is Disabled, the ACU waits for the drive cabinet to be switched from MAINT. to REMOTE, and then resumes tracking the target. If Enabled, the ACU returns to Standby immediately upon detection of the CONTROL switch being returned to the MAINT position. **NOTE:** Regardless of the setting of this parameter, the ACU cannot command the antenna unless the switch is in the REMOTE position.
Standby on drive cabinet power loss	Disabled	If Disabled, when power is lost to the drive cabinet, the ACU waits for power to be restored and then resumes tracking. If Enabled, the ACU returns to Standby immediately upon detection of loss of power.

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Tracking initiation delay [ms]	0	This parameter controls the delay between a tracking mode or target change. Whenever the tracking mode is changed (except for returning to Standby), or a new target is selected, the ACU waits for the amount of time of this parameter before initiating tracking. Also, output 1 on ACU terminal TB1 is closed and remains closed while tracking. This may be used to drive a warning beacon, horn, etc. In addition, when changing between targets or to or from manual mode, there is an additional one second delay. This delay is used to open output 1 on terminal TB1 and then close it again, which may be used to reset a horn with a fixed alarm time, so that it will sound again. Setting this parameter to a value other than 0 disables the delay and output 1 is not driven.

The parameters under this menu may be changed by selecting the desired parameter, and using the up and down arrow keys, toggling through the preprogrammed choices. When the desired setting is highlighted, press the [ENTER] key.

To save the changes, press [PRIOR] and answer yes when prompted to save the changes.

5.8.6.16 Factory Tests

The **Factory tests...** menu contains tests that are used at the factory during system testing. These tests are available to the user because some of these tests may be useful in the field during troubleshooting.

5.8.6.16.1 Video Tests

These tests are used to examine the display for malfunctioning pixels, data lines, etc.

The ACU must be in Standby, and the port performing the test must be at Operator or Supervisor level. During the test, the [STOP]/[RESUME] keys are still operational. To execute the **Video test**, use the following procedures.

1. From the **Main menu...**, select **Edit system configuration...**, **Factory tests...**, and **Video test**.

2. If the ACU is not in Standby mode, a message will appear alerting the operator to this fact and when the [ENTER] key is pressed, the ACU will return to the menu.

If the ACU is in Standby mode, a warning message will appear to alert the user that the display will be blanked for the test.

3. To begin the test, answer yes to the prompt and press [ENTER]. Note that the [PRIOR] key may be pressed at any time to terminate the test.

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4. Pressing the [ENTER] key will step through the test, with the following conditions occurring in the order listed:

- All pixels on
- All pixels off (display blank)
- Odd-numbered horizontal lines illuminated
- Even-numbered horizontal lines illuminated
- Odd-numbered vertical lines illuminated
- Even-numbered vertical lines illuminated

5. After the last test sequence is run, press the [ENTER] key and the following prompt will appear:

   Press [PRIOR] to end the test.
   Press [ENTER] to rerun the test.

6. Press [PRIOR] to restart the real-time display and return to the **Factory tests...** menu.

5.8.6.16.2 Keyboard Test

The **Keyboard test** is used to verify that the keypad and controller board are operating properly. This may be used either on the ACU front panel or on an optional 7200 Remote Control Unit.

The ACU must be in Standby, and the port that is to be tested (including the ACU front panel) must be at Operator or Supervisor level. During this test, all keys (e.g., [STOP], [RESUME], and [MAIN]) are disabled.

To execute the **Keyboard test**, use the following procedures.

1. From the **Main menu...**, select **Edit system configuration...**, **Factory tests...**, and **Keyboard test**.

2. A prompt appears advising the user that the [STOP], [RESUME], and [MAIN] keys are disabled during the test. Answer yes to proceed with the test. Press [ENTER].

3. A representation of the 7200 ACU keypad is drawn in the lower section of the display. Press any key and notice that the label of the key's representation on the display is shown in reverse video; releasing the key causes the key's label on the display to return to normal video. If more than two keys are pressed simultaneously, **FAULT** appears in reverse video on the display. All keys must be released to clear the fault and allow continuation of the test.

4. To end the test, press the [PRIOR] key twice.

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5.8.6.16.3 Reset ACU to ROM Defaults

Executing the **Reset ACU to ROM defaults** function is the final step in 7200 ACU production, after testing but before packaging.

> ***WARNING***
>
> ***Executing this function resets all parameters to their ROM defaults, erases all targets, and clears all stored steptrack data. The 7200 ACU will be unusable after executing this function until it has been reconfigured. It should not be necessary to execute this function in the field, and should only be used upon the advice of a VertexRSI Control & Structures Division engineer.***

5.8.6.16.4 I/O Loopback Tests

The **I/O loopback tests** function is used to verify operation of the I/O board during factory tests. The tests require the use of the 7200 Test Bed Unit (TBU), which is only available at the factory; therefore this test cannot be performed outside of the factory. The tests are left accessible in the ACU in order to test the I/O card along with the CPU and its firmware in place.

5.8.6.16.5 Force Faults Clear

The normal method used to clear faults is to execute **Clear/correct system faults** from the **Main menu**. **Force faults clear** forces all faults to clear if executing **Clear/correct system faults** fails to clear all faults (this may occur during a firmware upgrade).

5.8.6.16.6 Clear Message Buffer

This function clears all messages out of the message buffer. It only needs to be used when the message log is invalid due to NVRAM corruption or initial factory conditions.

5.8.6.17 Message Printer Options

An optional message printer may be attached to the system. When the printer is enabled (by setting the **Shell** parameter under the **Remote port configuration...** menu to **Printer**), messages are printed out as the status of the system changes. The parameters under **Message printer option...** allow the user to selectively include or exclude certain types of messages. The parameters are described in Table 5-40.

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TABLE 5-40 MESSAGE PRINTER OPTIONS PARAMETERS	
PARAMETER	**DESCRIPTION**
Target change/standby	When Enabled, a message is printed on the message printer whenever the ACU begins tracking a new target or when the ACU is placed in Standby. The target name is printed, along with the target number [the position of the target in the Track a target menu (target 1 is the first target in the first column, target 6 is the first target in the second column)].
Faults	When Enabled, faults are printed on the message printer as they occur, and fault acknowledgments are also printed.
New steptrack peak	When Enabled, a message is printed whenever Steptrack completes a peaking cycle. The message includes the target name, target number, date, time, and the antenna's current look angles.
New OPT solution	When Enabled, a message is printed whenever OPT completes generating a new solution. The message includes the target name, target number, and type of solution that has become available.
Parameter changes	When Enabled, a message is printed whenever changes are made (and saved) to any system parameters or target configuration.
User level change	When Enabled, a message is printed whenever the user level is changed on any port in the system.
System clock set	When Enabled, a message is printed when the user changes the system date and/or time.
Tracking signal modified	When Enabled, a message is printed when tracking signal parameters (frequency or polarization) are changed. Note that this message is NOT printed when the signal source is changed by tracking a new target, even if it changes the signal source.
Target scheduler status	When Enabled, whenever the Target scheduler changes to a new target, the time and date for the next target are printed. A message is also printed if the schedule is exhausted (empty) or an invalid entry is discovered in the schedule.
Initialization messages	When Enabled, messages are printed as each phase of initialization is completed. This parameter is usually only enabled for debugging purposes.
Tag with current position	When Enabled, the current position is printed along with the timestamp on the message. This is useful for troubleshooting position-dependent faults.
Execution trace	Usually only enabled for debugging. When enabled, a message is printed when: - a menu item is executed, - a menu is exited via [PRIOR], - [MAIN] is pressed. Messages are also printed for M&C items and menus, which usually results in a large number of uninformative messages.

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6.0 MAINTENANCE

This section presents information on maintaining the 7200 ACS to ensure optimum system performance.

6.1 Air Filter

The air filter on the back of the 7200 ACU (refer to Figure 6-1) should be cleaned at least every six months. If the ACU is in an environment that is exposed to a large amount of dust and dirt frequently, the filter should be checked for excessive dust accumulation at least once a month.

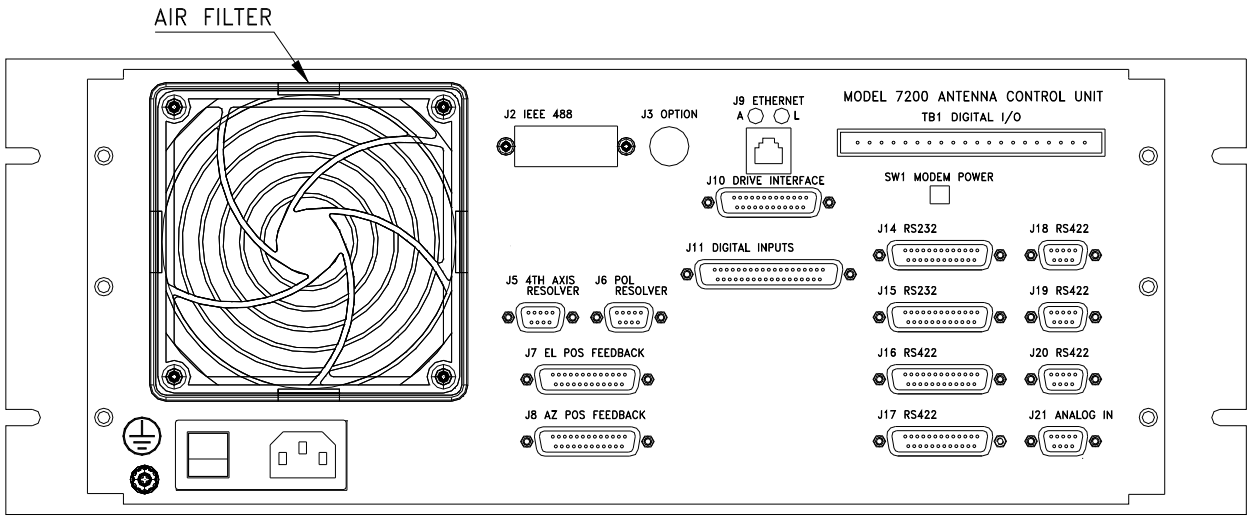


Figure 6-1 7200 ACU Rear Panel Fan

Before removing the filter, turn the power switch on the 7200 ACU to the off position. To remove the filter, lift up on the plastic housing of the exhaust fan, gradually working it off of the rear panel and remove the filter. Once removed, the filter can be cleaned with a high-pressured hose. If the filter needs to be replaced, replace it with VertexRSI part #BFN002. Replace the filter and secure the fan housing.

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6.2 Battery

6.2.1 Checking the Battery

The battery is a long-life lithium battery, but it is important to monthly monitor the strength of this battery. See Table 2-6 for more specific information about the VCPU battery. If the battery sufficiently discharges, all NVRAM parameters will be lost including the following:

- Modeling data
- Site data
- Targets
- Time/Date

To check if the battery charge is low, from the Main Menu, select **Display system status...**, then **Hardware diagnostics...** and finally **VCPU hardware diagnostics**. If the battery charge is low, "3.0V Battery Low" will be highlighted in reverse type.

6.2.2 Replacing the Battery

It is possible to replace the battery without losing any parameters.

NOTE: The battery must not be out of the socket more than 20 seconds or the NVRAM parameters and/or real time clock information may be lost

Before removing the original battery, acquire another VertexRSI part #BBA003 (Panasonic CR2354).

This 3V Lithium coin-type battery can be carefully pried out with a small screwdriver and the new battery can be replaced in reverse fashion.

IMPORTANT: The "+" side of the battery faces up.

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7.0 Engineering Drawings

This section contains the following engineering drawings called out in this manual:

200602 Remote Interface PMCU Model 7150

200607 POL Motor, 50Hz (Optional)

200608 POL Motor, 60Hz (Optional)

201157 Baseline AZ/EL Assembly (208 VAC) Model 7150 Series III

201158 Baseline AZ/EL Assembly (380-415 VAC) Model 7150 Series III

201357 Antenna Control Unit Assembly and Wiring Model 7200 Stock Level

201379 7200 ACU Top Configuration Level

201464 Brake Parts Kit, AZ & EL Brakes 7150 Series III

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APPENDIX A - ACRONYMS AND ABBREVIATIONS

The following is a list of acronyms and abbreviations that are used by VertexRSI Control Systems and may appear in this manual.

