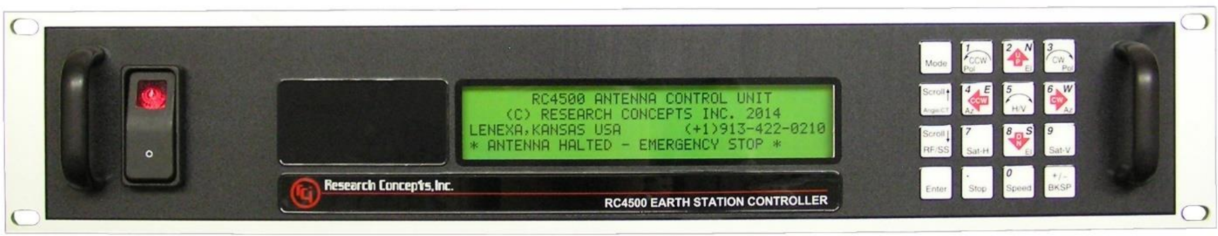
RC4500 ANTENNA CONTROLLER

USER'S MANUAL



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REVISION HISTORY

DATE	MODIFICATION	SW VERSION	INITIALS
18 AUG 2016	Initial release.	2.03	JDK
05 OCT 2016	Corrections made to many screenshots and descriptions. Reorganized chapters. The installation procedure is now separated from the trouble-shooting section.	2.03	JDK
10 NOV 2016	Updated warranty section.	N/A	BK
3 JAN 2017	Added detailed descriptions of signals for J6 – Auxiliary I/O and J7 – Antenna I/O connectors in sections 3.1.2.3 and 3.1.2.4	2.03	JDK
2 AUG 2017	Massive review of content. Added embedded ACU hardware section.	2.03	ECG

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   b. Purchase date
   c. Detailed description of the problem and circumstances when problem appears, including details on the electrical connection to associated equipment
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4. Water / Liquid damage

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For service call +1 (913) 422-0210 or email support@researchconcepts.com.

TABLE OF CONTENTS

1.0 INTRODUCTION

The RC4500 is a satellite antenna controller unit (ACU) designed to automate the operation of fixed-based antennas. Up to 100 satellite locations can be stored and automatically recalled. The ACU supports a variety of high-resolution sensors for position feedback and can control high-voltage motors when paired with an Antenna Interface Unit (AIU).

1.1 Manual Organization

Many hardware and software options are available with the RC4500 antenna controller. This manual is organized to 1) describe common features that apply to all controllers, and 2) provide a structure to define features unique to a specific application.

Chapter 1: Summarizes the manual contents and highlights the functionality and features.

Chapter 2: Covers the user interface and basic operations.

Chapter 3: Covers the mechanical and electrical components including the board set, interfaces, and common external components.

Chapter 4: Covers the calibration and installation procedures.

Chapter 5: Covers all modes and configuration screens in-depth.

Chapter 6: Covers trouble-shooting information, error code descriptions and other ACU topics.

Appendix A: Lists the expert access codes on a single page, which may be removed to eliminate the possibility of inexperienced users inadvertently clearing configuration data.

Appendix B: Covers “Mount Specific Data” which details features and values unique to a specific antenna mount.

Appendix C: Covers “Enclosure Specific Data” which details mechanical and electrical components unique to how the ACU is packaged if enclosure is provided by RCI.

Options: Additional appendices covering optional features.

1.2 Manual Conventions

Throughout the manual, representations of screens the user will see will be shown in the boxed format that follows:

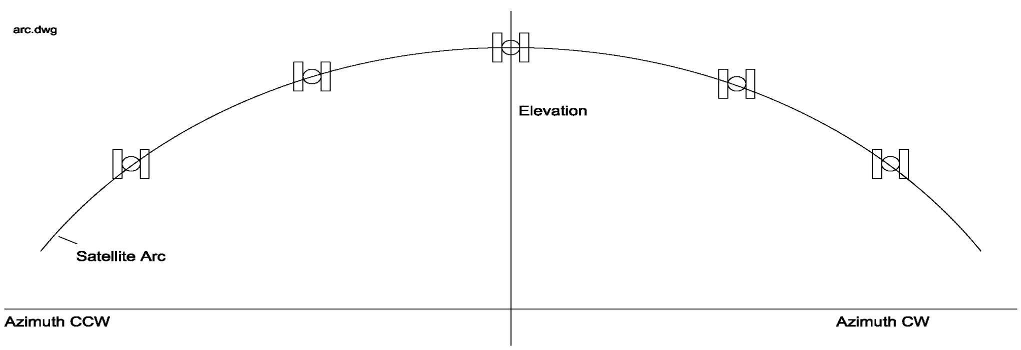
```
AZ: 179.97           RF: 50      MANUAL
EL:  42.45          SAT:
PL:  30.01  V       SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA    14:25:47
```

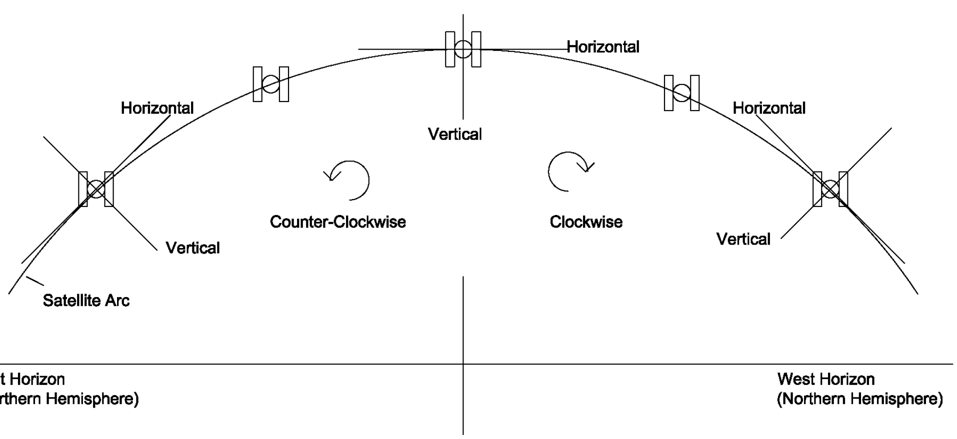
The ACU mode of operation will be capitalized (e.g. MANUAL).

Latitude and longitude of the mount are presented in decimal degrees format (e.g. +38.9557, -94.7567). The latitude, longitude and heading of the mount are collectively referred to as the mount's "position".

Satellite longitudes are presented in decimal degree/direction format (e.g. 79.0 W).

Movements of the mount are as observed from behind the reflector looking towards the satellite arc. The following drawings illustrate azimuth, elevation, and polarization direction:





1.3 RC4500 Features

The RC4500 performs its functions via digital and analog electronic equipment interfaced to the antenna's motor drive and position sensor systems. This equipment is controlled through embedded software algorithms run by the ACU microcontroller.

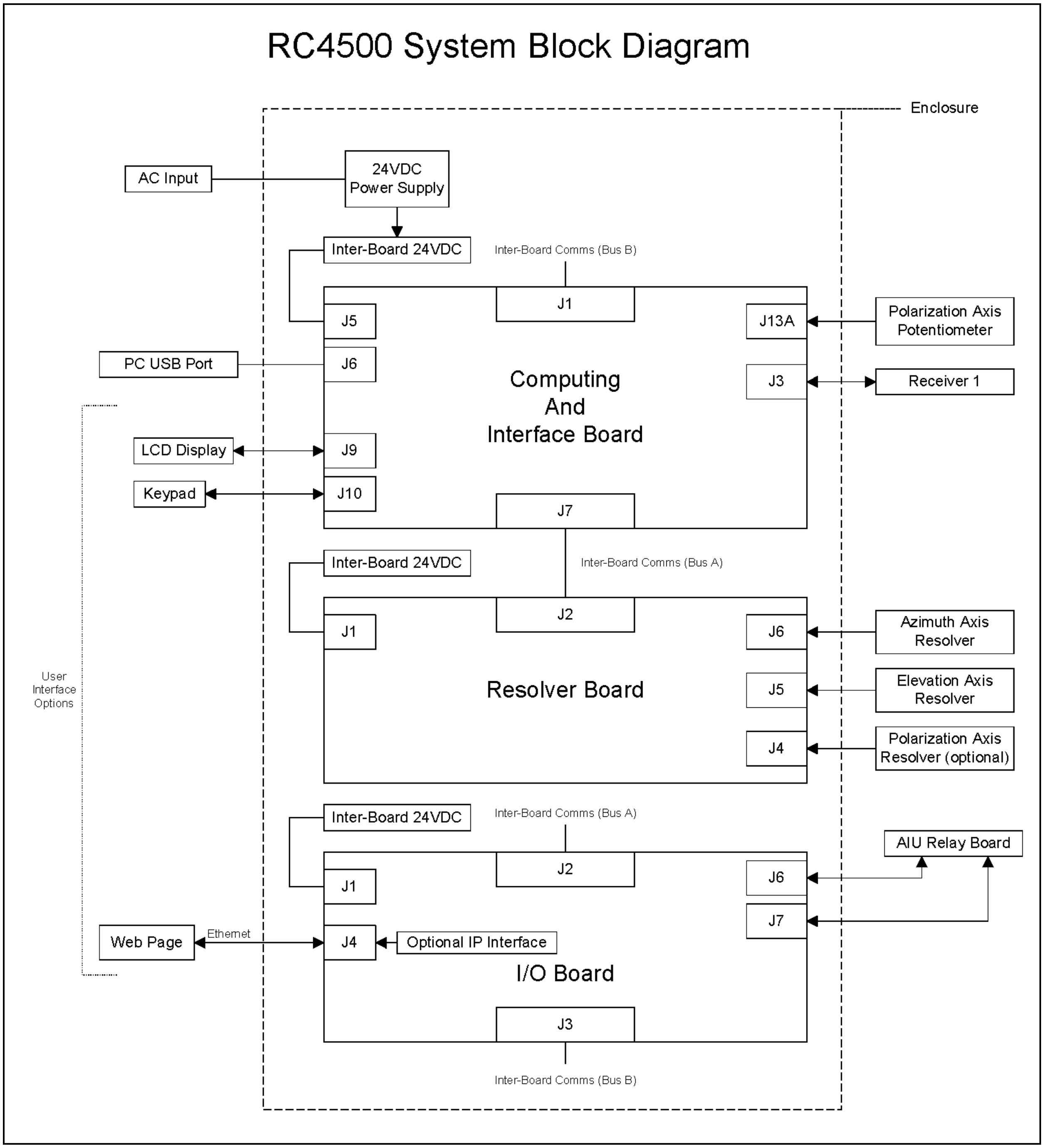
The following is a list of features included.

- Stack-able boards for flexible ACU packaging
- Automatic repositioning to stored satellites
- Automatic polarization control of rotating feeds
- Continuous monitoring of antenna drive status
- Automatic azimuth and elevation pointing solution calculation
- Optional automatic tracking of inclined orbit satellites
- Optional GPS receiver for system time updates
- Support for multiple band satellite operations
- Optional internal beacon receiver
- Optional internal spectrum analyzer
- Optional internal DVB-S/S2 receiver
- Multiple User Interface Options
    - Liquid Crystal Display (LCD) and keypad
    - Serial (RS-422/-232) remote control
    - Ethernet (IP-based) remote control
    - Single-Mode Fiber Optic remote control
- Motor drive interface via Antenna Interface Unit
- Internal motor drive board for direct-drive of low voltage DC motors

The following picture shows an example of the RC4500 board-set mounted in a 2U standard rack mount enclosure.

1.4 Hardware Overview

The following figure is a block diagram showing the major components of the RC4500 board set and how they interface with a typical antenna system.



1.5 Software Initialization

Two identification screens are displayed upon powering up the RC4500. These screens provide the ACU software configuration, version, and build numbers.

```
       RC4000 FIRMWARE BOOTLOADER
    (c) RESEARCH CONCEPTS INC. 2014
SN:1234     Last FW:AB-VWXYZ      BL:1.1
Please wait ...
```

```
    RC4500 MOBILE ANTENNA CONTROLLER
    (C) RESEARCH CONCEPTS INC. 2016
LENEXA, KANSAS USA      (+1)913-422-0210
RC45P-AB-VWXYZ                v1.00 bn10
```

The software configuration is presented in the form RC45X-AB-VWXYZ where:

"RC45" = a RC4500 antenna controller
"X" = User Interface Type
"AB" = Mount Type
"V" = Navigation Sensor option
"W" = Tracking option
"X" = Remote Control option
"Y" = Internal Receiver option
"Z" = External Receiver option

The following tables list the available values for each field.

User Interface Type

CATEGORY	DESIGNATION	DESCRIPTION
User Interface Type	P	Physical Front Panel

Mount Type

CATEGORY	DESIGNATION	DESCRIPTION
Mount Type	YA	Az/El Resolver, Pol Pot, 4K Drive
	YB	Az/El/Pol Resolver, 4K Drive
	YC	Az/El Resolver, Pol Pot, AIU IO
	YD	Az/El/Pol Resolver, AIU IO
	YE	Az/El Resolver, No Pol, AIU IO

Navigation Sensor Options

CATEGORY	DESIGNATOR	DESCRIPTION
Navigation Sensors	N	No Navigation Sensors supported
	O	GPS supported

Tracking Options

CATEGORY	DESIGNATOR	DESCRIPTION
Inclined Orbit Tracking	N	Tracking not supported
	T	Step & Memory Track supported
	E	Step & Memory & TLE supported

Remote Control Options

CATEGORY	DESIGNATOR	DESCRIPTION
Remote Control	N	No Remote Control Supported
	F	Single-Mode Fiber Converter
	I	Ethernet
	R	Serial

Internal Receiver Support

CATEGORY	DESIGNATOR	DESCRIPTION
Integrated Receiver	N	No Receivers Supported
	A	ASC Beacon Receiver
	B	Novella Beacon Receiver
	C	Avcom Spectrum Analyzer
	F	Avcom Spectrum Analyzer & Novella Beacon Receiver
	H	RCI DVB Receiver
	J	RCI DVB Receiver & Avcom Spectrum Analyzer/Beacon Receiver
	K	Avcom Spectrum Analyzer/Beacon Receiver

External Receiver Support

CATEGORY	DESIGNATOR	DESCRIPTION
Integrated Receiver	N	No Receivers Supported
	A	ASC Beacon Receiver
	B	External Novella Beacon Receiver
	M	Beijing Multitech MT3160 Beacon Receiver

1.6 Specifications

Physical	*Board Stack*	*Rack Mount*	*Embedded*
Size	6 1/8” x 7” x 3 ¾”	19” x 3.5” x 17” 2U Rack Encl.,17” Deep	9 ½” x 7 ½” x 3 ½”
Weight	2.6 lbs.	12 lbs.	7.2 lbs.
Input Power	24 VDC, 72W Typical	85 to 265 VAC, 50/60 Hz 72W Typical	24 VDC, 72W Typical
Temperature (Operational)	-40º to +60º C	0º to +50º C	-40º to +60º C
Temperature (Storage)	-40º to +70º C	-20º to +70ºC	-40º to +70º C
Relative Humidity	35% to 85%, non-condensing	35% to 85%, non-condensing	IP67 Rated Aluminum enclosure
Antenna Drive			
Azimuth/Elevation/Polarization	Commands to AIU via optically-isolated low-side transistor drivers; 70mA min sink each; 27VDC max		
Position Sense			
Azimuth	Resolver, 16-bit resolution		
Elevation	Resolver, 16-bit resolution		
Polarization	Potentiometer, 12-bit resolution Resolver, 16-bit resolution		
Limit Switch Inputs	Optically-isolated 24 VDC inputs, 5mA (typical)		
Signal-Strength			
Signal Input	AGC voltage input, -10 VDC to +10 VDC, 2 MOhm input impedance		
Lock Input	TTL or contact closure		
Track Mode			
Antenna Size	0.4 – 12.0 meters		
Antenna Mount Type	Elevation over Azimuth		
Tracking Accuracy	0.1 to 3.0 dB selectable; mount dependent		
Maximum Inclination	12 degrees		
Inclined Orbit Tracking	Step-Track, Memory-Track, Ephemeris-Track, Intelli-Search™		
Non-volatile RAM Backup	Duracell DL2450		

2.0 BASIC OPERATION

2.1 User Interface

The RC4500 allows multiple options for mechanizing the user interface. This section describes software operations as if the most basic "front panel" interface (keypad and LCD) was present. The front panel may be mechanized in multiple ways:

1) As an actual 4x40 LCD and 4x4 keypad matrix on the front plate of a rack mounted unit

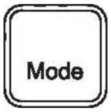
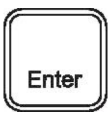
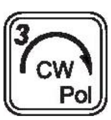
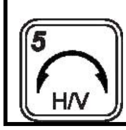
2) As a handheld unit with the LCD and keypad

3) As a representation of the LCD and keypad on a webpage

2.1.1 Keypad Usage

The keypad provides for both specific actions and general data input. The required key usage is provided in the detailed description of each mode.

The following table describes both the specific action and general data entry function of each key.

	KEY LABEL	SPECIFIC FUNCTION	GENERAL FUNCTION
	Mode	No specific function	Momentary push switches between modes within group. Button held for 3 seconds switches between operational and programming groups. Momentary push also exits sub-mode screens.
	Scroll Up Angle/CT	Toggles between angular and pulse az/el position display in Manual Mode	Scrolls forward through lists. Provides “YES” answer to prompts.
	Scroll Dn RF/SS	Toggles between RF/SS1/SS2 signal strength display in Manual Mode	Scrolls backward through lists. Provides “NO” answer to prompts.
	Enter	Heading Fix in Manual Mode	Complete entry of data. Select entry from list. Access sub-mode in CONFIG mode.
	1 Pol CCW	Jogs polarization motor counter-clockwise when pol movement is allowed	Supplies “1” for numeric entry and menu selection.
	2 N El UP	Jogs elevation axis up when in MANUAL mode	Supplies “2” for numeric entry and menu selection. Supplies NORTH for latitude entry.
	3 Pol CW	Jogs polarization motor clockwise when pol is movement allowed	Supplies “3” for numeric entry and menu selection.
	4 E Az CCW	Move azimuth axis counter-clockwise in MANUAL mode	Supplies “4” for numeric entry and menu selection. Supplies East for longitude entry. (123°45E)
	5 H/V	Commands Cross-Polarization movement in MANUAL mode, Store	Supplies “5” for numeric entry and menu selection.

	KEY LABEL	SPECIFIC FUNCTION	GENERAL FUNCTION
	6 W Az CW	Move azimuth axis clockwise in MANUAL mode	Supplies “6” for numeric entry and menu selection. Supplies West for longitude entry.
	7 Sat-H	Requests move to predefined Horizontal polarity position	Supplies “7” for numeric entry and menu selection. Signals current polarization value to be stored as the Horizontal value.
	8 S El DN	Jogs elevation axis down when in MANUAL mode	Supplies “8” for numeric entry and menu selection. Scrolls down during alphanumeric entries.
	9 Sat-V	Requests move to defined Vertical polarization	Supplies “9” for numeric entry and menu selection.
	0 Speed	Toggles motor drive speed between FAST and SLOW	Supplies “0” for numeric entry and menu selection.
	. (decimal point) Stop	Provides way to stop automatic movements	Provides delimiter for various data entries. Decimal point for floating point entry. Degree sign for lat/lon entry. Colon for time entry. Slash for date entry.
	+/- BKSP	Provides way to exit out of certain conditions - Selects Waveguide Switch in Manual	Toggles sign of numeric data entry when cursor is at beginning of entry field. Backspaces one field to the left during data entry.

2.1.2 Data Entry

This section provides instructions on the entry of various types of data.

Selection From List (<0-9>SELECT)

When the user is prompted to select an action from a displayed list, pressing the numbered key corresponding to the desired action will initiate the action.

Scrolling Through List (<SCR>THRU LIST)

When the user is prompted with a list of items, scroll through the list of items with the Scroll Up/Yes and Scroll Dn/No key. Press the Enter key to select the current item.

Alphanumeric Entry (NAME: SATCOM K2)

When prompted to enter an alphanumeric name, scroll through the list of characters with the 2/UP and 8/DN key. Use the 4/E key and the 6/W key to move forward and backward through the characters. Press the BKSP key to delete the last entered character. Press the Enter key at any time to accept the value.

Integer Data Entry (MODE: 240)

When prompted for an integer value, use the 0-9 and BKSP(-) keys to enter the value. Press the Enter key to accept the input.

Floating-Point Data Entry (HEADING:180.0)

When prompted for a floating-point value, use the 0-9, BKSP(-) and STOP(.) keys to enter the value. Press the Enter key to accept the input.

Decimal Degree Latitude/Longitude Entry (LAT:38.5627, LON:-94.4923)

Latitude/longitude values are entered as floating point numbers. Use negative values for the southern and western hemispheres.

Decimal Degree Longitude Entry (SAT LON:179.0E)

When prompted for a satellite longitude value, use the 0-9 and STOP(.) keys to enter the value. Press the Enter key, then the E/W key to select the eastern/western hemisphere.

Time/Date

When prompted for a time/date value, use the 0-9 key to enter the value. Use the STOP(.) key to enter a decimal point as the separator. Time in entered in HH:MM:SS format and date in MM/DD/YY format.

2.1.3 Display Layout

The following screen shows fields common to all ACU modes.

```
AZIM: 31561         SS1:625(Ku)      TRACK
ELEV: 11060         SAT:BRASIL A1
 POL: -45.0 H      STEP:IDLE         16:03
WAITING FOR NEXT PEAKUP            <0>MENU
```

The following list describes each field:

MODE TITLE: The title of the current mode is displayed in the upper right corner. In the above example, TRACK designates track mode.

DATA LABELS: The label will typically be followed by a colon to delimit between the label and the actual data. In the example shown above, “AZIM:” is the label for the current azimuth position.

DATA VALUES: The current value of relevant data for the mode is displayed following the appropriate data label. In the example above, the current azimuth position value is 31561.

STATUS INFORMATION: The bottom line of the displays information about the current state within the current mode. In the example above, “WAITING FOR NEXT PEAKUP” indicates the ACU is currently waiting to perform the next peak up movement.

USER PROMPTS: The bottom line of the display also includes available user actions. In the example above, “<0>MENU” indicates that pressing the 0 key will open the track menu.

TIME: The current time is may be displayed when useful or as a “sign of life”. In the example above, the current system time (16:03) is displayed with the colon flashing once per second.

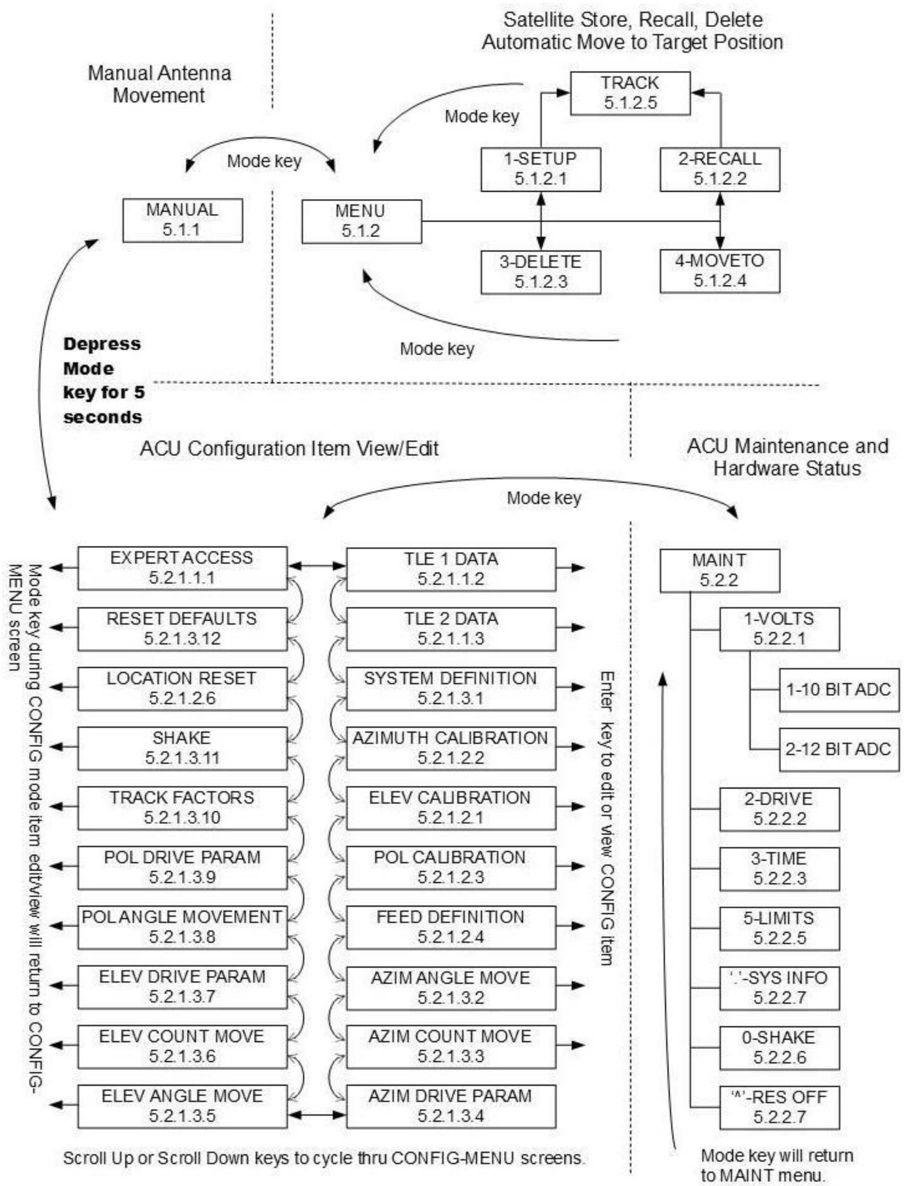
ALARM STATUS: Not shown in the above example is any alarm conditions. The alarm message will alternate with the text normally on the bottom line. See section 6.1.5 for more description of the alarm system.

