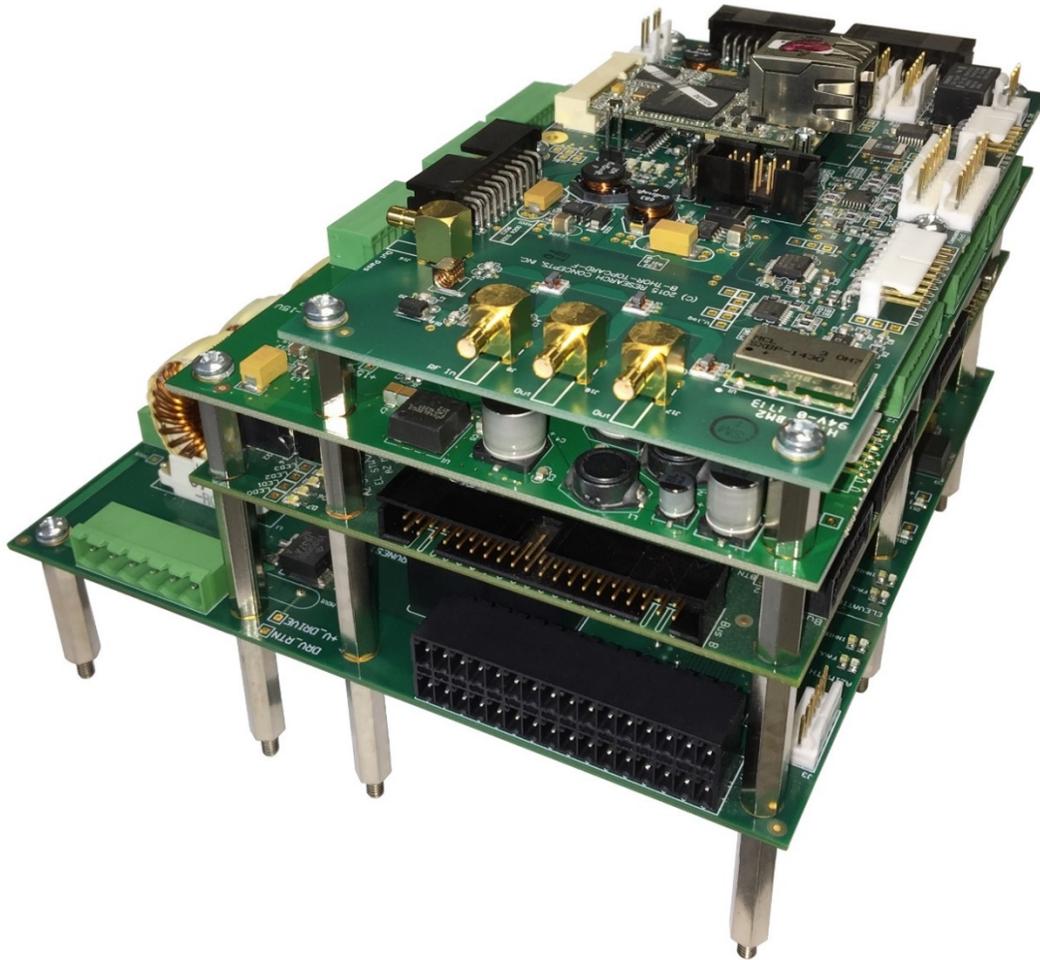


RC4600 SERVO ANTENNA CONTROLLER BOARD SET INTEGRATION MANUAL



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Table of Contents

1	INTRODUCTION	1
1.1	Manual Organization	1
1.2	Manual Conventions	2
1.3	RC4600 Features	3
1.4	Hardware Overview	4
1.5	Software Overview.....	5
1.5.1	Front Panel Overview.....	5
1.5.1.1	Operational Group Functions	5
1.5.1.1.1	Manual	5
1.5.1.1.2	Automatic Locate	5
1.5.1.1.3	Automatic Antenna Stow	6
1.5.1.2	Programming Group Functions	6
1.5.1.2.1	Configuration Screens	6
1.5.1.2.2	Maintenance Screens	6
1.5.2	Graphical User Interface Overview	7
1.6	Specifications.....	8
1.7	Part Number Scheme	9
2	SOFTWARE.....	10
2.1	Operation Overview	10
2.1.1	Front Panel Software Operation.....	11
2.1.1.1	Front Panel Software Overview	11
2.1.1.1.1	Modes	11
2.1.1.1.2	Keypad Usage	12
2.1.1.1.3	Data Entry	15
2.1.1.1.4	Display Layout	16
2.1.1.2	Front Panel Operating Group.....	17

2.1.1.2.1	MANUAL Mode.....	17
2.1.1.2.1.1	Heading Fix.....	19
2.1.1.2.2	MENU Mode	21
2.1.1.2.2.1	DEPLOY.....	21
2.1.1.2.2.2	STOW	22
2.1.1.2.2.3	LOCATE.....	23
2.1.1.2.2.3.1	Satellite Selection.....	25
2.1.1.2.2.3.2	LOCATE Automatic Movement.....	29
2.1.1.2.2.3.3	Azimuth Scan	30
2.1.1.2.2.3.4	Peak Up.....	31
2.1.1.2.2.3.5	Box Peak	32
2.1.1.2.2.3.6	Spiral Search.....	33
2.1.1.2.2.4	TRACK.....	34
2.1.1.2.2.5	POSITION.....	36
2.1.1.2.2.5.1	LAT/LON.....	36
2.1.1.2.2.5.2	HEADING	37
2.1.1.2.2.5.3	TILT	38
2.1.1.2.2.6	MOVETO.....	39
2.1.1.2.2.7	STANDBY	39
2.1.1.2.2.8	PEAKUP.....	40
2.1.1.3	Front Panel Programming Group.....	41
2.1.1.3.1	Configuration Mode	41
2.1.1.3.1.1	Normal Access Items.....	43
2.1.1.3.1.1.1	Expert Access Permission.....	43
2.1.1.3.1.1.2	Location Presets.....	44
2.1.1.3.1.1.3	Satellite Presets	45
2.1.1.3.1.1.4	DVB Detection Points.....	47

RC4600 ACU Board Set

2.1.1.3.1.1.5	Beacon Detection Points	49
2.1.1.3.1.1.6	TLE 1 Data	50
2.1.1.3.1.1.7	TLE 2 Data	51
2.1.1.3.1.2	Install Access Items	52
2.1.1.3.1.2.1	Azimuth Calibration	52
2.1.1.3.1.2.2	Elevation Calibration	53
2.1.1.3.1.2.3	Polarization Calibration	54
2.1.1.3.1.2.3.1	Multi-Feed Sensing Operation	54
2.1.1.3.1.2.4	Feed Definition	56
2.1.1.3.1.2.4.1	Multi-Feed Sensing Option	56
2.1.1.3.1.2.5	Autopeak	57
2.1.1.3.1.2.5.1	Multi-Feed Sensing	57
2.1.1.3.1.2.6	External Sig Factors	58
2.1.1.3.1.2.7	Beacon Sig Factors	59
2.1.1.3.1.2.8	RF Sig Factors	60
2.1.1.3.1.2.9	DVB Sig Factors	61
2.1.1.3.1.3	Super-User Access Items	62
2.1.1.3.1.3.1	System Definition	62
2.1.1.3.1.3.2	Azimuth Angle Movement	63
2.1.1.3.1.3.3	Azimuth Drive Parameters	64
2.1.1.3.1.3.4	Elevation Angle Movement	65
2.1.1.3.1.3.5	Elevation Drive Parameters	66
2.1.1.3.1.3.6	POL Angle Movement	67
2.1.1.3.1.3.7	POL Drive Parameters	68
2.1.1.3.1.3.8	Stow & Deploy	70
2.1.1.3.1.3.8.1	Multi-Feed Sensing	71
2.1.1.3.1.3.9	Track Factors	72

RC4600 ACU Board Set

2.1.1.3.1.3.10	Shake	74
2.1.1.3.1.3.11	Reset Defaults	75
2.1.1.3.2	Maintenance Items	76
2.1.1.3.2.1	VOLTS	76
2.1.1.3.2.1.1	10 Bit ADC Voltages.....	76
2.1.1.3.2.1.2	12 Bit ADC Voltages.....	77
2.1.1.3.2.2	DRIVE	78
2.1.1.3.2.3	TIME.....	78
2.1.1.3.2.4	SERVO MAINT	80
2.1.1.3.2.4.1	Secondary Servo Maintenance Profiles	82
2.1.1.3.2.4.1.1	Square Wave	82
2.1.1.3.2.4.1.2	Move To/Circle.....	83
2.1.1.3.2.4.1.3	Hold.....	83
2.1.1.3.2.5	LIMITS.....	84
2.1.1.3.2.6	GPS COM	85
2.1.1.3.2.7	CMP COM.....	85
2.1.1.3.2.7.1	Fluxgate Compass	85
2.1.1.3.2.7.2	Three Axis Compass	86
2.1.1.3.2.8	CMP CAL	86
2.1.1.3.2.8.1	Fluxgate Compass	86
2.1.1.3.2.8.2	Three Axis Compass	87
2.1.1.3.2.8.2.1	Mount.....	88
2.1.1.3.2.8.2.2	X/Y Calibration.....	89
2.1.1.3.2.8.2.3	Pitch/Roll Calibration	89
2.1.1.3.2.8.2.4	Reset Calibration to Factor Default	89
2.1.1.3.2.9	SHAKE	90
2.1.1.3.2.10	DVB.....	91

RC4600 ACU Board Set

2.1.1.3.2.10.1	Manual Tuning.....	91
2.1.1.3.2.10.2	Automatic Signpost Scanning	92
2.1.1.3.2.11	BCN.....	94
2.1.1.3.2.12	INCL.....	95
2.1.1.3.2.13	SYS INFO	96
2.1.2	Graphical User Interface Software Overview	97
2.1.2.1	Graphical User Interface Main Page	97
2.1.2.1.1	ACU Status Window	98
2.1.2.1.2	Antenna Position Display.....	98
2.1.2.1.2.1	Alternate Position Displays	99
2.1.2.1.2.1.1	Azimuth	99
2.1.2.1.2.1.2	Elevation.....	100
2.1.2.1.3	Local Jog Control.....	101
2.1.2.1.4	Main Display Window	102
2.1.2.1.4.1	Satellite Arc Display	102
2.1.2.1.4.2	Spectrum Analyzer Display.....	103
2.1.2.1.4.2.1	Frequency Controls	104
2.1.2.1.4.2.2	Amplitude Controls	104
2.1.2.1.4.2.3	Bandwidth Controls	104
2.1.2.1.4.2.4	Marker Controls.....	105
2.1.2.1.4.3	Tracking Diagnostic	105
2.1.2.1.5	Automatic Operations	106
2.1.2.1.5.1	Deploy	106
2.1.2.1.5.2	Stow	106
2.1.2.1.5.3	Locate	107
2.1.2.1.5.4	Track	108
2.1.2.1.5.4.1	Start Track.....	108

RC4600 ACU Board Set

2.1.2.1.5.4.2	Resume Track	109
2.1.2.1.5.5	Peak Up	109
2.1.2.1.5.6	Move To	110
2.1.2.1.5.7	Position	111
2.1.2.1.5.7.1	Lat/Lon.....	111
2.1.2.1.5.7.2	Heading	111
2.1.2.1.5.7.3	Tilt.....	112
2.1.2.1.5.8	Toggle Standby.....	112
2.1.2.1.5.9	Drive Reset	112
2.1.2.1.6	Signal Strength and Transmit Status.....	113
2.1.2.1.7	Maintenance	114
2.1.2.2	Configuration Page.....	115
2.1.2.2.1	Satellite Database.....	116
2.1.2.2.1.1	Satellite Configuration.....	117
2.1.2.2.2	System Settings.....	118
2.1.2.2.2.1	ACU Configuration	118
2.1.2.2.2.2	GUI Configuration	118
2.1.2.2.2.3	Additional IP Devices	119
2.1.2.2.3	Advanced.....	120
2.1.2.2.3.1	Satellite Database	120
2.1.2.2.3.2	Configuration Data	121
2.1.2.2.3.3	TLE Data	122
2.1.2.2.3.4	ACU Firmware.....	123
2.1.2.2.3.5	User Interface Firmware	124
3	INSTALLATION	125
3.1	Software Initialization.....	125
3.2	Motor and Velocity Feedback Calibration.....	126

RC4600 ACU Board Set

3.2.1	Elevation Axis	126
3.2.2	Azimuth Axis.....	127
3.2.3	Polarization Axis	128
3.3	Position Sensor Center of Travel Calibration	129
3.3.1	Elevation Axis	129
3.3.2	Azimuth Axis.....	129
3.3.2.1	Resolver or Optical Encoder	129
3.3.2.2	Potentiometer	129
3.3.3	Polarization Axis	130
3.3.3.1	Resolver or Optical Encoder	130
3.3.3.2	Potentiometer	130
3.4	Range of Travel and Limits Calibration	131
3.4.1	Elevation Axis.....	131
3.4.1.1	Up Limit	131
3.4.1.2	Down Limit.....	131
3.4.1.3	Stow Limit.....	131
3.4.2	Azimuth Axis.....	132
3.4.2.1	CW Limit.....	132
3.4.2.2	CCW Limit	132
3.4.2.3	Stow Limit.....	133
3.4.3	Polarization Axis	133
3.4.3.1	CW Limit.....	133
3.4.3.2	CCW Limit	134
3.4.3.3	Stow Limit.....	134
3.5	Navigation Sensor Communication	135
3.6	Compass Calibration	135
3.7	Azimuth and Elevation Alignment.....	136

RC4600 ACU Board Set

3.7.1	Elevation Alignment.....	137
3.7.2	Azimuth Alignment.....	137
3.8	Locate Source Calibration	138
3.8.1	L-Band Power Detector	138
3.8.2	Beacon Tracking Receiver	138
3.8.3	DVB Receiver	138
3.8.4	External Receiver	138
4	HARDWARE	139
4.1	Board Set Devices	139
4.1.1	Mechanical Mounting	139
4.1.2	Electrical Interfaces	142
4.1.2.1	Servo Drive Board	143
4.1.2.1.1	J1 – AZ/EL Drive Command.....	144
4.1.2.1.2	J2 – Drive Amplifier Power	147
4.1.2.1.3	J3 – DC Power.....	147
4.1.2.1.4	J4 – Azimuth Motor Drive	148
4.1.2.1.5	J5 – Elevation Motor Drive	148
4.1.2.1.6	J6 – Inter-board Bus B.....	149
4.1.2.1.7	J7 – Polarization Drive Power	149
4.1.2.1.8	J8 – Polarization Motor Drive Control.....	150
4.1.2.1.9	J9 – POL Motor Drive	151
4.1.2.1.10	Z200/201 – AZ & EL Motor Drives.....	152
4.1.2.2	Computing and Interface Board	153
4.1.2.2.1	J1 – Inter-board Bus B.....	153
4.1.2.2.2	J2 – Red/Green Buttons	154
4.1.2.2.3	J3 – Receiver.....	154
4.1.2.2.4	J4 – Dual Axis Inclinometer	155

RC4600 ACU Board Set

4.1.2.2.5	J5 – DC Power	155
4.1.2.2.6	J6 – USB.....	155
4.1.2.2.7	J7 – Inter-Board Bus A	156
4.1.2.2.8	J8 – Temperature Sensor.....	156
4.1.2.2.9	J9 – LCD.....	156
4.1.2.2.10	J10 – Keypad.....	156
4.1.2.2.11	J11 – Processor JTAG	156
4.1.2.2.12	J12 – PLD JTAG.....	157
4.1.2.2.13	J13A – Polarization Sensors	158
4.1.2.2.14	J13B – Accessories and Compass.....	159
4.1.2.2.15	J14A – Azimuth Sensors	160
4.1.2.2.16	J14B – Elevation Sensors	161
4.1.2.3	Servo Resolver Board	162
4.1.2.3.1	J1 – Inter-board Bus A.....	163
4.1.2.3.2	J2 – DC Power	163
4.1.2.3.3	J3 – AZ Resolver	163
4.1.2.3.4	J4 – EL Resolver	164
4.1.2.3.5	J5 – POL Resolver	164
4.1.2.3.6	J6 – AZ Axis Control.....	165
4.1.2.3.7	J7 – EL Axis Control	166
4.1.2.3.8	J8 – POL Axis Control	167
4.1.2.3.9	J10 - ICSP	167
4.1.2.4	Servo Encoder Board.....	168
4.1.2.4.1	J1 – Inter-board Bus A.....	169
4.1.2.4.2	J2 – DC Power	169
4.1.2.4.3	J3 – AZ Encoder.....	170
4.1.2.4.4	J4 – EL Encoder	170

RC4600 ACU Board Set

4.1.2.4.5	J5 – POL Encoder	171
4.1.2.4.6	J6 – AZ Axis Control	172
4.1.2.4.7	J7 – EL Axis Control	173
4.1.2.4.8	J8 – POL Axis Control	174
4.1.2.4.9	J9 – ISP	174
4.1.2.4.10	J10 – ICSP.....	174
4.1.2.5	Options Board	175
4.1.2.5.1	J1 – DC Power.....	176
4.1.2.5.2	J2 – Receiver 2.....	176
4.1.2.5.3	J3 – Inclinator	176
4.1.2.5.4	J4 – HPA Disable.....	177
4.1.2.5.5	J5 – Bar LEDs.....	177
4.1.2.5.6	J6 – Inter-Board Bus A	177
4.1.2.5.7	J7 – LEDs	178
4.1.2.5.8	J8 – RF In	178
4.1.2.5.9	J9 – IP Interface.....	178
4.1.2.5.10	J11 – JTAG	178
4.1.2.5.11	J12 – Fan1	179
4.1.2.5.12	J13 – Fan2.....	179
4.1.2.5.13	J14 – IP Reset	179
4.1.2.5.14	J15 – GPS	180
4.1.2.5.15	J16 – RF Pass	181
4.1.2.5.16	J17 – RF Out	181
4.1.2.5.17	J18 – RF Out	182
4.1.2.5.18	J21 – DVB-S2.....	182
4.2	External Equipment	183
4.2.1	Dual Axis Inclinator.....	183

RC4600 ACU Board Set

4.2.2	External GPS.....	183
4.2.2.1	External GPS Antenna	184
4.2.2.2	External GPS Receiver	185
4.2.3	Compass	185
4.2.3.1	Fluxgate Compass	186
4.2.3.2	3-Axis Compass	187
4.2.3.2.1	Mounting Considerations.....	188
4.2.4	Local Jog Panel.....	189
4.2.5	Handheld Remote Front Panel.....	190
5	SUPPORT.....	191
5.1	Troubleshooting.....	191
5.1.1	Warning Displays	191
5.1.1.1	General Warnings	191
5.1.1.2	Azimuth	191
5.1.1.3	Elevation.....	191
5.1.1.4	Polarization.....	192
5.1.1.5	GPS	192
5.1.1.6	Compass	192
5.1.1.7	Dual Axis Inclinometer	192
5.1.2	Alarm Displays	193
5.1.2.1	General Alarms	193
5.1.2.2	Azimuth	193
5.1.2.3	Elevation.....	193
5.1.2.4	Polarization.....	194
5.2	ACU Topics.....	195
5.2.1	Antenna Pointing Solution	195
5.2.2	Polarization Control	197

RC4600 ACU Board Set

5.2.3	Drive System	197
5.2.4	Position Sensing and Limits	197
5.2.4.1	Follow, Drift, and Drive Error Sensing	199
5.2.5	Timekeeping	199
5.2.6	Magnetic Variation	200
5.2.7	System Performance	201

1 INTRODUCTION

The RC4600 Servo Antenna Control Unit (ACU) board set consists of a stackable set of cards allowing for compact and flexible ACU packaging. The design and function of the RC4600 ACU is a continuation of development based on the RC4000 line of mobile antenna control systems.

PLEASE READ AND UNDERSTAND THE MANUAL. Due to the complexity of the functions performed by the RC4600, time invested in understanding its installation and operation will be well spent.

1.1 Manual Organization

The RC4600 board set allows for ACU functionality to be packaged in varied configurations. Also many hardware and software options are available for use with the RC4600 architecture. This manual is organized to:

- 1) Describe common hardware and software elements that will apply to all instances of the RC4600
- 2) Provide a structure to allow definition of elements unique to a specific use of the RC4600

Chapter 1 summarizes the contents of the manual and highlights the functionality and features of the RC4600.

Chapter 2 describes the core software features of the RC4600.

Chapter 3 describes the RC4600 board set hardware, interfaces and common external components.

Chapter 5 covers RC4600 common installation and calibration procedures, provides help for system troubleshooting and discusses detailed operational topics referred to in the manual

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 RC4600 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 RC4600. The following appendices will be included with every RC4600 manual:

APPENDIX REM - REMOTE CONTROL PROTOCOL
APPENDIX IP - IP-BASED REMOTE CONTROL
APPENDIX TRK - INCLINED ORBIT TRACKING
APPENDIX TLE - TWO LINE ELEMENT TRACKING

Example optional appendices that could accompany the manual include:

APPENDIX DVB - INTEGRATED DVB RECEIVER
APPENDIX BCN - INTEGRATED BEACON RECEIVER

1.2 Manual Conventions

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

AZ:	0.000	STOW	BCN: 2438	MANUAL
EL:	16.917		SAT:	
PL:	0.000		SPD: FAST	CST
<0-9>	JOG	ANTENNA	<MODE>MENU	14:25:47

The following table shows typical abbreviations used both on RC4600 screens and in the manual's text.

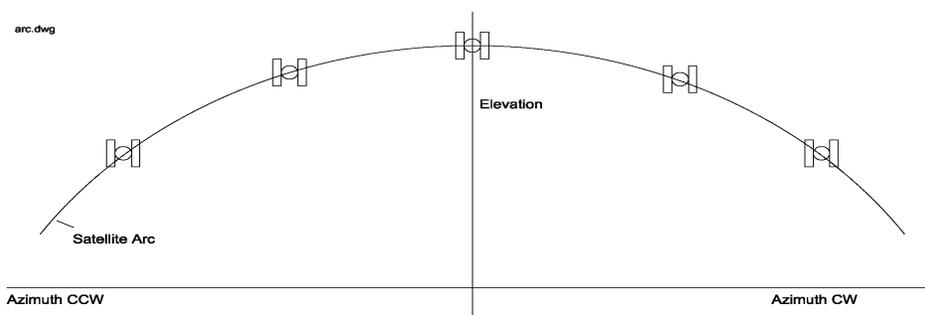
ITEM	ABBREVIATION(S)
Platform angles relative to reference position	az, el
Horizontal angles relative to the local horizontal plane	AZ, EL
True Heading (estimate)	th
True Heading (fixed)	TH
Clockwise	CW
Counter-Clockwise (Anti-Clockwise)	CCW
Down	DN
Latitude	LAT
Longitude	LON
Satellite	SAT
Global Positioning 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/minute (38°56 N) format.

When referring to an RC4600 mode of operation, that mode's name will be capitalized – ex. LOCATE.

Throughout the RC4600 manual and software, the latitude, longitude and true heading of the mount are collectively referred to as the mount's "position".

Movements of the mount (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 RC4600 Features

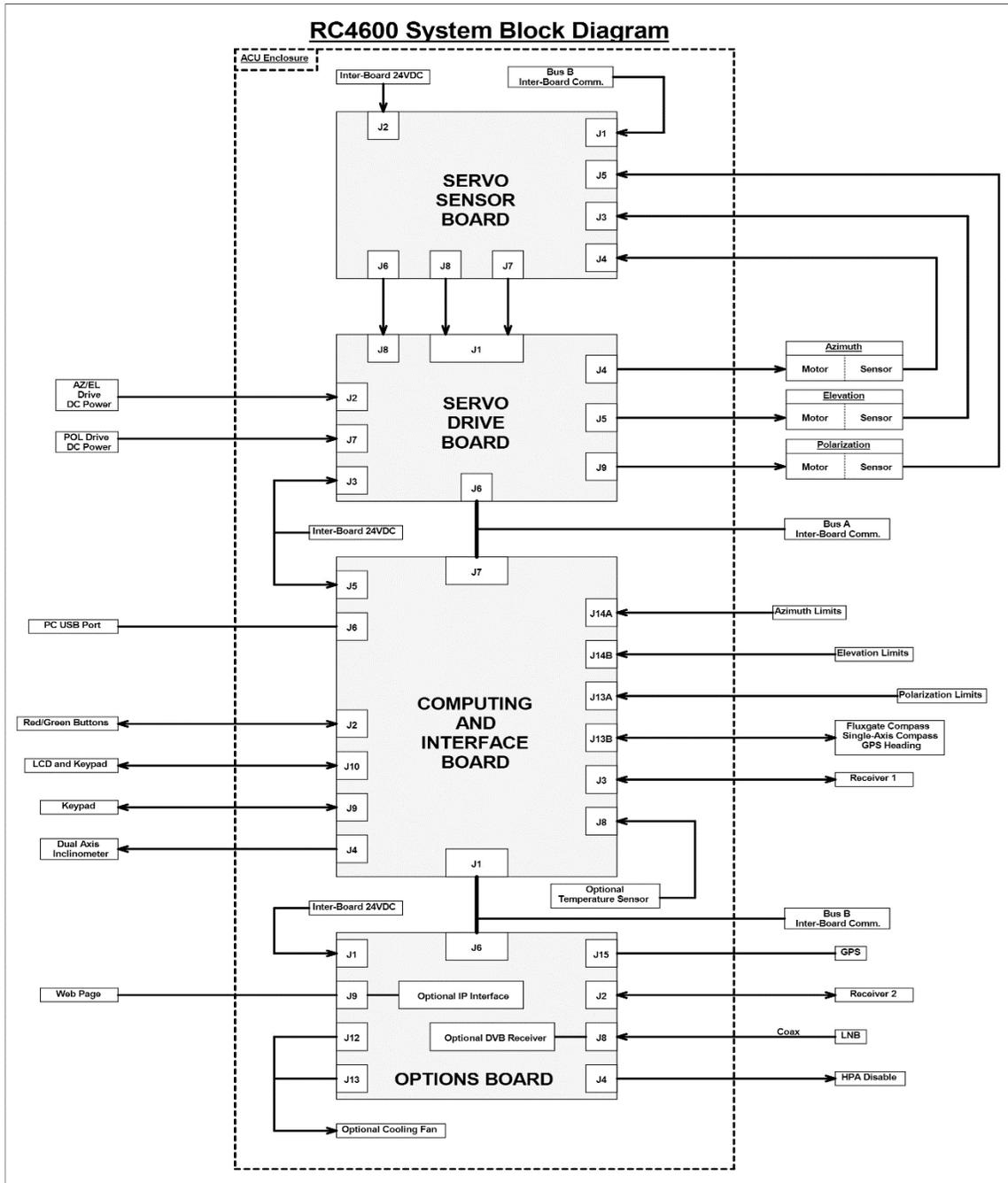
The RC4600 performs its functions via digital and analog electronic equipment interfaced to the antenna's motor drive and position sensor systems. This equipment is controlled through embedded software algorithms run by the RC4600's microcontroller.

The RC4600 ACU is designed to automate the operation of mobile (both vehicle mounted and deployable) mounts. Features provided include:

- Automatic azimuth and elevation pointing solution calculation
- Optional GPS receiver for determination of antenna latitude and longitude
- Automatic tracking of inclined orbit satellites
- Automatic polarization control of rotating feeds
- Battery backed-up non-volatile memory for storing satellite locations and configuration data
- Automatic repositioning to stored satellites
- Small stackable boards for flexible ACU packaging
- Continuous monitoring of antenna drive status
- Support for multiple band satellite operations
- Multiple Heading Sensor (Compass) Options
 - Fluxgate Compass
 - Three Axis Compass
 - Differential GPS Antenna Compass "GPS Compass"
- Multiple User Interface Options
- Optional Liquid Crystal Display (LCD) and keypad
- Ethernet (IP-based) remote control
 - Webpage Graphical User Interface (GUI)

1.4 Hardware Overview

The following figure is a block diagram showing the four major components of the RC4600 board set and how they interface with a typical antenna system.



