RC4800 ANTENNA CONTROLLER

INTEGRATION MANUAL

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Revision History

DATE	MODIFICATION	SW VERSION	INITIALS
	Initial Release	3.10	RLE

Limited Warranty

New Products

Research Concepts, Inc., RCI, warrants to the original purchaser this product shall be free from defects in material and workmanship for one year, unless expressed otherwise, from the date of the original purchase. During the warranty period, RCI will provide, free of charge, both parts and labor necessary to correct such defects.

To obtain such a warranty service, the ***original purchaser*** must:

1. Notify RCI as soon as possible after discovery of a possible defect, with:
    a. Model and serial number
    b. Purchase date
    c. Detailed description of the problem and circumstances when problem appears, including details on the electrical connection to associated equipment
2. Obtain an RMA number from RCI, then ship the product to RCI in original packaging or its equivalent, fully insured and shipping/customs charges prepaid. RCI is not responsible for damage during shipping.

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Repair fees for end users are a flat charge based on the equipment being repaired.

Repair fees for Dealers and OEMs are an hourly labor charge plus parts cost. ** Dealers and OEMs are responsible for receiving and shipping the products from their customer. **

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Correct maintenance, repair, and use are important to obtain proper performance from this product. Therefore, read the instruction manual carefully and completely. This warranty does not apply to any defect that RCI determines is due to, but not limited to:

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2. Misuse, abuse, neglect, or improper installation including disregard for installation of backup or safety override equipment
3. Accidental or intentional damage, including lightning
4. Water / Liquid damage

There are no implied warranties.

The foregoing constitutes RCI's entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages.

For service: +1 (913)422-0210 support @researchconcepts.com

Table of Contents

1 INTRODUCTION

The RC4800 Antenna Control Unit (ACU) consists of a set of proprietary PCBs and antenna specific servo drive units.

PLEASE READ AND UNDERSTAND THE MANUAL. Due to the complexity of the functions performed by the RC4800, time invested in understanding its installation and operation will be well spent.

1.1 Manual Organization

The RC4800 PCB set allows for ACU functionality to be packaged in varied configurations. Also, many hardware and software options are available for use with the RC4800 architecture. This manual is organized to:

1) Describe common hardware and software elements that will apply to all instances of the RC4800
2) Provide a structure to allow definition of elements unique to a specific use of the RC4800

Chapter 1 summarizes the contents of the manual and highlights the functionality and features of the RC4800.

Chapter 2 describes the core software features of the RC4800.

Chapter 3 covers RC4800 common installation and calibration procedures, provides help for system troubleshooting and discusses detailed operational topics referred to in the manual.

Chapter 4 describes the RC4800 PCB set hardware, interfaces, and common external components.

Appendix A supplies the expert access codes on a single page, which at management's discretion, may be removed to eliminate the possibility of inexperienced users inadvertently corrupting configuration data.

Appendix B, titled "MOUNT SPECIFIC DATA", details unique functions and values unique to a specific antenna mount.

Appendix C, titled "ENCLOSURE SPECIFIC DATA", details mechanical and electrical details on how the RC4800 is packaged. This appendix may not be supplied from RCI if the board set is not packaged in an RCI provided enclosure.

Separate appendices describe additional features of the RC4800. Example optional appendices that could accompany the manual include:

APPENDIX REM - REMOTE CONTROL PROTOCOL

1.2 Manual Conventions

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

```
AZ: 176.55          BCN:-68.0       MANUAL
EL:  46.44          SAT:
PL:  18.78          SPD:FAST            UTC
<MODE>MENU <0-9>JOG ANTENNA      14:25:47
```

The following table shows typical abbreviations used both on RC4800 screens and in the manual's text.

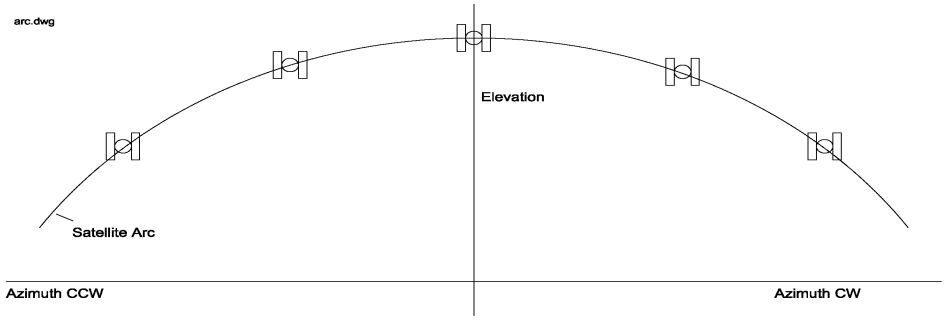
ITEM	ABREVIATION(S)
True azimuth angle	AZ
Elevation angle to horizon	EL
Polarization Angle	PL
Clockwise	CW
Counter-Clockwise (Anti-Clockwise)	CCW
Down	DN
Latitude	LAT
Longitude	LON
Satellite	SAT
Global Positioning System	GPS
Liquid Crystal Display	LCD
Signal Strength	SS

Satellite longitudes are presented in degree/decimal degree (79.0 W) format since that is the standard representation of satellite positions. Latitude and longitude of the mount are presented in degree/decimal (38.9554N, 94.7543W) format.

When referring to an ACU mode of operation, that mode's name will be capitalized – ex. RECALL.

Throughout the manual and software, the latitude, longitude and true heading of the antenna are collectively referred to as the antenna's "position".

Movements of the antenna (as seen from behind the antenna, looking at the arc of satellites) are represented by graphing the azimuth and elevation axes as shown below.



1.3 RC4800 Features

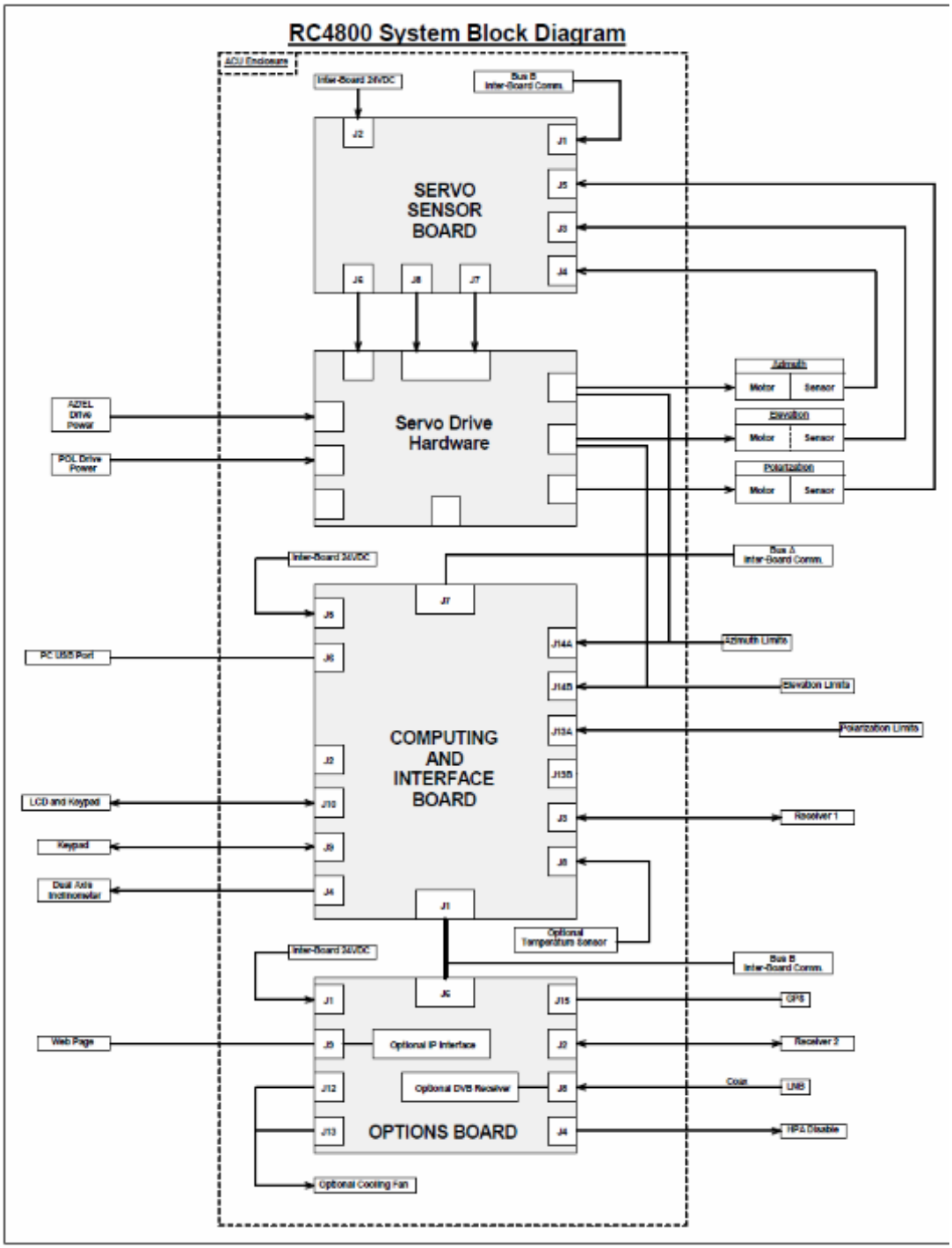
The ACU performs its functions via digital and analog electronic equipment interfaced to the antenna's motor drive and position sensor systems. This equipment is controlled through embedded software algorithms run by the ACU's microcontroller.

The RC4800 ACU is designed to automate the operation of high-performance earth station antennas. Features provided include:

- Automatic azimuth and elevation pointing solution calculation
- GPS receiver for accurate time-based tracking
- Automatic tracking of inclined orbit satellites via multiple tracking modes
    - Step Tracking
    - Enhanced Predictive Tracking
    - Two-Line Element Tracking (TLE)
- Automatic polarization control of rotating feeds
- Battery backed-up non-volatile memory for storing satellite locations and configuration data
- Automatic repositioning to stored satellites
- Continuous monitoring of antenna drive status
- Support for multiple band satellite operations
- Multiple User Interface Options
    - 4x40 Character Display + 4x4 keypad
    - Ethernet (IP-based) remote control Options
        - Remote 4x40 Character Display + 4x4 keypad
        - Intuitive Graphical User Interface (GUI)

1.4 Hardware Overview

The following figure is a block diagram showing the four major components of the RC4800 ACU and how they interface with a typical antenna system.



Individual interfaces will be described in detail in Chapter 4. NOTE: Appendix C “Enclosure Specific Data” will describe how these interfaces are mechanized for a board set in an enclosure.

1.5 Software Overview

The RC4800 allows easy antenna control via its mode-based operation. Multiple user interface (local and remote control) options exist. Section 2.1.1 highlights the software functions by showing data that would be presented if a user interface utilizes the 4x4 keypad and 4x40 character display. Section 2.1.2 highlights the software functions by showing data that would be presented when using the graphical user interface option. The screen displayed to the user is based on the current controller mode. Controller modes are divided into two major groups: operational and programming. The operational modes provide for the normal operation of the antenna. The programming group provides for initial configuration of the controller and will typically not be used on a day-by-day basis. The following example highlights the basic modes of operation provided by the RC4800.

1.5.1 Front Panel Overview

When using the physical font panel, or the remote front panel the screen displayed to the user is based on the current controller mode. Controller modes are divided into two major groups: operational and programming. The operational modes provide for the normal operation of the antenna. The programming group provides for initial configuration of the controller and will typically not be used on a day by day basis.

1.5.1.1 Operational Group Functions

1.5.1.1.1 Manual

In MANUAL mode the user may jog the antenna in Azimuth, Elevation and Polarization

```
AZ: 204.93           RF:-50.9       MANUAL
EL:  41.96         SAT:WB-1
PL:  45.00         SPD:FAST           UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

1.5.1.1.2 Automatic Recall

In RECALL mode, azimuth, elevation, and polarization pointing angles are generated from data stored in SETUP mode. The user selects which satellite to recall from the stored satellite list.

```
                                      RECALL
#   NAME         LON    INCL BAND TRK  TBL
1   WB-1       111.1W    0   KA  S/E   0%
<SCR>THRU LIST <ENTER>SELECT  <MODE>EXIT
```

1.5.1.1.3 Automatic Move To

From MOVETO mode, the user may ask for the antenna to be automatically moved to user specified or calculated positions via the longitude.

```
AZ: 204.93 ( 204.93) <0>SPD:FAST  MOVETO
EL:  41.39 (  41.39) <5>SENSOR:ANGLE
PL:  45.00 (  45.00) <6>LON:
<1>SET AZ <2>SET EL <3>SET POL  <4>START
```

1.5.1.2 Programming Group Functions

1.5.1.2.1 Configuration Screens

Configuration mode screens allow the user to customize and calibrate the operation of the ACU for use with a particular antenna. Note that most configuration items will be factory set for correct operation with a particular antenna.

```
MODE:2  ANT SIZE: 420       CONFIG-SYSTEM
        ANT LOOK:1

<2-MENU 3-MANUAL>
```

1.5.1.2.2 Maintenance Screens

Maintenance mode screens allow the user to monitor sensor inputs and perform periodic maintenance actions such as setting time and resetting drive errors.

```
 SYSTEM:12/25/18 13:28:50            TIME
DISPLAY:12/25/18 13:28:50        ZONE:UTC
GPS UTC:12/25/18 13:28:50     OFFSET:  0
1-DATE/TIME 2-ZONE 3-OFFSET 4-GPS SYNC
```

1.5.2 Graphical User Interface Overview

The graphical user interface control option is available via the IP interface of the controller. It is designed to provide all the functions available from the front panel operation in an easy-to-use interface. As well as provide current information of the system.

1.6 Specifications

	RC4800 BOARDSET
Physical	
Size	6 1/16" x 7" x 3 3/4" (PCB Set) / Drive components system dependent
Weight	2.6 lbs. (PCB Set) / Drive components system dependent
Temperature (Operational)	-40 to +60 deg. C.
Temperature (Storage)	-40 to +70 deg C.
Humidity	10% to 95% non-condensing
Position Sense	
Azimuth	16-Bit Resolver, 25-Bit Optical Encoder
Elevation	16-Bit Resolver, 25-Bit Optical Encoder
Polarization	16-Bit Resolver, 23-Bit Optical Encoder, Potentiometer
Limit Switch Inputs	EL Up/Down. AZ CW/CCW, POL CW/CCW, additional options available
Locate Mode	
AZ/EL Pointing Accuracy	±0.01° or better (16-bit), ±0.002° or better (25-bit)
POL Pointing Accuracy	±0.01° or better (16-bit), ±0.002° or better (23-bit), 0.1° or better (pot)
Positive Satellite Identification	Multiple Beacon Tracking Receiver Options, DVB-S2, Modem, and Spectrum Analyzer.
External AGC	Support for external analog signal source and lock input
Track Mode	
Antenna Size	0.4 – 25.0 meters
Tracking Accuracy	0.1 to 3.0 dB selectable; antenna dependent
Maximum Inclination	20°, standard
Tracking Modes	Step-Tracking, Predictive Tracking, NORAD TLE tracking

2 SOFTWARE

2.1 Operation Overview

The RC4800 allows multiple options for mechanizing the user interface. These can be divided into 2 distinct groups.

The first are versions that utilize a 4x4 keypad and 4x40 character display. Operation using this method will be described in section 2.1.1 and includes the following methods of control:

- Rackmount Front Panel
- Handheld Remote Front Panel (Section 4.2.1)
- IP based remote front panel

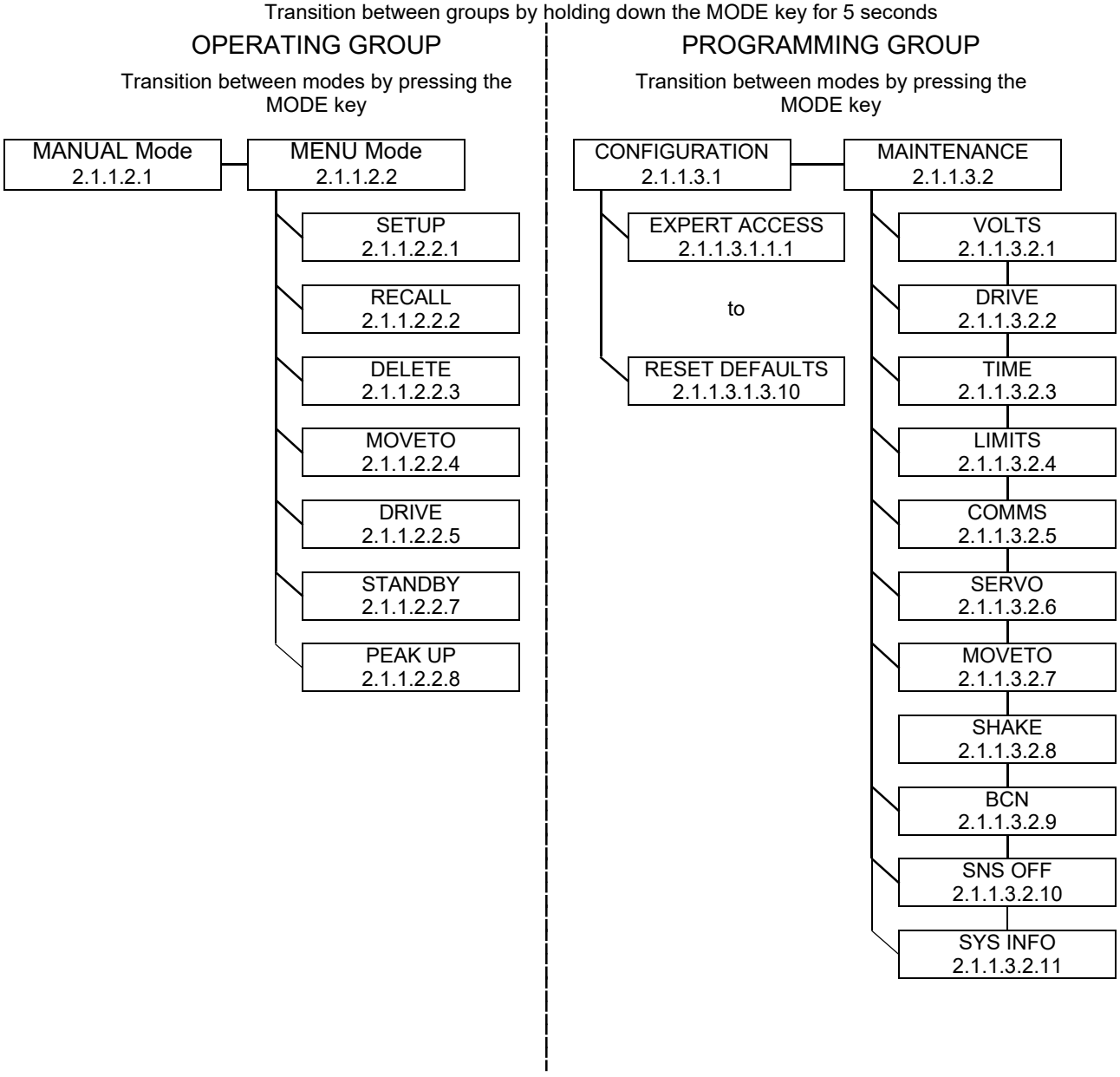
The second is an IP based graphical user interface (GUI) method of control. Operation using this method will be described in section 2.1.2.

2.1.1 Front Panel Software Operation

2.1.1.1 Front Panel Software Overview

2.1.1.1.1 Modes

The functionality of the RC4800 is achieved by placing the controller in the desired mode of operation. The diagram below shows the hierarchy of the RC4800's modes. Each mode has a unique display screen that presents the information applicable to that mode's operation.



After initial pairing of an ACU to an antenna, the programming modes will typically not be used. Section 2.1.1.2 will give further details on the operating modes and Section 2.1.1.3 will give further details on the programming modes. The rest of section 2.1.1.1 introduces common elements of all modes.

2.1.1.1.2 Keypad Usage

The keypad provides a flexible method of controlling the functionality of the ACU. While each ACU mode has different requirements for user input, the use of the keypad remains consistent throughout all modes.

The keypad provides for both specific actions and general data input. As an example, the <2/UP/N> key initiates an antenna up movement while in MANUAL mode but also allows for the entry of the number 2 when numeric entry is required or the indication of North when entering a latitude value. The required key usage is provided in the detailed description of each mode.

The table on the following page 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 5 seconds switches between operational and programming groups. Momentary push also exits sub-mode screens.
	Scroll Up Angle/CT	Toggles between multiple az/el position display options in Manual Mode	Scrolls forward through lists. Provides “YES” answer to prompts.
	Scroll Dn RF/SS	Toggles between displayed signal strength sources 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. Use to select option 1 from a numbered list.
	2 N El UP	Jogs elevation axis up when in MANUAL mode	Supplies “2” for numeric entry. Supplies NORTH for latitude entry (12°34N). Scrolls up during alphanumeric entries.
	3 Pol CW	Jogs polarization motor clockwise when pol is movement allowed	Supplies “3” for numeric entry.
	4 E Az CCW	Move azimuth axis counter-clockwise in MANUAL mode	Supplies “4” for numeric entry. Supplies East for longitude entry (123°45E).
	5 H/V	Commands Cross-Polarization movement in MANUAL mode, Store	Supplies “5” for numeric entry.

	KEY LABEL	SPECIFIC FUNCTION	GENERAL FUNCTION
	6 W Az CW	Move azimuth axis clockwise in MANUAL mode	Supplies “6” for numeric entry. Supplies West for longitude entry. (123°45W)
	7 Sat-H	Requests move to predefined Horizontal polarity position	Supplies “7” for numeric entry.
	8 S El DN	Jogs elevation axis down when in MANUAL mode	Supplies “8” for numeric entry. Supplies SOUTH for latitude entry (12°34S). Scrolls down during alphanumeric entries.
	9 Sat-V	Requests move to defined Vertical polarization	Supplies “9” for numeric entry.
	0 Speed	Toggles motor drive speed between FAST and SLOW	Supplies “0” for numeric entry.
	. (decimal point) Stop	Provides way to stop automatic movements	Provides delimiter for various data entries. Decimal point for floating point entry (2.50). Degree sign for lat/lon entry (38°56N). Colon for time entry (12:34:56). Slash for date entry (11/29/18).
	+/- BKSP	Provides way to exit out of certain conditions	Toggles sign of numeric data entry when cursor is at beginning of entry field. Backspaces one field to the left during data entry.

2.1.1.1.3 Data Entry

Many ACU screens request some type of user input. 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 to scroll through a list of items, pressing the <Scroll Up/Yes> key will move forward through the list and pressing the <Scroll Dn/No> key will move backward through the list. Pressing the <Enter> key when the desired item from the list is displayed will select the item.

Alphanumeric Entry (NAME:SES 3)

To manually enter the name of a satellite or location, the user scrolls through the list of characters (A-Z, 0-9 and blank) and selects the character by pressing the <6/CW/W> key. To scroll forward through the list of characters use the <2/UP/N> key and use the <8/DN/S> key to scroll backward.

To complete the entry of the alphanumeric string, press <Enter>. The user may delete through the string by using the <BKSP> key or move to the left to adjust once character by pressing the <4/CCW/E> key.

Integer Data Entry (SIZE: 240)

To enter whole numbers, use the 0-9 keys to enter the desired numeric string followed by the <Enter> key. Note that the data field will initially show the current value for the item until numeric entry is started. To terminate the entry without changing the value, the user may use the <Scroll Up/Yes> or <Scroll Dn/No> key. The <BKSP> key may be used to move back in the string to correct the input. Pressing the <Enter> key with the current value displayed will also result in no update.

Floating Point Data Entry (HEADING:180.0)

Entering floating point values is similar to entering integer values except that the decimal point is inserted by using the <Stop> key.

Degree/Decimal Latitude/Longitude Entry (TRUCK LAT:38.9556N)

Entering Latitude or Longitude is the same as floating point data entry. After entering the numeric value of latitude or longitude, the user is prompted to supply W(est) or E(ast) for longitude or N(orth) or S(outh) for latitude.

Degree/Decimal Longitude Entry (SAT LON:179.0E)

This entry is like the degree/minute entry but allows decimal fractions of degrees. This format will be used for satellite longitude entry where the degree/minute format is standard for vehicle position entry.

Time/Date

Time is entered in HH:MM:SS format and date in MM/DD/YY format.

2.1.1.1.4 Display Layout

The following screen shows many elements common to RC4800 mode displays.

```
AZ: 204.93          RF:-50.9       MANUAL
EL:  41.96        SAT:WB-1
PL:  45.00        SPD:FAST            UTC
<MODE>MENU <0-9>JOG ANTENNA     14:25:47
```

MODE TITLE: In the upper right corner, the title of the current ACU mode is displayed – in this example MANUAL designates that the ACU is currently in manual mode.

NOTE: if the mode title is preceded by an exclamation point (!), the mode was initiated by a remote command.

DATA LABELS: Since each mode presents a unique set of data, labels describing the data must be presented. The label will typically be followed by a colon to delimit between the label and the actual data. In the example shown, AZ: is the label for the current azimuth angle.

DATA VALUES: The current value of relevant data for the mode is displayed following the appropriate data label. In the example, the current azimuth angle (AZ:) is 204.93. Likewise, the satellite (SAT:) is WB-1.

USER PROMPTS: Since each mode requires unique (but similar) keypad inputs, prompts for relevant user action are included on the fourth line to the extent possible. In the above example, <MODE> tells the user that pushing the mode key will transition the ACU to MENU mode. There are several types of user data inputs as described in 2.1.1.1.3.

USER INFORMATION: When room allows, information about the current state of the ACU is displayed. In the above example, “SPD:FAST” describes the fact that since the ACU is currently configured for a jog in fast speed.

TIME: In some modes where data (such as azimuth position) may not change for long periods of time, the current time is displayed to reassure the user that the ACU is functioning. In the above example, the current system time (14:25:47) is displayed with the colon flashing once per second.

ALARM STATUS: While not shown in the above example, row 4 is used to display any alarm conditions the ACU has detected. The alarm message will alternate with the text normally on row 4. See section 5.1.2 for more description of the alarm system.

2.1.1.2 Front Panel Operating Group

Within the operating group of modes exists two high level modes – MANUAL and MENU. The MANUAL mode allows the user to manually jog the antenna while the MENU mode allows the user to select the modes that implement the RC4800's automatic movement features. While in either one of these modes, a momentary push of the Mode key will transition the RC4800 to the other mode.

2.1.1.2.1 MANUAL Mode

```
AZ: 204.93          RF:-50.9       MANUAL
EL:  41.96        SAT:WB-1
PL:  45.00        SPD:FAST             UTC
<MODE>MENU <0-9>JOG ANTENNA      14:25:47
```

In MANUAL mode, the user may jog the antenna in all three axes. A momentary push of the <Mode> key will move the controller from the MANUAL mode to the MENU mode.

AZ:

The azimuth field shows a current position value of the azimuth axis. It also shows the status of azimuth limits (STOW, CCW, CW). The limits will be displayed based on the table below. It is possible for different limits to have different sources (Switch Hardware for stow and Pot Based for CCW and CW).

	Switch Hardware + Software Limits	**Pot Based Hardware + Software Limits**	**No Hardware + Software Limits**
Limit Reached			
Hardware Limit	STOW, CCW, CW	STOW, CCW, CW	n/a
Software Limit	stow, ccw, cw	stow, ccw, cw	STOW, CCW, CW

The azimuth axis may be moved by pressing the <AZ CCW> or <AZ CW> keys.

EL:

The elevation field shows a current position value of the elevation axis. It also shows the status of elevation limits (STOW, DOWN, UP). The limits will be displayed based on the table below. It is possible for different limits to have different sources (Switch Hardware for Up and Down software for stow).

	Switch Hardware + Software Limits	**No Hardware + Software Limits**
Limit Reached		
Hardware Limit	STOW, DOWN, UP	n/a
Software Limit	stow, down, up	STOW, DOWN, UP

The elevation axis may be moved by pressing the <El UP> or <El DN> keys.

PL:

The polarization field shows a current angular value of the polarization axis. It also shows the status of polarization limits (STOW, CCW, CW). The limits will be displayed based on the table below. It is possible for different limits to have different sources (Switch Hardware for stow and Pot Based for CCW and CW).

	Switch Hardware + Software Limits	**Pot Based Hardware + Software Limits**	**No Hardware + Software Limits**
Limit Reached			
Hardware Limit	STOW, CCW, CW	STOW, CCW, CW	n/a
Software Limit	stow, ccw, cw	stow, ccw, cw	STOW, CCW, CW

This field will also show if the polarization axis has been placed at a predefined horizontal (H) or vertical (V) position.

The value of the predefined horizontal and vertical positions depends on what mode was active prior to entering the MANUAL mode. If a RECALL operation occurred prior to MANUAL, the H and V values will be those automatically calculated by the RECALL mode. H and V will be defined according to the reference defined in the POL CALIBRATION screen (ie. if REF = H, H = 0 & V = 90 if REF = V, V = 0 & H = 90).

The polarization axis may be moved manually by pressing the <Pol CCW> or <Pol CW> keys. The axis may also be moved automatically to the predefined horizontal or vertical positions by pressing the <H> or <V> keys.

In the MANUAL mode, whenever the <5 H/V> key is pressed the polarization axis will automatically move 90 degrees from its current position. The target position for this automatic “cross polarization” movement considers the user defined polarization axis limits.

RF/EXT/BCN:

This field shows the current signal strength sensed on the selected signal strength channel. By pressing the <Scroll Dn RF/SS> key the source of signal strength will rotate between an external signal strength input (**EXT**) and the RF input (**RF**). If the controller is equipped with an optional internal beacon receiver, **BCN** will also be available as a signal source.

The current signal strength will be displayed as a value between -99.9 and 99.9 for **RF**, **BCN,** and **EXT**.

If a signal lock input has been enabled associated with the observed channel, an “L” will be displayed to the right of the signal strength value whenever the signal lock condition has been satisfied.

SAT:

When the ACU knows the antenna is pointed at a previously stored satellite, the satellite name will be shown in this field.

SPD:

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

2.1.1.2.2 MENU Mode

MENU mode allows the user to select one of listed modes. Pressing the Mode key will move to MANUAL mode. The modes available to the user will vary depend on the current access level of the ACU (2.1.1.3.1.1.1). When in install or super user mode, the screen below will be presented to the user.

```
1-SETUP     2-RECALL    3-DELETE        MENU
4-MOVETO    5-DRIVE
                        9-STANDBY        UTC
<0-9>SELECT <MODE>MANUAL           00:04:31
```

When in normal user access mode, the screen below will be presented to the user.

```
1-RECALL SATELLITE                      MENU
2-DRIVE STATUS
3-MOVETO                9-STANDBY        UTC
<0-9>SELECT <MODE>MANUAL           00:04:31
```

MENU mode displays the time and time zone in the lower right-hand corner.

2.1.1.2.2.1 SETUP

The SETUP mode allows the user to store a satellite into the controller memory for selection via the RECALL mode (2.1.1.2.2.2). When entering the SETUP mode, the user is presented with the following screen.