2.1.4 Menu Structure

The functionality of the RC4500 is realized by placing the controller in the desired mode of operation. The following figure shows the hierarchy of the possible modes. Each mode has a unique display screen that presents the information applicable to that mode's operation.

Refer to the figure shown below. As illustrated, there are two main groups of modes: operating and configuration. Transitions between modes within a group are initiated via a momentary press of the Mode key, while a transition between the two groups requires the Mode key to be held down for three seconds.

After installation, the configuration group of modes will typically not be used for day to day operations. See Chapter 5 for the full details of each mode.



2.2 Operating Group

The Operating Mode consists of commonly used modes for control of an antenna. This section is intended to be a very abbreviated guide to the Operating Mode screens. An in-depth description of each screen can be found in section 5.1 OPERATING GROUP.

2.2.1 POWERUP Mode

Following the power-on screen, the ACU may remain in POWERUP mode if additional user interaction is required. For the RC4500, the following screen will be displayed if the mount position (latitude and longitude) has not been entered. It is not possible to exit POWERUP mode with the Mode key.

```
                                                LAT/LON
LAT:            LON:

ENTER LATITUDE DEGREES (+dd.dddd)
```

If the mount's position has been previously entered, no screen will appear.

After the position has been verified, the ACU will automatically transition to the mode defined by the INITIAL MODE configuration item in the SYSTEM DEFINITION screen (5.2.1.3.1.)

2.2.2 MENU Mode Basics

MENU mode allows the user to transition into one of several sub-modes.

```
1-SETUP      2-RECALL     3-DELETE          MENU
4-MOVETO
                                             UTC
<0-9>SELECT <MODE>MANUAL            14:37:23
```

For the RC4500, the following sub-modes exist:

1) SETUP – allows the user to create a new satellite entry in memory
2) RECALL – allows the user to return to a satellite position and resume tracking if necesssary
3) DELETE – allows the user to erase a satellite entry from memory
4) MOVETO – allows the user to automatically move the antenna to:
    a. A desired azimuth, elevation, and/or polarization position
    b. A calculated nominal position given a satellite longitude

A full detailed description of the MENU mode screen and all sub-modes can be found in section 5.1.2.

Momentarily pressing the Mode key from MENU mode will transition to MANUAL mode.

2.2.3 MANUAL Mode Basics

MANUAL mode allows the user to jog the antenna in all three axes via the keypad. The positions of all axis are displayed immediately to the right of the axis label. If a limit becomes active, its status will be displayed to the right of the axis position.

```
AZ: 179.97  CW          RF: 50      MANUAL
EL:  42.45             SAT:
PL:  30.01  V          SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA       14:25:47
```

Pressing the Scroll Up/Scroll Down key will cause the ACU to display alternate data that may be useful during basic operation. The Scroll Up key will toggle through the displayed position types (antenna angle, resolver angle, position count). The Scroll Down key will toggle through the various signal strength inputs that are available.

A full detailed description of the MANUAL mode screen and all displayed data can be found in section 5.1.1.

Momentarily pressing the Mode key from MANUAL mode will transition to MENU mode.

2.3 Configuration Group

The Configuration Mode consists of the CONFIG-MENU and MAINTENANCE mode. This section is intended to be a very abbreviated guide to the Configuration Mode screens. An in-depth description of each screen can be found in section 5.2 PROGRAMMING GROUP.

2.3.1 CONFIG Mode Basics

Configuration mode screens allow the user to customize and calibrate the operation of the ACU for a particular antenna. Modifications of CONFIG mode items should be performed according to the installation and calibration procedures in Chapter 4.

```
EXPERT ACCESS PERMISSION     CONFIG-MENU
TOGGLES EXPERT ACCESS ON & OFF

<SCR>THRU LIST <ENTER>SELECT <MODE>MAINT
```

Scroll UP/DN through
CONFIG screens

Allows continuous
cycle through screens

```
LOCATION RESET               CONFIG-MENU
RESET ANTENNA LOCATION

<SCR>THRU LIST <ENTER>SELECT <MODE>MAINT
```

A full detailed description of the CONFIG-MENU mode and all sub-modes can be found in section 5.2.1.

Momentarily pressing the Mode key from CONFIG-MENU mode will transition to MAINTENANCE (MAINT) mode.

2.3.2 MAINTENANCE Mode Basics

The maintenance mode screen allows the user to monitor sensor inputs, reset drive errors, and perform periodic maintenance actions such as setting the time/date.

```
1-VOLTS   2-DRIVE   3-TIME         MAINT
5-LIMITS
          0-SHAKE
^-RES OFF                     .-SYS INFO
```

A full detailed description of the MAINT mode screen can be found in section 5.2.2.

Momentarily pressing the Mode key from MAINTENANCE mode will transition to the CONFIG-MENU mode

3.0 MECHANICAL & ELECTRICAL INSTALLATION

This chapter covers integrating a RC4500 controller into an antenna system. Each section describes a mechanical package and its corresponding electrical interface. Choose the appropriate section for more information on installation requirements.

 Section 3.1 Rack-Mount Controller with Antenna Interface Unit, ACU controls high-voltage drives within the AIU	 Section 3.2 Embedded Controller inside Antenna Interface Unit, ACU controls high-voltage drives within the AIU
 Section 3.3 Board-Stack in Outdoor Enclosure, ACU direct drives low-voltage DC Motors	

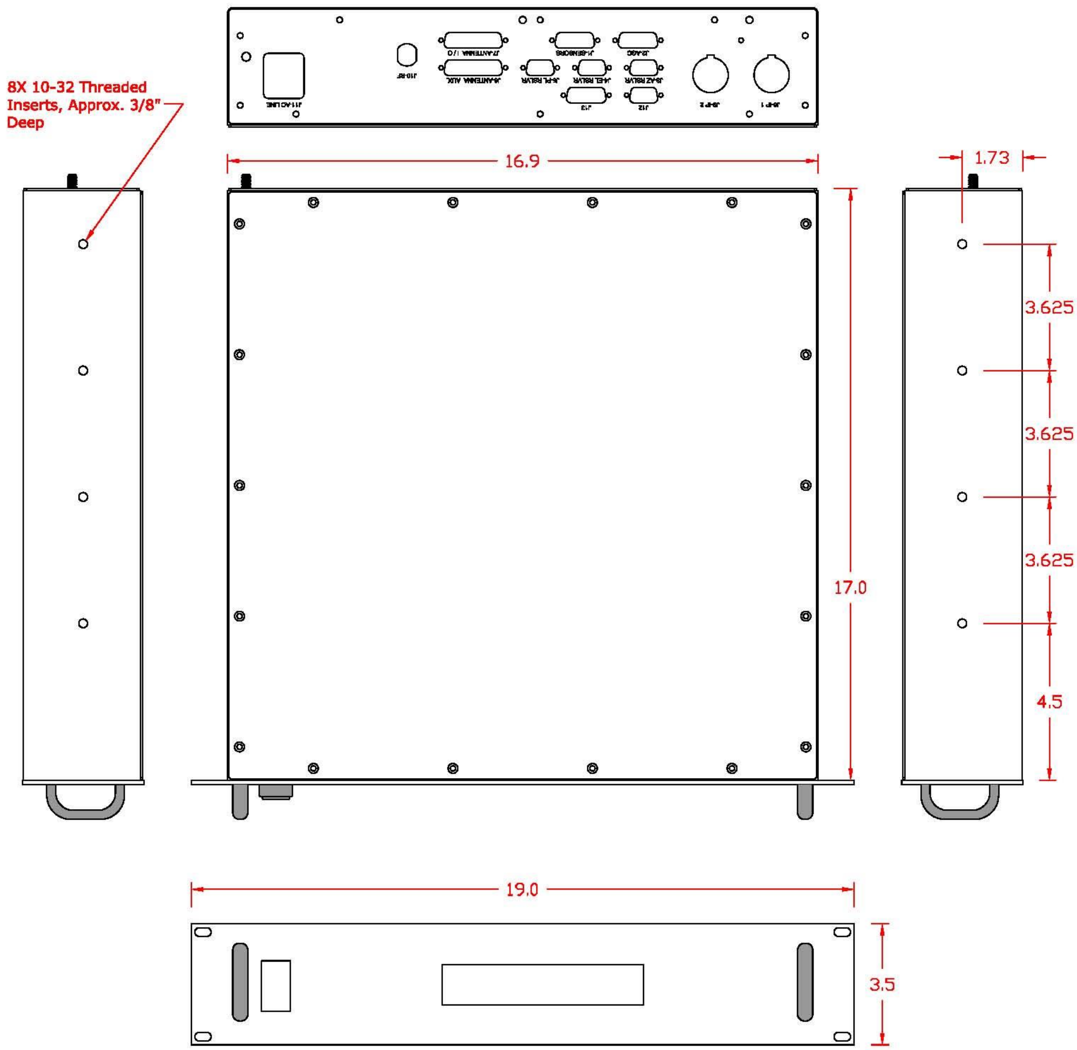
3.1 Rack-Mount Controller with Antenna Interface Unit

3.1.1 Mechanical Mounting

The ACU is packaged inside a standard, two rack unit (2U) chassis. The front panel has four (4) 10-32 screws for mounting. Additional mounting points on each side of the unit should be used to provide additional support via strapping or shelving. The back of the chassis must be supported to lessen stress on the front panel.

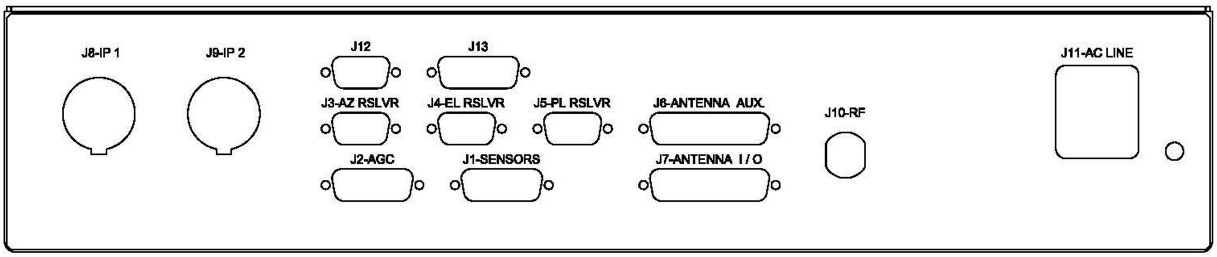
WARNING: RCI's warranty does not cover replacement of bent, twisted, or otherwise damaged faceplates due to inadequate support.

The following diagram shows the typical dimensions (in inches) of the rack-mount chassis.



3.1.2 Electrical Interface

The interface cables should be made long enough to allow the unit to be partially removed from the rack while still connected to the system. Connections are only made to the back panel of the unit. The location and description of each connector is shown below.



Ref Des	Part Number or Connector Type	Description
J1	15-pin D-subminiature receptacle	Sensors
J2	15-pin D-subminiature receptacle	External Receiver (AGC)
J3	9-pin D-subminiature receptacle	AZ Resolver
J4	9-pin D-subminiature receptacle	EL Resolver
J5	9-pin D-subminiature receptacle	POL Resolver
J6	25-pin D-subminiature receptacle	Antenna Auxiliary
J7	25-pin D-subminiature plug	Antenna I/O
J8	Molex 84700-0001	Ethernet (IP1)
J9	Molex 84700-0001	Ethernet (IP2)
J10	N jack, Amphenol 172129	RF (50Ω Impedance)
J11	Filtered AC inlet with fuse holder[<1>]	Power Input (AC Line)
J12	9 pin D-subminiature placeholder	Spare
J13	15 pin D-subminiature placeholder	Spare

<1> Fuse holder accepts 5mm X 20mm fuses such as Littelfuse # 215005.XP or Bussmann # BK/S505-5-R.
Fuse rating is 250V, 5A time delay/slow blow. One of the two fuses in the holder is a spare.

3.1.2.1 Power Input (AC Line)

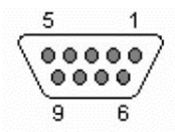
J11 is an IEC-C14 male power socket on the back panel for supplying AC power. The line cord shipped with the ACU has an IEC-C13 plug. The ACU can accept 85 to 265 VAC at 50/60 Hz.

3.1.2.2 Resolver Inputs

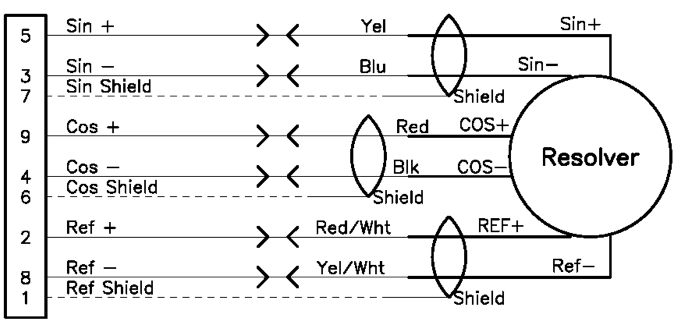
IMPORTANT: Shielded cable is required for the resolver connections. The shield must be connected to chassis ground at the ACU and NOT connected at the antenna.

Each resolver requires three (3) shielded twisted-pairs for each resolver to minimize noise pickup and cross-coupling, which can result in antenna positioning errors. A cable such as Belden 8777 (RCI p/n CBL-3X2_22STP1) is recommended. Most resolvers have flying lead connections. Wire-to-wire interconnects can be accomplished with solder and heat shrink tubing or a waterproof crimp connector such as 3M™ Scotchlok™ UY2 (RCI p/n CN-JIZR-2).

J3, J4 and J5 are identical connectors for Azimuth, Elevation and Polarization respectively. These connectors are 9 pin D-subminiature female receptacles. The duplicated pinout of these connectors allows for easy testing of the position sensing circuitry by swapping connectors. The individual pin descriptions are as follows:

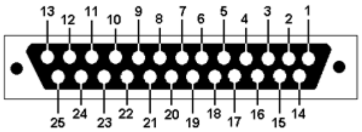


From Front



3.1.2.3 Auxiliary I/O

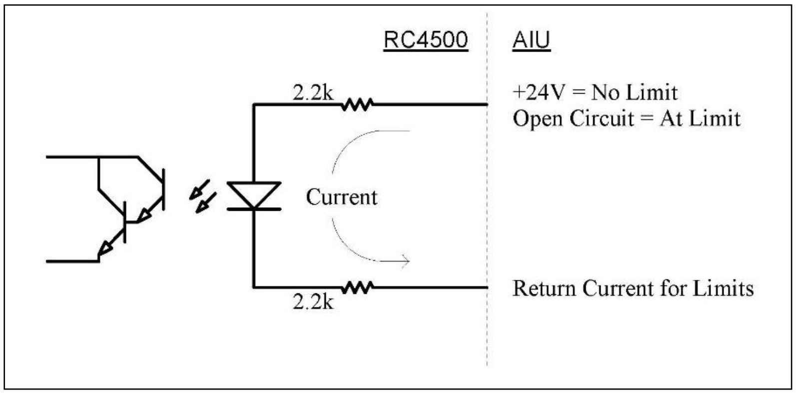
J6 is a 25-pin D-subminiature female receptacle used for Antenna Auxiliary I/O. This port provides six (6) optically-isolated, axis-specific limit inputs. Each input is rated for +24 VDC and draws 5mA. The individual pin descriptions are as follows:



From Front

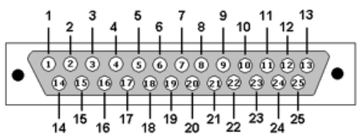
Pin #	Description
1	Relay 1 COM
2	Relay 1 NO
3	Azimuth CW Limit Return
4	Azimuth CCW/Summary Limit Return
5	Elevation Down Limit Return
6	Elevation Up Limit Return
7	Polarization CW Limit Return
8	Polarization CCW Limit Return
9	Drive Common (return path, same as J7 pins 2, 5, 8)
10	Relay 0 NC
11	NC
12	NC
13	ACU Chassis Ground
14	Relay 1 NC
15	Azimuth CW Limit Input (0V = limit active)
16	Azimuth CCW/Summary Limit Input (0V = limit active)
17	Elevation Down Limit Input (0V = limit active)
18	Elevation Up Limit Input (0V = limit active)
19	Polarization CW Limit Input (0V = limit active)
20	Polarization CCW Limit Input (0V = limit active)
21	NC
22	Relay 0 COM
23	Relay 0 NO
24	NC
25	ACU +24 VDC Unregulated, 750mA max, referenced to Chassis Ground

The following drawing illustrates the typical limit input circuit:



3.1.2.4 Antenna I/O

J7 is a 25-pin D-subminiature male receptacle used for Antenna I/O. This port provides nine (9) optically-isolated, pull-down driver outputs. Each output can tolerate up to 27 VDC and can sink 70mA. Current is returned via the Drive Common lines. This port also provides four (4) additional optically-isolated, limit inputs for drive faults, emergency stop, and maintenance indication. Each input is rated for +24 VDC and draws 5mA. The individual pin descriptions are as follows:



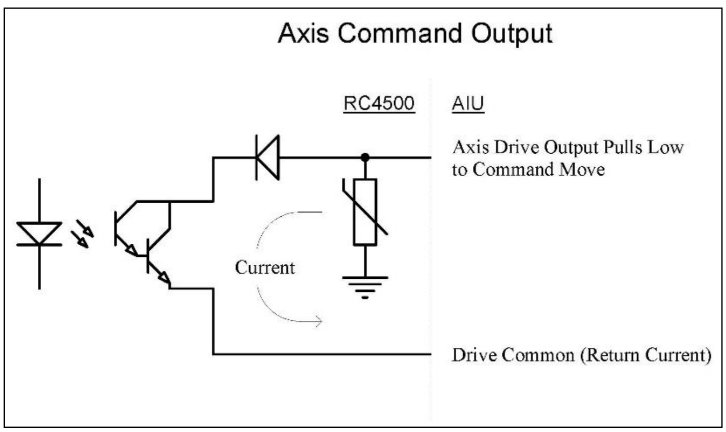
Pin #	Description
1	Azimuth CW Output (1.5V = move CW)
2	Drive Common (Azimuth output return, same as J6 pin 9)
3	Azimuth CCW Output (1.5V = move CCW)
4	Elevation Up Output (1.5V = move Up)
5	Drive Common (Elevation output return, same as J6 pin 9)
6	Elevation Down Output (1.5V = move Down)
7	Polarization CW Output (1.5V = move CW)
8	Drive Common (Polarization output return, same as J6 pin 9)
9	Polarization CCW Output (1.5V = move CCW)
10	Summary Limit Input (0V = limit active)
11	NC (future expansion for Azimuth Enable command)
12	NC (future expansion for Elevation Enable command)
13	NC (future expansion for Elevation Brake command)
14	Azimuth Drive Fault Input (0V = fault active)
15	Elevation Drive Fault Input (0V = fault active)
16	Emergency Stop Return

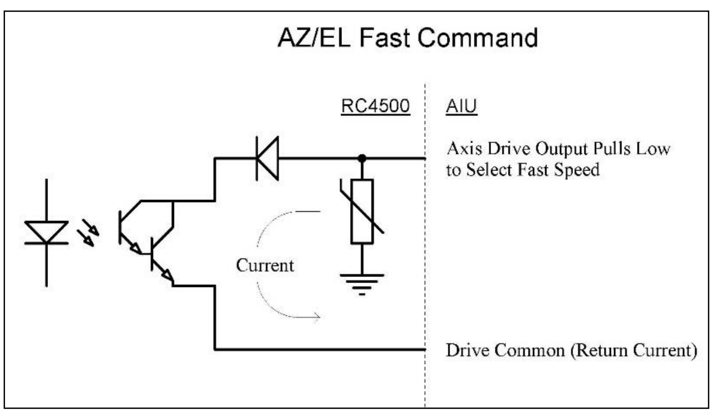
Pin #	Description
17	Summary Limit/Azimuth Drive Fault Return
18	Summary Limit/Elevation Drive Fault Return
19	Emergency Stop Input (0V = stop active)
20	NC (future expansion for Azimuth Brake command)
21	Azimuth Fast Output (1.5V = fast)
22	Elevation Fast Output (1.5V = fast)
23	Drive Enable Output (1.5V = drive enable)
24	Maintenance Input (0V = maintenance active) <1>
25	Maintenance Return

<1> Maintenance Input – When current flows through this circuit the controller assumes that the AIU is able to accept drive commands from the ACU. If current is not flowing the ACU disables antenna control and displays the 'Maintenance' alarm message.

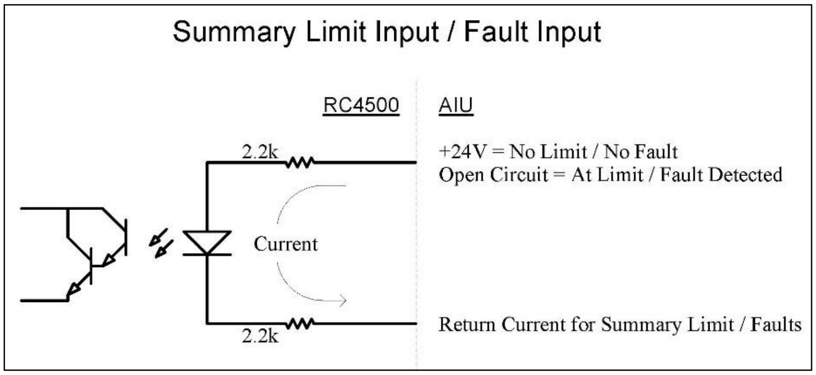
This terminal also powers all of the RC4500's isolated output drive circuits. 17 to 27 VDC is required to power the controller's output circuits. The current that powers the output drive circuits flows back to the AIU through the drive common pins.

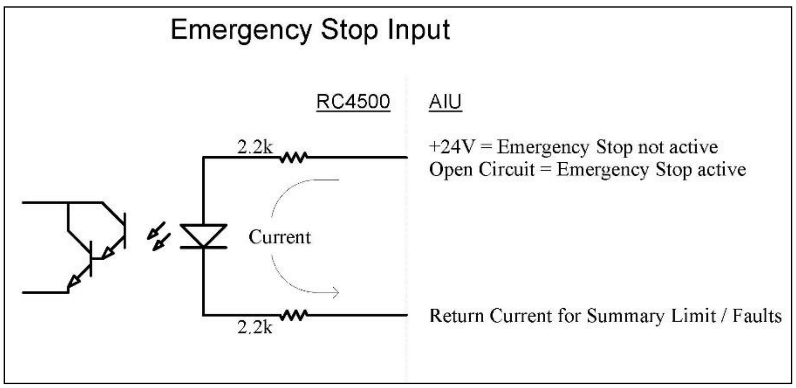
The following drawings illustrate the axis move and speed command output circuits:

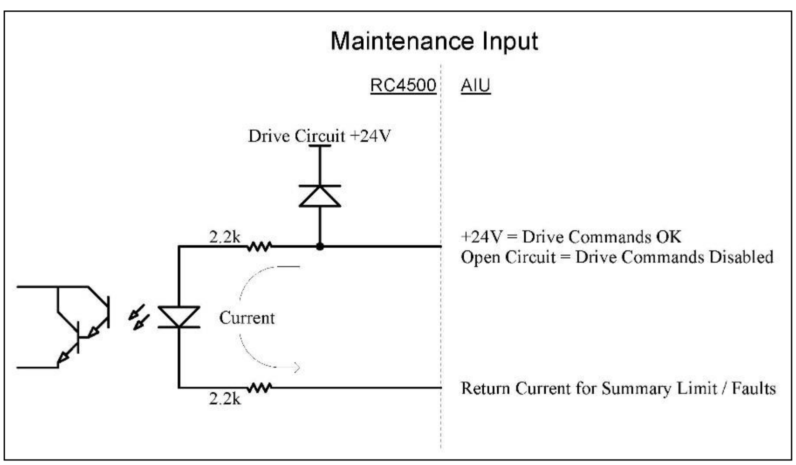




The following drawings illustrate the drive fault, emergency stop, and maintenance input circuits:





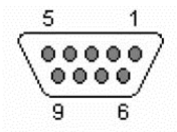


3.1.2.5 Sensors

J1 is a 9-pin D-subminiature female receptacle that allows a Polarization potentiometer to provide position sensing to the ACU.