A	Amperes
AC	Alternating Current
ACS	Antenna Control System
ACU	Antenna Control Unit
A/D	Analog-to-Digital
ADU	Antenna Drive Unit
AGC	Automatic Gain Control
AOS	Acquisition of Star
ASCII	American Standard Code for Information Interchange
ASSY	Assembly
AST	Adaptive Steptrack
AWG	American Wire Gauge
AZ	Azimuth
BCD	Binary Coded Decimal
BDC	Block Downconverter
BIT	Built-In Test
bps	bits per second
BW	Bandwidth
	Beamwidth
C	Celsius
CCW	Counterclockwise
CD	Compact Disc
CFE	Customer-Furnished Equipment
COM	Common
CPLD	Complex Programmable Logic Device
CPU	Central Processing Unit
CR	Carriage return
CRLF	Carriage return/line feed
CW	Clockwise
dB	Decibel
dBm	Decibel referred to 1 milliwatt
DC	Direct Current
deg	Degrees
DIP	
DMM	Digital Multimeter
DOS	Disk Operating System
DTR	Digital Tracking Receiver

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EEPROM	Electrically Erasable Programmable Read-Only Memory
EFT	
EIA	Electronic Industries Alliance
EIC	Encoder Input Circuit
EL	Elevation
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read-Only Memory
ESD	Electrostatic Discharge
E STOP	Emergency stop
FFT	Fast Fourier Transform
FLT	Fault
FSM	Finite State Machine
FWD	Forward
GHz	Gigahertz
GND	Ground
GPIB	General Purpose Interface Bus
HB	High Byte
HEX	Hexadecimal
HP	horsepower
Hz	Hertz
I/O	Input/Output
IC	Integrated Circuit
IEC	International Electrotechnical Commission
IEE	Institute of Electrical Engineers
IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate Frequency
IP	Internet Protocol
ISIO	Intelligent Serial Input/Output
kbps	kilobits per second
km	Kilometer
LAN	Local Area Network
LB	Low Byte
LED	Light-Emitting Diode
LNA	Low Noise Amplifier
LOS	Loss of Signal (Loss of Star)
LSB	Least Significant Bit
LSI	Large Scale Integration
LT	Long-term

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M	Meter
MAC	Media Access Control
Max	Maximum
M&C	Monitor and Control
mA	Milliamperes
mb	Multibody (propagator)
MHz	Megahertz
Min	Minimum
ms	Millisecond
MT	Menu Tree (M&C)
N/A	Not applicable
NC	No connection
NEC	National Electrical Code
NEMA	National Electrical Manufactures Association
NORAD	North American Air Defense Command
NVRAM	Nonvolatile Read-Only Memory
O&M	Operations and Maintenance
OPT	Orbit Prediction Tracking
PC	Printed circuit Personal Computer
PCB	Printed-Circuit Board
PH	Phase
PLL	Phase-Lock Loss
PMCU	Portable Maintenance Control Unit
POL	Polarization
p-p	Peak-to-peak
PROG	Program
PROM	Programmable Read-Only Memory
RAM	Random Access Memory
RC	Resistance-capacitance Request/Command (M&C)
RDC	Resolver-to-Digital Converter
REV	Reverse
RF	Radio Frequency
RFI	Radio Frequency Interference
RMS	Root mean square
ROM	Read-Only Memory
rpm	Revolutions per minute
sec	Second
SMT	Surface Mount Technology
SPST	Single-Pole Single-Throw
ST	Short-term
STD	Standard

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2b	Two-body (propagator)
TBT	Tracking Band Translator
TBU	Test Bed Unit
TCXO	Temperature Compensated Crystal Oscillator
TEE	True Equinox and Equator
TFP	Time and Frequency Processor
TIA	Telecommunications Industry Association
TT&C	Telemetry, Tracking, and Control
UTC	Coordinated Universal Time
V	Volts
VAC	Volts AC
VCPU	VertexRSI Central Processing Unit
VDC	Volts DC
VITA	VMEBUS International Trade Association
VME	Versa Module Eurocard (IEEE 1014)
WAN	Wide Area Network

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APPENDIX B - 7200 ACU PASSWORD PROTECTION

This appendix details the usage of the password protection system on the 7200. Procedures are provided for setting and changing the password. Procedures are also provided for clearing the password, if the user has forgotten the password or the user does not want password protection to be enabled on the system at any time.

The 7200 ACU, as shipped, has password protection enabled with all passwords cleared. The user can then set the password by entering the **Set user level (and passwords)...** menu and following the procedures provided in paragraph 5.8.4 in the Operations Section of this manual.

If the passwords have already been set, the ACU will ask for the old password first before accepting a new password.

If a password has been lost or the user wants to disable password protection, use the following procedures to reset a password or disable password protection.

The following tools are required:

- 1 flathead screwdriver for #10-32 screws
- 1 Phillips screwdriver for #6-32 screws
- 1 trimming tool or small flathead screwdriver

1. On the front of the 7200 ACU, set the DRIVE ENABLE switch to disable the drives.

2. Using a large flathead screwdriver, remove the four screws holding the 7200 ACU in the rack.

3. On the rear of the 7200 ACU, set the power switch to the off position.

4. On the rear of the 7200 ACU, check that all cables have enough slack to allow the unit to be pulled forward about 20 inches (50 centimeters).

5. Carefully slide the 7200 ACU forward until the hinge at the rear of the top cover clears the front of the rack.

6. Using a Phillips screwdriver, remove the two screws holding the front of the cover.

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7. Note the hinge on the right side of the 7200 ACU. Lift the cover of the 7200 ACU and lock it in place by pulling forward on the joint of the hinge. The slide mount can also be used to tilt the entire ACU in 45-degree increments for easier access.

8. Inside the 7200 ACU, disconnect the following cables:

   a. The 10-conductor cable from the daughtercard on the I/O card (800252) assembly.
   b. The 50-conductor cable from the I/O card (800252) assembly going into the middle of the card directly below the 10-conductor ribbon cable.
   c. The 26-conductor cable from the RDC card (800225) assembly going into the middle of the card directly below the previous cable.

9. Using a small flathead screwdriver or trimming tool, on the Force CPU card set the switch labeled 2 so that the arrow points to 0.

   NOTE: In the next step when the ACU is powered up, the display screen will indicate some alarm conditions because of the disconnected cables.

10. On the rear of the 7200 ACU, set the power switch to the on position. If desired, acknowledge any faults.

11. From the **Main menu**, select **Set user level (and passwords)...**. Verify that user levels can be changed without a password.

12. If password protection is not desired, go to step 17.

13. Using a small flathead screwdriver or tuning tool, set switch 2 so that the arrow points to position 4.

14. If password protection is desired, enter a password.

15. On the 7200 ACU rear panel, set the power switch to the off position for 5 seconds and then set the power switch to the on position.

16. Verify that the password protection has been enabled by changing the user level.

17. On the rear of the 7200 ACU, set the power switch to the off position.

18. Reconnect the ribbon cables to the cards.

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19. On the rear of the 7200 ACU, set the power switch to the on position.

20. Verify that the only fault showing is DRIVE DISABLED (LOW SIGNAL may also be displayed).

21. Verify that the resolver readout is steady.

22. Press the DRIVE ENABLE switch so that the drives are enabled.

23. Verify that all faults are cleared, with the possible exception of a low signal level.

24. On the rear of the 7200 ACU, set the power switch to the off position.

25. Holding the top left corner of the cover with one hand, press the hinge in with the other hand and lower the cover until it seats on top of the unit. Reinsert and tighten the two #6-32 screws that secure the cover.

26. Slide the 7200 ACU back into position and secure the front panel to the rack with four #10-32 screws.

27. On the rear of the 7200 ACU set the power switch to the on position. Verify that password protection has been set correctly.

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APPENDIX C - TWO-SPEED RESOLVER CALIBRATION

1.0 Introduction

This appendix contains instructions for calibrating the two-speed resolvers (two-speed resolver option only) in the 7200 ACS.

2.0 Setting Excitation Voltage

The two-speed system used on the 7200 ACU is stable to within +/-0.0005 degrees, hence bobble in the last one one-thousandth position may be present, but only by one count. An excessive bobble of more than 0.001 degree is usually caused by either poor or insufficient environmental shielding or low excitation voltage (providing there are no mechanical problems). The following procedures describe how to check the excitation voltage; shielding is discussed in Appendix E, Troubleshooting Guide Paragraph 5.0, of this manual.

1. Turn off the power to the 7200 ACU and slide it forward from the rack. Remove the four #6-32 screws holding the front of the top lid and lift the lid, locking it in place with the hinge found on the right side of the sub-rack inside the unit.

2. Power up the unit and disable the drives using the front DRIVE ENABLE switch as a precautionary measure. Locate the small blue trimpot on the left side of the 800225-05 RDC card. This trimpot adjusts the resolver excitation voltage level which can be measured at J7 (EL) or J8 (AZ) on the backpanel between pin 2 (R1, +Ref) and pin 8 (R2, GND).

3. Use an AC RMS voltmeter to set the voltage to at least 4 V RMS. If the bobble persists, raise the voltage up to a maximum of 9 V RMS. This should correct the problem on standard run lengths. If the bobble persists or does not diminish, a bad shield or signal wire connection may be the problem.

4. Re-enable the drives, and verify that no drive cabinet related errors are occurring. Resecure the top lid, slide unit back in rack, and resecure the unit using the #10-24 cup head screws.

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3.0 Two-Speed Internal Alignment

The resolver system used in the standard 800225-05 option package for the 7200 ACU is an electrical two-speed resolver type. Due to finite manufacturing tolerances, cable length differences, and other variables, the coarse and fine resolver 0 points may not necessarily coincide.

In the case of the standard 32 to 1 ratio, this can result in 11.25 degree skips and jumps when the antenna moves through an unaligned 0 point. To correct this, perform the following procedure:

1. From the **Main menu**, select **Edit system configuration...**, then **Position encoder configuration...**. Set **Encoder type** to **Standard accuracy (2500 Hz)** and save changes.

   This effectively ignores the fine (32:1) resolver, and provides a stable display with which to work while performing the alignment procedure.

2. From the **Main menu**, select **Display system status...**, then select **RDC states**. The fields indicated by --- **data** --- display the actual resolver position as being read by the 7200 ACU. Note that the value is in hexadecimal notation.

3. By alternating between this screen and **Manual antenna control**, move the antenna until the AZ and EL resolvers are on a multiple of 0800h (0800 hexadecimal); i.e.: 0000h, 0800h, 1000h, 1800h, 2000h, etc. When this is accomplished, record the fine resolver values for AZ and EL.

4. Return to the **Position encoder configuration...** menu. Change **Encoder type** to **2-speed resolvers**. Press [PRIOR] and save changes.

5. Re-enter the **Position encoder configuration...** menu. The **2-speed internal alignment** field will be visible. Enter the fine resolver values for AZ and EL that were recorded in step 3 in these fields, then press [PRIOR] and save changes.

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APPENDIX D - TRACKING TUTORIAL

This appendix contains information for quickly setting up tracking with the 7200 ACS. Even though this section has been written for an inexperienced operator, the user may still encounter difficulties. If while trying to use these procedures, the operator experiences problems, it is recommended that the user also refer to Section 5.0, Operation, to become more familiar with the system before attempting to track a target.

The 7200 has an easy-to-use context-sensitive help system that may be referenced at any time during this procedure by simply pressing the [HELP] key.

To quickly begin tracking a target with the 7200 ACS, use the following procedures.

<summarize steps here, without navigational fluff>

The first step is to tell the ACS about the location of the antenna on the earth, its site.

1. From the **Main menu...**, select **Edit system configuration...**, then **Site data...**.

   - Select **E. Longitude of site [deg]** and following the allowable range of values shown in the system prompt, use the numeric keys to enter the East longitude of the site; for West longitude, enter negative degrees.

   - Similarly, select **N. Latitude of site [deg]** then **Site altitude [meters]** and enter the site-specific values.

   - Press [PRIOR] and answer yes to the system prompt to save the changes.

The second step is to set the current date and time.

2. From the Edit system configuration menu, select **Set UTC date and time...**.

   - Select **Date** and enter the correct day of the month in Coordinated Universal Time (formerly Greenwich Mean Time, or GMT). Press [ENTER] and the month is highlighted.

   - Select the correct month using the up and down arrow keys. Press [ENTER] and the year is highlighted.

   - Enter the year and press [ENTER].

   - Set the time in the same manner as the date and press [ENTER].

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- To enter the date and time into the system, select **Await mark...** and the following message appears:

  System UTC date and time will be set to
  hh:mm:ss dd Mmm yyyy (Note: the time and date just entered will be displayed.)
  when [ENTER] is hit.
  Press [PRIOR] to cancel.

- Press [ENTER] to enter the date and time into the system. Press [PRIOR] twice to return to the **Main menu**.

The next step in the procedure is to calibrate the look angles. This requires pointing the antenna at a known position so that the encoder offsets can be set properly. Normally this known position will be a well station-kept satellite or one for which a calculated ephemeris can be obtained.

3. Approximate the antenna's current position. Estimate the antenna's azimuth angle using a reference such as a compass or platform centerline; to facilitate this, manually move the antenna, if necessary, with **Main menu, Tracking functions..., Manual antenna control...**. Estimate the elevation using a reference such as a mechanical inclinometer. The more accurate these estimates are, the easier it will be to peak on the first satellite. Go to **Main menu, Edit system configuration..., Position encoder configuration..., Current position [deg]** and enter these values.

4. Identify a stable satellite which has a known nominal longitude or box center in the operational region of the antenna. Go to **Main menu, Tracking functions...** to point the antenna at the satellite. This can be done with **Manual antenna control...** or automatically with **Immediate tracking...** To do it automatically, select **Edit immediate target...**, and select **Tracking mode**. Use the arrow keys to select the desired mode and [ENTER] to pick it; select "Move to longitude", or "Move to look angles" if published values are available. Select **Edit target parameters...** Depending on the choice of tracking mode, either enter the nominal longitude in the **E. Longitude of target [deg]** field (negating for West longitude) or the published azimuth and elevation in the **Look angles [deg]** field. In either case, **Bias angles [deg]** should be set to zero. Exit the menu and save the changes. The ACS is now ready to make the first attempt at pointing to a satellite. From the **Immediate tracking** menu select **Track immediate target**; verify the target information before the final confirmation to begin tracking.

5. Peak the antenna on the satellite (possibly using a receiver or spectrum analyzer). To find the satellite sweep azimuth because its estimation is usually less accurate than for elevation. Swing through the peak to make sure it is the main beam, not a sidelobe; peak both axes. Be careful not to peak on an adjacent satellite; The satellite may be verifiable with a TV receiver or spectrum analyzer. A TV receiver may be used to look for satellite

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identification or to compare its transponder output with published programming. A spectrum analyzer may be used if the satellite's spectrum profile is known.

Now that the antenna is pointing to a known position, the position encoder offsets can be configured.

6. The 7200 ACU will calculate the look angles for a given longitude if the site data has been set properly. From the **Main menu**, select **Tracking functions...**, **Immediate tracking..., Edit immediate target**... and **Move to longitude...**.

7. Select **E. Longitude of target [deg]** and enter the target's longitude. The desired look angles will be displayed on the **(Look angles [deg])** line of the display. Record both values to be used as the current position. Press [SHIFT] + [PRIOR] to return to the **Main menu**.

8. Select **Edit system configuration...** and **Position encoder configuration...**. Select **Encoder direction** and using the up and down arrow keys, set the encoder direction for each axis. The setting can be determined from **Main menu, Tracking functions..., Manual antenna control...**. Use "Reversed" for azimuth if pressing the right arrow moves the antenna in a counter-clockwise direction; use "Reversed" for elevation if pressing the up arrow produces downward motion of the antenna.