Individual interfaces will be described in detail in Chapter 2. 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 RC4600 allows easy antenna control via its mode-based operation. Multiple user interfaces (local and remote control) options exist. Section 1.5.1 highlights the software functions by showing data that would be presented if a user interface utilizes the 4x4 keypad and 4x40 LCD screen. Section 0 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 RC4600.

1.5.1 Front Panel Overview

When using the physical front 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 :	0.000	STOW	BCN : 2438	MANUAL
EL :	16.917		SAT :	
PL :	0.000		SPD : FAST	CST
<0-9> JOG ANTENNA			<MODE> MENU	14:25:47

1.5.1.1.2 Automatic Locate

In LOCATE mode, azimuth and elevation pointing angles are automatically calculated based on position data (Lat/Lon), platform heading, platform pitch/roll and the selected satellite. Position data may be obtained automatically from a GPS receiver, selected from a preset list of user defined positions or entered manually. Heading may be automatically obtained from a compass or entered manually. The platform pitch/roll will be automatically obtained from a tilt sensor. The user selects which satellite to locate from the satellite database or by manually entering satellite data. The RC4600 checks that the calculated pointing solution is within the antenna's range of movement and prompts the user to automatically position the antenna.

ANT :	38_57N	94_45W	178.7	LOCATE
SAT : WB-1		111.2W	AZ :	26.5
			EL :	41.8
<1> SELECT NEW SAT			READY TO LOCATE	

1.5.1.1.3 Automatic Antenna Stow

From STOW mode, the user may ask for the antenna to be automatically moved to the stow position.

```

az:    0.000  (  0.0)                STOW
el:    22.230  ( -75.5)
MOVING ANTENNA TO STOW                <STOP>HALT

```

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 RC4600 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: 240                CONFIG-SYSTEM
GPS:2 ANT LOOK:1                    DRIVE:1
COMP:2 COMP OFF:  0.0              DISPLAY:2
<1-LOCATE 2-MENU 3-MANUAL 4-VSAT 5-POS>

```

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:10/22/18 16:57:45            TIME
DISPLAY:10/22/18 16:57:45          ZONE:UTC
GPS UTC:10/22/18 16:57:45         OFFSET:  0
1-DATE 2-TIME 3-SYNC 4-ZONE 5-OFFSET

```

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

RC4600 BOARDSET	
Physical	
Size	6 1/16" x 7" x 3 3/4" (with RCI plate and RF board)
Weight	2.6 lbs.
Input Power	Default: 20 - 28 VDC Other options available
Fusing	Mount and input power dependent
Temperature (Operational)	-40 to +60 deg. C.
Temperature (Storage)	-40 to +70 deg C.
Humidity	35% to 85% (optional special-environmental kit available)
Antenna Drive	
Azimuth/Elevation	Default: 24VDC, 20 Amps (combined AZ/EL) Other options available
Polarization	24VDC, 2 Amps
Electromechanical Brakes (optional)	24 VDC, 850 mA
Position Sense	
Azimuth/Elevation	ENDAT optical encoder (25 bit) or Resolver (16 bit)
Polarization	ENDAT optical encoder (23 bit), Resolver (16 bit), Multi-Turn Potentiometer
Limit Switch Inputs	5 VDC inputs, standard: EL Up, EL Down, EL Stow, AZ Stow, Pol Stow typical + additional inputs optional, mount dependent
Locate Mode	
AZ/EL Pointing Accuracy	±0.006° (Resolver), ±0.001° (Optical Encoder)
POL Pointing Accuracy	±0.08° (typical)
Pitch and Roll Sensing	±15° pitch and roll
VSAT Mode	Single key-press-to-locate-operation for untrained operators
Positive Satellite Identification	Multiple Beacon Tracking Receiver Options, DVB-S2, and Spectrum Analyzer.
External AGC	Support for external analog signal source and lock input
Track Mode	
Antenna Size	0.4 – 10.0 meters
Tracking Accuracy	0.1 to 3.0 dB selectable; mount dependent
Maximum Inclination	15°, standard
Inclined Orbit Tracking Modes	Step-Tracking, Step/Memory Tracking, Predictive Tracking, NORAD TLE tracking

1.7 Part Number Scheme

As of October 2018, the RC4600 part numbering scheme consisted of 20 digits. This scheme is introduced here to highlight many of the options (both hardware and software) associated with customizing an ACU solution using the RC4600. The following table only briefly discusses each item within the PN scheme and in some cases provides a reference to applicable sections within the manual.

DIGIT	ITEM	DESCRIPTION
19	Always '4'	common starting digit for RC4000-based products
18	ACU Version	6 - RC4600
17	Antenna Manufacturer	1 character representing antenna maker
15.16	Mount Designator	2 digits identifying unique mount/antenna software support
14	Navigation	Specifies optional navigation equipment (GPS, Fluxgate Compass, etc)
13	Tracking	Tracking Option Available
12	Remote Control	Remote Control Option
11	Receiver 2 (internal)	Receiver support (DVB, Beacon Receiver, etc.)
10	Receiver 1 (external)	Receiver support (Beacon Receiver, modem, etc.)
9	Enclosure	Board set Packaging
8	ACU Interface	
7	RF Options	Auxiliary RF routing board, etc.
6	Power Supply	
5	Sensors	
4	Power Input	Specifies DC or AC power supply, etc.
3	GUI Branding	
2	Reserved	
1	Reserved	
0	Options	

2 SOFTWARE

2.1 Operation Overview

The RC4600 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 LCD display. Operation using this method will be described in section 0 and includes the following methods of control:

- Rackmount 4600 Front Panel
- Handheld Remote Front Panel (Section 4.2.5)
- IP based remote front panel

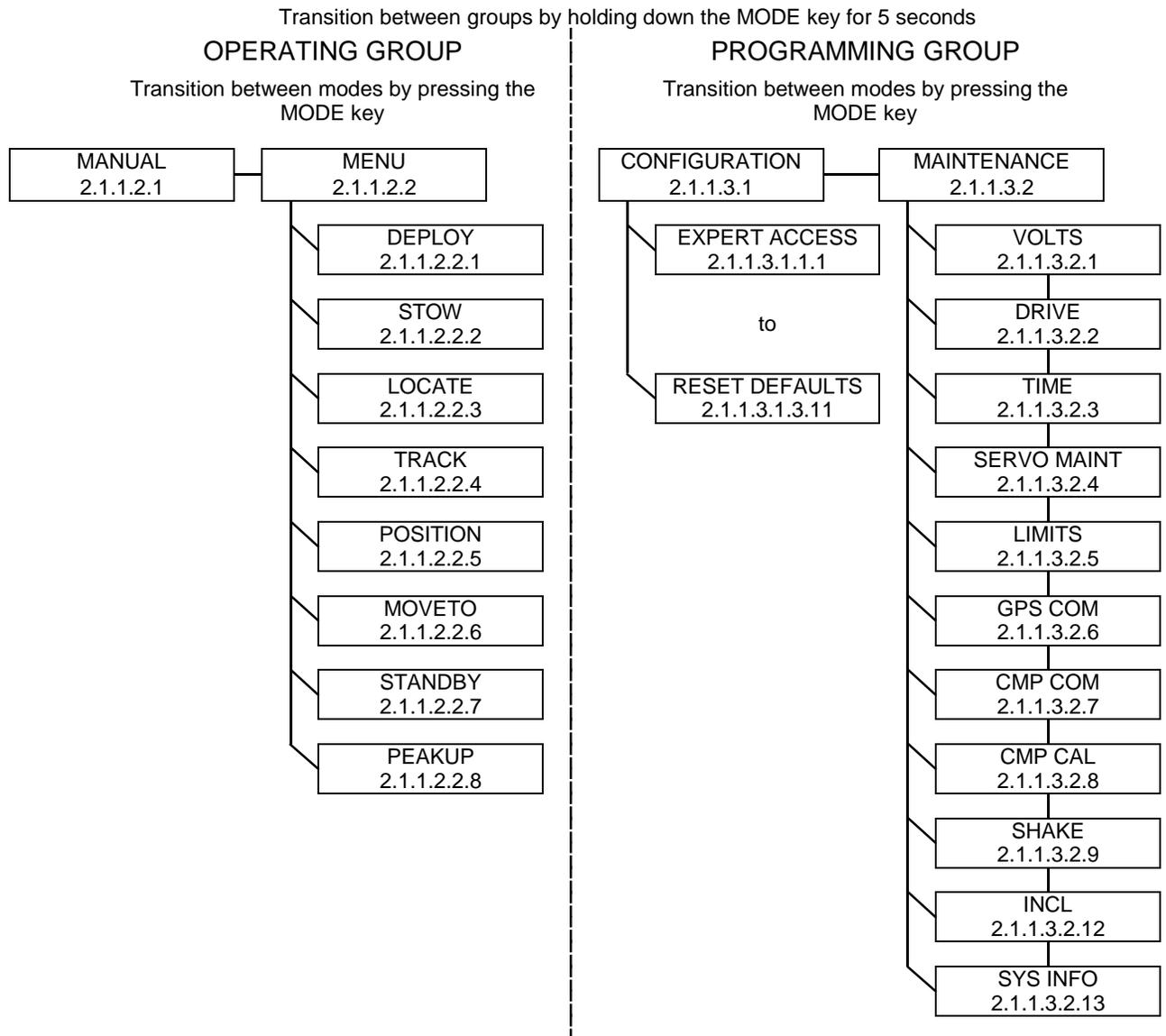
The second is an IP based graphical user interface (GUI) method of control. Operation using this method will be described in section 0.

2.1.1 Front Panel Software Operation

2.1.1.1 Front Panel Software Overview

2.1.1.1.1 Modes

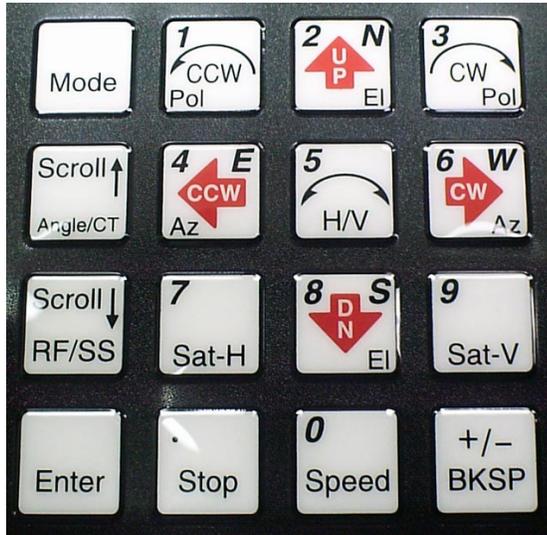
The functionality of the RC4600 is achieved by placing the controller in the desired mode of operation. The diagram below shows the hierarchy of the RC4600's modes. Each mode has a unique display screen that presents the information applicable to that mode's operation.



After initial pairing of an RC4600 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 introduces common elements of all modes.

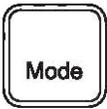
2.1.1.1.2 Keypad Usage

The keypad provides a flexible method of controlling the functionality of the RC4600. While each RC4600 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 EI 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 EI 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 RC4600 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 very similar to entering integer values except that the decimal point is inserted by using the <Stop> key.

Degree/Minute Latitude/Longitude Entry (TRUCK LAT:38°56N)

Entering Latitude or Longitude is similar to entering a floating point value but the decimal point is used to place the degree sign delimiter. Following the degree sign, only values from 0 to 59 are valid since they represent minutes. 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 similar to 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 RC4600 mode displays.

AZ:	-4.434	BCN:	659 L	TRACK
EL:	44.762	SAT:	GALAXY 28	(Ka)
		TLE:	IDLE	23:10
		WAITING TO REPOSITION...		<0>-MENU

MODE TITLE: In the upper right corner the title of the current RC4600 mode is displayed – in this example TRACK designates that the RC4600 is currently in track 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 horizontal 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 platform azimuth angle (AZ:) is -4.434. Likewise the satellite being tracked (SAT:) is GALAXY 28 (Ka).

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, <0> tells the user that pushing the mode key will transition the RC4600 to TRACK 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 RC4600 is displayed. In the above example, "WAITING TO REPOSITION..." describes the fact that since the RC4600 is currently in the IDLE portion of the TLE track operation the controller is waiting until the appropriate calculated time to perform the next TLE reposition movement.

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 RC4600 is functioning. In the above example, the current system time (23:10) 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 RC4600 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 RC4600's automatic movement features. While in either one of these modes, a momentary push of the Mode key will transition the RC4600 to the other mode.

2.1.1.2.1 MANUAL Mode

AZ :	0.000	STOW	BCN : 2438	MANUAL
EL :	16.917		SAT :	
PL :	0.000		SPD : FAST	CST
<0-9>	JOG	ANTENNA	<MODE>	MENU 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:/TH:/MG:/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.

The value displayed may be changed by the <Scroll Up/Angle CT> key. The display will rotate between showing local horizontal relative (AZ), true heading horizontal relative (TH), magnetic heading horizontal relative (MG) and platform relative (az) values. When first entering MANUAL mode, the field will always be initialized in the display mode selected by the Initial Azimuth Display configuration item (2.1.1.3.1.3.1).

The local horizontal relative azimuth angle is calculated by taking the current platform relative azimuth and elevation angles along with the pitch and roll of the mount. If there is currently no mount pitch and roll. The local horizontal relative azimuth angle will display the same value as the platform relative azimuth angle.

The true heading horizontal azimuth angle is derived by taking the current heading estimate of the mount (see the LOCATE function) and adding local horizontal relative azimuth angle and the magnetic variation for the current location. If there is currently no mount heading estimate, the field will display "*****". If the current heading estimate has not been "fixed" (either manually or automatically by the DVB receiver function), the field display th: instead of TH: to indicate that the heading value may be inaccurate due to compass error.

The magnetic heading horizontal azimuth angle is derived by taking the current heading estimate of the mount (see the LOCATE function) and adding local horizontal relative azimuth angle. If there is currently no mount heading estimate or lat/lon, the field will display "*****". If the current heading estimate has not been "fixed" (either manually or automatically by the DVB receiver function), the field display mg: instead of MG: to indicate that the heading value may be inaccurate due to compass error.

EL:/el:

The EL 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		
<i>Hardware Limit</i>	STOW, DOWN, UP	n/a
<i>Software Limit</i>	stow, down, up	STOW, DOWN, UP

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

The value displayed may be changed by the <Scroll Up/Angle> CT key. The display will rotate between showing local horizontal relative (EL) or platform relative (el) values.

The local horizontal relative elevation angle is calculated by taking the current platform relative azimuth and elevation angles along with the pitch and roll of the mount. If there is currently no mount pitch and roll. The local horizontal relative elevation angle will display the same value as the platform relative elevation angle.

Following a LOCATE operation, the azimuth and elevation limit fields will display the target angles in parenthesis. If a limit condition is active, the limit display will overwrite the target values.

PL:/pl:

The PL 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			
<i>Hardware Limit</i>	STOW, CCW, CW	STOW, CCW, CW	n/a
<i>Software Limit</i>	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 LOCATE operation occurred prior to MANUAL, the H and V values will be those automatically calculated by the LOCATE 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. For example, if a cross polarization movement of 90 degrees clockwise will move the axis beyond the clockwise limit, the movement will be achieved by moving 90 degrees counter-clockwise.

RF/EXT/BCN/DVB:

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. If the controller is equipped with an optional internal DVB-S2 receiver, **DVB** will also be available as a signal source.

The current signal strength will be displayed as a value between 0 and 1023 for **RF** and **BCN** or 0 and 4096 for **EXT** or **DVB**.

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.

SPD:

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

TIME DISPLAY

MANUAL mode will display the "display time" (2.1.1.3.2.3) and time zone in the lower right-hand corner.

2.1.1.2.1.1 Heading Fix

After a LOCATE operation has occurred, the operator is delivered to MANUAL mode and the user is given the ability to correct the mount's true heading based on where the selected satellite is found. This HEADING FIX capability is available when all the following conditions are true:

- 1) MANUAL mode was entered following a successful LOCATE
- 2) The selected satellite is geostationary (inclination = 0)
- 3) The mount's position has not already been saved
- 4) The heading has not already been fixed (automatically or manually)

When the above conditions are present, the "<0-9>JOG ANTENNA" message at the bottom of the LCD will alternate with "<ENTER>FIX HEADING" message. The user should positively identify that he is on the selected satellite and manually peak up in azimuth and elevation. When the Enter key is pressed, the MANUAL mode will switch to the following screen.

CURRENT HEADING: 178.7	HEADING FIX
ACTUAL HEADING: 175.4	SAT: GALAXY 28
DIFFERENCE: -3.3	
<BKSP>APPLY DIFF. TO HEADING <MODE>EXIT	

The HEADING FIX screen shows the name of the selected satellite in the SAT: field. The CURRENT HEADING field shows the heading originally determine by the LOCATE function based on the mount's current position. The ACTUAL HEADING field shows the where the user peaked up on the satellite while in MANUAL mode.

The DIFFERENCE field shows the value obtained by subtracting the CURRENT HEADING from the ACTUAL HEADING. This difference should reflect the error in the mount's true heading. Pushing the <BKSP> key will apply the difference to the mount's heading for use in subsequent LOCATE operations.

NOTE: to make this "fixed heading" persist through the next powering down of the RC4600, the mount's position would need to be "saved" via the POSITION mode. If the difference is applied, the RC4600 will proceed to the POSITION screen.

If the user is unsure that applying the difference is the correct thing to do, pressing the <Mode> key will return the RC4600 to the MANUAL mode.

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.

```

1-DEPLOY    2-STOW      3-LOCATE      MENU
4-TRACK
7-POSITION  8-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 DEPLOY

The DEPLOY mode automatically moves to the mount's predefined "deploy" position. See Appendix B for the list of deploy positions for the various mounts supported. The deploy command requires an explicit confirmation in order to initiate antenna movement.

```

<MODE>MENU (DO NOT DEPLOY)      DEPLOY
<BKSP>CONTINUE DEPLOY

```

Pressing the <BKSP> key will initiate the DEPLOY movement. If the DEPLOY mode was inadvertently entered, pressing the Mode key will return to the MENU mode without initiating antenna movement.

```

az:    0.000    (    0.0)      DEPLOY
el:   13.236    (   16.0)
MOVING ANTENNA TO DEPLOY      <STOP>HALT

```

As each axis moves, its label (az/el/pl) will flash and the current position will update. The target deploy positions will be displayed in parenthesis. The sequence of axis movement will be mount dependent.

Following completion of movement to the deploy position, the RC4600 will return to MANUAL mode. The automatic movement may be terminated anytime by pressing the <Stop> key.

The azimuth, elevation and polarization deploy positions are defined in the Stow/Deploy configuration screen (2.1.1.3.1.3.8).

2.1.1.2.2.2 STOW

The STOW mode automatically moves to the mount's predefined "stow" position. See Appendix B for the list of stow positions for the various mounts supported.

Like the DEPLOY mode, STOW requires an explicit confirmation to initiate movement.

```

                                     STOW
<MODE>MENU (DO NOT STOW)
<BKSP>CONTINUE STOW

```

After initiation a sequence of movements will be performed to stow the antenna. The sequence of axis movements will be mount dependent. As each axis moves, its label (az/el/pl) will flash and the current position will update. The target stow positions will be displayed in parenthesis.

```

az :    0.000    (    0.0 )                STOW
el :   13.236    (  -75.5 )
MOVING ANTENNA TO STOW                    <STOP>HALT

```

The following describes a typical sequence of movements:

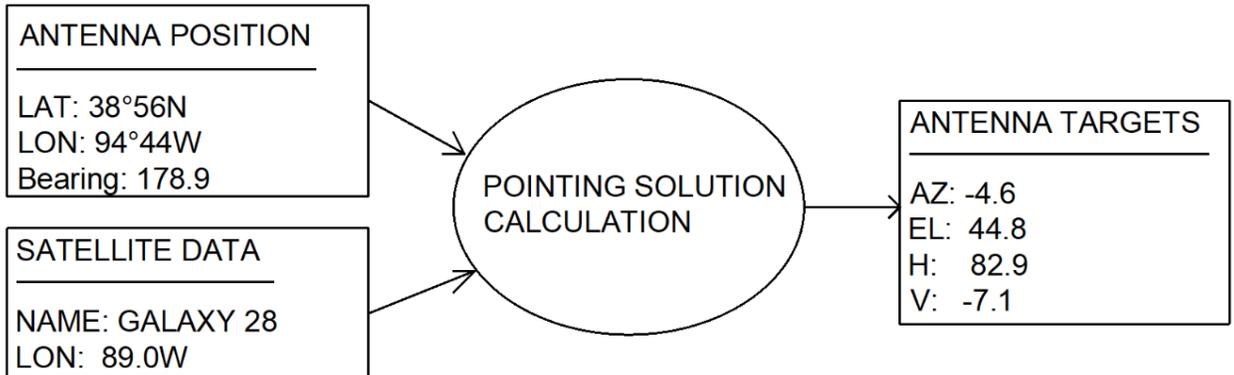
- the azimuth axis is moved to its predefined stow position (typically az:0.000). After moving to this indicated position, the RC4600 will confirm the position by looking to see if the azimuth stow switch is active. If the azimuth stow switch is not recognized, the mount will be moved a short distance to either side of the current position trying to find the azimuth stow switch. If the controller fails to see the azimuth stow switch the following message will be displayed: **"*CANNOT FIND AZ STOW SWITCH* <MODE>EXIT"** and no further stow movements will be performed.
- if stowing of the polarization axis is enabled, the polarization axis will next move to its predefined stow position. As with the azimuth axis, if a polarization stow switch (if the mount is so equipped) is not confirmed then the message **"*CANNOT FIND POL STOW SWITCH* <MODE>EXIT"** will be displayed and no further stow movements will be performed.
- if the azimuth and optional polarization movements complete successfully, then the elevation axis will move to its predefined stow position. Typically, this movement ends when the elevation stow limit is encountered.

Following completion of movement to the stow position, the RC4600 will return to MANUAL mode. The automatic movement may be terminated anytime by pressing the <Stop> key.

Many mounts have unique stow sequence requirements. Check Appendix B to see if your mount has any unique stow situations. The azimuth, elevation and polarization stow positions are defined in the Stow/Deploy configuration screen (2.1.1.3.1.3.8). Typically, the default parameters will be correct for a particular mount.

2.1.1.2.2.3 LOCATE

The LOCATE mode performs a calculation of the pointing angle (5.2.1) to a selected satellite based on the RC4600's estimate of where the antenna is positioned (lat/lon) and oriented (Antenna Bearing). After the calculation is performed, the user may initiate an automatic antenna movement to locate the selected satellite.



When the LOCATE mode is first entered, the following screen appears.

```

ANT:      38_57N  94_45W  178.9      LOCATE
SAT: GALAXY 28   89.0W           AZ:    -4.6
                                           EL:    44.8
<1>SELECT NEW SAT           READY TO LOCATE
  
```

ANT: 38_57N 94_45W 178.9

The ANT: field shows the RC4600's current estimate of antenna position. If no estimate of antenna position is available, the RC4600 will automatically attempt to obtain position information from the navigation sensors (GPS receiver and compass) if present prior to displaying the initial screen above.

Mount Position Initialization. In order to calculate a pointing solution, the RC4600 requires knowledge of the mount's "position". The three components of mount position are latitude, longitude, and true heading.

The current latitude, longitude and true heading where the RC4600 believes the antenna is positioned are displayed on the top line. The position data obviously affects the pointing angle that the RC4600 calculates and is displayed as a crosscheck for the user in case the vehicle has been moved and the RC4600's position has not been updated. If the lat/lon or heading data is not considered valid by the RC4600, asterisks will be displayed in the appropriate field and the "parameter needed" message will be triggered in the location readiness field.

The RC4600 polls the GPS receiver first to get latitude and longitude information. If no communication with the GPS is received, the error message "GPS OFFLINE" will be displayed. In this case the interface between the RC4600 and the GPS receiver would need to be checked. If the RC4600 is communicating with the GPS receiver but the GPS indicates it has not yet been able to generate a valid lat/lon, then the message "NAV NOT READY" will be displayed. The "NAV NOT READY" situation should typically not last for more than a minute. If it does, then investigate whether the GPS receiver's view of the sky is blocked by buildings, etc.

If a valid lat/lon is received from the GPS then the lat/lon information will be displayed. Next the RC4600 will flash "MAGVAR" while it calculates the local magnetic deviation as a function of latitude, longitude and time. After calculating the local magnetic variation, the RC4600 will poll the compass for magnetic heading information. The magnetic variation will be applied to the magnetic heading to form the estimated true heading of the mount.

If the navigation sensors (GPS and/or compass) are not working (or not available), the position information may be entered manually via the POSITION mode (2.1.1.2.2.5).

SAT: GALAXY 28 89.0W

<1>SELECT NEW SAT

The SAT: field shows the currently selected satellite's name and longitude. When the mode is first entered, the name of the last satellite selected will be displayed. If the user wishes to locate another satellite, he may start the process of selecting the new satellite by pressing the "1" key. See 2.1.1.2.2.3.1 for further details on the three methods of selecting a satellite.

When the selected satellite is changed, the LOCATE mode will automatically calculate new azimuth and elevation pointing targets.

AZ: -4.6

EL: 44.8

These fields show the azimuth and elevation pointing angles calculated for the selected satellite based on the current mount position estimate. If one of the required parameters is missing or the calculation has yielded an invalid answer, asterisks will be displayed in these fields.

NOTE: the displayed AZ target is not a true heading display but rather a mount-relative angle. The elevation target is a true elevation value.

MG:/TH:

If the user wishes to display a magnetic or true heading pointing solution (rather than antenna relative), he may choose how the azimuth data is presented by changing the Azimuth Display configuration item via the System Definition (2.1.1.3.1.3.1) screen.

Location Readiness Status

In the lower right corner of the display, a message is displayed showing the status of the location calculation. Three messages may be displayed:

- 1) **PARAMETER NEEDED.** The pointing angle calculation requires 3 sets of data:
 - a. Antenna lat/lon
 - b. Antenna Bearing
 - c. Satellite Information

If lat/lon and/or heading is missing/invalid, the user will need to go to POSITION mode (2.1.1.2.2.5) to enter valid data. If satellite information is missing/invalid, the user will need to supply that information via the mechanisms described in section 2.1.1.1.3.

- 2) **AZIM/ELEV RANGE ERROR.** These messages will occur if the pointing solution calculation yields an azimuth angle that is outside the clockwise or counter-clockwise azimuth software limits (2.1.1.3.1.2.1) or outside the up or down elevation software limits (2.1.1.3.1.2.2). The appropriate message will be displayed to indicate that the RC4600 does not think it can move the antenna to the correct position to acquire the satellite. The user may have to move the antenna to place it in an orientation that will allow the mount to move to the required position. Note that this message may indicate that the current position data is incorrect (example: wrong heading).
- 3) **READY TO LOCATE / PRESS <ENTER>.** This alternating message indicates that the RC4600 considers the calculated pointing solution valid. Pressing the <Enter> key will initiate automatic movement to find the selected satellite as described in section 2.1.1.2.2.3.2.

2.1.1.2.2.3.1 Satellite Selection

Several pieces of information must be provided to describe a satellite to the RC4600 before the satellite may be automatically located:

LONGITUDE: described in decimal degrees (180.0W to 180.0E)

INCLINATION: the number of degrees of orbital inclination. If a satellite is described as having an inclination greater than zero, the RC4600 will consider it an inclined orbit satellite and subsequently attempt to track its movement.

BAND: the RF band that the user's equipment will be receiving from the satellite. The band information helps determine tracking movement size and timing. Throughout the RC4600, the bands are assigned numbers from the following list: <0-C 1-Ku 2-L 3-X 4-Ka 5-S>

When the <1> key is selected from the main LOCATE screen, the following screen appears to allow the user to select new satellite information via three methods.