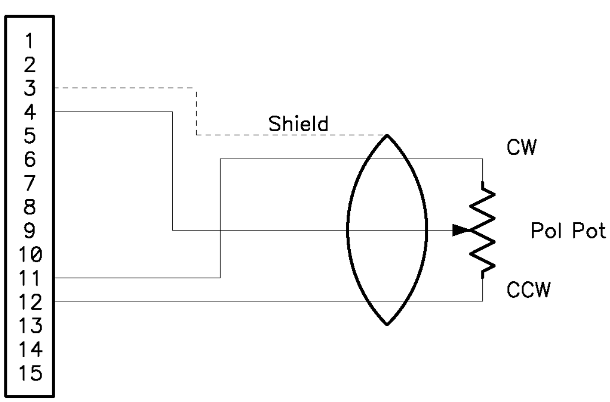
NOTE: A shielded wire should be used to minimize external noise pickup on the wiper line. The shield should be connected to Pin 3 at the ACU and NOT connected at the antenna.

The individual pin descriptions are as follows:



From Front

Pin #	Description
1	NC
2	NC
3	Polarization Potentiometer Shield
4	Polarization Potentiometer Wiper
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	Polarization Potentiometer +5V (CW)
12	Polarization Potentiometer Gnd (CCW)
13	NC
14	NC
15	NC

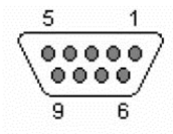


3.1.2.6 External Receiver (AGC)

J2 is a 9-pin D-subminiature female receptacle that connects to receivers/modems to provide signal strength indication for tracking. The received signal strength must be between -10 VDC and +10 VDC. The signal may be of either positive or negative polarity.

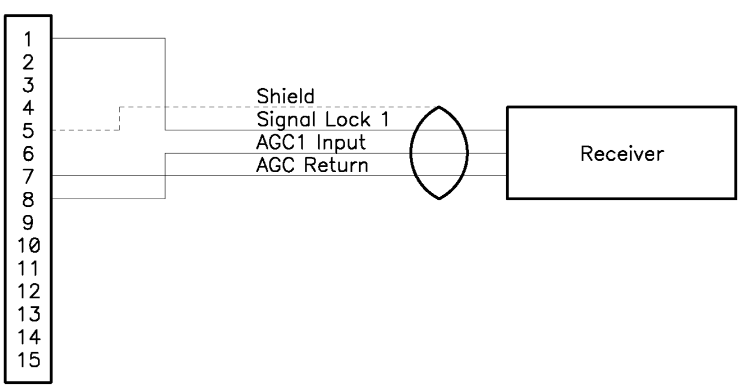
NOTE: A shielded wire should be used to minimize external noise pickup on the signal strength line. The shield should be connected to Pin 5 at the ACU and NOT connected at the receiver.

The individual pin descriptions are as follows:



From Front

Pin #	Description
1	Signal Lock Input (2.6 to 5.4 VDC Logic High, 0.0 to 1.1 VDC Logic Low)
2	NC
3	NC
4	NC
5	Shield (Ground)
6	+5 VDC, 125mA max
7	AGC Return (Ground)
8	AGC Signal Strength Input (+/-10 VDC)
9	Unregulated +24 VDC, 1A max
10	Ground
11	NC
12	NC
13	NC
14	NC
15	NC



3.1.2.7 RF Input

J10 is a 50Ω N Type female connector and is the input to an optional internal beacon receiver or spectrum analyzer. This input accepts the output of an LNB (950-2150 MHz, -50 to -5 dBm).

3.1.2.8 Integrated IP Option

The RC4500 may include an integrated IP option that utilizes an Ethernet port on the back panel. The Ethernet port is identified as J8-IP 1 and consists of an RJ45 receptacle.

There is a second port, J9-IP 2, that may be used in certain configurations where the ACU has an Ethernet switch installed.

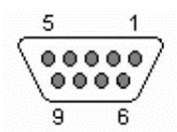
All antenna controllers are factory configured with the IP address of 192.168.1.1. Setting the IP address of the target PC to 192.168.1.2 with a subnet mask of 255.255.255.0 should allow a quick connection to the ACU.

Refer to Appendix IP for detailed information about IP-based remote control and configuration.

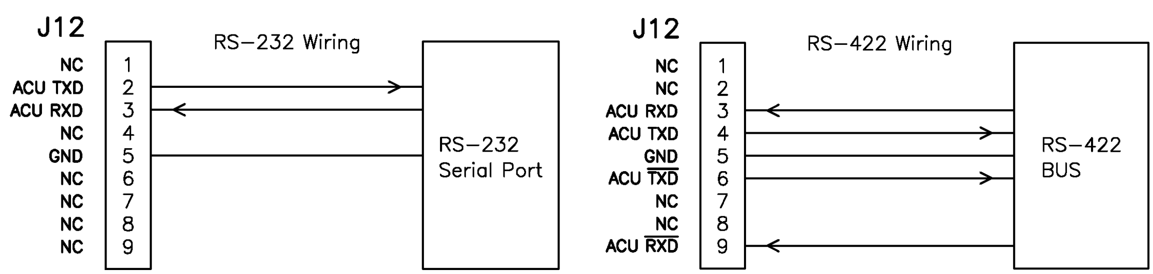
NOTE: IP and Serial remote control are mutually exclusive.

3.1.2.9 Serial Remote Control

When a serial remote control option is included, the spare connector J12 is utilized. The ACU may be configured to communicate either by the RS-232 or RS-422 standards. The individual pin descriptions are as follows:



From Front



Refer to Appendix REM for detailed information about serial-based remote control and configuration.

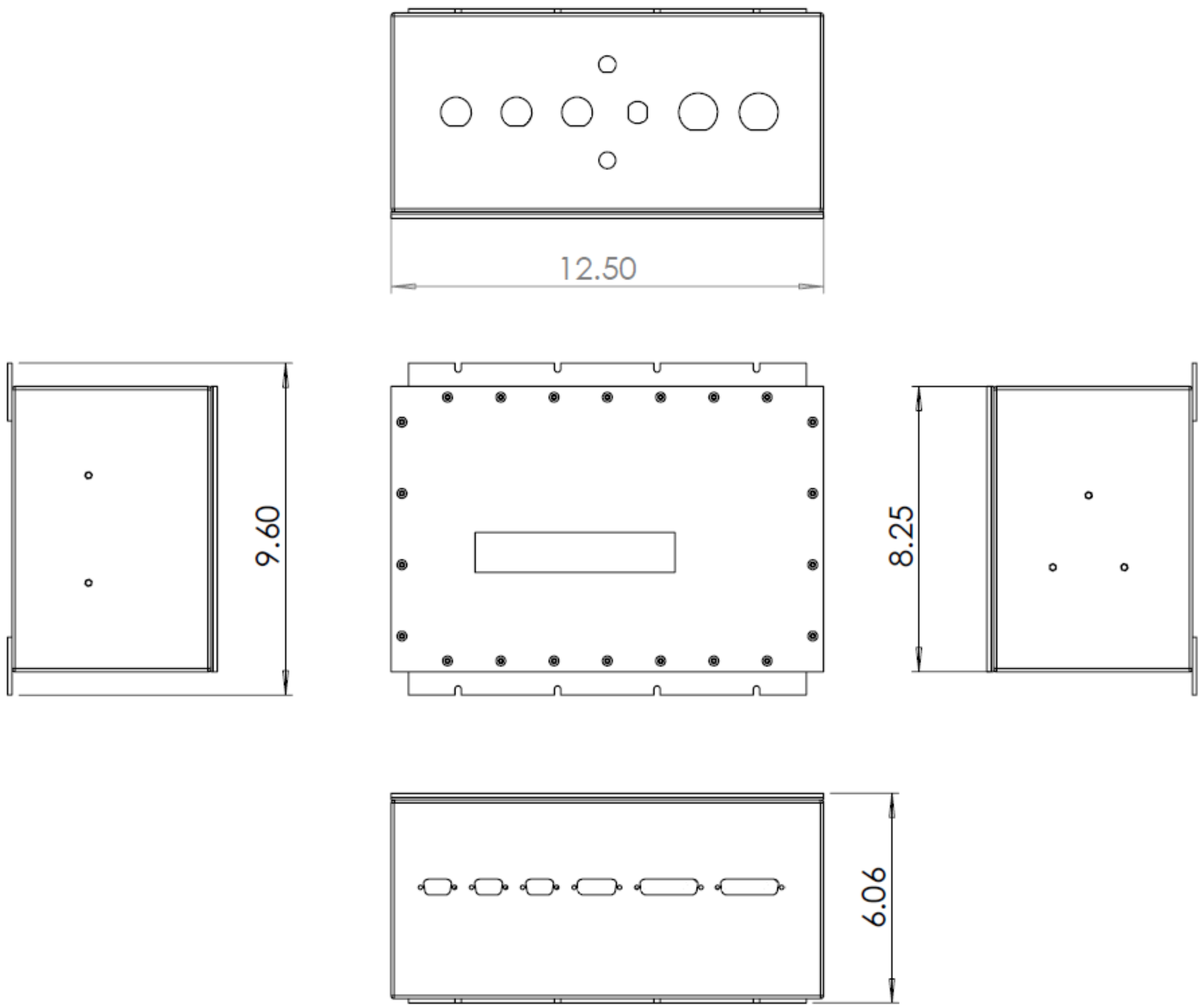
NOTE: Serial and IP remote control are mutually exclusive.

3.2 Embedded Controller inside Antenna Interface Unit

3.2.1 Mechanical Mounting

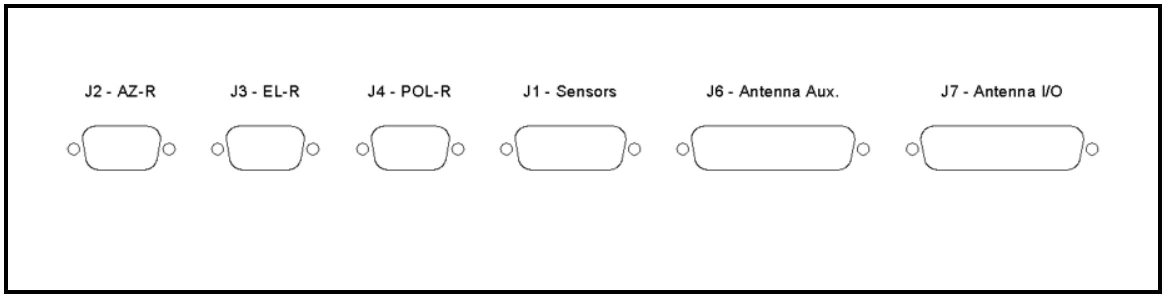
The ACU is packaged in a weatherproof enclosure mounted inside the antenna interface unit. The lid of the enclosure contains the front panel LCD and keypad. Additional mounting points on each side of the unit are used for optional equipment.

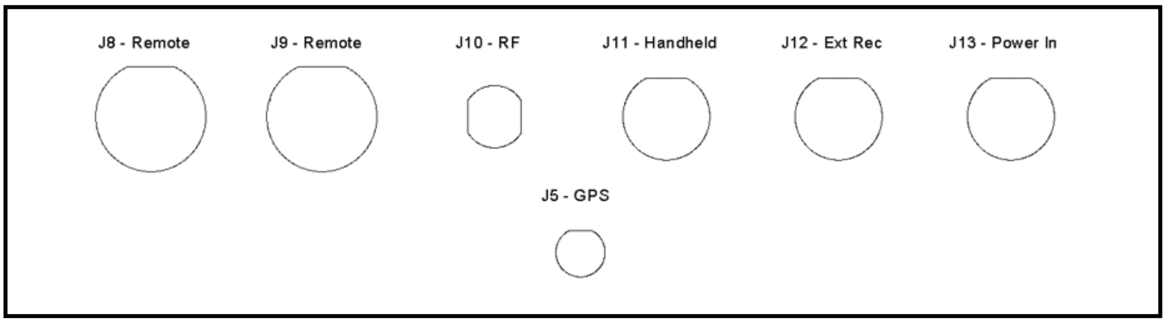
The following diagram shows the typical dimensions (in inches) of the ACU enclosure.



3.2.2 Electrical Interface

Connections are made to the front and back of the enclosure. The location and description of each connector is shown below.

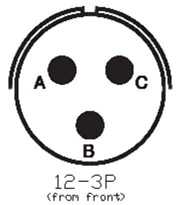




Ref Des	Part Number or Connector Type	Description
J1	15-pin D-subminiature receptacle	Sensors
J2	9-pin D-subminiature receptacle	AZ Resolver
J3	9-pin D-subminiature receptacle	EL Resolver
J4	9-pin D-subminiature receptacle	POL Resolver
J5	TNC jack, Amphenol 122192	GPS Antenna
J6	25-pin D-subminiature receptacle	Antenna Auxiliary
J7	25-pin D-subminiature plug	Antenna I/O
J8	Tyco 2008615-1	Ethernet (Remote)
J9	Tyco 2008615-1	Ethernet (Remote)
J10	N jack, Amphenol 172129	RF (50Ω Impedance)
J11	Amphenol MS3124E12-10S	Handheld Control
J12	Amphenol MS3124E12-10P	External Receiver (AGC)
J13	Amphenol MS3124E12-3P	Power Input

3.2.2.1 Power Input

J13 is a 3-pin circular connector for supplying AC power. The line cord shipped with the ACU has an IEC-C13 plug. The ACU can accept 85 to 265 VAC at 50/60 Hz. The pin definitions are as follows:



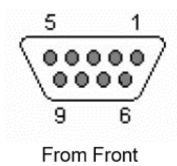
Pin #	Description
A	Neutral
B	Line
C	Earth Ground

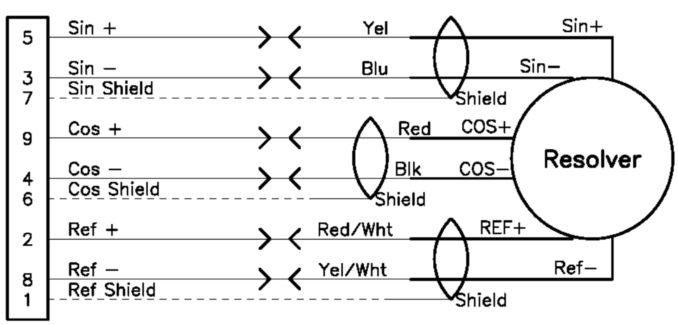
3.2.2.2 Resolver Inputs

IMPORTANT: Shielded cable is required for the resolver connections. The shield must be connected to chassis ground at the ACU and NOT connected at the antenna.

Each resolver requires three (3) shielded twisted-pairs for each resolver to minimize noise pickup and cross-coupling, which can result in antenna positioning errors. A cable such as Belden 8777 (RCI p/n CBL-3X2_22STP1) is recommended. Most resolvers have flying lead connections. Wire-to-wire interconnects can be accomplished with solder and heat shrink tubing or a waterproof crimp connector such as 3M™ Scotchlok™ UY2 (RCI p/n CN-JIZR-2).

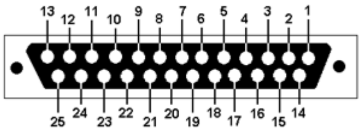
J3, J4 and J5 are identical connectors for Azimuth, Elevation and Polarization respectively. These connectors are 9-pin D-subminiature female receptacles. The duplicated pinout of these connectors allows for easy testing of the position sensing circuitry by swapping connectors. The individual pin descriptions are as follows:





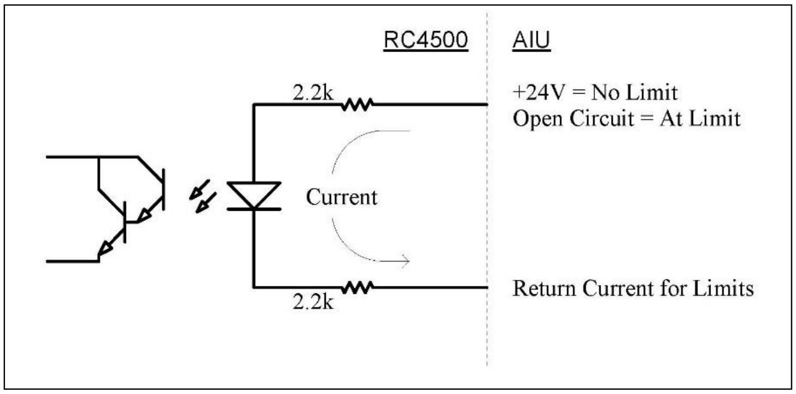
3.2.2.3 Auxiliary I/O

J6 is a 25-pin D-subminiature female receptacle used for Antenna Auxiliary I/O. This port provides six (6) optically-isolated, axis-specific limit inputs. Each input is rated for +24 VDC and draws 5mA. The individual pin descriptions are as follows:



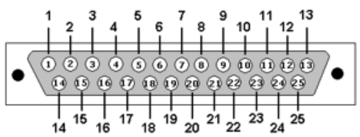
Pin #	Description
1	Relay 1 COM
2	Relay 1 NO
3	Azimuth CW Limit Return
4	Azimuth CCW/Summary Limit Return
5	Elevation Down Limit Return
6	Elevation Up Limit Return
7	Polarization CW Limit Return
8	Polarization CCW Limit Return
9	Drive Common (return path, same as J7 pins 2, 5, 8)
10	Relay 0 NC
11	NC
12	NC
13	ACU Chassis Ground
14	Relay 1 NC
15	Azimuth CW Limit Input (0V = limit active)
16	Azimuth CCW/Summary Limit Input (0V = limit active)
17	Elevation Down Limit Input (0V = limit active)
18	Elevation Up Limit Input (0V = limit active)
19	Polarization CW Limit Input (0V = limit active)
20	Polarization CCW Limit Input (0V = limit active)
21	NC
22	Relay 0 COM
23	Relay 0 NO
24	NC
25	ACU +24 VDC Unregulated, 750mA max, referenced to Chassis Ground

The following drawing illustrates the typical limit input circuit:



3.2.2.4 Antenna I/O

J7 is a 25-pin D-subminiature male receptacle used for Antenna I/O. This port provides nine (9) optically-isolated, pull-down driver outputs. Each output can tolerate up to 27 VDC and can sink 70mA. Current is returned via the Drive Common lines. This port also provides four (4) additional optically-isolated, limit inputs for drive faults, emergency stop, and maintenance indication. Each input is rated for +24 VDC and draws 5mA. The individual pin descriptions are as follows:



From Front

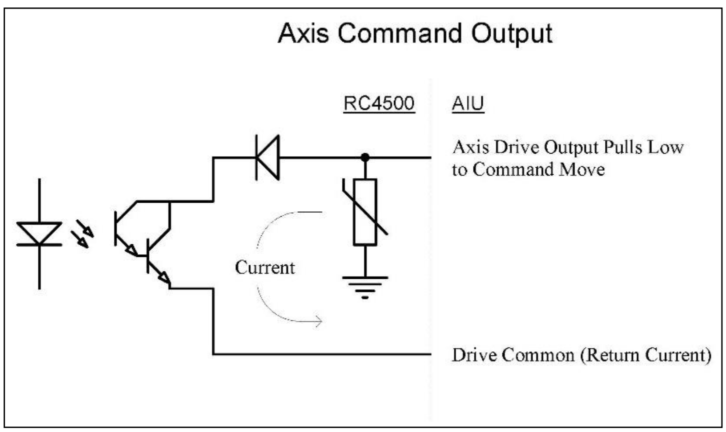
Pin #	Description
1	Azimuth CW Output (1.5V = move CW)
2	Drive Common (Azimuth output return, same as J6 pin 9)
3	Azimuth CCW Output (1.5V = move CCW)
4	Elevation Up Output (1.5V = move Up)
5	Drive Common (Elevation output return, same as J6 pin 9)
6	Elevation Down Output (1.5V = move Down)
7	Polarization CW Output (1.5V = move CW)
8	Drive Common (Polarization output return, same as J6 pin 9)
9	Polarization CCW Output (1.5V = move CCW)
10	Summary Limit Input (0V = limit active)
11	NC (future expansion for Azimuth Enable command)
12	NC (future expansion for Elevation Enable command)
13	NC (future expansion for Elevation Brake command)
14	Azimuth Drive Fault Input (0V = fault active)
15	Elevation Drive Fault Input (0V = fault active)
16	Emergency Stop Return

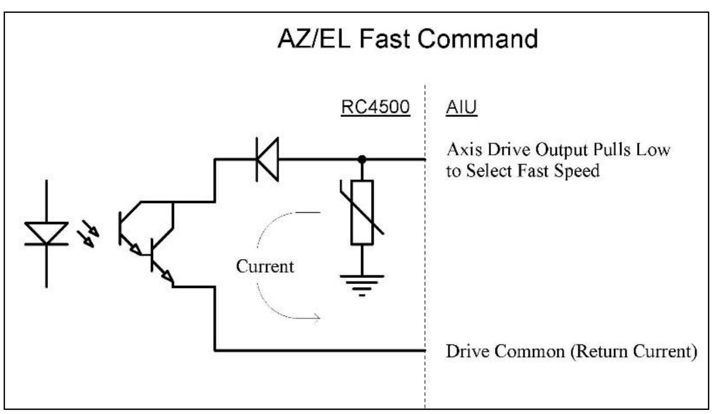
Pin #	Description
17	Summary Limit/Azimuth Drive Fault Return
18	Summary Limit/Elevation Drive Fault Return
19	Emergency Stop Input (0V = stop active)
20	NC (future expansion for Azimuth Brake command)
21	Azimuth Fast Output (1.5V = fast)
22	Elevation Fast Output (1.5V = fast)
23	Drive Enable Output (1.5V = drive enable)
24	Maintenance Input (0V = maintenance active) <1>
25	Maintenance Return

<1> Maintenance Input – When current flows through this circuit the controller assumes that the AIU is able to accept drive commands from the ACU. If current is not flowing the ACU disables antenna control and displays the 'Maintenance' alarm message.

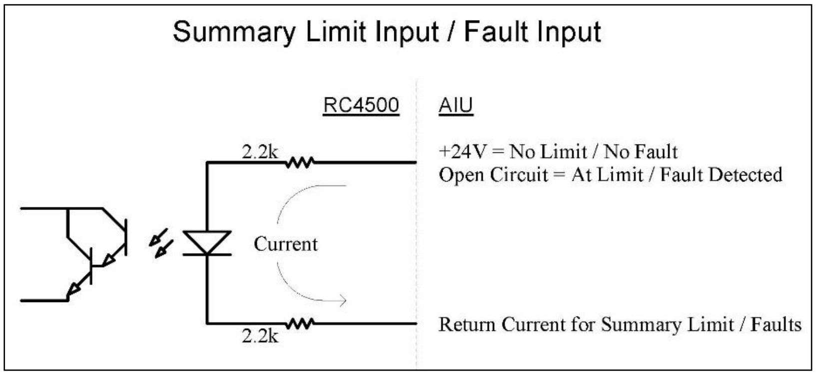
This terminal also powers all of the RC4500's isolated output drive circuits. 17 to 27 VDC is required to power the controller's output circuits. The current that powers the output drive circuits flows back to the AIU through the drive common pins.