9. Select **Current position [deg]** and enter values obtained in step 7 Press [PRIOR] and answer yes to save changes. Press [PRIOR] to return to the **Main menu.**

The steptrack defaults should now be set. It is best to configure the steptrack defaults prior to building any OPT targets. For most systems, no target-specific parameter adjustments will be necessary.

To set the -3 dB beamwidth, check the data sheet or approximate the value using the following equation:

freq = receive frequency (in GHz):

C-Band =	3.95 GHz
X-Band =	7.50 GHz
Ku-Band =	11.95 GHz

size = antenna diameter in meters

$$\textbf{-3 dB beamwidth} = \frac{\textbf{19}}{\textbf{frequency (GHz) * size (m)}}$$

10. From the **Main menu...**, select **Edit system configuration...** and **Steptrack defaults...**.

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11. Select **Receive -3 dB beamwidth [deg]** and enter the value obtained above.

12. Select **Step size [deg]**. This parameter should be set to approximately 8 percent of the **-3 dB beamwidth**, but no less than 0.02 on systems with standard resolvers. Enter the value and press [ENTER].

13. Select **Position deadband [deg]**. This parameter should be set between 5% & 10% of the **-3 dB beamwidth**, but no less than 0.02 on systems with standard resolvers. Enter the value and press [ENTER]. Answer yes to the system prompt to save changes and press [PRIOR] to return to the **Main menu**.

In normal environments, no other steptrack defaults require modifications from the preset values. The OPT defaults should remain at factory settings also.

SETTING THE OPTIMAL TRACK SPEED IN THE AZ & EL, AC INVERTERS

NOTE: This procedure is for estimating the Optimal Track Speed. After using this procedure, you may still have to make speed adjustments to obtain the correct track speed for your antenna and local conditions.

A. The 7150DU (See Section 4.4.1.2.2 AC Inverter Setup) has a parameter called ***NO25.*** This parameter sets the Track speed of the AZ or EL Axis. This speed is expressed in Hz. The Speed Range is 0 to 50 Hz. The factory setpoint is 5 Hz.

We will use the following calculation to create an optimal track speed. It will be 10% of the 3 dB beamwidth. To calculate the (3 dB beamwidth)/10, use the following equation:

freq = receive frequency (in GHz):

C-Band = 3.95 GHz
X-Band = 7.50 GHz
Ku-Band = 11.95 GHz

size = antenna diameter in meters

$$\text{OPTIMAL TRACK SPEED (Deg per Sec)} = \frac{19}{\text{frequency (GHz)} * \text{size (M)}} / 10$$

Example: Antenna size = 7.2 M
C-Band = 3.95 Ghz

(19 / (3.95*7.2)) / 10 = 0.066 Optimal Track Speed (Deg per Sec)

B. We will now determine the actual track speed of the antenna.
Set the 7150DU to Manual mode. Using the PMCU, set to Track Speed, record the current AZ angle. Run the AZ motor for 60 Seconds. Record the ending angle . Subtract the two angles and divide by 60. This will be your actual track speed.

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Example: Start AZ Angle: 95.00; After 60 seconds; Ending angle 98.00
(98.00-95.00)/60 = 0.05 Actual Track Speed

Using this information, we can calculate the value that needs to be entered in to the AC Inverter.

Check NO25 in Inverter. Enter Actual value.
Example NO25 = 5.0

Optimal Speed Value = (Optimal Track Speed X Value NO25) / (Actual Track Speed)

Example: (0.066 X 5) / 0.05 = 6.6 Hz

Reset NO25 to 6.6 Hz.
You are now set to your Optimal Track Speed.

C. You will now need to repeat this procedure for the Elevation Axis

D. After completing this procedure, you may have to fine-tune these speeds to obtain a track speed that is the best speed for Step Track and OPT.

Consult with VertexRSI for help with this setup if needed.

In normal environments, no other steptrack defaults require modifications from the preset values. The OPT defaults should remain at factory settings also.

14. From **Main menu...**, select **Edit System configuration...** and **Position loop parameters...** .

15. Select **Positioning deadband [deg]**. This parameter determines the accuracy of the position loop. The position loop will continue to move the antenna from the current position to the target until the antenna is within the deadband value for each axis. A small value will increase the accuracy of the position loop; setting this value too small will cause the antenna to oscillate. For standard resolvers this value should not be less than 0.01, for 2-speed resolvers/optical encoders this value should be around 0.003.

16. Select **Inching on time [ms]**. This parameter needs to be set just high enough to allow the antenna to move (usually 1 revolution of the motor). Setting this parameter too high can result in oscillation. This value can be 200-500ms depending on the amount of backlash in the drive train. For other antennas with excessive wear, the value could be somewhat higher.

The next step in the tracking sequence is to build a target.

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17. From the **Main menu...**, select **Tracking functions...**, **Edit a new or existing target...**.

18. Select a noninitialized item (represented as "----------") on the target selection menu and press [ENTER].

19. The **Edit target data** screen will appear. This screen contains **Target name** and **Tracking mode** parameters, and the submenu **Edit target parameters...**.

20. Select **Target name**. The following prompt appears:
    Arrow keys move around, change letters; up to 12 letters are allowed.

21. To create a target name, use the up and down arrow keys to scroll through the character set consisting of the following:

    - A blank space
    - Uppercase alphabet letters
    - Lowercase alphabet letters
    - Digits 0 through 9
    - Special characters:!"#$%&'()* +,-./:;< = >?@[\]^_`{|}~

22. When the desired character is highlighted, press the right arrow key to move to the next space (to create a target name of more than one letter). Pressing [ENTER] will enter the target name as selected by the user. (It is often helpful to use the satellite name as the target name.) Blank spaces may be included as part of the target's name.

The target mode must now be set for the target named in the above steps. The target parameters must also be edited. The target parameters made available for editing will be determined by the tracking mode selected for the target. For most systems, OPT will be the desired tracking mode.

23. Select **Tracking mode**. Using the up and down arrow keys, scroll through the following choices for the tracking mode:

    - Unused
    - Star tracking
    - OPT
    - Intelsat 11-element
    - Move to longitude
    - Move to look angles

24. When the desired tracking mode is highlighted, press [ENTER].

25. To edit the target parameters, select **Edit target parameters...**.

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26. If the **Tracking mode** is set to OPT, the steptrack parameters will be set to the default values, with the exception of -**3 dB beamwidth**, **Step size [deg]**, and **Position deadband [deg]**, which will retain the values set in the above steps. Select **OPT parameters...**.

    NOTE: If Tracking mode is other than OPT, refer to Section 5.0 of this manual for parameters that will be available for editing with other tracking modes.

27. Select **Spacecraft parameters...** and set the following parameters:

    - **Box center longitude [deg.East]**
    - **Longitude range [deg]**
    - **Estimated inclination [deg]**

28. Press the [SHIFT] and [PG DN] keys to move to screen 2 of the **Spacecraft parameters...** menu, and select **Tracking signal parameters...**. The parameters displayed will depend upon the setting of the **Tracking receiver input** parameter under **Tracking receiver setup...** in the **Edit system configuration...** menu. Select and edit the parameters.

    NOTE: Box limit and Orbit scan require the setting of the parameters listed in steps 32 and 33 -- if these are not set, DO NOT enable Box limit or Orbit scan as the system will attempt to track a target at zero longitude.

29. Enable **Box limit** and **Orbit scan.**

30. Press [PRIOR] and answer yes to the prompt to save the changes. Press [PRIOR] twice to return to the **Main menu**.

The 7200 ACU must be properly calibrated to the slope of the tracking signal in order to provide optimum performance of the **Steptrack** feature.

31. Peak the antenna on the satellite to be tracked (use **Orbit scan** if necessary to locate an inclined satellite).

32. When the beacon or signal has been acquired, from the **Main menu**, select **Edit system configuration...**, **Tracking receiver setup...**.

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If the tracking receiver provides an analog signal level:

- Adjust the input level at peak to approximately 8 Volts. With maximum output of 10V, 8 reserves more dynamic range for a weaker signal.
- Select and set **Set 0 dB point**.
- Insert a 3 dB attenuator in the RF path into the back of the beacon receiver.
- Select and set -**3 dB point**.
- Press [PRIOR] to back out of the menu and save the changes.

If a 3 dB attenuator is unavailable, there are two other methods that may be used to drop the signal to 3 dB:

- Move the antenna in EL by half the 3 dB beamwidth.
- On the VertexRSI Model TRC-14 or TRK-14 Receivers, use the level adjust to drop output voltage 1.5 V (this is close to a 3 dB drop).

33. To begin tracking the target configured above, from the **Main menu**, select **Tracking functions...** and **Track a target...**.

34. Select the target to be tracked from the target selection screen. If the **Confirm tracking** option in the **User interface options...** is enabled, verify that the information displayed in the confirmation prompt is correct, and answer yes. The system will begin tracking the target.

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APPENDIX E - 7200 Troubleshooting Guide

Table 1-1 lists the paragraph number for the probable causes and corrective action for each fault/error topic addressed in this guide.

TABLE 1-1 FAULT/ERROR TOPICS	
FAULT/ERROR	**PARAGRAPH NUMBER**
Drive Cabinet Unresponsive/Inverter Display Blank	1.0
Drive Cabinet Inverter Faults	2.0
7200 ACU Power-up Failures	3.0
Soft and Hard Travel Limits	4.0
Resolver Errors	5.0
7200 ACU Error Messages	6.0
Position Loop Errors	7.0
Target Acquisition Errors	8.0
AST/OPT Tracking Errors	9.0
Intelsat Tracking Errors	10.0
Password Lost	11.0

If after following troubleshooting methods listed in this appendix, a problem still exists, or if a problem is not addressed in this guide, contact technical support, (see Section 1.4 of this manual).

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1.0 Drive Cabinet Unresponsive/Inverter Display Blank

NOTE: This error can occur even if the ACU has not been installed.

If the drive cabinet does not respond to drive commands from local controls and the inverter display is blank (the inverters are not energized), follow these steps.

On the drive cabinet swing-out panel, check to see if the CONTROL POWER rocker switch (breaker) is in the ON position and verify that the green LED on the switch is illuminated. Also verify that the CONTROL switch is in the LOCAL position.

1. If the LED is **not** illuminated, check the following:

   a Verify power to the main power feeder and breaker.
   b. Verify that all emergency stop pushbuttons and interlocks are not activated.
   c. Check the input wiring to the 24 VDC power supply to verify that AC voltage is applied.
   d. If the conditions listed in steps a through c exist, measure the power supply output pins to verify that 24 VDC is available. If DC voltage is not available, disconnect the limit switch wiring from the drive cabinet to be sure that the +24 VDC lines from the cabinet are not shorted to ground. Recheck the power supply and if DC voltage is still not available, replace the power supply.

2. If the LED **is** illuminated and the main contactor is not energized, check the following:

   a. Shorted diode (02) across pins 7 and 8 of relay KC1 on the relay PCB.
   b. Tripped inverter circuit breaker.
   c. Loose wiring on any terminal on the relay PCB.
   d. Relay K7 (and diode D19 across pins 13 and 14) on the relay PCB.

2.0 Drive Cabinet Inverter Faults

NOTE: The fault codes in brackets are indicated on the inverter displays.

These faults are indicated by a display of AZ|EL FLT on the ACU. Refer to Section 4 for proper inverter parameter setup. For more comprehensive inverter fault information, see the inverter O&M manual provided on the product CD.

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2.1 Overcurrent [oC]

If overcurrent is detected [OC] will appear on the inverter display. The following conditions may be the cause of this error:

1. Excessive load inertia.
2. Acceleration time is too short -- increase it.
3. Starting frequency is set too high.
4. Motor connections are incorrect -- verify proper voltage connection.
5. If a motor brake is used, brake coil cannot be fed from the inverter output terminals.
6. Phase-to-phase or phase-to-ground short at the inverter output -- check for short in wiring or motor.

2.2 Overvoltage [oV]

[oV] will be displayed on the inverter if overvoltage occurs. This error can occur if the deceleration time is set too fast for load inertia. To correct this problem, increase the deceleration time.

2.3 Undervoltage [Uv]

If undervoltage is detected, [Uv] will be displayed on the inverter. Low input voltage is the cause of this error. Check for low voltage at inverter input terminals. This can be caused by instantaneous power failure or a brownout.

2.4 Overheating [oH]

If overheating occurs, [oH] will be displayed on the inverter. If this error occurs, check the cooling fans (if applicable) and/or clean the cooling fins on heat sinks. If the fans are operating properly and the fins are clean, check for excessive ambient temperature.

2.6 Motor Overload [oL1]

When a motor overload is detected, [oL1] is displayed on the inverter. When this error occurs, restart the inverter and check output current. If it is higher than the specifications on the nameplate, correct the overload.

2.6 Drive Overload [oL2]

When a drive overload is detected, [oL2] is displayed on the inverter. Be sure the drive's capacity is correctly rated.

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3.0 7200 ACU Power-Up Failures

3.1 No Audible Beep at Power-Up

If an audible beep is not heard upon power up of the ACU, check the following:

1. Verify that power is available at the unit.
2. Check the fuse in the power entry module.
3. Verify that proper voltage/frequency has been selected at power input on the back of the unit.

3.2 Display Shows Blinking Cursor Only

If only a blinking cursor appears in the upper left corner of the screen:

1. Open the lid and check serial connection from the rear panel, connector TB6, to the top right serial port on the display driver board.

2. With lid open, turn on power and observe the light sequence on the CPU card. The status of the lights should be as follows:

    a. D1, HALT: always green
    b. D4, RESET: red, then green

3. If the lighting sequence is as listed in steps 2a and 2b, check crimps for good connections on the power supply.

4. If the lighting sequence is not as listed in steps 2a and 2b:

    a. Verify rotary switch settings:
        1.) S2 should be set to 0-3, wherever current firmware is stored
        2.) S3 should be set to 0
    b. Verify dipswitch settings:
        1.) S6 should be set to ALL OFF (UP), except pos. 8
        2.) S4 should be set to ALL OFF (UP)
    c. Eject the board and reinsert it.
    d. Contact VertexRSI for support.