```

<1>CHOOSE FROM SAT DATABASE          LOCATE
<2>MANUALLY ENTER SAT DATA
                                     <MODE>EXIT
  
```

<1>CHOOSE FROM SAT DATABASE

#	NAME	LON	INC	BAND	EPH	LOCATE
3	GALAXY 28	89.0W	0	KA	Y	

<SCR>THRU LIST <ENTER>SELECT <MODE>EXIT

When the user chooses to select a satellite from the satellite database, a screen appears allowing the user to scroll through the list and select a satellite by pressing the Enter key. The satellite database contains data for 20 satellites programmed by the user via the Satellite Presets configuration mode (2.1.1.3.1.1.3). **It is strongly suggested that the user program and use the satellite database.**

<2>MANUALLY ENTER SAT DATA

LON:	INCLIN:	LOCATE
BAND:		
LONGITUDE <DDD.T DEG>		

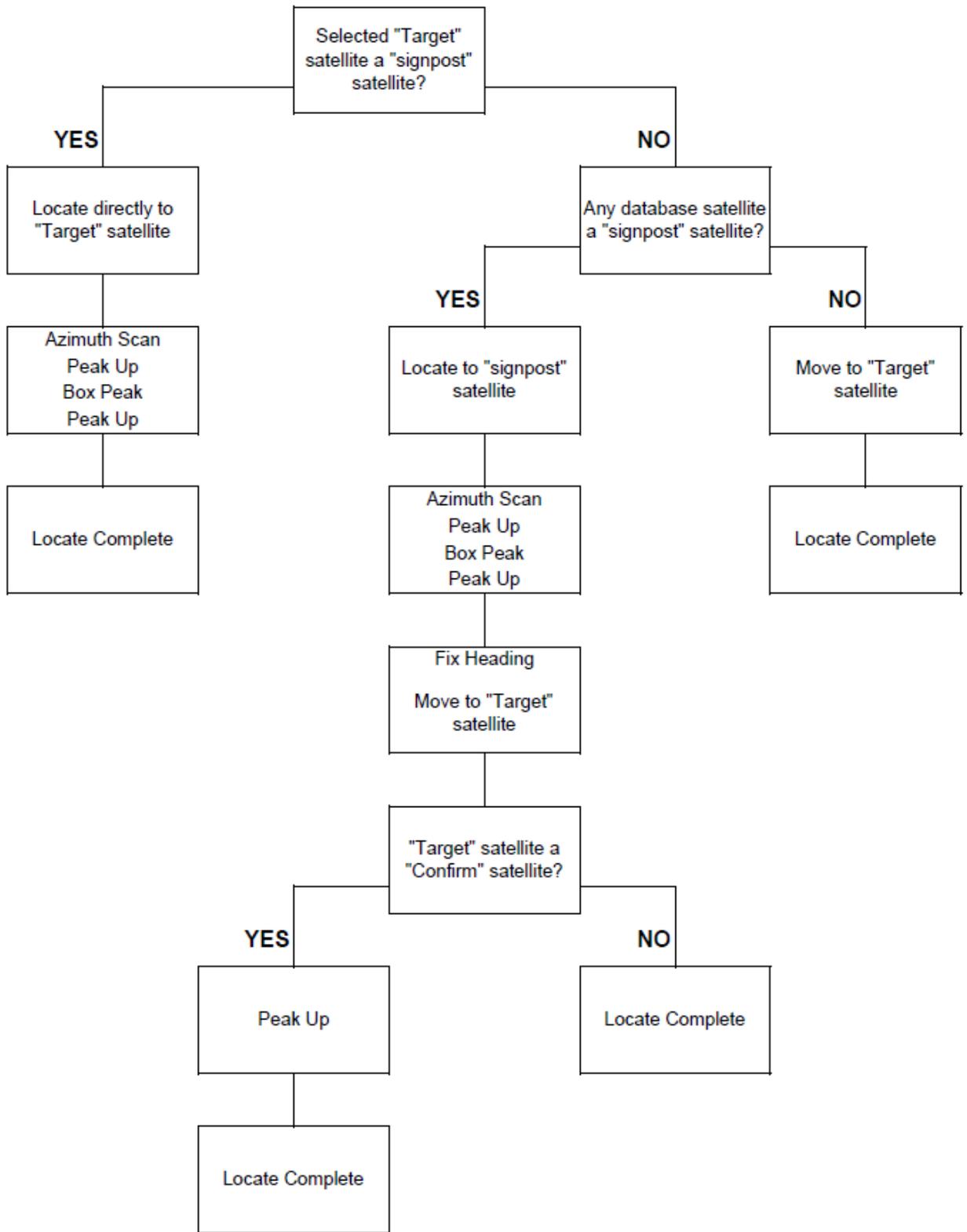
When the user chooses to manually enter the satellite data, a screen appears with fields to enter the three required pieces of data.

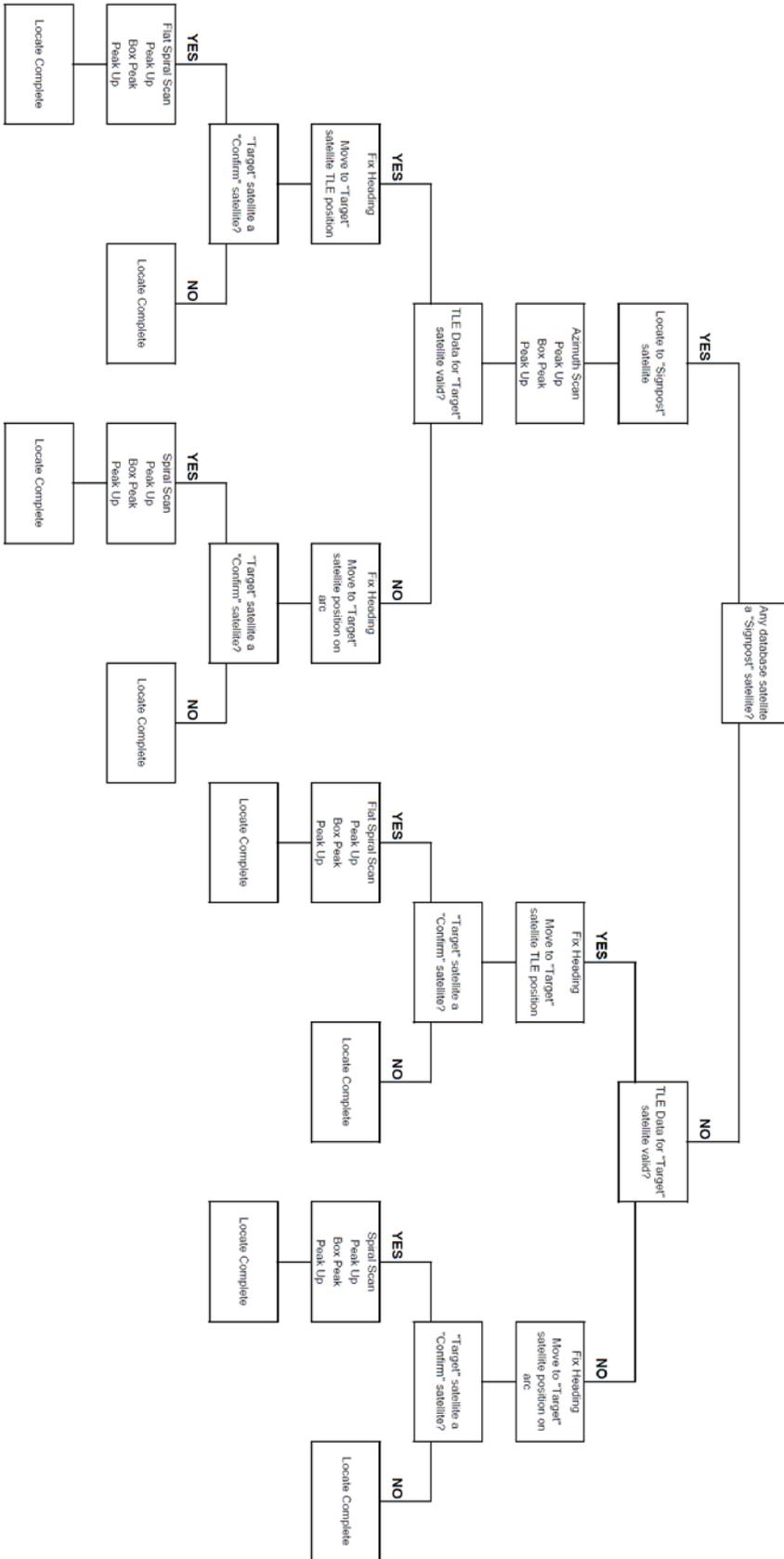
When locating a satellite, the RC4600 will use the information available in the satellite database to locate the selected satellite. The trees for selecting which satellite to use for a locate is shown in the flowchart on the following two pages.

The first tree is for satellites that have are not defined as inclined in the satellite database (2.1.1.3.1.1.3). The second tree, if for satellites that are defined as inclined in the satellite databased.

There are 3 types of satellites defined in the locate tree. The characteristics of each type of satellite are described below.

- “Target” Satellite
 - This is the satellite that was selected in the LOCATE mode.
 - It is the end location of any locate routine.
- “Signpost” Satellite
 - This is a satellite that has a DVB or Beacon frequency set to signpost.
 - Can also be the “Target” satellite.
 - Will be used to auto fix heading.
- “Confirm” Satellite
 - This is a satellite that has a DVB or Beacon set to confirm.





2.1.1.2.2.3.2 LOCATE Automatic Movement

Before automatic movement to the calculated position is initiated, the RC4600 requests that a polarization position be selected. This is so the polarization mechanism will be in the correct position to be able to detect received signal strength.

Note: this selection is not requested if the feed type is defined as “circular” (2.1.1.3.1.2.4) or if the polarization automove is disabled (2.1.1.3.1.2.5). In this case the RC4600 will immediately begin the locate automatic movement after ENTER is pressed from the main LOCATE screen.

```
H-HORIZONTAL:  -7.1          LOCATE
V-  VERTICAL:   82.9
8-   NEUTRAL:   37.9
<H/V/8>SELECT RX POLARIZATION <MODE>MENU
```

The RC4600 calculates the vertical polarization position as a function of mount latitude/longitude and satellite longitude. The horizontal position is calculated as 90 degrees from the vertical in the direction (Clockwise/Counter-Clockwise) that will maintain the horizontal position within the polarization axis' range of movement. The “neutral” position represents the polarization angle halfway between the calculated vertical and horizontal values. The neutral position may be appropriate if the Locate Source configuration item is set to 5 (RF).

Immediately following the polarization selection, the RC4600 will begin moving to the calculated position to continue the locate process. The progress of the movement is displayed on the following screen.

```
AZ:  -3.345 (  5.4 )  BCN:          LOCATE
EL:  30.677 ( 45.0 )  SAT: GALAXY 28
MOVING TO START OF SCAN          <STOP>HALT
```

The current angular values for AZ/EL/PL are displayed along with the target position for each axis in parenthesis. The label for the current axis being moved will flash. Movement may be halted at any time by pressing the <Stop> key. Halting movement will return the controller to the MANUAL mode.

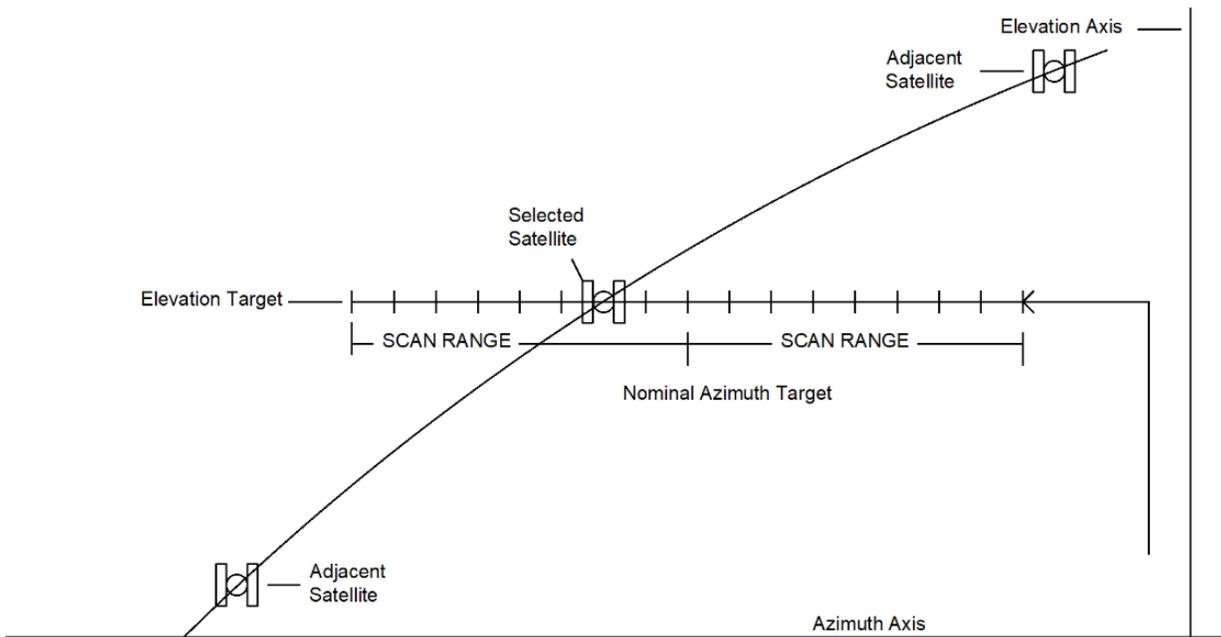
If below the down limit in elevation, the first automatic movement will be in the platform local elevation axis to ensure that the mount is brought out of the elevation stow and down regions. If above the down limit, or after moving above the down limit the RC4600 will then make an automated move in local horizontal angles to the first point of the locate routine.

If the Locate Source configuration item is set to 0 (NONE), the LOCATE mode will finish by moving to the nominal target azimuth position. A final movement to the target elevation will also be performed to account for change in mount elevation due to vehicle tilt. Following this movement, the controller will return to MANUAL mode where the user should peak up and confirm the identity of the satellite.

If the Locate Source configuration item (2.1.1.3.1.2.5) is set to anything other than 0, an azimuth scanning movement (2.1.1.2.2.3.3) will be performed if the selected satellite does not have an inclined orbit. If the satellite does have an inclined orbit, a spiral search movement (2.1.1.2.2.3.6) will be performed. For both scanning movements to be successful, the user is required to have the receiving equipment (prior to the movement) configured for the RC4600 to be able to detect signal strength.

2.1.1.2.2.3.3 Azimuth Scan

The figure shows the movements made to perform an azimuth scanning operation. This operation enables the RC4600 to try to compensate for any antenna bearing errors.



- 1) As part of the basic LOCATE movement, the mount will be moved to the target elevation position and the polarization axis will be moved to the correct orientation.
- 2) Azimuth Scan moves to the end of the “scan range” that is shortest distance away from the current azimuth position. Azimuth Scan will begin trying to detect a satellite from this position.
- 3) Azimuth Scan moves across the “scan range” and samples the lock signal or signal strength for the current locate source. Note that in order to compensate for any vehicle tilt, occasionally elevation movements are also made to stay on the target elevation. Note also that the Azimuth Scan movement may be truncated due to the limits of azimuth movement.
- 4) After completing the Azimuth Scan, the RC4600 will return the antenna to the “Center of Lock” or location of peak signal strength.

During the Azimuth Scan, line 4 of the display will provide information on what step of the locate is currently being performed. In the display below, the RC4600 is currently “SCANNING AZIM FOR LOCK”.

```

AZ :  -0.549 (  -8.3 )  BCN :  50    LOCATE
EL :  44.811 (  44.8 )  SAT : GALAXY 28

SCANNING AZIM FOR LOCK          <STOP>HALT
    
```

The “scan range” is a receiver specific user-defined angular value that determines the range to be searched by the Azimuth Scan routine. Since the angular range is user-selectable, there are two factors to take into consideration when setting this value.

- 1) The scan range should be larger than the accuracy of the compass. For example, if the compass is accurate to $\pm 5^\circ$ the scan range should be at least ± 5 . A scan range of double the compass accuracy is usually recommended for optimum operation.
- 2) Always ensure that there are not multiple satellites within the “scan range” that have the same carrier or beacon frequency. When this occurs, the RC4600 will have difficulty determining which satellite is the desired target.

Following the completion of the Azimuth Scan, the RC4600 will immediately move to performing an azimuth and elevation peak up.

2.1.1.2.2.3.4 Peak Up

The Peak Up routine will automatically begin at the end of an Azimuth Scan. If the heading has already been fixed, it will also perform this routine automatically at the end of a locate if the “TARGET PEAK” configuration item is set to option 1-5 (2.1.1.3.1.2.5).

If Azimuth Scan finds a lock or signal strength peak, it will return to the azimuth position where it noted the lock or peak. This position may not be the absolute peak position due to the lag of signal strength sensing during the Azimuth Scan. The Peak Up routine will next perform a “fine tune” peaking process. While executing this, line 4 will display “PERFORMING PEAKUP”.

During the Peak Up, small jogs in azimuth and elevation will be made to find the local peak position. The step sizes taken will approximate a theoretical signal strength change of 0.3 dB (according to antenna size, operating band, etc.).

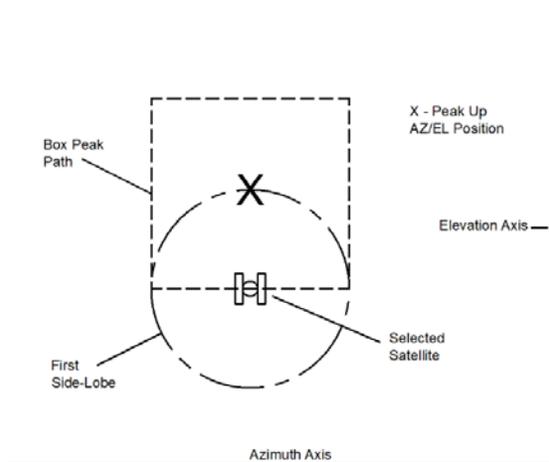
The Peak Up routine can also be manually activated from the MENU mode (2.1.1.2.2.8).

During the Peak Up operation, line 4 of the display shows “PERFORMING PEAK UP (***)”. Where *** corresponds to the size of the current peaking step in thousandths of a degree (i.e. 113=0.113°). The axis that is currently moving will also flash during the Peak Up operation.

AZ:	26.250	(	26.2)	BCN:	597L	LOCATE
EL:	41.769	(	41.7)	SAT:	WB-1	
PERFORMING PEAK UP (113)						<STOP>HALT

2.1.1.2.2.3.5 Box Peak

The Box Peak is a second peak operation that can be used to move the antenna from a first side-lobe and onto the main beam. If the "TARGET PEAK" configuration item (2.1.1.3.1.2.5) is set to 4 or 5, the RC4600 will perform this operation immediately at the end of a Peak Up during all locates.



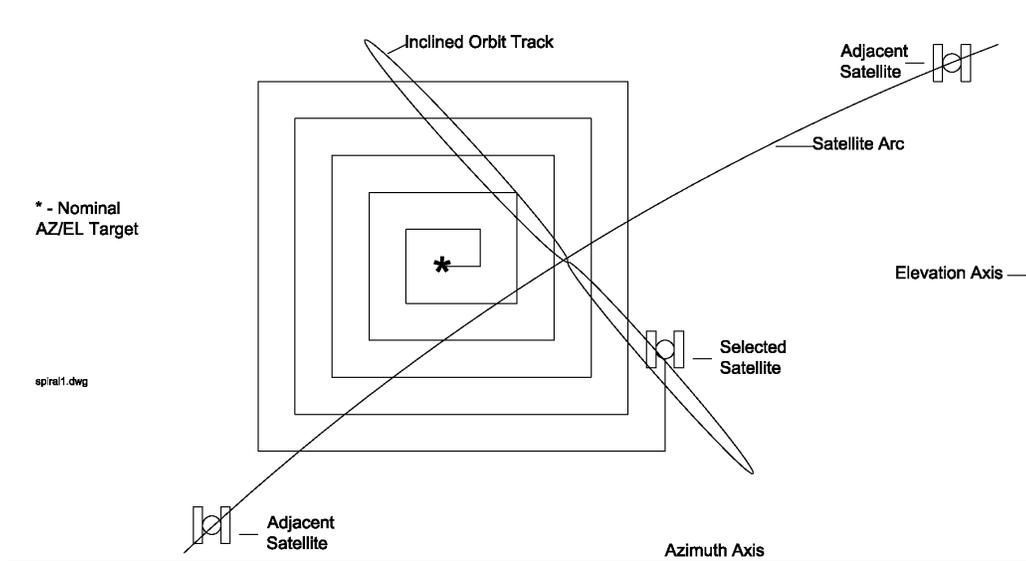
During the Box Peak routine, the antenna will scan a box that is calculated (according to antenna size, operating band, etc.) by the RC4600 to be the distance from the Peak Up routine final location. After completing this process, the RC4600 will then move to the location of peak signal strength perform a second Peak Up (2.1.1.2.2.3.4).

During the Box Peak operation, line 4 of the display shows the current direction and step number so the user can keep track of the progress of the operation.

AZ :	25.714	(	26.2)	BCN :	250L	LOCATE
EL :	41.098	(	41.7)	SAT :	WB-1	
						SIG
BOX PEAK	(CW 1)					<STOP>HALT

2.1.1.2.2.3.6 Spiral Search

The Spiral Search operation performs somewhat differently from the Azimuth Scanning operation. Whereas Azimuth Scanning counts on the fact that a non-inclined orbit satellite should be at the calculated elevation, Spiral Search must account for the fact that at a particular time an inclined orbit satellite may be above or below the nominal target elevation. The figure shows the movements made to perform the Spiral Search operation.



- 1) As part of the basic LOCATE movement, the mount will be moved to the target elevation position and the polarization axis will be moved to the correct orientation.
- 2) Spiral Search will move to the target azimuth (correcting for elevation if needed) and take an initial signal strength sample. Note that the target azimuth may be slightly off due to initial compass error.
- 3) If no hot spot is initially found, Spiral Search will begin searching an area around the target position by stepping in a CW/UP/CCW/DN sequence using increasing number of steps in each direction to create a spiral-like pattern. Spiral Search looks for a signal strength above a defined threshold to declare an end to the Spiral Search operation. If TLE information is available for the satellite, the Spiral Search will perform a search that is wide in azimuth and short in elevation. The term for this is a "Flat Spiral Search"
- 4) At the end of the Spiral Search, the RC4600 will perform a Peak Up (2.1.1.2.2.3.4) and a Box Peak (2.1.1.2.2.3.5).

During the Spiral Search operation, line 4 of the display shows the current direction and step number so the user can keep track of the operation's progress.

```

AZ :  -1.817 (  -2.0 )  BCN:  50    LOCATE
EL :  44.868 (  44.8 )  SAT:OG1
                                     SIG
SPIRAL SEARCH (CW 1)                <STOP>HALT
    
```

2.1.1.2.4 TRACK

Prior to entering TRACK mode, a LOCATE operation should be performed to initially place the antenna on the satellite. When the TRACK mode is first entered, the following screen appears.

```

<1>CHOOSE FROM SAT DATABASE          TRACK
<2>MANUALLY ENTER SAT DATA
                                     <MODE>EXIT

```

Several pieces of information must be provided to describe a satellite to the RC4600 before the satellite may be automatically tracked:

LONGITUDE: described in decimal degrees (180.0W to 180.0E)

INCLINATION: the number of degrees of orbital inclination. If a satellite is described as having an inclination greater than zero, the RC4600 will consider it an inclined orbit satellite and subsequently attempt to track its movement.

BAND: the RF band that the user's equipment will be receiving from the satellite. The band information helps determine tracking movement size and timing. Throughout the RC4600, the bands are assigned numbers from the following list: <0-C 1-Ku 2-L 3-X 4-Ka 5-S>

<1>CHOOSE FROM SAT DATABASE

When the user chooses to select a satellite from the satellite database, a screen appears allowing the user to scroll through the list and select a satellite by pressing the Enter key. The satellite database contains data for 20 satellites programmed by the user via the Satellite Presets configuration mode (2.1.1.3.1.1.3). **It is strongly suggested that the user program and use the satellite database.**

```

                                     TRACK
#   NAME           LON  INC  BAND  EPH  TBL
1  OG1             92.8W  4   KA   Y   ---
<SCR>THRU LIST <ENTER>SELECT <MODE>EXIT

```

<2>MANUALLY ENTER SAT DATA

```

                                     TRACK
LON:                INCLIN:
BAND:
LONGITUDE <DDD.T DEG>

```

When the user chooses to manually enter the satellite data, a screen appears with fields to enter the three required pieces of data.

Once a satellite is selected the RC4600 will display the screen below to prompt the user to verify that the antenna is currently peaked on target.

```

                                     TRACK
*   CONFIRM ANTENNA IS PEAKED UP   *
* ON TARGET SATELLITE IN AZ/EL/POL *
<ENTER>CONTINUE                    <MODE>EXIT

```

If the satellite selected is a Preset Satellite that has been previously tracked, the screen below will appear before prompting the user to confirm that the antenna is peaked on target. The user should choose if a new track is desired or if they would like to resume an existing track.

```

                                     TRACK
*   TRACK TABLE DATA ALREADY EXISTS   *
*   RESUME PREVIOUS OR START NEW TRACK   *
<ENTER>RESUME <BKSP>NEW                 <MODE>EXIT

```

Once the user has confirmed the antenna is currently peaked on the satellite, the controller will begin the TRACK operation.

Details of TRACK mode are available in the separate appendices TRK and TLE describing inclined orbit tracking. The following descriptions give an overview of how tracking is performed.

The RC4600 tracking algorithm can be divided into four distinct stages:

- 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 maintained in the controller's memory. The interval between Step Track operation is determined from antenna size, frequency band, satellite inclination and a user specified maximum allowable error (2.1.1.3.1.3.9). When a track table entry exists for the current sidereal time, Step Track can transition to Memory Track or TLE Track depending on the TRACK MODE configuration item (2.1.1.3.1.3.9).
- Memory Track
 - In Memory Track, the controller smoothly moves the antenna to azimuth and elevation positions derived from entries in the track table. The time between movements is determined by the same factors which govern the time between Step Track operations. By increasing the maximum allowable error, antenna movements can be performed less frequently. In Memory Track, the accuracy of the track table is monitored by periodically peaking up on the selected signal source. If the error exceeds the maximum allowable error, all entries in the track table are flagged for 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 RC4600 will be constantly calculating pointing angles from the TLE data set. Anytime the current position is different from the calculated position, the RC4600 will move the antenna to close this error.
- Track Search
 - Track Search is entered when the satellite signal has been lost. The RC4600 utilizes Intelli-Search, an efficient search algorithm that minimizes errors associated with traditional box searches and frees the user from having to update vague search window parameters. This scheme accounts for the specific mount geometry, calculates the nominal trajectory for the satellite, and then searches in an area that coincides with the satellite's expected path. When the satellite is located, the controller re-enters the Step Track mode.

2.1.1.2.2.5 POSITION

The POSITION mode allows the user to set the latitude, longitude and heading of the antenna for subsequent use in calculating pointing angles to satellites. The first screen that appears shows the current mount position used in the RC4600. Also shown are the source that was used to acquire the current position data. If any field was not already populated, *** would be shown.

```
L/L: 38_57N  94_45W  GPS          POSITION
ANT BEARING: 178.9 COMPASS      NOT SAVED
P:  0.51 R:  0.37  AUTO          <4>SAVE
<1>LAT/LON <2>HEADING <3>TILT <MODE>MENU
```

The position shown in the screen will not be retained at power off unless the position is explicitly saved by pressing the <4> key. Starting a track on a satellite will also force a position save. If the position is saved, the date and time the position was saved is noted.

2.1.1.2.2.5.1 LAT/LON

When the user chooses to modify latitude and longitude, a screen appears showing three options for updating the current lat/lon.