```
SATELLITE PARAMETERS                    SETUP
NAME:              INCLIN:     TRACKING:
 LON:                BAND:       SIGNAL:
NAME <UP/DN/LF/RT ALPHANUMERIC>
```

NAME: NAME <UP/DN/LF/RT ALPHANUMERIC>

The user is prompted to enter an up to 10-character name for the satellite that is being setup. Alphanumeric characters can be scrolled through by pressing the <UP> and <DOWN> keys. The cursor can be moved left or right using the <CCW> and <CW> keys respectively. Pressing the <ENTER> key will terminate the current field and move the cursor to the LON: field.

LON: LONGITUDE <DDD.T FORMAT>

The user is prompted to enter the longitude of the satellite. The longitude will be used for tracking, and for determining a search box around the satellite if the signal is lost. To set the longitude, the user will enter the numeric value and press <ENTER>. The user will then select East or West Longitude by pressing the <E/CCW> or <W/CW> key respectively and pressing <ENTER>. The cursor will then be moved to the inclination field.

INCLIN: INCLINATION <1-20 DEG> <0>NON-INCLINED

The user is prompted to enter the inclination for the satellite. This information will be used for tracking and to determine a search box around the satellite if the signal is lost. The user should input the appropriate values using the number keys on the keypad and the press <ENTER>. The cursor will then be moved to the BAND: field.

BAND: BAND <0-C 1-KU 2-L 3-X 4-KA 5-S>

The user is prompted to enter the band for the satellite. This information is used for tracking operations. The user should enter the correct data based on the prompts shown on the bottom line and then press <ENTER>. The cursor will then be moved to the TRACKING: field.

TRACKING: <0-NONE 1-EPT 2-STEP 3-STP/TLE 4-TLE>

The user is prompted to select a tracking mode for the satellite being setup. Each mode is briefly described below.

1. EPT The main tracking mode for the RC4800 is Enhanced Predictive tracking (EPT). This tracking is divided into 3-phases:
    a. The initial phase is a basic step track operation. During this time, the ACU will constantly step track based on input parameters entered previously during the SETUP operation
    b. After 3 hours, the ACU will transition to a smart step track operation based on the calculated inclination and the current phase of the orbit.
    c. After 6 hours, the ACU will transition to a fully predictive tracking mode, with peaking operations only occurring at basepoints that occur 48 times per day.

2. STEP This mode will cause the ACU to perform the basic step track operations constantly. If the signal is lost in this mode, the ACU will revert to EPT tracking until the signal returns.

3. STP/TLE This mode will be the same as STEP, with TLE tracking mode being used when a signal is lost rather than EPT.

4. TLE This mode will use TLE tracking at all times.

After selecting the tracking mode, the user will press the <ENTER> key and the cursor will be moved to the SIGNAL: field.

SIGNAL: <SIGNAL SOURCE 0-NONE 2-BEACON>

The user is prompted to select a signal source for the satellite being SETUP. If the tracking mode selected is 1-3, 0-NONE will not be considered a valid signal source. The user should enter the correct data based on the prompts shown on the bottom line and then press <ENTER>. If the signal source is set to 0-NONE, the ACU will skip the Beacon setup page and proceed immediately to section 2.1.1.2.2.1.2.

2.1.1.2.2.1.1 Beacon SETUP

When the signal source is set to 2-BEACON, the ACU will transition to a screen for entering beacon frequency information for the satellite being SETUP. The first screen shows the prompt for an antenna with a linear feed. The second screen shows the prompt for an antenna with a circular feed.

```
BEACON PARAMETERS                    SETUP
HFREQ:           HMOD:
VFREQ:           VMOD:
HORZ BEACON FREQUENCY <0-300000.00 MHz>
```

```
BEACON PARAMETERS                    SETUP
FREQ:             MOD:

BEACON FREQUENCY <0-300000.00 MHz>
```

HFREQ:/VFREQ:/FREQ: BEACON FREQUENCY <0-30000.00 MHz>

In the linear case, the user is prompted to enter a frequency for both the horizontal and vertical beacon. If the beacon information for either polarization is unknown, the frequency should be set to 0. In the circular feed case, the user is prompted to enter a single beacon frequency. The user should input the value using the numeric keypad and then press <ENTER>.

HMOD:/VMOD:/MOD: BEACON MODULATION <0-CW,1-BPSK>

In the linear case, the user is prompted to select between CW and BPSK for both the horizontal and vertical beacon. If the beacon information for either polarization is unknown, the MOD should be set to 0. In the circular feed case, the user is prompted to enter a single beacon modulation. The user should input the value from the prompt on the bottom line and then press <ENTER>.

2.1.1.2.2.1.2 AZ/EL Positioning

After entering the beacon frequency, the ACU will transition to the SETUP AZ/EL jog screen. The message “<ENTER>SAVE AZ/EL POSITION” will be flashing on the bottom line.

```
AZ: 204.81          RF:-50.9        SETUP
EL:  41.84
PL:   5.00        SPD:FAST
<0-9>JOG ANTENNA <BKSP>BEACON <MODE>EXIT
```

From this screen the user can jog the antenna in AZ and EL to properly position the antenna. Pressing the <BKSP> key will drop into the beacon control screen shown below.

```
BEACON PARAMETERS     BCN:-46.0 L  SETUP
H-FREQ:20199.00  DEMOD:CW   ATTEN: 0

<H,V>TUNE BEACON <ENTER>EDIT  <BKSP>EDIT
```

From this screen, the user can tune to either the horizontal or vertical frequency that was set in the previous step. When a circular feed is use, the receiver will be tuned to the single frequency automatically. Pressing the <BKSP> key will return to the SETUP AZ/EL jog screen.

```
AZ: 204.81          BCN:-46.0 L      SETUP
EL:  41.84
PL:   5.00          SPD:FAST
<0-9>JOG ANTENNA <BKSP>BEACON <MODE>EXIT
```

After properly peaking the antenna using the beacon receiver, or an external method pressing <ENTER> will store the azimuth and elevation angles for the satellite. If a linear feed is being used, the controller will transition to the SETUP POL jog screen. If a circular feed is being used, the controller will exit the SETUP mode.

The SETUP POL jog screen allows the user to adjust the polarization to the proper position. The message "<ENTER>SAVE H-POL POSITION" will be flashing on the bottom line of the display.

```
AZ: 204.81          BCN:-46.0 L      SETUP
EL:  41.84
PL:   5.00          SPD:FAST
<0-9>JOG ANTENNA <BKSP>BEACON <MODE>EXIT
```

The user should manually move the polarization to the horizontal position, and then press the <ENTER> key. The flashing message on the bottom line will then change to "<ENTER>SAVE V-POL POSITION". The user should manually move the polarization to the vertical position and the press the <ENTER> key.

If the satellite being SETUP has a tracking mode other than 0-NONE, the ACU will immediately transition into RECALL mode (2.1.1.2.2.2). If the satellite tracking mode is setup as 0-NONE, the ACU will immediately transition into MANUAL mode (2.1.1.2.1).

2.1.1.2.2.2 RECALL

The RECALL mode allows the user to position the antenna to satellites that were previously stored using the SETUP mode (2.1.1.2.2.1). When entering the RECALL mode, a scrollable list of satellites will be shown.

```
                                          RECALL
#    NAME         LON    INCL BAND TRK   TBL
1    WB-1       111.1W    0    KA  S/E    0%
<SCR>THRU LIST <ENTER>SELECT   <MODE>EXIT
```

Using the <SCROLL UP> and <SCROLL DN> keys the user can scroll through the list of satellites stored in memory. Pressing the <ENTER> key will select the current satellite displayed.

If there are no satellites in memory, the following screen will be displayed.

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

After a satellite has been selected, the controller will prompt the user to specify the desired polarization. For antennas with circular feeds, this step will be skipped.

```
H-HORIZONTAL:    5.00                 RECALL
V-  VERTICAL: -85.00   SAT:WB-1

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

After selecting the polarization, the antenna will begin moving to the selected satellite. When the automatic movement is completed, the controller will transition to the MANUAL mode (2.1.1.2.1) for satellites with the tracking set to 0-NONE or TRACK mode (2.1.1.2.2.6) for all other tracking modes.

2.1.1.2.2.3 DELETE

The DELETE mode allows a satellite that was stored via the SETUP mode (2.1.1.2.2.1) to be deleted from the ACU memory.

```
                                          DELETE
#    NAME          LON    INCL BAND TRK   TBL
1    WB-1        111.1W    0    KA  S/E    0%
<SCR>THRU LIST <ENTER>SELECT   <MODE>EXIT
```

Using the <SCROLL UP> and <SCROLL DN> keys the user can scroll through the list of satellites stored in memory. Pressing the <ENTER> key will select the current satellite displayed to delete. All satellite can be deleted by using the “DELETE ALL STORED SATELLITES” at the end of the list.

If there are no satellites in memory, the following screen will be displayed.

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

2.1.1.2.2.4 MOVETO

The MOVETO mode is intended to provide an easy way to move the antenna to a certain position for doing testing such as cutting antenna patterns. This mode is also useful for tuning up automatic movements.

```
AZ: 204.93 ( 204.93) <0>SPD:FAST  MOVETO
EL:  41.39 (  41.39) <5>SENSOR:ANGLE
PL:  45.00 (  45.00) <6>LON:
<1>SET AZ <2>SET EL <3>SET POL  <4>START
```

The current azimuth, elevation, and polarization angles are displayed. When the mode is first entered, the current positions shown are the target positions. New target positions can be selected for azimuth, elevation, and polarization by pressing the <1>, <2>, or <3> key respectively. After setting target positions and setting the desired speed, the automatic movement may be initiated by pressing the <4> key.

<0> SPEED:FAST

The state of this field when this mode is entered will be “FAST”. This means that any move will be using the standard speed control of the ACU. When the <0/Speed> key is pressed, this field will change to “SLOW”. This means that the move will never go faster than the slow speed set in the “DRIVE PARAMETERS” configuration screen corresponding to the axis being moved.

<5>SENSOR:ANGLE

The state of this field when this mode is entered will be “ANGLE”. This means that all the movements requested will occur in angles. When the <5> key is pressed this field will change to “COUNT”. This means that all movements requested will occur in counts.

<6>LON:

This field allows the ACU to auto calculate AZ/EL/PL targets based on a satellite orbital slot and the location of the antenna.

2.1.1.2.2.5 DRIVE

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

The DRIVE mode provides the way to reset drive system errors (FOLLOW/DRIFT/DRIVE) for each axis. See section 5.1.2 for descriptions of these conditions. An axis’ drive status may be reset by pressing the corresponding key.

2.1.1.2.2.6 TRACK

The TRACK mode is automatically entered via the SETUP (2.1.1.2.2.1) or RECALL (2.1.1.2.2.2) modes if the tracking field for a selected satellite is set to any value other than 0-NONE.

The following screen will be displayed for all track modes, with a brief description of each mode described below.

```
AZ: 204.58 PEAK:  78 BCN:-46.0 L   TRACK
EL:  41.88 BASE:1087 SAT:WB-1       (Ka)
PL:  18.78          STEP:IDLE      19:18
WAITING FOR NEXT PEAKUP...       <0>MENU
```

Fields that are unique to the tracking mode are described below:

PEAK: 78

This field shows the time in seconds to the next scheduled AZ/EL peakup.

BASE:1087

This field shows the time in seconds to the next schedule track table base point.

STEP:IDLE

This field shows the current sub-mode (STEP/EPT/TLE) and state (IDLE/PEAKING/REPOSITION).

The bottom line gives a description of the status of the TRACK mode. Additionally, the bottom line indicates the press <0> will enter the TRACK MENU sub-mode (2.1.1.2.2.6.1). This option will not be displayed in normal access level.

Tracking on the RC4800 can be divided into four separate sub-modes. The sub-mode chosen by the ACU will be a function of the tracking mode selected when storing the satellite, and the current information stored in the track table for the satellite.

- Step Track
    - In Step Track, the controller periodically peaks on the selected signal source by jogging the antenna in azimuth and elevation. The time and position are recorded in a track table base points maintained in the controller's memory. The interval between Step Track operation is determine from antenna size, frequency band, satellite inclination and a user specified maximum allowable error (2.1.1.3.1.3.8).
- Enhanced Predictive Track (EPT) Track
    - EPT Track is divided into 2 unique phases.
        - Phase 1: The ACU will transition to the first EPT phase after 6 base points in a row have been stored via the Step Track sub-mode. In this phase, the ACU will use the algorithm to determine the amplitude and phase of the inclined orbit. Using this data, the ACU will smartly calculate the peaking interval and only peak as need.
        - Phase 2: The ACU will transition to the second EPT phase after 6 base points have been stored via EPT phase 1. During this phase, the ACU uses the EPT model and current time to accurately calculate the satellite position every 5 seconds. During this phase, the ACU will peak at each basepoint to constantly refine the model. When tracking via EPT, the ACU will be able to track an inclined satellite forever without update.
- Two-Line Element (TLE) Track
    - In TLE track, the controller smoothly moves the antenna to azimuth and elevation positions derived from the two-line element data set. The ACU will be constantly calculating pointing angles from the TLE data set. Anytime the current position is different from the calculated position, the ACU will move the antenna to close this error.
- Track Search
    - Track Search is entered when the satellite signal has been lost during Step Tracking when there is no EPT or TLE model to fall back on. The ACU utilizes Intelli-Search, an efficient search algorithm that 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 sub-mode.

2.1.1.2.2.6.1 TRACK MENU

Pressing the <0> key from the TRACK mode (2.1.1.2.2.6) will drop into the TRACK MENU sub-mode. This sub-mode is not available in the normal user access level.

```
AZ: 204.58 PEAK:  78 BCN:-46.0 L   TRACK
EL:  41.88 BASE:1087 SAT:WB-1       (Ka)
TRACK MENU <1>PEAKUP NOW <2>VIEW TABLE
<3>MODIFY FACTORS <BKSP>EXIT       83845
```

Pressing the <1> key from the TRACK MENU sub-mode will begin a step tracking peaking operation immediately. Once completed, the ACU will return to the TRACK mode.

Pressing the <2> key from the TRACK MENU sub-mode will allow the user to view the track table basepoints that are stored in memory.

```
AZ: 204.58 PEAK:  78 BCN:-46.0 L   TRACK
EL:  41.88 BASE:1087 SAT:WB-1       (Ka)
TRACK TABLE <SCROLL>UP/DOWN <BKSP>EXIT
44 78980  204.66    41.95  <1>DEL  84150
```

Using the <SCROLL UP> and <SCROLL DN> keys the user can scroll through the list of track table base points. Each entry provides the following information:

- Base Point Number – 44
- Base Point Sidereal Time – 78980
- Base Point AZ Angle – 204.66
- Base Point EL Angle – 41.95

Additionally, any track table basepoint in memory can be deleted by pressing the <1> key. Pressing the <BKSP> key will return the ACU to the TRACK MENU sub-mode.

Pressing the <3> key from the TRACK MENU sub-mode allows the user to modify various parameters related to the tracking operation.

```
AZ: 204.58 PEAK:  78 BCN:-46.0 L   TRACK
EL:  41.88 BASE:1087 SAT:WB-1       (Ka)
FACTORS MENU <SCROLL>UP/DOWN <ENTER>EXIT
MAX ERROR (1/10 dB) <1-30>: 3
```

From the TRACK FACTORS sub-mode, the following configuration items related to the tracking can be modified directly.

- Max Error – Max Error in Track Factors Configuration Screen (2.1.1.3.1.3.8).
- Search Width – Search in Track Factor Configuration Screen (2.1.1.3.1.3.8).
- Track Table Clear – Clears all track table base points.
- Update Flags – When in Step track mode, flags all base points for updating.
- Update time – When in Step track mode, sets how often base point is checked for accuracy.
- Search Retry – When the signal is lost, determines how frequently the ACU will search.
- Signal Threshold – Receiver specific Low Signal Threshold (2.1.1.3.1.2.6)

2.1.1.2.2.7 STANDBY

The STANDBY mode allows the user to enable or disable the servo drive amplifiers. When the drives are inactive, all azimuth and elevation movements will not be allowed. Additionally, while in this state "* ANTENNA IN STANDBY – DRIVES INACTIVE *" will flash on line 4 of the display.

```
                                        STANDBY
DRIVES: INACTIVE

<ENTER>MAKE DRIVES ACTIVE      <MODE>MENU
```

When the drives are inactive, pressing the <ENTER> key will switch them to the active state.

```
                                        STANDBY
DRIVES: ACTIVE

<ENTER>MAKE DRIVES INACTIVE    <MODE>MENU
```

When the drives are active, pressing the <ENTER> key will switch them to the inactive state. At power on, the drives will be in the inactive state. The only exception will be if the controller was powered cycled while tracking. When this occurs, the controller will make the drives active at power on and resume tracking.

2.1.1.2.2.8 PEAKUP

The PEAKUP mode performs a quick peak on the signal source currently displayed on the top line of the display in MANUAL mode. This is the same routine that is used during the TRACK operation (2.1.1.2.2.6).

2.1.1.3 Front Panel Programming Group

The programming group has two high-level modes (CONFIG-MENU and MAINTENANCE). Both modes serve as a menu system for sub-modes below them. Momentarily pressing the <Mode> key will switch between these modes in a similar fashion as the MANUAL and MENU modes switched in the operating group.

2.1.1.3.1 Configuration Mode

The CONFIG mode allows users to view and/or modify various controller parameters and to enable or disable certain features. The CONFIG mode groups configuration items into screens containing between 1 to 11 individual items. The top-level CONFIG-MENU allows the user to scroll through the list of configuration item groups. As the user scrolls through the CONFIG-MENU screens, a group title (line 1) and brief description (line 2) of group items is presented to identify the set of configuration items to view or modify.

The example CONFIG-MENU screen identifies the AZIMUTH CALIBRATION group. The description “AZ REFERENCE VOLTAGE/LIMITS/SCALE FACTOR” provides an overview of the type of configuration items that will be available for viewing and/or modification.

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

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

To move through the CONFIG-MENU list, press the <Scroll Up/Yes> key to advance to the next screen or press the <Scroll Dn/No> key to move to the previous screen. To select the currently identified group for viewing/modification, press the <Enter> key and the screen showing the individual items in the group will appear. Momentarily pressing the <Mode> key will move from the CONFIG-MENU mode to the MAINTENANCE mode.

If the AZIMUTH CALIBRATION group were selected, the following screen would appear:

```
VREF:2.50                      CONFIG-AZIM
 CCW:-192.0   CW:192.0   SF: 87.95
PSF:10430           ROFF:  0.00    DIR:0
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

In this example there are seven individual configuration items related to the azimuth axis. To move between the items, use the <Scroll Up> and <Scroll Dn> keys. The cursor will flash at the beginning of the data field for the item currently selected. On line 4, a prompt briefly describing the item and showing the valid range of data will appear. Data may be entered for the item as described in section 2.1.1.1.3. Momentarily pressing the <Mode> key will return to the CONFIG-MENU mode.

The following table lists all the configuration item group titles and descriptions as they appear in the CONFIG-MENU mode. Details for each group are provided in the following subparagraphs. The table also shows which configuration item groups are available according to how the expert access permission (2.1.1.3.1.1.1) is set.

Additional configuration item screens may appear if they are unique to an optional feature (DVB, Beacon, etc.).

GROUP TITLE	GROUP DESCRIPTION	PARA.
NORMAL ACCESS ITEMS		
EXPERT ACCESS PERMISSION	SETS EXPERT ACCESS PERMISSION	2.1.1.3.1.1.1
BEACON DETECTION POINTS	LIST OF PRESET BEACON FREQUENCIES	2.1.1.3.1.1.2
TLE 1 DATA	LINE 1 – TWO LINE ELEMENT SET	2.1.1.3.1.1.3
TLE 2 DATA	LINE 2 – TWO LINE ELEMENT SET	2.1.1.3.1.1.4
INSTALL ITEMS		
AZIMUTH CALIBRATION	AZ REFERENCE VOLTAGE/LIMITS/SCALE FACTOR	2.1.1.3.1.2.1
ELEVATION CALIBRATION	EL REFERENCE VOLTAGE/LIMITS/SCALE FACTOR	2.1.1.3.1.2.2
POLARIZATION CALIBRATION	POL REFERENCE VOLTAGE/LIMITS/SCALE FACTOR	2.1.1.3.1.2.3
FEED DEFINITION	SPECIFY FEED TYPE/BAND/ID	2.1.1.3.1.2.4
EXTERNAL SIG FACTORS	EXTERNAL SIGNAL/SEARCH PARAMETERS	2.1.1.3.1.2.5
BEACON SIG FACTORS	BEACON SCAN/SEARCH PARAMETERS	2.1.1.3.1.2.6
SUPER ITEMS		
SYSTEM DEFINITION	INDICATE PRESENCE OF SYSTEM OPTIONS	2.1.1.3.1.3.1
AZIMUTH ANGLE MOVEMENT	AZIMUTH ANGLE-BASED MOVE PARAMETERS	2.1.1.3.1.3.2
AZIMUTH DRIVE PARAMETERS	AZIM VOLTAGE/CURRENT/IR/JAM/DEADBANDS	2.1.1.3.1.3.3
ELEVATION ANGLE MOVEMENT	ELEVATION ANGLE-BASED MOVE PARAMETERS	2.1.1.3.1.3.4
ELEVATION DRIVE PARAMETERS	ELEV VOLTAGE/CURRENT/IR/JAM/DEADBANDS	2.1.1.3.1.3.5
POL ANGLE MOVEMENT	POL ANGLE-BASED MOVE PARAMETERS	2.1.1.3.1.3.6
POL DRIVE PARAMETERS	POL VOLTAGE/CURRENT/IR/JAM/DEADBANDS	2.1.1.3.1.3.7
TRACK FACTORS	INCLINED ORBIT TRACKING PARAMETERS	2.1.1.3.1.3.8
SHAKE	SETUP SHAKE MOVES/CYCLES/DELAY	2.1.1.3.1.3.9
LOCATION RESET	RESET ANTENNA LOCATION	2.1.1.3.1.3.10
RESET DEFAULTS	RESTORES PROGRAMMING TO FACTORY DEFAULTS	2.1.1.3.1.3.11

2.1.1.3.1.1 Normal Access Items

The seven configuration groups contained in the “Normal” access allows the user to change items that would typically be required to be changed following system configuration. Also available is the “Expert Access Permission” configuration screen to allow the user to change from “Normal” access to “Install” or “Super” access.

2.1.1.3.1.1.1 Expert Access Permission

```
EXPERT ACCESS:     0          CONFIG-EXPERT


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

The Expert Access level is used to control access to controller modes and configuration items.

The available expert access levels are: “Normal” (0), “Install” (1), and “Super“ (2). The user is restricted to basic operational modes and preset item lists when Expert Access is set to “Normal” (0). The user has access to all controller modes and general configuration items when Expert Access is set to “Install” (1). The user has access to all controller modes and all configuration items when Expert Access is set to “Super” (2).

When the Expert Access screen is displayed, the current expert access level is displayed 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. If the information is lost, call the factory for assistance.

2.1.1.3.1.1.2 Beacon Detection Points

This group allows the user to view beacon information for each satellite stored in memory (2.1.1.2.2.1.1).

```
SAT#:1     NAME:WB-1            CONFIG-BCN
          HFREQ:20199.00    HMOD:0
          VFREQ:    0.00    VMOD:0
<SCR>THRU LIST <ENTER>MODIFY DATA
```

SAT#: <SCR> THRU LIST, <ENTER> TO MODIFY DATA

This field identifies the stored satellite number that is currently being displayed. When in this field, using the <SCROLL UP> or <SCROLL DN> keys will move through the list.

To modify the data, press the <ENTER> key. The cursor will move to the HFREQ field.

NAME:

Name stored in memory for the current satellite.

HFREQ: HORZ BEACON FREQUENCY <0-30000.00 MHz>

This field identifies the horizontal beacon frequency associated with corresponding stored satellite. This field should be the value of the LO configuration item (2.1.1.3.1.2.4) plus the beacon frequency in L-Band.

For circular satellites, this will be the beacon frequency used during tracking operations.

HMOD: HORZ BEACON MODULATION <0-CW 1-BPSK>

This field describes the type of demodulation required for the horizontal beacon signal. CW = Continuous Wave, BPSK = Binary Phase-Shift Keying.

This setting is ignored if the beacon receiver being used does not support BPSK beacons.

VFREQ: VERT BEACON FREQUENCY <0-30000.00 MHz>

This field identifies the vertical beacon frequency associated with corresponding stored satellite. This field should be the value of the LO configuration item (2.1.1.3.1.2.4) plus the beacon frequency in L-Band.

For circular satellites, this frequency will not be used and will be 0.00 by default.

VMOD: VERT BEACON MODULATION <0-CW 1-BPSK>

This field describes the type of demodulation required for the vertical beacon signal. CW = Continuous Wave, BPSK = Binary Phase-Shift Keying.

This setting is ignored if the beacon receiver being used does not support BPSK beacons.

For circular satellites, this modulation will not be used and will be 0 by default.

2.1.1.3.1.1.3 TLE 1 Data

Note: It is suggested to enter TLE data via the GUI as described in 2.1.2.2.1.1.

The RC4800 uses one screen to show each line of TLE data. The top line of each screen identifies which line is being displayed (TLE1 or TLE2). The top line will also show the stored satellite number and satellite name. The user may scroll through stored satellites via the <Scroll Up> or <Scroll Dn> keys.

When a TLE data screen is initialized it shows the existing TLE data stored.

```
SAT#:1    NAME:WB-1          CONFIG-TLE1
1 29643  06054    21032.29527314
-.00000048  00000-0  00000+0 0  9992
<SCR>THRU LIST <ENTER>MODIFY DATA
```

When scrolling through stored satellites, if the stored satellite does not have TLE data, the following screen will be shown.

```
SAT#:1   WB-1                CONFIG-TLE1
      ** TLE DATA NOT SELECTED **
     ** IN SATELLITE PRESET LIST **
<SCR>THRU LIST <ENTER>MODIFY DATA
```

After scrolling to the desired stored satellite number, the user may begin to enter data by pressing the <ENTER> key. The cursor will then be placed on the first data character of the first field. The data can then be entered one field at a time.

To enter data, the 0 through 9 numbers, the "." are available directly from the RC4800 keypad. To enter a "+" use the <Scroll Up> key and to enter a "-" use the <Scroll Dn> key. After a number is keyed, the cursor will advance to the next position in the field. When the last number of a field has been entered, pressing the <Enter> key will move to the next field. Numbers can be deleted by pressing the <BKSP> key.

Field 3 (classification) and Field 6 (Piece of Launch Designator) from Line 1 will not be entered, as they contain alphabetic characters. Instead, the user should just skip these field when entering via the TLE Data configuration screens.

After entering the 69th character the RC4800 will calculate the data's checksum and compare it to the last character. If the calculated and entered checksums do not match, an error will be flagged as shown below.

```
SAT#:1    NAME:WB-1          CONFIG-TLE1
1 29643  06054    21032.29527314
-.00000048  00000-0  00000+0 0  9993
<0-9 UP(+) DN(-) BKSP ENTER>     CHK:ERR
```

If the calculated and entered checksums match, an indication of CHK:OK will appear as shown below.

```
SAT#:1    NAME:WB-1          CONFIG-TLE1
1 29643  06054    21032.29527314
-.00000048  00000-0  00000+0 0  9992
<0-9 UP(+) DN(-) BKSP ENTER>     CHK:OK
```

2.1.1.3.1.1.4 TLE 2 Data

Note: It is suggested to enter TLE data via the GUI as described in 2.1.2.2.1.1.

The RC4800 uses one screen to show each line of TLE data. The top line of each screen identifies which line is being displayed (TLE1 or TLE2). The top line will also show the stored satellite number and satellite name. The user may scroll through stored satellites via the <Scroll Up> or <Scroll Dn> keys.

When a TLE data screen is initialized it shows the existing TLE data stored.

```
SAT#:1     NAME:WB-1           CONFIG-TLE2
2 29643    0.0167   84.6392 0001775
 229.6479 172.5173   1.00271423 51878
<SCR>THRU LIST <ENTER>MODIFY DATA
```

When scrolling through stored satellites, if the stored satellite does not have TLE data, the following screen will be shown.

```
SAT#:1    WB-1                 CONFIG-TLE1
       ** TLE DATA NOT SELECTED **
      ** IN SATELLITE PRESET LIST **
<SCR>THRU LIST <ENTER>MODIFY DATA
```

After scrolling to the desired stored satellite number, the user may begin to enter data by pressing the <ENTER> key. The cursor will then be placed on the first data character of the first field. The data can then be entered one field at a time.

To enter data, the 0 through 9 numbers, the "." are available directly from the RC4800 keypad. To enter a "+" use the <Scroll Up> key and to enter a "-" use the <Scroll Dn> key. After a number is keyed, the cursor will advance to the next position in the field. When the last number of a field has been entered, pressing the <Enter> key will move to the next field. Numbers can be deleted by pressing the <BKSP> key.

After entering the 69th character the RC4800 will calculate the data's checksum and compare it to the last character. If the calculated and entered checksums do not match, an error will be flagged as shown below.

```
SAT#:1     NAME:WB-1           CONFIG-TLE2
2 29643    0.0167   84.6392 0001775
 229.6479 172.5173   1.00271423 51877
<0-9 UP(+) DN(-) BKSP ENTER>      CHK:ERR
```

If the calculated and entered checksums match, an indication of CHK:OK will appear as shown below.

```
SAT#:1     NAME:WB-1           CONFIG-TLE2
2 29643    0.0167   84.6392 0001775
 229.6479 172.5173   1.00271423 51878
<0-9 UP(+) DN(-) BKSP ENTER>      CHK:OK
```

2.1.1.3.1.2 Install Access Items

This installation group of configuration groups are items that are most typically changed for pairing a controller with an antenna.

2.1.1.3.1.2.1 Azimuth Calibration

```
                                   CONFIG-AZIM
 CCW:   90.000 CW: 270.000
                          SOFF:    0.000 DIR:0
TRUE CCW LIMIT <0.000-360.000 DEGREES>
```

CCW: TRUE CCW LIMIT <0.000-360.000 DEGREES>

CW: TRUE CW LIMIT <0.000-360.000 DEGREES>

These items specify the software limits for the antenna's azimuth range of travel.

How these limits are displayed in MANUAL mode is described in section 2.1.1.2.1.

SOFF: SENSOR OFFSET <+/-90.000 DEGREES>

This value specifies the offset between the on-axis position sensor and true pointing angles. The value should be set using the Sensor Offset maintenance screen (2.1.1.3.2.10).

DIR: SENSOR DIRECTION <0-NORMAL, 1-REVERSED>

The sensor direction defines whether the polarity of the azimuth on-axis position sensor matches that of the ACU software. If the sensor angle decreases as the antenna moves CW, the DIR item must be described as reversed.

2.1.1.3.1.2.2 Elevation Calibration

```
                                   CONFIG-ELEV
DOWN:    5.000 UP:   80.000
                        SOFF:    0.000 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 items specify the software limits for the antenna's elevation range of travel.

How these limits are displayed in MANUAL mode is described in section 2.1.1.2.1.

SOFF: **SENSOR OFFSET <+/- 90.0 DEGREES>**

This value specifies the offset between the on-axis position sensor and true pointing angles. The value should be set using the Sensor Offset maintenance screen (2.1.1.3.2.10).

DIR: **SENSOR DIRECTION <0-NORMAL, 1-REVERSED>**

The sensor direction defines whether the polarity of the elevation on-axis position sensor matches that of the ACU software. If the sensor angle decreases as the antenna moves UP, the DIR item must be described as reversed.

2.1.1.3.1.2.3 Polarization Calibration

```
        VREF:2.50  OFF:  0.000 CONFIG-POL
 CCW: -90.000 CW:  90.000 SF: 45.00
                        SOFF:   0.000 DIR:0
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

VREF: ZERO DEG VOLTAGE <1.00-4.00 VOLTS>

The zero-degree voltage from the potentiometer is the voltage present when the polarization axis is in its center of motion.

See Polarization Calibration in 3.3.2.2.

OFF: ANGLE OFFSET <+/-90.000 DEGREES>

The angle offset is used to correct for discrepancies between the potentiometer electrical angle and mechanical alignment of the feed.

See Polarization Calibration in 3.3.2.2.

CCW: CCW LIMIT <+/-180.000 DEGREES>

CW: CW LIMIT <+/-180.000 DEGREES>

These items specify the software limits for the antenna's polarization range of travel relative to the antenna’s center polarization (0.0) position.

How these limits are displayed in MANUAL mode is described in section 2.1.1.2.1.

SF: POT SCALE FACTOR <1.00–180.00 DEG/V>

This value specifies the polarization scale factor applicable to the potentiometer-based polarization feedback.