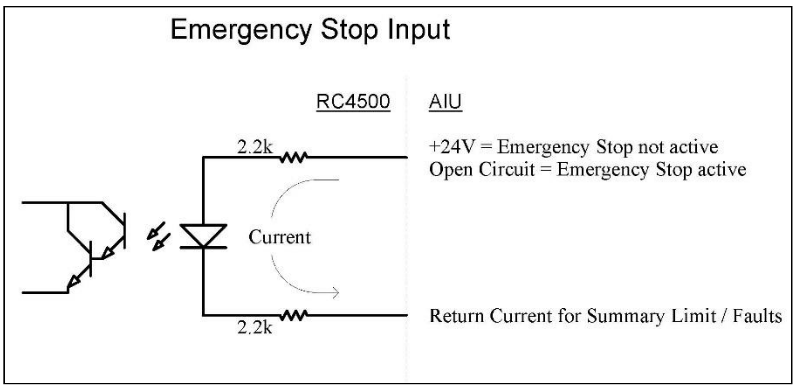
The following drawings illustrate the axis move and speed command output circuits:

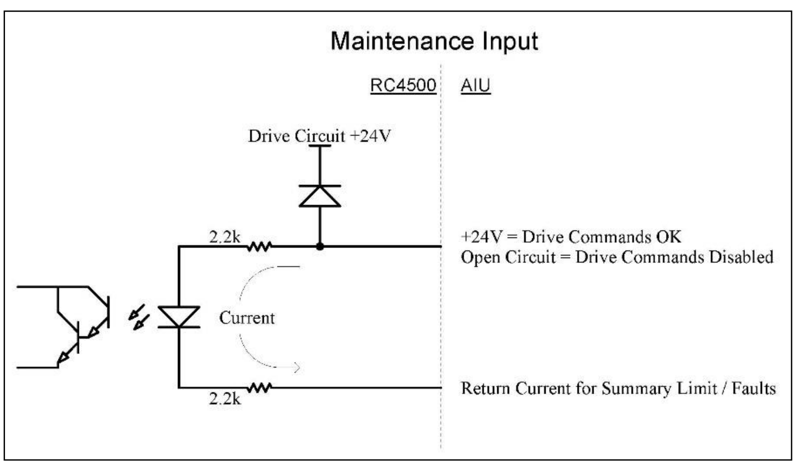




The following drawings illustrate the drive fault, emergency stop, and maintenance input circuits:





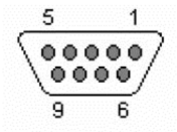


3.2.2.5 Sensors

J1 is a 9-pin D-subminiature female receptacle that allows a Polarization potentiometer to provide position sensing to the ACU.

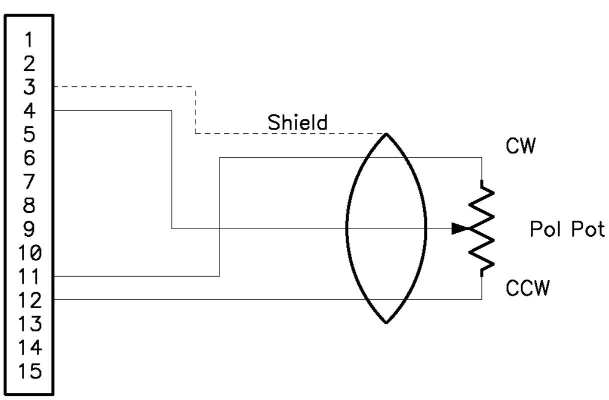
NOTE: A shielded wire should be used to minimize external noise pickup. The shield should be connected to the Pin 3 at the ACU and NOT connected at the antenna.

The individual pin descriptions are as follows:



From Front

Pin #	Description
1	NC
2	NC
3	Polarization Potentiometer Shield
4	Polarization Potentiometer Wiper
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	Polarization Potentiometer +5V (CW)
12	Polarization Potentiometer Gnd (CCW)
13	NC
14	NC
15	NC

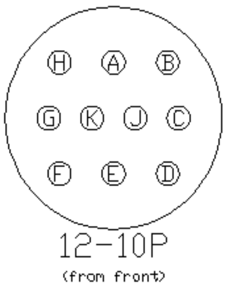


3.2.2.6 External Receiver (AGC)

J12 is a 10-pin circular connector for controlling receivers/modems and to receive signal strength and lock for tracking. The received signal strength must be between -10 VDC and +10 VDC. The signal may be either positive or negative polarity.

NOTE: A shielded wire should be used to minimize external noise pickup. The shield should be connected to ground at the ACU and NOT connected at the receiver.

The individual pin descriptions are as follows:



Pin #	Description
A	+24VDC
B	+5VDC
C	Ext Rec Lock
D	Ext Rec Signal Strength
E	Ext Rec RS232 In
F	Ext Rec RS232 Out
G	Ground
H	GPS RS232 Out
J	Ground
K	Shield (Ground)

3.1.2.7 RF Input

J10 is a 50Ω N Type female connector and is the input to an optional internal beacon receiver or spectrum analyzer. This input accepts the output of an LNB (950-2150 MHz, -50 to -5 dBm.)

3.1.2.8 Integrated IP Option

The RC4500 may include an integrated IP option that utilizes an Ethernet port. The Ethernet port is identified as J8-Remote and consists of an RJ45 receptacle.

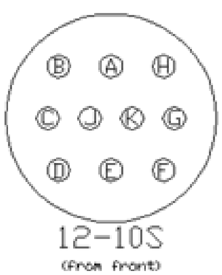
There is a second port, J9-Remote, that may be used in certain configurations where the ACU has an Ethernet switch installed.

All antenna controllers are factory configured with the IP address of 192.168.1.1. Setting the IP address of the target PC to 192.168.1.2 with a subnet mask of 255.255.255.0 should allow a quick connection to the ACU.

Refer to Appendix IP for detailed information about IP-based remote control and configuration.

3.1.2.9 Handheld Control

J11 is a 10-pin circular connector for the external handheld control. The cable is proprietary and included as part with the handheld. For reference, the individual pin descriptions are as follows:

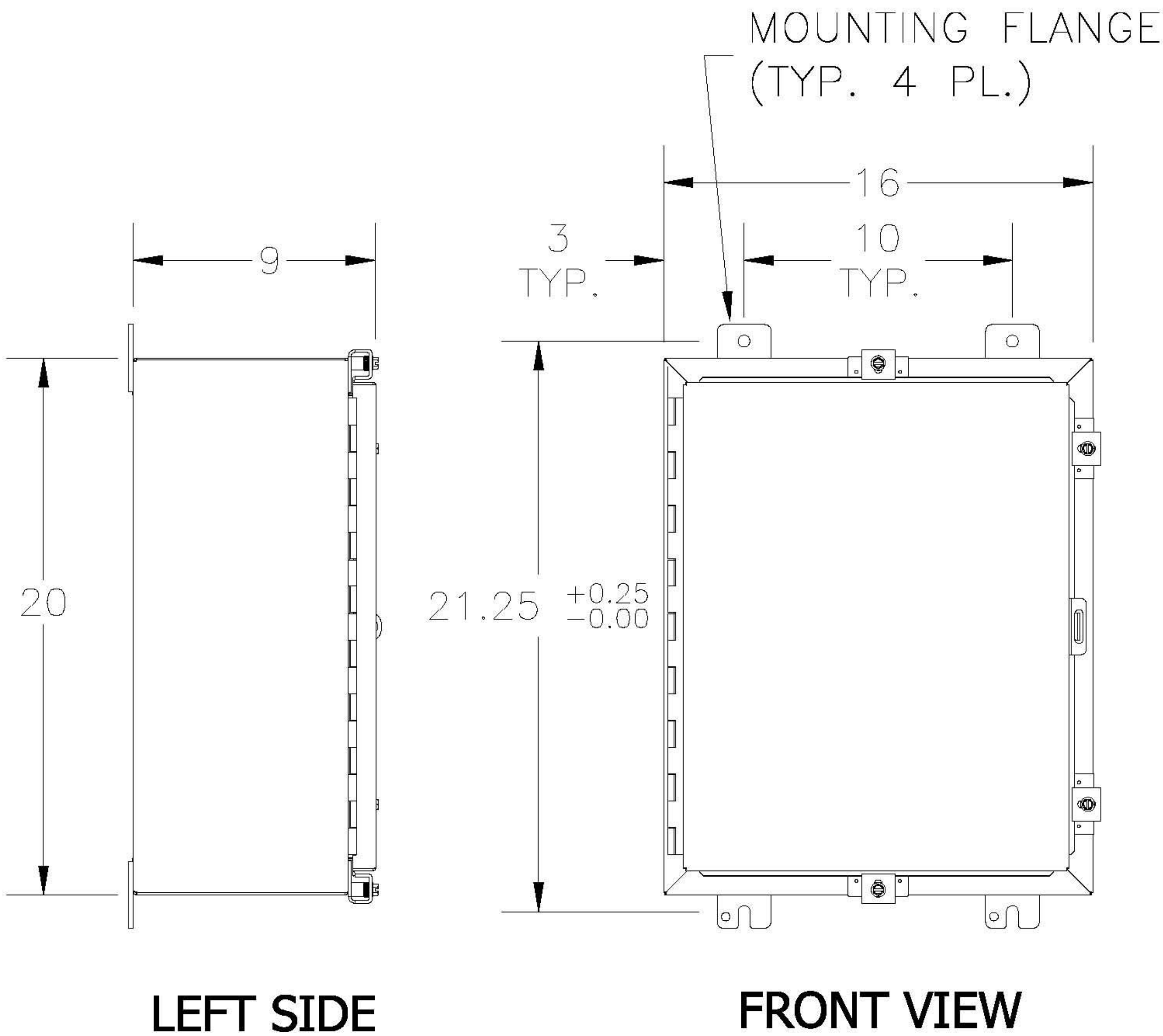


Pin #	Description
A	Ground
B	+24V
C	Ground
D	Data Tx+
E	Data Tx-
F	N/C
G	Data Rx-
H	Data Rx+
J	N/C
K	N/C

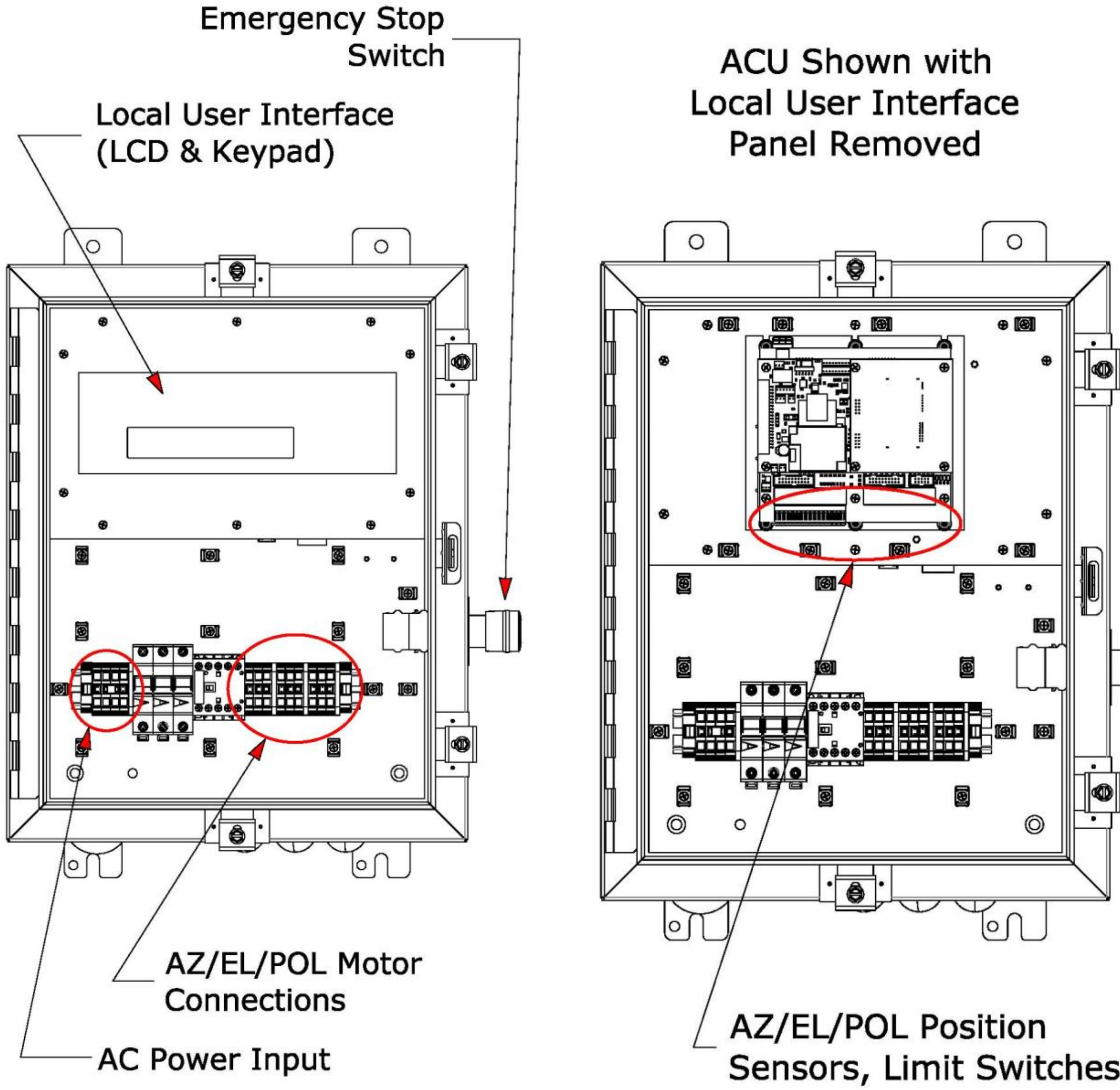
3.3 Board-Stack in Enclosure with Direct Drive to LVDC Motors

3.3.1 Mechanical Mounting

The ACU is packaged as a board-stack inside an outdoor weatherproof enclosure. The following diagram shows the dimensions of the outdoor enclosure. The outdoor enclosure can be mounted using the four mounting flanges that are welded to the back of the housing. The mounting flanges shown can accept 3/8” diameter bolts (not included). The following drawing shows the enclosure dimensions in inches:



3.3.2 Electrical Interface

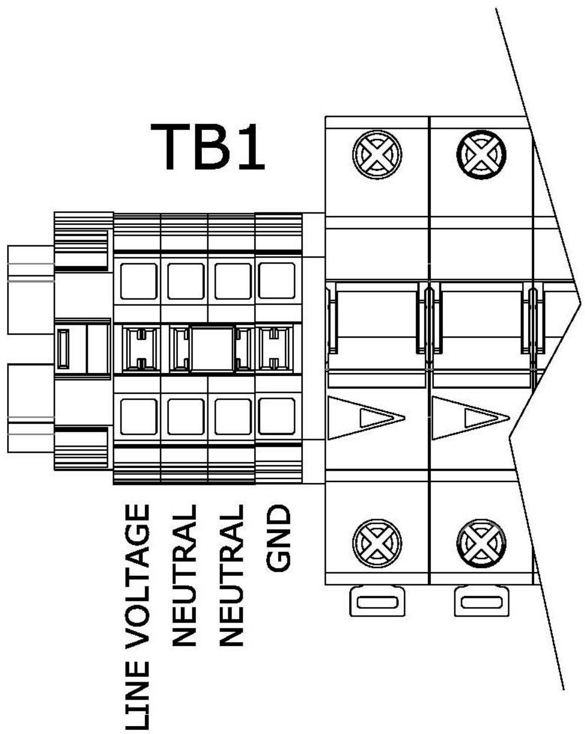


3.3.2.1 AC Power Input

The AC Mains must be connected to the terminal block TB1, which is mounted to the DIN rail at the bottom of the enclosure’s inner panel.

The power supply of the ACU can automatically accommodate single phase AC input between 85 to 265 VAC and between 47 to 63 Hz. The power supply card (located on the bottom of the board-stack) will convert the AC input into 24 VDC power for use by the drive section and for powering the other board-set cards.

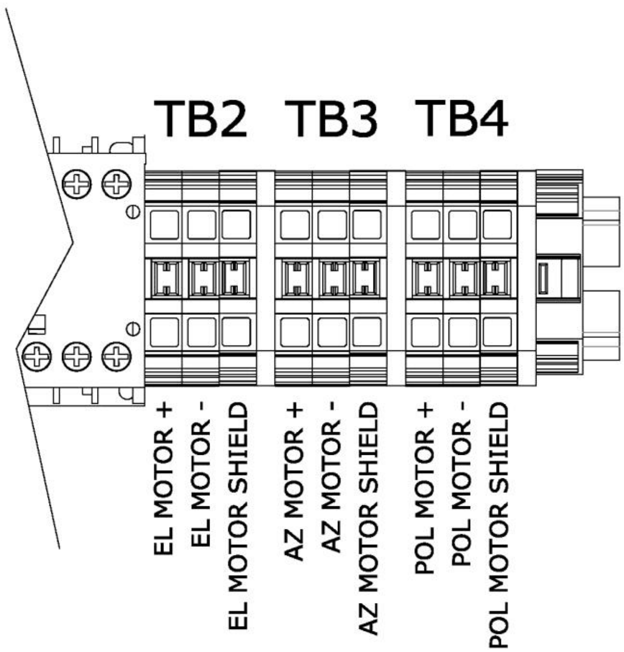
The power input terminal blocks can accept wire diameters up to 10 AWG (6 mm^2).



3.3.2.2 Motor Drive

The ACU drive section is designed to drive azimuth, elevation and polarization motors up to +24 VDC @ 10 Amps. The motor drive module supports IR compensation, current limiting, adjustable acceleration / deceleration profiles, dual speed operation and dynamic braking. The drive train is also protected with resettable fuses.

The motor drive terminal blocks can accept wire diameters up to 10 AWG (6 mm^2).



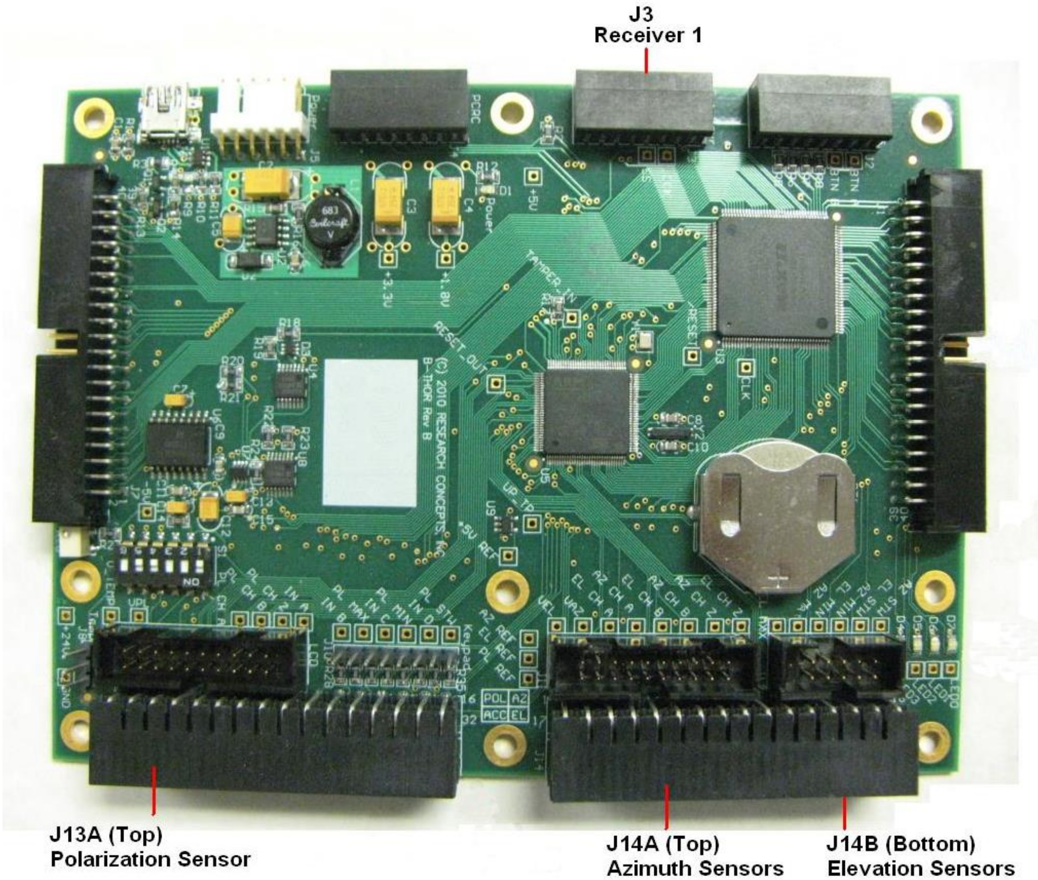
The following table describes the polarity of the RC4500's motor drive output signals.

Axis	Motor Polarity
Elevation	TB2: EL MOTOR + has higher polarity when moving Elevation Up
Azimuth	TB3: AZ MOTOR + has higher polarity when moving Azimuth CW
Polarization	TB4: POL MOTOR + has higher polarity when moving Polarization CW

3.3.2.3 Computing and Interface Board

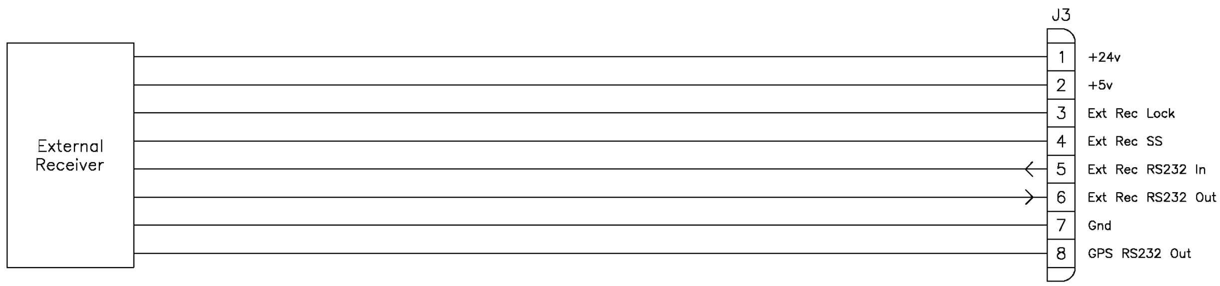
The Computing/Interface Board is part of the board-stack located behind the Local User Interface Panel. The following connections to the Computing/Interface Board may be made during installation.

- Azimuth Limits (J14A)
- Elevation Limits (J14B)
- Polarization Sensors & Limits (J13A)
- Receivers/Signal Strength & Lock Inputs (J3)



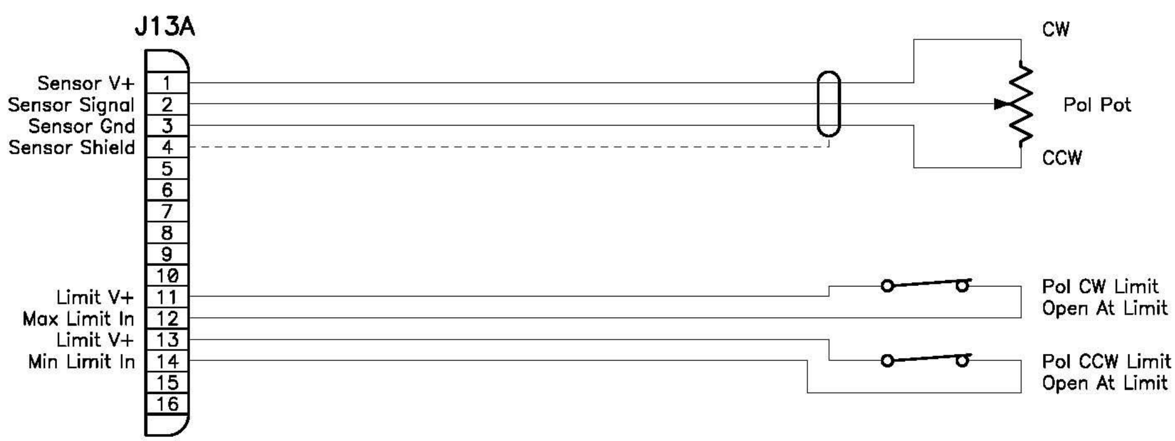
3.3.2.3.1 Receiver 1

J3 provides support for various types of receivers/modems. The mating connector is Phoenix p/n 1881383. The individual pin descriptions are as follows:



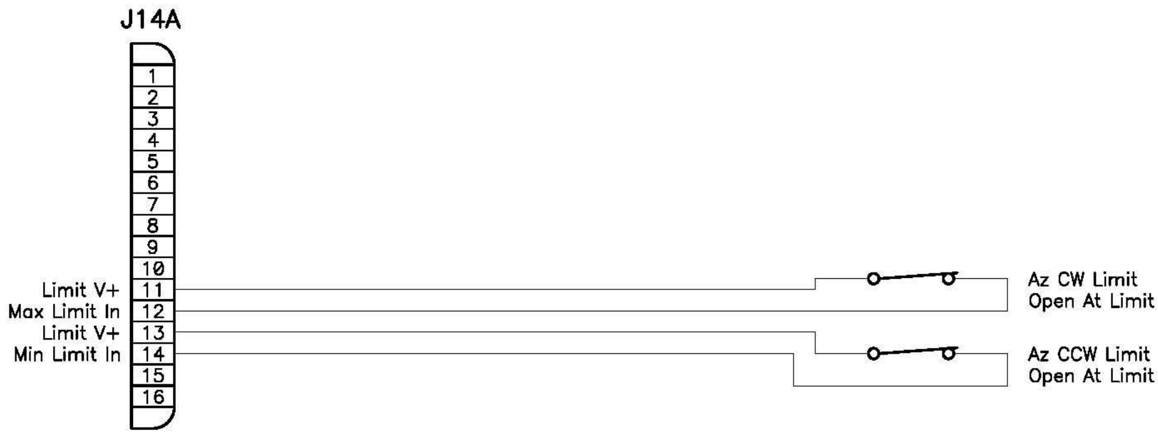
3.3.2.3.2 Polarization Sensor

J13 is a double row header. The top 16 pins are designated "J13A" and provides potentiometer and limit switch feedback for the polarization axis. The mating connector is Phoenix p/n 1952403.