```
<1>ENTER MANUAL LOCATION          LAT/LON
<2>SELECT PRESET LOCATION
<3>GET LOCATION FROM GPS
                                <MODE>EXIT
```

<1>ENTER MANUAL LOCATION

```
LAT:          LON:          LAT/LON
<0-9 .>ENTER DEG.MIN      <SCR UP>EXIT
```

The user is provided two fields to manually enter lat and lon. See 2.1.1.1.3 for instructions on how to enter latitude and longitude.

<2>SELECT PRESET LOCATION

```
#   LAT      LON      NAME      LAT/LON
1   38_57N   94_45W   RCI
<SCR>THRU LIST <ENTER>SELECT <BKSP>EXIT
```

The user scrolls through the list of preset locations and selects the displayed location by pressing the Enter key. Note that the number within the list (1) is displayed along with the name and lat/lon. Preset locations can be saved in the "LOCATION PRESETS" configuration screen (2.1.1.3.1.2).

<3>GET LOCATION FROM GPS

```

GPS: 38_57N 94_45W
UTC: 21:42:00
LAT/ LON
<MODE>EXIT

```

When option 3 is selected, the RC4600 will pull in the lat/lon from the GPS. Once complete the controller will automatically move back to the main POSITION screen. Note that if movement is required to acquire the GPS information, the following screen will be displayed so the user can confirm the movement.

```

* ANTENNA MOVEMENT REQUIRED *
* TO DETERMINE LOCATION *
<ENTER>CONFIRM MOVE
LAT/ LON
<MODE>EXIT

```

2.1.1.2.2.5.2 HEADING

When the user chooses to modify latitude and longitude, a screen appears showing three options for updating the current lat/lon.

```

<1>ENTER MAGNETIC HEADING HEADING
<2>ENTER TRUE HEADING
<3>GET HEADING FROM COMPASS
<MODE>EXIT

```

<1>ENTER MAGNETIC HEADING

```

MAG: HEADING
MAGVAR: 1.7
TRUE:
<0-9 .>ENTER DEGREES <SCR UP>EXIT

```

When option 1 is selected, the user is prompted to enter a magnetic heading of the antenna. After magnetic heading is entered, the RC4600 will apply the magnetic variation to generate the true heading of the mount's azimuth centerline.

<2>ENTER TRUE HEADING

```

MAG: HEADING
MAGVAR: 1.7
TRUE:
<0-9 .>ENTER DEGREES <SCR UP>EXIT

```

When option 2 is selected, the user is prompted to enter a true heading of the antenna. After true heading is entered, the RC4600 will apply the magnetic variation to generate the magnetic heading of the mount's azimuth centerline.

<3>GET HEADING FROM COMPASS

```

CMP HDG: 176.9                                HEADING
OFFSET:   0.0
MAGVAR:   1.7
HEADING:  178.6                                <MODE>EXIT

```

When option 3 is selected, the RC4600 will pull in the heading from the compass. After the compass heading has been pulled in, the RC4600 will apply the offset and the magnetic variation to generate the heading of the mount's azimuth centerline. Once complete the controller will automatically move back to the main POSITION screen. Note that if movement is required to acquire the compass information, the following screen will be displayed so the user can confirm the movement.

```

                                HEADING
*   ANTENNA MOVEMENT REQUIRED   *
*   TO DETERMINE HEADING      *
<ENTER>CONFIRM MOVE           <MODE>EXIT

```

2.1.1.2.2.5.3 TILT

```

                                POSITION
PITCH:   0.51
ROLL:    0.37

```

When option 3 is selected, the RC4600 will pull in the tilt from the dual axis inclinometer (4.2.1). Once complete the controller will automatically move back to the main POSITION screen. Note that if movement is required to acquire the pitch and roll information, the following screen will be displayed so the user can confirm the movement.

```

                                POSITION
*   ANTENNA MOVEMENT REQUIRED   *
*   TO DETERMINE PITCH/ROLL   *
<ENTER>CONFIRM MOVE           <MODE>EXIT

```

2.1.1.2.2.6 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 :    0.000 (    0.00)                MOVETO
EL :   15.996 (   16.00) <5>SENSOR:PLATFORM
PL :    0.000 (    0.00) <0> SPEED:NORMAL
SET<1>AZ<2>EL<3>PL                <4>START MOVE
```

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:NORMAL

The state of this field when this mode is entered will be “NORMAL”. This means that any move will be using the standard speed control of the RC4600. 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:PLATFORM

The state of this field when this mode is entered will be “PLATFORM”. This means that all of the angles displayed, and all movements requested will occur in platform relative angles. When the <5> key is pressed this field will change to “HORIZON”. This means that the angles displayed, and all movements requested will occur in local horizontal relative platform angles.

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.

```
DRIVES : INACTIVE                STANDBY
<ENTER>MAKE DRIVES ACTIVE      <MODE>MENU
```

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

```
DRIVES : ACTIVE                STANDBY
<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 LOCATE operation (2.1.1.2.2.3.4).

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:-150.000 CW:150.000 SF: 87.95
OFF:-180.0000   DIR:1
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

In this example there are six 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.). Descriptions of those screens will be provided in their appropriate appendices.

GROUP TITLE	GROUP DESCRIPTION	PARA.
NORMAL ACCESS ITEMS		
EXPERT ACCESS PERMISSION	SETS EXPERT ACCESS PERMISSION	2.1.1.3.1.1.1
LOCATION PRESETS	LIST OF PRESET TRUCK LOCATIONS	2.1.1.3.1.1.2
SATELLITE PRESETS	LIST OF PRESET SATELLITES	2.1.1.3.1.1.3
DVB DETECTION POINTS	LIST OF PRESET DVB CARRIERS	2.1.1.3.1.1.4
BEACON DETECTION POINTS	LIST OF PRESET BEACON FREQUENCIES	2.1.1.3.1.1.5
TLE 1 DATA	LINE 1 – TWO LINE ELEMENT SET	0
TLE 2 DATA	LINE 2 – TWO LINE ELEMENT SET	2.1.1.3.1.1.7
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
AUTOPEAK	GLOBAL SCAN/SEARCH PARAMETERS	2.1.1.3.1.2.5
EXTERNAL SIG FACTORS	EXTERNAL SIGNAL/SEARCH PARAMETERS	2.1.1.3.1.2.6
BEACON SIG FACTORS	BEACON SCAN/SEARCH PARAMETERS	2.1.1.3.1.2.7
RF SIG FACTORS	RF SCAN/SEARCH PARAMETERS	2.1.1.3.1.2.8
DVB SIG FACTORS	DVB SCAN/SEARC PARAMETERS	2.1.1.3.1.2.9
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
STOW & DEPLOY	AZ/EL/POL STOW & DEPLOY POSITIONS	2.1.1.3.1.3.8
TRACK FACTORS	INCLINED ORBIT TRACKING PARAMETERS	2.1.1.3.1.3.9
SHAKE	SETUP SHAKE MOVES/CYCLES/DELAY	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 Location Presets

This group allows the user to customize a list of 20 commonly used mount locations. This list may be used for selecting mount lat/lon in the POSITION mode.

```
LOC#: 1                                CONFIG-LOCS
NAME: RCI
LAT: 38_57N      LON: 94_45W
<SCR>THRU LIST <ENTER>MODIFY DATA
```

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

This field identifies the list number (1-20) 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 NAME field.

NAME: **PRESET NAME (10 CHARACTERS MAX)**

This field allows a user to enter a name (up to 10 characters). See 2.1.1.1.3 for instructions on how to enter alphanumeric data.

LAT: **LATITUDE <DEG.MIN FORMAT>**

This field allows a user to enter a location's latitude in degrees/minutes format. See 2.1.1.1.3 for instructions on how to enter a latitude.

LON: **LONGITUDE <DEG.MIN FORMAT>**

This field allows a user to enter a location's longitude in degrees/minutes format. See 2.1.1.1.3 for instructions on how to enter a longitude.

2.1.1.3.1.1.3 Satellite Presets

This group allows the user to customize a list of 20 commonly used satellites. The LOCATE mode allows the user to select a satellite (2.1.1.2.2.3) from this “preset” list.

SAT#: 1	NAME: OG1	CONFIG- SATS
LON: 92.8W	BAND: 4	INCL: 0
SKEW: 0.0		POL: 0
		EPH: 1
<SCR> THRU LIST <ENTER> MODIFY DATA		

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

This field identifies the list number (1-20) 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 NAME field.

NAME: PRESET NAME (10 CHARACTERS MAX)

This field allows a user to enter a name (up to 10 characters). See 2.1.1.1.3 for instructions on how to enter alphanumeric data.

LON: LONGITUDE <DDD.T FORMAT>

This field allows a user to enter a satellite’s longitude in decimal format. See 2.1.1.1.3 for instructions on how to enter satellite longitude.

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

This field allows the user to specify the RF band associated with this satellite. This data is used by the RC4600 to determine the effective bandwidth of the mount thus affecting size and frequency of movements made.

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

This field allows the user to define the current inclination of the satellite in degrees. For non-inclined satellites, the field should be set to 0.

POL: DEFAULT POL <0-NONE 1-H 2-V>

This field allows the user to specify the default polarization type associated with this satellite. The options are:

- 0) None – Used for circular polarization
- 1) H – Horizontal linear polarization
- 2) V – Vertical linear polarization

SKEW: **POL SKEW <+/-90.0 DEG> (UNKNOWN->0.0)**

This field describes if the satellite's polarization axis is oriented non-orthogonal to the earth's equatorial plane. The sign convention is that described in 5.2.2.

EPH: **EPHEMERIS DATA <0>NONE <1>TLE**

This field allows the user to define if TLE data should be used when calculating satellite pointing angles. If this is set to 1, valid TLE information will have to be available (0 and 2.1.1.3.1.1.7).

2.1.1.3.1.1.4 DVB Detection Points

This group allows the user to define a DVB carrier for each of the 20 satellite presets (2.1.1.3.1.1.3).

```
SAT#:9      NAME:GALAXY 3C      CONFIG-DVB
LOC:1 STD:1  FREQ:11780  SYM:20760  POL:1
FEC:3  MOD:0
<SCR>THRU LIST <ENTER>MODIFY DATA
```

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

This field identifies the satellite preset number (1-20) 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 FREQ field.

NAME: PRESET NAME (10 CHARACTERS MAX)

This field allows a user to enter a name (up to 10 characters). See 2.1.1.3 for instructions on how to enter alphanumeric data.

LOC: LOCATE <0-OFF, 1-SIGNPOST, 2-CONFIRM>

0-OFF: The DVB detection point will not be used during a LOCATE.

1-SIGNPOST: The DVB detection point can be used during a LOCATE.

2-CONFIRM: The DVB detection point can only be used for peaking after a signpost carrier has been found. All inclined DVB detections points should be set to this.

STD: DVB STANDARD <1-S1 2-S2>

This field allows the user to specify the DVB standard of the carrier.

FREQ: <1000-30000> MHz

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

SYM: SYMBOL RATE <1000-30000> kS/sec

This field allows the user to specify the symbol rate associated with this carrier.

POL: POLARIZATION <1-H 2-V>

This field specifies the polarization of the DVB carrier.

This setting is ignored if the satellite preset polarization is set to none.

FEC: FEC N/N+1 <0-9,0=AUTO> (Ex: 3=3/4)

This field allows the user to specify the forward error correction code associated with this carrier. This data is used by the positive identification feature to tune the DVB receiver.

Enter the first number of the FEC scheme. Example: to select 5/6, enter 5.

This field should be set to AUTO when the DVB standard used is DVB-S2. When using the DVB-S standard, this field should be set to the appropriate FEC for the satellite.

MOD: MODULATION <0-AUTO,1-Q, 2-8, 3-16, 4-32>

This field allows the user to specify the modulation scheme for a DVB-S2 carrier. Enter 1 for QPSK or 2 for 8PSK, etc.

This field can be set to AUTO when the DVB standard is DVB-S2. This field should be set to 1 for all DVB-S carriers.

2.1.1.3.1.1.5 Beacon Detection Points

This group allows the user to define a satellite beacon for each of the 20 satellite presets (2.1.1.3.1.1.3).

SAT#: 1	NAME: OG1	CONFIG-BCN
LOC: 0	FREQ: 20198.53	MOD: 0 POL: 1
<SCR> THRU LIST <ENTER> MODIFY DATA		

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

This field identifies the satellite preset number (1-20) 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 FREQ field.

NAME: PRESET NAME (10 CHARACTERS MAX)

This field allows a user to enter a name (up to 10 characters). See 2.1.1.3 for instructions on how to enter alphanumeric data.

LOC: LOCATE <0-OFF, 1-SIGNPOST, 2-CONFIRM>

0-OFF: The beacon detection point will not be used during a LOCATE.

1-SIGNPOST: The beacon detection point can be used during a LOCATE.

2-CONFIRM: The beacon detection point can only be used for peaking after a signpost beacon has been found. All inclined beacons should be set to this.

FREQ: BEACON FREQUENCY <0-30000.00 MHz>

This field identifies the beacon frequency that should be associated with corresponding preset 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.

MOD: DEMODULATION <0-CW,1-BPSK>

This field describes the type of demodulation required for the 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.

POL: POLARIZATION <1-H 2-V>

This field specifies the polarization of the beacon frequency.

This setting is ignored if the satellite preset polarization is set to none.

2.1.1.3.1.1.6 TLE 1 Data

Note: It is suggested to enter TLE data via the GUI as described in 2.1.2.3.1.

The RC4600 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 satellite preset number and satellite name from the preset satellite screen (2.1.1.3.1.1.3). The user may scroll through preset satellite numbers via the <Scroll Up> or <Scroll Dn> keys.

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

```
SAT#:1    OG1                                CONFIG-TLE1
1 32763U 08016A    18337.45104302
-.00000177 00000-0 00000+0 0 9992
<SCR>THRU LIST <ENTER>MODIFY DATA
```

When scrolling through preset satellites, if the TLE option for a preset satellite is set to none (2.1.1.3.1.1.3), the following screen will be displayed.

```
SAT#:2    WB-1                                CONFIG-TLE1
*          TLE DATA NOT ENABLED             *
*          FOR THIS SATELLITE PRESET         *
<SCR>THRU LIST <ENTER>MODIFY DATA
```

After scrolling to the desired preset satellite number, the user may begin to entering 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 RC4000 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 RC4600 will calculate the data's checksum and compare it to the last character. If the calculated and entered checksums don't match, an error will be flagged as shown below.

```
SAT#:1    OG1                                CONFIG-TLE1
1 32763  08016    18337.45104302
-.00000177 00000-0 00000+0 9 9992
<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    OG1                                CONFIG-TLE1
1 32763  08016    18337.45104302
-.00000177 00000-0 00000+0 0 9992
<0-9 UP(+) DN(-) BKSP ENTER>          CHK:OK
```

2.1.1.3.1.1.7 TLE 2 Data

Note: It is suggested to enter TLE data via the GUI as described in 2.1.2.3.1.

The RC4600 uses one screen to show each line of data. The top line of each screen identifies which line is being displayed (TLE1 or TLE2). The top line will also show the satellite preset number and satellite name from the preset satellite screen (2.1.1.3.1.1.3). The user may scroll through preset satellite numbers via the <Scroll Up> or <Scroll Dn> keys.

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

```
SAT#:1    OG1                                CONFIG-TLE2
2 32763   3.6648   2.7341 0002731
 266.9506 232.0819 1.00271033 38861
<SCR>THRU LIST <ENTER>MODIFY DATA
```

When scrolling through preset satellites, if the TLE option for a preset satellite is set to none (2.1.1.3.1.1.3), the following screen will be displayed.

```
SAT#:2    WB-1                                CONFIG-TLE2
*          TLE DATA NOT ENABLED             *
*          FOR THIS SATELLITE PRESET         *
<SCR>THRU LIST <ENTER>MODIFY DATA
```

After scrolling to the desired preset satellite number, the user may begin to entering 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 RC4000 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 RC4600 will calculate the data's checksum and compare it to the last character. If the calculated and entered checksums don't match, an error will be flagged as shown below.

```
SAT#:1    OG1                                CONFIG-TLE2
2 32763   3.6648   2.7341 0002731
 266.9506 232.0819 1.00271033 38862
<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    OG1                                CONFIG-TLE2
2 32763   3.6648   2.7341 0002731
 266.9506 232.0819 1.00271033 38861
<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

```
VREF:2.50                                CONFIG-AZIM
CCW:-192.000 CW:192.000 SF:87.95
OFF:-180.0000 DIR:1
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>
```

VREF: ZERO DEG VOLTAGE <1.00-4.00 VOLTS>

The zero degree voltage is the voltage present when the azimuth axis is in its center of motion. See Azimuth Calibration in 3.3.2.2.

CCW: CCW LIMIT <+/-300.0 DEGREES>

CW: CW LIMIT <+/-300.0 DEGREES>

These items specify the antenna's azimuth range of travel relative to the antenna's center azimuth (0.000) position.

These positions are used to trigger the azimuth range error message when the RC4600 calculates an antenna pointing solution in LOCATE mode, it checks these values to see if the dish can be physically moved to that 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 azimuth scale factor applicable to the potentiometer-based azimuth feedback. NOTE: The default value for this item will typically be correct.

OFF: SENSOR OFFSET <+/- 359.9999>

The sensor offset defines the offset to be applied to the angle read directly from the azimuth sensor for the purpose of displaying the platform local azimuth angle. Example: If when at the center azimuth position the raw azimuth sensor angle reads 181.313, a sensor offset of -181.3130 will result in a platform local azimuth angle of 0.000.

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

The sensor direction defines whether the polarity of the azimuth sensor matches that of the RC4600 software. If the raw azimuth sensor angle decreases as the mount moves CW, the DIR item must be described as reversed.

2.1.1.3.1.2.2 Elevation Calibration

```

                                CONFIG-ELEV
DOWN:  10.000 UP: 90.000
OFF: -180.0000   DIR:1
DOWN LIMIT <-20.0-120.0 DEGREES>

```

DOWN: **DOWN LIMIT <-20.0-120.0 DEGREES>**

UP: **UP LIMIT <-20.0-120.0 DEGREES>**

These items specify the antenna's elevation range of travel in platform local angles.

These positions are used to trigger the elevation range error message when the RC4600 calculates an antenna pointing solution in LOCATE mode, it checks these values to see if the dish can be physically moved to that position.

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

OFF: **SENSOR OFFSET <+/- 359.9999>**

The sensor offset defines the offset to be applied to the angle read directly from the elevation sensor for the purpose of displaying the platform local elevation angle.

Example: If RF look angle of the antenna is 17.800 and the reflector face is orthogonal to the antenna platform and the raw elevation sensor angle reads 181.313, a sensor offset of -163.5130 will result in a platform local elevation angle of 17.800.

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

The sensor direction defines whether the polarity of the elevation sensor matches that of the RC4600 software. If the raw elevation sensor angle decreases as the mount moves up, the DIR item must be described as reversed.

2.1.1.3.1.2.3 Polarization Calibration

```

VREF: 2.50 OFF: 0.0 CONFIG-POL
CCW: -92.000 CW: 92.000 SF: 43.05
ZERO DEG VOLTAGE <1.00-4.00 VOLTS>

```

VREF: ZERO DEG VOLTAGE <1.00-4.00 VOLTS>

The zero degree voltage is the voltage present when the polarization axis is in its center of motion. See Polarization Calibration in 3.3.3.

OFF: ANGLE OFFSET <+/-90.0 DEGREES>

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

CCW: CCW LIMIT <+/-1800.0 DEGREES>

CW: CW LIMIT <+/-180.0 DEGREES>

These items specify the antenna's polarization range of travel relative to the antenna's center polarization (0.000) position.

These positions are used when the RC4600 calculates an antenna pointing solution in LOCATE mode, it checks these values to see if the feed can be physically moved to that 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. NOTE: The default value for this item will typically be correct.

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 RC4600 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: 0.0 CONFIG-POL
CCW: -92.000 CW: 92.000 SF: 43.05
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 (2.1.1.3.2.5). The inputs are combined to create a feed number. The table below shows how each feed number is defined, and the defaults for the feed number. Due to the high configurability of the RC4600, these values can all be modified if desired. However, the defaults on all RC4600 units using the Multi-Feed Sensing system will be as shown.

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 (2.1.1.3.1.2.4). 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)
- Autopeak (2.1.1.3.1.2.5)
- POL Angle Movement (2.1.1.3.1.3.6)
- POL Drive Parameters (2.1.1.3.1.3.7)
- POL Stow (2.1.1.3.1.3.8.1)

Refer to the mount specific appendix to determine if the RC4600 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>LINEAR

```

TYPE: <0>CIRCULAR <1>LINEAR

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.

Linear 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. The controller will also move the feed to the appropriate positions in LOCATE mode (2.1.1.2.2.3).

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 may be used to determine the apparent beam-width 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 RC4600 when the feed is positioned at 0.000 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 RC4600. 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>LINEAR

```

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 Autopeak

```

CONFIG-AUTOPEAK
LOCATE SOURCE: 2          SCAN: 2
TARGET PEAK: 4  POL AUTOMOVE: 1  TILT: 1
<0-NONE 1-EXT 2-BCN 5-RF 6-DVB 8-AUTO>

```

LOCATE SOURCE: <0-NONE 1-EXT 2-BCN 5-RF 6-DVB 8-AUTO>

The locate source item defines which source of input will be used in LOCATE mode. Auto will follow the order listed in the table below. If the controller is not equipped with an internal beacon receiver or DVB receiver, options 2 and 6 will be unavailable.

<i>Process</i>	Scanning	Peaking
<i>First Source</i>	DVB	Beacon
<i>Second Source</i>	Beacon	DVB
<i>Third Source</i>	RF	n/a

TARGET PEAK: <0-OFF 1-E 2-AE 3-AEP 4-AE+ 5-AEP+>

The target peak item defines the type of peaking operation that will be performed on the target satellite. Refer to sections 2.1.1.2.2.3.4 and 2.1.1.2.2.3.5 for further discussion of this feature.

SCAN: **SCAN TRIES** <1-3>

This item specifies modified scan ranges that will be used if the initial azimuth scan did not end successfully

- 1 The RC4600 will attempt only a single scan during LOCATE. The scan range is defined in the locate source specific signal factors screen.
- 2 If the first scan is unsuccessful, then the RC4600 will attempt a second scan that doubles the scan range specified in the locate source specific signal factors screen.
- 3 The RC4600 will attempt the steps described for option 2. If both operations fail, then the RC4600 will attempt a third scan that will move limit to limit in the azimuth axis.

POL AUTOMOVE **LOCATE AUTOMOVE** <0>DISABLE <1>ENABLE

This item lets the user specify whether the LOCATE mode should attempt to automatically orient the polarization axis.

TILT: <0>OFF <1>INCLIN

This item defines if the dual axis inclinometer should be used to convert local platform angles into local horizontal angles. This item should only be disabled if the tilt sensor is malfunctioning.

2.1.1.3.1.2.5.1 Multi-Feed Sensing

If the mutli-feed option is available, an additional feed index number will show in the configuration group. When this option is used, each feed will have unique autopeak configuration items.

2.1.1.3.1.2.6 External Sig Factors

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

LOCK: 1	TIME: 3.0	CONFIG-EXT
THRES: 0	SENSE: 1	
SCAN RG: 6	SRCH AZ: 5	SRCH:EL: 5
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 RC4600 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: SCAN SLOW THRESHOLD <0-1023>

The threshold item defines what the minimum RF signal strength should be to switch from fast RF scanning to slow external receiver scanning.

If different bands are received that exhibit different "off satellite" signal strengths, the highest "off satellite" value should be used to avoid the possibility of recognizing noise as a satellite.

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

The polarity flag tells the RC4600 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.

SCAN RG: SCAN RANGE <1-90 DEGREES>

The scan range item defines how many degrees to either side of the nominal azimuth target the azimuth scan operation will search.

SRCH AZ: SPIRAL SEARCH AZIM LIMIT <1 – 20 DEGREES>**SRCH EL: SPIRAL SEARCH ELEV LIMIT <1 – 15 DEGREES>**

The search azimuth/elev limit items define the area that the spiral search pattern can search to recognize a satellite. If a satellite is not recognized after searching the area defined by these limits, the spiral search will return to the normal target position. The larger the limits, the longer time a search might take. If the limits are too small to account for azimuth target inaccuracy due to heading error or to account for elevation movement an inclined orbit satellite may exhibit, the spiral search may quit before moving over the satellite.

2.1.1.3.1.2.7 Beacon Sig Factors

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

LOCK: 1	TIME: 1.5	CONFIG-BCN
THRES: 0	SENSE: 1	
SCAN RG: 6	SRCH AZ: 5	SRCH:EL: 5
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 RC4600 will wait after each step before sampling signal strength. Increasing this value may be required for noisy carriers.

THRES: SCAN SLOW THRESHOLD <0-1023>

The threshold item defines what the minimum RF signal strength should be to switch from fast RF scanning to slow external receiver scanning.

If different bands are received that exhibit different “off satellite” signal strengths, the highest “off satellite” value should be used to avoid the possibility of recognizing noise as a satellite.

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

The polarity flag tells the RC4600 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.

SCAN RG: SCAN RANGE <1-90 DEGREES>

The scan range item defines how many degrees to either side of the nominal azimuth target the azimuth scan operation will search.

SRCH AZ: SPIRAL SEARCH AZIM LIMIT <1 – 20 DEGREES>

SRCH EL: SPIRAL SEARCH ELEV LIMIT <1 – 15 DEGREES>

The search azimuth/elev limit items define the area that the spiral search pattern can search to recognize a satellite. If a satellite is not recognized after searching the area defined by these limits, the spiral search will return to the normal target position. The larger the limits, the longer time a search might take. If the limits are too small to account for azimuth target inaccuracy due to heading error or to account for elevation movement an inclined orbit satellite may exhibit, the spiral search may quit before moving over the satellite.

2.1.1.3.1.2.8 RF Sig Factors

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

LOCK:0	THRES: 100	CONFIG-RF
SCAN RG:10	SRCH AZ: 5	SRCH:EL: 5
LOCK SOURCE <0-NONE 1-EXT 2-THRES>		

LOCK: LOCK SOURCE <0-NONE 1-EXT 2-THRES>

When the locate source is set to RF (5), 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 (2.1.1.3.1.2.6).

Option 2 is used to define a threshold for using the RF when the locate source is set to AUTO (8). If LOCK is set to 2 and the RF for a target satellite is above the THRES value set below, the RC4600 will use the RF to peak on the target satellite.

THRES: SCAN SLOW THRESHOLD <0-1023>

This item defines the amount of displayed value (of RF signal strength) above the average noise floor reading that indicates the antenna is passing across a satellite. When the RF signal strength reaches this threshold level, the scan movement will transition from fast to slow speed.

If LOCK is set to THRES (2) this will set the value of the RF signal strength that will trigger a target satellite peakup in LOCATE mode.

SCAN RG: SCAN RANGE <1 – 90 DEGREES>

The scan range item defines how many degrees to either side of the nominal azimuth target the azimuth scanning operation will search.

SRCH AZ: SPIRAL SEARCH AZIM LIMIT <1 – 20 DEGREES>

SRCH EL: SPIRAL SEARCH ELEV LIMIT <1 – 15 DEGREES>

The search azimuth/elevation limit items define the area that the spiral search pattern is allowed to search to recognize a satellite. If a satellite is not recognized after searching the area defined by these limits, the spiral search will return to the normal target position. The larger the limits, the longer time a search might take. If the limits are too small to account for azimuth target inaccuracy due to heading error or to account for elevation movement an inclined orbit satellite may exhibit, the spiral search may quit before moving over the satellite.

2.1.1.3.1.2.9 DVB Sig Factors

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

```
          THRES: 10          TIME: 0.0          CONFIG-DVB  
SCAN RG: 40  
SCAN SLOW THRESHOLD <0-1023>
```

THRES: SCAN SLOW THRESHOLD <0-1023>

This field specifies at what value above the open-sky noise floor that the scan for a signpost will transition from high speed to low speed. This value should be set low enough that slow speed will be triggered quickly as the scan approaches a satellite. Conversely, it should be set at a high enough value that the transition won't be fooled by noise in the open-sky value.