See Polarization Calibration in 3.3.2.2.

SOFF: SENSOR OFFSET <+/- 90.0 DEGREES>

This value specifies the offset between the on-axis position sensor and true pointing angles.

See Polarization Calibration in 3.3.2.1.

DIR: SENSOR DIRECTION <0-NORMAL, 1-REVERSED>

The sensor direction defines whether the polarity of the polarization on-axis position sensor matches that of the ACU software. If the sensor angle decreases as the feed moves CW, the DIR item must be described as reversed.

2.1.1.3.1.2.3.1 Multi-Feed Sensing Operation

When multiple, swappable feeds exist in a system, the optional feed sensing capability allows the RC4800 to detect and configure itself according to the currently attached feed. The multi-feed system allows for unique configuration screens for 8 different feeds.

When the multi-feed option is purchased, an additional feed number item will appear on the top line of the display as shown below. The user can use the <Scroll Up> and <Scroll Dn> buttons to scroll through the polarization calibration screen for each feed.

```
POL#:0 VREF:2.50  OFF:  0.000 CONFIG-POL
 CCW: -90.000 CW:  90.000 SF: 45.00
                    SOFF:   0.000 DIR:0
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

POL#: FEED INDEX NUMBER

This is the index number for the current Polarization Calibration screen displayed.

Each unique feed is sensed via inputs A, B, and C respectively. The current state of these inputs can be viewed in the LIMITS maintenance screen (2.1.1.3.2.4). The inputs are combined to create a feed number. The table below shows the standard for how each feed number is defined. Due to the high configurability of the RC4800, these values can all be modified in the baseline code. See the mount specific appendix for POL ID bit schemes for each specific antenna.

FEED #	Bit C	Bit B	Bit A	Default Sensed Feed	Default Feed Identifier
0	0	0	0	C-Band Linear	“C-LP”
1	0	0	1	X-Band Linear	“X-LP”
2	0	1	0	Ku-Band Linear	“KULP”
3	0	1	1	Ka-Band Linear	“KALP”
4	1	0	0	C-Band Circular	“C-CP”
5	1	0	1	X-Band Circular	X-CP”
6	1	1	0	Ku-Band Circular	“KUCP”
7	1	1	1	Ka-Band Circular	KACP”

The feed number will carry over no matter what configuration screen the user is in. So that feed “0” in the polarization calibration screen refers to feed “0” in the feed definition configuration screen. Configuration groups that will show unique values based on the feed sensed are listed below.

- Polarization Calibration
- Feed Definition (2.1.1.3.1.2.4)
- POL Angle Movement (2.1.1.3.1.3.6)
- POL Drive Parameters (2.1.1.3.1.3.7)

Refer to the mount specific appendix to determine if the RC4800 being used is equipped with the Multi-Feed Sensing option.

2.1.1.3.1.2.4 Feed Definition

```
                                        CONFIG-FEED
TYPE:0    LO:18250
BAND:4   REF:0
<0>CIRCULAR <1>SINGLE <2>DUAL
```

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

The polarization type configuration item specifies the configuration of the feed. This item will be used by the controller to determine the appropriate automatic movement of the polarization axis.

Circular type specifies that no movement will be needed to align the polarization axis. No Angle information will be displayed in MANUAL mode.

Single type specifies that the feed must be moved to separate horizontal and vertical polarization positions. Angle and limit information will be displayed in MANUAL mode.

Dual type specifies that the feed can receive both horizontal and vertical polarization from a single position. Angle and limit information will be displayed in MANUAL mode.

BAND: FEED BAND <0-C 1-KU 2-L 3-X 4-KA 5-S>

Defines the frequency band of the associated feed. This information will be used to determine the apparent beamwidth of the system.

LO: FEED LNB FREQ <0-30000 MHZ>

This value defines the frequency of the associated LNB's local oscillator. This information may be used for tuning of integrated receivers.

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

The polarity received by the RC4800 when the feed is positioned at 0.0 and a satellite with the same longitude of the antenna is being used.

2.1.1.3.1.2.4.1 Multi-Feed Sensing Option

This section is for the Feed Definition configuration group when the feed sensing option is available on the RC4800. See section 2.1.1.3.1.2.3.1 for more information.

```
POL#:7                                  CONFIG-FEED
TYPE:0    LO:18250   ID:KACP
BAND:4   REF:0
<0>CIRCULAR <1>SINGLE <2>DUAL
```

POL#: FEED INDEX NUMBER

This is the index number for the current Feed Definition screen displayed.

ID: POL AXIS LABEL (4 CHARACTERS MAX)

This is an alphanumeric string used to identify the feed. When the multi-feed option is present, these will be displayed in front of the polarization angle in MANUAL mode.

2.1.1.3.1.2.5 External Sig Factors

This screen defines parameters for when the external source is used as the locate source.

```
   LOCK:1          TIME:1.0      CONFIG-EXT
  THRES:-99.9    SENSE:1

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

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

When the locate source is set to EXT (1), this item defines whether a discrete signal lock input is required to indicate a satellite has been found.

If a signal lock input is used, it may be defined as either having a HI (>3.5 VDC) or LO (< 0.8 VDC) level that indicates lock.

TIME: LOCK TIME <0.0-10.0> SECONDS

This item defines how long the RC4800 will wait after each step before sampling signal strength. Increasing this value may be required to allow equipment such as a modem to generate an AGC output.

THRES: LOW SIGNAL THRESHOLD <-99.9-0.0 dBm>

This item specifies the signal level that the tracking function will use to determine that the signal is lost if the tracking source is set to external.

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

The polarity flag tells the RC4800 what the sense is on the signal strength input voltage. A positive sense is defined as one that increases in voltage as the signal strength increases. If the signal strength voltage decreases as the signal strength increases, its polarity is considered negative.

2.1.1.3.1.2.6 Beacon Sig Factors

This screen defines parameters for when the internal beacon receiver is used as the locate source.

```
   LOCK:1          TIME:1.0      CONFIG-BCN
  THRES:-99.9    SENSE:1

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

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

When the internal beacon receiver is used as a locate source, this item defines whether a discrete signal lock input is required to indicate a satellite has been found.

For internal beacon receivers, this value is set correctly by default and should not be changed.

TIME: LOCK TIME <0.0-10.0> SECONDS

This item defines how long the RC4800 will wait after each step before sampling signal strength. Increasing this value may be required for noisy carriers.

THRES: LOW SIGNAL THRESHOLD <-99.9-0.0 dBm>

This item specifies the signal level that the tracking function will use to determine that the signal is lost if the tracking source is set to beacon.

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

The polarity flag tells the RC4800 what the sense is on the signal strength input voltage. A positive sense is defined as one that increases in voltage as the signal strength increases. If the signal strength voltage decreases as the signal strength increases, its polarity is considered negative.

For internal beacon receivers, this value is set correctly by default and should not be changed.

2.1.1.3.1.2.7 RF Sig Factors

This screen defines parameters for when the L-band power detector is used as the locate source.

```
                                        CONFIG-RF
   LOCK:0       THRES:-99.9

LOCK SOURCE <0-NONE 1-EXT>
```

LOCK: LOCK SOURCE <0-NONE 1-EXT>

When the tracking source is set to RF, this item defines whether a discrete signal lock input is required to indicate a satellite has been found. If a signal lock is used, it must be defined in the External Sig Factors configuration group (2.1.1.3.1.2.5).

THRES: LOW SIGNAL THRESHOLD <-99.9-0.0 dBm>

This item specifies the signal level that the tracking function will use to determine that the signal is lost if the tracking source is set to RF.

2.1.1.3.1.2.8 Location Reset

This screen allows an installed to clear all satellite and track table data from the ACU.

```
RESET CODE:                  CONFIG-DEFAULTS


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

2.1.1.3.1.3 Super-User Access Items

This set of configuration groups allows the user to modify parameters that are not typically changed. Usually these items address parameters that have been previously characterized for the antenna the controller is paired with. The need to access these items would typically only occur if a unique customization of the system was required.

2.1.1.3.1.3.1 System Definition

```
MODE:2   ANT SIZE: 420        CONFIG-SYSTEM
         ANT LOOK:1

<2-MENU 3-MANUAL>
```

The System Definition configuration screen allows the user to indicate information about the antenna system.

MODE: <2-MENU 3-MANUAL>

This item specifies into which mode that the RC4800 will boot into.

Selection 2 will direct the RC4800 to boot in MENU mode.

Selection 3 will direct the RC4800 to boot in MANUAL mode.

ANT SIZE: ANTENNA SIZE <1-9999 CM>

This item specifies the size of the reflector in centimeters. For example, a 4.2 meter diameter reflector would require a value of 420 (cm) be specified.

The antenna size is used by inclined orbit tracking algorithms to characterize the antenna's beam-width thus affecting timing of various tracking movements. The value is also used by scanning and peaking algorithms to determine movements.

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

This item is used for antennas that have multiple feed boom configurations. For mounts that don't have multiple feed boom configuration items, this value should be set to 1.

2.1.1.3.1.3.2 Azimuth Angle Movement

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
                              CONFIG-AZ ANG
 REF GAIN:1.00       FOLLOW: 0.2
MAX ERROR: 0.005      DRIFT: 0.2
REFERENCE GAIN <0.00-1.00>
```

The Azimuth Angle Movement configuration screen allows the user to indicate various information about the Azimuth Axis angular movement.

REF GAIN: **REFERENCE GAIN <0.0 – 1.00>**

This item defines what percentage of full-scale drive voltage output is sent to the azimuth servo drive module.

MAX ERROR: **MAX ERROR <0.001-5.000 DEGREES>**

This item specifies how far away from the azimuth target position the azimuth sensor needs to be to consider a movement complete. This item must be 50% of the DRIFT field or less for proper operation.

FOLLOW: **FOLLOW SLOP <0.1-10.0 DEG, 0=OFF>**

This item defines how closely the azimuth antenna movement should “follow” the calculated azimuth movement by the RC4800. For example, 0.2 indicates that the during a movement the actual antenna position in azimuth should never be more than 0.2 degrees away from the position calculated by the RC4800 move profile.

DRIFT: **DRIFT SLOP <0.1-10.0 DEG, 0=OFF>**

This item defines how closely the RC4800 should be able to hold the azimuth axis when not moving. For example, 0.2 indicates that while position holding the position in azimuth should never be more than 0.2 degrees away from the target position.

2.1.1.3.1.3.3 Azimuth Drive Parameters

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
        Kp:2.00  Ki:0.15   CONFIG-AZ DRV
Im:1.00    CL:10.0   FST: 1.00  ACC: 0.5
Kph:4.00  MAX: 1.08  SLW: 0.10  ACH: 0.5
Kp <0.00-99.9>
```

The Azimuth Drive Parameters configuration screen allows the user to set parameters for the azimuth motor drive.

Kp: **Kp <0.0 – 99.9>**

This item specifies the proportional constant for the azimuth movement position servo implemented by the RC4800.

Ki: **Ki <0.0 – 99.9>**

This item specifies the integral constant for the azimuth movement position servo implemented by the RC4800.

Im: **Im <0.0 – 99.9>**

This item specifies the maximum amount that the integral term can contribute to the azimuth movement position servo implemented by the RC4800.

Kph: **Kp <0.0 – 99.9>**

This item specifies the proportional constant for the azimuth hold position servo implemented by the RC4800.

CL: **CURRENT LIMIT <0-25.0 AMPS, 0=OFF>**

This item specifies the maximum current level the servo drive for the azimuth axis should output. If the controller senses a current above this level, a drive error will be indicated in the drive maintenance screen (2.1.1.2.2.5).

MAX: **MAX <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity of the azimuth axis in deg/sec at the rated voltage of the power supply being used to power the system.

FST: **FAST <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity that will be used during automatic azimuth moves in deg/sec. It also specifies the speed the RC4800 will target when an azimuth fast jog is requested. This item should never be more than 90% of the MAX item specified above.

SLW: **SLOW <0.0 – 99.99 DEG/SEC>**

This item specifies the azimuth velocity RC4800 will target when a slow movement is requested.

ACC: ACCEL <0.0 – 99.9 DEG/SEC^2>

This item specifies the target acceleration and deceleration of the azimuth movement profile.

ACH: ACCEL <0.0 – 99.9 DEG/SEC^2>

This item specifies the target acceleration and deceleration of the azimuth hold profile.

2.1.1.3.1.3.4 Elevation Angle Movement

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
                                CONFIG-EL ANG
 REF GAIN:1.00        FOLLOW: 0.2
MAX ERROR: 0.005       DRIFT: 0.2
REFERENCE GAIN <0.00-1.00>
```

The Elevation Angle Movement configuration screen allows the user to indicate various information about the Elevation Axis angular movement.

REF GAIN: REFERENCE GAIN <0.0 – 1.00>

This item defines what percentage of full-scale drive voltage output is sent to the elevation servo drive module.

MAX ERROR: MAX ERROR <0.001-5.000 DEGREES>

This item specifies how far away from the elevation target position the elevation sensor needs to be to consider a movement complete. This item must be 50% of the DRIFT field or less for proper operation.

FOLLOW: FOLLOW SLOP <0.1-10.0 DEG, 0=OFF>

This item defines how closely the elevation antenna movement should “follow” the calculated elevation movement by the RC4800. For example, 0.2 indicates that the during a movement the actual antenna position in elevation should never be more than 0.2 degrees away from the position calculated by the RC4800 move profile.

DRIFT: DRIFT SLOP <0.1-10.0 DEG, 0=OFF>

This item defines how closely the RC4800 should be able to hold the elevation axis when not moving. For example, 0.2 indicates that while position holding the position in elevation should never be more than 0.2 degrees away from the target position.

2.1.1.3.1.3.5 Elevation Drive Parameters

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
         Kp:2.00  Ki:0.15   CONFIG-EL DRV
Im:1.00    CL:10.0   FST: 1.00  ACC: 0.5
Kph:4.00  MAX: 1.08  SLW: 0.10  ACH: 0.5
Kp <0.00-99.9>
```

The Elevation Drive Parameters configuration screen allows the user to set parameters for the elevation motor drive.

Kp: **Kp <0.0 – 99.9>**

This item specifies the proportional constant for the elevation movement position servo implemented by the RC4800.

Ki: **Ki <0.0 – 99.9>**

This item specifies the integral constant for the elevation movement position servo implemented by the RC4800.

Im: **Im <0.0 – 99.9>**

This item specifies the maximum amount that the integral term can contribute to the elevation movement position servo implemented by the RC4800.

Kph: **Kp <0.0 – 99.9>**

This item specifies the proportional constant for the elevation hold position servo implemented by the RC4800.

CL: **CURRENT LIMIT <0-25.0 AMPS, 0=OFF>**

This item specifies the maximum current level the servo drive for the elevation axis should output. If the controller senses a current above this level, a drive error will be indicated in the drive maintenance screen (2.1.1.2.2.5).

MAX: **MAX <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity of the elevation axis in deg/sec at the rated voltage of the power supply being used to power the system.

FST: **FAST <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity that will be used during automatic elevation moves in deg/sec. It also specifies the speed the RC4800 will target when an elevation fast jog is requested. This item should never be more than 90% of the MAX item specified above.

SLW: **SLOW <0.0 – 99.99 DEG/SEC>**

This item specifies the elevation velocity RC4800 will target when a slow movement is requested.

ACC: ACCEL <0.0 – 99.9 DEG/SEC^2>

This item specifies the target acceleration and deceleration of the elevation movement profile.

ACH: ACCEL <0.0 – 99.9 DEG/SEC^2>

This item specifies the target acceleration and deceleration of the elevation hold profile.

2.1.1.3.1.3.6 POL Angle Movement

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
                          CONFIG-PL ANG
 REF GAIN:1.00       FOLLOW: 0.2
MAX ERROR: 0.005      DRIFT: 0.2
REFERENCE GAIN <0.00-1.00>
```

The Polarization Angle Movement configuration screen allows the user to indicate various information about the Polarization Axis angular movement.

REF GAIN: REFERENCE GAIN <0.0 – 1.00>

This item defines what percentage of full-scale drive voltage output is sent to the polarization servo drive module.

MAX ERROR: MAX ERROR <0.001-5.000 DEGREES>

This item specifies how far away from the polarization target position the polarization sensor needs to be to consider a movement complete. This item must be 50% of the DRIFT field or less for proper operation.

FOLLOW: FOLLOW SLOP <0.1-10.0 DEG, 0=OFF>

This item defines how closely the feed movement should “follow” the calculated feed movement by the RC4800. For example, 0.2 indicates that the during a movement the actual feed position should never be more than 0.2 degrees away from the position calculated by the RC4800 move profile.

DRIFT: DRIFT SLOP <0.1-10.0 DEG, 0=OFF>

This item defines how closely the RC4800 should be able to hold the polarization axis when not moving. For example, 0.2 indicates that while not being commanded to move the position in polarization should never be more than 0.2 degrees away from the target position.

2.1.1.3.1.3.6.1 Multi-Feed Sensing Option

This section is for the POL Angle Movement configuration group when the feed sensing option is available on the RC4800. See section 2.1.1.3.1.2.3.1 for more information.

```
POL#:0                    CONFIG-PL ANG
 REF GAIN:1.00       FOLLOW: 0.2
MAX ERROR: 0.005      DRIFT: 0.2
REFERENCE GAIN <0.00-1.00>
```

POL#: FEED INDEX NUMBER

This is the index number for the current POL Angle Movement screen displayed.

2.1.1.3.1.3.7 POL Drive Parameters

NOTE: These items are critical to the antenna functioning properly and should not be changed without understanding the consequences of the changes.

```
         Kp:2.00  Ki:0.15   CONFIG-AZ DRV
Im:1.00    CL:10.0   FST: 1.00  ACC: 0.5
Kph:4.00  MAX: 1.08  SLW: 0.10  ACH: 0.5
Kp <0.00-99.9>
```

The Polarization Drive Parameters configuration screen allows the user to set parameters for the polarization motor drive.

Kp: **Kp <0.0 – 99.9>**

This item specifies the proportional constant for the polarization movement position servo implemented by the RC4800.

Ki: **Ki <0.0 – 99.9>**

This item specifies the integral constant for the polarization movement position servo implemented by the RC4800.

Im: **Im <0.0 – 99.9>**

This item specifies the maximum amount that the integral term can contribute to the polarization movement position servo implemented by the RC4800.

CL: **CURRENT LIMIT <0-25.0 AMPS, 0=OFF>**

This item specifies the maximum current level the servo drive for the polarization axis should output. If the controller senses a current above this level, a drive error will be indicated in the drive maintenance screen (2.1.1.2.2.5).

MAX: **MAX <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity of the polarization axis in deg/sec at the rated voltage of the power supply being used to power the system.

FST: **FAST <0.0 – 99.99 DEG/SEC>**

This item specifies the maximum velocity that will be used during automatic polarization moves in deg/sec. It also specifies the speed the RC4800 will target when an polarization fast jog is requested. This item should never be more than 90% of the MAX item specified above.

SLW: **SLOW <0.0 – 99.99 DEG/SEC>**

This item specifies the polarization velocity RC4800 will target when a slow movement is requested.

ACC: **ACCEL <0.0 – 99.9 DEG/SEC^2>**

This item specifies the target acceleration and deceleration of the polarization movement profile.

2.1.1.3.1.3.7.1 Multi-Feed Sensing Option

This section is for the POL Drive Parameters configuration group when the feed sensing option is available on the RC4800. See section 2.1.1.3.1.2.3.1 for more information.

```
POL#:0  Kp:2.00  Ki:0.15   CONFIG-AZ DRV
Im:1.00    CL:10.0   FST: 1.00  ACC: 0.5
Kph:4.00  MAX: 1.08  SLW: 0.10  ACH: 0.5
Kp <0.00-99.9>
```

POL#: FEED INDEX NUMBER

This is the index number for the current POL Drive Parameters screen displayed.

2.1.1.3.1.3.8 Track Factors

```
   SEARCH: 0                  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.

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

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%.

2.1.1.3.1.3.9 Shake

```
AZ 1:  90.0 2: 270.0 3:   0.0 CONF-SHAKE
EL 1:  40.0 2:  30.0 3:   0.0 CYCLE:  10
PL 1:   0.0 2:   0.0 3:   0.0 DELAY:   1
MOVE 1 AZIM <0.0-360.0 DEGREES>
```

AZ #: **MOVE # AZIM <0.0-360.0 DEGREES>**

The AZ field allows the user to specify the azimuth target for moves 1, 2 or 3.

EL #: **MOVE # ELEV <+/-90.0 DEGREES>**

The EL field allows the user to specify the elevation target for moves 1, 2 or 3.

PL #: **MOVE # POL <+/-180.0 DEGREES>**

The PL field allows the user to specify the polarization target for moves 1, 2 or 3.

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

The CYCLE field allows the user to specify the total number of movement cycles the SHAKE function will perform.

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

The DELAY field allows the user to specify the amount of time (in seconds) that the SHAKE function will wait between “moves”. Specifying a value of 0 will cause no delay between “moves”.

2.1.1.3.1.3.10 Location Reset

```
RESET CODE:                CONFIG-DEFAULTS


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

The Location Reset screen is used to clear out all satellites and track tables currently stored in the controller's memory. To reset the location, the user must key in the 5-digit code listed on the 4th line followed by the <ENTER>.

2.1.1.3.1.3.11 Reset Defaults

```
RESET CODE:                CONFIG-DEFAULTS


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

The Reset Defaults screen is used to reset the controller's memory. To reset the system memory, the user must key in a 5-digit code followed by the <ENTER> key.

There are two levels of resets that are possible.

1. A first level reset clears NVRAM values including the current selected satellite, the saved position, stored satellite data, and track table data.

2. The full reset clears the NVRAM data and resets all FLASH configuration values to default values.

NOTE: The first level access code is "12345". The full reset code is the same as the INSTALL level Expert Access code given in Appendix A. This appendix may have been removed by a system manager to limit use of the codes.

2.1.1.3.2 Maintenance Items

```
1-VOLTS   2-DRIVE  3-TIME          MAINT
4-LIMITS  5-COMMS  6-SERVO
8-MOVETO  0-SHAKE             <>-BCN
^-SNS OFF                     .-SYS INFO
```

2.1.1.3.2.1 VOLTS

The VOLTS maintenance screen shows the current voltage levels sense at the microcontroller's analog to digital inputs. As there are too many input channels to show on one screen, the user is prompted to choose either the 10-bit resolution voltages or the 12-bit resolution voltages.

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

There are four 12-bit resolution channels that read values from the azimuth, elevation and polarization sensors along with a higher resolution receiver channel. These values will be of more interest during system calibration.

The eight 10-bit resolution channels deal with other sensors such as the L-band power detector, internal temperature sensor, etc.

2.1.1.3.2.1.1 10 Bit ADC Voltages

The 10 BIT ADC maintenance screen shows the current voltage levels sensed at the microcontroller's eight 10-bit resolution analog to digital inputs. The voltage will be displayed in the 0.000 to 5.000 range. If the microcontroller sees less than 0.001, it will display "UNDER".

Next to the scaled voltage will be the current analog to digital "count" (0 to 1023).

```
1- SAC:1.423  441  5-  RF:1.971  611 ADC
2-TEMP:3.277 1016  6-SPAR:1.571  487  10
3-REC3:1.548  480  7-DRIV:1.571  487 BIT
4-REC2:0.000    0  8-BATT:3.187  988
```

1-SAC: Single Axis Compass (Optional)

2-TEMP: Optional off-board temperature sensor

3-REC3: External receiver AGC voltage from options board

4-REC2: Not currently used

5-RF: Voltage from options board L-band power detector

6-SPAR: Not currently used

7-DRIV: Drive current sensing feedback

8-BATT: Microprocessor backup battery voltage

2.1.1.3.2.1.2 12 Bit ADC Voltages

The 12 BIT ADC maintenance screen shows the current voltage levels sensed at the microcontroller's four 12-bit resolution analog to digital inputs. The voltage will be displayed in the 0.0001 to 5.0000 range. If the microcontroller sees less than 0.0001, it will display "UNDER".

Next to the scaled voltage will be the current analog to digital "count" (0 to 4095).

Note that the EL and SIG analog to digital channels have some associated scaling and conditioning circuitry in the RC4800. Therefore, the voltages seen at this screen may not be exactly the same as the input voltages external to the RC4800.

```
 AZ: 2.5421   2083   30495        12 BIT ADC
 EL: 1.4567   1193   32409              L1:0
POL: 2.5000   2048                      L2:0
SIG: 3.3358   2732                      L3:1
```

AZ:

Shows the current voltage from the azimuth potentiometer, the current A to D counts for the azimuth potentiometer, and the azimuth resolver count (if equipped). If the potentiometer is not present on the system, UNDER will be displayed.

EL:

Shows the current scaled voltage from the elevation inclinometer, the current A to D counts for the elevation inclinometer, and the elevation resolver count (if equipped).

POL:

Shows the current voltage from the polarization potentiometer, the current A to D counts for the polarization potentiometer, and the polarization resolver count (if equipped). If the potentiometer is not present on the system, UNDER will be displayed.

SIG:

Shows the scaled AGC voltage from the computing and interface board's "Receiver" port (4.1.2.1.3).

L1:

Shows the state of the lock input from the computing and interface board's "Receiver" port (4.1.2.1.3).

L2:

Shows the state of the lock input from the options board's "Receiver" port (4.1.2.4.2).

L3:

Not currently used on the RC4800.

2.1.1.3.2.2 DRIVE

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

The DRIVE maintenance screen provides the way to reset drive system errors (FOLLOW/DRIFT/DRIVE) for each axis. See section 5.1.2 for descriptions of these conditions. An axis' drive status may be reset by pressing the corresponding key.

2.1.1.3.2.3 TIME

The TIME maintenance screen allows the user to set the system and display time.

Note that all dates are displayed and entered in month/day/year (MM/DD/YY) format. All times are displayed and entered in hour/minute/second (HH:MM:SS) format. Refer to section 2.1.1.1.3 for instructions on entering date and time.

```
 SYSTEM:12/25/18 13:28:50             TIME
DISPLAY:12/25/18 13:28:50         ZONE:UTC
GPS UTC:12/25/18 13:28:50      OFFSET:  0
1-DATE/TIME 2-ZONE 3-OFFSET 4-GPS SYNC
```

SYSTEM:DD/MM/YY HH:MM:SS

Current date and UTC time as maintained by the RC4800's real-time clock. This time is used for all time-based tracking and peaking operations, as well as for calculating sidereal time for track table points.

DISPLAY: DD/MM/YY HH:MM:SS

Current time that will be displayed in several screens (MANUAL, MENU). This time is offset from the system time by the OFFSET number of hours described later.

GPS UTC: DD/MM/YY HH:MM:SS

Universal Coordinated Time (UTC) from the GPS if valid time data is being received. If valid time data is not being received, a GPS status message is displayed:

GPS OFFLINE - no serial data from GPS is being received.

WAITING FOR GPS - serial data is being received from GPS but data indicates an accurate time solution cannot be guaranteed.

NO GPS PRESENT - The GPS present configuration item has been set to indicate that a GPS receiver is not installed.

ZONE:

A three-character alphanumeric time zone string the user may customize for displaying during the MANUAL and MENU modes. This string may be changed by selecting action 4-ZONE.

OFFSET:

The number of hours the displayed reference time is offset from system time.

The values for the time parameters may be altered by the actions described below.

1-DATE/TIME ENTER UTC DATE (MM.DD.YY)/ENTER UTC TIME (HH.MM.SS)

This action allows the user to manually set the system date and time. The prompt indicates that the / delimiter for date is entered by using the (decimal point) key.

2-ZONE ENTER 3 LETTER TIME ZONE

The user may enter three alphanumeric characters (ex. CST) for a time zone designator.

3-OFFSET ENTER TIMEZONE OFFSET <-11/+12 HOURS>

The user may enter the number of hours of offset from system time for offsetting displayed time.

4-GPS SYNC

If valid GPS UTC data is being received, pressing the <4> key will cause system time to be synchronized with the current GPS UTC time.

2.1.1.3.2.4 LIMITS

The limits maintenance screen shows the current state of each limit switch as sensed by the RC4800's microcontroller. The state of each limit is shown as 0 (not at limit), 1 (at hardware limit), or 2 (at software limit). The limits maintenance screen will show the state of the input, even if the input is not used by the software.

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

The limits maintenance screen also shows the status of:

R: Red Button (Stow)

G: Green Button (Locate)

A, B, C, D Auxiliary switch inputs, most used as POL ID BITs (2.1.1.3.1.2.3.1)

<BKSP>MAKE LIMITS INACTIVE <MODE>EXIT

From this screen the user may inactivate software logic that prevents axis movement due to a limit switch by pressing the BKSP switch. **Note that inactivating limits should be done with caution. Whenever limits are "INACTIVE" the alarm system will flash the following:**

** WARNING – LIMITS INACTIVE **

The limit switch logic may be returned to "ACTIVE" by pressing BKSP again.

No automatic movements are possible with the limits in an inactive state.

2.1.1.3.2.5 COMMS

This screen allows the user to ascertain if the GPS sensor is communicating correctly with the RC4800.

```
<1>VIEW GPS DATA                    COMMS
```

2.1.1.3.2.5.1 GPS Data

Pressing the <1> key allows the user to ascertain if the GPS receiver is communicating correctly with the RC4800.

```
<BKSP> TO FREEZE DISPLAY        GPS COMMS
7E  $GPRMC,233723,A,3857.3305,N,09445.26
00,W,000.0,000.0,171218,002.1,E*6B  $GPG
GA,233723,3857.3305,N,09445.2600,W,2,10,
```

The screen shows the raw ASCII data coming from the GPS receiver. If there is correct communication established with the GPS, somewhere in the lines of displayed characters the strings “GPRMC” and/or “GPGGA” should be recognizable. GPRMC and GPGGA are names of data sentences defined by the NMEA-0183 standard. These two sentences are transmitted once a second by the GPS receiver.

$GPRMC,233723,A,3857.3305,N,09445.2600.W.000.0,000.0,171218,002.1,E*6B

NOTE: In the second field beyond the GPRMC string there will be either an “A” or a “V”. “A” indicates that the GPS receiver is generating a valid navigation solution. “V” indicates conditions aren’t correct yet for calculating a navigation solution. This latter condition may indicate that the GPS receiver does not have a good enough view of the sky or that the receiver has not been powered on long enough to generate a solution. Under normal conditions the receiver should generate a solution within 2 minutes of powering on. If the unit has not been powered on for a long time and/or the receiver has been moved a considerable distance from its last known location, the “time-to-first-fix” may be up to 4 minutes.

If no characters are being received from the GPS, the message “INITIALIZING GPS” will remain on line 4 of the display. Normally this message will go away within 3 seconds of entering this mode.

2.1.1.3.2.6 SERVO

NOTE: Normal drive safety checks are not enabled when in this mode. Only personnel who are thoroughly experienced with drive system should access this mode. Direct visibility of the antenna system should be established to verify safe operation of the antenna.

Great care should be exercised in this operating mode to prevent antenna damage.

After the entering the SERVO MAINT maintenance mode, the warning screen below appears:

```
             !!! CAUTION !!!          SERVO
MODE PUTS ANTENNA IN UNPROTECTED STATE
   *** QUALIFIED OPERATORS ONLY ***
<ENTER>CONFIRM MOVE              <MODE>EXIT
```

After pressing <ENTER>, the manual movement SERVO MAINT screen appears:

```
A: 204.93      VEL    AMP  AMP         SERVO
E:  41.39     0.00     0.0  0.0       MANUAL
P:  45.00  AXIS:AZ SPD:  0% DISP:T
<ENTER>PROFILE <BKSP>CHANGE AXIS    24576
```

A: 204.93

The current angle from the azimuth axis. Will display the true azimuth angle or raw sensor angle depending on the status of the DISP field discussed later.

E: 41.39

The current angle from the elevation axis. Will display the true elevation angle or raw sensor angle depending on the status of the DISP field discussed later.