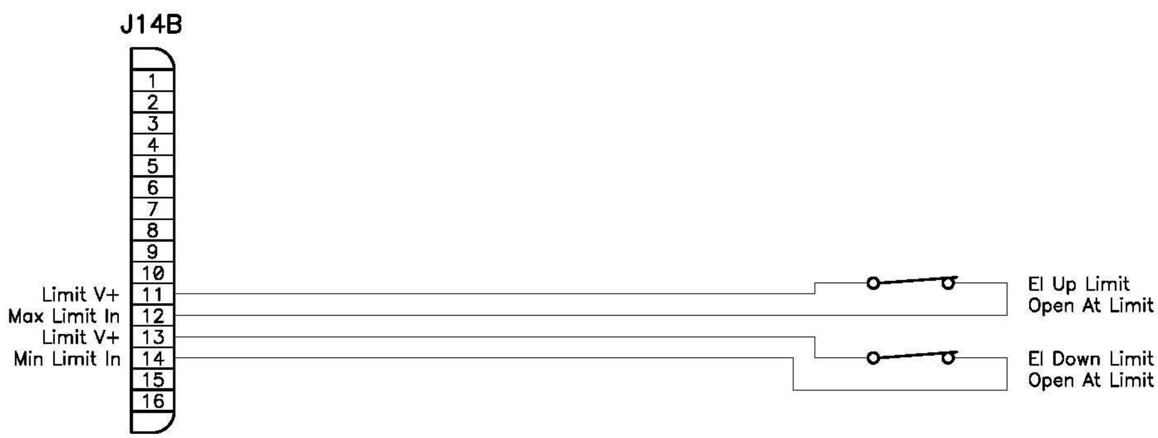
3.3.2.3.3 Azimuth Limits

J14 is a double row header. The top 16 pins are designated "J14A" and provides limit switch feedback for the azimuth axis. The mating connector is Phoenix p/n 1952403. The V+ side of each limit switch circuit supplies +5VDC protected by a 250mA resettable fuse.



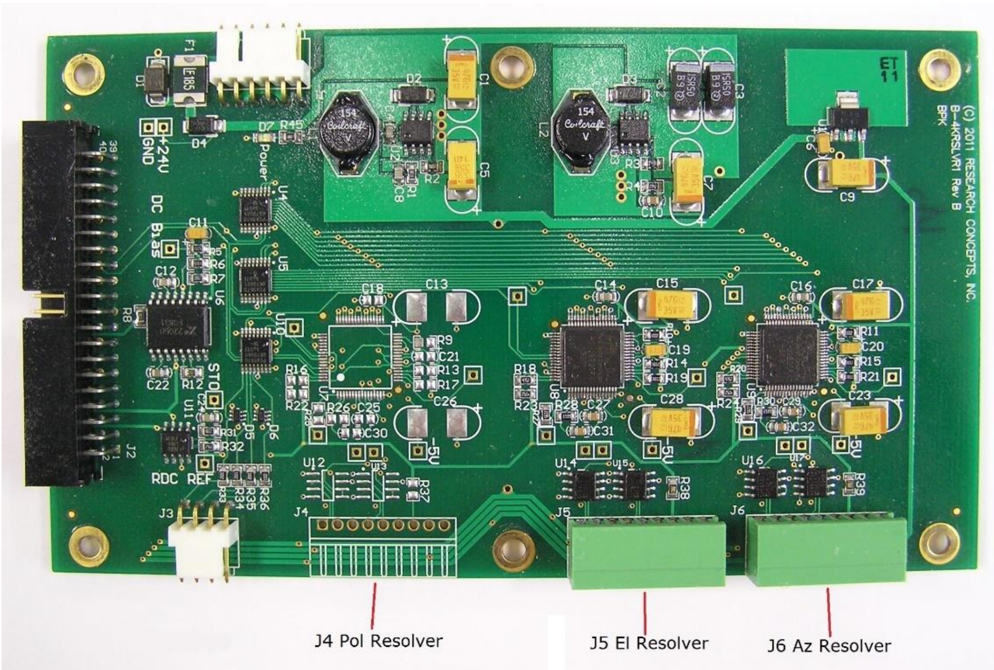
3.3.2.3.4 Elevation Limits

J14 is a double row header. The bottom 16 pins are designated "J14B" and provides limit switch feedback for the elevation axis. The mating connector is Phoenix p/n 1952403. The V+ side of each limit switch circuit supplies +5VDC protected by a 250mA resettable fuse.



3.3.2.4 Resolver Board

The Resolver Board allows an ACU to be able to sense axis positions via resolvers by utilizing resolver-to-digital converters.



NOTE: The J4 Pol Resolver connector and PCB components are not installed on the Resolver Board when the polarization position sensor is not a resolver.

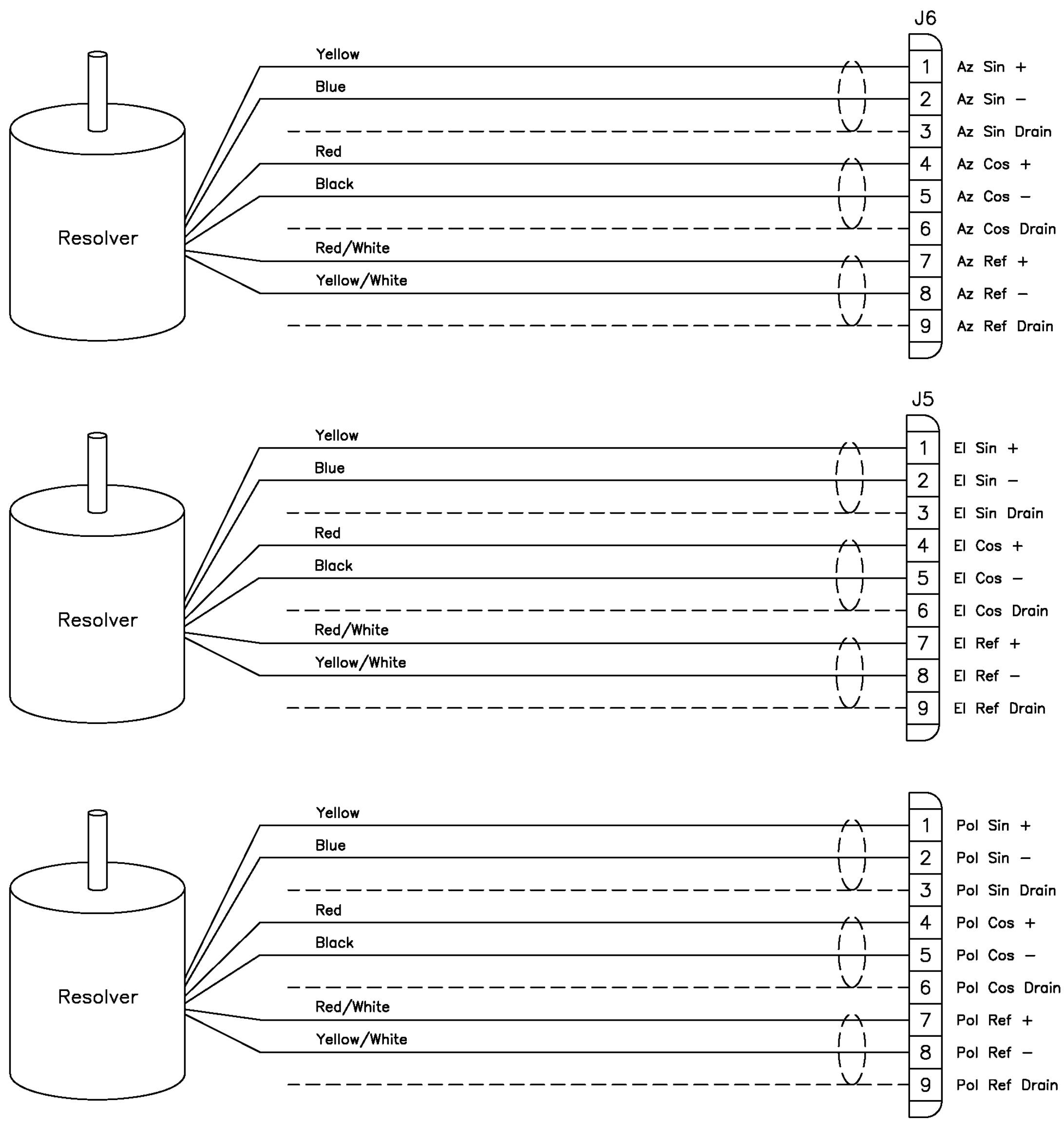
3.3.2.4.1 A/El/Pol Resolver

IMPORTANT: Shielded cable is required for the resolver connections. The shield must be connected to chassis ground at the ACU and NOT connected at the antenna.

Each resolver requires three (3) shielded twisted-pairs for each resolver to minimize noise pickup and cross-coupling, which can result in antenna positioning errors. A cable such as Belden 8777 (RCI p/n CBL-3X2_22STP1) is recommended. Most resolvers have flying lead connections. Wire-to-wire interconnects can be accomplished with solder and heat shrink tubing or a waterproof crimp connector such as 3M™ Scotchlok™ UY2 (RCI p/n CN-JIZR-2).

J6, J5 and J4 are identical connectors for Azimuth, Elevation and Polarization respectively. The mating connector is Phoenix p/n 1881396. The duplicated pinout of these connectors allows for easy testing of the position sensing circuitry by swapping connectors.

The individual pin descriptions are as follows:



4.0 SOFTWARE CONFIGURATION

This chapter covers how to configure the RC4500 for optimum performance. The following table lists the steps required in the most efficient order.

A general knowledge of how to operate the ACU is required. Please review Chapter 2 for information on how to navigate the ACU modes and enter data.

The procedures are written to cover a generic mount type. Any variation will be discussed in Appendix B and/or one or more option-specific appendices.

SECTION	ACTION	COMPLETE
4.1	Software Initialization	
4.1.1	Mount LAT/LON Definition	
4.1.2	Define Antenna Size	
4.1.3	Define Polarization Equipment	
4.1.4	Define System Time	
4.2	Initial Calibration	
4.2.1	Position Sense Direction	
4.2.2	Fast and Slow Speed Settings	
4.2.3	Determine Offset Angles & Reference Voltages	
4.2.4	Scale Factors	
4.2.5	Verify and Set Limits	
4.3	Final Calibration	
4.3.1	Drive System Checkout	
4.3.2	Signal Strength Adjustment	

4.1 Software Initialization

From the factory, the ACU will arrive with all configuration items in the default state. The CONFIG > RESET DEFAULTS screen (5.2.1.3.12) can be used to return the ACU to this default state any time in the future.

It is recommended to change expert access level to INSTALL when performing an system installation. This will allow the user to access all the necessary configuration screens. The expert access level can be changed in the CONFIG > EXPERT ACCESS screen (5.2.1.1.1).

```
EXPERT ACCESS:    1          CONFIG-EXPERT


0-NORMAL/1-INSTALL/2-SUPER<5 DIGIT CODE>
```

4.1.1 Mount LAT/LON Definition

After powering-on the ACU for the first time, the ACU will request the mount location. Use this screen to enter the latitude/longitude of the mount. This screen will not appear again unless the location is cleared through CONFIG > LOCATION RESET (5.2.1.2.6) or CONFIG > RESET DEFAULTS (5.2.1.3.12).

```
                                     LAT/LON
LAT:_        LON:

ENTER LATITUDE DEGREES (+dd.dddd)
```

After the location has been confirmed, the ACU will automatically transition to the mode defined by the MODE field in CONFIG > SYSTEM DEFINITION (5.2.1.3.1).

4.1.2 Define Antenna Size

Use the ANT SIZE field in CONFIG > SYSTEM DEFINITION (5.2.1.3.1) to define the antenna size in centimeters. This value is used to characterize the antenna’s beam width thus affecting the size and timing of tracking and autopeak movements.

```
MODE:2  ANT SIZE: 500        CONFIG-SYSTEM
        ANT LOOK:1            DRIVE:3

ANTENNA SIZE <1-9999 CM>
```

4.1.3 Define Polarization Equipment

Go to CONFIG > FEED DEFINITION (5.2.1.2.4) to configure items related to the antenna's feed.

```
                                CONFIG-FEED
TYPE:1   LO:10750
BAND:1  REF:0
<0>CIRCULAR <1>SINGLE <2>DUAL
```

Set the TYPE field to the type of feed present. CIRCULAR indicates that no polarization movement is required. SINGLE indicates a feed with just one (1) orientation; separate movements are required to achieve horizontal and vertical polarization. DUAL indicates separate two (2) feeds exist 90 degrees apart; one movement is required to achieve both polarizations.

Set the BAND field to the frequency band of the feed.

Set the LO field to the frequency of the LNB's local oscillator.

Set the REF field to the orientation achieved when the polarization axis is at the 0.0-degree position.

4.1.4 Define System Time

Go to MAINT > TIME to check and set the date and time. Accurate date/time is particularly important for installations performing Two Line Element (TLE) tracking.

All dates are displayed and entered in day/month/year (DD/MM/YY) format. All times are displayed and entered in hour/minute/second (HH:MM:SS) format. Refer to section 2.1.2 for instructions on entering date and time.

```
 SYSTEM:11/10/97 22:26:40          TIME
DISPLAY:11/10/97 16:26:40      ZONE:UTC
                              OFFSET:  0
1-DATE 2-TIME 4-ZONE 5-OFFSET
```

4.2 Initial Calibration

This section provides steps to complete the initial calibration of the ACU with the antenna.

4.2.1 Position Sense Direction

Whether the motors are controlled via an AIU or directly via the antenna controller LVDC motor drive, the motor directions should be verified before continuing.

IMPORTANT: Care should be taken when initially moving a mount since limit switches may not yet be configured. Only local jog movements should be used during the following tests.

Verify the jog command, antenna movement, and displayed position change match the following table for each axis. Refer to Section 1.2 for conventions regarding direction.

	Keypad Jog Command	Antenna Movement	Displayed Position Change
EL	Up	Up	Position Increases
AZ	CW	CW	Position Increases
POL	CW	CW	Position Increases

The motor wiring should be reversed before continuing if the axis PHYSICALLY moves in the opposite direction. Keep in mind that changing the motor direction may also change the sensor direction.

The sense direction should be reversed before continuing if the axis POSITION moves in the opposite direction. If the axis implements a potentiometer the direction can be changed by reversing the positive and negative terminal wires to the pot. If the axis implements a resolver the direction can be changed with the DIR field in the CONFIG > AXIS CALIBRATION screen.

```
                                CONFIG-ELEV
DOWN:    0.000 UP:   90.000
 PSF:10431           ROFF:-180.000 DIR:0
DOWN LIMIT <-20.000-120.000 DEGREES>
```

4.2.2 Fast and Slow Speed Settings

There are two different speed systems available. The first system simply has a relay driver output that selects one of two speeds. These two speeds can be adjusted to the desired level within the AIU.

The second system controls the fast and slow speeds directly from the ACU low-voltage motor drive. Both fast and slow speeds may be fine-tuned for each axis. The CONFIG > AXIS DRIVE screen contains configuration items for customizing the characteristics of the motor drive for each axis.

```
     FAST:100  ACC:250     CONFIG-AZ DRV
     SLOW: 50  DEC:250 JAM:    4 FDB:1000
       CL:100   IR:   0 RUN: 200 SDB: 500
FAST VOLTAGE <0-100 % OF MAX>
```

FAST: FAST VOLTAGE <0-100 % OF MAX>
SLOW: SLOW VOLTAGE <0-100 % OF MAX>

The FAST/SLOW fields represent the percentage of the maximum voltage that the drive will output to the motor. The output voltage is decreased by way of pulse width modulation.

The slow speed for an axis should be set low enough that automatic movements perform smoothly. Care should be taken that slow speed is not set so low that the axis is prone to jamming.

4.2.3 Determine Reference Voltages/Offset Angles

The reference voltage/offset angle parameters for each axis must be determined for the displayed angle to match the antenna's true position.

4.2.3.1 Azimuth/Elevation Offset Angles

Step 1) Go to the MAINT > RES OFF screen.

```
     TRUE      RAW       REF       RES OFF
az:   0.00   178.76     0.00    (-178.76)
el:  40.00    65.00     0.00    ( -25.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

Step 2) Manually position or jog the antenna to the center of travel in azimuth and elevation.

Step 3) Loosen the retaining clamp and rotate the resolver to approximately the center of travel. The angles in the "RAW" column should be close to 180.00 degrees. Re-tighten the clamp when finished.

Step 4a) Manually position or jog the antenna to a known satellite position. Press <5> and enter the satellite longitude. The reference angles will automatically be calculated.

OR

Step 4b) Manually position or jog the antenna to a known physical position. Press <1> then <3> and enter the reference angles that coincide with the physical position.

```
     TRUE      RAW       REF       RES OFF
az: 180.00   178.76   180.00    (-178.76)
el:  45.00   181.40    45.00    ( -25.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

Step 5) Press the <7> then <9> key on the keypad to calculate the new resolver offset angles. The ROFF field will automatically be changed in the CONFIG > AZIMUTH CALIBRATION and CONFIG > ELEVATION CALIBRATION screens. The "TRUE" column shows the displayed angle as it will appear in all other ACU modes.

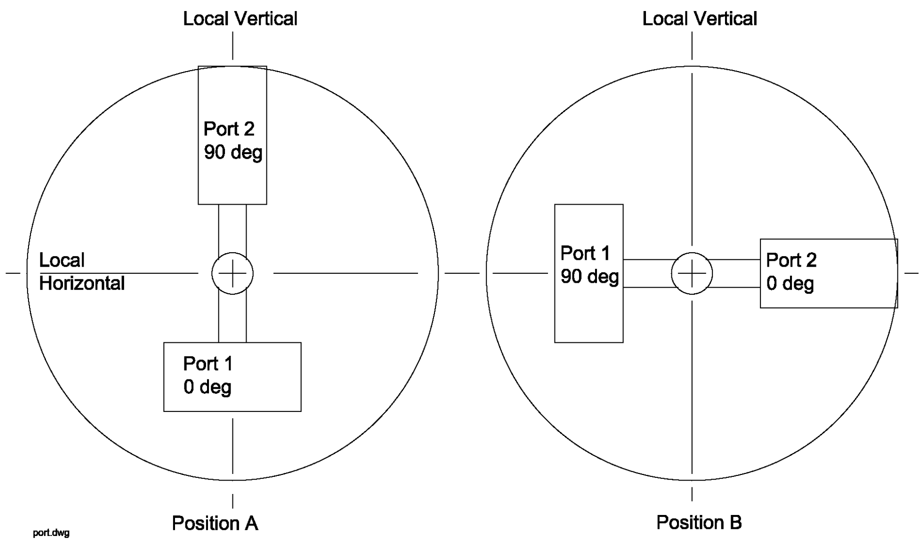
```
     TRUE      RAW       REF       RES OFF
az: 180.00   178.76   180.00    (   1.24)
el:  45.00   181.40    45.00    (-136.40)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

4.2.3.2 Polarization Reference Voltage/Offset Angle

IMPORTANT: Level the antenna platform so there is no pitch or roll before performing this procedure.

Identify the type of position sensor that is used. Follow the Reference Voltage procedure (4.2.3.3.1) if the sensor is a potentiometer. Follow the Offset Angle procedure (4.2.3.3.2) if the sensor is a resolver.

The polarization axis must be aligned with the local vertical or 0.0 degrees. The following diagram shows a typical situation where two waveguides rotate together. The polarity of a waveguide is determined by its narrow dimension. Position A shows port 1 in the local vertical orientation. Position B shows port 2 in the local vertical orientation.



4.2.3.3.1 Polarization Reference Voltage

Step 1) Using an accurate inclinometer or level, manually position the polarization axis so that the waveguides align with the local vertical and horizontal orientations.

Step 2) Go to the MAINT > VOLTS > 12 BIT ADC VOLTAGES screen.

```
 AZ: 0.0012      1   31659       12 BIT ADC
 EL: 0.0012      1   32264             L1:0
POL: 2.5000   2048   14939             L2:1
SIG: 3.3346   2731                     L3:1
```

Step 3) Loosen the retaining clamp and rotate the potentiometer approximately to the center of travel. The POL voltage should be close to 2.500 volts. Re-tighten the clamp when finished. Note the final voltage for the next step.

Step 4) Enter the final voltage from Step 3 into the VREF field in the CONFIG > POLARIZATION CALIBRATION screen.

```
       VREF:2.500 OFF:   0.000 CONFIG-POL
 CCW:-100.000 CW: 100.000 SF: 40.000

ZERO DEG VOLTAGE <1.000-4.000 VOLTS>
```

Step 5) Verify the data has been entered correctly by returning to MANUAL mode. The displayed polarization angle should be 0.00 +/- 0.1 degrees.

```
AZ: 185.93            RF: 50       MANUAL
EL:  29.61           SAT:
PL:    0.00          SPD:FAST         UTC
<MODE>MENU <0-9>JOG ANTENNA      14:25:47
```

4.2.3.3.2 Polarization Offset for Resolver

Step 1) Using an accurate inclinometer or level, manually position the polarization axis so that the waveguides align with the local vertical and horizontal orientations.

Step 2) Set the ROFF field to 0.000 in the CONFIG > POLARIZATION CALIBRATION screen.

```
                               CONFIG-POL
 CCW:-100.000 CW: 100.000
 PSF:10431           ROFF:    0.000 DIR:0
RESOLVER OFFSET <+/-300.000 DEGREES>
```

Step 3) Go to MANUAL mode and press the SCROLL UP key until PL changes to PR. The displayed position now shows the raw resolver angle.

```
AR: 185.93            RF: 50       MANUAL
ER:  29.61           SAT:
PR: 185.46           SPD:FAST         UTC
<MODE>MENU <0-9>JOG ANTENNA      14:25:47
```

Step 4) Loosen the retaining clamp and rotate the potentiometer approximately to the center of travel. The angle should be close to 180.00 degrees. Re-tighten the clamp when finished. Note the final angle next to PR for the next step.

Step 5) Enter the final angle from Step 4 into the ROFF field in the CONFIG > POLARIZATION CALIBRATION screen.

```
                              CONFIG-POL
 CCW:-100.000 CW: 100.000
 PSF:10431           ROFF:-185.460 DIR:0
RESOLVER OFFSET <+/-300.000 DEGREES>
```

Step 6) Verify the data has been entered correctly by returning to MANUAL mode. The displayed polarization angle should be 0.00 degrees.

```
AZ: 185.93            RF: 50      MANUAL
EL:  29.61           SAT:
PL:    0.00          SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

4.2.4 Scale Factors

IMPORTANT: Normally, the default scale factors for a mount are correct and should NOT be changed. Perform scale factor calibration only if Appendix B suggests these values need to be characterized.

4.2.4.1 Azimuth/Elevation Pulse Scale Factor

This value specifies the approximate number of pulses measured per radian of travel. This value allows the ACU to correctly display the resolver position in angular format. The value is also used for pulse-based movement.

Typically, for a resolver sensor that rotates on-axis, the pulse scale factor is 10431. Ensure this value exists in the PSF field in the CONFIG > AXIS CALIBRATION screen.

```
                              CONFIG-ELEV
DOWN:    0.000 UP:   90.000
 PSF:10431              ROFF:-180.000 DIR:0
DOWN LIMIT <-20.000-120.000 DEGREES>
```

4.2.4.3 Polarization Scale Factor

Identify the type of position sensor that is used and follow the procedure below that corresponds.

The following procedures depend on having correctly completed the polarization zero voltage/offset angle procedure in Section 4.2.3.2.

4.2.4.3.1 Polarization Scale Factor for Potentiometer

Step 1) Using an accurate inclinometer or level, manually position the polarization axis to a physical angle at least 45.0 degrees from the local vertical. This angle will be denoted *P_delta* for Step 4.