3.3 CPU boot-up failure

If a problem during boot-up occurs, or the following message is displayed: “24 System test in progress.....”, an error has occurred within the boot process. Perform the following, depending on which version of firmware is currently installed:

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1. If firmware is between versions 4.2.3 and 4.3.8, press the "./EXP" button on the keypad, and keep it pressed in while cycling power to reboot the ACU. A message will appear asking you to confirm resetting ACU to ROM defaults. Respond with a YES, and press the ENTER button. All parameters will now need to be re-entered into the ACU.

2. If firmware is version 4.4.7, the hinged lid on the ACU will need to be opened, and Switch S4 located on the CPU board. It will be necessary to disconnect the left-most ribbon cables from the I/O board and possibly the RDC board to access this switch. Dipswitch position #8 should be moved into the ON (down) position, and the CPU Reset button pressed (or ACU power cycled). After about 7 seconds, the ACU will automatically reset to ROM defaults. The Dipswitch position #8 should now be moved back into the OFF (up) position, ribbon cables put back into place, and top lid secured. All parameters will now need to be re-entered into the ACU.

3. If firmware is version 4.4.8 or later, Dipswitch position #7 on Switch S4 should be moved into the ON (down) position, and the CPU Reset button pressed (or ACU power cycled). After about 7 seconds, the ACU will automatically reset to ROM defaults. The Dipswitch position #7 should now be moved back into the OFF (up) position, ribbon cables put back into place, and top lid secured. All parameters will now need to be re-entered into the ACU.

3.4 Bus Error Occurs on Boot Up

If a bus error occurs when system is booted up:

1. A problem with one or more cards on the bus prevented the CPU from "talking" to the card(s). To determine which board has a problem, from the **Main menu**, select **Display system status...** and **Power-up test report**.

2. Verify all cards are properly installed in the 7200 ACU.

3. Contact VertexRSI for support.

4.0 Soft and Hard Travel Limits

4.1 Axis Immobile With Summary Limit (Hard Limit)

This error occurs when the ACU has reached a travel limit. Because the limit is a summary limit, the ACU cannot tell which axis has reached the limit. An immobile error will soon be displayed, indicating which axis has reached the limit.

4.2 Summary Limit Fault (When Antenna is not in a Limit)

If a summary limit fault is detected when the antenna is not in a limit, verify that polarization summary limits are jumpered out in the drive cabinet (TB1-7, TB1-8, and TB1-9). See Table 4-2 (in Section 4.0 of this manual) for details.

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5.0 Resolver Errors

For all resolver errors, check the cable first and make sure that D-subconnector is securely connected to the back of the ACU. Also verify that shield lines are connected to the ACU, but OPEN at the resolver. Shield lines should not short to each other. [Refer to Table 4-4 (in Section 4.0 of this manual) to ensure that shielding pairs are installed correctly.]

The following resolver DC resistance readings are listed as a checklist. It is important that the S lead pairs match each other. If measuring from the D-connector end, there will be some extra cable resistance.

- Two-speed:
  - R1-R2: 17 ohms
  - S1-S3: 152 ohms
  - S2-S4: 152 ohms
  - S11-S13: 562 ohms
  - S12-S14: 562 ohms

- Standard (2500 Hz @ 4.4 V RMS)
  - R1-R2: 19 ohms
  - S1-S3: 6.8 ohms
  - S2-S4: 6.8 ohms

- High accuracy (400 Hz @ 11.8 V RMS)
  - R1-R2: 120 ohms
  - S1-S3: 475 ohms
  - S2-S4: 475 ohms

5.1 Resolver Readout Bobble

If the resolver readout bobbles, especially in the last few bits on the RDC status display, there may be insufficient excitation voltage (this problem is common with the two-speed resolvers). Use an oscilloscope to measure the AC component on the S2 or S3 lead (it is recommended that the bottom of the appropriate transient suppressor be used as a tie point; refer to the appropriate drawing in Section 8.0). As the spatial angle of the resolver shaft changes, the sine wave should peak at 2 V RMS [5.65 V peak-to-peak (p-p)]. Higher voltages will cause saturation of the RDC's and should be avoided. Lower voltages will reduce the signal to noise level.

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5.2 Resolver Readouts Erratic with Antenna Motion

If the resolver readouts become erratic with antenna motion, (i.e., the readout functions properly through a certain angular range, but begins to flicker and roll, large jumps occur, etc), a bad connection is usually the cause. This occurs because a small signal is being coupled into the very high impedance input of the RDC, causing the system to behave erratically.

5.3 Resolver Readouts not Changing with Antenna Motion

When the resolver readouts do not change when the ACU commands the antenna to move, an axis immobile error will occur (unless **Motion limits** are disabled). Refer to paragraph 6.1 for further troubleshooting procedures.

5.4 Resolver Readouts Varying Rapidly or Resolver Jumping by Large Increments

If the resolver readouts are varying rapidly (spinning), or if the resolver is jumping by large increments, determine if the problem is in the ACU or the resolver (+cable) by following these steps:

1. Connect a spare resolver to ACU, if available.

2. If there is another resolver of the same type in the system, (e.g., if there is a problem with azimuth resolver, the azimuth and elevation resolvers are of the same type), disable motion errors, and switch the resolver cables at the back of the ACU. Manually run the antenna and see if motion is apparent.

    a. If motion is detected, the problem is in the ACU. If a spare RDC card is available, change it out with the old one. If the problem still exists, contact VertexRSI.
    b. If no motion is detected, buzz out cable. If the cable is good, replace the resolver. Check for water in the resolvers.

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6.0 7200 ACU Error Messages

Axis Fault (Applies to: AZ, EL)

Description: This fault occurs when an axis fault device such as a motor handcrank interlock or an elevation reflector hatch is activated. Electrical power is removed from the faulted axis motor controller(s). See "Motor # handcrank" also.

To Correct: Check axis interlocks to ensure that the have not been activated. If they have not, check the wiring.

Box Violation Limit (Applies to: Four Compass Directions)

Description: This fault occurs when the antenna has reached the box limit defined by the target nominal longitude and the target estimated inclination.

To Correct: If the inclination of the target is greater than estimated then increase the estimated inclination so it encompasses the lateral movement of the target. Verify that the target nominal longitude is correct.

Brake Set (Applies to: AZ, EL - Systems with Brakes Only)

Description: This fault occurs if the brakes have been commanded to be released (brake coil energized) but the brake status switch indicates that the brakes are still engaged.

To Correct: Check the brake(s) to ensure that they are releasing properly. If they are then check the wiring to ensure proper status is being received.

Brake Set While Tracking (Applies to: AZ, EL – Systems with Brakes Only)

Description: This fault occurs if the brakes become set (engaged) while the ACU is still maintaining a command to release the brakes (i.e. uncommanded setting of the brakes). This fault latches on the ACU and can be cleared by exercising the Clear/Correct System Fault command. This fault will normally occur if the operator quickly exits the manual bias screen.

To Correct: Check the brakes to ensure that they are operating properly. Check the wiring to the brake coil to ensure that the command circuit is intact. Check the circuit breaker for the brake circuit to ensure it has not been tripped.

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Bus error "card name and number" (Applies to: All systems)

Description: This fault occurs when a card inside the VME card cage fails to respond when addressed by the CPU. It means the CPU is not able to communicate with the card that displays the bus error.

To Correct: Locate the card in the VME card cage and ensure that it is correctly and completely plugged into the card cage.

Encoder Error (Applies to: AZ or EL)

Description: This fault occurs when the CPU is no longer receiving position data from the encoder/resolver.

To Correct: Check to see that the wiring to the position encoder has not become disconnected. For AZ/EL optical encoders ensure that the encoder DC power supply has not failed. It should be 5VDC at the junction box to the encoder.

Immobile (Applies to: AZ, EL, and POL)

Description: This fault occurs when an axis is commanded to move and it does not move the user-specified distance within a user specified time period (par - **Immobile/reversed timeout [ms])**.

To Correct: Review the following possible causes and take corrective action as needed:

1) Increase **Immobile/reversed timeout [ms]** parameter.
2) Reduce the **Immobile/Reversed tolerance [deg]** parameter.
3) and/or increase the Immobile/Reversed timeout [ms] parameter. The user can also disable the axis immobile errors.

Intelsat data expired (Applies to: All systems tracking Intelsat targets)

Description: This fault occurs when the Intelsat data set in the ACU is no longer valid. Standard data sets are valid for 170 hours.

To Correct: Check to ensure that the UTC time shown on the ACU is correct. Obtain a current data set and enter it into the ACU.

Intelsat data invalid--cannot track (Applies to: All systems tracking Intelsat targets)

Description: This fault occurs if the Intelsat data set is entered incorrectly.

To Correct: Reenter the set being careful to check that the set entered exactly matches the set given.

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Intelsat pre-epoch prediction (Applies to: All systems tracking Intelsat targets)

Description: This fault occurs when the Intelsat data set in the 7200 ACU is valid in the future but not at the present moment. Using the future data set given, the 7200 ACU automatically back calculates the satellites current location and points the antenna in that direction.

To Correct: Check to ensure that the UTC time shown on the 7200 ACU is correct. Enter a currently valid data set or wait until the future set is valid.

Invalid target in target schedule (Applies to: All systems)

Description: This fault occurs when a target is placed in the target scheduler and then the target is deleted.

To Correct: Create a new target with the same name as the one in the target scheduler.

Keyboard Stop (Applies to: 7200 ACU)

Description: This status occurs when the Stop button on the 7200 ACU is pressed and thus tracking is halted.

To Correct: Press the Resume [shift - Stop] key and then tracking is resumed.

Low Tracking Signal Level (Applies to: All systems when operating in a tracking mode.

Description: This fault occurs when the signal level from the tracking receiver is lower than the minimum level set in the steptrack parameters menu.

To Correct: Check the Low Tracking signal level and ensure that it is set much lower than the peak value in dB (a value about 1 dB above the first sidelobe is recommended, about -10 dB). If this value is set properly, then determine what has caused the signal level to drop and correct as required.

Non-volatile RAM corrupted (Applies to: All systems)

Description: This fault occurs when the RAM that stores the parameters does not have matching checksums.

To Correct: This fault can only be corrected by manually checking all the parameters and modifying the default parameters back to the desired setting.

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OPT cannot track (Applies to: All systems)

Description: This fault occurs if an OPT target (without a model) moves to the satellite position (current position or Orbit Scan if enabled) and does not have a beacon signal at least as strong as the "Low Signal level" parameter setting.

To Correct: Ensure that the tracking receiver signal amplitude is adequate for tracking purposes.

Remote control panel link failure (Applies to: Systems with two or more 7200's)

Description: This fault occurs when a remote 7200 ACU serial link connection is broken.

To Correct: Check the cabling between the 7200 ACU and the 7150 ADU to ensure that the connectors have not become loose or disconnected. If the physical connections are proper then check the protocol for that port under the Edit System Configuration/ Remote Port Configuration menu. It should be as follows: bps (baud) 19200, Parity none, Data bits 8, Stop bits 1, M&C echo Disabled, M&C echo Disabled, M&C Newline CR, Shell Visual.

Reversed (Applies to: AZ, EL and POL)

Description: This fault occurs if the antenna is commanded from the 7200 ACU to move in one direction but it responds by moving in the opposite direction. It must move as far as the Immobile/Reversed tolerance [deg] setting before a fault will occur.

To Correct: First increase the Immobile/Reversed tolerance setting. If the fault persists verify that the antenna is actually driving in the direction indicated by the axis display. If it is not, change the position encoder direction under the Edit System Configuration\Position Encoder Configuration menu on the 7200 ACU.

Simulation (Applies to: All systems)

Description: This status occurs when the user has placed the ACU in simulation mode.

To Correct: Change the Operational mode parameter (found in Edit system configuration/Built-in simulator-setup) from "Simulation" back to "Live".

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Soft Limit (Applies to: AZ, EL or POL)

Description: This fault occurs when the antenna has reached the operational limit. Operational limits can be set [by the operator] in software around the nominal AZ/EL/POL position of the target being tracked.

To Correct: If the operational limits are not set properly then adjust then as required. Do not set then larger than the travel limits of the antenna.

Summary Limit (Applies to: AZ, EL or POL)

Description: This fault occurs when the antenna has reached the full mechanical travel limits of the antenna. These limits are set by VertexRSI field personnel and should not be adjusted. Incorrect adjustment of these limits could cause damage to the antenna structure.

To Correct: Drive antenna away from the limit. If the limit does not clear inspect the limit switch to ensure proper operation. It should have a contact closure in the normal operating position. If the limit switch is operating properly then check the wiring between the limit switch and the 7150 ADU.

Sun outage -- **Steptrack inhibited** (Applies to: All systems)

Description: This status occurs when the 7200 determines that the sun is directly behind the target.

To Correct: This is only a temporary situation and this status will clear once the sun is no longer directly behind the target.

SYSFAIL line - **timeout** (Applies to: All systems)

Description: This fault occurs when one of the 7200 VME cards declares a failure.

To Correct: Determine which card in the VME bus is the cause of the failure; Replace the card.

Task aborted (Applies to: All systems)

Description: This fault occurs when a routine in the software is halted due to a problem in the code.

To Correct: Call VertexRSI Personnel.

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Tracking Receiver fault (Applies to: Systems with TRL Tracking Receivers)

Description: This fault occurs when the TRL tracking receiver detects a fault (i.e. Local Oscillator fault, Analog input board failure, phase lock loop failure etc.) within itself.

To Correct: Check the TRL display to find out which internal problem has caused the fault at the ACU. Should there be defective parts, call VertexRSI for support.

Tracking Receiver in LOCAL control (Applies to: System with TRL Tracking Receivers)

Description: This status occurs when the local/remote(LCL/REM) switch is toggled to the local position on the TRL tracking receiver.

To Correct: If the local/remote switch on the TRL is in the local position (amber LED lit) then press the local/remote switch again to toggle the system into remote. If the TRL is already in remote mode (green LED lit) then check to ensure that the serial port connected to the SCU is selected, in the TRL software, as the port in control.