P: 45.00

The current angle from the polarization axis. Will display the angle relative to the center of travel or raw sensor angle depending on the status of the DISP field discussed later.

VEL
0.00

This field shows the current position sensor velocity of the axis displayed to the right of the AXIS field.

AMP
0.0

This field shows the current draw from the azimuth servo drive. For systems with a single drive, only one current will be shown.

MANUAL

Current servo maintenance profile. A description of each mode can be found in 2.1.1.3.2.6.1.

AXIS: AZ
This field shows the current axis that corresponds to the position sensor velocity (VEL), commanded speed (SPD:), and current sensed (AMP:).

SPD: 0%

Current commanded speed for the axis speed for manual moves. Available values are 0%, 5%, 10%, 25%, 50%, 90% and 100%. These will be combined with the axis specific REF GAIN values (2.1.1.3.1.3.2 for AZ, 2.1.1.3.1.3.4 for EL, 2.1.1.3.1.3.6 for POL) to determine the speed command that is sent to axis drive hardware using the equation below.

$$Voltage = \pm 10\ volts\ \times SPD\ \times REF\ GAIN$$

DISP: T

This item specifies the current angle displayed for azimuth, elevation, and polarization. Possible values are T (True Pointing Angles) and S (raw sensor angle).

24576

This item is a count of the number of servo clock cycles since entering the servo maintenance screen. It will increment at 128 counts per second.

The actions below describe the function of each key when in the manual servo maintenance profile.

MODE

The <MODE> key is used to return the controller back to the maintenance items menu.

1, 2, 3, 4, 6, 8

These keys are used to jog the antenna in the same method as described in MANUAL mode (2.1.1.2.1).

SCROLL UP

The <SCROLL UP> key is used to change the displayed angles from local platform angle (P), raw sensor angle (S), and local horizontal angle (H).

SCROLL DOWN

The <SCROLL Down> key is used to change the displayed signal source.

5, 7, 9, STOP

These keys are unused in the manual servo maintenance profile.

0-SPEED

The <0-SPEED> key is used to change the commanded speed percentage.

BKSP

The <BKSP> key is used to change the axis field between AZ, EL and PL.

ENTER

The <ENTER> key will allow you go enter the profile selection screen shown below. From this screen, you will be able to change to one of the additional profiles described in section 2.1.1.3.2.6.1.

```
PROFILE:MANUAL                          SERVO
                                      PROFILE
                                    FW: 1.04
<SCROLL UP/DN>CHANGE PROFILE <ENTER>RUN
```

When the profile selection screen is entered, the manual profile will always be displayed on the top line. The <SCROLL UP> and <SCROLL DOWN> buttons will allow the user to scroll through the list of profiles. Pressing the <ENTER> key will select the profile listed on the top line and transition into the appropriate screen for that mode.

The software version that is running on the servo sensor board is also reported for diagnostic purposes.

2.1.1.3.2.6.1 Secondary Servo Maintenance Profiles

A description of each type of secondary servo maintenance profile is found in the next few subsections.

2.1.1.3.2.6.1.1 Square Wave

For each axis, there is a unique square wave profile. This mode will send a square wave position command to the corresponding axis servo drive. Upon entering the square wave mode, the user will be prompted with the following screen.

```
<1>SQUARE WAVE AMPLITUDE:  1.00     SERVO
<2>SQUARE WAVE PERIOD:  5.0        SQUARE

<0>SPEED: FAST <ENTER>RUN PROFILE
```

<1>SQUARE WAVE AMPLITUDE

This item specifies the amplitude of the position square wave from 0.00 to 99.99 degrees in relation to the deploy position for the selected axis. For example, when set to 1.00 the controller will perform a square wave from deploy position to the deploy position + 1.00 degrees.

<2>SQUARE WAVE PERIOD

This item specifies the period of the position square wave from 0.0 to 99.9 seconds.

<0>SPEED

This item specifies whether the square wave movement should use the slow of fast velocity defined the axis angle movement configuration screen as the maximum velocity.

Pressing the <ENTER> key will start the square wave movement and return the RC4800 to the servo maintenance main screen. This profile will then continue at the period selected until the <MODE> or <ENTER> key is pressed.

2.1.1.3.2.6.1.2 Move To/Circle

This mode will allow the antenna to draw a circle out using the azimuth and elevation axis. Upon entering this mode, the user will be prompted with the following screen. Unlike some move profiles, this profile does not provide information useful for servo tuning and is purely designed for demonstration purposes.

```
<1>CIRCLE RADIUS:  2.0              SERVO
<2>CIRCLE PERIOD: 16.0             CIRCLE

<0>SPEED: FAST <ENTER>RUN PROFILE
```

<1>CIRCLE RADIUS

This item describes the radius of the circle drawn in degrees from 0.0 to 99.9. The radius will be relative to the current azimuth and elevation position of the antenna.

<2>CIRCLE PERIOD

This item describes the amount of time it will take the RC4800 to draw two complete circles. If the fast speed of each axis does not allow the RC4800 to complete the two circles in this amount of time, it will automatically move back to the start position after the specified time.

<0>SPEED

This item specifies whether the circular movement should use the slow of fast velocity defined the axis angle movement configuration screen as the maximum velocity.

Pressing the <ENTER> key will start the circular movement and return the RC4800 to the servo maintenance main screen. This profile will then continue at the period selected until the <MODE> or <ENTER> key is pressed.

2.1.1.3.2.6.1.3 Hold

This mode allows for the same position hold function that is found in MANUAL mode when the drives are not in standby. The purpose of this mode is to allow the logging of data this is used when performing wind testing on an antenna. Upon entering this mode, the user will be automatically taken to the servo maintenance main screen, and the position hold function will be turned on.

2.1.1.3.2.7 MOVETO

The MOVETO mode is intended to provide an easy way to move the antenna to a certain position for doing testing such as cutting antenna patterns. This mode is also useful for tuning up automatic movements.

```
AZ: 204.93 ( 204.93) <0>SPD:FAST  MOVETO
EL:  41.39 (  41.39) <5>SENSOR:ANGLE
PL:  45.00 (  45.00) <6>LON:
<1>SET AZ <2>SET EL <3>SET POL  <4>START
```

The current azimuth, elevation, and polarization angles are displayed. When the mode is first entered, the current positions shown are the target positions. New target positions can be selected for azimuth, elevation, and polarization by pressing the <1>, <2>, or <3> key respectively. After setting target positions and setting the desired speed, the automatic movement may be initiated by pressing the <4> key.

<0> SPEED:FAST

The state of this field when this mode is entered will be “FAST”. This means that any move will be using the standard speed control of the ACU. When the <0/Speed> key is pressed, this field will change to “SLOW”. This means that the move will never go faster than the slow speed set in the “DRIVE PARAMETERS” configuration screen corresponding to the axis being moved.

<5>SENSOR:ANGLE

The state of this field when this mode is entered will be “ANGLE”. This means that all the movements requested will occur in angles. When the <5> key is pressed this field will change to “COUNT”. This means that all movements requested will occur in counts.

<6>LON:

This field allows the ACU to auto calculate AZ/EL/PL targets based on a satellite orbital slot and the location of the antenna.

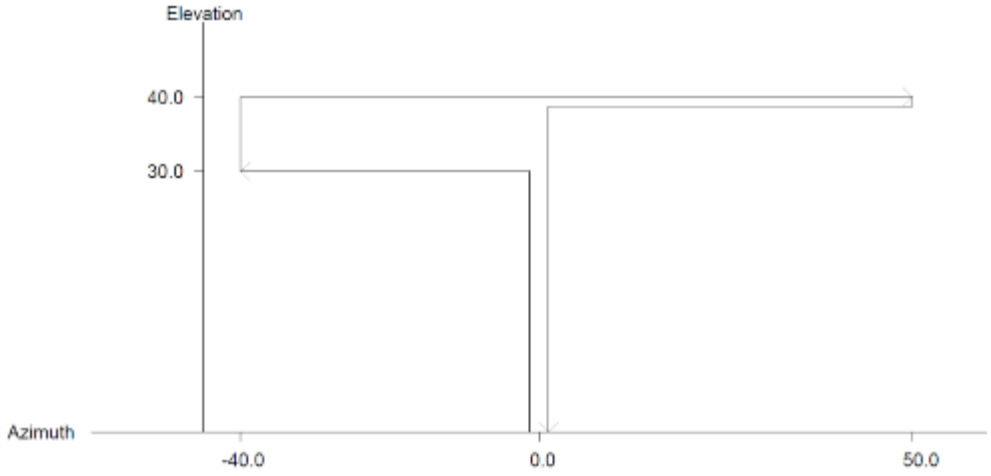
2.1.1.3.2.8 SHAKE

The SHAKE mode performs repetitive mount movements. The SHAKE mode is for support of mount testing and for automatic mount demonstrations such as trade shows.

The SHAKE mode implements a repetitive sequence of three “moves”. Each “move” is programmed with azimuth, elevation and polarization targets. Moves # 1 and 2 proceed in the order elevation, polarization and azimuth. Move # 3 proceeds in the order of azimuth, polarization and elevation to accommodate a “stow-like” sequence.

```
AZ 1: -40.0 2:  50.0 3:   0.0       SHAKE
EL 1:  30.0 2:  40.0 3: -75.0 CYCLE: 100
PL 1: -10.0 2:  10.0 3:   0.0 DELAY:   5
<1>START <CONFIG MENU>MODIFY  <MODE>EXIT
```

This opening screen shows the programmed values for the SHAKE mode. The azimuth (AZ), elevation (EL) and polarization (PL) targets for each of the three “moves” is displayed. Also displayed is the programmed number of movement CYCLES to accomplish and the time in seconds to DELAY between each “move”. The pattern the above move targets describe is shown in the following figure.



The programming of the targets, cycles and delay is accomplished via the SHAKE configuration screen (2.1.1.3.1.3.9). To initiate the SHAKE sequence, press the <1> key. If you wish to modify the SHAKE parameters go to the CONFIG-SHAKE mode. To exit out of SHAKE press the <MODE> key.

When SHAKE is started the following screen appears:

```
AZIM:  28.1 (  90.0)                SHAKE
ELEV:  40.0 (  30.0)
 POL: -13.8 ( -10.0)      CYCLE:   1/ 100
SHAKE RUNNING...   <STOP>HALT <MODE>EXIT
```

As each axis moves its header (AZIM, ELEV, POL) flashes and the current position is updated. The CYCLE field shows the current cycle / total cycles. When the SHAKE function is delaying between moves, "DELAY” is displayed.

Movement may be stopped at any time by pressing the <STOP> or <MODE> keys.

2.1.1.3.2.9 BCN

Pressing the <ENTER> key from the maintenance mode enters the beacon receiver maintenance screen. This screen is provided to manually control the beacon receiver, during diagnostic procedures. When entering the screen, the user is presented with the screen below.

```
az: 204.9 RF:-50.7 SS:-51.6 L          BCN
el:  41.5 ^-ATT: 0 .-AUTO  7-FR:20199.80
pl:  45.0 v-MOD:CW           LO:18250.00
<5,9,.,<>>TUNE BEACON      9-IF: 1949.80
```

Manual Antenna Control

Azimuth, elevation and polarization angles as well as limit status are shown in the upper left corner of the display. The antenna may be moved as if it is in the MANUAL mode (2.1.1.2.1).

7-FR RF <xxxxx.yy> MHz

This field allows the user to enter the actual frequency of the satellite's beacon. When the frequency is entered, the IF frequency will be derived from the LO frequency. The resulting IF frequency is displayed in the IF field. The beacon receiver will then be tuned to that IF frequency.

9- IF: IF <940.00-2150.00> MHz

This field allows the user to enter the intermediate frequency of the satellite's beacon. When the frequency is entered, the RF frequency will be derived from the LO frequency. The resulting RF frequency is displayed in the FR field. The beacon receiver will then be tune to the IF frequency.

.-ATT: ATTENUATION <0-40> dB

This field allows the user to change the input attenuation of the beacon receiver. Press the <STOP> key to enter this field. Pressing the <SCROLL UP> key from the beacon maintenance screen will cause the controller to auto attenuate the beacon receiver.

v-MOD: CW or BP

The <ENTER> key may be pressed to toggle the beacon receiver's demodulation mode between continuous wave (CW) or BPSK (BP) settings.

This setting is ignored if the beacon receiver being used does not support BPSK beacons.

LO: xxxxx.yy MHz

This field indicates the current LO frequency as defined in the feed definition configuration screen (2.1.1.3.1.2.4).

SS: -51.6 L

This field indicates the current signal strength and lock status from the beacon receiver.

RF: -50.7

This field indicates the current signal strength from the L-Band power detector.

2.1.1.3.2.10 SNS OFF

Pressing the <Scroll Up> key from the maintenance menu enters the sensor offset maintenance screen. This screen allows sensor offsets to be calculated and set for the on-axis position sensors

```
      TRUE       RAW       REF       SNS OFF
az: 204.93     32.55    180.00    (  -7.61)
el:  45.00     26.96    180.00    (  18.03)
<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 sensor angles plus the sensor offset. The azimuth angle is the true heading. The elevation angle is the RF-look angle above the horizontal.

RAW: The angle displayed is the actual resolver angle plus an automatic offset of -180.00 degrees. This automatic offset keeps the resolver centered within its dynamic range. This angle can be from -180.00 degrees to +180.00 degrees.

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.

SNS OFF: The angles in this column are the current sensor offset angles.

The antenna can be jogged while in this mode.

2.1.1.3.2.11 SYS INFO

Pressing the <.> button from the maintenance mode screen enters into the system information maintenance screen. This screen displays various system and software information.