Step 2) Go to the MAINT > VOLTS > 12 BIT ADC VOLTAGES screen. The POL voltage will be denoted *V_delta* for Step 4.

```
 AZ: 0.0012     1  31659      12 BIT ADC
 EL: 0.0012     1  32264            L1:0
POL: 2.5000  2048  14939            L2:1
SIG: 3.3346  2731                   L3:1
```

Step 3) Go to the CONFIG > POLARIZATION CALIBRATION screen. The value from the field VREF will be denoted *V_ref* for Step 4.

```
      VREF:2.500 OFF:  0.000 CONFIG-POL
CCW:-100.000 CW: 100.000 SF: 40.000

POT SCALE FACTOR <1.000-180.000 DEG/V>
```

Step 4) Calculate the scale factor in degrees per volt as follows

SF = (P_delta – 0.00) / (V_delta – V_ref)

For example, if *P_delta* = -90.0 degrees, *V_delta* = 1.42 volts, *V_ref* = 2.50 volts, the scale factor can be calculated as:

SF = (-90.00 – 0.00) / (1.42 – 2.50) = -90.00 / -1.08 = 83.333

Step 5) Enter the value calculate in Step 4 into the SF field in the CONFIG > POLARIZATION CALIBRATION screen.

```
      VREF:2.500 OFF:  0.000 CONFIG-POL
CCW:-100.000 CW: 100.000 SF: 83.333

POT SCALE FACTOR <1.000-180.000 DEG/V>
```

4.2.4.3.2 Polarization Scale Factor for Resolver

This value specifies the approximate number of pulses measured per radian of travel. This value allows the ACU to correctly display the resolver position in angular format. The value is also used for pulse-based movement.

Typically, for a resolver sensor that rotates on-axis, the pulse scale factor is 10431. Ensure this value exists in the PSF field in the CONFIG > POLARIZATION CALIBRATION screen.

```
                              CONFIG-POL
 CCW:-100.000 CW: 100.000
 PSF:10431            ROFF:   0.000 DIR:0
RESOLVER OFFSET <+/-300.000 DEGREES>
```

4.2.5 Verify and Set Limits

At this point in the calibration process, the limits for each axis can be properly verified and adjusted if necessary. The RC4500 typically interfaces to discrete limit switches (either directly or via AIU interface) which halt all movement in the related direction. The ACU also includes soft limits that limit axis travel based on the current angular sensor.

4.2.5.1 Azimuth Limits

Step 1) Go to the CONFIG > AZIMUTH CALIBRATION screen. Use the CCW and CW fields to set the software limits outside the physical limits.

```
                                                   CONFIG-AZIM
 CCW:-200.000 CW: 200.000
 PSF:10431          ROFF:-180.000 DIR:0
CCW LIMIT <+/-300.000 DEGREES>
```

Step 2) Verify the azimuth clockwise and counter-clockwise physical limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “CCW” or “CW” will be displayed to the right of the azimuth position.

```
AZ: 180.32      CW     RF: 50       MANUAL
EL:   42.45           SAT:
PL:   30.01   V       SPD:FAST         UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

Step 3) Go to the CONFIG > AZIMUTH CALIBRATION screen. Use the CCW and CW fields to set the software limits just inside the physical limits.

```
                                                   CONFIG-AZIM
 CCW:-180.000 CW: 180.000
 PSF:10431          ROFF:-180.000 DIR:0
CCW LIMIT <+/-300.000 DEGREES>
```

Step 4) Verify the azimuth clockwise and counter-clockwise software limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “ccw” or “cw” will be displayed to the right of the azimuth position.

```
AZ: 180.00      cw     RF: 50       MANUAL
EL:   42.45           SAT:
PL:   30.01   V       SPD:FAST         UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

4.2.5.2 Elevation Limits

Step 1) Go to the CONFIG > ELEVATION CALIBRATION screen. Use the DOWN and UP fields to set the software limits outside the physical limits.

```
                                CONFIG-ELEV
DOWN:    0.000 UP:   100.000
 PSF:10431           ROFF:-180.000 DIR:0
DOWN LIMIT <-20.000-120.000 DEGREES>
```

Step 2) Verify the elevation up and down physical limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “DOWN” or “UP” will be displayed to the right of the elevation position.

```
AZ: 179.97            RF: 50      MANUAL
EL:  85.66      UP   SAT:
PL:  30.01   V       SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

Step 3) Go to the CONFIG > ELEVATION CALIBRATION screen. Use the DOWN and UP fields to set the software limits just inside the physical limits.

```
                                CONFIG-ELEV
DOWN:    5.000 UP:    85.000
 PSF:10431           ROFF:-180.000 DIR:0
DOWN LIMIT <-20.000-120.000 DEGREES>
```

Step 4) Verify the elevation up and down software limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “down” or “up” will be displayed to the right of the elevation position.

```
AZ: 179.97            RF: 50      MANUAL
EL:  85.00      up   SAT:
PL:  30.01   V       SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

4.2.5.3 Polarization Limits

Step 1) Go to the CONFIG > POLARIZATION CALIBRATION screen. Use the CCW and CW fields to set the software limits outside the physical limits.

```
       VREF:2.500 OFF:  0.000 CONFIG-POL
 CCW:-180.000 CW: 180.000 SF: 40.000

CCW LIMIT <+/-180.000 DEGREES>
```

Step 2) Verify the azimuth clockwise and counter-clockwise physical limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “CCW” or “CW” will be displayed to the right of the azimuth position.

```
AZ: 179.97              RF: 50      MANUAL
EL:  42.45             SAT:
PL:-100.64     CCW     SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

Step 3) Go to the CONFIG > POLARIZATION CALIBRATION screen. Use the CCW and CW fields to set the software limits just inside the physical limits.

```
       VREF:2.500 OFF:  0.000 CONFIG-POL
 CCW:-100.000 CW: 100.000 SF: 40.000

CCW LIMIT <+/-180.000 DEGREES>
```

Step 4) Verify the azimuth clockwise and counter-clockwise software limits by jogging the antenna in MANUAL mode to each limit. Verify that no movement can occur beyond these limits. When each limit is activated, the text “ccw” or “cw” will be displayed to the right of the azimuth position.

```
AZ: 179.97              RF: 50      MANUAL
EL:  42.45             SAT:
PL:-100.01     ccw     SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

4.3 Final Calibration

4.3.1 Drive System Checkout

Confirm the configuration of the drive system for all three axes. Manually move the mount to each axis limit and confirm drive current to the motor is shut off when the limit is reached. Also check the displayed position value and confirm that it is reasonable.

SETUP (5.1.2.1) several dummy satellites and RECALL (5.1.2.2) them to check out the automatic drive system. If the mount does not smoothly move to the target position, the drive parameters may have to be adjusted.

4.3.2 Signal Strength Adjustment

The ACU can sense satellite signal strength via the signal strength input circuits. Correct adjustment of the signal strength parameters is required for tracking operations.

4.3.2.1 Signal Strength Channel

The ACU requires an input signal which indicates the strength of the received signal. This signal is typically generated by a receiver or modem. On satellite receivers, this signal output typically varies in proportion to the received power of the transponder and may also be referred to as a 'Signal Strength' or 'Tuning Meter' output.

Signal strength levels from receivers and modems vary widely. The ACU provides two circuits that are designed to accommodate any signal strength input that varies between +/-10 VDC. These circuits are called REC1 and REC2.

The REC1 input is designated for external signal sources. It is routed to the microcontroller's 12-bit ADC and can be seen in the AD VOLTAGES Maintenance as source "SIG". When navigating through the ACU modes, this input is labeled "EXT" for external.

The REC2 input is designated for internal (integrated) signal sources. It is routed to the microcontroller's 10-bit ADC and can be seen in the AD VOLTAGES Maintenance as source "4-REC2". When navigating through the ACU modes, this input is labeled based on the receiver. For example, an integrated beacon receiver is labeled "BCN".

4.3.2.2 Amplifier Gain vs. Frequency Characterization

The amplifier gain vs. frequency characteristic is the variation of the amplifier gain with changing frequency. The ideal response is to have a "flat" gain characteristic where the gain does not vary with frequency.

Amplifiers with poor characteristics can cause problems with tracking. When the receiver is tuned to various transponders, gain flatness problems could cause the signal to be above the threshold, when in fact no satellite signal is present. For certain transponders, gain flatness problems could also cause the controller's input scaling network to be saturated when the antenna is aligned with a strong satellite, making it impossible for the controller to detect changes in signal strength when attempting to peak the antenna.

There are four places in a satellite receiving system that may have gain flatness problems that can affect the operation of the tracker. These are the LNB, the coaxial cable connecting the LNB to the receiver, line amps (or bullet amps) inserted in the 950 - 1750 MHz IF, and the receiver's IF or AGC stages. If a spectrum analyzer is connected into the receiver's block IF line, the gain flatness of the LNB and any line amps present can be observed. When the antenna is pointed away from any satellite, the spectrum analyzer displays the received noise, which should be constant with frequency. If the display is not a horizontal line then some gain variation with frequency is present.

To test the gain flatness of the satellite receiver, perform the following procedure. The procedure assumes a single receiver, single frequency band system.

1. Position the antenna well off of any satellite. Tune the receiver to each transponder. Make sure that the signal strength reading is below the threshold assigned via CONFIG mode.

2. Align the antenna with a strong satellite. Tune the receiver to each active transponder on the satellite. Make sure that the signal strength is well above the threshold and below 999.

If the system fails either of the tests above, then the user can attempt to correct the problem by correcting the gain flatness problem. Most gain flatness problems can be traced to a problem with the coaxial cable connecting the antenna to the receiver (sometimes called a 'suck-out') or to bullet amplifiers. Some bullet amplifiers have been observed to have terrible gain flatness characteristics.

5.0 MODE DESCRIPTIONS

5.1 Operating Group

The operating group contains two base modes, MANUAL and MENU. While in either one of these modes, a momentary push of the Mode key will transition the ACU to the other mode.

5.1.1 Manual Mode

```
AZ: 179.97      CW      RF: 436     MANUAL
EL:  42.45             SAT:
PL:  30.01  V          SPD:FAST        UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

The MANUAL mode allows the antenna to be jogged in all three axes. The azimuth axis is jogged by pressing the 4-Az CCW or 6-Az CW key, the elevation axis is jogged by pressing the 2-El Up or 8-El Dn key, and the polarization axis is jogged by pressing the 1-Pol CCW or 3-Pol CW key. Several automatic movements are also available in MANUAL mode. Pressing the 7-H or 9-V keys moves the polarization to the horizontal or vertical position. The horizontal/vertical positions correspond to the last satellite selected in RECALL mode (5.1.2.2). If no satellite has been selected, these positions default to 0 or 90 degrees depending on the REF field in the CONFIG > FEED DEFINITION screen (5.2.1.2.4). Pressing the 5-H/V key moves "cross-pol" (or 90-degrees) from the current position.

The following fields make up the MANUAL mode display:

AZ/AR/AZ:

This field shows the current azimuth position value. Pressing the Scroll Up-Angle CT key will rotate the between antenna true heading angle (AZ), resolver angle (AR) and resolver digitized count (AZ).

Any active limits will be displayed to the right of this field. A hard-limit is indicated by "CCW" or "CW". A soft-limit is indicated by "ccw" or "cw".

EL/ER/EL:

This field shows the current elevation position value. Pressing the Scroll Up-Angle CT key will rotate the between antenna boresight angle (EL), resolver angle (ER) and resolver digitized count (EL).

Any active limits will be displayed to the right of this field. A hard-limit is indicated by "DOWN" or "UP". A soft-limit is indicated by "down" or "up".

PL/PR/PL:

This field shows the current polarization position value. Pressing the Scroll Up-Angle CT key will rotate the between antenna polarization angle (PL), resolver angle (PR) and resolver digitized count/pulse count (PL). Raw resolver angle and resolver count will only be displayed if a polarization resolver is present. The pulse count will only be displayed if a polarization pulse sensor is present.

An ‘H’ or ‘V’ will be follow the position value when close to the horizontal or vertical position.

Any active limits will be displayed to the right of this field. A hard-limit is indicated by “CCW” or “CW”. A soft-limit is indicated by “ccw” or “cw”.

RF/EXT:

The signal strength field shows the current signal strength. By pressing the Scroll Dn-RF/SS key, the signal source will rotate the displayed channel between RF and EXT.

The current signal strength will be displayed as a value between 0 and 4000. If a signal lock input is available, an ‘L’ will be displayed to the right of the signal strength value when signal lock condition has been satisfied.

SPD:

This field shows the selected drive speed. The speed may be toggled between FAST and SLOW by pressing the 0-Speed key.

TIME DISPLAY

The reference time (6.2.2) and time zone are displayed in the lower right-hand corner.

5.1.2 Menu Mode

The MENU mode provides a menu system for selecting various operational sub-modes.

```
1-SETUP     2-RECALL    3-DELETE       MENU
4-MOVETO
                                        UTC
<0-9>SELECT <MODE>MANUAL           14:37:23
```

The reference time (6.2.2) and time zone are displayed in the lower right-hand corner.

Available sub-modes are described in the following sections.

5.1.2.1 Setup Mode

The SETUP mode saves a satellite's name, azimuth and elevation positions, horizontal and vertical polarization positions and RF band in memory. Up to 100 satellites may be stored. Up to 20 may be enabled for inclined orbit tracking. Stored satellites may be returned to later via RECALL mode.

The first screen that appears asks the user to enter basic satellite data. The name, longitude, band, inclination, type of tracking and signal source are requested.

```
NAME:                                  SETUP
LON:               INCLIN:
BAND:            TRACKING:         SIG:
NAME (10-CHARACTERS)
```

The next screen allows the user to peak up on the satellite in azimuth and elevation. Press the ENTER key to save the azimuth and elevation positions.

```
AZ:  54.13              RF: 503     SETUP
EL:  48.95
PL:-124.74             SPD:FAST
<0-9>JOG ANTENNA <ENTER>SAVE AZ/EL POS
```

The next two screens allow the user to peak up the horizontal and vertical polarization position. Press the ENTER key to save the horizontal position. Press the ENTER key again to save the vertical position.

```
AZ:  54.13              RF: 503     SETUP
EL:  48.95
PL:-124.74             SPD:FAST
<0-9>JOG ANTENNA <ENTER>SAVE HORZ POL
```

```
AZ:  54.13              RF: 503     SETUP
EL:  48.95
PL:-34.74              SPD:FAST
<0-9>JOG ANTENNA <ENTER>SAVE VERT POL
```

The ACU will return to MANUAL mode if the satellite is not inclined. Otherwise, the user will be prompted to select the initial receive polarization.

```
H-HORIZONTAL:-124.74
V-  VERTICAL: -34.74  SAT:

<H/V>SELECT RX POLARIZATION   <MODE>MENU
```

After selecting the polarization, the ACU will automatically switch to TRACK mode (5.1.2.5).

5.1.2.2 Recall Mode

The RECALL mode returns the antenna to a satellite position stored in the controller's memory.

```
                                        RECALL
#   NAME        LON    INCL BAND TRK   TBL
1   A           90.0W    0    KU  OFF ----
<SCR>THRU LIST <ENTER>SELECT  <MODE>EXIT
```

Use the Scroll Up/Scroll Dn keys to scroll through the list of satellites stored in memory. Press the ENTER key to select the desired satellite.

If no satellites are currently stored the following screen will appear.

```
                                        RECALL
 *       NO SATELLITES IN MEMORY      *
 *     USE SETUP MODE TO STORE NEW    *
                        <MODE> TO EXIT
```

After a satellite has been selected, the controller will prompt the user to specify the desired polarization.

```
H-HORIZONTAL:-124.74                    RECALL
V-  VERTICAL: -34.74  SAT:A

<H/V>SELECT RX POLARIZATION   <MODE>MENU
```

The antenna will begin moving to the selected satellite. When the automatic move is completed, control will transfer to MANUAL mode if the satellite is not inclined. Otherwise, the ACU will automatically switch to TRACK mode (5.1.2.5).

5.1.2.3 Delete

The DELETE mode allows a stored satellite to be removed from memory.

```
                                        DELETE
#   NAME        LON    BAND INCL TRK TBL
1   ABC         90.0W   KU    N   OFF ----
<SCR>THRU LIST <ENTER>SELECT  <MODE>EXIT
```

Use the Scroll Up/Scroll Dn keys to scroll through the list of satellites stored in memory. Press the ENTER key to select the satellite to delete. All satellites can be deleted by using the “DELETE ALL” option at the end of the list.

If no satellites are currently stored the following screen will appear.

```
                                        DELETE
 *       NO SATELLITES IN MEMORY      *
 *     USE SETUP MODE TO STORE NEW    *
                        <MODE> TO EXIT
```

5.1.2.4 MoveTo Mode

The MOVETO mode allows the antenna to be moved to a desired or calculated position.

```
AZ: 123.45 ( 123.45) <0>SPD:FAST  MOVETO
EL:  41.56 (  41.56) <5>SENSOR:PRIMARY
PL: -13.34 ( -13.34) <6>LON:
SET <1>AZ<2>EL<6>POL <4>START MOVE
```

The current azimuth, elevation and polarization angles are displayed. When the mode is first entered, the current positions are shown as the target positions. All values are true antenna angles.

The following actions are available:

<1>AZ, <2>EL, <3>POL

Use the 1-key, 2-key, and 3-key to enter the azimuth, elevation, and polarization targets.

<4>START MOVE

Press the 4-key to initiate the automatic movement.

<5>SENSOR:PRIMARY

Press the 5-key to toggle the sensor that will be used for display and entry. Primary refers to the antenna angular sensors. Secondary refers to resolver/pulse counts. The secondary sensor is typically higher-resolution.

<6>LON:

Press the 6-key to enter a satellite longitude. The ACU will calculate the target azimuth, elevation, and horizontal polarization angles for the given longitude.

5.1.2.5 Track Mode

NOTE: This mode is only available on ACUs that were purchased with a tracking option.

The TRACK mode is automatically entered via the SETUP or RECALL modes if the selected satellite has been defined as having an inclined orbit.

The following descriptions give a brief overview of available track modes. Refer to Appendix TRK for complete detail on TRACK mode.

```
AZ:  31561  340.44   EXT:2730       TRACK
EL:  11060   49.27   SAT:BRASIL A1  (KU)
PL:  26517    6.54   STEP:PEAKING    AGC
JOGGING ANTENNA TO FIND MAXIMUM SIGNAL
```

The RC4500 track system has four (4) sub-modes:

1) **STEP TRACK** – For this sub-mode, the controller periodically peaks on the receiver's signal strength by jogging the antenna. The time and position are recorded in a non-volatile track table. The interval between peak-ups is determined by antenna beam, satellite inclination and a user specified maximum allowable error (in dB). When a track table entry exists, STEP TRACK switches to MEMORY TRACK.

2) **MEMORY TRACK** – For this sub-mode, the controller smoothly moves the antenna to azimuth and elevation positions derived from entries in the track table. The time between movements is determined by the same factors which govern the time between peak-up operations in STEP TRACK. The accuracy of the track table is monitored by periodically peaking up on the receiver's signal strength. If the error exceeds a level set by the user, all entries in the track table are flagged for update.

3) **TLE TRACK** – For this sub-mode, the controller uses azimuth and elevation positions calculated from Two-Line Element data to build the track table. The track table is continuously updated while TLE TRACK is active. The time between movements is again determined by the same factors which govern the time between peak-up operations in STEP TRACK. When receiver signal strength is available, STEP TRACK will switch to TLE TRACK if signal is lost. TLE TRACK switches back to STEP TRACK once the signal returns. If no signal strength is available, TLE TRACK will be constantly active. Although track table data exists, no transition from STEP TRACK to MEMORY TRACK will occur when TLE tracking is specified.

4) **TRACK SEARCH** – This mode is entered when the satellite signal has been lost. The ACU utilizes Intelli-Search, an efficient search algorithm that minimizes errors associated with traditional box searches and frees the user from having to update search window parameters. This scheme accounts for the specific mount geometry, calculates the nominal trajectory for the satellite, and then searches in an area that coincides with the satellite's expected path. When the satellite is located, the controller re-enters the STEP TRACK mode.

5.2 Configuration Group

The programming group contains two base modes, CONFIG-MENU and MAINTENANCE. Both of these modes serve as a menu for sub-modes below them. While in either one of these modes, a momentary push of the Mode key will transition the ACU to the other mode.

5.2.1 Configuration Mode

The CONFIG-MENU mode allows the user to customize the ACU operation for a particular installation.

This mode organizes all the available configuration parameters into collections of similar items. The example below shows a typical collection overview screen. The title and description indicates the type of items that are contained.

```
AZIMUTH CALIBRATION           CONFIG-MENU
AZ REFERENCE VOLTAGE/LIMITS/SCALE FACTOR

<SCR>THRU LIST <ENTER>SELECT <MODE>MAINT
```

Press the Scroll Up/Scroll Dn keys to scroll through the list of collections. Press the Enter key to display a screen with the contained items. As an example, the AZIMUTH CALIBRATION screen is shown below.

```
                              CONFIG-AZIM
 CCW:-180.000 CW: 180.000
 PSF:10431           ROFF:-179.049 DIR:0
CCW LIMIT <+/-300.000 DEGREES>
```

Press the Scroll Up/Scroll Dn keys to move between the fields in the screen. The cursor will flash at the beginning of the data field for the item currently selected. A prompt describing the item and showing the valid range of data will appear on the bottom line. Data may be entered for the item as described in sSection 2.1.2.

Momentarily pressing the Mode key will return to list of collections.

The following table lists all the collection titles and descriptions as they appear in CONFIG-MENU mode. The table also shows which collections are available according to how the expert access permission (5.2.1.1.1) is set. Details for each screen are provided in the following sections.

Additional screens may be available if they are unique to optional features. Descriptions of those screens will be provided in their respective appendices.

Title	Description	Section
NORMAL ACCESS ITEMS		
EXPERT ACCESS PERMISSION	Sets Expert Access Level	5.2.1.1.1
TLE 1 DATA	TLE Data Set – Line 1	5.2.1.1.2
TLE 2 DATA	TLE Data Set – Line 2	5.2.1.1.3
INSTALLATION ITEMS		
AZIMUTH CALIBRATION	Azimuth Offsets, Limits, Scale Factors	5.2.1.2.1
ELEVATION CALIBRATION	Elevation Offset, Limits, Scale Factors	5.2.1.2.2
POLARIZATION CALIBRATION	Polarization Offsets, Limits, Scale Factors	5.2.1.2.3
FEED DEFINITION	Feed Type, Band, ID, Reference	5.2.1.2.4
EXTERNAL SIG FACTORS	External Signal Source Parameters	5.2.1.2.5
LOCATION RESET	Reset Antenna Latitude/Longitude	5.2.1.2.6
SUPER-USER ITEMS		
SYSTEM DEFINITION	Enable System Options	5.2.1.3.1
AZIM ANGLE MOVEMENT	Azimuth Angle-Based Move Parameters	5.2.1.3.2
AZIM COUNT MOVEMENT	Azimuth Count-Based Move Parameters	5.2.1.3.3
AZIMUTH DRIVE PARAMETERS	Azimuth Drive Parameters	5.2.1.3.4
ELEVATION ANGLE MOVEMENT	Elevation Angle-Based Move Parameters	5.2.1.3.5
ELEVATION COUNT MOVEMENT	Elevation Count-Based Move Parameters	5.2.1.3.6
ELEVATION DRIVE PARAMETERS	Elevation Drive Parameters	5.2.1.3.7
POL ANGLE MOVEMENT	Polarization Angle-Based Move Parameters	5.2.1.3.8
POL DRIVE PARAMETERS	Polarization Drive Parameters	5.2.1.3.9
SHAKE	Shake Parameters	5.2.1.3.10
RESET DEFAULTS	Restore Options To Factory Defaults	5.2.1.3.11

5.2.1.1 NORMAL ACCESS ITEMS

The configuration groups contained in the “Normal” access level allow the user access to items that may need to be changed as part of routine maintenance procedures.

5.2.1.1.1 Expert Access Permission

```
EXPERT ACCESS:      0      CONFIG-EXPERT


0-NORMAL/1-INSTALL/2-SUPER<5 DIGIT CODE>
```

The expert access level can be modified through the EXPERT ACCESS PERMISSION screen.

The expert access level is used to control access to controller modes and configuration items. The available levels are: NORMAL, INSTALL, and SUPER-USER. The user is restricted to basic operational modes when the level is set to NORMAL (level 0). The user has access to all operational modes and most configuration items when the level is set to INSTALL (level 1). The user has access to all modes and all configuration items when the level is set to SUPER-USER (level 2).

This screen displays the current expert access level after EXPERT ACCESS. To change state of the flag, the user must key in a 5-digit code followed by the ENTER key. This code is found in Appendix A "Expert Access Codes" at the end of this manual.

5.2.1.1.2 TLE 1 Data

NOTE: This screen is only available on ACUs that were purchased with the TLE Tracking option.

The TLE 1 DATA screen is used to view/modify line 1 of a Two-Line Element (TLE) data set.