Tracking Receiver out of band (Applies to: Systems with TRL Tracking Receivers)

Description: This fault occurs when a non-L-Band frequency is selected in the ACU for which the TRL tracking receiver does not have a conversion table already established.

To Correct: A conversion table must be entered into the TRL receiver so it can recognize the frequency the user is trying to select at the ACU. Also check to ensure that the frequency entered is within the valid range of frequencies for which this antenna operates.

Tracking Receiver serial link failure (Applies to: Systems with DTR or TRL Tracking Receivers)

Description: This fault occurs when the Tracking Receiver serial link is not configured correctly or is disconnected.

To Correct: Ensure that the cable has not been disconnected on either end. If the connections are correct then check that the software protocols in both the Tracking Receiver and the ACU are compatible with each other (i.e. same baud rate, parity bits, stop bits etc.). Ensure that the communications driver shell that the ACU is using is set to proper setting, i.e. “DTR” or "TRL".

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Tracking signal input saturated (Applies to: All systems)

Description: This fault occurs when the signal received from the tracking receiver reaches 10 VDC. This fault is a latching fault and will not clear without user intervention.

To Correct: On a clear day (no clouds in antenna direction), peak the antenna on the target and then set the "0 dB" point at 8.0 VDC.

On systems with TRL tracking receivers, this can be done by adjusting the input attenuation level found under the tracking signal parameter menu for a specific target. On systems with TRC/TRK tracking receivers, this can be done by adjusting the level adjustment on the front of the tracking receiver.

6.1 Axis Immobile

If an **Axis immobile** error is displayed on the ACU, check for the following conditions:

1. Setting of **Immobile/reversed tolerance [deg]** parameter is too high -- reset parameter.

2. Tracking speed potentiometer at drive cabinet is set too low -- reset the tracking speed.

3. Insufficient start torque (low elevation angles)--boost starting torque in the inverter.

4. Encoders are decoupled from the antenna -- reconnect the encoders.

5. Encoders are miswired -- check the wiring on the encoders.

6. The drive cabinet interface cable has failed -- check the cable and replace if necessary.

7. Failure at I/O board -- the ACU cannot successfully command the drive cabinet. Check and/or replace the board.

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6.2 Axis Reversed

An **Axis reversed** error may be caused by the following conditions:

1. At installation time, the motor phasing was reversed -- check the phasing and correct if necessary.

2. A sudden slew from one direction to the other could be caused by a low setting of the **Immobile/reversed timeout [ms]** -- reset the parameter.

3. Miswired encoders -- check the wiring on the encoders.

6.3 Axis Runaway

If an **Axis runaway** error is displayed at the ACU, check the following conditions:

1. **Runaway angle** is set too tight -- reset the parameter.

2. Encoder failure (typically cable failure or ground loop) -- check for both conditions.

3. RDC failure -- check and replace if necessary.

4. Drive cabinet interface cable failure -- check the cable and replace if necessary.

5. I/O board failure -- output is "stuck on". Check the board, and replace if necessary.

7.0 Position Loop Errors

7.1 Overshooting (Motor Turning On and Off Repeatedly)

NOTE: For flyaway/small antennas only: decrease Positioning deadband [deg] in the Position loop parameters... menu.

If the motor is turning on and off repeatedly, decrease tracking speed until the overshooting ceases.

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7.2 Too Long to Reposition to a New Satellite

If the system is taking too long to reposition to a new satellite:

1. Turn slew speed potentiometer in drive cabinet to maximum.

2. Decrease **Slew ->track transition [deg]** parameter to optimize slewing motion (default value drops out of slew long before the target is acquired).

8.0 Target Acquisition Errors

The following conditions may be the cause of errors occurring during target acquisition:

1. If a western longitude is entered without a leading "-". To enter 99 degrees west, enter "-99.0".

2. Offsets and site data may be incorrect -- verify the data (these should be recorded in Section 6.0).

9.0 AST/OPT Tracking Errors

9.1 Target Tracking from Spacecraft

If a target was initially set up in **Move to longitude...** mode but the mode was changed to OPT and now is tracking from the spacecraft, re-enter the longitude of the spacecraft. This step is necessary because when tracking modes are changed, the target is reset to default values, which includes 0 degrees longitude.

9.2 "Low Tracking Signal Level" Error Displayed

If a "Low tracking signal level" error is displayed:

1. Verify that the target and polarization are correct.

2. Check the tracking receiver:

   a. Verify that the beacon frequency is correct.
   b. If the ACU switches, check to see if the tracking receiver is in REMOTE.
   c. Check the RF to the receiver, especially LNA switches.

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9.3 "Excessive Tracking Signal Noise" Error Displayed

This is a notification, NOT a fault. If no other faults are occurring, the system is still functioning nominally.

9.4 Large Signal Fluctuation During AST Operations

If a large signal fluctuation occurs during AST operations, check the low speed potentiometer at the drive cabinet, and verify that the antenna is not overshooting.

9.5 Poor Tracking Performance

If the system is not adequately tracking:

1. Check settings of tracking parameters. Refer to the table in paragraph 5.8 of this manual that lists the parameters for the tracking mode of the target.

2. Verify that the steptrack step size is greater than the position loop deadband. If the step size is equal to or less than the position loop deadband, the steptrack function will not operate correctly.

3. Verify that the signal level into the beacon receiver is within acceptable limits. (The maximum RF levels for the VertexRSI TRC-14 and TRK-14 receivers are -60 dBm).

4. Check the calibration of the beacon signal. The 0 dBm level should be set at approximately 7.5 V to 8.5 V. Also note that calibration must be performed separately for each A/D in use.

5. Check for proper mechanical/electrical connections of resolvers.

6. Check resolver alignment. (If the bellows coupling between resolver and pickoff shaft appears visibly bent, the resolver is out of alignment.)

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10.0 Intelsat (IESS-412) Tracking Errors

10.1 "Intelsat data expired" Error Displayed

An "Intelsat data expired" error may be displayed if the current date/time is greater than 170 hours after the epoch. Update the data as required.

10.2 "Intelsat pre-epoch prediction" Error Displayed

The error "Intelsat pre-epoch prediction" will be displayed if the current date/time is before epoch on the 11-element set report. The previous (unexpired) set should be used until the current date/time is after epoch.

10.3 "Intelsat data invalid--cannot track" Error Displayed

The error "Intelsat data invalid--cannot track" is displayed when the 11-element set entered failed the 170 hour test (i.e., the predictions from the 11-element set at epoch plus 170 hours do not agree with the latitude and longitude at epoch plus 170 hours on the 11-element set report. Check the values entered in the ACU.

11.0 Password Lost

If a password is lost, it must be cleared and a new password must be entered because the 7200 ACU has no provision to recover a lost password. Follow the procedure in Appendix B of this manual to clear the password and enter a new one.

> ***NOTE: To prevent movement of the antenna by the ACU while resetting a password, press the DRIVE ENABLE button on the front panel of the ACU.***

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APPENDIX F – SITE TEST PROCEDURE

This appendix contains the Site Acceptance Test Procedure.

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1.0 SITE ACCEPTANCE TEST PROCEDURE

1.1 Preliminary Information

This test procedure is intended to serve as the final proof of performance document for the 7200 ACS, subsequent to field installation and set-up. Prior to the performance of these tests, the system must have been installed and adjusted as described in Section 4.0 of this manual. All motor rotation directions should be normalized, all limit stops should be set, and the Radio Frequency (RF) equipment used to provide the analog tracking signal should be calibrated for proper system performance.

This procedure is provided for both two, three-axis and four-axis systems. Ignore all references to the POL axis drive components for two-axis systems. The 3-axis system has POL and the four-axis has POL & 4th Axis.

1.2 Drive Cabinet Line Voltage Measurements and Power-Up

1. Using an AC voltmeter with the main circuit breaker OFF, measure and record the voltages on the line (upper) side of the main breaker as indicated below (record data under the appropriate heading for the main power provided for this system):

3-PHASE SYSTEMS (4-WIRE + GROUND)	
A phase to B phase	VAC
B phase to C phase	VAC
C phase to A phase	VAC
A phase to Neutral	VAC
B phase to Neutral	VAC
C phase to Neutral	VAC

SINGLE-PHASE SYSTEMS (3-WIRE 2-WIRE + GROUND)	
L1 to L2	VAC
L1 to Neutral	VAC
L2 to Neutral	VAC

SINGLE-PHASE SYSTEMS (2-WIRE + GROUND)	
Line to Neutral	VAC

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2. Inside the drive cabinet set the MAIN CIRCUIT BREAKER to ON. _____(Check)

3. Verify that the EMERGENCY STOP button is in the out position. _____(Check)

4. Turn all circuit breakers to the ON position and verify that the green LED in the on the Relay PCB is illuminated. _____(Check)

5. Verify that the CONTROL switch is in the MAINT position. _____(Check)

1.3 Motor Phasing Tests

1. Set the AZIMUTH and ELEVATION switches (Located on the PMCU) to TRACKING SPEED. _____(Check)

2. Jog AZ briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. _____(Check)

3. Jog EL briefly up and then down, checking to see that the resulting motion corresponds to the respective switch commands. _____(Check)

4. Jog POL briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. (N/A if "POL" is unavailable) _____(Check)

5. Jog 4th Axis briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. (N/A if "4th Axis" is unavailable) _____(Check)

6. Set the AZIMUTH and ELEVATION switches (Located on the PMCU) to SLEW SPEED. _____(Check)

7. Jog AZ briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. _____(Check)

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8. Jog EL briefly up and then down, checking to see that the resulting motion corresponds to the respective switch commands. _____(Check)

9. Jog POL briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. (N/A if "POL" is unavailable) _____(Check)

10. Jog 4th Axis briefly CW and then CCW, checking to see that the resulting motion corresponds to the respective switch commands. (N/A if "4th Axis" is unavailable) _____(Check)

11. Repeat steps 1-10 for any remaining PMCU connections. Record the number of connections. _____ (Record)

1.4 Miscellaneous Error and Fault Messages

1. In the drive cabinet, set the DRIVE CIRCUIT BREAKER to OFF. Verify that the 7200 ACU display shows **NO POWER AT DRIVE CABINET**. _____(Check)

2. In the drive cabinet, set the DRIVE CIRCUIT BREAKER to ON. _____(Check)

3. Press the EMERGENCY STOP button on the side of the drive cabinet. Verify that the 7200 ACU display shows **E STOP**. _____(Check)

4. Verify that the customer interface FLT contacts open. _____(Check)

5. Set the EMERGENCY STOP button to the out position. _____(Check)

6. Verify that the inverters reset and that there are no fault messages displayed. _____(Check)

7. Verify a closed circuit between the customer interface FLT terminals. _____(Check)

8. Repeat steps 1-7 for any remaining E-Stop interlocks and record info in the following table.

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ADDITIONAL E-STOP INTERLOCKS			
No.	Description	Drives Disabled	ACU Message
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
5		☐	☐
6		☐	☐
7		☐	☐
8		☐	☐
9		☐	☐
10		☐	☐

1.5 Limit Switch Tests

NOTE: This test may be combined with 6.7, Software Limit Tests, on slow-moving antennas where running through both software travel limits and limit switches independently would be very time-consuming. To perform the tests in this fashion, first verify that the Soft limits parameter is Enabled, (refer to paragraph 5.8.6). Use Manual antenna control from the ACU (refer to paragraph 5.8) to drive the antenna into its soft limit, then at the drive cabinet, complete the test by driving the antenna into the travel limit switch.

In this paragraph, the function and setting of the electrical limit switches on the antenna structure will be checked. Drive the antenna from the drive cabinet, which allows high speed jogging while also providing viewing access for any possible obstructions.

Use the following procedures to test the limit switches.

1. a. Drive the antenna using the JOG AZ CW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the AZ angle at which the limit occurred. _____ (Record)
   d. Verify that the antenna will drive in the CCW direction. _____(Check)

2. a. Drive the antenna using the JOG AZ CCW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the AZ angle at which the limit occurred. _____(Record)
   d. Verify that the antenna will drive in the CW direction. _____(Check)

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3. a. Drive the antenna using the JOG EL UP switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the EL angle at which the limit occurred. _____(Record)
   d. Verify that the antenna will drive in the DOWN direction. _____(Check)

4. a. Drive the antenna using the JOG EL DOWN switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the EL angle at which the limit occurred. _____(Record)
   d. Verify that the antenna will drive in the UP direction. _____(Check)

THREE AXIS SYSTEM (IF APPLICABLE)

5. a. Drive the antenna using the JOG POL CW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the POL angle at which the limit occurred. _____(Record)
   d. Check that the feed will drive in the CCW direction. _____(Check)

6. a. Drive the antenna using the JOG POL CCW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the POL angle at which the limit occurred. _____(Record)
   d. Check that the feed will drive in the CW direction. _____(Check)

FOUR AXIS SYSTEM (IF APPLICABLE)

5. a. Drive the antenna using the JOG 4th Axis CW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the 4th Axis angle at which the limit occurred. _____(Record)
   d. Check that the feed will drive in the CCW direction. _____(Check)

6. a. Drive the antenna using the JOG 4th Axis CCW switch until the limit switch stops the movement of the antenna. _____(Check)
   b. Check the 7200 ACU display for a **SUM LIMIT** message. _____(Check)
   c. Record the 4th Axis angle at which the limit occurred. _____(Record)
   d. Check that the feed will drive in the CW direction. _____(Check)

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1.6 Manual Antenna Control Tests

1. From the **Main menu**, select **Tracking functions...** and then **Manual antenna control**. _____(Check)

2. Jog AZ CCW and observe that **Azimuth: CCW** and **Speed: Track (low)** are highlighted and that the AZ angle decreases. _____(Check)

3. Jog AZ CW and observe that **Azimuth: CW** and **Speed: Track (low)** are highlighted and that the AZ angle increases. _____(Check)

4. Jog EL DOWN and observe that **Elevation: Down** and **Speed: Track (low)** are highlighted and that the EL angle decreases. _____(Check)

5. Jog EL UP and observe that **Elevation: Up** and **Speed: Track (low)** are highlighted and that the EL angle increases. _____(Check)

THREE AXIS SYSTEM

6. Jog POL and observe that **Polarization: CCW** is highlighted and that the POL angle decreases. _____(Check)

7. Jog POL CW and observe that **Polarization: CW** is highlighted and that the POL angle increases. _____(Check)

FOUR AXIS SYSTEM

8. Jog 4th Axis CCW and observe that **Polarization: CCW** is highlighted and that the POL angle decreases. _____(Check)

9. Jog 4th Axis CW and observe that **Polarization: CW** is highlighted and that the POL angle increases. _____(Check)

10. Hold the [SHIFT] key down and jog AZ CCW and observe that **Azimuth: CCW** and **Speed: Slew (high)** are highlighted and that the AZ angle decreases. _____(Check)

11. Hold the [SHIFT] key down and jog AZ CW and observe that **Azimuth: CW** and **Speed: Slew (high)** are highlighted and that the AZ angle increases. _____(Check)

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12. Hold the [SHIFT] key down and jog EL DOWN and observe that **Elevation: Down** and **Speed: Slew (high)** are highlighted and that the EL angle decreases. _____(Check)

13. Hold the [SHIFT] key down and jog EL UP and observe that **Elevation: Up** and **Speed: Slew (high)** are highlighted and that the EL angle increases. _____(Check)

    NOTE: When moving the antenna in sticky mode, pressing the +/- key and the direction-activating key starts the antenna movement, and pressing the direction-activating key stops the antenna movement.