```
Serial Number: 1001          SYSTEM INFO
Firmware: RC4800-S08-OPITN
Version:3.10.47
Lat:38.9555N Lon:94.7543W     <MODE>EXIT
```

Serial Number:

Serial number of the current controller being used. This is programmed at the factory.

Firmware:

Current firmware that is installed on the controller. It includes the controller identifier (RC4800), the type of antenna (S08), and the software options (OPITN).

Version:

The current version of the software. The version number of the software is increased for the implementation of significant software improvement or changes.

Lat:38.9555N Lon:94.7543W

The antenna location stored in the ACU memory.

2.1.2 Graphical User Interface Software Overview

The Graphical User Interface to the ACU can be accessed by navigating to the IP address of the controller using a web browser. The default IP address of the ACU is 192.168.1.1

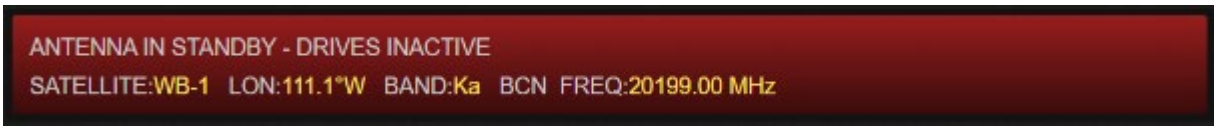
2.1.2.1 Graphical User Interface Main Page

The main page contains all important information about the status of the RC4800 as well as the antenna. The main page offers easy access to automatic operations needed for daily use (Recall/Peak Up/Move To), and manual jog control of the antenna. Sub-menus will be displayed when there is additional information that needs to be displayed or retrieved from the user.

2.1.2.1.1 ACU Status Window

The ACU status window shows current information about the RC4800 and any satellite information that may be available.

Any alarms that are currently present will also display in the ACU status window box. In the image below, the standby alarm is displayed. Note that the box will also turn red when an alarm is present.



2.1.2.1.2 Antenna Position Display

The antenna position display at the bottom of the page shows the current status of the Azimuth, Elevation and Polarization axis. The information is displayed both numerically and graphically. These positions are updated continuously during all operations.

If the antenna was at a limit, the limit would show inside of the smaller box.

2.1.2.1.3 Local Jog Control

The bottom right side of the main page provides a keypad for manual jog control of the antenna. The keys provide the ability to jog the antenna in azimuth, elevation, and polarization. It also provides the ability to move to the preset H and V positions, as well as providing the ability to move the feed a preset 90° to cross pol.

The keypad also provides the ability to change the speed via a Fast/Slow button. The button will always highlight the speed that the next jog is going use. In the image below, the next jog is set for Fast speed.

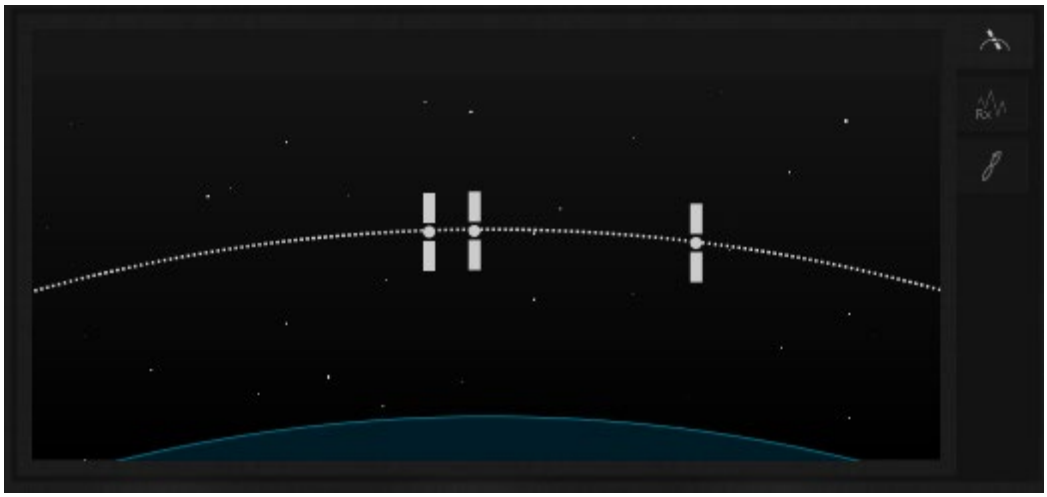
The keypad also provides a <STOP> key. This key can be used during any automatic movement to stop the current operation.

2.1.2.1.4 Main Display Window

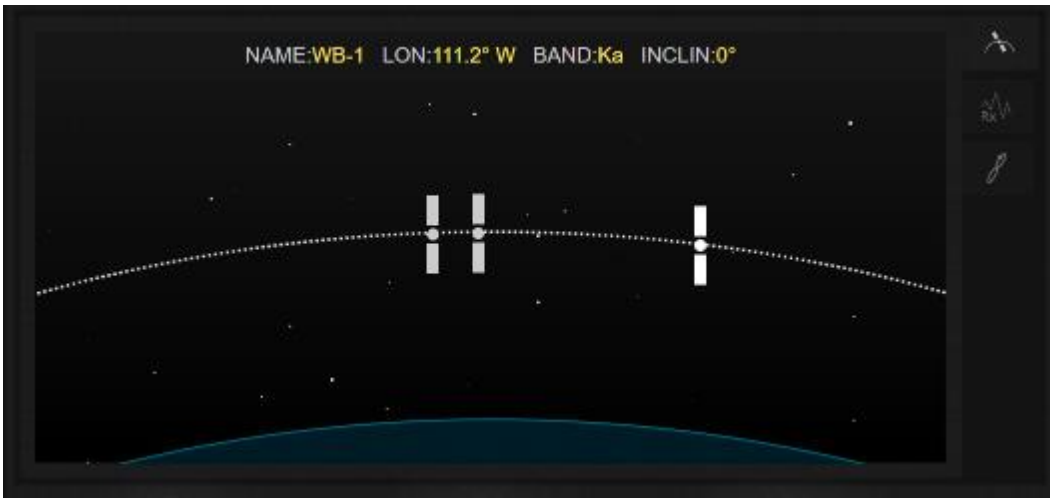
The center section of the display can be used for multiple functions. These include displaying the satellite arc, spectrum analyzer display, tracking diagnostics, and many additional antenna specific functions.

2.1.2.1.4.1 Satellite Arc Display

The center section of the display is used to display the satellite arc of the current satellites stored in the controller memory.



When ‘hovering” over a satellite with a mouse, information for that satellite preset will be displayed in the upper portion of the window as shown below. Clicking on a satellite will start a RECALL automatic movement as described in section 2.1.1.2.2.2.



2.1.2.1.4.2 Spectrum Analyzer Display

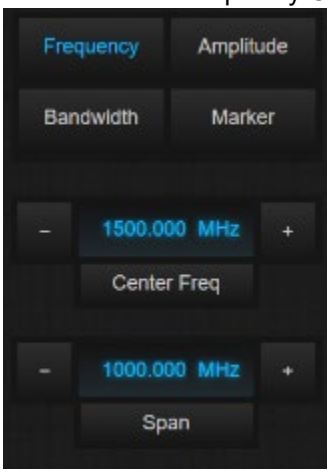
If the ACU is equipped with the spectrum analyzer option, a button will be available on the left side of the main display that will allow you to switch to the spectrum analyzer display.

The Spectrum Analyzer functional window consists of the spectrum display on the left side and spectrum analyzer controls on the right side.

The spectrum display with 10 by 10 graticule, shows the start frequency center frequency and stop frequency beneath, all in MHz.

The right side of the spectrum display shows the graticular amplitude levels. The controls on the right side of the window are Frequency, Amplitude, Bandwidth, and Marker.

2.1.2.1.4.2.1 Frequency Controls



The Frequency control allows the Center Frequency and Span to be controlled. Both parameters may be incremented by using the + - keys. The Increment for Center frequency is 1/5th of one division. Additionally, the center frequency may be adjusted by direct entry in the numeric window. Center Frequency can be adjusted to be anywhere within the range of 950 to 2150MHz. The allowable spans are:

0.000 MHz, 0.010 MHz, 0.020 MHz, 0.050 MHz, 0.100 MHz, 0.200 MHz, 0.500 MHz, 1.000 MHz, 2.000 MHz, 5.000 MHz, 10.000 MHz, 20.000 MHz, 50.000 MHz, 100.000 MHz, 200.000 MHz, 500.000 MHz, 1000.000 MHz, and 1100, MHz.

Span is sometimes adjusted automatically based on changed in center frequency.

2.1.2.1.4.2.2 Amplitude Controls

The Amplitude control allows the Reference Level and Vertical Scale (dB/division) to be adjusted. Again, both controls are incremented/ decremented via the + - buttons. The allowable values for Scale are 1, 2, 5, and 10 dB per division. The Reference Level increments by the amount a dB currently used in the dB/div field. For example, if the scale is set to 5 dB/div, the reference level will be incremented in 5 dB steps and can also be directly entered. The allowable Reference Level range is -70 to 0dB.

2.1.2.1.4.2.3 Bandwidth Controls

The Bandwidth Controls allows the Resolution Bandwidth (RBW) and Video Bandwidth (VBW) to be seen. The Resolution Bandwidth can be adjusted to:

30 KHz, 10 KHz, 30 KHz, 100 KHz, 300 KHz, and 1000 KHz.

The Video Bandwidth can be adjusted to:

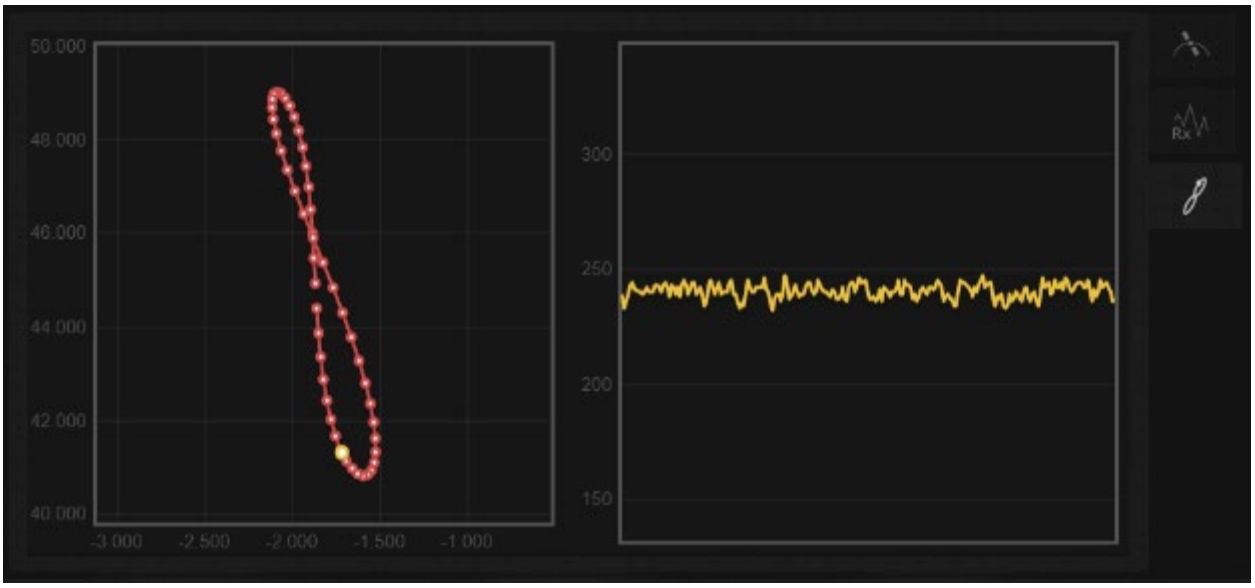
300 Hz, 3 KHz, 30 KHz, and 300 KHz.

2.1.2.1.4.2.4 Marker Controls

The Marker controls allows the position of the marker on the spectrum to be controlled. The Marker is designated by a red mark with a dotted line running to the vertical scale on the right. The Marker Level is displayed to the left of the red mark on each sweep. The Marker Frequency is displayed in the Freq. window. The Marker Frequency can be set by direct entry or using the + - buttons to increment by 1/5th of a frequency division. The Find Peak Button positions the Marker on the highest level visible on the current sweep. The Marker -> CF changes the Center Frequency of the span to that of the Current Marker.

2.1.2.1.4.3 Tracking Diagnostic

When in the TRACK mode, the tracking diagnostic tab shows information about the current pointing position, track table points, and the last 2 minutes and 30 seconds of signal strength data.



In the image above, the left box shows the current pointing angles in azimuth and elevation (yellow dot), and the track table points (red dots) and the path that the ACU will take between points.

The box on the right shows a graphical representation of the last 2 minutes and 30 seconds of signal strength.

The range on the vertical axis for both boxes, and the horizontal axis for the left box will adjust as needed to accommodate the data that is being displayed.

2.1.2.1.5 Automatic Operations

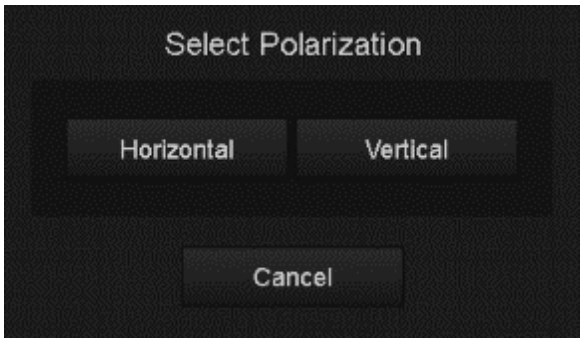
Down the left side of the display eight boxes that provide various automatic operations for the ACU. Each of those functions are described in the corresponding section below.

2.1.2.1.5.1 Setup

Operation of this function from the GUI is currently under development. Check back with the manufacturer for details on availability.

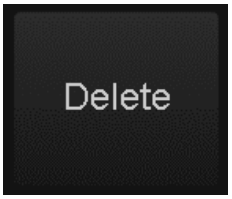
2.1.2.1.5.2 Recall

The <Recall> button allows the user to enter the RECALL mode (2.1.1.2.2.2). After clicking the <Recall> button, the user is presented with a list of satellites stored in memory. Selecting one of the satellites in the list will begin a recall operation. If the antenna is equipped with a linear feed, a box to select the receive polarization will also be presented.



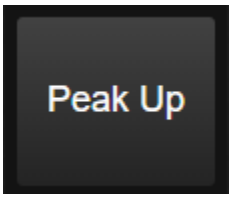
Clicking the <Cancel> button at any time will return to the main page.

2.1.2.1.5.3 Delete



Operation of this function from the GUI is currently under development. Check back with the manufacturer for details on availability.

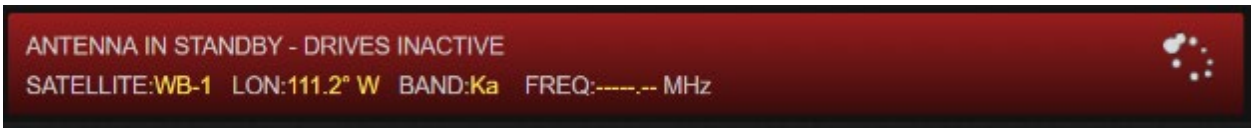
2.1.2.1.5.4 Peak Up



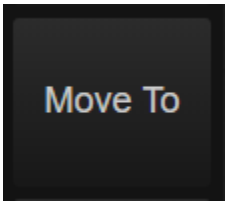
The <Peak Up> button immediately performs a Peak Up (2.1.1.2.2.8) using the currently selected signal source (2.1.2.1.6).

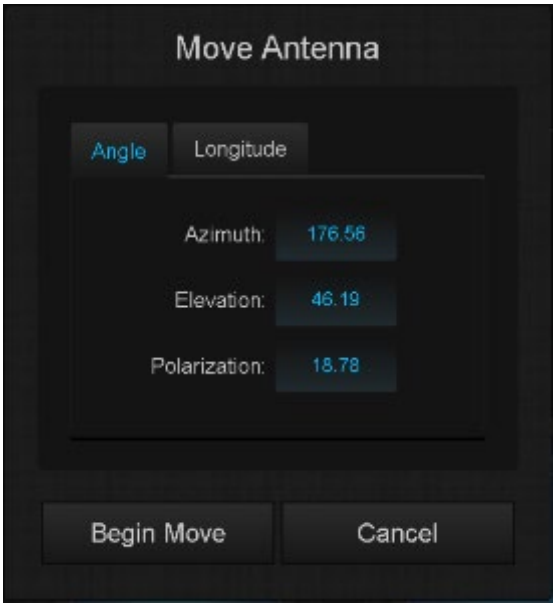
2.1.2.1.5.5 Toggle Standby

The <Toggle Standby> button transitions the drives between the active and inactive state. When in the inactive state, the ACU Status Window will indicate as shown below.



2.1.2.1.5.6 Move To





The <Move To> button allows the user to move the antenna to a specified azimuth, elevation, and polarization angles. After clicking the <Move To> button, the user will be presented with a dialog box to enter azimuth, elevation, and polarization angles.

Additionally, by clicking the Longitude tab, the user can command the ACU to calculate the pointing angles for a specific longitudinal slot.

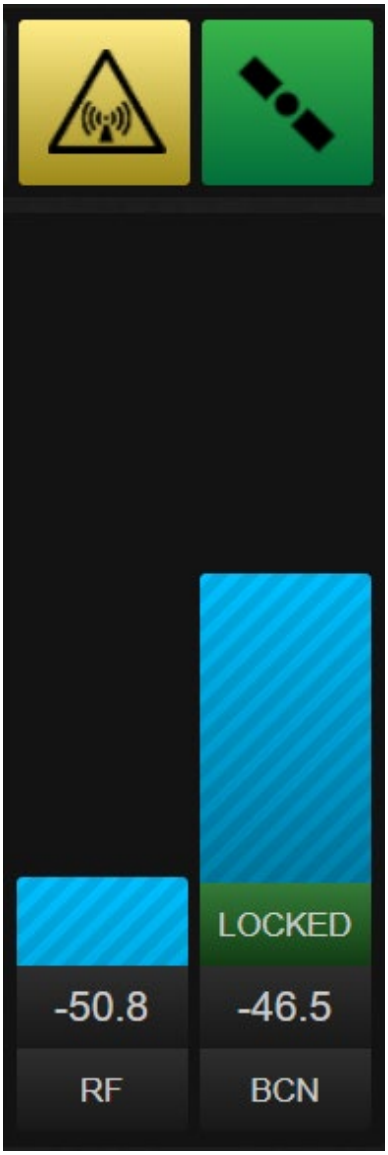
After entering the desired values, clicking <Begin Move> will begin an automatic movement to the specified position.

Clicking <Cancel> will return the user to the main page.

2.1.2.1.5.7 Drive Reset

If a drive alarm is currently present on the ACU, the <Drive Reset> button will appear. Clicking the <Drive Reset> button will reset all drive errors that are currently present. When a drive alarm is present the ACU status window will indicate as shown below.

2.1.2.1.6 Signal Strength and Transmit Status



On the right side of the main display are two bars for signal strength, and two icons that indicate transmit and satellite status.

The left signal strength value will always display signal strength coming from the L-Band power detector. In addition to the graphical representation, the numeric value of the signal strength is displayed at the bottom.

The right signal strength value is the current signal strength source being used by the RC4800 for tracking and peaking.

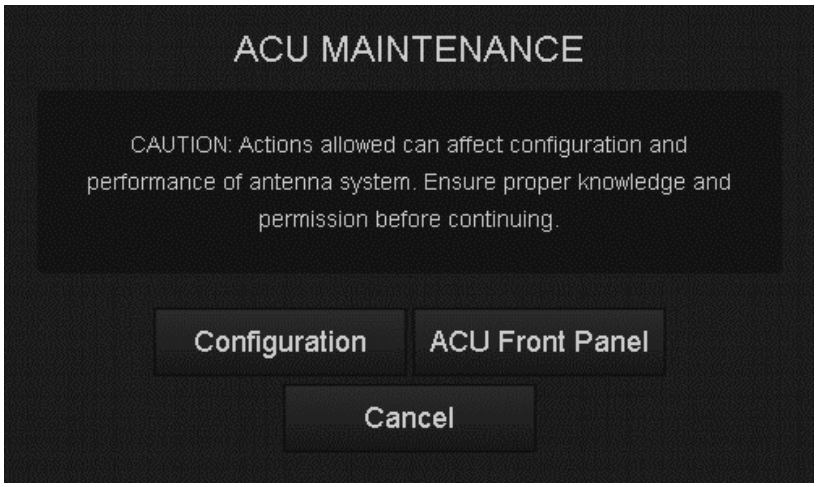
It can be toggled between, BCN (Beacon Receiver), RF (L-Band Power), and EXT (External AGC). If the signal strength source being used supports a lock input, the green “LOCKED” box will show at the bottom of the graphical signal strength when the receiver is locked.

The indicator shown below indicates that the antenna is in a state where it is OK to transmit. When moving or at the down limit, the indicator will be grayed out.

The indicator shown below indicates that the ACU is currently on satellite.

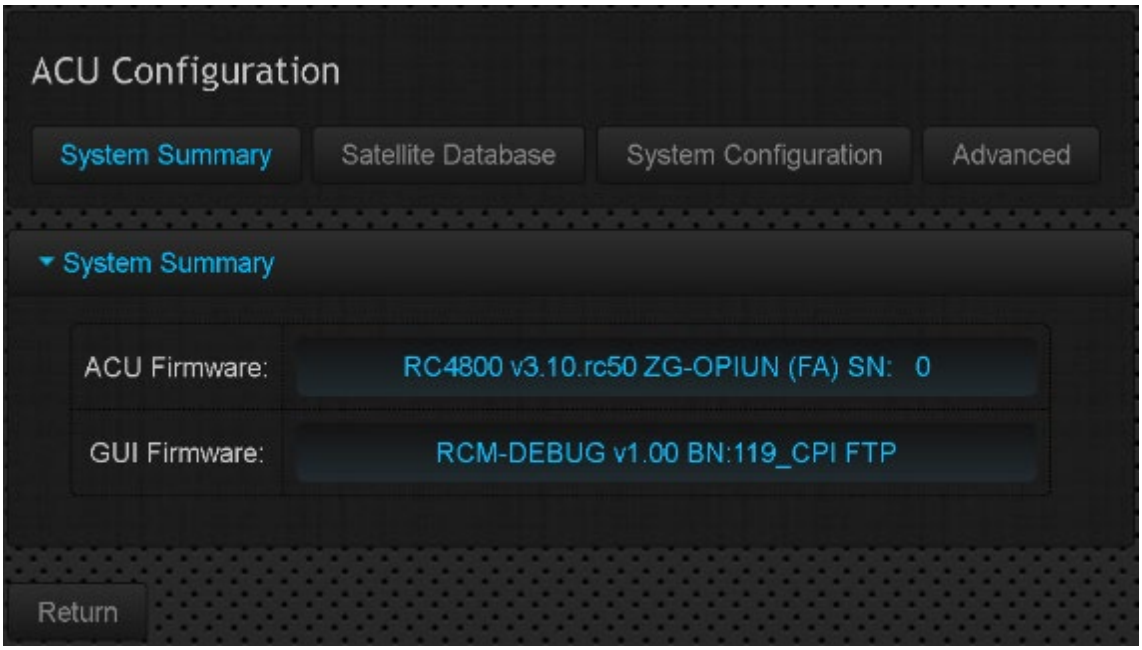
2.1.2.1.7 Maintenance

Clicking on the wrench and screwdriver in the upper right hand corner of the main page will open the dialog box below. This dialog box will allow you to access the remote front panel interface (2.1.1) and the configuration web page (2.1.2.2).



2.1.2.2 Configuration Page

The main configuration page for the ACU is available by navigating a web browser to the IP address of the controller /config (192.168.1.1/config). Upon entry to the configuration page, the System Summary tab is selected by default.

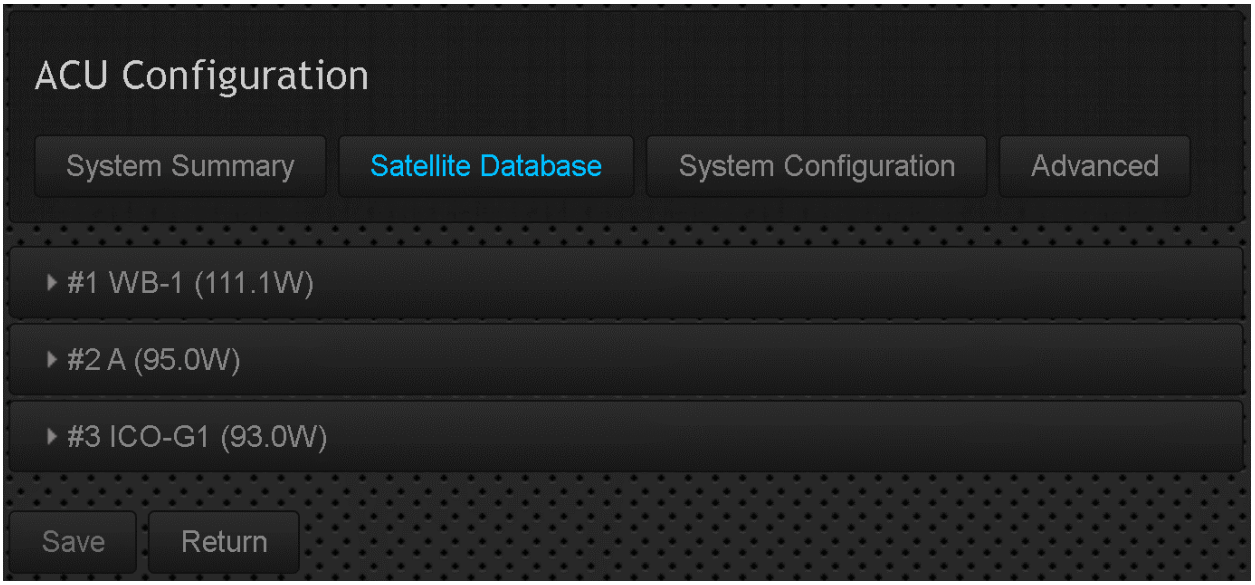


The System Summary tab will provide you with the current software on the ACU, as well as the serial number for the controller. At the bottom of the window is a <Return> button. Clicking this button will always return the user to the main page of the GUI (2.1.2.1).

Three additional tabs are available in addition to the System Summary. Each of these tabs is described in detail in the sections below.

2.1.2.2.1 Satellite Database

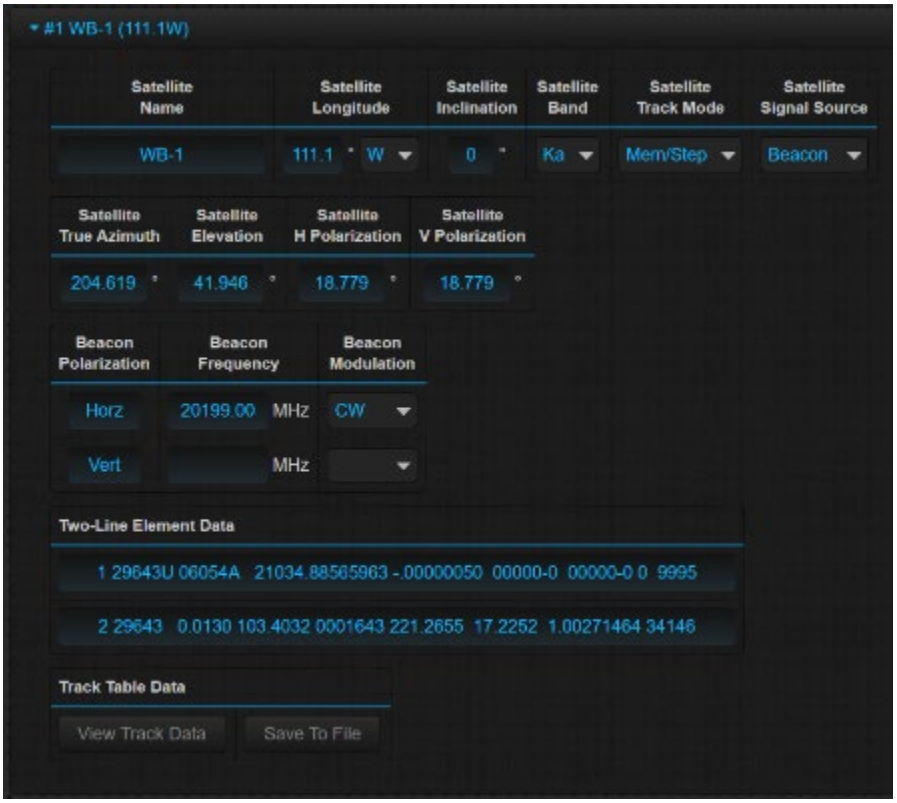
The Satellite Database tab gives the user to edit information about the satellites stored in memory. Each satellite entry can be expanded individually. The following screen shows an example of a satellite list with 3 stored satellites.



At the bottom of the screen there is a <Save> button in addition to the <Return> button. The <Save> button will become active anytime the webpage detects that information about a satellite has changed. If the <Save> button is not clicked after changing the satellite information, the database will not be updated.

2.1.2.2.1.1 Satellite Configuration

Clicking on a satellite in the database will expand the satellite to show additional fields. All fields in the satellite dropdown are editable by typing on a keyboard. Additionally, the Two-Line Element data can be copied and pasted into the window.



The satellite configuration window allows the user to set the items configured during the SETUP mode (2.1.1.2.2.1) and that are found in the following configuration screens:

- Beacon Detection Points (2.1.1.3.1.1.2)
- TLE 1 Data (2.1.1.3.1.1.3)
- TLE 2 Data (2.1.1.3.1.1.4)

After adjusting the desired parameters for the satellite ensure that the <Save> button at the bottom of the page is clicked prior to any further operations.

In addition to setting parameters, the satellite dropdown also allows the user to view the track table basepoints in a .xml format or download the table to a comma separated data file.

2.1.2.2.2 System Configuration

The System Configuration tab allows the user to modify various information about the ACU.

2.1.2.2.2.1 ACU Configuration

The ACU configuration window allows the user to adjust information about the current feed that is being used. For systems that have the multi-feed sensing system (0), there may be additional antenna specific feed configuration items available here. Consult the mount specific appendix for more information on these.

2.1.2.2.2.2 GUI Configuration

The GUI Configuration window allows the user to adjust the IP characteristics of the controller. If changes are made to any of these setting a reset of the IP interface will occur automatically. For additional information on how to reset the IP setting the defaults, see section 4.1.2.4.13.

2.1.2.2.2.3 Additional IP Devices

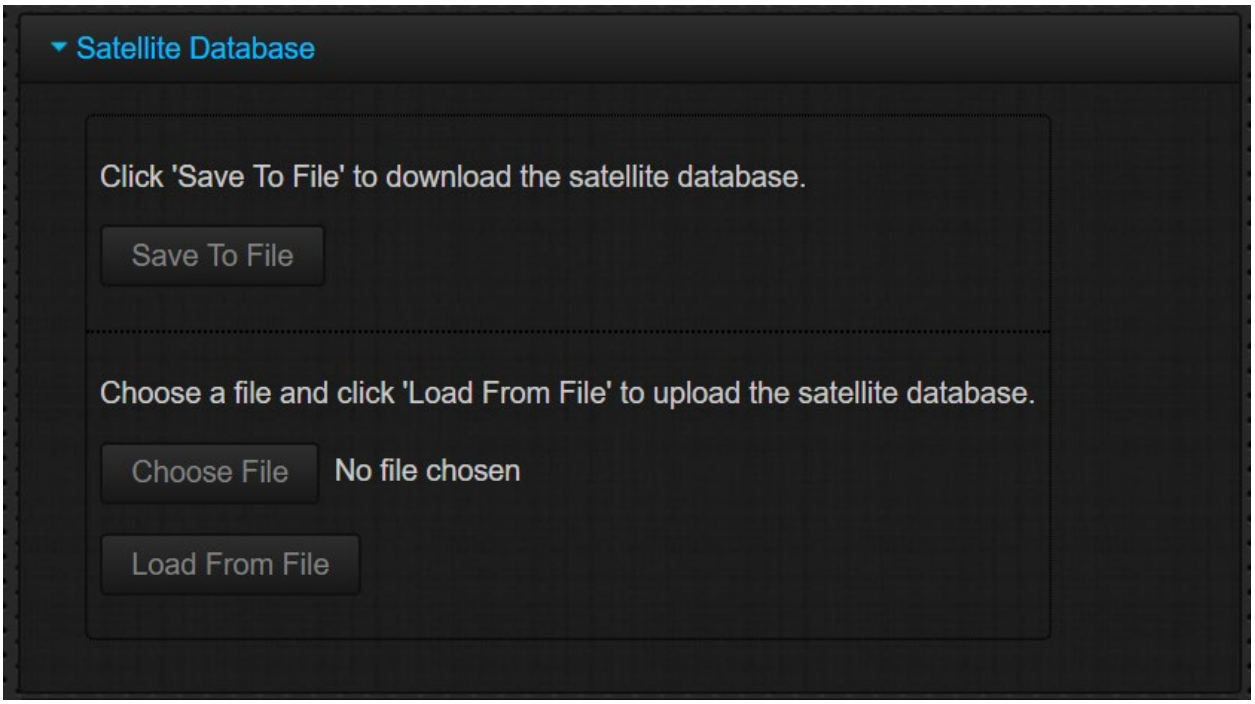
If there are any other IP devices on the system that the ACU needs to communicate with (Spectrum Analyzer, Modem, etc.), an additional window will exist to notify the ACU of the IP parameters of that device. The example below if for an IP based beacon receiver and spectrum analyzer combination.

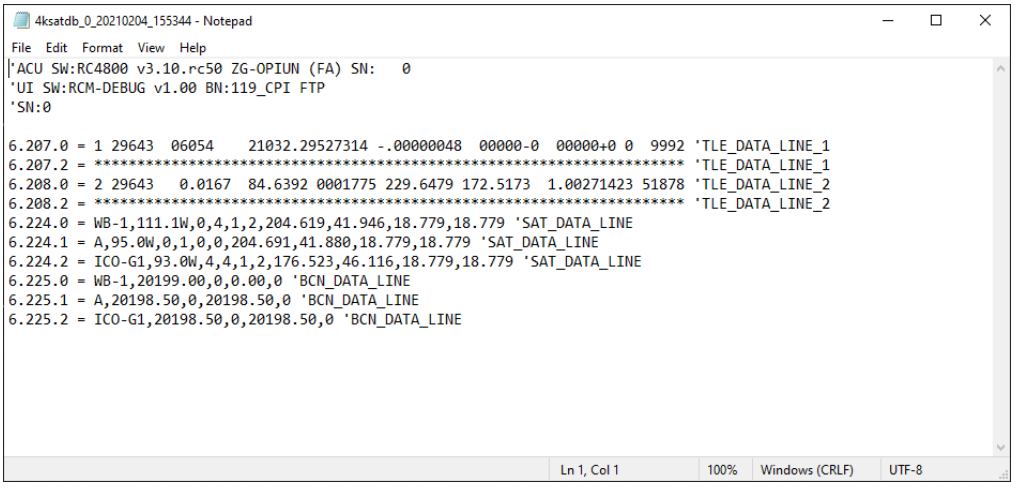
2.1.2.2.3 Advanced

The Advanced tab provides the user with the ability to upload and download configuration data from the ACU. Additionally, the Advanced tab provides the user with the ability to load new firmware and user interface software onto the ACU.

2.1.2.2.3.1 Satellite Database

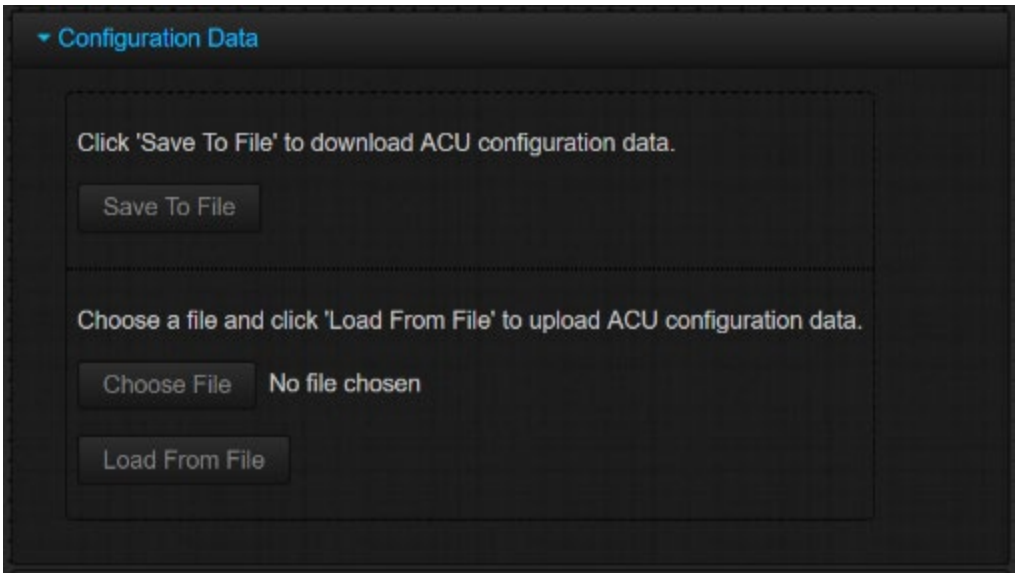
The Satellite Database window allows the user to download a text file that contains all the information contained in the Satellite Database (2.1.2.2.1). Additionally, by clicking <Choose File>, the user would be able to browse to a previously downloaded Satellite Database text file and load the database into the current RC4800.

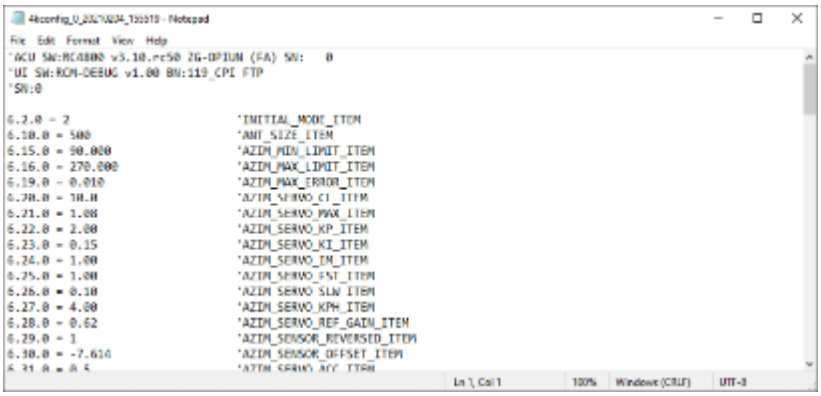


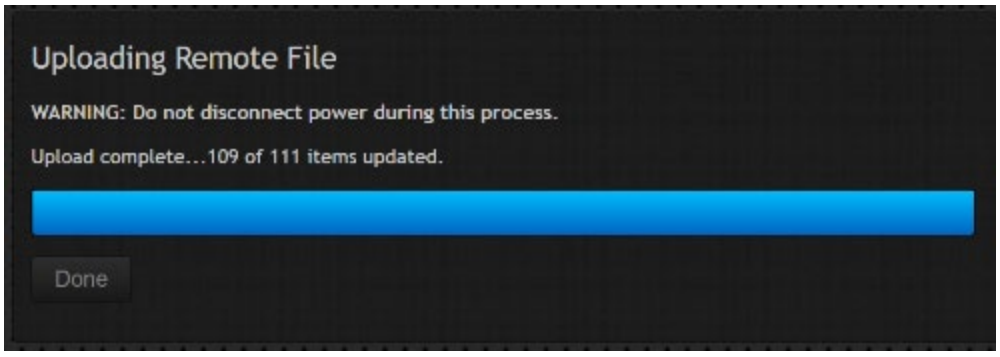


2.1.2.2.3.2 Configuration Data

The Configuration Data window allows the user to download a text file that contains all the configuration items contained in the ACU (2.1.1.3.1). Additionally, by clicking <Choose File>, the user would be able to browse to a previously downloaded Configuration Data text file and load the configuration into the current ACU. After uploading a configuration file, the dialog box will confirm what number of items were uploaded. Some items, such as serial number, cannot be changed via a configuration file.

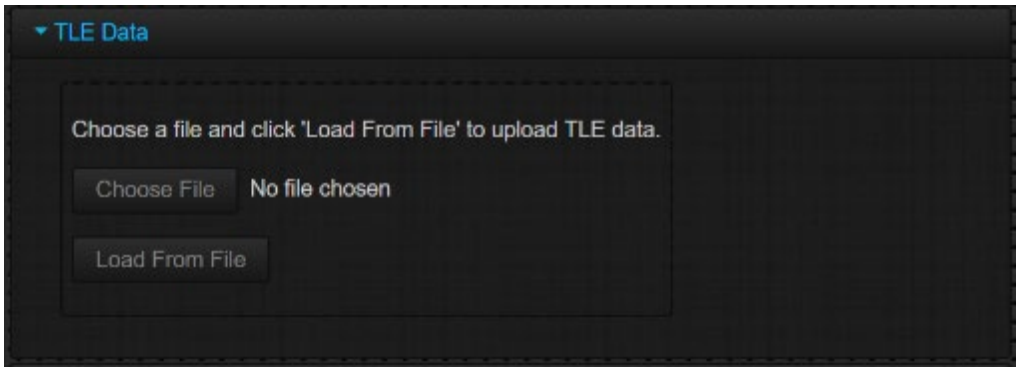


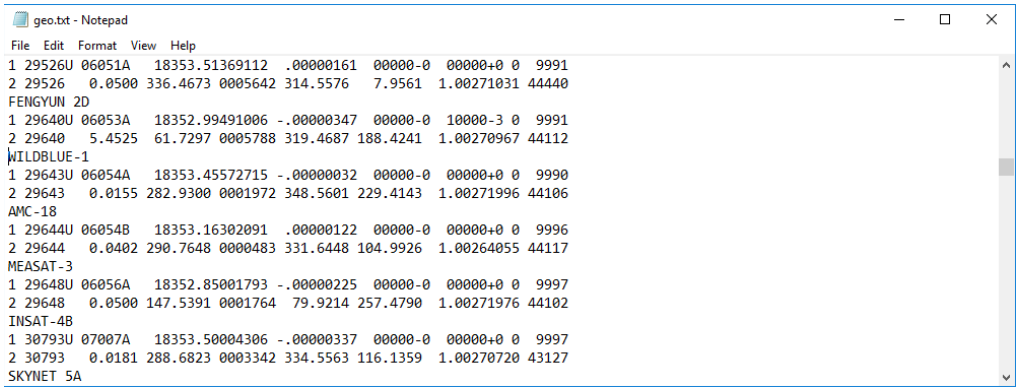


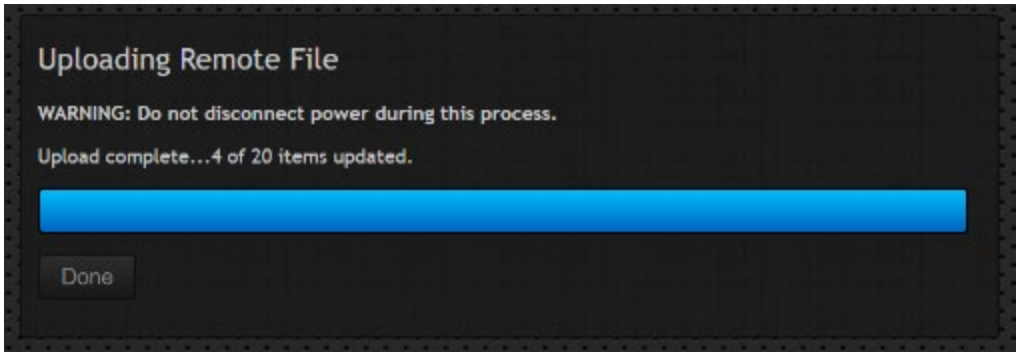


2.1.2.2.3.3 TLE Data

The TLE Data window allows the user to upload TLE data from a text file. Any satellite in the database that has TLE data will have the NORAD catalog number associated with it. When a text file is loaded, the ACU will match the catalog number with the corresponding data in the config file and update the TLE data in the controller. Reliable TLE data text files can be downloaded from www.celestrak.com/elements.



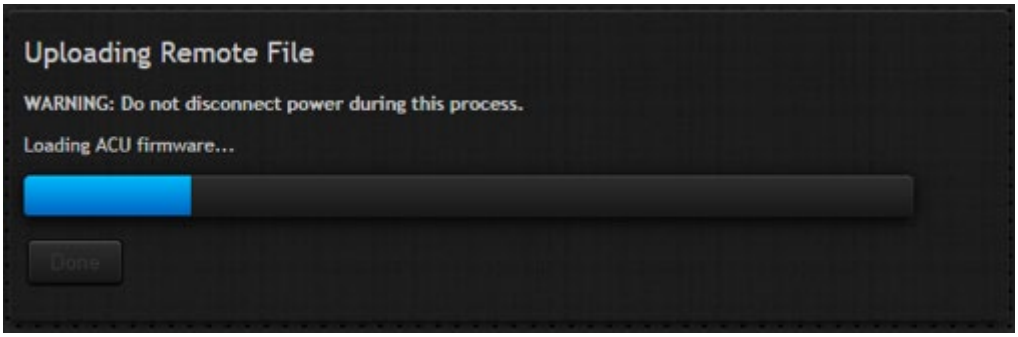




2.1.2.2.3.4 ACU Firmware

The ACU Firmware window allows the user to update the current software on the ACU. Prior to updating the ACU Firmware, the configuration data from the controller should be downloaded via the Configuration Data window (2.1.2.2.3.2).

After clicking the <Start Update> button, the window will change to show the status of the software update. Once the software is fully transferred and installed, the <Done> button will change from grayed out to active. Clicking the <Done> button will return the user to the main configuration page.



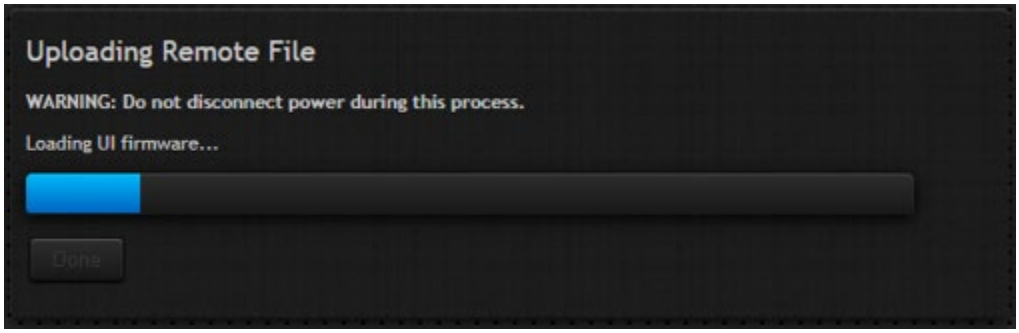
After installing the new software, the user should reset defaults on the ACU (2.1.1.3.1.3.11) and load the configuration data file that was downloaded prior to upgrading the software.

2.1.2.2.3.5 User Interface Firmware

The User Interface Firmware window allows the user to update the current user interface software on the ACU.

NOTE: Updating the user interface firmware may cause the IP settings of the ACU to be reset to factory defaults. The default IP address of the ACU is 192.168.1.1.

After clicking the <Start Update> button, the window will change to show the status of the software update. Once the software is fully transferred and installed, the <Done> button will change from grayed out to active. Clicking the <Done> button will return the user to the main configuration page.



3 INSTALLATION

3.1 Software Initialization

NOTE: Extreme caution should be used during initial installation. Limit switches and polarity of motors/sensors may not be configured correctly. Do not take the drives out of standby until calibration has been completed.

!!! After Completing the Installation Section, Save a known good configuration file !!!

This section describes the steps that would be used for initial pairing of an RC4800 with an antenna.

Initial Power Application. Before powering the unit on for the first time, please confirm that the input voltage the unit is configured for matches the intended input supply voltage.

Antenna Location: Upon initial power up, the Lat/Lon of the antenna will need to set prior to advancing further into the operation of the controller.

```
                                  INITIAL SETUP
LAT:              LON:

ENTER LATITUDE DEGREES (dd.dddd)
```

Enable Expert Access. To perform installation steps described below, expert access permission must be enabled. Expert access permission is disabled as the factory default. See section 2.1.1.3.1.1.1 for instructions on enabling expert access permission.

After installation is complete, expert access may be turned off to lessen risk of configuration settings being unintentionally modified. Disabling expert access will also present a less complex set of screens for normal operation.

System Definition. The SYSTEM DEFINITION configuration screen (2.1.1.3.1.3.1) allows the user to indicate the antenna diameter.