```
SAT#:3   SAT K2              CONFIG-TLE1
1 16276  85109    01089.41658071
-.00000230  00000-0  10000-3 0   862
<SCR>THRU LIST, <ENTER>MODIFY DATA
```

The top of this screen shows the index number and satellite name associated with this entry. The user may scroll through index numbers using the SCROLL UP or SCROLL DN keys. Satellites that were not setup for TLE tracking will not appear in the list.

The user may begin to edit data by pressing the ENTER key. The cursor will then be placed in the first field. The value for each field should be entered exactly as it appears ignoring letters and spaces. Floating point values should be entered as detailed in Section 2.1.2. For complex values (e.g. “10000-3”), use the SCROLL UP key to enter a ‘+’ and the SCROLL DN key to enter a ‘-‘. Use the BKSP key to erase previously entered data. Pressing the ENTER key to advance to the next field.

The ACU will calculate the data's checksum after the last field is entered and indicate “OK” if the data appears good or “ERR” if a mismatch has occurred.

The following screen will be displayed if no satellites have been setup with TLE data:

```
                             CONFIG-TLE1
  * NO TRACKED SATELLITES IN MEMORY *

                              <MODE>EXIT
```

5.2.1.1.3 TLE 2 Data

NOTE: This screen is only available on ACUs that were purchased with the TLE Tracking option.

The TLE 2 DATA screen is used to view/modify line 2 of a Two-Line Element (TLE) data set.

```
SAT#:3   SAT K2              CONFIG-TLE2
2 16276   3.6693  80.7624 0003295
 214.0161 248.7192  1.00272265 36335
<SCR>THRU LIST, <ENTER>MODIFY DATA
```

The screen functions identically to the TLE 1 DATA screen.

5.2.1.2 INSTALL ACCESS GROUPS

The configuration groups contained in the “Install” access level allow the user access to items that are typically changed as part of the installation procedure.

5.2.1.2.1 Azimuth Calibration

The AZIMUTH CALIBRATION screen is used to configure position sensors on the azimuth axis.

```
                             CONFIG-AZIM
 CCW:-180.000 CW: 180.000
 PSF:10431           ROFF:-180.000 DIR:0
CCW LIMIT <+/-300.000 DEGREES>
```

CCW: CCW LIMIT <+/- 300.000 DEGREES>
CW: CW LIMIT <+/- 300.000 DEGREES>

These fields specify the range of axis movement. The angles refer to the resolver angle viewed next to “AR” in MANUAL mode (Section 5.1.1). The CCW field should be set to the value indicated when the axis is at the counter-clockwise limit. Likewise, the CW field should be set to the value indicated when the axis is at the clockwise limit.

NOTE: These values represent “soft” limits when discrete switches are present. Otherwise, these values represent “hard” limits.

PSF: PULSE SCALE FACTOR <1 – 32767 CNTS/RAD>

This field specifies the number of counts per radian of axis travel. This value is used to determine the position when moving in counts.

ROFF: RESOLVER OFFSET <+/- 300.000 DEGREES>

This field specifies the offset applied to the raw resolver angle when determining the axis angle.

DIR: COUNT DIRECTION <0-NORMAL 1-REVERSED>

This field specifies the polarity of the raw resolver angle. This value can be used to reverse the indicated movement direction.

5.2.1.2.2 Elevation Calibration

The ELEVATION CALIBRATION screen is used to configure position sensors on the elevation axis.

```
                             CONFIG-ELEV
DOWN:   0.000 UP:  90.000
 PSF:10431           ROFF:-180.000 DIR:0
DOWN LIMIT <-20.000-120.000 DEGREES>
```

DOWN: DOWN LIMIT <-20.000-120.000 DEGREES>
UP: UP LIMIT <-20.000-120.000 DEGREES>

These fields specify the range of axis movement. The angles refer to the resolver angle viewed next to “ER” in MANUAL mode (Section 5.1.1). The DOWN field should be set to the value indicated when the axis is at the lower limit. Likewise, the UP field should be set to the value indicated when the axis is at the upper limit.

NOTE: These values represent “soft” limits when discrete switches are present. Otherwise, these values represent “hard” limits.

PSF: PULSE SCALE FACTOR <1 – 32767 CNTS/RAD>

This field specifies the number of counts per radian of axis travel. This value is used to determine the position when moving in counts.

ROFF: RESOLVER OFFSET <+/- 300.000 DEGREES>

This field specifies the offset applied to the raw resolver angle when determining the axis angle.

DIR: COUNT DIRECTION <0-NORMAL 1-REVERSED>

This field specifies the polarity of the raw resolver angle. This value can be used to reverse the indicated movement direction.

5.2.1.2.3 Polarization Calibration

The POLARIZATION CALIBRATION screen is used to configure position sensors on the azimuth axis.

```
      VREF:2.500 OFF:  0.000 CONFIG-POL
CCW:-100.000 CW: 100.000 SF: 40.000

ZERO DEG VOLTAGE <1.000-4.000 VOLTS>
```

VREF: ZERO DEG VOLTAGE <1.000 - 4.000 VOLTS>

This field specifies the voltage present when the polarization axis is at its center of travel.

OFF: ANGLE OFFSET <+/-90.000 DEGREES>

This field specifies the offset applied to the raw potentiometer angle. This value can be used to correct for discrepancies between the axis electrical and mechanical alignment.

CW: CW LIMIT<+/-180.000 DEGREES>
CCW: CCW LIMIT<+/-180.000 DEGREES>

These fields specify the range of axis movement. The angles refer to the angle viewed in MANUAL mode (Section 5.1.1). The CCW field should be set to the value indicated when the axis is at the counter-clockwise limit. Likewise, the CW field should be set to the value indicated when the axis is at the clockwise limit.

NOTE: These values represent “soft” limits when discrete switches are present. Otherwise, these values represent “hard” limits.

SF: POT SCALE FACTOR <1.000 –180.000 DEG/V>

This field specifies the degrees of axis travel per voltage change. This value is used to determine the angular position.

5.2.1.2.4 Feed Definition

The FEED DEFINITION screen is used to configure items related to the antenna's feed

```
                             CONFIG-FEED
TYPE:1   LO:10750
BAND:1  REF:0
<0>CIRCULAR <1>SINGLE <2>DUAL
```

TYPE: <0>CIRCULAR <1>SINGLE <2>DUAL

This field specifies the type of feed present. This value is used to determine the appropriate automatic movement of the polarization axis.

CIRCULAR indicates that no polarization movement is required.

SINGLE indicates a feed with just one (1) orientation. Separate movements are required to achieve horizontal and vertical polarization.

DUAL indicates separate two (2) feeds exist 90 degrees apart. One movement is required to achieve both horizontal and vertical polarization.

BAND: <0-C 1-Ku 2-L 3-X 4-Ka 5-S>

This field specifies the frequency band of the feed. This value is used to determine the apparent beam width of the antenna.

LO: FEED LNB LO FREQ <0 – 30000 MHz>

This field specifies the frequency of the LNB's local oscillator. This value is used for when tuning an integrated receiver.

REF: POLARITY AT ZERO DEG <0>HORZ <1>VERT

This field specifies the orientation achieved when the polarization axis is at the 0.0-degree position.

5.2.1.2.5 External Sig Factors

The EXTERNAL SIG FACTORS screen is used to configure parameters for external signal strength.

```
   LOCK:0         TIME:1.0     CONFIG-EXT
  THRES:  10    SENSE:1

LOCK TYPE <0>NONE <1>HI <2>LO
```

LOCK: LOCK TYPE <0>NONE <1>HI <2>LO

This field specifies if a discrete lock input is available to indicate the signal strength is good. If a lock is available, this value indicates the level of the lock is HI (>3.5 VDC) or LO (< 0.8 VDC).

TIME: LOCK TIME <0.0 – 10.0 SECONDS>

This field specifies how long the ACU will wait for a lock to appear.

THRES: SCAN SLOW THRESHOLD <0 – 4000>

This field specifies the minimum signal strength required for the tracking system to recognize a satellite is present. If different bands are received that exhibit different “off satellite” signal strengths, the highest “off satellite” value should be used to avoid the possibility of recognizing noise as a satellite.

NOTE: The signal strength value is considered to be zero (0) if a lock is available but not active.

SENSE: INPUT SENSE POLARITY <0>NEG <1>POS

This field specifies the polarity of signal strength input voltage. This value should be set to POS if the signal strength voltage increases as the RF signal strength increases. This value should be set to NEG if the voltage decreases as the RF signal increases.

5.2.1.2.6 RF Sig Factors

The RF SIG FACTORS screen is used to configure parameters for RF signal strength.

```
                              CONFIG-RF
   LOCK:0      THRES: 200

LOCK SOURCE <0-NONE 1-SS1 2-SS2>
```

LOCK: LOCK SOURCE <0-NONE 1-SS1 2-SS2>

This field specifies the lock channel that should be used as the discrete lock input for RF signal strength. The lock parameters must be set correctly within their respective SIG FACTORS screen.

THRES: SCAN SLOW THRESHOLD <0 – 4000>

This field specifies the minimum signal strength required for the tracking system to recognize a satellite is present. If different bands are received that exhibit different “off satellite” signal strengths, the highest “off satellite” value should be used to avoid the possibility of recognizing noise as a satellite.

NOTE: The signal strength value is considered to be zero (0) if a lock is available but not active.

5.2.1.2.7 Location Reset

The LOCATION RESET screen is used to reset the antenna latitude/longitude.

```
RESET CODE:                   CONFIG-LOC


<5 DIGIT CODE>ENTER 12345 TO RESET
```

Key in the 5-digit code “12345” and press ENTER. A confirmation screen will appear. Press the “BKSP” key to confirm all satellites will be deleted.

```
                              CONFIG-LOC
 *  RESETTING ANTENNA LOCATION WILL    *
 *  CLEAR ALL STORED SATELLITE DATA    *
<BKSP>CONFIRM RESET           <MODE>EXIT
```

The screen immediately switches to the LAT/LON screen and waits for the user to enter a new antenna latitude/longitude.

NOTE: The antenna configuration items are not modified when the location is reset.

5.2.1.3 SUPER-USER ACCESS GROUPS

The configuration groups contained in the “Super-User” access level allow the user access to items that are not typically changed during the installation procedure. The need to access these items would only occur if a unique customization is required.

5.2.1.3.1 System Definition

The SYSTEM DEFINITION screen is used to configure the system option and antenna parameters.

```
MODE:2  ANT SIZE: 500      CONFIG-SYSTEM
        ANT LOOK:1          DRIVE:3

<2-MENU 3-MANUAL>
```

MODE: <2-MENU 3-MANUAL>

This field specifies to which mode the ACU will switch to upon power up.

ANT SIZE: ANTENNA SIZE <1 – 9999 CM>

This field specifies the size of the reflector in centimeters. For example, a 1.8m antenna diameter should be entered as 180. This value is used to characterize the antenna’s beam width.

ANT LOOK: ANT LOOK REFERENCE <1>HIGH <0>LOW

This field specifies the elevation pointing angle direction. This value must always be <1>HIGH.

DRIVE: DRIVE OPTION <0-SINGLE 1-AE 2-AP 3-AEP>

This field specifies the simultaneous motion option. This value may have to be modified on systems with heavy current requirements.

5.2.1.3.2 Azimuth Angle Movement

The AZIMUTH ANGLE MOVEMENT screen is used to configure angle-based automatic movements.

```
                                CONFIG-AZ ANG
FAST/SLOW: 2.500    COAST:0.100
MAX ERROR:0.200     TRIES: 3
FAST/SLOW THRES <0.000-10.000 DEGREES>
```

FAST/SLOW: FAST/SLOW THRES <0.000 – 10.000 DEGREES>

This field specifies the distance from the target position where the drive speed switches from fast to slow.

MAX ERROR: MAX ERROR <0.000 – 5.000 DEGREES>

This field specifies the maximum acceptable error between the final resting position and a target position.

COAST: COAST RANGE <0.000 – 5.000 DEGREES>

This field specifies the distance from the target position where the drive will be deactivated. This value is used to let the antenna coast into position. If the distance to the target position is less than this value, the drive will be deactivated when its position is within MAX ERROR.

NOTE: The drive deceleration (5.2.1.3.4) should be set before adjusting the coast value.

TRIES: MAX NUMBER OF TRIES <0 – 10>

This field specifies the maximum number of attempts which will be made to be within MAX ERROR from the target position.

5.2.1.3.3 Azimuth Count Movement

The AZIMUTH COUNT MOVEMENT screen is used to configure count-based automatic movements.

```
                              CONFIG-AZ COUNT
FAST/SLOW: 50       COAST:  3
MAX ERROR: 1        TRIES: 3
FAST/SLOW THRESHOLD <0-999 COUNTS>
```

The fields in this screen are similar to the fields that configure angle-based moves in the AZIMUTH ANGLE MOVEMENT screen. However, these fields specify values in terms of counts instead of angles. Refer to Section 5.2.1.3.2 for field descriptions.

FAST/SLOW: FAST/SLOW THRESHOLD <0 – 999 COUNTS>
MAX ERROR: MAX ERROR <0 – 10 COUNTS>
COAST: COAST RANGE <0 – 999 COUNTS>
TRIES: MAX NUMBER OF TRIES <0 – 10>

5.2.1.3.4 Azimuth Drive Parameters

The AZIMUTH DRIVE PARAMETERS screen is used to configure motor drive operation. Refer to Section 6.2.3 for more information on how these parameters affect antenna movement.

```
     FAST:100 ACC:250       CONFIG-AZ DRV
     SLOW: 50 DEC:250 JAM: 0.20 FDB:1000
       CL:100   IR:   0 RUN: 2.00 SDB: 500
FAST VOLTAGE <0-100 % OF MAX>
```

FAST: FAST VOLTAGE <0 – 100 % OF MAX>
SLOW: SLOW VOLTAGE <0 – 100 % OF MAX>

These fields specify the percentage of maximum voltage that the motor drive will output to the motor. The maximum voltage is 24VDC. The output voltage is decreased using pulse width modulation.

CL: CURRENT LIMIT <0 – 10 AMPSx10, 0=OFF >

This field specifies the percentage of maximum current that the motor drive will allow to the motor. The maximum current setting is 10 Amps.

ACC: ACCELERATION <0 – 999 MSEC>
DEC: DECELERATION <0 – 999 MSEC>

These fields specify the time it takes (in milliseconds) to ramp from 0 to MAX during acceleration or and MAX to 0 during deceleration. These values are used to define a slope of 24/ACC and 24/DEC. The slope remains the same if the max voltage is less than 24VDC.

IR: IR COMPENSATION <0 – 100 UNITS, 0=OFF>

This field specifies the IR compensation factor of the motor drive system. This value adjusts gain in the motor drive that counteracts the impedance of the system.

JAM : JAM SLOP <0.00 – 10.00 DEG, 0=OFF>

This field specifies the amount of movement that must be sensed to avoid declaring a jam alarm. Setting this value too high will trigger false jams since the mount may not be able to move that far in the required interval (usually 3 seconds). Setting this value too low may allow mechanical slop to appear as movement thus never triggering a jam.

RUN: RUNAWAY SLOP <0.00 – 10.00 DEG, 0=OFF>

This field specifies the amount of movement that must be sensed before declaring a runaway alarm. Setting this value too low may allow position sensor noise or slight movement due to wind to trigger a runaway. Setting this value too high will take a long time to generate a runaway and risks antenna damage.

FDB: FAST ANTI-REV DEADBAND <0 – 9999 MSEC>
SDB: SLOW ANTI-REV DEADBAND <0 – 9999 MSEC>

These fields specify the amount of time that the drive will wait before moving the antenna in the opposite direction. These values keep the antenna from rapidly changing direction which may cause antenna damage. The FDB is the interval if the antenna had been moving fast. The SDB is the interval if the antenna had been moving slow.

5.2.1.3.5 Elevation Angle Movement

The ELEVATION ANGLE MOVEMENT screen is used to configure angle-based automatic movements.

```
                         CONFIG-EL ANG
FAST/SLOW: 2.500    COAST:0.100
MAX ERROR:0.200     TRIES: 3
FAST/SLOW THRES <0.000-10.000 DEGREES>
```

This screen functions identically to the AZIMUTH ANGLE MOVEMENT screen. Refer to Section 5.2.1.3.2 for field descriptions.

5.2.1.3.6 Elevation Count Movement

The ELEVATION COUNT MOVEMENT screen is used to configure count-based automatic movements.

```
                       CONFIG-EL COUNT
FAST/SLOW: 50       COAST:  3
MAX ERROR: 1        TRIES: 3
FAST/SLOW THRESHOLD <0-999 COUNTS>
```

This screen functions identically to the AZIMUTH COUNT MOVEMENT screen. Refer to Section 5.2.1.3.2 for field descriptions.

5.2.1.3.7 Elevation Drive Parameters

The ELEVATION DRIVE PARAMETERS screen is used to configure motor drive operation. Refer to Section 6.2.3 for more information on how these parameters affect antenna movement.

```
     FAST:100 ACC:250      CONFIG-EL DRV
     SLOW: 50 DEC:250 JAM: 0.20 FDB:1000
       CL:100  IR:   0 RUN: 2.00 SDB: 500
FAST VOLTAGE <0-100 % OF MAX>
```

This screen functions identically to the AZIMUTH DRIVE PARAMETERS screen. Refer to Section 5.2.1.3.4 for field descriptions.

5.2.1.3.8 Polarization Angle Movement

The POLARIZATION ANGLE MOVEMENT screen is used to configure angle-based automatic movements.

```
                                CONFIG-PL ANG
FAST/SLOW: 2.500    COAST:0.100
MAX ERROR:0.200     TRIES: 3
FAST/SLOW THRES <0.000-10.000 DEGREES>
```

This screen functions identically to the AZIMUTH ANGLE MOVEMENT screen. Refer to Section 5.2.1.3.2 for field descriptions.

5.2.1.3.9 Polarization Count Movement

The POLARIZATION COUNT MOVEMENT screen is used to configure count-based automatic movements.

```
                              CONFIG-PL COUNT
FAST/SLOW: 50       COAST:  3
MAX ERROR: 1        TRIES: 3
FAST/SLOW THRESHOLD <0-999 COUNTS>
```

This screen functions identically to the AZIMUTH COUNT MOVEMENT screen. Refer to Section 5.2.1.3.2 for field descriptions.

5.2.1.3.10 Polarization Drive Parameters

The POLARIZATION DRIVE PARAMETERS screen is used to configure motor drive operation. Refer to Section 6.2.3 for more information on how these parameters affect antenna movement.

```
     FAST:100 ACC:250      CONFIG-PL DRV
     SLOW: 50 DEC:250 JAM: 0.20 FDB:1000
       CL:100   IR:   0 RUN: 2.00 SDB: 500
FAST VOLTAGE <0-100 % OF MAX>
```

This screen functions identically to the AZIMUTH DRIVE PARAMETERS screen. Refer to Section 5.2.1.3.4 for field descriptions.

5.2.1.3.10 Track Factors

NOTE: This screen is only available on ACUs that were purchased with the tracking option.

The TRACK FACTORS screen is used to configure track system operation. See Appendix TRK for detailed information on the following parameters.

```
   SEARCH: 3                      CONFIG-TRACK
MAX ERROR: 3  TIME: 2
  HOLDOFF:120  LOG:0    AZDP:1.0
<0-MANUAL,1-NARROW,3-NOMINAL,10-WIDE>
```

SEARCH: <0-MANUAL,1-NARROW,3-NOMINAL,10-WIDE>

This field specifies the sweep width of the Intelli-Search algorithm. Setting this value too large may cause mistaken alignment on an adjacent satellite. Setting this value too small may not sweep over a region which is wide enough to find the satellite.

The search is disabled by setting the value to zero (0). The search should be disabled for transmit applications or for antennas which move very slowly.

MAX ERROR: ENTER MAX ERROR IN TENTHS OF A dB <1-30>

This field specifies the maximum antenna tracking error in tenths of a dB. This value determines the step sizes and the frequency of peak-up operations. This value should not be made smaller than 3 (0.3 dB) for most antennas.

HOLDOFF: SET PEAKUP HOLDOFF TIME <1 - 999 SECONDS>

This field specifies the number of seconds before a track-table entry during which a peaking operation should not occur. The reason for this holdoff is to avoid a situation where a regular peak-up takes too long and the track table entry time is missed.

TIME: SIGNAL SAMPLE TIME <2-99 SECONDS>

This field specifies the number of seconds that will be spent sampling signal strength following each peak-up move. Increasing this value will improve the ability to determine the position of higher signal but will also make total peak-up time proportionately longer.

LOG: <0>DISABLE <1>ENABLE TRACK DATA LOGGING

This field is used to enable the output of diagnostic data to the ACU log system. A factory technician may request this data while troubleshooting track system performance.

AZDP: AZ/EL DELTA FACTOR <0.5 – 1.5>

This field specifies the step size delta factor. This value is used to compensate non-uniform antenna diameters. The default value of 1.0 will calculate steps assuming the antenna’s azimuth and elevation diameters are the same. A value of 1.1 will increase elevation steps by 10% and decrease azimuth steps by 10%. A value of 0.9 will decrease elevation steps by 10% and increase azimuth steps by 10%.

5.2.1.3.11 Shake

The SHAKE screen is used to configure shake function parameters.

```
AZ 1: -40.0 2:  50.0 3:   0.0 CONF-SHAKE
EL 1:  30.0 2:  40.0 3: -67.5 CYCLE: 100
PL 1: -10.0 2:  10.0 3:   0.0 DELAY:  15
MOVE 1 AZIM <-180.0/180.0>
```

AZ #: **MOVE # AZIM <-180.0/180.0>**
EL #: **MOVE # ELEV <-90.0/90.0>**
PL #: **MOVE # POL <-180.0/180.0>**

These fields specify the azimuth, elevation, and polarization target positions for move 1, 2, and 3.

CYCLE: **NUMBER OF SHAKE CYCLES <1-9999>**

This field specifies the total number of movement cycles to perform.

DELAY: **DELAY <0-999 SECONDS>**

This field specifies the amount of time to wait between cycles.

5.2.1.3.12 Reset Defaults

The RESET DEFAULTS screen is used to reset all configuration values to their factory defaults and delete all stored satellite data.

```
RESET CODE:      0       CONFIG-DEFAULTS


<5 DIGIT CODE>RESET TO FACTORY DEFAULTS
```

The user must key in a 5-digit code followed by the ENTER key to perform the reset operation. Refer to Appendix A for the required code.

5.2.2 Maintenance Menu Mode

The MAINTENANCE mode provides a menu system for selecting various maintenance sub-modes.

```
1-VOLTS   2-DRIVE   3-TIME         MAINT
5-LIMITS
          0-SHAKE
^-RES OFF                     .-SYS INFO
```

5.2.2.1 ADC Volts Mode

The ADC VOLTS mode shows the current voltage levels sensed on the ACU analog inputs. There are two internal converters available, an 8-channel 10-bit and a 4-channel 12-bit. The following sections describe how each channel is used.

```
<1>10 BIT ADC VOLTAGES       AD VOLTAGES
<2>12 BIT ADC VOLTAGES


```

5.2.2.1.1 10-Bit ADC Voltages

The sensed voltage and ADC count for each input will be displayed next to the channel labels. The voltage range is 0.000 to 3.300. The count range is 0 to 1024.

```
1- SAC:1.590  493  5-  RF:0.106   38 ADC
2-TEMP:3.297 1022  6-SPAR:1.658  514  10
3-REC2:1.577  489  7-DRIV:1.597  495 BIT
4-REC3:1.955  606  8-BATT:3.081  955
```

The follow describes how each channel is typically used:

1-SAC: Single Axis Compass
2-TEMP: Internal Temperature Sensor
3-REC2: Receiver 2 (Internal)
4-REC3: Receiver 3 (Spare)
5-RF: L-Band Power Detector
6-SPAR: Spare
7-DRIV: Drive Board Feedback
8-BATT: Battery Voltage

5.2.2.1.2 12-Bit ADC Voltages

The sensed voltage and ADC count for each input will be displayed next to the channel labels. The voltage range is 0.000 to 5.000. The count range is 0 to 4096.