14. Repeat steps 2 through 12 in **Sticky** mode. _____(Check)

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1.7 Software Limit Tests

The software (soft) limits provide an added margin of safety when the location of the 7200 ACU or the remote link causes obstructed visibility of the antenna. Test the function and setting of each soft limit by driving the antenna from the 7200 ACU using **Manual antenna control**. Record the tested Motion Limit parameters in the following table.

MOTION LIMITS			
Soft limits	Enabled ☐		Disabled ☐
Lower/CCW soft limits [deg]	AZ:	EL:	POL:
Upper/CW software limits [deg]	AZ:	EL:	POL:

1. From the **Main menu**, select **Tracking functions...** and then select **Manual antenna control**. _____(Check)

2. Press the [+/-] key and the direction key to drive the antenna CW in AZ until the soft limit stops the movement of the antenna. _____(Check)

3. Check the display for an **AZIMUTH CW SOFT LIMIT** message. _____(Check)

4. Record the AZ angle at which the limit occurred. _____(Record)

5. Drive the antenna CCW in AZ to check that the antenna will back out of the soft limit. _____(Check)

6. Drive the antenna CCW in AZ until the soft limit stops the movement of the antenna. _____(Check)

7. Check the display for a **SOFT LIMIT** message. _____(Check)

8. Record the AZ angle at which the limit occurred. _____(Record)

9. Drive the antenna CW in AZ to check that the antenna will back out of the soft limit. _____(Check)

10. Drive the antenna up in EL until the soft limit stops the movement of the antenna. _____(Check)

11. Check the display for a SOFT LIMIT message. _____(Check)

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12. Record the EL angle at which the limit occurred. _____(Record)

13. Drive the antenna down in EL to check that the antenna will back out of the soft limit. _____(Check)

14. Drive the antenna down in EL until the soft limit stops the movement of the antenna. _____(Check)

15. Check the display for a SOFT LIMIT message. _____(Check)

16. Record the EL angle at which the limit occurred. _____(Record)

17. Drive the antenna up in EL to check that the antenna will back out of the soft limit. _____(Check)

THREE AXIS SYSTEM

18. Drive the feed tube CCW until the soft limit stops the movement of the feed tube. _____(Check)

19. Check the display for a SOFT LIMIT message. _____(Check)

20. Record the POL angle at which the limit occurred. _____(Record)

21. Drive the feed tube CW to check that the feed tube will back out of the soft limit. _____(Check)

22. Drive the feed tube CW until the soft limit stops the movement of the feed tube. _____(Check)

23. Check the display for a SOFT LIMIT message. _____(Check)

24. Record the POL angle at which the limit occurred. _____(Record)

25. Drive the feed tube CCW to check that the feed tube will back out of the soft limit. _____(Check)

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FOUR AXIS SYSTEM

26. Drive the feed tube CCW until the soft limit stops the movement of the feed tube. _____(Check)

27. Check the display for a SOFT LIMIT message. _____(Check)

28. Record the 4th Axis angle at which the limit occurred. _____(Record)

29. Drive the feed tube CW to check that the feed tube will back out of the soft limit. _____(Check)

30. Drive the feed tube CW until the soft limit stops the movement of the feed tube. _____(Check)

31. Check the display for a SOFT LIMIT message. _____(Check)

32. Record the 4th Axis angle at which the limit occurred. _____(Record)

33. Drive the feed tube CCW to check that the feed tube will back out of the soft limit. _____(Check)

1.8 Steptrack Tests

1.8.1 Input Signal Variation

Accurate tracking is predicated on a stable reference tracking signal. Therefore, the stability of the tracking signal must be established before system tracking accuracy can be evaluated.

Observe the beacon level on the 7200 display with the antenna parked at beam center for at least one minute and record the signal variation in the following table.

Signal Variation (dB)	

If the observed variation is in excess of +/- 0.1 dB, evaluation of the system tracking accuracy will be uncertain, limited by the amount of fluctuation present.

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1.8.2Tracking Accuracy

Record Steptrack Defaults Parameters in the following table.

STEPTRACK DEFAULTS	
Cycle time (hh:mm:ss)	
Receive -3dB beamwidth (deg)	
Step size (deg)	
Position deadband (deg)	
Maximum no. of cycles	
Cycle to start rate estimates	
Peaking correction limit (%BW)	
Weight adjustment value (0-1)	
Low tracking signal level (dB)	
Signal threshold (dB)	
Axis to peak first (AZ,EL)	
# of samples	
Sun outage protection (enabled,disabled)	

1. In **Manual antenna control**, move the antenna off beam center in the direction listed in the following table until the signal level drops 2dB.

2. Activate **Steptrack** and allow the system to repeak the antenna and record the resulting signal level from the 7200 ACU display below in the TRACK LEVEL column.

3. Return to **Manual antenna control** and manually peak the antenna and record the resulting signal level in the MANUAL LEVEL column. Repeat steps 1-3 for each subsequent direction listed in the following table.

DIRECTION	TRACK LEVEL	MANUAL LEVEL	ERROR
AZ CCW			
AZ CW			
EL UP			
EL DOWN			

NOTE: If the level achieved in Steptrack is greater than that achieved in manual peaking, enter a zero for the error.

4. Calculate the RMS tracking accuracy as follows:

$$RMS\ TRACKING\ ERROR = \left[\frac{(AZCCW)^2 + (AZCW)^2 + (ELDOWN)^2 + (ELUP)^2}{2}\right]^{1/2}$$

5. Record the RMS TRACKING ERROR (< 0.1 dB, Nominal) _____dB(Record)

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1.8.3 Orbit Prediction Tracking (OPT)

1. Configure an OPT target, based upon the simulated satellite nominal location and inclination and record the information in the following table.

MENU	VALUE
TARGET #	
TARGET NAME	
TARGET MODE	OPT
TARGET PARAMETERS	
SPACECRAFT PARAMETERS	
Box Center (deg East)	
Longitude range (deg)	
Est. Inclination (deg)	
Box Limit	
Orbit Scan	
Tracking Signal Parameters	
Freq. (MHz)	
RF Input	
Attenuation (dB)	

2. Execute the target. Verify that the following sequence of events occurs successfully:

   a. Target name appears and antenna is moved to AZ/EL for nominal longitude. _____(Check)

   b. Orbit scan is initiated (if required) and satellite is acquired. _____(Check)

   c. OPT mode takes over and steptrack activity is initiated with a 2-minute cycle time. _____(Check)

   d. After approximately 1.25 hours, a short-term model is generated and followed, with steptrack cycle time lengthened to 10 minutes. _____(Check)

3. Disconnect the signal input to the tracking receiver. Verify that a “lowsignal" alarm appears and the system follows the OPT model. _____(Check)

4. Reconnect the tracking receiver. Verify that the "low signal" alarm disappears and a steptrack cycle is started. _____(Check)

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1.9 System Parameter Recording

TRACKING RECEIVER SETUP	
Receiver Controller	
0 dB Setting	
A/D Slope	

STEPTRACK DEFAULTS	
Cycle Time	
Receive -3 dB Beamwidth (deg)	
Step Size (deg)	
Position Deadband (deg)	
Maximum No. of Cycles	
Cycle To Start Rate Estimates	
Peaking Correction Limit (%BW)	
Weight Adjustment Value	
Low Tracking Signal Level (dB)	
Signal Threshold Level (dB)	
Axis to Peak First	
# of Samples	
Sun Outage Protection	

POSITION ENCODER CONFIGURATION				
	Azimuth	**Elevation**	**POL**	**4th Axis**
Encoder Direction (forward,reversed)				
Current Position				
Offsets				
Encoder Type				
Two-Speed Internal Alignment			N/A	N/A

MOTION LIMITS			
	Azimuth	**Elevation**	**POL**
Soft Limits (enabled, disabled)			

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Lower/CCW soft limits (deg)			
Upper/CW soft limits (deg)			
Motion Errors (enabled, disabled)			
Immobile/reversed timeout (ms)			
Immobile/reversed tolerance (deg)			
Runaway Angle (deg)			N/A

POSITION LOOP PARAMETERS			
	Azimuth	**Elevation**	**POL**
Positioning deadband (deg)			
Slew rate (Enabled or Disabled)			
Slew -> track trasition (deg)			N/A
Slew -> stop coast time (ms)			N/A
Track -> stop coast time (ms)			
Inching on time (ms)			

SITE DATA	
Antenna Name	
E. Longitude of Site (deg)	
N. Latitude of Site (deg)	
Site Altitude (meters)	
Timezone Offset (hh:mm:ss)	
Timezone Abbreviation	

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RF GEOMETRY		
Polarization Axis (enabled, disabled)		
Antenna Droop Correction (enabled, disabled)		
Amplitude Droop Correction (deg)		
Elevation Alignment (deg)		
XEL Correction (enabled, disabled & value)		

ACU REMOTE PORT CONFIGURATION (PORTS 1-4)				
Port #	1	2	3	4
bps (Baud)				
Parity				
Data Bits				
Stop Bits				
Shell				
Echo				
Newline				
Checksums				
Handshake				
Screen lines				
RS232/RS422				

ACU REMOTE PORT CONFIGURATION (PORTS 5-7)			
Port #	5	6	7
bps (Baud)			
Parity			
Data Bits			
Stop Bits			
Shell			
Echo			
Newline			
Checksums			
Handshake			
Screen lines			
RS232/RS422			

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USER INTERFACE	
UTC Display (enabled, disabled)	
Local Time Display (enabled, disabled)	
UTC Date Format (dd Mmm)	
Local Date Format (dd Mmm)	
Tracking Signal display (enabled, disabled)	
Signal Units (dB, V)	
User Level Display (enabled, disabled)	
Confirm Tracking (enabled, disabled)	
Confirm Edits (enabled, disabled)	
Warning Bell (enabled, disabled)	
Audible Alarm (enabled, disabled)	
Monitor Can [STOP/RESUME] (enabled, disabled)	
Monitor Can Clear Faults (enabled, disabled)	
YES/NO Default Answer (Yes, No)	
Always Show Target Position (enabled, disabled)	
Command Angle Display (Error, Position)	
Auto-advance when editing (enabled, disabled)	
Alarm on Standby (enabled, disabled)	

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TRACKING RESTORATION OPTIONS	
Standby after boot (enabled, disabled)	
Standby on emergency stop (enabled, disabled)	
Standby on motor controller fault (enabled, disabled)	
Standby on maintenance override (enabled, disabled)	
Standby on ADU power loss (enabled, disabled)	
Tracking initiation delay (ms)	

MESSAGE PRINTER OPTIONS	
Target Change/Standby (enabled, disabled)	
Faults (enabled, disabled)	
New Steptrack Peak (enabled, disabled)	
New OPT Solution (enabled, disabled)	
Parameter Changes (enabled, disabled)	
User Level Changes (enabled, disabled)	
System Clock Set (enabled, disabled)	
Tracking signal modified (enabled, disabled)	
Target Scheduler Status (enabled, disabled)	
Initialization messages (enabled, disabled)	
Tag w/ Current Position (enabled, disabled)	
Execution Trace (enabled, disabled)	

A – Fixed remote port table	M. Neely	8-14-06	D. Harrison	8-14-06	6695
New Release, (from CG-1260-)	M. Neely	6-25-02	D. Harding	6-25-02	4137
Rev. No/change	Revised By	Date	Approved By	Date	ECO#

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COMMENTS

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VertexRSI COPY

PROVISIONAL ACCEPTANCE

The site acceptance test of the Model 7200 Antenna Control System is complete except for the discrepancies as noted below. Control of the system is now transferred to the customer. This discrepancy list is considered to be final.

Customer: _____ Location: _____

Equipment: _____ Date: _____

(Customer Representative)

_____

(VertexRSI Representative)

_____

Discrepancy List

_____

_____

_____

_____

_____

_____

_____

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CUSTOMER COPY

PROVISIONAL ACCEPTANCE

The site acceptance test of the Model 7200 Antenna Control System is complete except for the discrepancies as noted below. Control of the system is now transferred to the customer. This discrepancy list is considered to be final.