TIME: SAMPLE TIME <0.0-10.0> SECONDS

This item defines how long the RC4600 will wait after each step before sampling signal strength. Increasing this value may be required for noisy carriers.

SCAN RG: SCAN RANGE <1-90 DEGREES>

This field specifies the number of degrees on either side of the estimated satellite position that will be scanned.

This number should be somewhat larger than the worst-case error that can be obtained from the compass. Example: if you have confidence that the compass will never have more than a 15° error, then the scan range could be set to a value of 20.

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

```

          ANT SIZE: 240          CONFIG-SYSTEM
GPS: 2
COMP: 2  COMP OFF:  0.0  DISPLAY: 2
<0-DISABLED 1-ANY 2-DEPLOY 3-STOW>

```

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

ANT SIZE: ANTENNA SIZE <1-9999 CM>

This item specifies the size of the reflector in centimeters. For example, a 2.4 meter diameter reflector would require a value of 240 (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.

GPS: <0-DISABLED 1-ANY 2-DEPLOY 3-STOW>

This item specifies the location the antenna will need to be in when reading the data from the GPS receiver. This will be the location that gives the GPS antenna the best view of the sky. If specified as disabled (0), the user will have to manually enter the lat/lon information via the POSITION mode (2.1.1.2.2.5). If the GPS is specified as "DEPLOY" or "STOW", the RC4600 will require that the dish be moved to the corresponding position to obtain GPS location information.

COMP: <0-DISABLED 1-ANY 2-DEPLOY 3-STOW>

This item specifies the location the antenna will need to be in when reading the data from the compass. This will be the location where the compass is level to the ground. If specified as disabled (0), the user will have to manually enter the heading information via the POSITION mode (2.1.1.2.2.5). If COMP is specified as "DEPLOY" or "STOW", the RC4600 will require that the dish be moved to the corresponding position to obtain heading information.

COMP OFF: COMPASS OFFSET <+/-180.0 DEGREES>

This item specifies the number of degrees to offset the heading reading with respect to the heading of the centerline of the azimuth axis. The default value for this reading is 0.0. A value other than 0.0 may need to be entered to correct for an intentional difference between the alignment of the compass and the centerline of azimuth movement.

DISPLAY: <1>PLAT <2>HORZ <3>MAG <4>TRUE

This value allows the user to select what format (Platform, Local Horizontal, Local Magnetic Heading or Local True Heading) the position is initially displayed in the MANUAL and LOCATE modes.

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:0.60	FOLLOW: 1.0
MAX ERROR:0.010	DRIFT: 0.5
REFERENCE GAIN <0.0 - 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.

FOLLOW: FOLLOW SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the azimuth antenna movement should “follow” the calculated azimuth movement by the RC4600. For example, 1.0 indicates that during a movement the actual antenna position in azimuth should never be more than 1.0 degrees away from the position calculated by the RC4600 move profile.

MAX ERROR: MAX ERROR <0.001-10.000 DEGREES>

This item specifies how far away from the azimuth target position the azimuth sensor needs to be to consider a movement complete.

DRIFT: DRIFT SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the RC4600 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: 3.00	MAX: 1.07	ACC: 2.0	CONF-AZ	DRV
Ki: 0.01	FST: 0.95	DEC: 8.0	CL: 6.0	
Im: 0.10	SLW: 0.10	Kfe: 1.00		
Kp <0.0 - 99.9>				

The Azimuth Drive Parameters configuration screen allows the user to set the parameters that are used by the position servo implemented by the RC4600.

Kp: Kp <0.0 - 99.9>

This item specifies the proportional constant for the azimuth position servo implemented by the RC4600.

MAX: MAX <0.0 - 99.99>

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.

ACC: ACCEL <0.0 - 99.9>

This item specifies the value that the acceleration is clamped to for the azimuth axis in deg/sec/sec.

Ki: Ki <0.0 - 99.9>

This item specifies the integral constant for the azimuth position servo implemented by the RC4600.

FST: FAST <0.0 - 99.99>

This item specifies the maximum velocity that will be used during automatic azimuth moves in deg/sec. It also specifies the speed the RC4600 will target when an azimuth fast jog is requested. This item should never be more than 90% of the MAX item specified above.

DEC: DECEL <0.0 - 99.9>

This item specifies the value that the deceleration is clamped to for the azimuth axis in deg/sec/sec.

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 (2.1.1.3.2.2).

Im: Im <0.0 - 99.9>

This item specifies the maximum amount that the integral term can contribute to the azimuth position servo implemented by the RC4600.

SLW: SLOW <0.0 – 99.99>

This item specifies the azimuth velocity that will be used for azimuth scanning (2.1.1.2.2.3.3). It also specifies the speed the RC4600 will target when an azimuth slow movement is requested.

Kfe: Kfe <0.0 – 99.9>

This item specifies the proportional constant that will be used for reducing the difference between the current position and the calculated position during antenna movement.

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: 0.60	FOLLOW: 1.0	
MAX ERROR: 0.010	DRIFT: 0.2	
REFERENCE GAIN <0.0 – 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.

FOLLOW: FOLLOW SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the elevation antenna movement should “follow” the calculated elevation movement by the RC4600. For example, 1.0 indicates that the during a movement the actual antenna position in elevation should never be more than 1.0 degrees away from the position calculated by the RC4600 move profile.

MAX ERROR: MAX ERROR <0.001-10.000 DEGREES>

This item specifies how far away from the elevation target position the elevation sensor needs to be to consider a movement complete.

DRIFT: DRIFT SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the RC4600 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: 3.00	MAX: 0.75	ACC: 2.0	CONF-EL	DRV
Ki: 0.01	FST: 0.65	DEC: 2.0	CL: 9.5	
Im: 0.10	SLW: 0.10	Kfe: 1.00		
Kp <0.0 - 99.9>				

The Elevation Drive Parameters configuration screen allows the user to set the parameters that are used by the position servo implemented by the RC4600.

Kp: Kp <0.0 - 99.9>

This item specifies the proportional constant for the elevation position servo implemented by the RC4600.

MAX: MAX <0.0 - 99.99>

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.

ACC: ACCEL <0.0 - 99.9>

This item specifies the value that the acceleration is clamped to for the elevation axis in deg/sec/sec.

Ki: Ki <0.0 - 99.9>

This item specifies the integral constant for the elevation position servo implemented by the RC4600.

FST: FAST <0.0 - 99.99>

This item specifies the maximum velocity that will be used during automatic elevation moves in deg/sec. It also specifies the speed the RC4600 will target when an elevation fast jog is requested. This item should never be more than 90% of the MAX item specified above.

DEC: DECEL <0.0 - 99.9>

This item specifies the value that the deceleration is clamped to for the elevation axis in deg/sec/sec.

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 (2.1.1.3.2.2).

Im: Im <0.0 - 99.9>

This item specifies the maximum amount that the integral term can contribute to the elevation position servo implemented by the RC4600.

SLW: SLOW <0.0 – 99.99>

This item specifies the speed the RC4600 will target when an elevation slow movement is requested.

Kfe: Kfe <0.0 – 99.9>

This item specifies the proportional constant that will be used for reducing the difference between the current position and the calculated position during antenna movement.

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-POL ANG	
REF GAIN: 0.60	FOLLOW: 1.0
MAX ERROR: 0.010	DRIFT: 0.2
REFERENCE GAIN <0.0 – 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 drive module.

FOLLOW: FOLLOW SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the polarization antenna movement should “follow” the calculated polarization movement by the RC4600. For example, 1.0 indicates that the during a movement the actual antenna position in polarization should never be more than 1.0 degrees away from the position calculated by the RC4600 move profile.

MAX ERROR: MAX ERROR <0.001-10.000 DEGREES>

This item specifies how far away from the polarization target position the polarization sensor needs to be to consider a movement complete.

DRIFT: DRIFT SLOP <0.0-99.0 DEG, 0.0=OFF>

This item defines how closely the RC4600 should be able to hold the polarization axis when not moving. For example, 0.2 indicates that while position holding the position in polarization should never be more than 0.2 degrees away from the target position.

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:4.00 MAX: 1.07 ACC: 4.0 CONFIG-PL DRV
Ki:0.01 FST: 0.95 DEC: 8.0
Im:0.01 SLW: 0.10
Kp <0.0 - 99.9>
```

The Polarization Drive Parameters configuration screen allows the user to set the parameters that are used by the position servo implemented by the RC4600.

Kp: Kp <0.0 – 99.9>

This item specifies the proportional constant for the polarization position servo implemented by the RC4600.

MAX: MAX <0.0 – 99.99>

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.

ACC: ACCEL <0.0 – 99.9>

This item specifies the value that the acceleration is clamped to for the polarization axis in deg/sec/sec.

Ki: Ki <0.0 – 99.9>

This item specifies the integral constant for the polarization position servo implemented by the RC4600.

FST: FAST <0.0 – 99.99>

This item specifies the maximum velocity that will be used during automatic polarization moves in deg/sec. It also specifies the speed the RC4600 will target when an polarization fast jog is requested. This item should never be more than 90% of the MAX item specified above.

DEC: DECEL <0.0 – 99.9>

This item specifies the value that the deceleration is clamped to for the polarization axis in deg/sec/sec.

Im: Im <0.0 – 99.9>

This item specifies the maximum amount that the integral term can contribute to the polarization position servo implemented by the RC4600.

SLW: SLOW <0.0 – 99.99>

This item specifies the speed the RC4600 will target when an polarization slow movement is requested.

Kfe: **Kfe <0.0 – 99.9>**

This item specifies the proportional constant that will be used for reducing the difference between the current position and the calculated position during antenna movement.

2.1.1.3.1.3.8 Stow & Deploy

AZ_STW:	0.0	AZ_DEP:	0.0	CONFIG-STOW
EL_STW:	-75.5	EL_DEP:	16.0	SNUG: 2.5
PL_STW:	0.0	PL_DEP:	0.0	PL_MOVE: 0
AZIMUTH STOW <+/-180.0 DEGREES>				

AZ_STW: **AZIMUTH STOW <+/-180.0 DEGREES>**

EL_STW: **ELEVATION STOW <-90.0/120.0 DEGREES>**

PL_STW: **POL STOW <+/-180.0 DEGREES>**

These items define the STOW position.

AZ_DEP: **AZIMUTH DEPLOY<+/-180.0 DEGREES>**

EL_DEP: **ELEVATION_DEPLOY <+/-90.0 DEGREES>**

PL_DEP: **POL DEPLOY <+/-180.0 DEGREES>**

These items define the DEPLOY position.

SNUG: **ELEV STOW DELAY TIME <0.0-10.0 SECS>**

Or

SNUG: **ELEV STOW CURRENT LIMIT <0.0-10.0 AMPS>**

On certain mounts there needs to be a delay between the time that the elevation stow limit is sensed and when the elevation motor is de-energized. For mounts where this is not the case, this item is ignored by setting to 0.0 seconds.

Alternatively, on antennas which implement a current-based stow, the SNUG item represents the amount of current output to the elevation motor that must be reached after the antenna reaches the stow limit for the motor to be de-energized.

PL_MOVE: **POL MOVE<0-NONE 1-STOW 2-DEPLOY 3-BOTH>**

This item defines whether the polarization axis is moved during a STOW and/or DEPLOY.

0 – the polarization axis will not be moved as part of either STOW or DEPLOY

1 – polarization will move to the PL_STW position as part of STOW (no DEPLOY movement)

2 – polarization will move to the PL_DEP position as part of DEPLOY (no STOW movement)

3 – polarization will move during both STOW and DEPLOY

NOTE: the default value is to have polarization move during DEPLOY to be consistent with earlier versions of the software. Default STOW movement is per mount type.

2.1.1.3.1.3.8.1 Multi-Feed Sensing

This section is for the Stow & Deploy configuration group when the feed sensing option is available on the RC4600. See section 2.1.1.3.1.2.3.1 for more information.

When this option is available, the Stow & Deploy screens will be broken into two groups listed below.

AZ/EL STOW & DEPLOY

The AZ/EL STOW & DEPLOY group allows the user to change the target positions for STOW and DEPLOY movements for the azimuth and elevation axes. The fields are the same as described in section 0.

```
AZ_STW:    0.0  AZ_DEP:    0.0  CONFIG-STOW
EL_STW:   -75.5  EL_DEP:   16.0  SNUG:  2.5
AZIMUTH STOW <+/-180.0 DEGREES>
```

POL STOW & DEPLOY

The POL STOW & DEPLOY group allows the user to change the target positions for STOW and DEPLOY movements for the polarization axis. Each feed will have a unique stow and deploy screen based on feed index number. All other field are the same as described in section 0.

```
POL#:0                                CONFIG-STOW
PL_STW:    0.0  PL_DEP:    0.0  PL_MOVE:0
<SCR> THRU LIST, <ENTER> TO MODIFY DATA
```

POL#: FEED INDEX NUMBER

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

2.1.1.3.1.3.9 Track Factors

SEARCH: 2	SIG: 1	CONFIG-TRACK
MAX ERROR: 3	TIME: 3	MODE: 1
HOLDOFF: 40	LOG: 1	AZDP: 1.0
<0-DISABLED, 1-NARROW, 3-NOMINAL, 10-WIDE>		

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

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

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

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

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

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

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

SIG: <1-EXT 2-BCN 5-RF 6-DVB 8-AUTO>

This field specifies the signal source that will be used when in the step track sub-mode.

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.

MODE: <1>MEM/STP <2>STP/MEM <3>STP/TLE <4>TLE

The MODE field specifies a priority of how to proceed when a track is initiated.

- 1 MEM/STP The RC4600 will use memory track any time a track table entry corresponding to the current time is available. If track table data is not available for the current time, Step Track will be used.
- 2 STP/MEM The RC4600 will use step track as long as a signal is present. If the signal is lost the controller will use memory track if track table data is available.

- 3 STP/TLE The RC4600 will begin with Step Track. If the signal is lost the controller will use TLE to continue tracking the satellite.
- 4 TLE The RC4600 will track only using TLE.

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%.

2.1.1.3.1.3.10 Shake

AZ	1:	0.0	2:	0.0	3:	0.0	CONF-SHAKE
EL	1:	20.0	2:	60.0	3:	20.0	CYCLE: 100
PL	1:	0.0	2:	0.0	3:	0.0	DELAY: 5
MOVE 1 AZIM <+/-180.0 DEGREES>							

AZ #: **MOVE # AZIM <+/-180.0 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".

2.1.1.3.1.3.11 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

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: Not currently used

2-TEMP: Optional off-board temperature sensor

3-REC3: External receiver AGC voltage from options board (4.1.2.5.2)

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 RC4000. Therefore, the voltages seen at this screen may not be exactly the same as the input voltages external to the RC4600.

AZ :	2 . 7 7 2 9	2 2 7 1	1 2	BIT	ADC
EL :	UNDER	0		L 1 :	0
POL :	UNDER	0		L 2 :	0
SIG :	3 . 3 3 5 8	2 7 3 2		L 3 :	1

AZ:

Shows the current voltage from the azimuth potentiometer. If potentiometer is not present on the system, UNDER will be displayed.

EL:

Currently unused on the RC4600.

POL:

Show the current voltage from the polarization potentiometer. If 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 (4.1.2.2.3).

L1:

Shows the state of the lock input from the computing and interface board's "Receiver" port (4.1.2.2.3).

L2:

Shows the state of the lock input from the options board's "Receiver" port (4.1.2.5.2).

L3:

Not currently used on the RC4600.

2.1.1.3.2.2 DRIVE

1-AZIM:FOLLOW				DRIVE	RESET
2-ELEV:DRIFT	F:	7	3:	0	A: 0
3-POL:OK	C:	0	4:	0	E: 0
<1-3> RESET AXIS <4>COUNTS <MODE>EXIT					

The DRIVE maintenance screen provides the way to reset drive system errors (FOLLOW/DRIFT/DRIVE) for each axis. See section 5.2.4.1 for descriptions of these conditions. An axis' drive status may be reset by pressing the corresponding key.

The additional items shown on this screen are for internal diagnostic purposes only.

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 2-TIME 3-SYNC 4-ZONE 5-OFFSET			

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

Current date and UTC time as maintained by the RC4600'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 ENTER UTC DATE (MM.DD.YY)

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

2-TIME ENTER UTC TIME (HH.MM.SS)

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

3-SYNC

If valid GPS UTC data is being received, pressing the 3 key will cause system time to be synchronized with the current GPS UTC time.

4-ZONE ENTER 3 LETTER TIME ZONE

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

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

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

2.1.1.3.2.4 SERVO MAINT

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:  23.879  AXIS  VEL    AMP    RF    SERVO
E:  41.396  AZ    0.00  0.0   265  MANUAL
P:  45.000  SPD:  0%  DISP:P   CNT:  2704
<ENTER>PROFILE <BKSP>CHANGE AXIS

```

A: 23.879

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

E: 41.396

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

P: 45.000

The current angle from the polarization axis. Will display the raw sensor angle, local platform angle, or local horizontal angle depending on the status of the DISP field discussed later.

**AXIS
AZ**

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

**VEL
0.00**

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

**RF
265**

Current displayed signal strength source and value.

MANUAL

Current servo maintenance profile. A description of each mode can be found in 2.1.1.3.2.4.1.

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.

$$\text{Voltage} = \pm 10 \text{ volts} \times \text{SPD} \times \text{REF GAIN}$$

DISP: P

This item specifies the current angle displayed for azimuth, elevation, and polarization. Possible values are P (local platform angle), S (raw sensor angle), and H (local horizontal angle).

CNT: 2704

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 to 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 2.1.1.3.2.4.1.

```

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.

2.1.1.3.2.4.1 Secondary Servo Maintenance Profiles

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

2.1.1.3.2.4.1.1 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 or 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 RC4600 to the servo maintenance main screen. This profile will then continue at the period selected until the <MODE> or <ENTER> key is pressed.

2.1.1.3.2.4.1.2 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 RC4600 to draw two complete circles. If the fast speed of each axis does not allow the RC4600 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 or fast velocity defined in the axis angle movement configuration screen as the maximum velocity.

Pressing the <ENTER> key will start the circular movement and return the RC4600 to the servo maintenance main screen. This profile will then continue at the period selected until the <MODE> or <ENTER> key is pressed.

2.1.1.3.2.4.1.3 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.

2.1.1.3.2.5 LIMITS

The limits maintenance screen shows the current state of each limit switch as sensed by the RC4600's microcontroller. The state of each limit is shown as 0 (not at limit) or 1 (at 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/Make Drives Inactive)
- G:** Green Button (Locate/Make Drives Active)
- A, B, C** Auxiliary switch inputs, most commonly used as POL ID BITs (2.1.1.3.1.2.3.1)
- D** E-Stop switch input

<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 (stow/deploy/etc.) are possible with the limits in an inactive state.

2.1.1.3.2.6 GPS COM

This screen allows the user to ascertain if the GPS receiver is communicating correctly with the RC4600.

```
<BKSP> TO FREEZE DISPLAY          GPS COMM
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.

2.1.1.3.2.7 CMP COM

This screen allows the user to ascertain if the compass is communicating correctly with the RC4600.

2.1.1.3.2.7.1 Fluxgate Compass

The screen shows the raw ASCII data coming from the fluxgate compass. If there is correct communication established with the compass, somewhere in the lines of displayed characters the string “HCHDM” should be recognizable.

```
<BKSP> TO FREEZE DISPLAY          CMP COMM
$HCHDM,266.1,M*2A  $HCHDM,266.0,M*2B  $H
CHDM,266.0,M*2B  $HCHDM,266.0,M*2B  $HCH
DM,266.0,M*2B  $HCHDM,266.0,M*2B  $HCHDM
```

Following the “HCHDM” should be a number indicating the current magnetic heading (266.0 in example) the compass is reading. If this value is 800.0, it indicates the fluxgate’s sensor is either saturated by an unreasonably high magnetic field or the magnetic field strength is unreasonably low. If the “800.0” number is seen, the placement of the fluxgate should be checked.

2.1.1.3.2.7.2 Three Axis Compass

The screen shows the raw ASCII data coming from the three-axis compass. If there is correct communication established with the compass, somewhere in the lines of displayed characters the string "OHPR" should be recognizable.

```
<BKSP> TO FREEZE DISPLAY          CMP COMM
$OHPR,266.1,0.8,0.1*2A  $OHPR,266.1,0.8,
0.1*2A  $OHPR,266.1,0.8,0.1*2A  $OHPR,26
6.1,0.8,0.1*2A  $OHPR,266.1,0.8,0.1*2A
```

Following the OHPR should be a number indicating the current magnetic heading (266.1 in example) the compass is reading. The two fields following the heading are the pitch and roll currently being reported by the three-axis compass.

2.1.1.3.2.8 CMP CAL

The compass calibration procedure is performed to compensate for sources of hard and soft iron magnetic deviations from the host mount. Review the discussion on the importance of selecting a suitable site for performing calibration in section 3.6.

2.1.1.3.2.8.1 Fluxgate Compass

NOTE: the fluxgate compass must be in a level orientation to perform a good calibration.

The user is prompted to hit the Enter key to begin the procedure. If the user is not confident that the location for calibration is adequate or does not have the ability to move the mount, the user may exit the procedure the <MODE> key.

```
8-PT COMPASS CAL
<ENTER>BEGIN CALIBRATION          <MODE>EXIT
```

Fields to show the quality of the calibration are displayed. Until the calibration is finished, an "*" is displayed. Following successful completion of the procedure, the scores reported by the fluxgate compass will be displayed. Each procedure has unique messages for prompting the user on how to proceed.

MOVE TO INITIAL HEADING & <ENTER>

ROTATE 45 DEG.(START + 45/90/135/180/225/270/315) & <ENTER>

The eight-point calibration procedure requires the mount to be moved 45 degrees at a time. The first prompt asks for the mount to be moved to an initial position. After moving to the requested position, the user must let the compass know by pressing the Enter key. These steps will be repeated for 45, 90, 135, 180, 225, 270 and 315 degrees.

The requirement is not that the mount be initially placed at a true heading of 0 degrees initially. Rather the value indicates the number of degrees from the starting orientation. Also the movement each time needs only be +/- 15 degrees from the requested 45 each time. Marking out eight equidistant bearings before the procedure is performed may be beneficial.

MOVEMENT MAY STOP-PERFORMING CALCULATION

When the calibration has collected enough data, the “movement may be stopped” message is displayed. Do not mode out of calibration until the calibration finished message is displayed.

CALIBRATION FINISHED, <MODE> TO EXIT

This message indicates the fluxgate has finished performing its calibration calculations. At this time new calibration scores are displayed.

```

8 PT COMPASS CAL
CAL QUALITY: 8          ( 0-9 , >6 PREFERRED )
MAG ENVIRON: 7          ( 0-9 , >5 PREFERRED )
CALIBRATION FINISHED, <MODE> TO EXIT

```

COMM ERROR

At any time during the calibration procedures, if the RC4600 detects an abnormal response from the fluxgate, the communication error message is displayed. Exit the procedure by pressing the Mode key.

2.1.1.3.2.8.2 Three Axis Compass

The three-axis compass calibration screen allows the user to perform various compass calibration actions. The screen also displays real-time heading, pitch and roll currently being reported by the three-axis compass.

```

HDG: 266.1 MOUNT: 2 3 AXIS
PITCH: 0.8
ROLL: 0.1 COUNT: 42
<.>X/Y CAL <BKSP>ZERO P/R <7>MNT <9>RST

```

COUNT:

This field shows the total number of correctly parsed messages from the compass. This number should be increasing at a rate of approximately 4 times a second.

HDG/PITCH/ROLL:

These fields show the instantaneous magnetic heading and accelerometer pitch/roll values. These values reflect any previous compass calibration that may have been done.

MOUNT:

This field shows the current orientation value.

2.1.1.3.2.8.2.1 Mount

Pressing the <7> key will allow you to change the position that the compass is mounted in. The table below shows the possible mounting combinations for the three-axis compass. Only change the mount if needed. A new X/Y calibration (2.1.1.3.2.8.2.2) and pitch/roll calibration (0) should be performed anytime the compass mount position is changed. All compasses come from RCI calibrated for mount position 2 (Front).



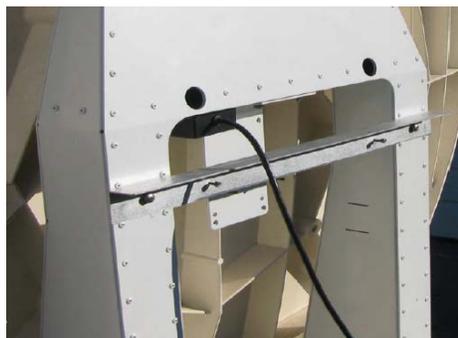
Orientation #1 "Top"



Orientation #2 "Front"



Orientation #3 "Left"



Orientation #4 "Bottom"



Orientation #5 "Back"



Orientation #6 "Right"

2.1.1.3.2.8.2.2 X/Y Calibration

NOTE: All compass calibration actions should take place with the antenna platform level.

Pressing the <STOP> key will enter the X/Y calibration mode. The user will be prompted with the screen below. If not ready to proceed with the calibration pressing <BKSP> will return to the main CMP CAL screen.

```

                                     3 AXIS
* X/Y CALIBRATION REQUIRES 30 SECOND, *
* 360 DEGREE TURN WITH PLATFORM LEVEL *
<ENTER>CONTINUE                       <BKSP>CANCEL

```

Pressing the <ENTER> key will enter the compass calibration. The antenna should be in the correct position for compass calibration based on the COMP item in the system definition configuration screen (2.1.1.3.1.3.1).

The antenna pedestal should then be rotated in a complete circle. For best results, take at least 30 seconds to slowly turn a complete circle. After turning a complete circle, press the <STOP> key to finish the calibration.

2.1.1.3.2.8.2.3 Pitch/Roll Calibration

NOTE: All compass calibration actions should take place with the antenna platform level.

Pressing the <BKSP> key will enter the pitch/roll calibration screen. The user will be prompted with the screen below. If not ready to proceed with the calibration pressing <BKSP> will return to the main CMP CAL screen.

```

                                     3 AXIS
*     PITCH AND ROLL ZEROING MUST BE     *
*     PERFORMED WITH THE PLATFORM LEVEL   *
<ENTER>CONTINUE                       <BKSP>CANCEL

```

Pressing the <ENTER> key will enter the pitch/roll calibration. The antenna should be in the correct position for pitch/roll calibration based on the COMP item in the system definition configuration screen (2.1.1.3.1.3.1).

2.1.1.3.2.8.2.4 Reset Calibration to Factor Default

Press the <9> key to reset the compass to factory defaults. This option is useful when the calibration was completed incorrectly or done in an unsuitable environment. In this case, the resulting values of heading, pitch, and roll contain large errors. Resetting to factory defaults will make the compass useable until the calibration can be done correctly.

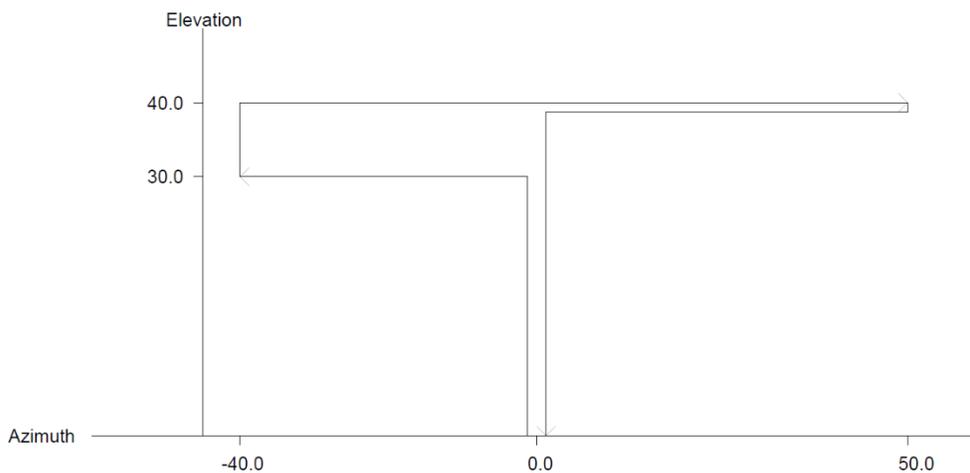
2.1.1.3.2.9 SHAKE

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 (2.1.1.3.1.3.10). 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:

```
az: 0.000 ( 0.0 ) SHAKE
el: 21.617 ( 30.0 )
pl: 0.000 ( 0.0 ) CYCLE: 1 / 100
SHAKE RUNNING... <STOP>HALT <MODE>EXIT
```

As each axis moves its header (az, el, pl) 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.