```
 AZ: 2.5000  2048  32768      12 BIT ADC
 EL: 0.0012     1   8191            L1:1
POL: UNDER      0                   L2:0
SIG: 3.3346  2731                   L3:1
```

The following list describes each field:

AZ: Azimuth Potentiometer
EL: Elevation Inclinometer
POL: Polarization Potentiometer
SIG: Receiver 1 (External)
L1: Receiver 1 (External) Digital Lock
L2: Receiver 2 (Internal) Digital Lock
L3: Receiver 3 (Spare)

If resolver sensors are available, the raw resolver counts will also be displayed next to the ADC counts.

5.2.2.2 Drive Reset Mode

The DRIVE RESET mode provides a way to reset a drive system error for each axis.

```
1-AZIM: JAMMED                DRIVE RESET
2-ELEV: RUNAWAY
3- POL: OK
RESET <1-3>AXIS                <MODE>EXIT
```

The drive status can be reset by pressing the corresponding key.

5.2.2.3 Time/Date Mode

The TIME/DATE mode allows the user to set the system and reference time (6.2.2).

```
SYSTEM:11/10/97 22:26:40           TIME
DISPLAY:11/10/97 16:26:40      ZONE:UTC
                              OFFSET:  0
1-DATE 2-TIME 4-ZONE 5-OFFSET
```

The following list describes each field:

SYSTEM: Current date and time as maintained by the ACU's real-time clock. Modify the date by selecting 1-DATE and entering the current date in DD.MM.YY format. Modify the time by selecting 2-TIME and entering the current time in HH.MM.SS format.

DISPLAY: Current "reference" time as displayed in MENU and MANUAL.

ZONE: A three-character time zone string displayed in MENU and MANUAL. Modify this string by selecting 4-ZONE and entering three alphanumeric characters.

OFFSET: The hour offset between system time and the reference time. Modify the offset by selecting 5-OFFSET and enter a number of hours.

5.2.2.4 GPS Comm Mode

NOTE: This mode is only available on ACUs that were purchased with a GPS receiver option.

The GPS COMM mode allows the user to determine if the GPS receiver is communicating correctly with the ACU.

```
<BKSP> TO FREEZE DISPLAY       GPS COMM
$GPRMC,133544,V,3856.0856,N,09444.8377,
W,000.0,000.0,080499,003.6,E*7B≡≡$GPGGA,
190449,3856.0856,N,09444.8377,W,0,00,,,M
```

The screen shows the raw ASCII data coming from the GPS receiver. The strings "$GPRMC" and/or "$GPGGA" indicates the GPS receiver is working correctly.

5.2.2.5 Limits Mode

The LIMITS mode shows the current state of all digital limit inputs.

```
AZIM CW:0 CCW:1 STOW:0 R:0 G:0    LIMITS
ELEV UP:1  DN:1 STOW:1            ACTIVE
 POL CW:0 CCW:1 STOW:0 A:0 B:0 C:0 D:0
<BKSP>MAKE LIMITS INACTIVE    <MODE>EXIT
```

The following list describes each field:

AZIM CW:	Azimuth Clockwise Limit
AZIM CCW:	Azimuth Counter-Clockwise Limit
AZIM STOW:	Azimuth Stow Limit
ELEV UP:	Elevation Up Limit
ELEV DN:	Elevation Down Limit
ELEV STOW:	Elevation Stow Limit
POL CW:	Polarization Clockwise Limit
POL CCW:	Polarization Counter-Clockwise Limit
POL STOW:	Polarization Stow Limit
R:	Red Button (Stow)
G:	Green Button (Locate)
A, B, C, D:	Auxiliary Switch Inputs (Pol-ID Bits)

The user may inactivate software logic that prevents axis movement due to a limit switch by pressing the BKSP switch. The limit switch logic may be returned to “ACTIVE” by pressing BKSP again.

5.2.2.6 Shake Mode

The SHAKE mode performs a repetitive sequence of three (3) moves.

```
AZ 1: -40.0 2:  50.0 3:   0.0      SHAKE
EL 1:  30.0 2:  40.0 3: -67.5 CYCLE: 100
PL 1: -10.0 2:  10.0 3:   0.0 DELAY:   1
<1>START <CONFIG-SHAKE>EDIT <MODE>MAINT
```

Go to CONFIG > SHAKE to modify the shake parameters (5.2.1.3.10). Select <1>START to begin the shake sequence. When shake is started the following screen appears:

```
AZIM:   0.2                        SHAKE
ELEV: -55.3                        DELAY
POL:   0.6                CYCLE:  1/   5
<STOP>HALT MOTION <MODE>MAINT
```

Movement may be stopped at any time by pressing the Stop or Mode key.

5.2.2.7 Resolver Offset Mode

The RESOLVER OFFSET mode assists the system installer with setting up resolver offsets.

```
     TRUE       RAW        REF        RES OFF
az:   0.00    178.76       0.00    (-178.76)
el:  40.00     65.00       0.00    ( -25.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

The following list describes each column:

TRUE: The angles in this column are the same angles that will be displayed in all other controller modes. These angles are raw resolver angles plus the resolver offset. The azimuth angle is the true heading. The elevation angle is the RF-look angle above the horizontal.

RAW: The angles in this column are the actual resolver angles.

REF: The angles in this column are user-defined reference angles. These can be set directly by selecting <1>AZ or <3>EL and entering a value. These angles can also be calculated by selecting <5>LON and entering a satellite longitude.

RES OFF: The angles in this column are the current resolver offset angles.

The antenna can be jogged while in this mode.

See Section 4.2.3.1 for instructions on using this mode.

5.2.2.8 System Info Mode

The SYSTEM INFO mode displays important information about the antenna controller.

```
Serial Number: 0                 SYSTEM INFO
Firmware: RC4K-TEST-GTRSB
Version: 0.07 BN: EG0926
Lat: 38.9557 Lon: -94.7544        <MODE>EXIT
```

The antenna latitude/longitude is also displayed in this mode.

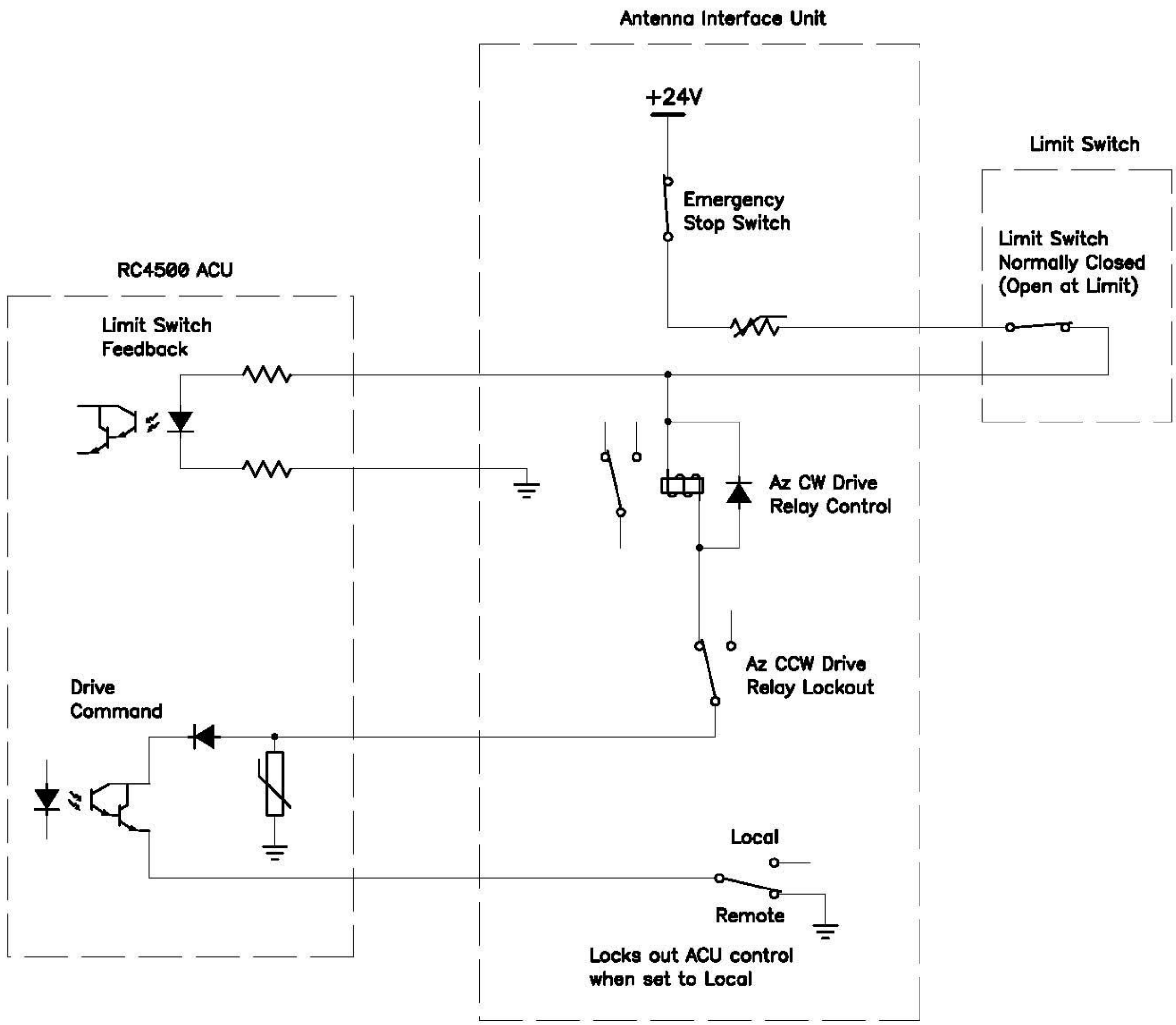
6.0 SUPPORT

6.1 Troubleshooting

This section provides tips for debugging typical problems. There are many interfaces between the RC4500 and position sensors, limit switches, mechanical components of the mount, other satellite equipment, etc. Some problems are due to interactions that are not readily apparent. Review all of the troubleshooting sections to see if a situation similar to yours is described.

6.1.1 Limit Switches

The various limit switches serve as safety interlocks to prevent mount damage. The RC4500 checks for limit conditions via both software and a Programmable Logic Device. The limit switches connect directly to the Antenna Interface Unit via the relay board. Each limit switch has a normally closed set of contacts (limit switch opens at the limit.) The following diagram is a representation of a single limit switch interfaced to the Antenna Interface Unit and to the RC4500 Antenna Control Unit.



The AIU transmits limit status information back to the RC4500 through low impedance current loops. These current loops drive the LED portion of opto-isolators in the RC4500. An open circuit between the RC4500 Limit Switch Feedback opto-isolator and the AIU will result in a limit indication.

When operating correctly, the Normally Closed contact of the Limit Switch will open upon reaching a limit, which will allow the limit status to indicate on a local control panel of the AIU and will not allow remote or local commands to move the axis in the direction of the limit.

6.1.2 Motor Drive

Axis JAMMED error displayed. A jammed error indicates that the axis was commanded to move, but the RC4500 did not sense any movement within several seconds. A jammed condition may indicate one of several conditions:

The mount's mechanical drive mechanism is physically jammed. Inspect the mount to determine if some mechanical problem (slipped gears, etc) exists. Unusual conditions such as icing may also cause the mount to jam.

The mount's position is not being sensed correctly by the RC4500. After resetting the drive error, go to MANUAL mode and attempt to jog the axis in question. If the axis does move, check to see if the axis' displayed position is updating. If the RC4500 doesn't sense movement, it will declare a jam even though the axis is moving.

The AIU's motor drive is failing to output the required voltage to move the axis. Can the axis be driven manually from a local control panel at the AIU? If not, check the limit switch circuit as shown in Chapter 2 and refer to schematics provided with the AIU.

6.1.3 Automatic Movements

The mount begins an automatic movement but generates an "axis jammed" error. All automatic movements move to a "target" location. If far enough away from the target, the move will initially be done in the FAST speed for the axis and then switch to SLOW when close to the target. If the SLOW speed has been set too low, the axis may jam. Attempt to move the axis in SLOW speed from the MANAUL mode to duplicate the situation. If SLOW speed seems to be the problem, adjust the drive voltage up as discussed in section 4.2.2.

6.1.4 GPS

The interface between the RC4500 and the optional GPS receiver is via an RS-232 serial port. The data stream from the GPS receiver is parsed in multiple places in order to receive latitude, longitude and time data. The following messages may be displayed when the RC4500 is attempting to receive data from the GPS:

**** NO GPS PRESENT **.** This message indicates that the gps_present item in the System Definition (5.2.1.3.1) configuration item as been set to 0 indicating that no GPS is attached to the RC4500. No attempt will be made to parse GPS data in this state. If a GPS is truly attached, set the gps_present item to 1. Note that if the GPS option was not purchased with the controller, the gps_present item will not be allowed to be set to 1.

****INITIALIZING** or STARTING GPS.** This message indicates that the RC4500 has sent a command to the GPS receiver to start communication. Normally this message should only appear momentarily until the first response from the GPS has been received.

****GPS OFFLINE**.** This message means that no data has received from the GPS. If this message persists, troubleshooting of GPS communications as described below should be performed.

To check that communication with the GPS is occurring, move to the GPS Serial Port Diagnostics (5.2.2.4) screen. The data on the screen should update approximately once a second. If no data is being displayed or the GPRMC data stream described in 5.2.2.4 is unrecognizable, the integrity of the cabling between the RC4500 and the GPS receiver should be checked.

****NO GPS NAV**.** This message means that correct data streams are being received from the GPS, but the received data indicates that the GPS has not yet formulated a navigation solution (latitude and longitude.)

Under normal conditions the GPS should generate a navigation solution within 4 minutes of powering on. If the GPS has not been powered on for several weeks or if the GPS has been moved a considerable distance from the last position that it generated a navigation solution, the time it takes to generate a solution may go beyond 4 minutes. When the GPS is powered up, it assumes it is at the same lat/lon as when it was powered down. It also has stored the ephemeris data it had at that time. While powered down the GPS' real time clock will continue to timekeep.

The GPS will not generate a navigation solution if it cannot "see" 4 satellites. Check that the GPS unit has a clear view of the sky. If parked next to a tall building, even if the GPS has a seemingly clear view of the sky, the current GPS satellite constellation may be such that too many satellites are masked.

RF Interference. Strong interference from transmitting antennas close to the GPS receiver may also disrupt the receiver's ability to "see" satellites. Attempt to turn off transmitting sources (satellite phones, etc.) close to the GPS antenna to see if that affects the GPS' performance.

6.1.5 Alarm Displays

The alarm system monitors important parameters and flashes a message on the bottom line of the LCD display if an error is found. The parameters monitored include the condition of the lithium battery, status of the azimuth and elevation antenna drive systems and the values of certain variables. Some error codes have priority over others. Alarm conditions are sampled sequentially, with the highest priority sampled first. As corrective action is taken for each error, the code is eliminated, and if there is a lesser error, it will then appear.

6.1.5.1 FLASH / NVRAM VERSION MISMATCH

If the RC4500 recognizes a mismatch in the stored data (antenna mount type data) then this error code will appear. The only time this error typically would occur is during a software change in the ACU. A system reset to defaults may clear this error (5.2.1.3.11).

6.1.5.2 FLASH / NVRAM DATA CORRUPT

If there is corrupt data stored, then this error code will appear. The only time this error typically would occur is during a software change in the ACU. A system reset to defaults may clear this error (5.2.1.3.11).

6.1.5.3 LOW BATTERY ALARM

The RC4500 constantly monitors the level of the lithium battery via a 10 bit ADC channel on the microcontroller. When the power level is low, this error code will appear. Replace the battery with a Duracell DL2450. Make sure that the unit is unplugged from the AC or DC input power before removing the cover to change the battery.

6.1.5.4 TIME / DATE ERROR

This alarm code indicates either the Time or Date is corrupt. The time and date are entered via the Maintenance menu, refer to section 5.2.2.3 Time Maintenance.

6.1.5.5 AZIMUTH / ELEVATION / POLARIZATION JAMMED

The RC4500 continuously monitors the axis positions to detect incorrect movement of the mount. If an axis has been commanded to move and the RC4500 does not detect movement within a prescribed time, the controller will declare a "JAMMED" condition and not allow further movement in that axis until the condition has been reset.

More information is provided with regards to troubleshooting JAMMED errors in section 6.1.2.

6.1.5.6 AZIMUTH / ELEVATION / POLARIZATION RUNAWAY

If the RC4500 senses movement in an axis when no movement should be occurring, the RC4500 will declare a "RUNAWAY" condition. Like JAMMED, the RUNAWAY condition must be reset before further movement in the axis may occur.

6.1.5.7 LIMITS INACTIVE WARNING

It is possible to inactivate software logic that prevents axis movement due to a limit switch via the MAINTENANCE – LIMITS mode. Refer to section 5.2.2.5. While in this state, the RC4500 will display "** WARNING – LIMITS INACTIVE **".

6.1.5.8 AZIMUTH DRIVE FAULT

When the I/O Board receives an Azimuth Drive Fault indication from the AIU, it will pass the error signal to the Computing Board. This error will only be applicable to those AIU's which have axis drive fault signals that can be fed back to the ACU. While in this state, the RC4500 will display
"* AIU AZIMUTH FAULT *".

6.1.5.9 ELEVATION DRIVE FAULT

When the I/O Board receives an Elevation Drive Fault indication from the AIU, it will pass the error signal to the Computing Board. This error will only be applicable to those AIU's which have axis drive fault signals that can be fed back to the ACU. While in this state, the RC4500 will display
"* AIU ELEVATION FAULT *".

6.1.5.10 EMERGENCY STOP

When the I/O Board receives an Emergency Stop indication from the AIU, it will pass the error signal to the Computing Board. This alarm code will be displayed when the emergency stop switch has been depressed at the AIU. The alarm will continue to display until the switch has be deactivated. During the time when this alarm is active, the RC4500 will not allow any movement of the antenna and will display "* ANTENNA HALTED – EMERGENCY STOP *".

6.1.5.11 MAINTENANCE ALARM

When the I/O Board receives a Maintenance Status indication from the AIU, it will pass the error signal to the Computing Board. This alarm code will be displayed when the Remote/Local switch has been set to Local at the AIU. The alarm will continue to display until the switch has been set back to Remote. During the time when this alarm is active, the AIU will be able to command movements locally but the RC4500 ACU will not allow any movement of the antenna remotely and the RC4500 will display
"* AIU LOCAL CONTROL ACTIVE *".

6.1.5.12 MOVEMENT INTERLOCK

If the antenna has a movement interlock switch that has feedback to the RC4500, this error code will display if the interlock is not in a position that allows safe antenna movement via the ACU.

6.2 Antenna Controller Topics

6.2.1 Timekeeping

There are several versions of time discussed within this manual.

1) System Time – Time from the battery-backed real-time clock within the ACU. System time is set to Universal Coordinated Time (UTC) at the factory. It will vary slightly from UTC due to the real-time clock tolerances.

2) Sidereal Time – Time used for maintaining track tables. The period of a satellite's motion is one sidereal day (approximately 23 hours 56 minutes 4 seconds). Sidereal time is generated from system time by calculating the number of seconds since January 1, 2000.

   IMPORTANT: System time should not be modified while active track tables are present. If system time is changed, the information stored in track tables for inclined orbit satellites will no longer be valid.

3) GPS Time – The ACU can parse time from the data sent by the GPS receiver. This time is available after the GPS receiver has sufficiently locked onto several GPS satellites. The ACU allows the user to synchronize system time to the UTC reported by the GPS receiver.

4) Reference Time –The user can choose an alternate time by specifying an hourly offset (from system time) and three-letter zone designator. This time is displayed in MENU and MANUAL modes.

See Section 5.2.2.3 for details on time maintenance.

6.2.3 Drive System

The ACU implements several mechanisms for the driving and monitoring of the azimuth, elevation and polarization axis.

6.2.3.1 Jam and Runaway Sensing

The axis positions are continuously monitored to detect incorrect movement of the mount. If an axis has been commanded to move but movement is not detected within a prescribed time (usually 3 seconds), the controller will declare a "JAM" condition and not allow further movement until the condition has been reset.

Similarly, if movement is detected in an axis but no move was commanded, the controller will declare a "RUNAWAY" condition and not allow further movement until the condition has been reset.

6.2.3.2 Anti-Reversal

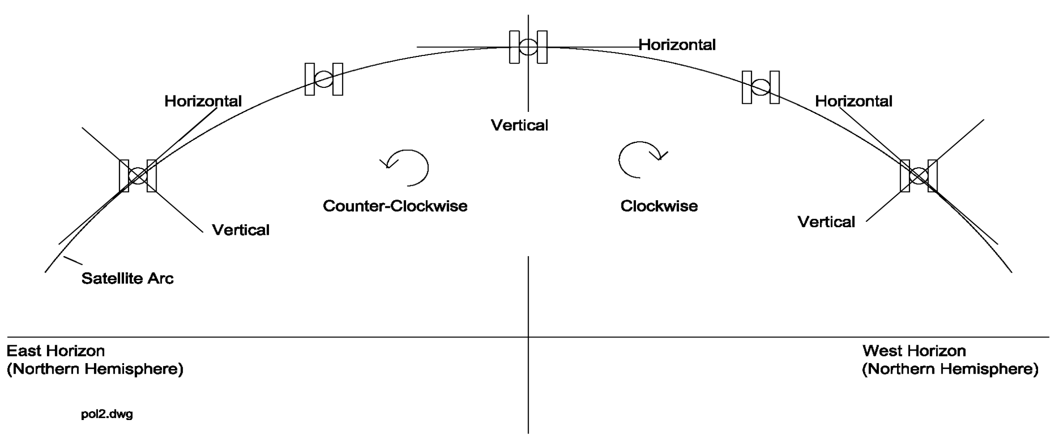
In order to save wear on the drive motors, the ACU limits how fast an axis may reverse its direction. This mechanism prevents a motor from instantly changing direction before coasting to a stop in the original direction.

6.2.3.3 Automatic Movements

In order to provide smooth automatic movement to target positions, the controller utilizes several parameters to account for different mount characteristics.

The FAST/SLOW THRESHOLD parameter defines how far away from a target position the drive will switch from fast to slow motor speed. The COAST RANGE defines where the drive will de-energize to allow the mount's inertia to coast into the target position. The MAX ERROR parameter defines how close to the target position will be considered "good enough".

6.2.4 Polarization Control



The ACU calculates the required position and automatically moves the polarization axis as part of the satellite RECALL function. The following diagram shows the polarization axis sign convention used. The diagram depicts looking at the arc of satellites from behind the antenna.

The RC4500 allows the user to specify the type of polarization axis mechanism present. If a circular polarization scheme is present, no automatic movement of the polarization axis is performed. If a linear polarization scheme is present, the RC4500 will calculate the theoretical position as a function of mount latitude, mount longitude and satellite longitude.

6.2.5 Tracking Performance

The Max Track Error parameter has more influence over the operation of the tracking system than any other. Most notably, this value determines the azimuth and elevation peak-up step sizes.

Some users erroneously conclude that the smallest Max Track Error leads to the tightest track. However, the controller cannot peak-up properly when the value of this parameter is reduced to a point where the step sizes are close to the mechanical hysteresis (slop) of the antenna mount. This can lead to PEAK LIMIT errors or the antenna peaking itself off of the satellite.

Here is the process which can lead to this undesirable result:

1) The Max Track Error is set to a low value which results in an elevation peak-up step size of just one position count.

2) When a peak-up occurs, the controller measures the signal strength at the current antenna position, and then moves the antenna up or down in elevation in an attempt to find the strongest satellite signal. For this example, the controller records the signal strength and moves the antenna up in elevation by one position count.

3) Due to mechanical hysteresis, the antenna's pointing angle does not change even though the antenna's position has moved one position count.

4) Thermal noise in the receiver's AGC circuit or changing atmospheric conditions result in the controller measuring a stronger AGC input at the “new” antenna position.

5) Since a stronger signal was measured when the antenna moved up, the controller concludes that the satellite has moved up. The controller will again move up by one position count. At the new position, the controller will measure the signal strength again to determine if the signal is stronger at the new position than at the starting position. This process will continue until a weaker signal strength is recorded. When that occurs, the controller will back up one step and conclude that it has found the elevation peak.

The problem occurs when the controller makes the wrong decision at step 4. Any time the controller step size is comparable in magnitude to the antenna's mechanical hysteresis, a problem WILL eventually occur.

The solution to this problem is simple. The Max Track Error must be set large enough that a single step results in a clear change in signal strength. For most antennas, a Max Track Error greater than 2 (0.3dB) is appropriate.

APPENDIX A - EXPERT ACCESS CODES

To set the expert access level to INSTALL permission or to RESET SYSTEM DEFAULTS, enter the five-digit code:

42458

To set the expert access level to SUPER-USER permission, enter the five-digit code:

20261

This page can be removed from the manual to prevent the possibility of inexperienced users accessing restricted items.