Customer: _____ Location: _____

Equipment: _____ Date: _____

(Customer Representative)

_____

(VertexRSI Representative)

_____

Discrepancy List

_____

_____

_____

_____

_____

_____

_____

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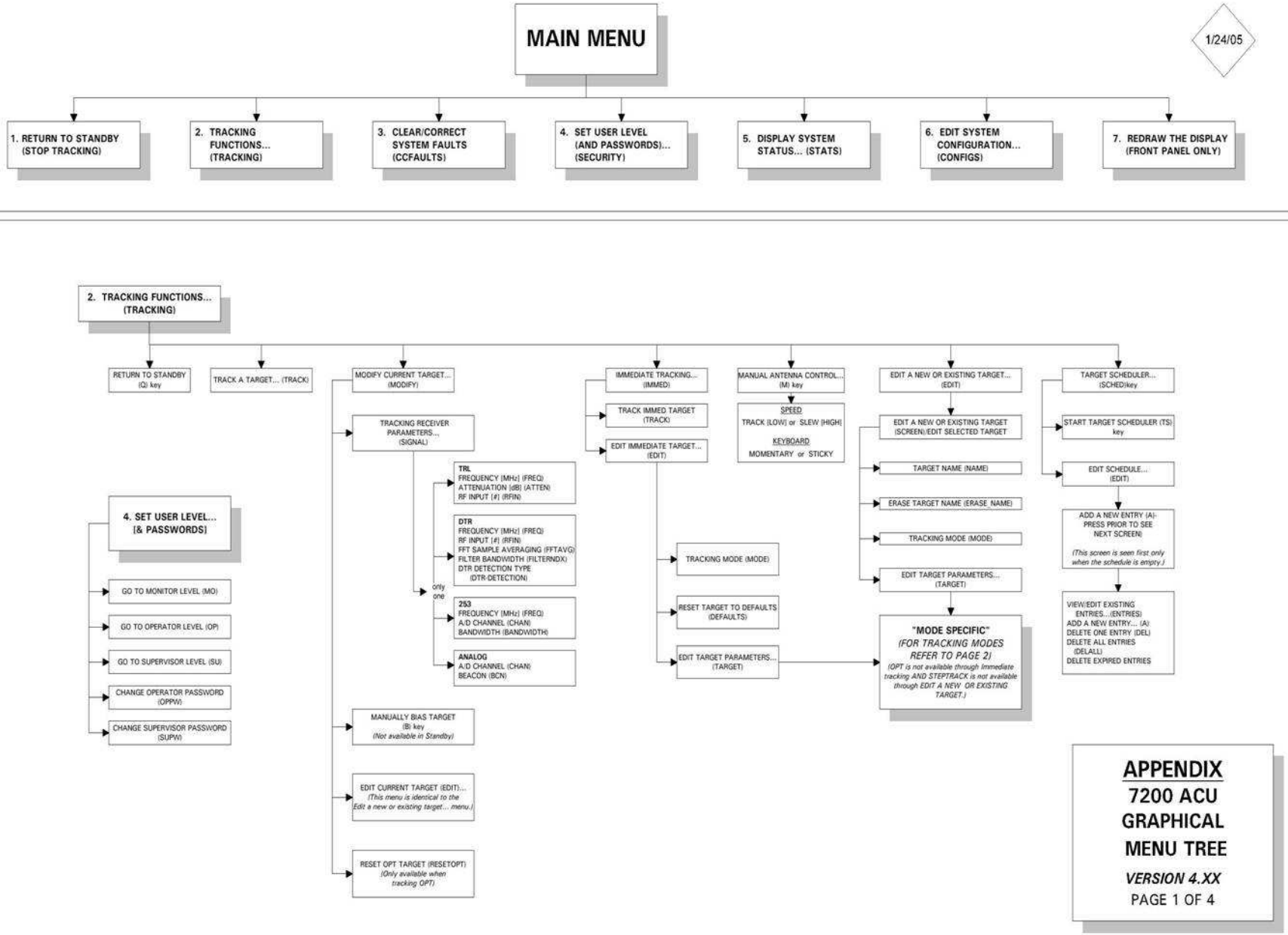
APPENDIX G – GRAPHICAL MENU TREE

This appendix contains the Graphical Menu Tree.

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NOTE: Words in parenthesis are M & C Command names. The word "key" following the identifier in parenthesis, denotes that the M & C Command is a "keyword" and can be executed anywhere within the menu.

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"MODE SPECIFIC " PARAMETERS
CONTINUED FROM PAGE 1

MOVE TO LOOK ANGLES TRACKING MODE

- LOOK ANGLES [DEG] (LOOKANGLES)
- BIAS ANGLES [DEG] (BA)

STAR TRACKING MODE

- STAR (STAR)
- RIGHT ASCENSION [DEG] (ASCENSION)
- DECLINATION [DEG] (DECLINATION)
- EPOCH [JULIAN DATE] (EPOCH)
- TIME BIAS (TIMEBIAS)
- POLARAIZATION [DEG]
- BIAS ANGLES [DEG] (BA)

MOVE TO LONGITUDE TRACKING MODE

- E LONGITUDE OF TARGET [DEG] (E_LONG)
- LOOK ANGLES [DEG] (LOOKANGLES)
- POLARIZATION [DEG] (POL)
- BIAS ANGLES [DEG] (BA)

INTELSAT 11-ELEMENT (IESS-412) TRACKING MODE

- TEST ELEMENT SET (TEST)
- YEAR (YEAR)
- MONTH (MONTH)
- DAY (DAY)
- HOUR (HOUR)
- MINUTE (MIINUTE)
- SECOND (SECOND)
- LM0 [DEG. E] (LM0)
- LM1 [DEG/DAY] (LM1)
- LM2 [DEG/DAY/DAY] (LM2)
- LONC [DEG. E] (LONC)
- LONC1 [DEG/DAY] (LONC1)
- LONS [DEG. E] (LONS)
- LONS1 [DEG/DAY] (LONS1)
- LATC [DEG. N] (LATC)
- LATC1 [DEG/DAY] (LATC1)
- LATS [DEG. N] (LATS)
- LATS1 [DEG/DAY] (LATS1)
- LONGITUDE AT 170 HOURS [DEG. E] (LON170)
- LATITUDE AT 170 HOURS [DEG. N] (LAT170)
- POLARIZATION ANGLE [DEG] (POL)
- BIAS ANGLES [DEG] (BA)
- POINTING UPDATE TIME [MS] (POINTING)

OPT

SPACECRAFT PARAMETERS... (SPACECRAFT)

- BOX CENTER LONGITUDE [DEG. EAST] (BOXCENTER)
- LONGITUDE RANGE [DEG] (LONGRANGE)
- ESTIMATED INCLINATION [DEG] (INCLINATION)
- BOX LIMIT (BOXLIMIT)
- ORBIT SCAN (ORBITSCAN)
- TRACKING SIGNAL PARAMETERS... (RCV))
- CALIBRATE TRACKING SIGNAL... (CALSIG)
  - SET 0dB POINT (0DBPOINT)
  - SET -3dB POINT (3DBPOINT)
  - 0 dB SETTING (DBSET)
  - A/D SLOPE (ADSLOPE)
  - MANUAL ANTENNA CONTROL... (M) key
    - SPEED: TRACK [LOW] or SLEW [HIGH]
    - KEYBOARD: MOMENTARY or STICKY

only one

- **TRL**: FREQUENCY [MHz] (FREQ), ATTENUATION [dB] (ATTEN), RF INPUT [#] (RFIN)
- **DTR**: FREQUENCY [MHz] (FREQ), RF INPUT [#] (RFIN), FFT SAMPLE AVERAGING (FFTAVG), FILTER BANDWIDTH (FILTERNDX), DTR DETECTION TYPE (DTR-DETECTION)
- **253**: FREQUENCY [MHz] (FREQ), A/D CHANNEL (CHAN), BANDWIDTH (BANDWIDTH)
- **ANALOG**: A/D CHANNEL (CHAN), BEACON (BCN)

STEPTRACK PARAMETERS... (AST)
(Also available in IMMEDIATE TRACKING)

- CYCLE TIME (CYCLET)
- RECEIVE -3 dB BEAMWIDTH [DEG] (BW)
- STEP SIZE [DEG] (STEPSIZE)
- POSITION DEADBAND [DEG] (DEADBAND)
- MAXIMUM NO. OF CYCLES (#CYCLES)
- CYCLE TO START RATE ESTIMATES (RATECYCLE)
- PEAKING CORRECTION LIMIT [%BW] (PEAKLIMIT)
- WEIGHT ADJUSTMENT VALUE (WEIGHT)
- LOW TRACKING SIGNAL LEVEL [dB] (LOWSIGNAL)
- SIGNAL THRESHOLD [dB] (THRESHOLD)
- AXIS TO PEAK FIRST (1STAXIS)
- # OF SAMPLES (#SAMPLES)
- SUN OUTAGE PROTECTION (SUN)

OPT PARAMETERS... (OPTPARAMS)

- CYCLE TIME WITH ST SOLUTION [MIN] (CYCLEST)
- CYCLE TIME WITH LT SOLUTION [MIN] (CYCLELT)
- SIGNAL FLUCTUATION LIMIT [dB] (SIGLIMIT)
- MIN. ST SOLUTION TIME SPAN [HRS] (STSOL)
- MIN. LT SOLUTION TIME SPAN [HRS] (LTSOL)
- ADVANCED OPT PARAMETERS... (ADVANCED)
  - ST DISCARD POINT (STDISCARD)
  - LT DISCARD POINT (LTDISCARD)
  - dB COLLECT CYCLE TIME [ms] (DBCYCLE)
  - PROPAGATOR CYCLE TIME [ms] (PROPCYCLET)
  - MAX SOLUTION RMS (MAXSOL)
  - MAX STEPTRACK FIT [dB] (MAXFIT)
  - MAX STEPTRACK STD [dB] (MAXSTD)
  - USE SOLUTIONS (SOLUTIONS)
  - INHIBIT STEPTRACK DURING NOISE (INHIBIT_AST)
  - NON-GEOSYNCHRONOUS SUPPORT... (NON_GEO)
    - NON-GEOSYNCHRONOUS TRACKING (NGTRACK)
    - ORBITAL PERIOD [SECONDS] (PERIOD)
    - ORBIT ECCENTRICITY (ECCENTRICITY)
    - ORBIT ARGUMENT OF PERIGEE [DEG] (PERIGEE)

RESET OPT TARGET (RESETOPT)

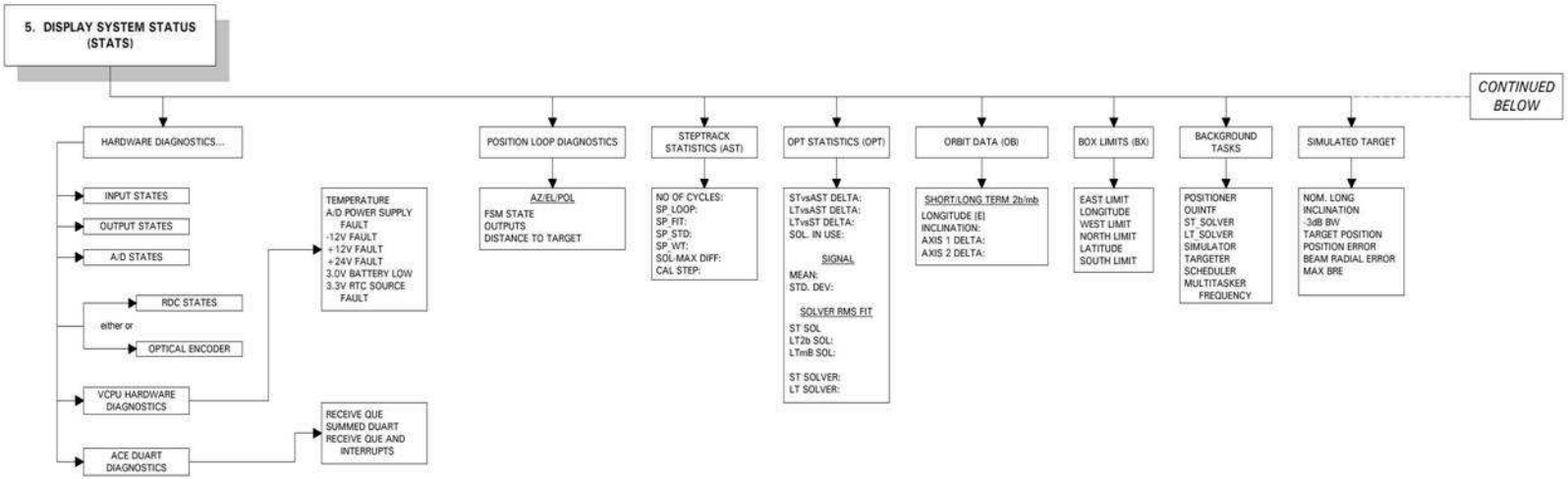
ORBITAL ELEMENT SET TRACKING MODE (OPTIONAL)

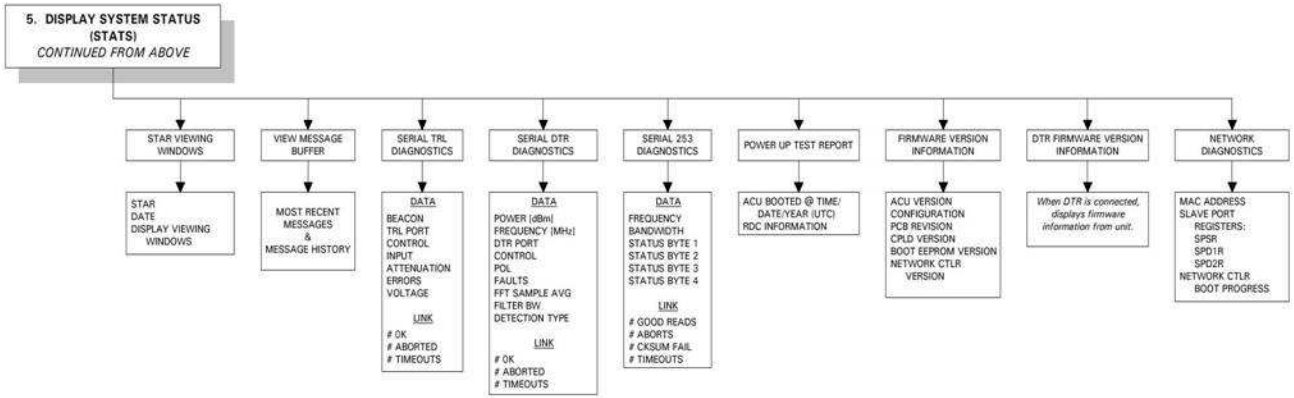
- TEST ELEMENT SET (TEST)
- YEAR (YEAR)
- MONTH (MONTH)
- DAY (DAY)
- HOUR (HOUR)
- MINUTE (MINUTE)
- SECOND (SECOND)
- X POSITION [km] (XPOS)
- Y POSITION [km] (YPOS)
- Z POSITION [km] (ZPOS)
- X VELOCITY [m/sec] (XVEL)
- Y VELOCITY [m/sec] (YVEL)
- Z VELOCITY [m/sec] (ZVEL)
- POLARIZATION ANGLE [DEG] (POL)
- BIAS ANGLES [DEG] (BA)
- POINTING UPDATE TIME [MS] (POINTING)

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NOTE: Words in parenthesis are M & C Command names. The word "key" following the identifier in parenthesis, denotes that the M & C Command is a "keyword" and can be executed anywhere within the menu.