2.1.1.3.2.10 DVB

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

```
<1>MANUALLY TUNE DVB & JOG ANTENNA   DVB
<2>AUTOMATICALLY SCAN FOR SIGNPOSTS
```

Two different DVB maintenance modes can be selected from the main screen.

2.1.1.3.2.10.1 Manual Tuning

This mode allows the user to test the DVB receiver's ability to lock onto a DVB Carrier. When the mode is entered, the current tuning parameters are read from the DVB receiver.

```
a:  25.857   RF:588   SS:2866 L           DVB
e:  41.474  ^-ST:2   9-SY:30000  7-FR:19741
          v-MD:3    +-FE:5           LO:18250
<5,7,9,^,v>TUNE  5-SP:**           IF:1491
```

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).

RF: 588

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

^-STD: DVB STANDARD <1-S1, 2-S2>

This field allows the user to specify the DVB standard of the carrier.

v-MD: MOD <0-AUTO,1-Q,2-8,3-16,4-32>

This field allows the user to specify the modulation scheme for a DVB-S2 carrier. Enter 1 for QPSK or 2 for 8PSK, etc.

This field can be set to AUTO when the DVB standard is DVB-S2. This field should be set to 1 for all DVB-S carriers.

SS: 2866 L

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

9-SY: SYMBOL RATE <1000-30000>Ks/sec

This field allows the user to specify the symbol rate associated with this carrier.

+FE: FEC N/N+1 <0-9,0=AUTO>

This field allows the user to specify the forward error correction code associated with this carrier. This data is used by the positive identification feature to tune the DVB receiver.

Enter the first number of the FEC scheme. Example: to select 5/6, enter 5.

This field should be set to AUTO when the DVB standard used is DVB-S2. When using the DVB-S standard, this field should be set to the appropriate FEC for the satellite.

5-SP: SIGNPOST# <1-20>

Allows for the use of a DVB detection point for tuning the DVB receiver.

7-FR: RF FREQUENCY <1000-30000>

This field identifies the carrier frequency in RF.

LO: xxxxx MHz

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

IF: xxxx MHz

This field indicates the current intermediate frequency from the RF and the LO fields.

2.1.1.3.2.10.2 Automatic Signpost Scanning

This mode allows the integrated DVB receiver to "learn" the identification parameters of DVB streams transmitted by a satellite. In order to use this feature, the ACU must first be peaked up in azimuth, elevation and polarization on an identified satellite.

The length of time it will take the DVB receiver to scan for identifiable transport streams is a function of the minimum symbol rate that the receiver is requested to search for. The smaller the symbol rate -> the longer it will take to search the full (950 -2150) frequency range.

Upon entering this mode, the minimum symbol rate is set to 10 MSamples per second. The estimated time to complete a scan is shown.

```

<1> MIN SYMBOL RATE: 10 MS/s           DVB
ESTIMATED SCAN TIME: 90 Sec
                        S: 51 T: 50 FW:4.12
<2> START AUTOMATIC SIGNPOST SCAN
```

FW:

This field shows the firmware version running in the options board microprocessor.

S:

This field shows the current temperature reported by the DVB board in degrees Celsius.

T:

This field shows the current temperature reported by the options board in degrees Celsius.

<1> MINIMUM SYMBOL RATE: <1-45> MSymbols/sec

The user may reduce the estimated scan time by increasing the minimum symbol rate to scan for. Pressing the <1> key allows the user to enter a minimum symbol rate from 1 to 45 MSamples per second. After entering a new minimum, a new estimated scan time will be displayed.

<2>START AUTOMATIC SIGNPOST SCAN

After a minimum symbol rate is chosen, the user may initiate the automatic scan by pressing the <2> key. The following screen appears to show the progression of the scan.

```

ESTIMATED TIME:   90 Sec                               DVB
  ELAPSED TIME:    6 Sec
SIGNPOSTS FOUND:  0   5%
SCAN IN PROGRESS      <.>STOP <MODE>EXIT

```

The estimated scan time (in seconds) is displayed as a reference and the elapsed time since initiation of the scan is updated. The percentage complete is also shown for an estimate on how much of the scan is remaining.

As the DVB-S2 receiver identifies transport streams, the "SIGNPOSTS FOUND" field is incremented. NOTE: this field should initially show 0 as an indication that the DVB-S2 receiver has acknowledged the request to automatically scan for transport streams. If this field shows -1, it indicates that the request to scan was not acknowledged by the DVB-S2 receiver. This unlikely condition probably indicates that communication with the DVB-S2 receiver is not functioning.

The scan may be stopped at any time by pressing the STOP key.

If no DVB transport streams are found, the scan will end with the following screen:

```

                                                                    DVB
* NO SIGNPOSTS FOUND *
                                                                    <MODE>EXIT

```

If transport streams have been found and after the DVB receiver has finished scanning the 950 - 2150 range of frequencies, the following screen will be displayed with the parameters for the first transport stream. The user may scroll through the list of identified transport streams by using the <SCROLL UP> and <SCROLL DN> keys.

```

SP  IF   RF      SYM   FEC   STD  MOD
 1 1491 19741 29998  5/6   S2  16APSK
<SCROLL UP/DN>VIEW RESULTS      <MODE>EXIT

```

If the user wishes to use a transport stream, it can be entered as a DVB detection point as described in section 2.1.1.3.1.4. The reliability of carriers found using this method is unknown. It is important that the user make every effort to determine that the carrier is reliable prior to adding as a detection point.

2.1.1.3.2.11 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.

a:	25.906	SS:	791 L	.-AN:	0	BCN
e:	41.474	RF:	578	5-FR:	20199.80	
		<>DM:	CW	LO:	18250.00	
<5,9,.,>	>TUNE	BCN		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).

5-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.

.-AN: 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.

<>DM: 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: 791 L

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

RF: 578

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

2.1.1.3.2.12 INCL

Pressing the <SCROLL UP> button from the maintenance mode enters the INCL maintenance screen. The INCL maintenance screen is provided as a diagnostic tool for the dual axis inclinometer. When entering the screen, the user is presented with the screen below.

	CUR	AVG	DUAL-TILT
P:	0.52	0.52	SEC: 144
R:	0.37	0.37	CNT: 293
			<MODE> EXIT

CUR

Column header for the current values being read from the dual axis inclinometer.

AVG

Column header for the average values read from the dual axis inclinometer since entering the INCL maintenance screen.

P:

Row identifier for the pitch value from the dual axis inclinometer.

R:

Row identifier for the roll value from the dual axis inclinometer.

SEC:

Elapsed time in seconds since entering the INCL maintenance screen.

CNT:

This field shows the total number of correctly parsed messages from the dual axis inclinometer. This number should be increasing at a rate of approximately 2 times a second.

2.1.1.3.2.13 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: 999          SYSTEM INFO
Firmware: RC46-S03-GEILN
Version:2.11 BN:1
                                <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 (RC46), the type of antenna (S03), and the software options (GEILN).

Version:

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

BN:

The build number of the software. The build number is incremented each time a new software is built and is used for identification purposes only. Different build numbers do not necessarily indicate a software change.

2.1.2 Graphical User Interface Software Overview

The Graphical User Interface to the RC4600 can be accessed by navigating to the IP address of the controller using a web browser. The default IP address of the RC4600 is 192.168.1.1

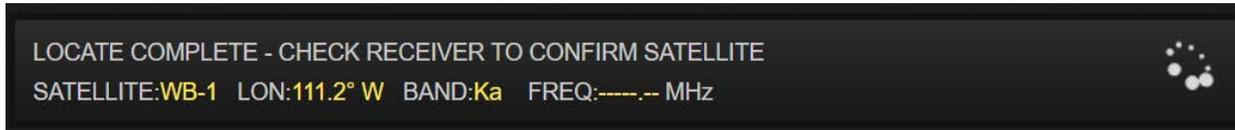
2.1.2.1 Graphical User Interface Main Page

The main page contains all important information about the current status of the RC4600 as well as the antenna. The main page offers easy access to automatic operations needed for daily used (Locate/Stow/Deploy), 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.

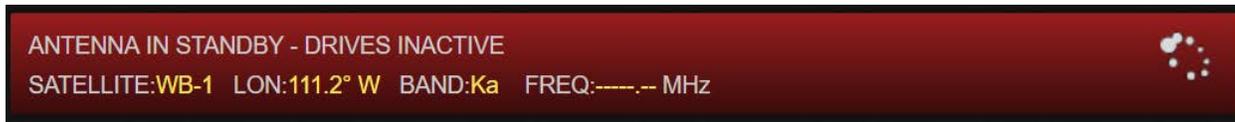


2.1.2.1.1 ACU Status Window

The ACU status window shows current information about the RC4600 and the last satellite located.



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.

Targets for auto-moves are also displayed in the smaller boxes. In this case, the elevation target for the last locate was 41.800. If the antenna was at a limit, the limit would show inside of the box as well.



2.1.2.1.2.1 Alternate Position Displays

By default, the GUI always displays the local horizontal azimuth, elevation and polarization angles. Additional readouts such as local platform angles, or true azimuth angles can be switched to by clicking on the label under each gauge.

2.1.2.1.2.1.1 Azimuth

The table below shows each of the options for the azimuth display.

Local Horizontal	True Horizontal	Magnetic Horizontal	Local Platform
Platform Angle + Pitch/Roll	Platform Angle + Pitch/Roll + Bearing + Magnetic Deviation	Platform Angle + Pitch/Roll + Bearing	Platform Angle
 <p>A circular gauge with a green face and a scale from -150 to 150. The needle points to approximately 26.4. Below the gauge is a digital display showing 26.400. At the bottom, a label reads 'Azimuth'.</p>	 <p>A circular gauge with a green face and a scale from -150 to 150. The needle points to approximately 205.2. Below the gauge is a digital display showing 205.200. At the bottom, a label reads 'True'.</p>	 <p>A circular gauge with a green face and a scale from -150 to 150. The needle points to approximately 203.5. Below the gauge is a digital display showing 203.500. At the bottom, a label reads 'Magnetic'.</p>	 <p>A circular gauge with a green face and a scale from -150 to 150. The needle points to approximately 26.4. Below the gauge is a digital display showing 26.400. At the bottom, a label reads 'Platform'.</p>

2.1.2.1.2.1.2 Elevation

The table below shows each of the options for the elevation display.

Local Horizontal	Local Platform
Platform Angle + Pitch/Roll	Platform Angle
 A circular gauge with a scale from -30 to 120 degrees. The needle points to approximately 41.800. Below the gauge is a digital display showing 41.774 and the label "Elevation".	 A circular gauge with a scale from -30 to 120 degrees. The needle points to approximately 41.800. Below the gauge is a digital display showing 41.474 and the label "Platform".

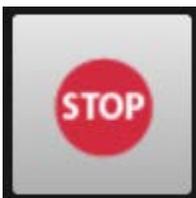
2.1.2.1.3 Local Jog Control

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 to 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.

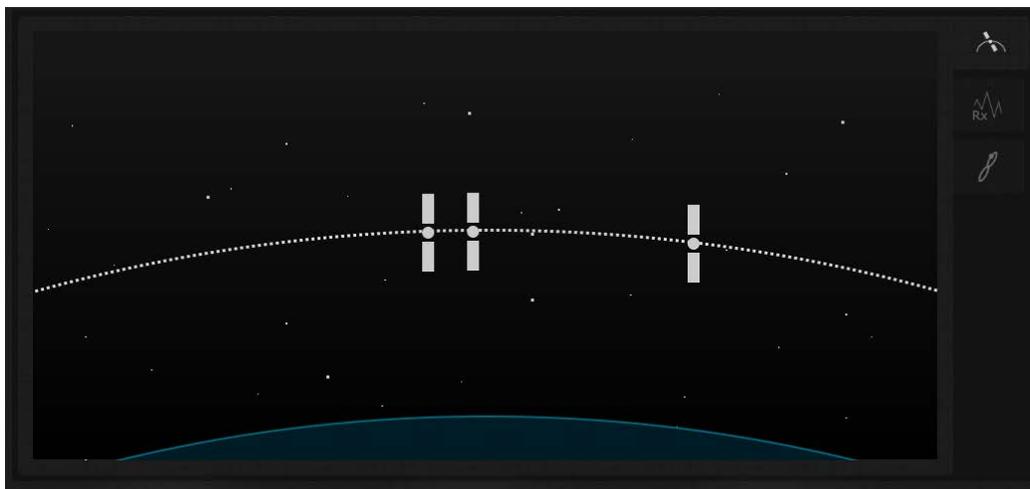


2.1.2.1.4 Main Display Window

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.

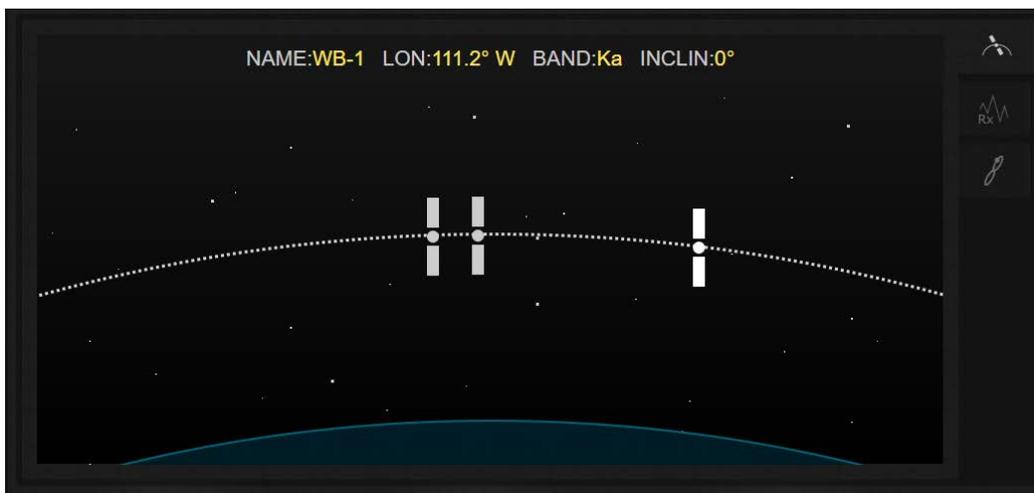
2.1.2.1.4.1 Satellite Arc Display

The center section of the display is used to display the satellite arc of the current satellites in the satellite database (2.1.2.2.1).



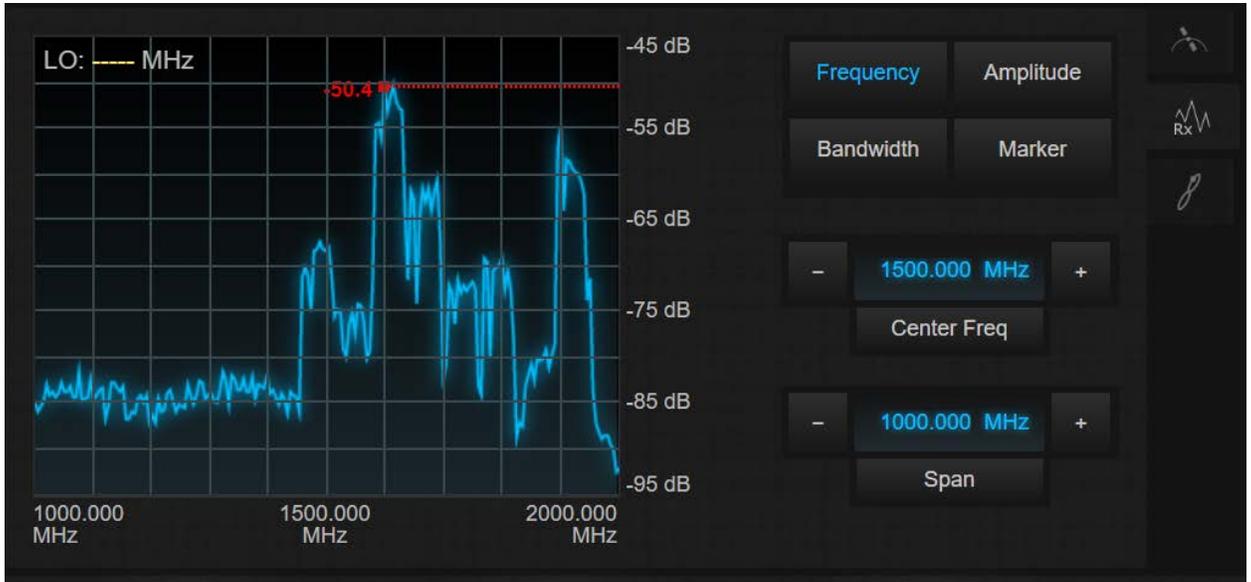
The preset satellites shown will be specific to the current band the RC4600 is configured to use in the Feed Definition configuration screen (2.1.1.3.1.2.4). In the window above, the RC4600 is set for a Ka-Band feed. Since only three preset satellites are configured for Ka-Band, only 3 are shown.

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 LOCATE automatic movement as described in section 2.1.1.2.2.3.2.



2.1.2.1.4.2 Spectrum Analyzer Display

If the RC4600 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.

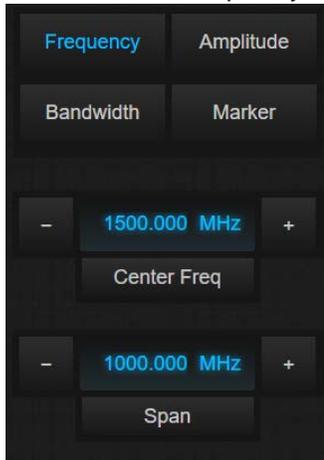


The Spectrum Analyzer functional window consists of the spectrum display on the left side and spectrum analyzer controls on the right side.

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



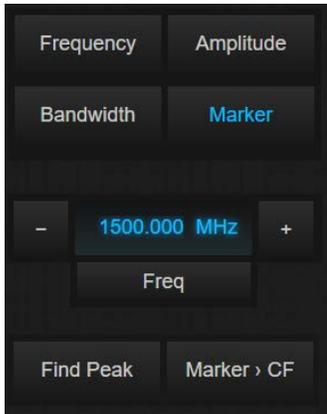
The Bandwidth Controls allows the Resolution Bandwidth (RBW) and Video Bandwidth (VBW) to be seen. The Resolution Bandwidth can be adjusted to:

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.

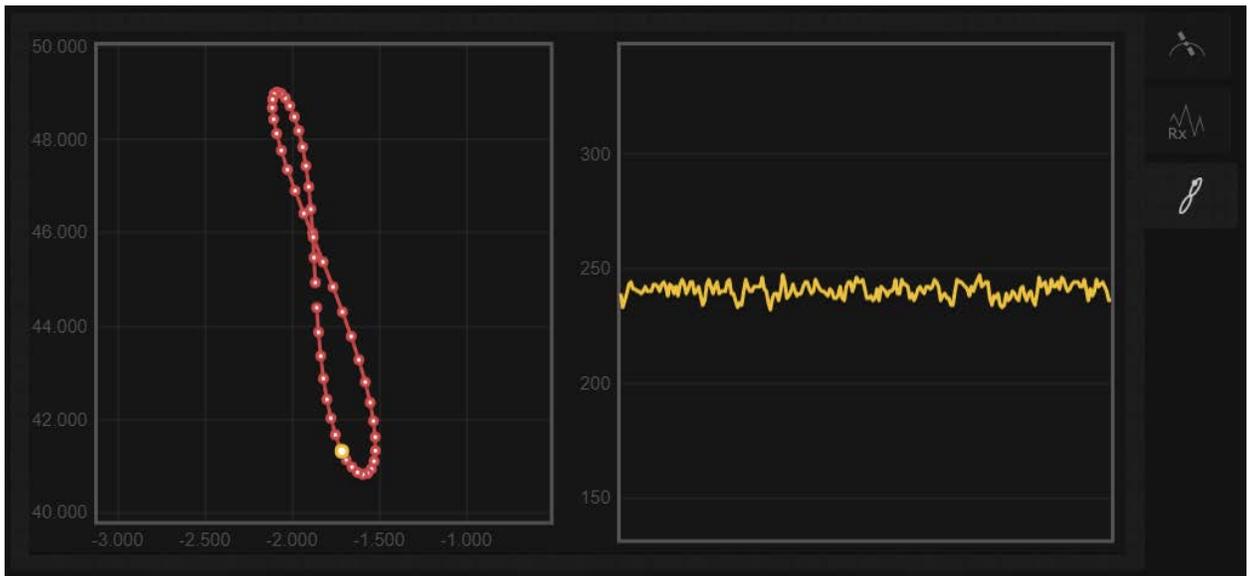
2.1.2.1.4.2.4 Marker Controls



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 RC4600 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 RC4600. Each of those functions are described in the corresponding section below.

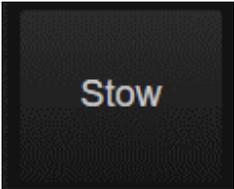
2.1.2.1.5.1 Deploy



The <Deploy> button automatically moves the antenna to the predefined "deploy" position (2.1.1.3.1.3.8). Further discussion of the DEPLOY mode can be found in section 2.1.1.2.2.1. Prior to entering the DEPLOY mode, the RC4600 will confirm that you want to deploy the antenna. Clicking <YES> will enter the DEPLOY mode. Clicking <NO> will return the GUI to the main page. When the deploy operation is finished, the RC4600 will exit DEPLOY mode, and the ACU Status Window (2.1.2.1.1) will notify the user.



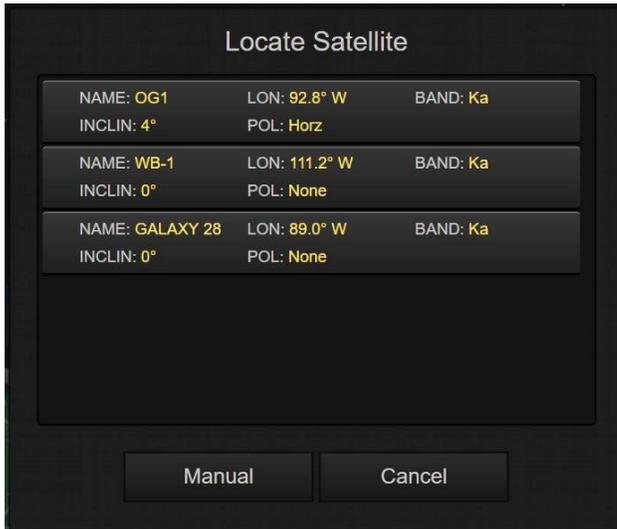
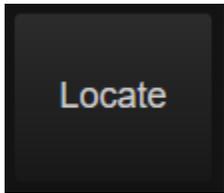
2.1.2.1.5.2 Stow



The <Stow> button automatically moves the antenna to the predefined "stow" position (2.1.1.3.1.3.8). Further discussion of the STOW mode can be found in section 2.1.1.2.2.2. Prior to entering the STOW mode, the RC4600 will confirm that you want to stow the antenna. Clicking <YES> will enter the STOW mode. Clicking <NO> will return the GUI to the main page. When the stow operation is finished, the RC4600 will exit STOW mode, and the ACU Status Window (2.1.2.1.1) will notify the user.

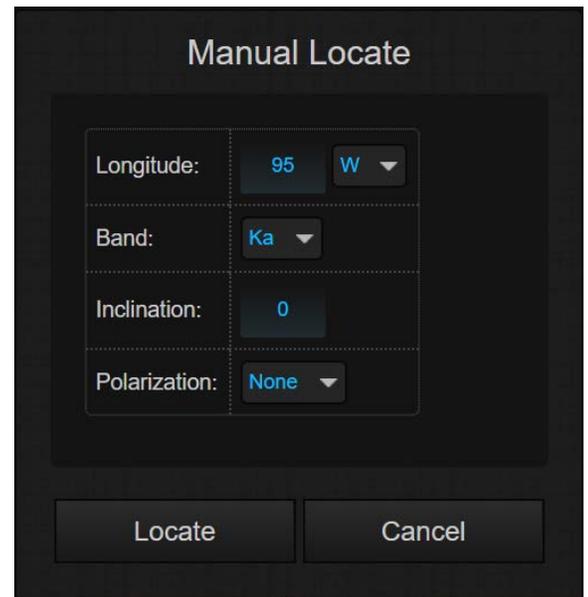


2.1.2.1.5.3 Locate

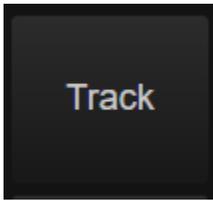


The <Locate> button allows the user to enter the LOCATE mode (2.1.1.2.2.3). After clicking the <Locate> button, the user is presented with a list of preset satellites. The list of satellites is the set of satellites from the database that have the same band as the feed is currently set to in the Feed Definition configuration screen (2.1.1.3.1.2.4). Selecting one of the satellites in the list will begin an automatic locate (2.1.1.2.2.3.2).

Clicking the <Manual> button will present the user with a box that allows them to type in the details of the satellite they want to locate. After entering the details, clicking the <Locate> button will start an auto locate based on the data input.



2.1.2.1.5.4 Track



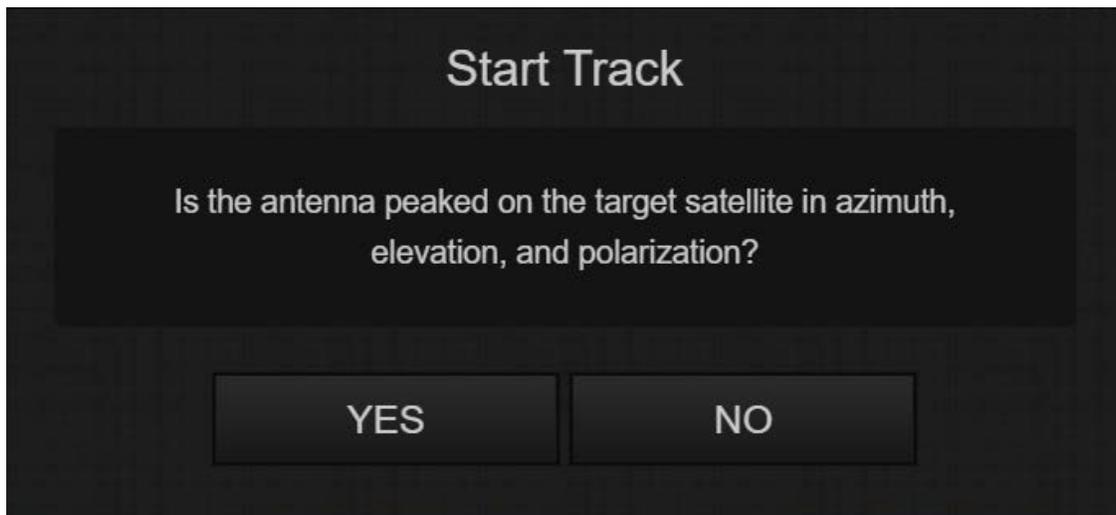
The <Track> button allows the user to enter the TRACK mode (2.1.1.2.2.4). After clicking the <Track> button, the user is presented with a list of preset satellites. The list of satellites is the set of satellites from the database that have the same band as the feed is currently set to in the Feed Definition configuration screen (2.1.1.3.1.2.4). Selecting one of the satellites in the list will begin an automatic locate will then present the user with one of the options listed in the next few sub sections.