```
MODE:2   ANT SIZE: 420        CONFIG-SYSTEM
         ANT LOOK:1

<2-MENU 3-MANUAL>
```

Azimuth/Elevation/Polarization Calibration. The next three sections calibrate the mount's elevation, azimuth, and polarization axes. Prior to beginning this calibration, each axis should be placed in the center of travel.

For each axis, motor and encoder polarity, position feedback, limit switch status will be confirmed, and total range of movement will be tested.

Throughout axis calibration, the maintenance (2.1.1.3.2) and configuration (2.1.1.3.1) modes will be used extensively. Before beginning axes calibration, the installer should become familiar with accessing these modes and screens.

3.2 Motor and Encoder Direction Calibration

3.2.1 Elevation Axis

NOTE: Prior to beginning the Elevation Motor and Tach Calibration the antenna should be manually moved to the center of elevation travel.

STEP 1: Motor and Pulse Sensor Phasing

With the elevation axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 0% jog up in elevation for 20 seconds and verify that there is no antenna movement. Next at a speed of 0% jog down in elevation for 20 seconds and verify that there is no antenna movement.

If the elevation axis moves in either direction at 0% speed, the polarity of the tach feedback is reversed. Swap the A and B channels from the pulse sensor or reverse the tachometer wiring prior to proceeding.

If the elevation axis did not move during this test, the phasing of the motors and tach match, and no modification to wiring is needed.

STEP 2: Motor Direction

With the elevation axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 25% jog up in elevation and verify that the antenna moves up. If the antenna moves down, both the motor leads and feedback from the tachometer need to be reversed prior to proceeding.

If the elevation moved in the correct direction during this test, the motor is wired correctly and no modification to wiring is needed.

3.2.2 Azimuth Axis

NOTE: Prior to beginning the Azimuth Motor and Tach Calibration the antenna should be manually moved to the center of azimuth travel.

STEP 1: Motor and Tach Feedback Phasing

With the azimuth axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 0% jog CW in azimuth for 20 seconds and verify that there is no antenna movement. Next at a speed of 0% jog CCW in azimuth for 20 seconds and verify that there is no antenna movement.

If the azimuth axis moves in either direction at 0% speed, the polarity of the tach feedback is reversed. Swap the A and B channels from the pulse sensor or reverse the tachometer wiring prior to proceeding.

If the azimuth axis did not move during this test, the phasing of the motors and tach match, and no modification to wiring is needed.

STEP 2: Motor Direction

With the azimuth axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 25% jog CW in azimuth and verify that the antenna moves clockwise as defined in section 1.2. If the antenna moves counterclockwise, both the motor leads and the feedback from the tachometer need to be reversed prior to proceeding.

If the azimuth moved in the correct direction during this test, the motor is wired correctly and no modification to wiring is needed.

3.2.3 Polarization Axis

NOTE: Prior to beginning the Polarization Motor and Tach Calibration the antenna should be manually moved to the center of polarization travel.

STEP 1: Motor and Tach Feedback Phasing

NOTE: This step is only required for mounts that use velocity feedback for polarization.

With the polarization axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 0% jog CW in polarization for 20 seconds and verify that there is no antenna movement. Next at a speed of 0% jog CCW in polarization for 20 seconds and verify that there is no antenna movement.

If the polarization axis moves in either direction at 0% speed, the polarity of the tach feedback is reversed. Swap the A and B channels from the pulse sensor or reverse the tachometer wiring prior to proceeding.

If the polarization axis did not move during this test, the phasing of the motors and tach match, and no modification to wiring is needed.

STEP 2: Motor Direction

With the polarization axis in the center of travel, go to the Servo Maintenance screen (2.1.1.3.2.6).

At a speed of 25% jog CW in polarization and verify that the polarization axis moves clockwise as defined in section 1.2. If the polarization axis moves counterclockwise, the motor leads and the feedback from the tachometer (if present) need to be reversed prior to proceeding.

If the polarization axis moved in the correct direction during this test, the motor is wired correctly and no modification to wiring is needed.

3.3 Primary Position Sensor Calibration

3.3.1 Azimuth and Elevation Axis

Prior to beginning this step, the antenna should be manually peaked on a geostationary satellite. This peaking can be done via an external device such as a beacon receiver or spectrum analyzer or can be done via the ACU's beacon maintenance mode (2.1.1.3.2.9).

With the ACU properly peaked on a geostationary satellite, the user should navigate to the SNS OFF maintenance screen.

```
     TRUE       RAW       REF       SNS OFF
az: 212.24     32.24    180.00    (   0.00)
el:  39.80     39.80    180.00    (   0.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

STEP 1: Input Satellite Longitude

The user should press the <5> key to activate the longitude input function of the sensor offset screen. The user should then enter the longitude of the satellite the ACU is peaked on.

```
     TRUE       RAW     111.1W      SNS OFF
az: 212.24     32.24    205.01    (   0.00)
el:  39.80     39.80     41.80    (   0.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

At this point, the 'REF' values that were shown upon entry to the screen will be replaced with the calculated angles for the longitude entered.

Pressing the <7> key will update the SOFF: item in the Azimuth Calibration configuration screen (2.1.1.3.1.2.1). Pressing the <9> key will update the SOFF: item in the Elevation Calibration configuration screen (2.1.1.3.1.2.2). The offsets and update 'TRUE' angles will be displayed as shown below.

```
     TRUE       RAW     111.1W      SNS OFF
az: 205.01     32.24    205.01    (  -7.23)
el:  41.80     39.80     41.80    (   2.00)
<1-AZ,3-EL>REF <5>LON <7-AZ,9-EL>OFFSET
```

The user should now exit the Sensor Offset screen, and then hold down the mode button for 5 seconds to trigger a flash save of the configuration items.

3.3.2 Polarization Axis

NOTE: The following procedure is not required for non-motorized or circular feeds.

3.3.2.1 Resolver or Optical Encoder

Prior to beginning this step, the polarization axis should be moved via the servo maintenance screen to the center of travel.

While still in the servo maintenance screen, the user should record the true polarization angle.

The user should then enter appropriate value into the SOFF: field in the polarization calibration screen (2.1.1.3.1.2.3). For example, if the true angle in the servo maintenance screen is 2.346, the user would enter in a sensor offset of -2.346.

3.3.2.2 Potentiometer

Prior to beginning this step, the feed should be moved via servo maintenance screen to the polarization center of travel.

The following procedure should then be followed to configure the polarization potentiometer. The values determined during this process will be input into the Polarization Calibration configuration screen (2.1.1.3.1.2.3).

```
        VREF:2.50  OFF:  0.000 CONFIG-POL
 CCW: -90.000 CW:  90.000 SF: 45.00

ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

STEP 1: Polarization Potentiometer Reference Voltage.

Move to the 12-Bit Voltage maintenance screen. The polarization voltage shown on the screen should be 2.500 ± 0.05 volts. If the value is not within this range, loosen the potentiometer restraining collar and rotate the shaft such that the displayed value is as near 2.500 volts as possible. Secure the collar and record the voltage.

RECORDED POLARIZATION CENTER VOLTAGE_____ V

Move to the Polarization Calibration screen and enter the recorded value in the VREF item. This will define to the ACU's software the voltage that should be seen when the polarization axis is in its center position. To verify that data has been entered correctly, return to the MANUAL mode screen. The displayed polarization angle should be 0.0 ± 0.5 degrees.

STEP 2. Polarization Scale Factor.

To calculate the polarization scale factor, move the feed between two known physical polarization positions and note the difference in the sensed polarization voltage between the two locations. If definite reference points are available on the feed (±90 degree positions for example), these may be used. Otherwise use the difference in polarization between the horizontal and vertical of a satellite. Record the voltages corresponding to each.

Example: at +90 degree reference position the polarization voltage is 4.358. At the –90 degree reference position the azimuth voltage is 0.642. The azimuth scale factor is calculated as:

180 degrees / (4.358 – 0.642) = 48.44 degrees / volt.

48.44 would be entered as the scale factor.

3.4 Range of Travel and Limits Calibration

3.4.1 Elevation Axis

3.4.1.1 Up Limit

If the antenna being used has a physical UP limit switch, from MANUAL mode move the axis to the limit switch and verify that the “UP” limit is displayed.

If the controller displays “up” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical UP limit switch and verify that the “UP” limit is no longer displayed in MANUAL mode. The software Up limit should be set 1° lower than the Up limit switch in the elevation calibration screen (2.1.1.3.1.2.2).

If the antenna being used does not have a physical UP limit switch, the antenna should be moved to the mechanical end of travel, and a software up limit should be set 3° below the end of mechanical travel in the elevation calibration screen (2.1.1.3.1.2.2).

For example, if the mechanical end of travel is at an elevation angle of 85°, the user should set the software up limit to 82°. If the antenna has mechanical travel above 92°, it is recommended that the software up limit is set to 90°.

3.4.1.2 Down Limit

If the antenna being used has a physical Down limit switch, from MANUAL mode move the axis to the limit switch and verify that the “DOWN” limit is displayed.

If the controller displays “down” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical Down limit switch and verify that the “DOWN” limit is no longer displayed in MANUAL mode. The software Down limit should be set 1° higher than the Down limit switch in the elevation calibration screen (2.1.1.3.1.2.2).

If the antenna being used does not have a physical DOWN limit switch, the antenna should be moved to the mechanical end of travel, and a software down limit should be set 3° above the end of mechanical travel in the elevation calibration screen (2.1.1.3.1.2.2).

For example, if the mechanical end of travel is at an elevation angle of 10°, the user should set the software down limit to 13°. If the antenna has mechanical travel below 2°, it is recommended that the software down limit is set to 5°.

3.4.2 Azimuth Axis

NOTE: The setting of Azimuth limits described here is for the Northern hemisphere. The same procedure should be followed, but the values should be adjusted for antennas in the Southern hemisphere.

3.4.2.1 CW Limit

If the antenna being used has a physical CW limit switch, from MANUAL mode move the axis to the limit switch and verify that the “CW” limit is displayed.

If the controller displays “cw” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical CW limit switch and verify that the “CW” limit is no longer displayed in MANUAL mode. The software CW limit should be set 1° CCW from the CW limit switch in the Azimuth Calibration screen (2.1.1.3.1.2.1).

If the antenna being used does not have a physical CW limit switch, the antenna should be moved to the mechanical end of travel, and a software CW limit should be set 3° inside the end of mechanical travel in the azimuth calibration screen (2.1.1.3.1.2.1).

For example, if the mechanical end of travel is at an azimuth angle of 275°, the user should set the software CW limit to 272°.

3.4.2.2 CCW Limit

If the antenna being used has a physical CCW limit switch, from MANUAL mode move the axis to the limit switch and verify that the “CCW” limit is displayed.

If the controller displays “ccw” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical CCW limit switch and verify that the “CCW” limit is no longer displayed in MANUAL mode. The software CCW limit should be set 1° CW from the CCW limit switch in the Azimuth Calibration screen (2.1.1.3.1.2.1).

If the antenna being used does not have a physical CCW limit switch, the antenna should be moved to the mechanical end of travel, and a software CCW limit should be set 3° inside the end of mechanical travel in the azimuth calibration screen (2.1.1.3.1.2.1).

For example, if the mechanical end of travel is at an azimuth angle of 85°, the user should set the software CCW limit to 88°.

3.4.3 Polarization Axis

NOTE: If the antenna uses potentiometer-based hardware limits, the polarization potentiometer scale factor should be set prior to testing the CW limit.

3.4.3.1 CW Limit

If the feed being used has a physical CW limit switch, from MANUAL mode move the feed to the limit switch and verify that the “CW” limit is displayed.

If the controller displays “cw” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical CW limit switch and verify that the “CW” limit is no longer displayed in MANUAL mode. The software CW limit should be set 1° CCW from the CW limit switch in the Polarization Calibration screen (2.1.1.3.1.2.3).

If the feed being used does not have a physical CW limit switch, the feed should be moved to the mechanical end of travel, and a software CW limit should be set 3° inside the end of mechanical travel in the polarization calibration screen (2.1.1.3.1.2.3).

For example, if the mechanical end of travel is at a polarization angle of 93°, the user should set the software CW limit to 90°. If the feed has mechanical travel above 95°, it is recommended that the software CW limit is set to 92°.

3.4.3.2 CCW Limit

If the feed being used has a physical CCW limit switch, from MANUAL mode move the feed to the limit switch and verify that the “CCW” limit is displayed.

If the controller displays “ccw” prior to hitting the switch, this means that a software limit has been reached prior to the physical switch. The software limit should be adjusted to a position beyond the physical limit for limit switch testing, and then set properly after switch testing.

The user should then move back out of the physical CCW limit switch and verify that the “CCW” limit is no longer displayed in MANUAL mode. The software CCW limit should be set 1° CW from the CCW limit switch in the Polarization Calibration screen (2.1.1.3.1.2.3).

If the feed being used does not have a physical CCW limit switch, the antenna should be moved to the mechanical end of travel, and a software CW limit should be set 3° inside the end of mechanical travel in the polarization calibration screen (2.1.1.3.1.2.3).

For example, if the mechanical end of travel is at a polarization angle of -93°, the user should set the software CW limit to -90°. If the feed has mechanical travel above -95°, it is recommended that the software CW limit is set to -92°.

3.5 Locate Source Calibration

The RC4800 can sense satellite signal strength via the L-Band power detector, multiple internal receivers, and external signal strength inputs. This section describes how to configure the signal strength input circuits for use with various locate sources. Correct adjustment of the signal strength parameters is required for the TRACK mode to work correctly.

3.5.1 L-Band Power Detector

The simplest detection scheme is to connect the LNB output to the L-band power detector. For best results, insert inline attenuation or amplification so that the RF display is approximately -50.0 when the reflector is pointed at open sky. The L-band input power detector makes use of a 10-bit ADC labeled “5-RF” (2.1.1.3.2.1.1). See the RF Sig Factors section (2.1.1.3.1.2.7) for a discussion of the characteristics of the L-Band power detector.

3.5.2 Beacon Tracking Receiver

If the ACU is configured with an internal beacon tracking receiver (BTR), the Beacon Sig Factors configuration items (2.1.1.3.1.2.6) should be adjusted for optimal performance. The table below shows items that are preset by the factory, and which may need to be adjusted to the integrator.

Set By Factory	Set by Integrator
LOCK	TIME
SENSE	THRES

3.5.3 External Receiver

The ACU external receiver allows for the use of a wide range of analog voltage input signal sources. If using an external receiver as the locate source, all items in the External Sig Factors configuration screen (2.1.1.3.1.2.5) should be configured for optimal performance.

4 HARDWARE

This chapter describes both the RC4800 PCB set and common external devices that may be used for integrating an antenna system.

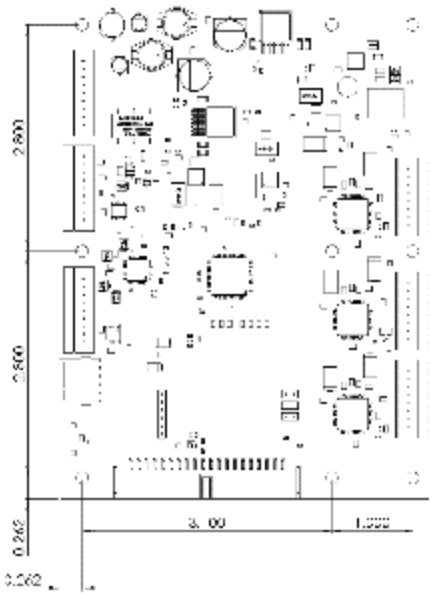
4.1 Board Set Devices

This section describes the mechanical and electrical interfaces of the boards that comprise the RC4800 PCB set. NOTE: details on how the board set is packaged in an enclosure and how interfaces are connected to an antenna system will be detailed in Appendix C – Enclosure Specific Data.

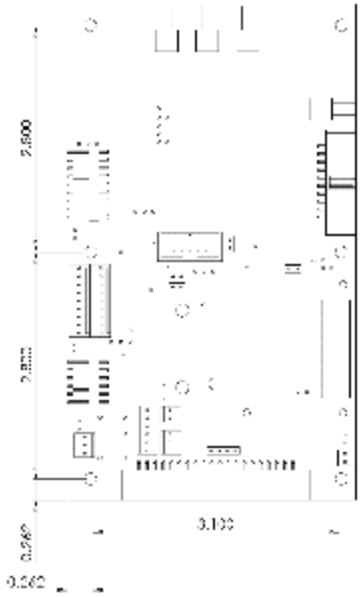
4.1.1 Mechanical Mounting

The following pictures shows an example RC4800 board set with all cards stacked together.

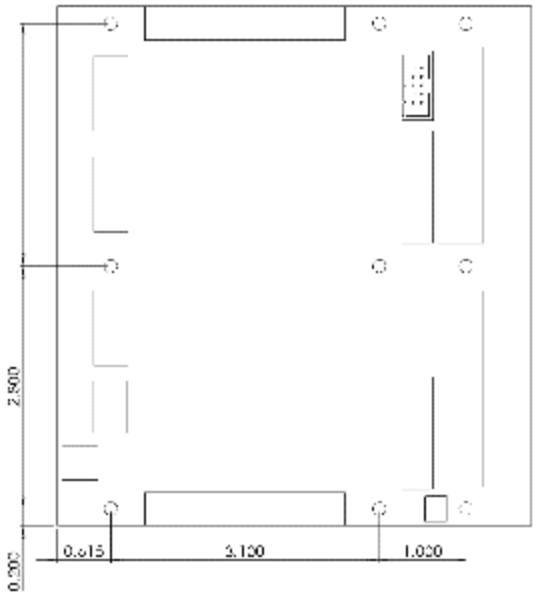
The following drawings show the mounting hole spacing for the Computing Board, Servo Sensor Board and Options Board, respectively. The Computing Board and Servo Sensor Board use nine #6 mounting holes. The Options Board uses six #6 mounting holes. Each board's mounting holes are designed to lineup with the mounting holes in the other boards to allow for "stacking" of the PCBs.



Servo Sensor Board



Options Board



Computing Board

4.1.2 Electrical Interfaces

The interfaces available from each RC4800 board are detailed in this section. For context, typical uses of individual interfaces within an antenna system are described. Differences to these interfaces and how they are accommodated for a particular mount will be described in Appendix B - Mount Specific Data and in Appendix C - Enclosure Specific Data.

As each interface is defined, its connector designation, PCB board nomenclature, Manufacturer and Manufacturer part number will initially be shown in bold. For example:

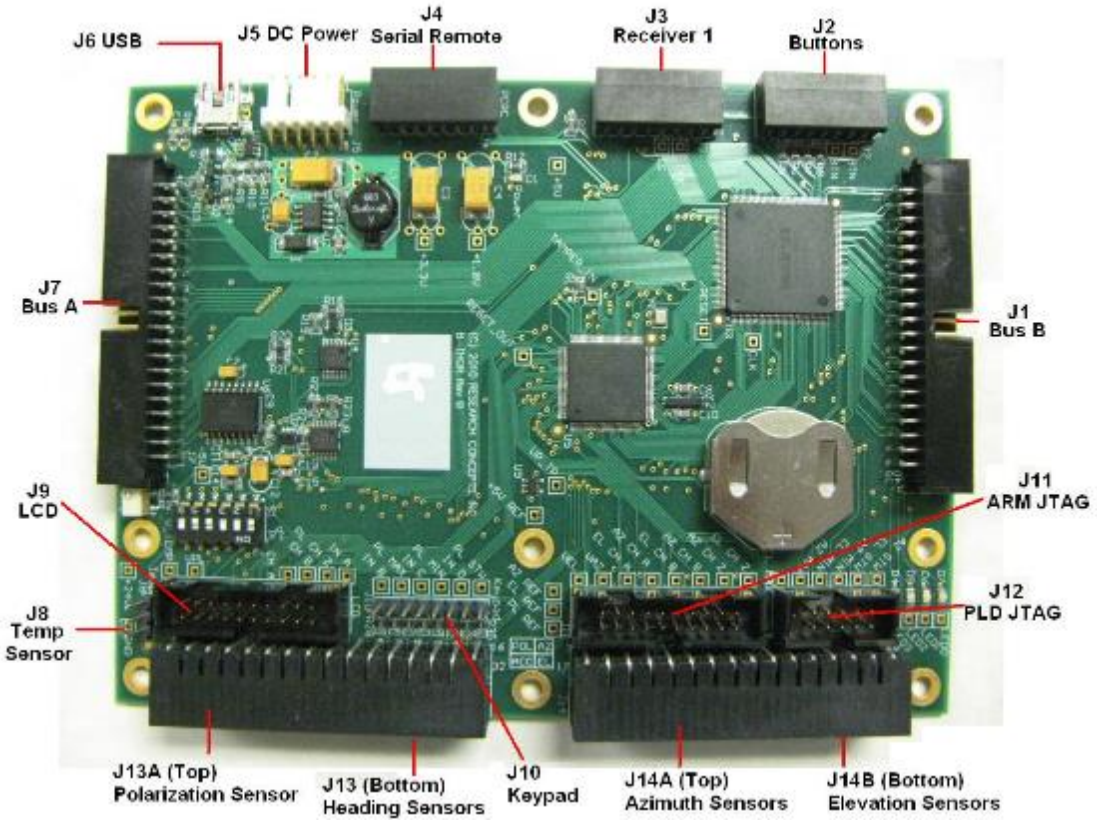
Designation	PCB Marking	Manufacturer	Part Number
J1	**AZ/EL Drive Command**	**Phoenix Contact**	**1953855**

If there is no nomenclature on the PCB for a particular connector, it will be shown as "unmarked".

4.1.2.1 Computing and Interface Board

The Computing/Interface Board's main functions are:

1) Run top-level ACU software
2) Detect antenna sensor data via multiple interfaces
3) Control functions on the Servo Drive and Options Boards



The picture shows the top of the card. Spacers greater than 0.500" in length are required between the bottom of the card and the top of the Sensor Board. If the Options Board is stacked above the card, spacers greater than 0.437" are required.

The Computing/Interface Board uses a 3V, 2450 size coin cell battery.

4.1.2.1.1 J1 – Inter-board Bus B

Designation	PCB Marking	Manufacturer	Part Number
J1	**Bus B**	**TE Connectivity**	**510310-8**

Bus B is used to provide an interface between circuit boards in the ACU.

4.1.2.1.2 J2 – Red/Green Buttons

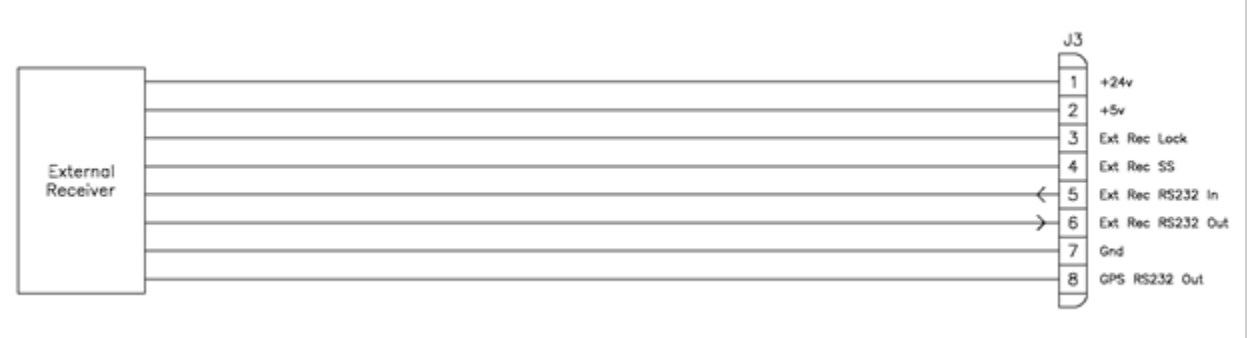
Designation	PCB Marking	Manufacturer	Part Number
J2	**Buttons**	**Phoenix Contact**	**1939303**

The two inputs and two outputs of J2 are most typically allocated to support the “Red/Green” button user interface option.

4.1.2.1.3 J3 – Receiver

Designation	PCB Marking	Manufacturer	Part Number
J3	**Ext Rcvr**	**Phoenix Contact**	**1939303**

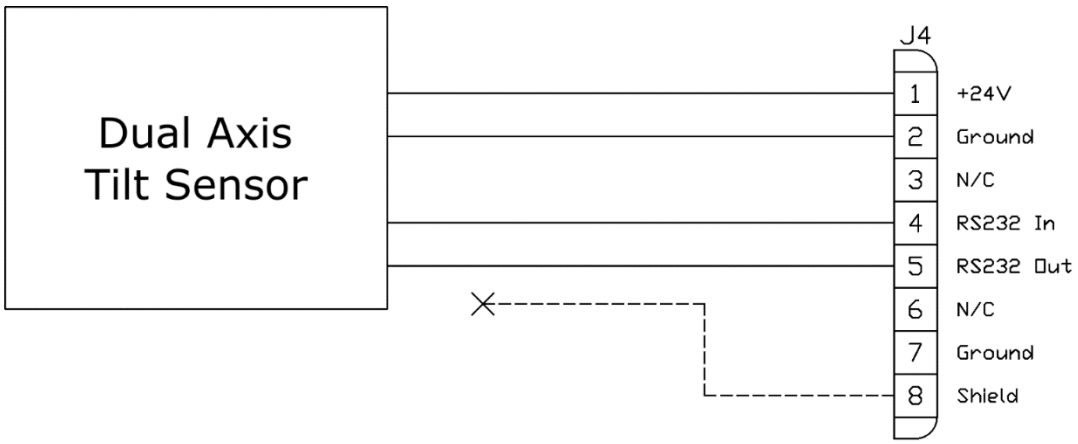
The J3 connector is allocated to support various types of receivers.



4.1.2.1.4 J4 – Serial Remote Control

Designation	PCB Marking	Manufacturer	Part Number
J4	**PCRC**	**Phoenix Contact**	**1939303**

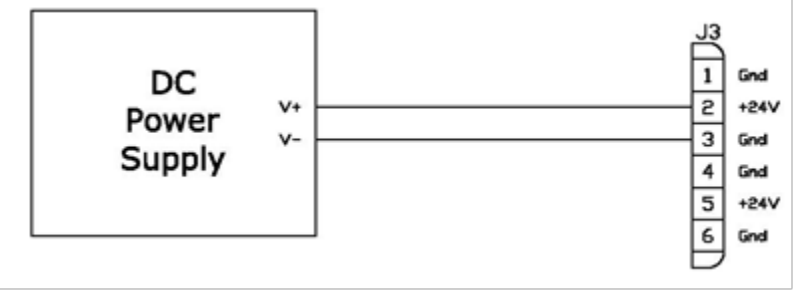
The PCRC connector is a serial port that is used to interface with the additional serial devices such as a dual axis tilt sensor.



4.1.2.1.5 J5 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J5	**Boardstack Power**	**Molex**	**22-11-2064**

J5 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.1.6 J6 – USB

Designation	PCB Marking	Manufacturer	Part Number
J6	**Unmarked**	**Various**	**USB Mini B**

The J6 USB mini B female connector allows for the initial programming of software onto the ACU. This is for in factory use only.

4.1.2.1.7 J7 – Inter-Board Bus A

Designation	PCB Marking	Manufacturer	Part Number
J7	**Bus A**	**TE Connectivity**	**510310-8**

Bus A is used to provide an interface between circuit boards in the ACU.

4.1.2.1.8 J8 – Temperature Sensor

Designation	PCB Marking	Manufacturer	Part Number
J8	**Temp**	**Molex**	**22-11-2032**

J8 provides an interface to an external temperature sensor. This is not a standard feature and would only be available if needed for a specific application.

4.1.2.1.9 J9 – LCD

Designation	PCB Marking	Manufacturer	Part Number
J9	**LCD**	**TE Connectivity**	**103308-5**

The J9 connector allows a 4x40 column character LCD to be utilized as part of the user interface. This will be a standard option on rackmount controllers and will be unused on embedded versions.

4.1.2.1.10 J10 – Keypad

Designation	PCB Marking	Manufacturer	Part Number
J10	**Keypad**	**TE Connectivity**	**9-146274-0 (x9)**

The J10 connector allows a 4x4 keypad to be utilized as part of the user interface. This will be a standard option on rackmount controller and will be unused on embedded versions.

4.1.2.1.11 J11 – Processor JTAG

Designation	PCB Marking	Manufacturer	Part Number
J11	**Unmarked**	**TE Connectivity**	**103308-5**

Factory use only.

4.1.2.1.12 J12 – PLD JTAG

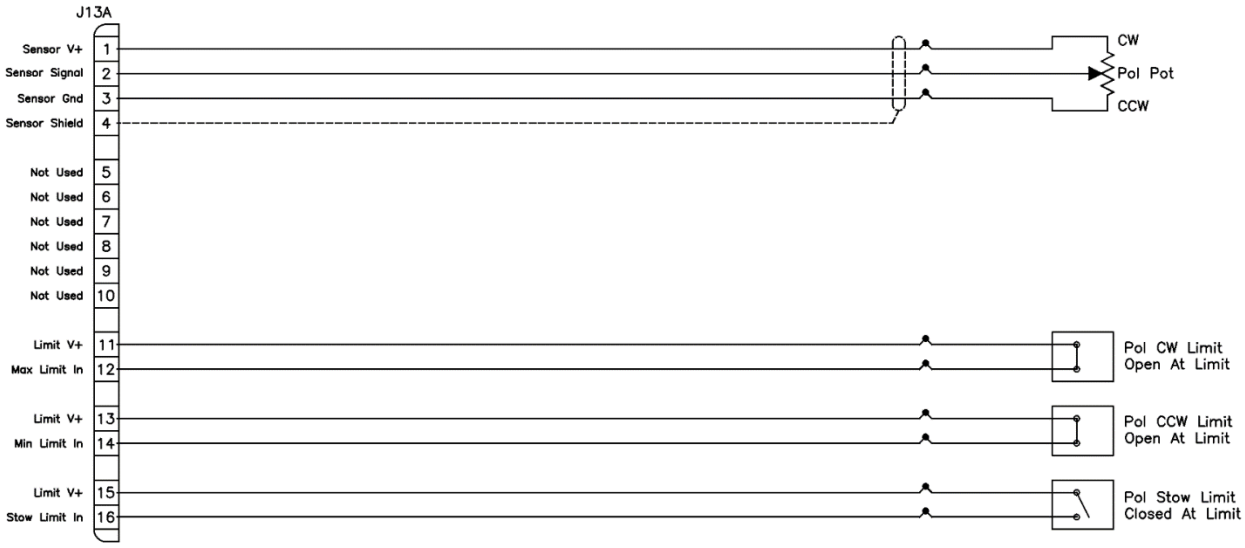
Designation	PCB Marking	Manufacturer	Part Number
J12	**Unmarked**	**TE Connectivity**	**103308-1**

Factory use only.

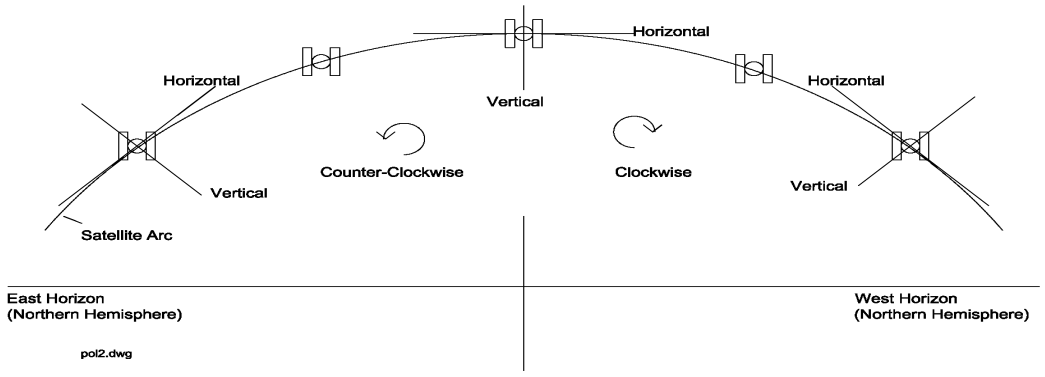
4.1.2.1.13 J13A – Polarization Sensors

Designation	PCB Marking	Manufacturer	Part Number
J13A	**POL**	**Phoenix Contact**	**1953855 (Top Row)**

J13 provides a double row of pins. The top 16 pins are designated "J13A" and are allocated to supporting potentiometer, pulse and limit switch feedback from the polarization axis.