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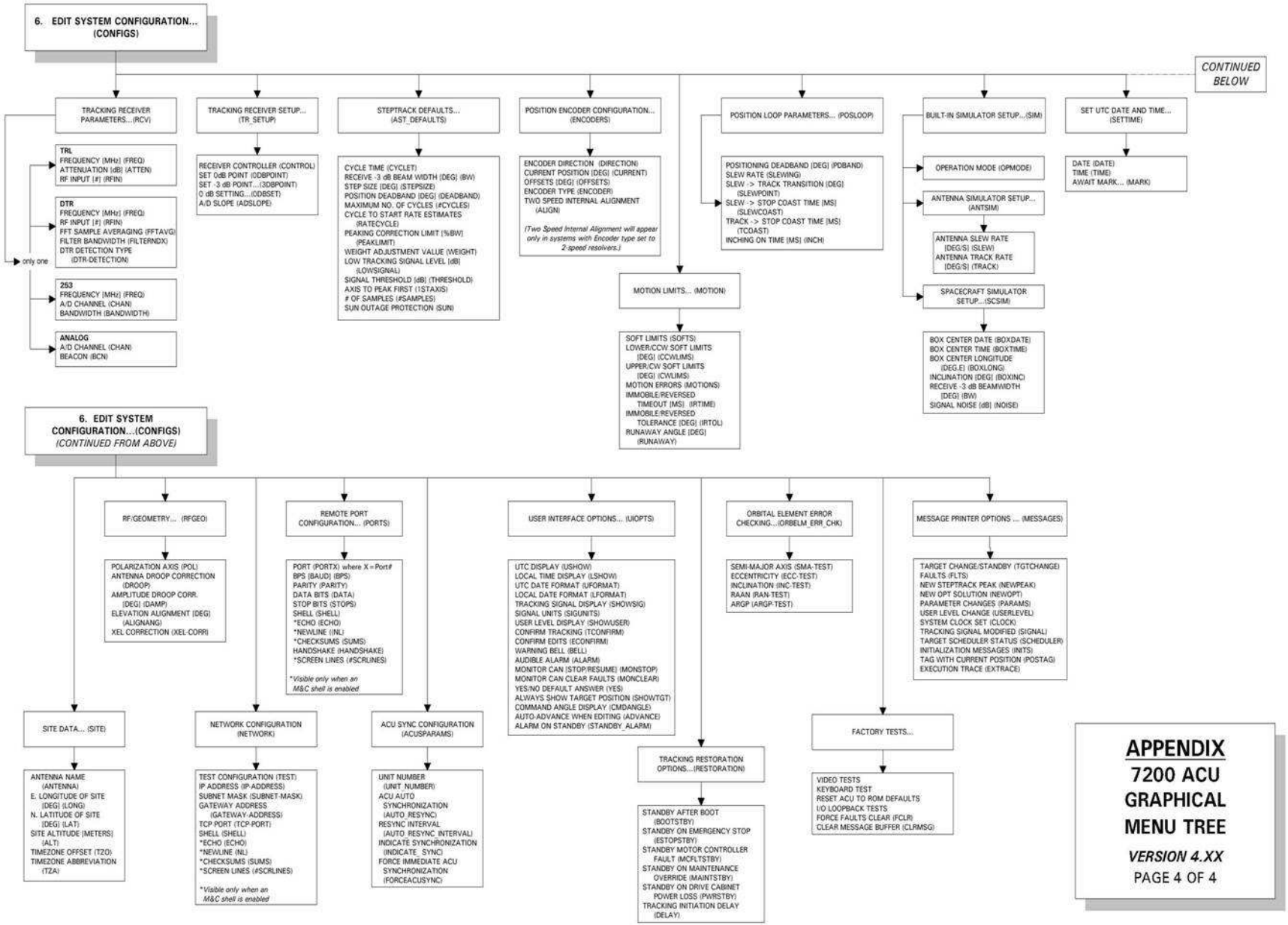




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APPENDIX H - VENDOR DATA

This appendix contains the O & M Manual for the Inverter Drives. This file is not included in the PDF version of this manual, but can be downloaded from: http://www.gdsatcom.com/controls.php under the "Supplemental Information" link.

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Appendix J
FIELD PROCEDURE(s) TO INSTALL CTB055

STANDARD METHOD

1. Strip the insulation from the Resolver wire (Approx 3/8″)
2. Strip the insulation from the connecting cable (Approx 2/8″)
3. Twist the two wires tightly together
4. Solder the two wires
5. Cut the exposed twisted wires to a final length of about ¼″
6. Insert the two wires into one side of the CTB055.
7. Crimp using the approved 3M crimping tool (Part # E9-BM).

Insert solders wires in to one side only



ALTERNATE METHOD IF CTB055 IS NOT AVAILABLE

1. Strip the insulation from the Resolver wire (Approx 3/8″)
2. Strip the insulation from the connecting cable (Approx 2/8″)
3. Slip some appropriately sized heat shrink over one of the wires
4. Twist the two wires tightly together
5. Solder the two wires
6. Position the heat shrink over the exposed soldered wires

7. Using a heat gun or alternate appropriate heat source, heat the shrink tubing so that the entire exposed soldered wires are appropriately covered.

Appendix K

NORAD Tracking

The 7200 ACU supports the utilization of "NORAD 2-line element sets", also known as "NORAD TLE". The use of the name "NORAD" is historical, as the NORAD organization no longer exists and has been replaced with Space Command. The name "NORAD TLE" continues as people are used to it.

Space Command maintains general perturbation element sets on all resident space objects. These element sets are periodically refined so as to maintain a reasonable prediction capability on all space objects. In turn, these element sets are provided to users. The purpose of the "NORAD tracking" function in the 7200 ACU is to use the NORAD TLE sets to provide the user with a means of propagating these element sets in real time and point the antenna under control of the ACU at the space object.

It is important to clarify that not just any prediction model will suffice. The NORAD element sets are "mean" values obtained by removing periodic variations in a particular way. In order to obtain good predictions, these periodic variations must be reconstructed (by the prediction model) in exactly the same way they were removed by NORAD. Hence, inputting NORAD element sets into a different model (even though the model may be more accurate or even a numerical integrator) will result in degraded predictions. The NORAD element sets must be used with SGP4 or SPD4 as implementing in the 7200 ACU in order to retain maximum prediction accuracy.

Element set Format

A NORAD two-line element set actually consists of three lines of information. The first line is the name of the target followed by two 69-character lines of data which can be used together with the NORAD SGP4/SDP4 orbital model to determine the position and velocity of the associated satellite. The only valid characters in a two-line element set are the numbers 0-9, the capital letters A-Z, the period, the space, and the plus and minus signs—no other characters are valid.

Of course, not all valid characters can be used in all columns within the element set. Figure 1 shows what type of character is valid for each column. Columns with a space or period can have no other character. Columns with an 'N' can have any number 0-9 or, in some cases, a space. Columns with an 'A' can have any character A-Z or a space. The column with a 'C' can only have a character representing the classification of the element set—normally either a 'U' for unclassified data or an 'S' for secret data (of course, only unclassified data are

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publicly available). Columns with a '+' can have either a plus sign, a minus sign, or a space and columns with a '-' can have either a plus or minus sign (if the rest of the field is not blank).

Data for each satellite consists of three lines in the following format:

```
AAAAAAAAAAAAAAAAAAAAAA

1 NNNNNU NNNNNAAA NNNNN.NNNNNNNN +.NNNNNNNN +NNNNN-N +NNNNN-N N NNNNN

2 NNNNN NNN.NNNN NNN.NNNN NNNNNNN NNN.NNNN NNN.NNNN NN.NNNNNNNNNNNNNN
```

Line 0 is a twenty-four character name (to be consistent with the name length in the NORAD SATCAT).

Lines 1 and 2 are the standard Two-Line Orbital Element Set Format identical to that used by NORAD and NASA. The format description is:

Line 1

Column	Description
01	Line Number of Element Data
03-07	Satellite Number
08	Classification (U=Unclassified)
10-11	International Designator (Last two digits of launch year)
12-14	International Designator (Launch number of the year)
15-17	International Designator (Piece of the launch)
19-20	Epoch Year (Last two digits of year)
21-32	Epoch (Day of the year and fractional portion of the day)
34-43	First Time Derivative of the Mean Motion
45-52	Second Time Derivative of Mean Motion (decimal point assumed)
54-61	BSTAR drag term (decimal point assumed)
63	Ephemeris type
65-68	Element number
69	Checksum (Modulo 10) (Letters, blanks, periods, plus signs = 0; minus signs = 1)

Line 2

Column	Description
01	Line Number of Element Data
03-07	Satellite Number
09-16	Inclination [Degrees]
18-25	Right Ascension of the Ascending Node [Degrees]

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27-33	Eccentricity (decimal point assumed)
35-42	Argument of Perigee [Degrees]
44-51	Mean Anomaly [Degrees]
53-63	Mean Motion [Revs per day]
64-68	Revolution number at epoch [Revs]
69	Checksum (Modulo 10)

All other columns are blank or fixed.

Example:
NOAA 14

1 23455U 94089A 97320.90946019 .00000140 00000-0 10191-3 0 2621

2 23455 99.0090 272.6745 0008546 223.1686 136.8816 14.11711747148495

The epoch defines the time to which all of the time-varying fields in the element set are referenced.

The format of the epoch is best expelled with an example:
An epoch of 98001.00000000 corresponds to 0000 UT on 1998 January 01—in other words, midnight between 1997 December 31 and 1998 January 01. An epoch of 98000.00000000 would actually correspond to the beginning of 1997 December 31—strange as that might seem. Note that the epoch day starts at UT midnight (not noon) and that all times are measured mean solar rather than sidereal time units.

The 2-line element data can be entered into the 7200 ACU by use of the front panel or the M&C system. For most users the M&C is the best and most efficient way to setup and maintain NORAD targets. It is possible to build a NORAD target at the front panel. The 7200 ACU is not capable of receiving the NORAD TLE information directly, so the user is responsible to select the correct information from the TLE sets and place it into the parameters listed below.

From the "Main menu..."

The user selects: "Tracking Functions...", "Edit a new or existing target..."

Then select the target number and set tracking mode to "NORAD (2-line elements)".

Enter "Edit target parameters..."

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The ACU will display each required parameter that must be read from the two-line element set.

Parameter: " Year"
Limits: 2000 to 2099
Description:
Year is the year portion of the Epoch time on which the element set is based.
Note: The input value MUST be a 4 digit number.
e.g.: 2090 is OK but 90 is not. 2001 is OK but 01 is not.

Parameter: " Day of year"
Limits: 0.0 to 365.0
Description:
Day of year and fractional portion of the day on which the element set is based.
Note: Input is up to 12 digit real value.

Parameter: " BSTAR"
Limits: -1.0 to 1.0
Description:
B* (BSTAR) represents a drag co-efficient. It is made up of the ballistic co-efficient of the object multiplied by a reference value of atmospheric density.
Note: B* has units of 1 / (earth radii)

Parameter: " Inclination [Degrees]"
Limits: 0.0001 to 179.9999
Description:
Earth Centered Inertial Orbital Inclination in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: degrees

Parameter: " RAAN [degrees]"
Limits: 0.0 to 360.0
Description:
Right Ascension of Ascending Node in a True Earth Mean Equinox (TEME) reference
fixed at the time of Epoch. Units: Degrees

Parameter: " Eccentricity"
Limits: 0.0 to 1.0
Description:
Earth Centered Inertial Eccentricity in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: None

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Parameter: " Arg. of Perigee [Degrees]"
Limits: 0.0 to 360.0
Description:
Earth Centered Inertial Argument of Perigee in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: degrees

Parameter: " Mean Anomaly [degrees]"
Limits: 0.0 to 360.0
Description:
Earth Centered Inertial Mean Anomaly in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: degrees

Parameter: " Mean Motion [revs per day]"
Limits: 0.0 to 100.0
Description:
Earth Centered Inertial Mean Motion in a True Earth Mean Equinox (TEME) reference fixed at the time of Epoch. Units: revs per day

Parameter: " Polarization angle [deg]"
Limits: 0 to 90
Description:
Polarization angle used with Norad 2 line tracking, if polarization is enabled. If the ACU doesn't control polarization, this value is irrelevant.

Parameter: "Bias angles [deg]"
Limits: -180 to 180
Description:
These angles are added to the calculated lookangles to come up with the target position.

Note:

1. 4 digits are required for year (e.g.: 2000, not 00).
2. The ACU will select the propagator (SPP4 or SDP4) when tracking starts based on the orbital period. If less than 225 minutes SGP4 will be used. For greater or equal to 225 minutes DSP4 will be used.
3. Decimal points must be supplied for the elements that do not have them in the original sets. This includes BSTAR and Eccentricity.
4. The data is taken from the following locations:

	Line	Column
Epoch Year	1	19-20
Epoch DOY	1	21-32

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BSTAR	1	54-61
Inclination	2	09-16
RAAN	2	18-25
Eccentricity	2	27-33
ARGP	2	35-42
Mean Anomaly	2	44-51
Mean Motion	2	53-63

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