Clicking the <Immediate> button will start a track in the current position, using the currently selected signal source (0).

2.1.2.1.5.4.1 Start Track

If the satellite currently being selected for tracking has not been tracked before, the user will be prompted with the following screen.

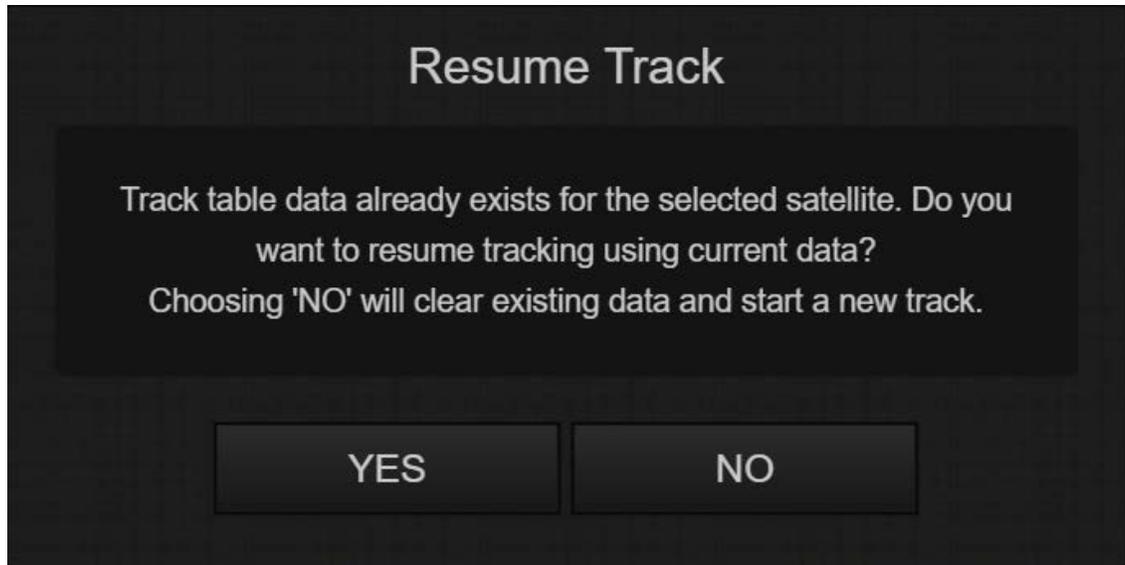


Clicking <YES> will perform a Peak Up (2.1.1.2.2.3.4) using the track source and then begin the track, or immediately start a TLE track.

Clicking <NO> will return the user to the main page.

2.1.2.1.5.4.2 Resume Track

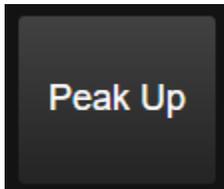
If the satellite currently being selected for tracking has been tracked before, the user will be prompted with the following screen.



Clicking <YES> will use the track table data, or TLE data that already exists for the satellite. If there is data for the current time, the RC4600 will position the antenna to the appropriate angles automatically. If there is not data for the current time, the RC4600 will perform a Peak Up (2.1.1.2.2.3.4) using the track source and then begin the track.

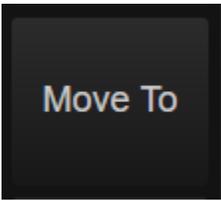
Clicking <NO> will return the user to the main page.

2.1.2.1.5.5 Peak Up

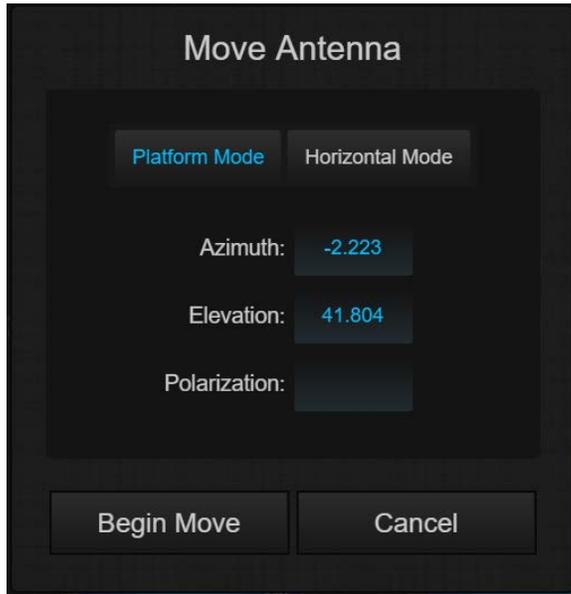


The <Peak Up> button immediately performs a Peak Up (2.1.1.2.2.3.4) using the currently selected signal source (0).

2.1.2.1.5.6 Move To



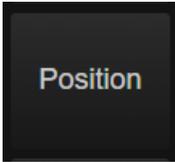
The <Move To> button allows the user to move the antenna to a specified azimuth, elevation, and polarization angles. After clicking the <Move To> button, the user will be presented with a dialog box to enter azimuth, elevation, and polarization angles.



The angles can be entered in both local platform angles or local horizontal angles. After entering the angles, clicking <Begin Move> will begin an automatic movement to the specified position.

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

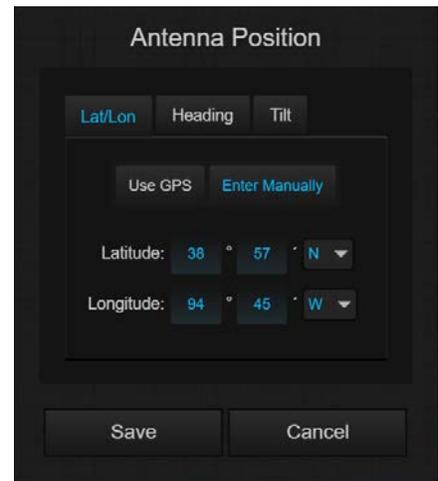
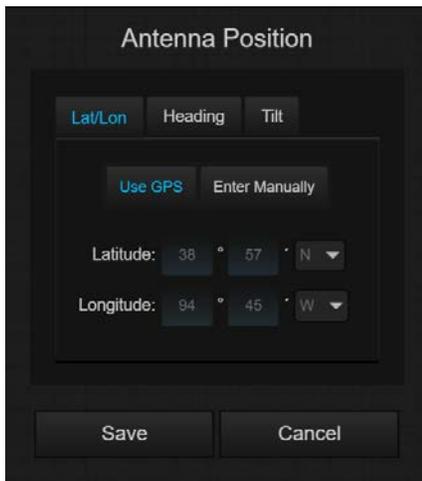
2.1.2.1.5.7 Position



The <Position> button will open a dialog box that allows the user to specify the values and the source of the Lat/Lon, heading, and Tilt.

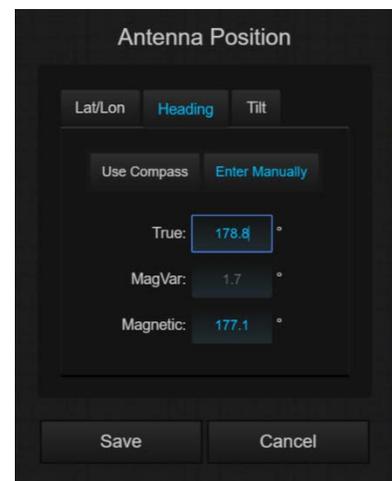
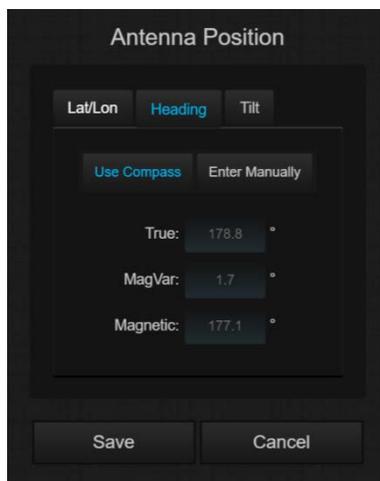
2.1.2.1.5.7.1 Lat/Lon

The Lat/Lon dialog allows the user to select between <Use GPS> and <Enter Manually>. If the RC4600 already has a value for Latitude and Longitude, they will be shown. When set to <Use GPS>, the fields will be grayed out to show that they can't be modified. When set to <Enter Manually>, the fields will be blue to indicate that they can be modified.



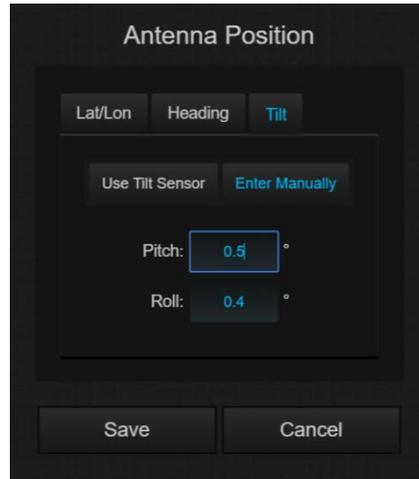
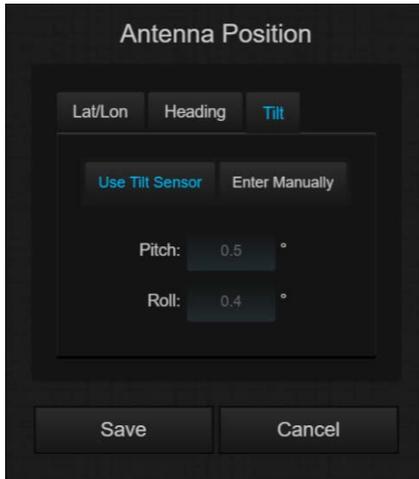
2.1.2.1.5.7.2 Heading

The Heading dialog allows the user to select between <Use Compass> and <Enter Manually>. If the RC4600 already has a value for True and Magnetic, they will be shown. When set to <Use Compass>, the fields will be grayed out to show that they can't be modified. When set to <Enter Manually>, the fields will be blue to indicate that they can be modified.



2.1.2.1.5.7.3 Tilt

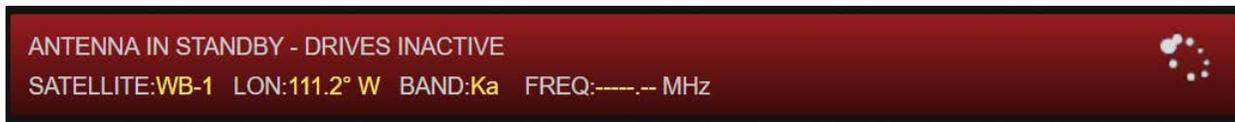
The Tilt dialog allows the user to select between <Use Tilt Sensor> and <Enter Manually>. If the RC4600 already has a value for Pitch and Roll, they will be shown. When set to <Use Tilt Sensor>, the fields will be grayed out to show that they can't be modified. When set to <Enter Manually>, the fields will be blue to indicate that they can be modified.



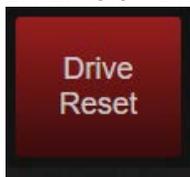
2.1.2.1.5.8 Toggle Standby



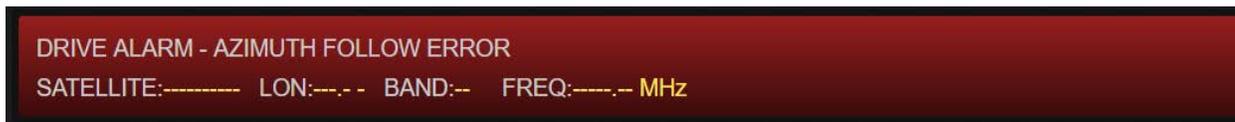
The <Toggle Standby> button transitions the drives between the active and inactive state. When in the inactive state, the ACU Status Window will indicate as shown below.

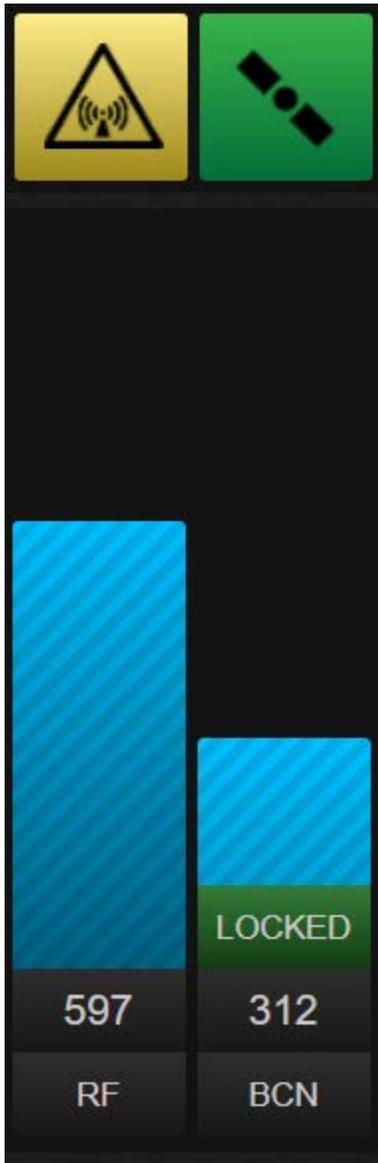


2.1.2.1.5.9 Drive Reset



If a drive alarm is currently present on the RC4600, 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 locate 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.

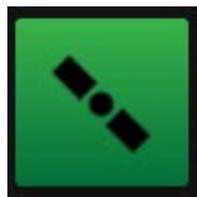
The right signal strength value is the current signal strength source being used by the RC4600 for tracking, locates, and peaking.

It can be toggled between, BCN (Beacon Receiver), RF (L-Band Power), DVB (DVB Receiver), 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 below the down limit, the indicator will be grayed out.



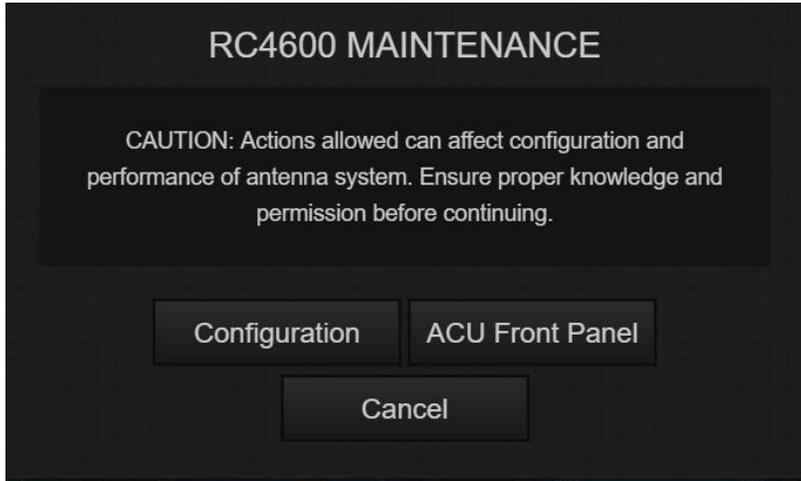
The indicator shown below indicates that the previous LOCATE finished successfully. This indicator will stay green until the RC4600 is powered off, or a new LOCATE is started. The indicator will be grayed out at the end of a LOCATE if it was unsuccessful.



2.1.2.1.7 Maintenance

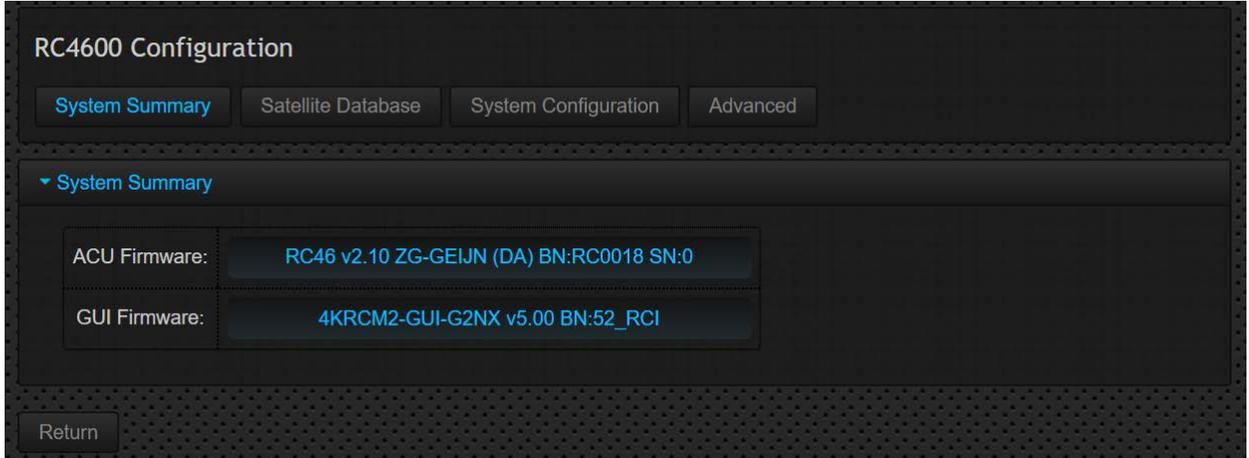


Clicking on the wrench and screwdriver in the upper right hand corner of the main page will open the dialog box below. This dialog box will allow you to access the remote front panel interface (2.1.1) and the configuration web page (2.1.2.2).



2.1.2.2 Configuration Page

The main configuration page for the RC4600 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.

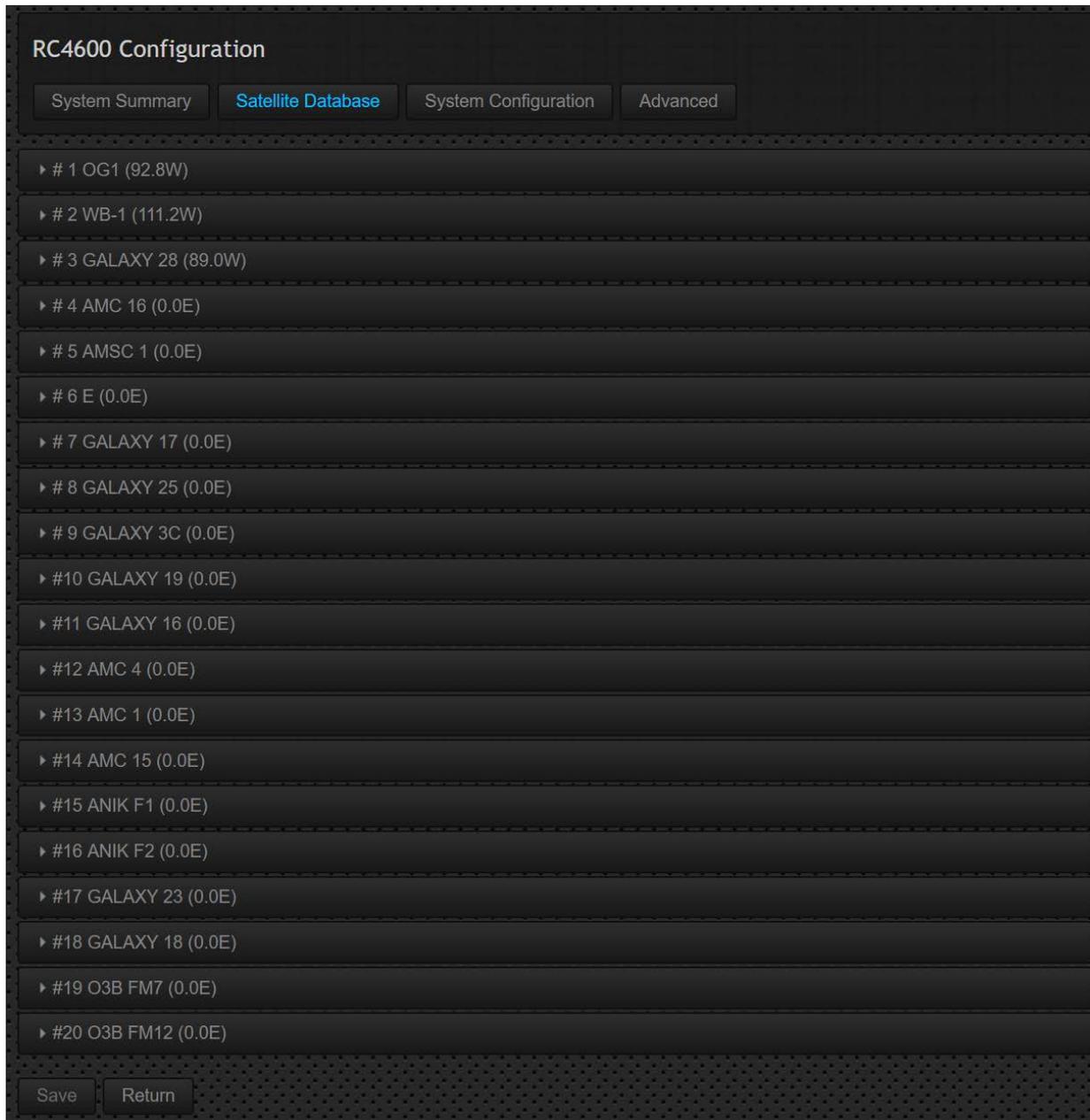


The System Summary tab will provide you with the current software on the RC4600, as well as the serial number for the controller. At the bottom of the window is a <Return> button. Clicking this button will always return the user to the main page of the GUI (2.1.2.1).

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 preset list of 20 satellites. Each satellite entry can be expanded individually. The following screen shows an example full satellite database list.



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 field. All fields in the satellite preset are editable by typing on a keyboard. Additionally, the Two-Line Element data can be copied and pasted into the window.

▼ # 2 WB-1 (111.2W)

Satellite Name	Satellite Longitude	Satellite Band	Satellite Inclination	Satellite Pol Offset	Satellite Final Pol
WB-1	111.2 ° W	Ka	0 °	0.0 °	None

DVB Polarization	DVB Frequency	DVB Symbol Rate	DVB FEC	DVB Standard	DVB Locate
Horz	19741 MHz	30000 kS/sec	Auto	S2	Signpost

Beacon Polarization	Beacon Frequency	Beacon Modulation	Beacon Locate
Horz	20199.50 MHz	CW	Signpost

Two-Line Element Data

Disabled

```
1 29643U 06054A 18354.53254523 -00000033 00000-0 00000+0 0 9995
2 29643 0.0136 298.7137 0002035 336.2664 254.6405 1.00271924 44115
```

The satellite configuration window allows the user to set the items that are found in the following configuration screens:

- Satellite Presets (2.1.1.3.1.1.3)
- DVB Detection Points (2.1.1.3.1.1.4)
- Beacon Detection Points (2.1.1.3.1.1.5)
- TLE 1 Data (0)
- TLE 2 Data (2.1.1.3.1.1.7)

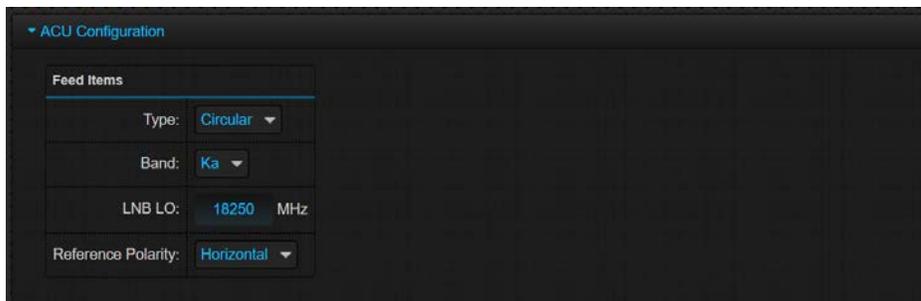
After adjusting the desired parameters for the satellite preset, ensure that the <Save> button and the bottom of the page is clicked prior to any further operations.

2.1.2.2.2 System Settings

The System Configuration tab allows the user to modify various information about the RC4600.

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 (2.1.1.3.1.2.3.1), this window will not be available. In addition to the feed information, there may be additional antenna specific ACU 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 settings a reset of the IP interface will occur automatically. For additional information on how to reset the IP settings to the defaults, see section 4.1.2.5.13.



2.1.2.2.3 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 is for an IP based beacon receiver and spectrum analyzer combination.



The screenshot displays the 'SBS2 Configuration' window, which is divided into two main sections: 'TCP/IP Settings' and 'Powerup Settings'. The 'TCP/IP Settings' section includes fields for 'IP Address' (192 . 168 . 1 . 15) and 'Port' (26482). The 'Powerup Settings' section includes fields for 'Center Freq' (1500.000 MHz), 'Span' (1000.000 MHz), 'Ref Level' (-40 dB), 'Scale' (5 dB/div), 'RBW' (1000 kHz), and 'VBW' (30 kHz).

TCP/IP Settings	
IP Address:	192 . 168 . 1 . 15
Port:	26482

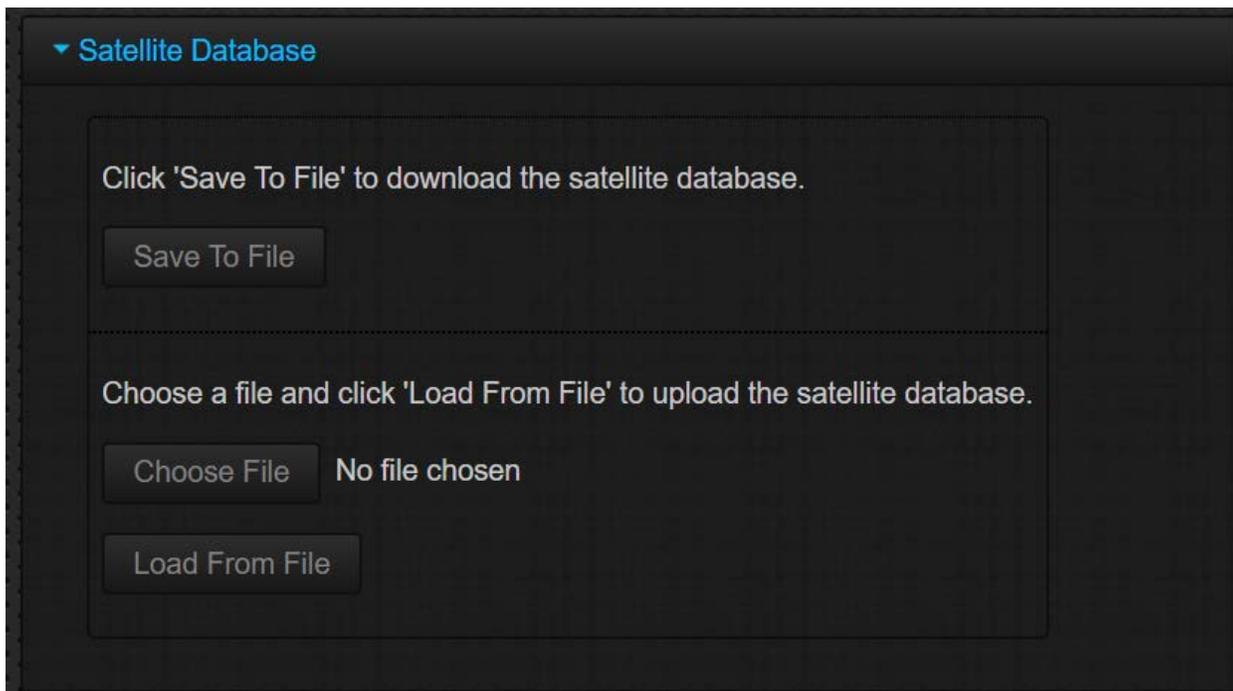
Powerup Settings	
Center Freq:	1500.000 MHz
Span:	1000.000 MHz
Ref Level:	-40 dB
Scale:	5 dB/div
RBW:	1000 kHz
VBW:	30 kHz

2.1.2.2.3 Advanced

The Advanced tab provides the user with the ability to upload and download configuration data from the RC4600. Additionally, the Advanced tab provides the user with the ability to load new firmware and user interface software onto the RC4600.