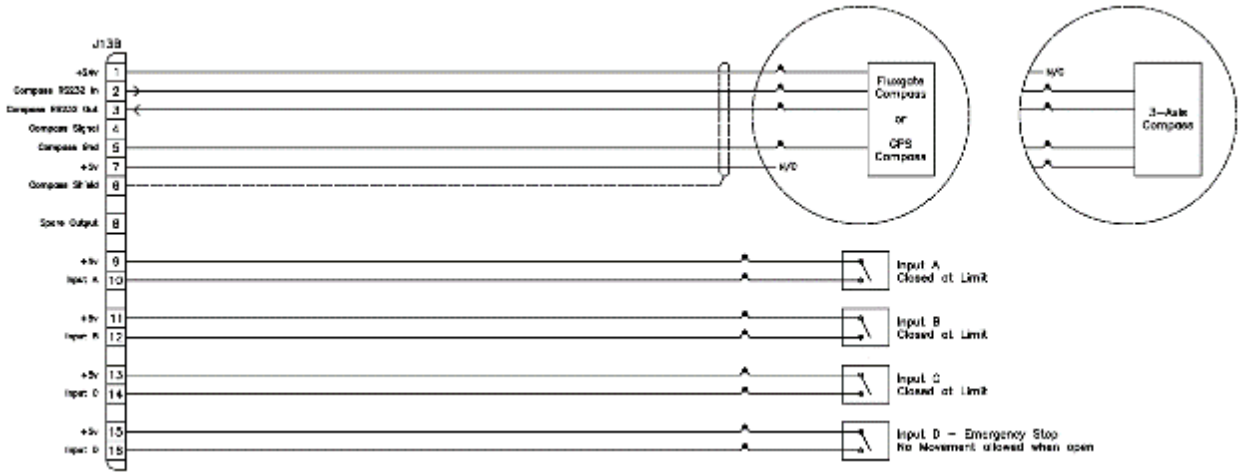
The directional sense of polarization movement is defined as CW or CCW, as seen by an observer standing behind the antenna reflector looking 'through' the reflector at the satellite. **See diagram below.** The reference position for the polarization position angle is vertical polarization for a satellite located at the same longitude as the antenna. In the northern hemisphere, the vertical polarization angle increases for satellites farther to the west.



4.1.2.1.14 J13B – Accessories and Compass

Designation	PCB Marking	Manufacturer	Part Number
J13B	**ACC**	**Phoenix Contact**	**1953855 (Bottom Row)**

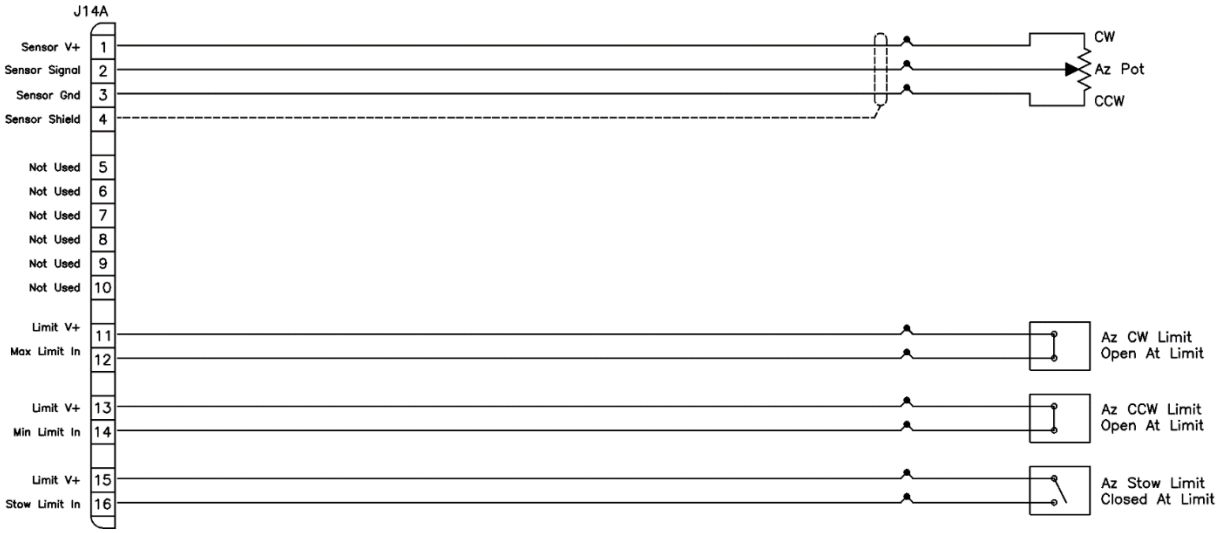
J13 provides a double row of pins. The bottom 16 pins are designated "J13B" and are typically allocated for interfacing to various compass options (Fluxgate Compass Shown). Additionally, inputs A, B, C and D are routed to this connector. On the ACU input D is always used as emergency stop, with the other inputs allocated as needed for a specific application.



4.1.2.1.15 J14A – Azimuth Sensors

Designation	PCB Marking	Manufacturer	Part Number
J14A	**AZ**	**Phoenix Contact**	**1953855 (Top Row)**

J14 provides a double row of pins. The top 16 pins are designated "J14A" and are allocated to supporting potentiometer, pulse and limit switch feedback from the azimuth axis.

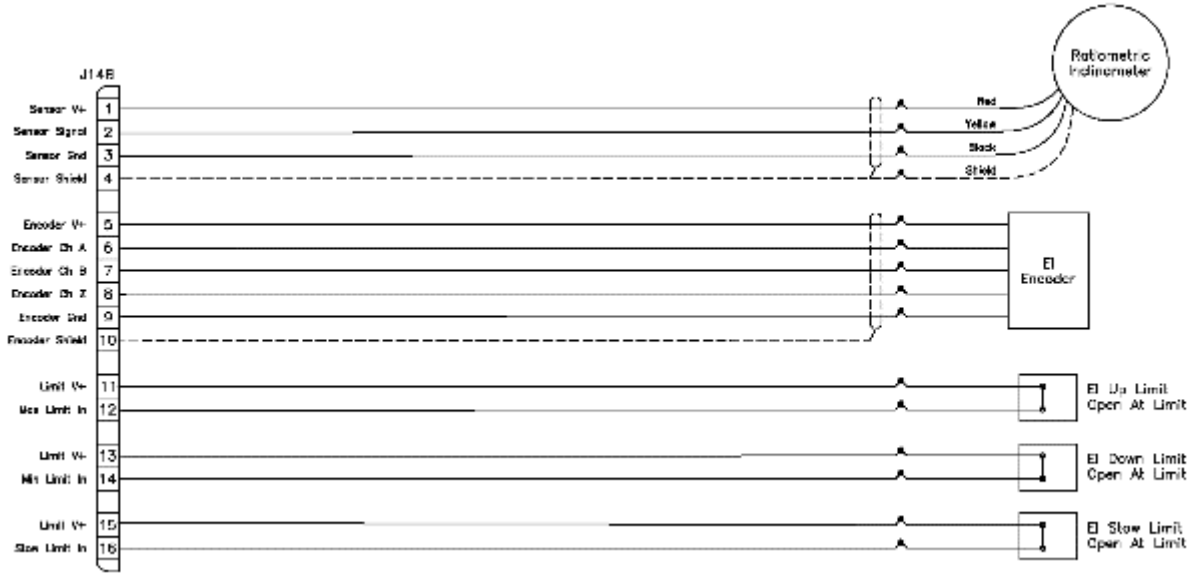


The directional sense of azimuth movement is defined as clockwise (CW) or counter-clockwise (CCW), as viewed by an observer located above the antenna. On the controller, CW movement results in a greater sensed azimuth position.

4.1.2.1.16 J14B – Elevation Sensors

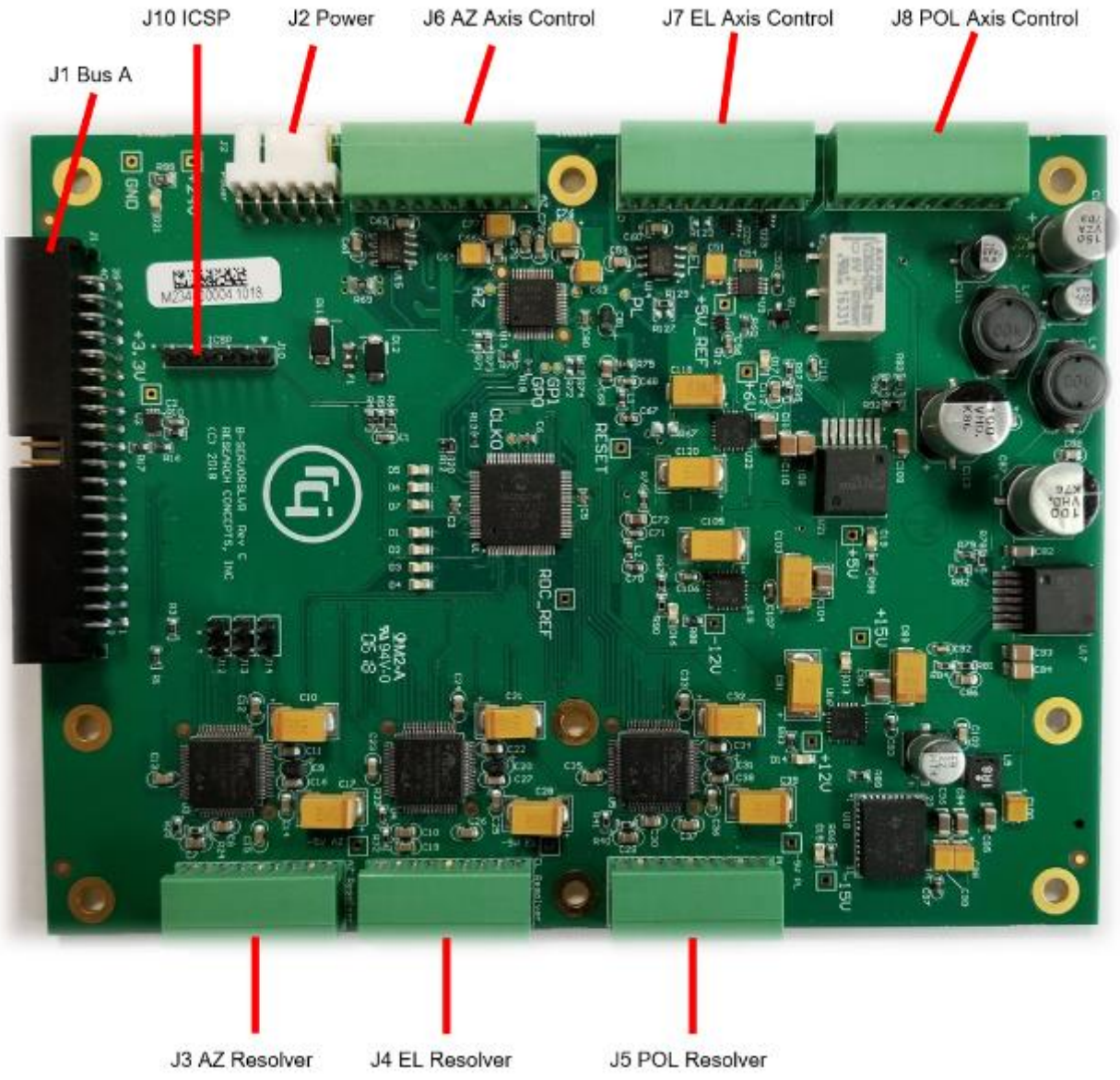
Designation	PCB Marking	Manufacturer	Part Number
J14B	**EL**	**Phoenix Contact**	**1953855 (Bottom Row)**

J14 provides a double row of pins. The bottom 16 pins are designated "J14B" and are allocated to supporting limit switch feedback from the elevation axis.



4.1.2.2 Servo Resolver Board

The Servo Resolver Board allows an RC4800-based ACU to be able to sense axis positions via 16-bit resolvers by utilizing resolver-to-digital converters. The card is also responsible for producing analog voltages used to interface to servo amplifier drives.



4.1.2.2.1 J1 – Inter-board Bus A

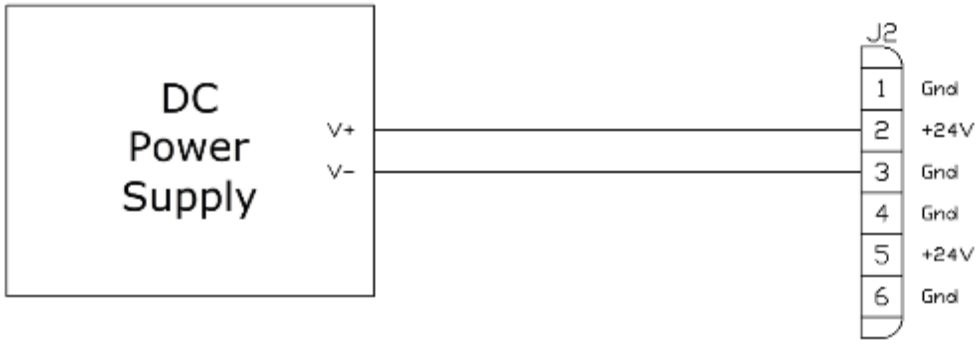
Designation	PCB Marking	Manufacturer	Part Number
J1	**Unmarked**	**TE Connectivity**	**510310-8**

Bus A is used to provide an interface between circuit boards in the ACU.

4.1.2.2.2 J2 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J2	**Power**	**Molex**	**22-11-2064**

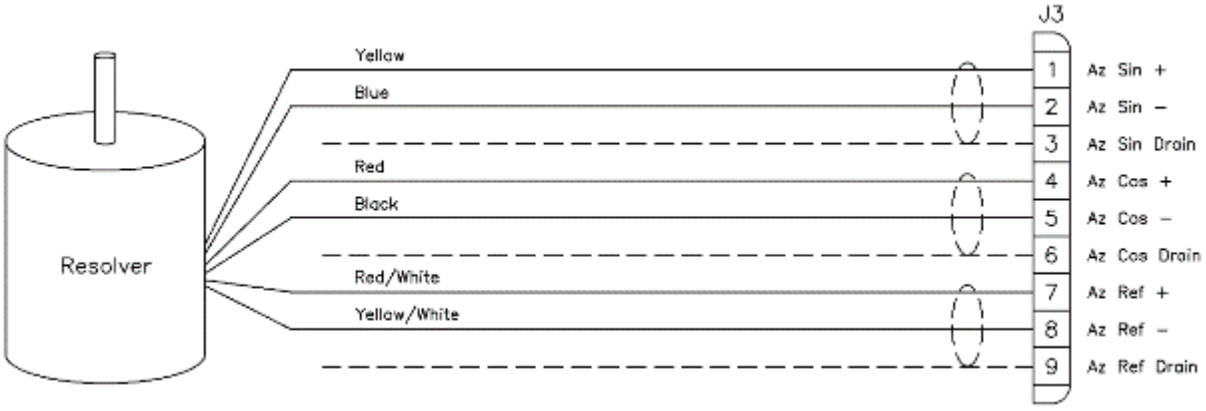
J2 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.2.3 J3 – AZ Resolver

Designation	PCB Marking	Manufacturer	Part Number
J3	**AZ Resolver**	**Phoenix Contact**	**1881516**

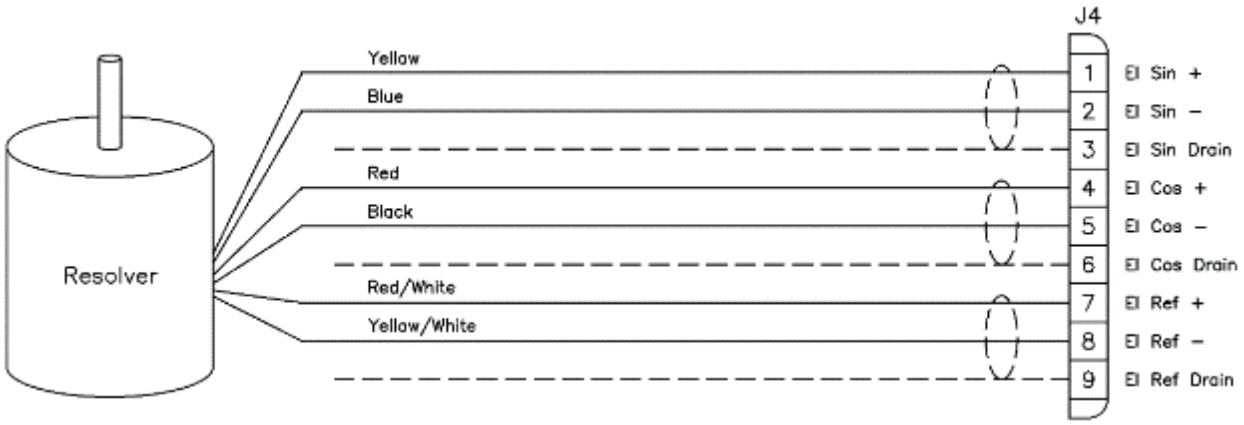
J3 is dedicated to the Azimuth Axis Resolver.



4.1.2.2.4 J4 – EL Resolver

J4 is dedicated to the Elevation Axis Resolver.

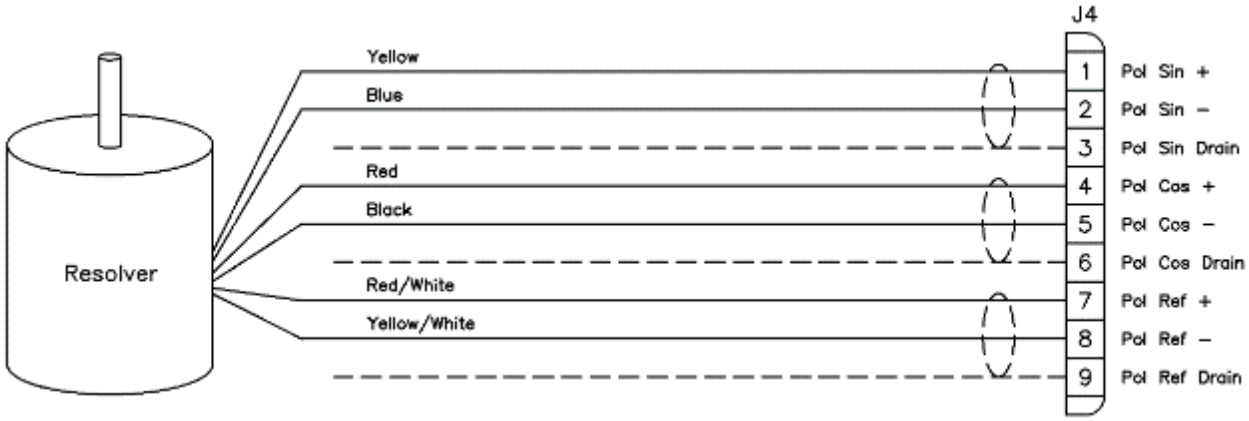
Designation	PCB Marking	Manufacturer	Part Number
J4	**EL Resolver**	**Phoenix Contact**	**1881516**



4.1.2.2.5 J5 – POL Resolver

J5 is dedicated to the Polarization Axis Resolver.

Designation	PCB Marking	Manufacturer	Part Number
J5	**PL Resolver**	**Phoenix Contact**	**1881516**



4.1.2.2.6 J6 – AZ Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J6	**AZ**	**Phoenix Contact**	**1881529**

J6 is dedicated to the control of the drive for the Azimuth axis. The table below describes the output of each pin.

Pin	Signal	Description
1	Fault Input	0V or open=OK, 5V=Fault
2	+5V	+5VDC Source
3	MIN Limit Input	Discrete limit switch input
4	+5V	+5VDC source
5	MAX Limit Input	Discrete limit switch input
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

4.1.2.2.7 J7 – EL Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J7	**EL**	**Phoenix Contact**	**1881529**

J7 is dedicated to the control of the drive for the Elevation axis. The table below describes the output of each pin.

Pin	Signal	Description
1	Fault Input	0V or open=OK, 5V=Fault
2	+5V	+5VDC Source
3	MIN Limit Input	Discrete limit switch input
4	+5V	+5VDC source
5	MAX Limit Input	Discrete limit switch input
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

4.1.2.2.8 J8 – POL Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J8	**PL**	**Phoenix Contact**	**1881529**

J8 is dedicated to the control of the drive for the Polarization axis. The table below describes the output of each pin.

Pin	Signal	Description
1	PWM Output 2	PWM signal for POL H-Bridge
2	Ground	Digital Ground
3	PWM Output 1	PWM signal for POL H-Bridge
4	Ground	Digital Ground
5	N/C	Not Used
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

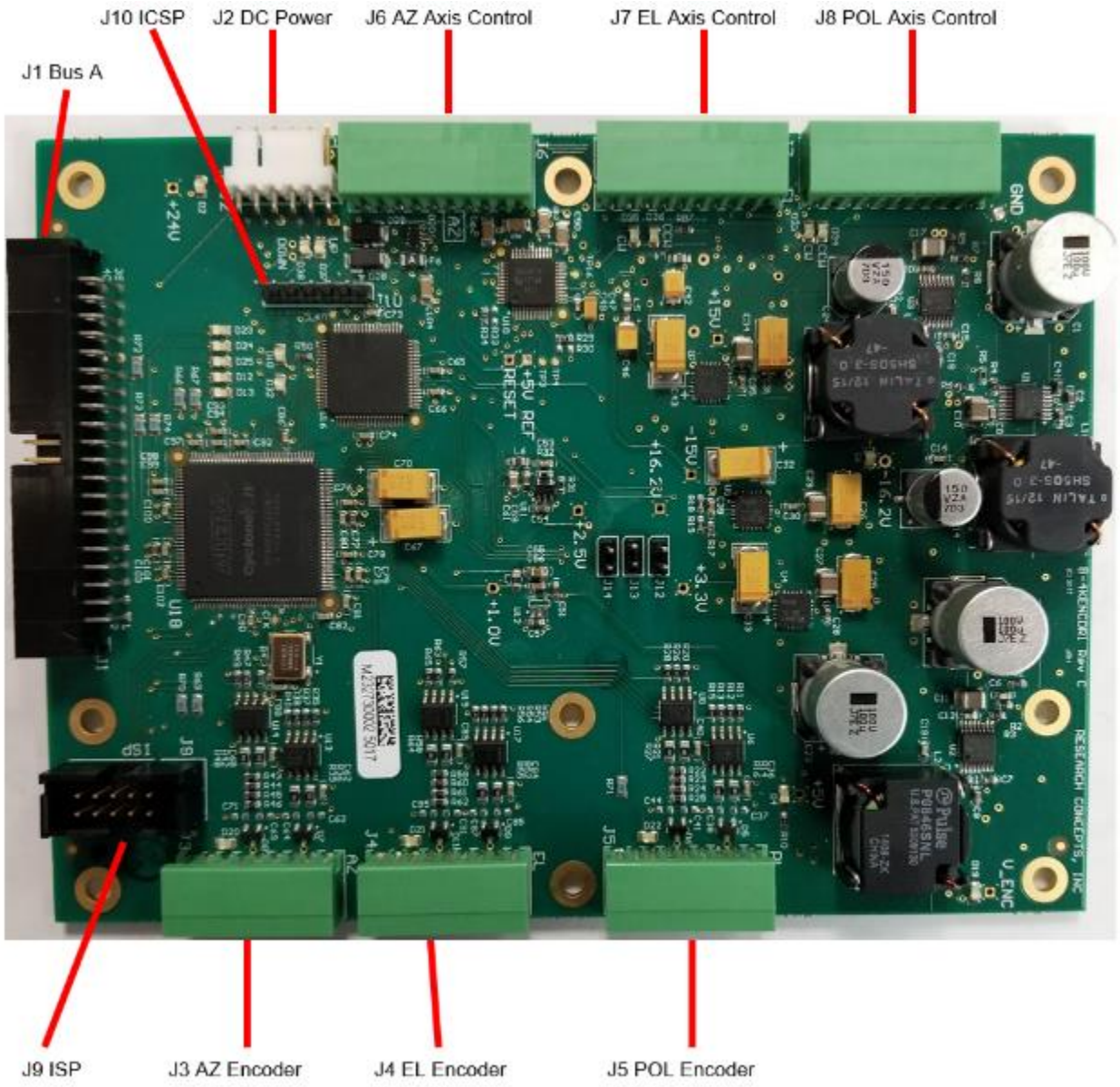
4.1.2.2.9 J10 - ICSP

Designation	PCB Marking	Manufacturer	Part Number
J10	**ICSP**	**TE Connectivity**	**9-146274-0 (x6)**

Factory use only.

4.1.2.3 Servo Encoder Board

The Servo Encoder Board allows an RC4800-based ACU to be able to sense axis positions via 25-bit optical encoders for AZ/EL and 23-bit optical encoders for POL. The card is also responsible for producing analog voltages used to interface to servo motor drives.



4.1.2.3.1 J1 – Inter-board Bus A

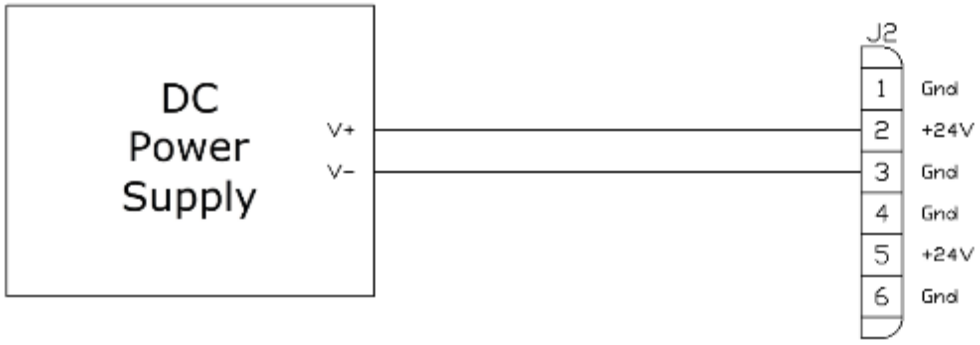
Designation	PCB Marking	Manufacturer	Part Number
J1	**Unmarked**	**TE Connectivity**	**510310-8**

Bus A is used to provide an interface between circuit boards in the ACU.

4.1.2.3.2 J2 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J2	**Power**	**Molex**	**22-11-2064**

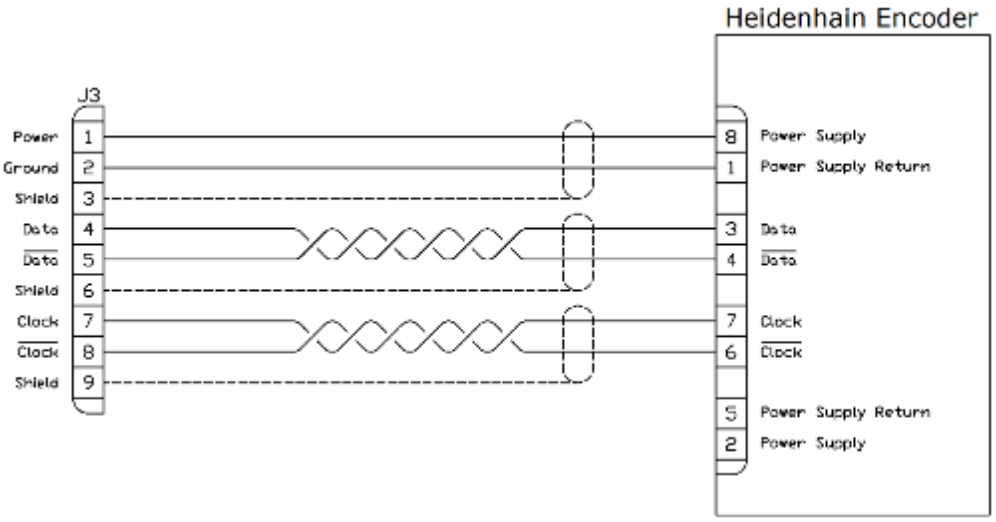
J2 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.3.3 J3 – AZ Encoder

Designation	PCB Marking	Manufacturer	Part Number
J3	**AZ**	**Phoenix Contact**	**1881516**

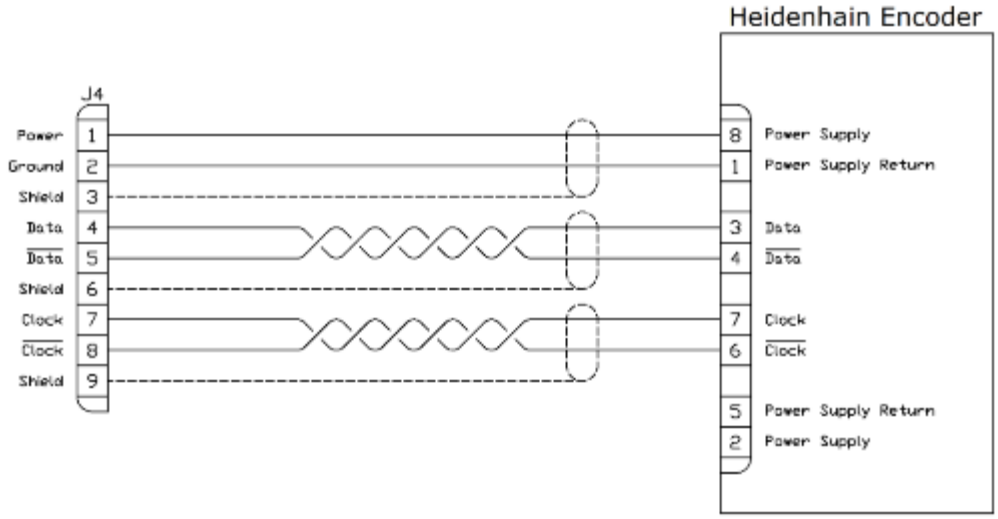
J3 is dedicated to the Azimuth Axis Optical Encoder.



4.1.2.3.4 J4 – EL Encoder

Designation	PCB Marking	Manufacturer	Part Number
J4	**EL**	**Phoenix Contact**	**1881516**

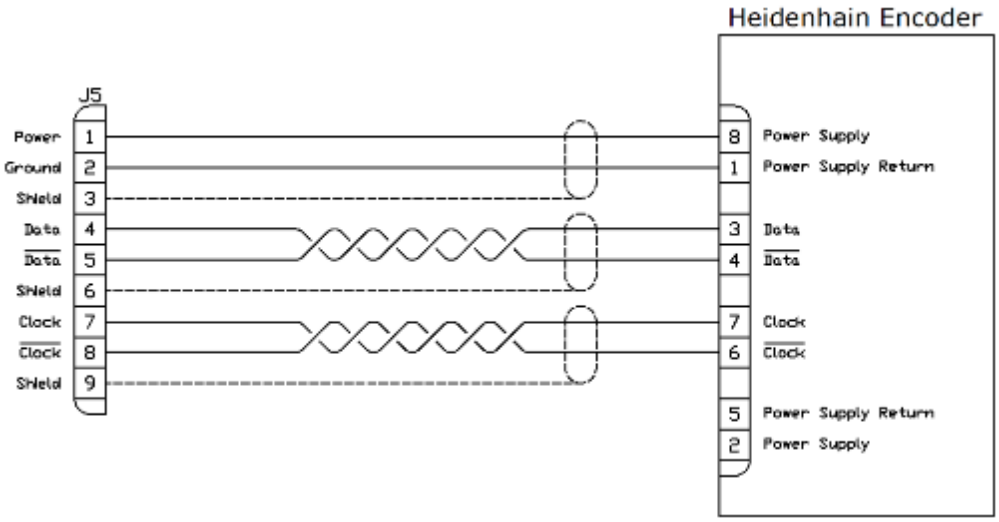
J3 is dedicated to the Elevation Axis Optical Encoder.



4.1.2.3.5 J5 – POL Encoder

Designation	PCB Marking	Manufacturer	Part Number
J5	**PL**	**Phoenix Contact**	**1881516**

J5 is dedicated to the Polarization Axis Optical Encoder.



4.1.2.3.6 J6 – AZ Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J6	**AZ**	**Phoenix Contact**	**1881529**

J6 is dedicated to the control of the drive for the Azimuth axis. The table below describes the output of each pin.

Pin	Signal	Description
1	Fault Input	0V or open=OK, 5V=Fault
2	+5V	+5VDC Source
3	MIN Limit Input	CCW Directional Bit
4	+5V	+5VDC source
5	MAX Limit Input	CW Directional Bit
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

4.1.2.3.7 J7 – EL Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J7	**EL**	**Phoenix Contact**	**1881529**

J7 is dedicated to the control of the drive for the Elevation axis. The table below describes the output of each pin.

Pin	Signal	Description
1	Fault Input	0V or open=OK, 5V=Fault
2	+5V	+5VDC Source
3	MIN Limit Input	Down Directional Bit
4	+5V	+5VDC source
5	MAX Limit Input	Up Directional Bit
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

4.1.2.3.8 J8 – POL Axis Control

Designation	PCB Marking	Manufacturer	Part Number
J8	**PL**	**Phoenix Contact**	**1881529**

J8 is dedicated to the control of the drive for the Polarization axis. The table below describes the output of each pin.

Pin	Signal	Description
1	PWM Output 2	PWM signal for POL H-Bridge
2	Ground	Digital Ground
3	PWM Output 1	PWM signal for POL H-Bridge
4	Ground	Digital Ground
5	N/C	Not Used
6	Ground	Digital Ground
7	Inhibit Output	High (open) = OK, Low (short to ground) = Inhibit Drive
8	Shield	Chassis Ground
9	Analog Velocity Ground	Return path for Analog Output
10	Analog Velocity Output	Analog voltage source (+10VDC to -10VDC) for servo drive control.

4.1.2.3.9 J9 – ISP

Designation	PCB Marking	Manufacturer	Part Number
J9	**ISP**	**TE Connectivity**	**103308-1**

Factory use only.

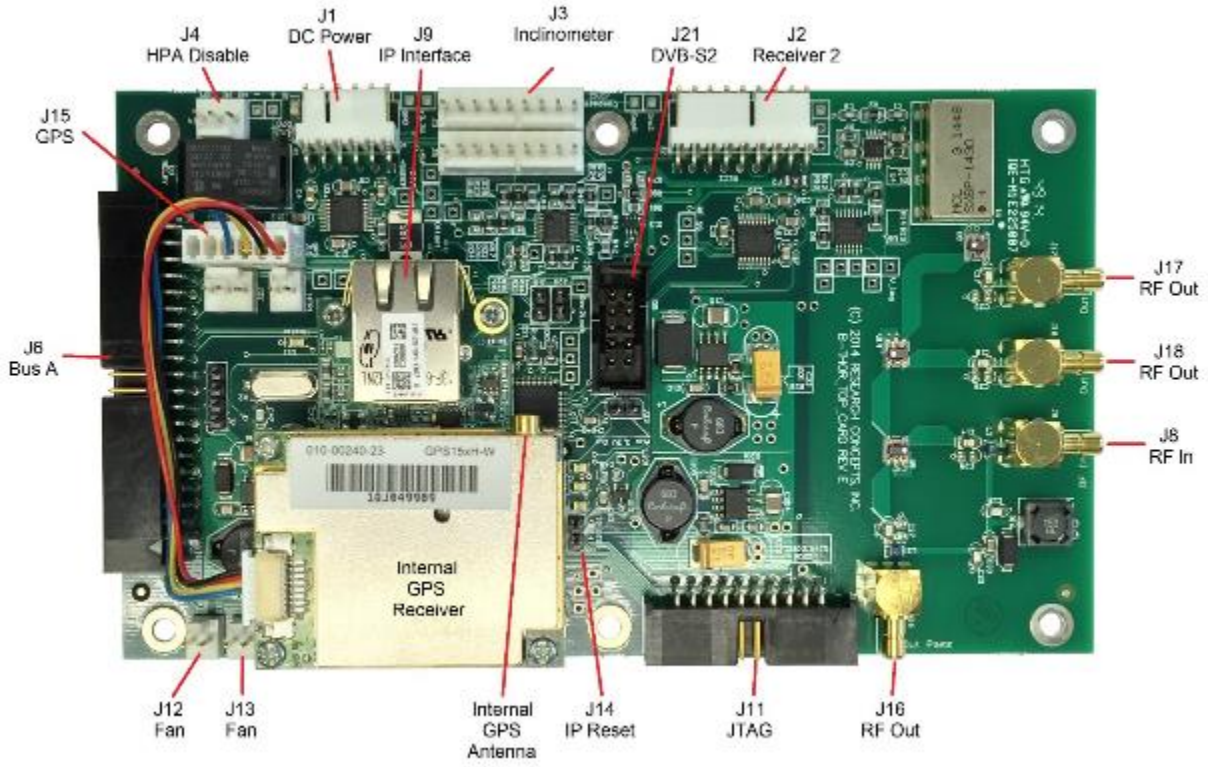
4.1.2.3.10 J10 – ICSP

Designation	PCB Marking	Manufacturer	Part Number
J10	**ICSP**	**TE Connectivity**	**9-146274-0 (x6)**

Factory use only.

4.1.2.4 Options Board

The Options Board allows an ACU to be customized with the desired set of optional features such as GPS, DVB, Beacon and Spectrum Analyzer.

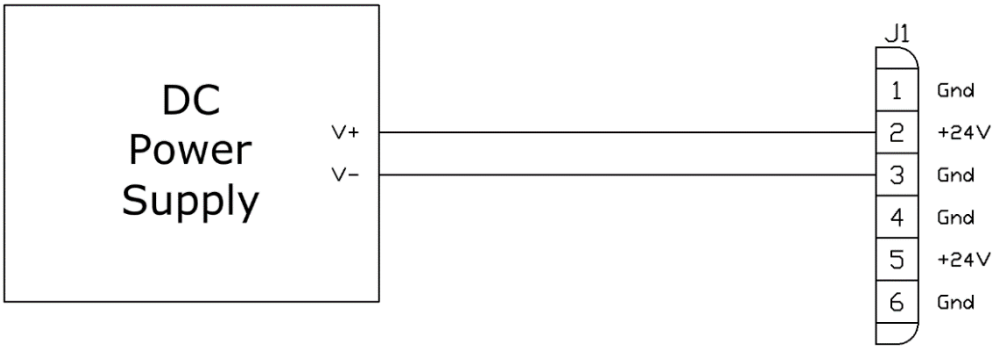


Spacers supporting the options board need to be greater than 0.437”.

4.1.2.4.1 J1 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J1	**Power**	**Molex**	**22-11-2064**

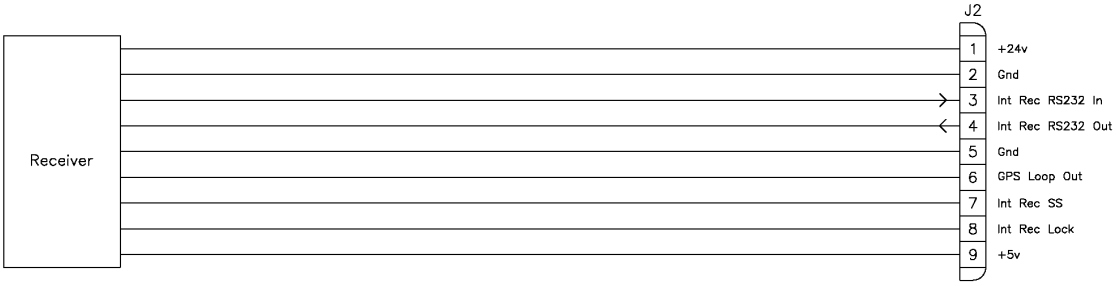
J1 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.4.2 J2 – Receiver 2

Designation	PCB Marking	Manufacturer	Part Number
J1	**Power**	**Molex**	**22-11-2094**

The J2 connector is allocated to support various types of receivers.



If there is software support for a particular receiver present, then the use of J2 I/O will be unique to that receiver and will be detailed in an appendix describing that software option.

4.1.2.4.3 J3 – Inclinometer

Designation	PCB Marking	Manufacturer	Part Number
J3	**Compass/Incl**	**Molex**	**22-11-2092**

This connector is not utilized for standard applications.

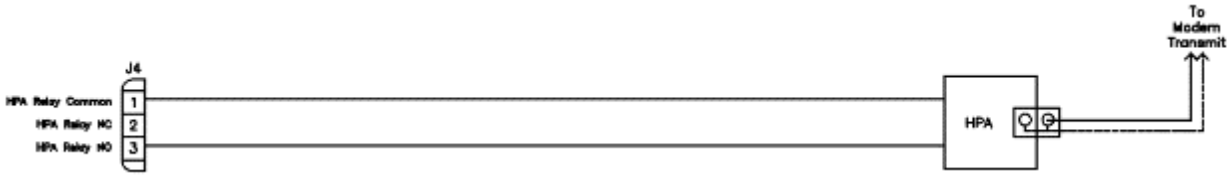
4.1.2.4.4 J4 – HPA Disable

Designation	PCB Marking	Manufacturer	Part Number
J4	**NO NC COM**	**Molex**	**22-11-2032**

The HPA disable is in a form-C contact arrangement with normally-open, normally-closed and common contacts. While the antenna is below the down elevation limit or while the antenna is performing any large-scale auto-moves, such as deploy, locate, or stow, the normally-closed and common pins will be connected. After the auto-move is complete, the connection will be released.

Some system configurations support special functions for the HPA Disable. Please consult Appendix B – Mount Specific Data for details on this.

The default contact arrangement is shown below:



4.1.2.4.5 J5 – Bar LEDs

Designation	PCB Marking	Manufacturer	Part Number
J5	**Unmarked**	**Molex**	**22-11-2092**

This connector is not utilized for standard applications.

4.1.2.4.6 J6 – Inter-Board Bus A

Designation	PCB Marking	Manufacturer	Part Number
J6	**BUS**	**TE Connectivity**	**510310-8**

Bus A is used to provide an interface between circuit boards in the ACU.

4.1.2.4.7 J7 – LEDs

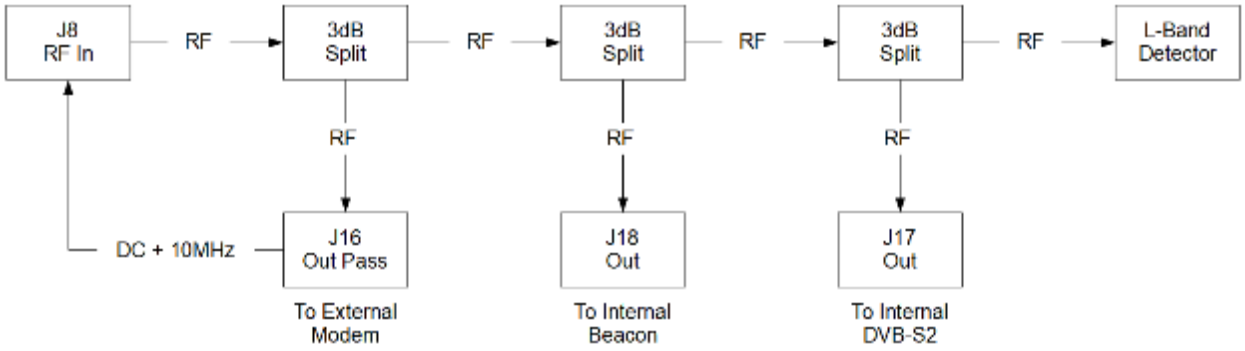
Designation	PCB Marking	Manufacturer	Part Number
J7	**Unmarked**	**TE Connectivity**	**9-146274-0 (x4)**

This connector is not utilized for standard applications.

4.1.2.4.8 J8 – RF In

Designation	PCB Marking	Manufacturer	Part Number
J8	**RF In**	**Amphenol RF**	**142146**

The block diagram below shows the RF path for the ACU.



4.1.2.4.9 J9 – IP Interface

Designation	PCB Marking	Manufacturer	Part Number
J9	**Unmarked**	**Digi International**	**498-0090**

This connector is for an IP interface device. The interface presented to the user will be a female RJ45 socket on the IP interface device.

4.1.2.4.10 J11 – JTAG

Designation	PCB Marking	Manufacturer	Part Number
J11	**JTAG**	**TE Connectivity**	**103308-1**

Factor use only

4.1.2.4.11 J12 – Fan1

Designation	PCB Marking	Manufacturer	Part Number
J12	**FAN1**	**Molex**	**22-11-2022**

Interface for internal cooling fan.

4.1.2.4.12 J13 – Fan2

Designation	PCB Marking	Manufacturer	Part Number
J13	**FAN2**	**Molex**	**22-11-2022**

Interface for internal cooling fan.

4.1.2.4.13 J14 – IP Reset

Designation	PCB Marking	Manufacturer	Part Number
J14	**IP RES**	**TE Connectivity**	**9-146274-0 (x2)**

Placing a jumper across these pins for 10 seconds while the controller is powered on will reset the IP interface to the default IP address (192.168.1.1).

4.1.2.4.14 J15 – GPS

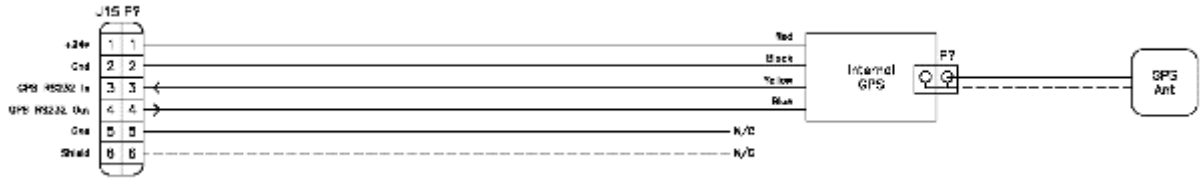
Designation	PCB Marking	Manufacturer	Part Number
J15	**GPS**	**Molex**	**22-11-2062**

The J15 connector supports either 1) an internally mounted GPS receiver requiring a separate external antenna or 2) an external integrated GPS receiver/antenna.

NOTE: the GPS receiver configuration is transparent to software.

Internal GPS

The internal GPS receiver (Garmin GPS 15xH) will be mounted to the options board and J15 will supply power, ground and serial data. An external GPS antenna will then be attached to the GPS receiver.



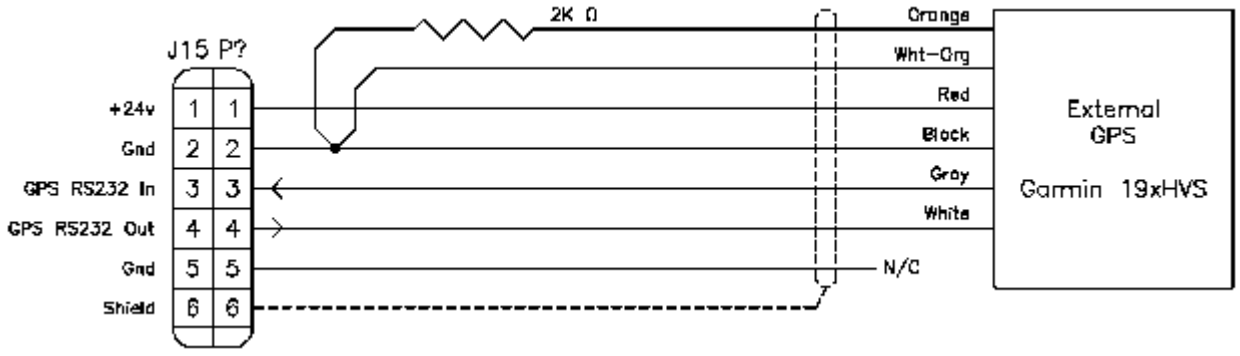
The connection to an active GPS antenna is provided through an MCX RF connector, the antenna should have a male connector installed on the end of its cable. The antenna must provide between 10dB to 30dB net gain between the antenna feed point and the connection to the GPS.

An example antenna is the Synergy Systems, LLC part number AR-05 active GPS antenna. This antenna has a center frequency of 1575.42 MHz and has a gain of 28dB.

External GPS

If the external GPS receiver is used, power/ground and serial data will be supplied from J15.

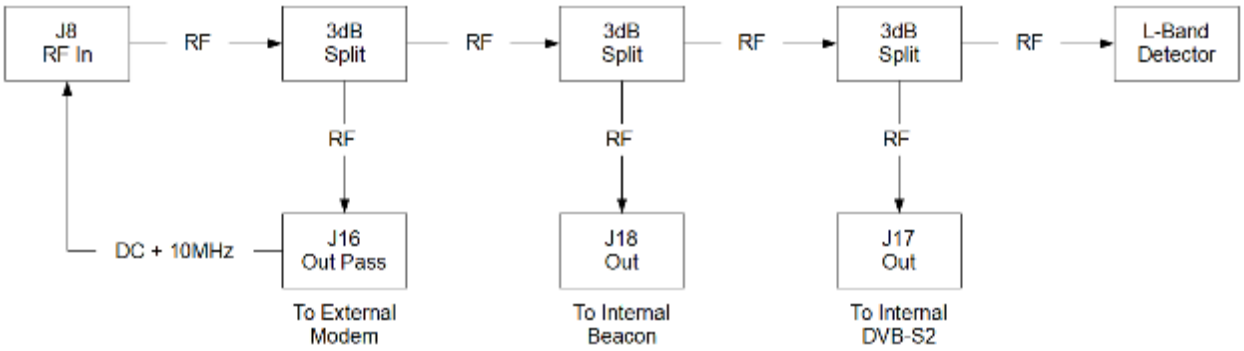
The diagram below shows the wiring connections for a Garmin 19xHVS.



4.1.2.4.15 J16 – RF Pass

Designation	PCB Marking	Manufacturer	Part Number
J16	**Out Pass**	**Amphenol RF**	**142146**

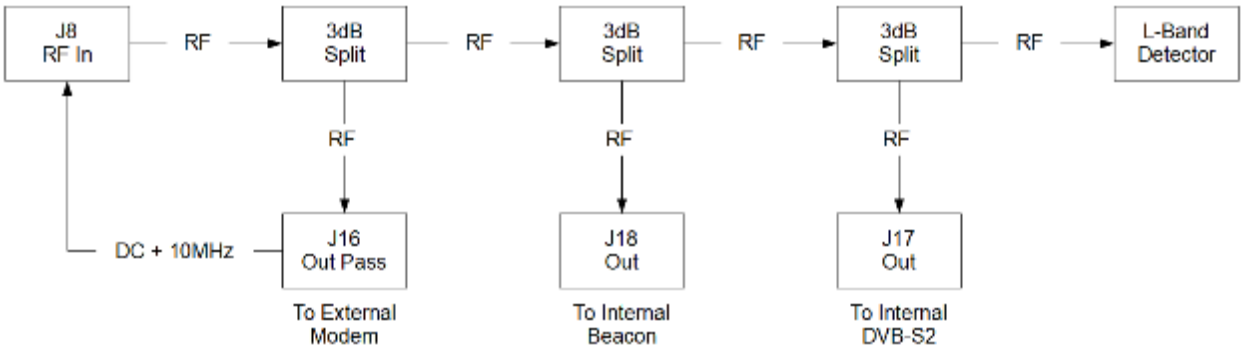
The block diagram below shows the RF path for the ACU.



4.1.2.4.16 J17 – RF Out

Designation	PCB Marking	Manufacturer	Part Number
J17	**Out**	**Amphenol RF**	**142146**

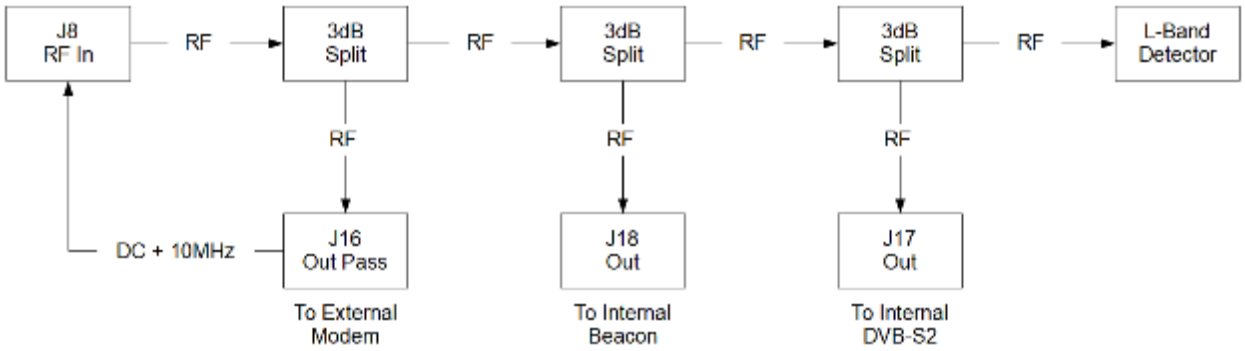
The block diagram below shows the RF path for the ACU.



4.1.2.4.17 J18 – RF Out

Designation	PCB Marking	Manufacturer	Part Number
J18	**Out**	**Amphenol RF**	**142146**

The block diagram below shows the RF path for the ACU.



4.1.2.4.18 J21 – DVB-S2

Designation	PCB Marking	Manufacturer	Part Number
J21	**Unmarked**	**TE Connectivity**	**103308-1**

This connector is purposed for connecting to the internal DVB-S2 receiver board.

4.2 External Equipment

4.2.1 Handheld Remote Front Panel

The optional Handheld Remote Front Panel (HHRFP) implements the traditional 16 button keypad and 4x40 character LCD user interface. However, it allows a much longer distance than what could be achieved by directly connecting to the LCD and keypad connectors on the computing card.

5 SUPPORT

5.1 Troubleshooting

5.1.1 Warning Displays

5.1.1.1 General Warnings

Alarm	**Description/Recommended Action**
Low Battery	Battery used to backup NVRAM and Date/Time is low. Replace internal battery backup.
Invalid Date/Time	Date/Time is corrupt. Reset the Date/Time via maintenance or GPS time sync.
Limits Inactive	The software limits of the controller are currently disabled. Reactivate limits via Limits maintenance screen.
Local Jog Connected	A local jog panel or handheld remote front panel is currently connected to the ACU. Disconnect the local jog panel or handheld remote front panel.
Standby	AZ/EL/POL drives are currently disabled. Toggle Standby on and off via the Standby menu mode.

5.1.1.2 Azimuth

Warning	**Description/Recommended Action**
CCW, ccw	Antenna is at the azimuth hardware limit (CCW) or azimuth software limit (ccw), move the antenna azimuth CW out of the limit.
CW, cw	Antenna is at the azimuth hardware limit (CCW) or azimuth software limit (ccw), move the antenna azimuth CCW out of the limit.

5.1.1.3 Elevation

Warning	**Description/Recommended Action**
DOWN, down	Antenna is at the elevation hardware limit (DOWN) or azimuth software limit (down), move the antenna elevation up out of the limit.
UP, up	Antenna is at the elevation hardware limit (UP) or elevation software limit (up), move the antenna elevation down out of the limit.

5.1.1.4 Polarization

Warning	Description/Recommended Action
CCW, ccw	Antenna is at the polarization hardware limit (CCW) or polarization software limit (ccw), move the antenna polarization CW out of the limit.
CW, cw	Antenna is at the polarization hardware limit (CCW) or polarization software limit (ccw), move the antenna polarization CCW out of the limit.

5.1.1.5 GPS

Warning	Description/Recommended Action
GPS Offline	ACU is not receiving information from the GPS receiver
Waiting For GPS	ACU is waiting for the GPS to report that it has a valid Lat/Lon

5.1.2 Alarm Displays

5.1.2.1 General Alarms

Alarm	Description/Recommended Action
Flash Version Mismatch	Flash Memory Structure error. Reset defaults, recalibration of controller will be required.
Flash Data Corrupt	Items in Flash Memory are corrupt. Reset defaults, recalibration of controller will be required.
NVRAM Version Mismatch	NVRAM version doesn't match Flash Memory version. Reset Defaults, recalibration of controller will be required.
NVRAM Data Corrupt	Items in NVRAM are corrupt. Reset defaults, recalibration of controller will be required.
Emergency Stop	The emergency stop input on the controller is currently open. Reset the input to clear alarm.

5.1.2.2 Azimuth

Alarm	Description/Recommended Action
Drift	Antenna was attempting to hold an azimuth position and the antenna drifted outside of the drift error configuration item range. Verify axis movement working as expected and that the drift error configuration item is set properly.
Follow	Antenna was moving and the difference between the current position and the calculated position was outside of the follow error configuration item range. Verify axis movement working as expected and that the follow error configuration item is set properly.
Drive	The current sensed from the azimuth axis was higher than the current limit configuration item. Verify axis movement working as expected and that the current limit configuration item is set properly.
Off-Axis	An alarm in a different axis has occurred that disables movement in this axis. Clear the error from the off axis.

5.1.2.3 Elevation

Alarm	**Description/Recommended Action**
Drift	Antenna was attempting to hold an elevation position and the antenna drifted outside of the drift error configuration item range. Verify axis movement working as expected and that the drift error configuration item is set properly.
Follow	Antenna was moving and the difference between the current position and the calculated position was outside of the follow error configuration item range. Verify axis movement working as expected and that the follow error configuration item is set properly.
Drive	The current sensed from the elevation axis was higher than the current limit configuration item. Verify axis movement working as expected and that the current limit configuration item is set properly.
Off-Axis	An alarm in a different axis has occurred that disables movement in this axis. Clear the error from the off axis.

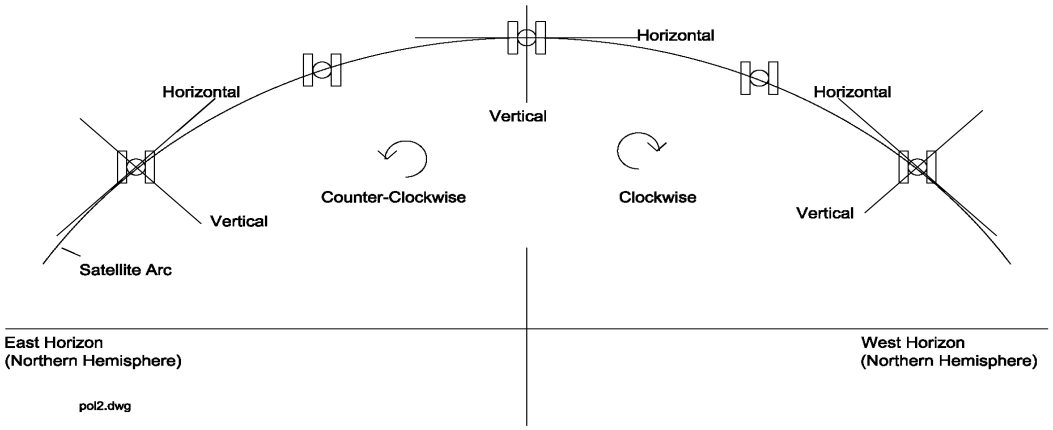
5.1.2.4 Polarization

Alarm	**Description/Recommended Action**
Drift	Antenna was attempting to hold an azimuth position and the antenna drifted outside of the drift error configuration item range. Verify axis movement working as expected and that the drift error configuration item is set properly.
Follow	Antenna was moving and the difference between the current position and the calculated position was outside of the follow error configuration item range. Verify axis movement working as expected and that the follow error configuration item is set properly.
Drive	The current sensed from the azimuth axis was higher that the current limit configuration item. Verify axis movement working as expected and that the current limit configuration item is set properly.
Off-Axis	An alarm in a different axis has occurred that disables movement in this axis. Clear the error from the off axis.

5.2 ACU Topics

5.2.1 Polarization Control

The ACU 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 ACU allows the user to specify the type of polarization axis mechanism present. If a circular polarized feed is present, no automatic movement of the polarization axis is performed.

5.2.2 Drive System

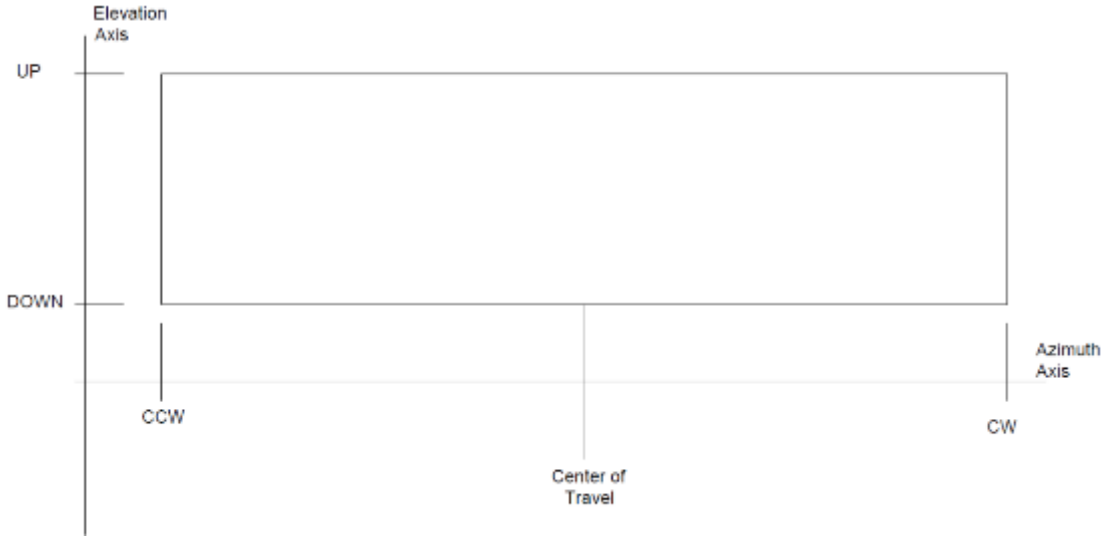
The RC4800 implements several mechanisms for the driving and monitoring of the azimuth, elevation and polarization axis.

5.2.3 Position Sensing and Limits

The RC4800 senses absolute axis position using feedback from various sensors (potentiometers, resolvers, encoders, etc). The sensed information is scaled appropriately for the antenna. This sensed position is displayed in angular format.

The boresight of the antenna is displayed for the azimuth and elevation axis. In elevation, this angle is with respect to the local horizontal. In azimuth, this angle the true azimuth pointing angle.

The following diagram shows a typical range of movement for an earth station antenna



In the azimuth axis, movement in one direction is disabled when clockwise and counterclockwise limit switches are activated.

In the elevation axis, movement in one direction is disabled when up and down limit switches are activated.

5.2.3.1 Follow, Drift, and Drive Error Sensing

The RC4800 continuously monitors the axis positions to detect incorrect movement of the antenna. If an axis has been commanded to move and the ACU detects that the movement is not “following” the calculated path, the controller will declare a “FOLLOW” condition and not allow further movement until the condition has been reset.

Similarly, if the ACU is holding position in an axis and the position “drifts” away from the held position and the controller cannot correct it out, the ACU will declare a “DRIFT” condition and not allow further movement until the condition has been reset.

The RC4800 also continuously monitors the azimuth and elevation motor drive current. If at any time the current sensed rises above the value set in the system configuration, the ACU will declare a “DRIVE” condition and not allow further movement until the condition has been reset.

In some applications, the current output from each drive is also limited by the setting of the servo drive. This value can only be changed by factory technicians.

5.2.4 Timekeeping

There are several versions of time (system, sidereal, display and GPS) discussed within this manual.

System time is maintained by the ACU's real time clock. The real-time clock is backed up by battery so that system time is available as soon as the ACU powers up. The system time is used to calculate **sidereal time** for maintaining track tables. Since satellite's do not experience time shifts (such as from Standard Time to Daylight Savings Time or when moving from one time zone to another), it is recommended that system time 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.

The ACU's system time is set to approximately **Universal Coordinated Time (UTC)** at the factory. It will vary from UTC due to the tolerance of the real-time clock.

The GPS receiver allows the ACU to parse UTC from the data sent by the GPS receiver. This data is only available when the GPS receiver is sufficiently locked on to GPS satellites to determine UTC. The ACU allows the user to synchronize system time to the UTC reported by the GPS receiver. The ACU will also automatically synchronize time shortly after power on, and at an 11 hour interval during operation.

The period of a satellite's motion is one sidereal day (approximately 23 hours 56 minutes 4 seconds). Base points in the track table for an inclined orbit satellite are stored at intervals of 1/48th of a sidereal day. The ACU determines at what point in a sidereal day (with respect to the reference) it is by calculating how many sidereal days have passed from January 1, 2000 until the present system time.

In several screens the ACU displays a **display time**. The user may designate a three-letter time zone designation and an hourly offset from system time. This allows the user to display local time or some other time without modifying system time. If system time is maintained close to UTC, the time displayed may be of use to operators for coordinating events.

See section 2.1.1.3.2.3 for details on time maintenance.