2.1.2.2.3.1 Satellite Database

The Satellite Databased 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 RC4600.



```

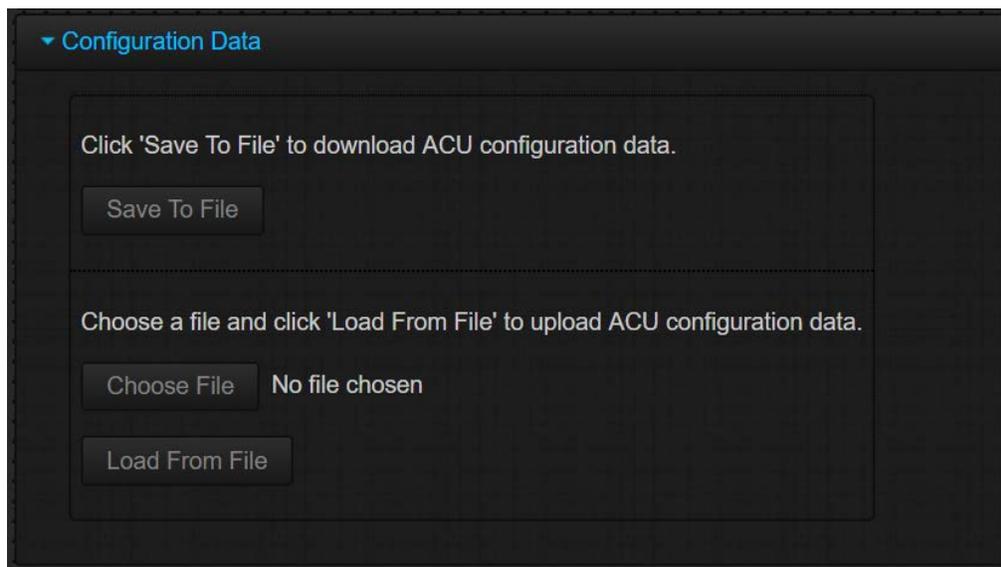
4ksatdb_0_20181221_002325.txt - Notepad
File Edit Format View Help
|'ACU SW:RC46 v2.10 ZG-GEI3N (DA) BN:RC0018 SN:0
|'UI SW:4KRCM2-GUI-G2NX v5.00 BN:52_RCI
|'SN:0

4.184.0 = OG1                'SAT_PRESET_NAME
4.184.1 = WB-1                'SAT_PRESET_NAME
4.184.2 = GALAXY 28          'SAT_PRESET_NAME
4.184.3 = AMC 16             'SAT_PRESET_NAME
4.184.4 = AMSC 1            'SAT_PRESET_NAME
4.184.5 = E                  'SAT_PRESET_NAME
4.184.6 = GALAXY 17          'SAT_PRESET_NAME
4.184.7 = GALAXY 25          'SAT_PRESET_NAME
4.184.8 = GALAXY 3C          'SAT_PRESET_NAME
4.184.9 = GALAXY 19          'SAT_PRESET_NAME
4.184.10 = GALAXY 16         'SAT_PRESET_NAME
4.184.11 = AMC 4             'SAT_PRESET_NAME
4.184.12 = AMC 1            'SAT_PRESET_NAME
4.184.13 = AMC 15           'SAT_PRESET_NAME

```

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 RC4600 (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 RC4600. 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.

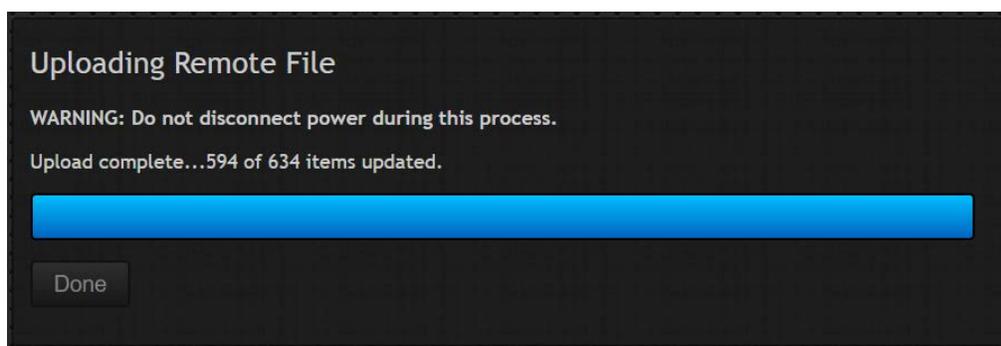


```

4kconfig_0_20181221_002945.txt - Notepad
File Edit Format View Help
|ACU SW:RC46 v2.10 ZG-GEI1N (DA) BN:RC0018 SN:0
|UI SW:4KRCM2-GUI-G2NX v5.00 BN:52_RCI
|SN:0

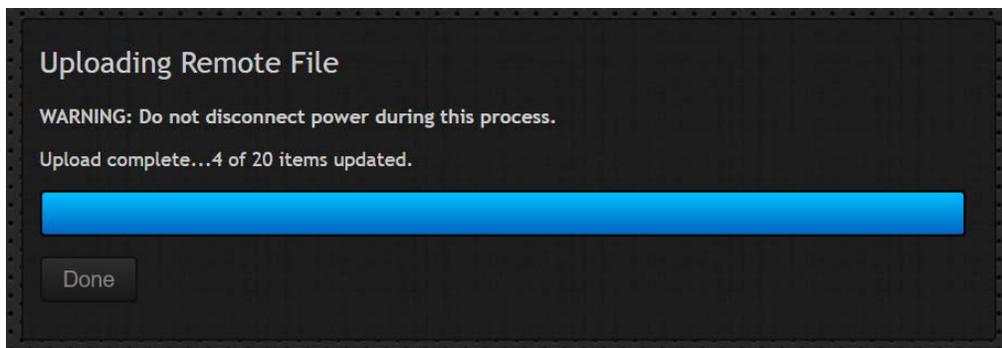
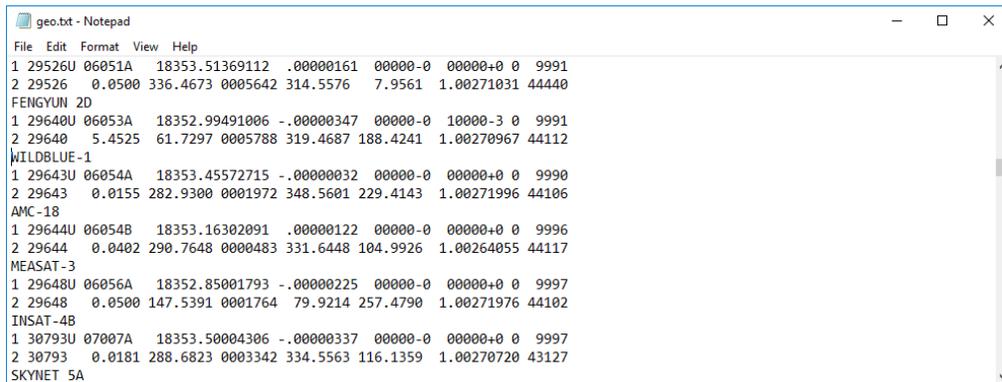
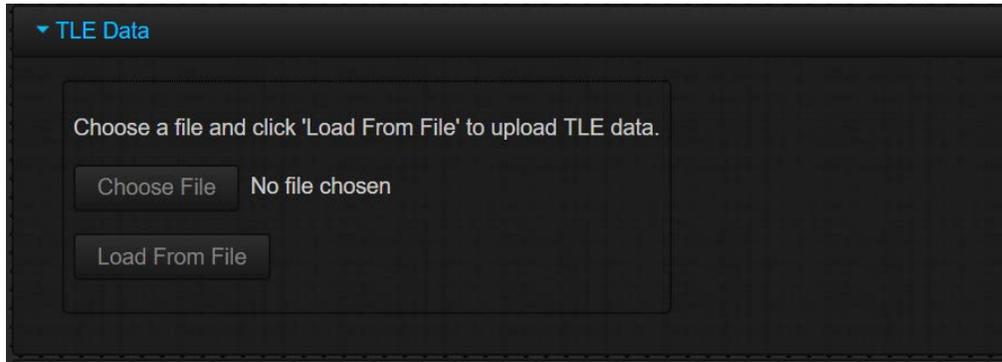
4.1.0 = 2          *EXPERT_ACCESS_ITEM
4.2.0 = 2          *INITIAL_MODE_ITEM
4.3.0 = 2          *INITIAL_AZIM_DISPLAY_ITEM
4.4.0 = 2          *GPS_PRESENT_ITEM
4.5.0 = 2          *COMPASS_PRESENT_ITEM
4.6.0 = -2.9      *COMPASS_OFFSET_ITEM
4.7.0 = 2          *MAX_SCAN_TRIES_ITEM
4.8.0 = 1          *TILT_COMPENSATION_ITEM
4.9.0 = 3          *SIMULTANEOUS_DRIVE_ITEM
4.10.0 = 240      *ANT_SIZE_ITEM
4.12.0 = 2.50     *AZIM_ZERO_VOLT_ITEM
4.13.0 = 87.95    *AZIM_SCALE_FACTOR_ITEM
4.15.0 = -88.000  *AZIM_MIN_LIMIT_ITEM
4.16.0 = 88.000  *AZIM_MAX_LIMIT_ITEM

```



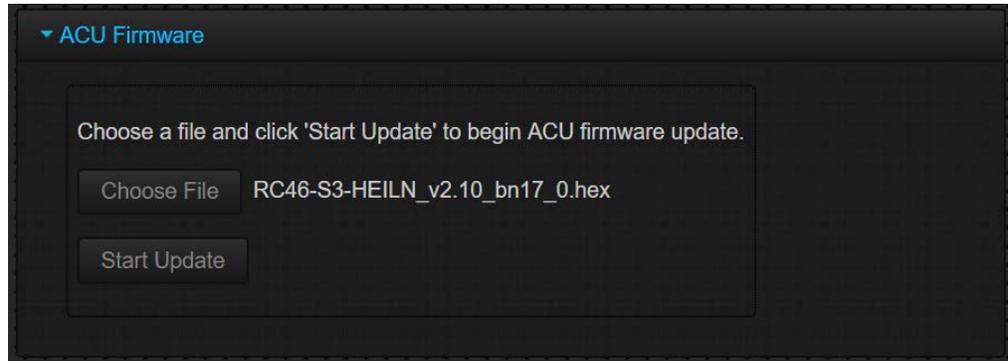
2.1.2.2.3.3 TLE Data

The TLE Data window allows the user to 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 RC4600 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.

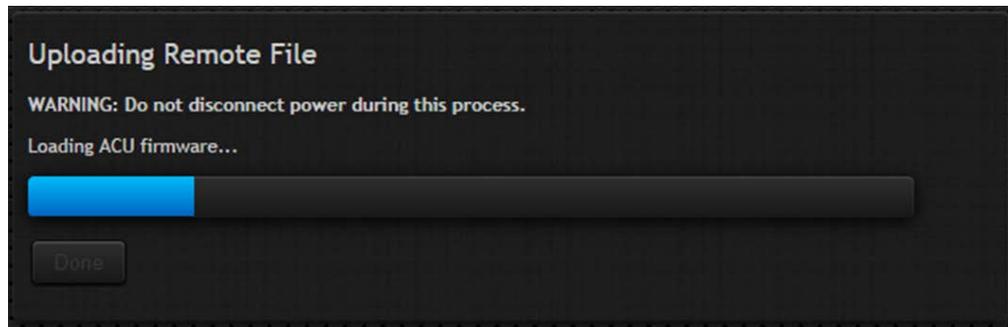


2.1.2.2.3.4 ACU Firmware

The ACU Firmware window allows the user to update the current software on the RC4600. 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 RC4600 (2.1.1.3.1.3.11) and load the configuration data file that was downloaded prior to upgrading the software.

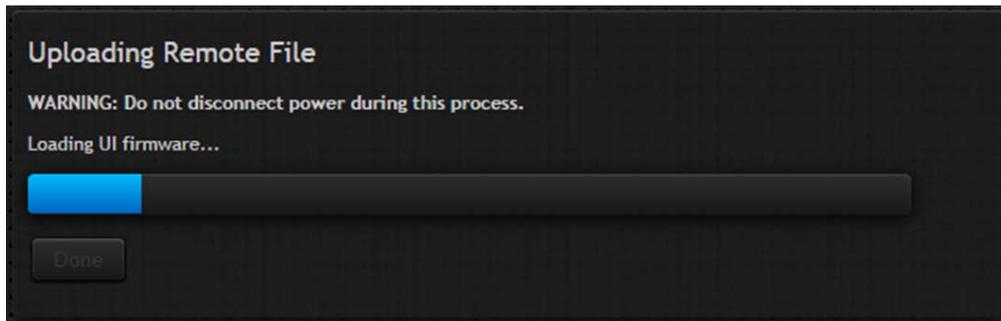
2.1.2.2.3.5 User Interface Firmware

The User Interface Firmware window allows the user to update the current user interface software on the RC4600.

NOTE: Updating the user interface firmware may cause the IP settings of the RC4600 to be reset to factory defaults. The default IP address of the RC4600 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 RC4600 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.

Enable Expert Access. To perform RC4600 installation steps described below, expert access permission must be enabled. Expert access permission is disable 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 location where the GPS receiver has the best view of the sky, and the position where the compass heading should be initialized from.

```

          ANT SIZE: 240          CONFIG-SYSTEM
GPS: 2
COMP: 2  COMP OFF:  0.0  DISPLAY: 2
<0-DISABLED 1-ANY 2-DEPLOY 3-STOW>

```

Follow the description in section 2.1.1.3.1.3.1 and set the SYSTEM DEFINITION items to the correct value for this installation.

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 installed should become familiar with accessing these modes and screens.

3.2 Motor and Velocity Feedback 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 (2.1.1.3.2.4).

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 (2.1.1.3.2.4).

At a speed of 50% 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 (2.1.1.3.2.4).

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 (2.1.1.3.2.4).

At a speed of 50% jog CW in azimuth and verify that the antenna moves clockwise as defined in section 1.2. If the antenna moves counter clockwise, 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 (2.1.1.3.2.4).

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 (2.1.1.3.2.4).

At a speed of 50% jog CW in polarization and verify that the polarization axis moves clockwise as defined in section 5.2.2. If the polarization axis moves counter clockwise, 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 Position Sensor Center of Travel Calibration

3.3.1 Elevation Axis

Prior to beginning this step, the antenna platform should be leveled in both pitch and roll. The elevation axis should then be moved via the servo maintenance screen to the position where the face is vertical to the ground.

While still in the servo maintenance screen, the user should record the sensor elevation angle.

The user should then enter the negative elevation sensor angle into the sensor offset field in the elevation calibration screen (2.1.1.3.1.2.2). For example, if the sensor angle in the servo maintenance screen is 178.648, the user would enter in a sensor offset of -178.648.

3.3.2 Azimuth Axis

3.3.2.1 Resolver or Optical Encoder

Prior to beginning this step, the antenna platform should be leveled in both pitch and roll. The azimuth axis should then be moved via the servo maintenance screen to the center of travel.

While still in the servo maintenance screen, the user should record the sensor azimuth angle.

The user should then enter the negative azimuth sensor angle into the sensor offset field in the azimuth calibration screen (2.1.1.3.1.2.1). For example, if the sensor angle in the servo maintenance screen is 178.648, the user would enter in a sensor offset of -178.648.

3.3.2.2 Potentiometer

Prior to beginning this step, the antenna platform should be leveled in both pitch and roll. The azimuth axis should then be moved via the servo maintenance screen to the center of travel.

The user should then navigate to the 12 Bit ADC voltage screen (2.1.1.3.2.1.2) and record the AZ voltage.

The user should then enter the voltage in the VREF field in the azimuth calibration screen (2.1.1.3.1.2.1).

3.3.3 Polarization Axis

3.3.3.1 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 sensor polarization angle.

The user should then enter the negative polarization sensor angle into the sensor offset field in the polarization calibration screen (2.1.1.3.1.2.3). For example, if the sensor angle in the servo maintenance screen is 178.648, the user would enter in a sensor offset of -178.648.

3.3.3.2 Potentiometer

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

The user should then navigate to the 12 Bit ADC voltage screen (2.1.1.3.2.1.2) and record the AZ voltage.

The user should then enter the voltage in the VREF field in the azimuth calibration screen (2.1.1.3.1.2.3).

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. 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.

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 platform 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. 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.

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 platform 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°.

3.4.1.3 Stow Limit

NOTE: Prior to testing the elevation Stow limit, the Azimuth Stow (3.4.2.3) and Polarization Stow (3.4.3.3) should be verified.

If the antenna being used has a physical STOW limit switch, from MANUAL mode move the axis to the limit switch and verify that the “STOW” limit is displayed. Note that the antenna will not be able to move below the DOWN limit, or above the UP limit unless that azimuth stow, and polarization stow conditions are met. The user should then move back out of the physical STOW limit switch and verify that the “STOW” limit is no longer displayed in MANUAL mode.

If the antenna being used does not have a physical STOW limit switch, the antenna should be moved to the position that is most logical for antenna storage. This value should then be entered into the Stow/Deploy screen (2.1.1.3.1.3.8) for the elevation stow position.

3.4.2 Azimuth Axis

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

To calculate the azimuth scale factor, move the dish between two known physical azimuth platform positions and note the difference in the sensed azimuth voltage between the two locations.

Example: at +90° platform azimuth the voltage is 3.86. At the -90° platform azimuth voltage is 1.14. The azimuth scale factor is calculated as:

$$180 \text{ degrees} / (3.86 - 1.14) = 66.16 \text{ degrees} / \text{volt.}$$

66.16 would be entered as the scale factor in the azimuth calibration screen (2.1.1.3.1.2.1).

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.

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 platform angle of 175°, the user should set the software CW limit to 172°. If the antenna has mechanical travel above 195°, it is recommended that the software CW limit is set to 192°.

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 “CW” 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.

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 up 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 platform angle of -175° , the user should set the software CCW limit to -172° . If the antenna has mechanical travel above -195° , it is recommended that the software CCW limit is set to -192° .

3.4.2.3 Stow Limit

If the antenna being used has a physical STOW limit switch, from MANUAL mode move the axis to the limit switch and verify that the "STOW" limit is displayed. The user should then move out of the physical STOW limit switch and verify that the "STOW" limit is no longer displayed in MANUAL mode.

If the antenna being used does not have a physical STOW limit switch, the antenna should be moved to the position that is most logical for antenna storage. This value should then be entered into the Stow/Deploy screen (2.1.1.3.1.3.8) for the azimuth stow position.

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.

To calculate the polarization scale factor, move the axis between two known physical positions and note the difference in the sensed polarization voltage between the two locations.

Example: at $+90^\circ$ the voltage is 3.86. At the -90° the voltage is 1.14. The polarization scale factor is calculated as:

$$180 \text{ degrees} / (3.86 - 1.14) = 66.16 \text{ degrees} / \text{volt}.$$

66.16 would be entered as the scale factor in the polarization calibration screen (2.1.1.3.1.2.3).

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.

If the feed 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 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.

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°.

3.4.3.3 Stow Limit

If the feed being used has a physical STOW limit switch, from MANUAL mode move the axis to the limit switch and verify that the “STOW” limit is displayed. The user should then move out of the physical STOW limit switch and verify that the “STOW” limit is no longer displayed in MANUAL mode.

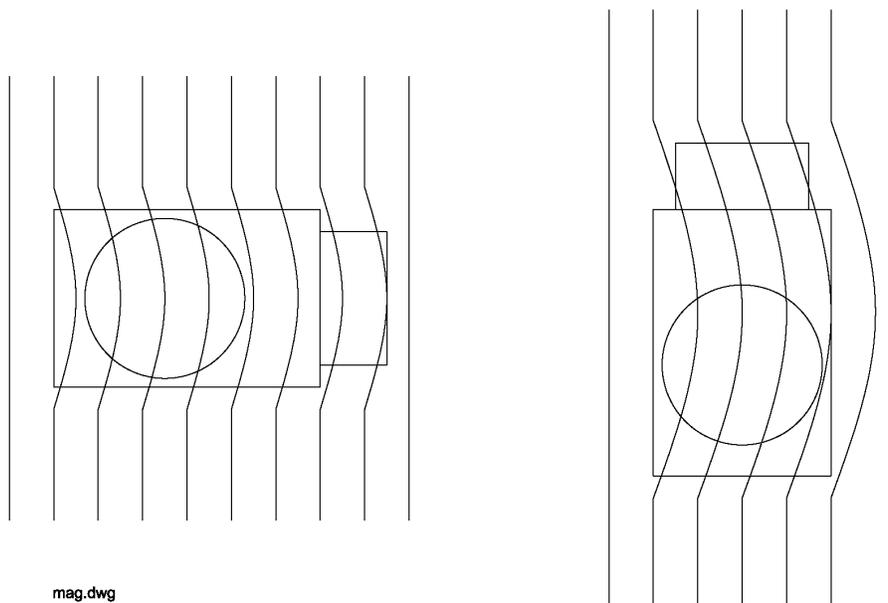
If the feed being used does not have a physical STOW limit switch, the feed should be moved to the position that is most logical for antenna storage. This value should then be entered into the Stow/Deploy screen (2.1.1.3.1.3.8) for the polarization stow position.

3.5 Navigation Sensor Communication

Confirm that valid serial data is coming in from the GPS, compass, and dual axis tilt sensor. See the GPS COM (2.1.1.3.2.6), CMP COM (2.1.1.3.2.7), and INCL (2.1.1.3.2.10) maintenance screen descriptions.

3.6 Compass Calibration

Ferrous metal on or near the antenna distort the earth's magnetic field in the vicinity of the compass. The compass, without calibration indicates the direction of the distorted magnetic field. The compass calibration procedure provides a method to correct for this distortion of the earth's magnetic field and obtain the antenna's actual magnetic heading.



Review the discussion of system accuracy in section 5.2.7. Since the compass calibration only corrects for distortion of the magnetic field caused by the antenna and antenna equipment, it is important that the calibration take place in an area where the earth's magnetic field is not disturbed by structures or objects containing ferrous metals. Below is a listing of the characteristics of a good calibration site.

- 1 Level ground, preferably higher than the surrounding area. Avoid low valleys.
- 2 Free from structures containing a large amount of ferrous metal. It is of key importance to avoid areas adjacent to multi-story buildings, railroad tracks, bridges, truck yards, parking lots full of cars, and high voltage power lines.
- 3 Trees and wooden objects pose no problem for calibration.
- 4 Asphalt parking lots can provide a good calibration site. Care should be taken, though, in that asphalt is often laid over concrete which may contain reinforcing rod.

If a location is questionable, walking around with a simple wet compass will often show whether magnetic irregularities are present. A good site is important since the overall performance of the Satellite Locator is only as good as its calibration.

Section 2.1.1.3.2.8 describes how to perform the compass calibration procedure.

3.7 Azimuth and Elevation Alignment

This step attempts to discover and compensate for offsets in azimuth and elevation position sensing.

Offsets may be introduced due to several factors including mechanical tolerances and slight inaccuracies in installation. For example, the compass may not be exactly aligned with the azimuth reference position.

The following alignment procedure relies on the fact that it is possible to determine how the dish is pointing based on the actual antenna angles required to intercept a satellite (at a known longitude) when the antenna's latitude and longitude are known.

The following test should be performed as many times as possible. The steps required are:

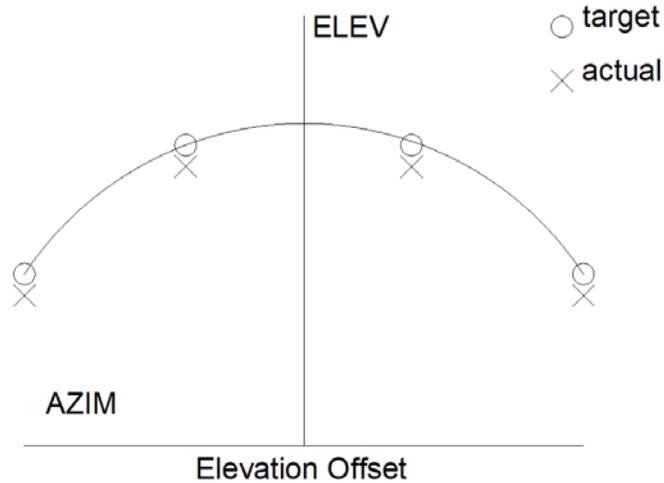
- 1 Set the azimuth and elevation offsets as described in section 3.3
- 2 Record the vehicle heading in the following table.
- 3 Command the ACU to LOCATE a satellite and record the target azimuth and elevation positions in the CALC'D column.
- 4 Manually peak the antenna so it's perfectly aligned with the satellite and record the actual angles in the ACTUAL column.
- 5 Compute the difference between the target and actual positions.
- 6 Repeat steps 3-5 for a second satellite.

HDG.	SAT	AZIMUTH			ELEVATION		
		CALC'D	ACTUAL	DIFF.	CALC'D	ACTUAL	DIFF.
1	1						
	2						
2	1						
	2						
3	1						
	2						
4	1						
	2						
5	1						
	2						
6	1						
	2						
7	1						
	2						
8	1						
	2						
TOTAL							
AVG.							

3.7.1 Elevation Alignment

It is easy to observe errors in the elevation calibration.

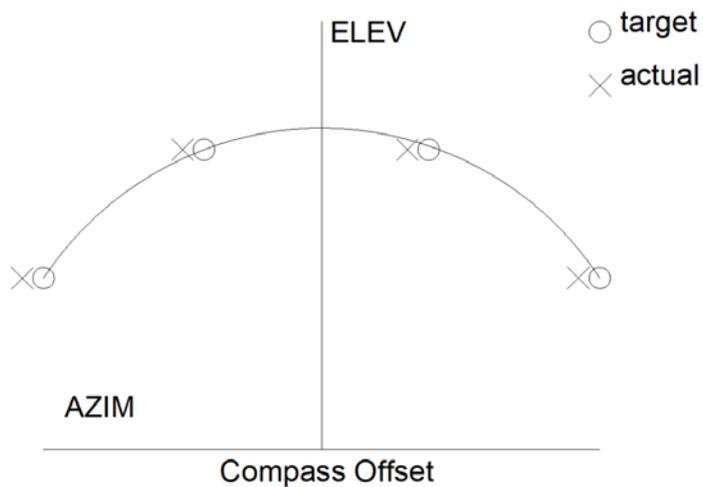
If test data shows that the actual elevation angle that a satellite is found is consistently above or below the calculated target, then it can be concluded that the elevation sensor offset configuration item is incorrect (2.1.1.3.1.2.2). Adjust the value until the angles display correctly for all satellites.



3.7.2 Azimuth Alignment

It is not as easy to observe errors in azimuth calibration. This is because the error from the compass reading will not be consistent from location to location and even from different vehicle headings at the same location.

If, after multiple tests, a consistent error in actual vs. calculated azimuth target is observed, then a modification of the Compass Offset field in the System definition screen (2.1.1.3.1.3.1) may be applied.



3.8 Locate Source Calibration

The RC4600 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 LOCATE and TRACK modes to work correctly.

3.8.1 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 200 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 section 2.1.1.3.1.2.8 (RF Sig Factors) for a discussion of the characteristics of the L-Band power detector.

3.8.2 Beacon Tracking Receiver

If the RC4600 is configured with an internal beacon tracking receiver (BTR), the Beacon Sig Factors configuration items (2.1.1.3.1.2.7) 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
	SCAN RG
	SRCH AZ
	SRCH EL

3.8.3 DVB Receiver

If the RC4600 is configured with an internal DVB receiver, the DVB Sig Factors configuration items (2.1.1.3.1.2.9) should be configured for optimal performance.

NOTE: For the DVB, the default parameters should work for most applications.

3.8.4 External Receiver

The RC4600 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 (2.1.1.3.1.2.6) should be configured for optimal performance.

4 HARDWARE

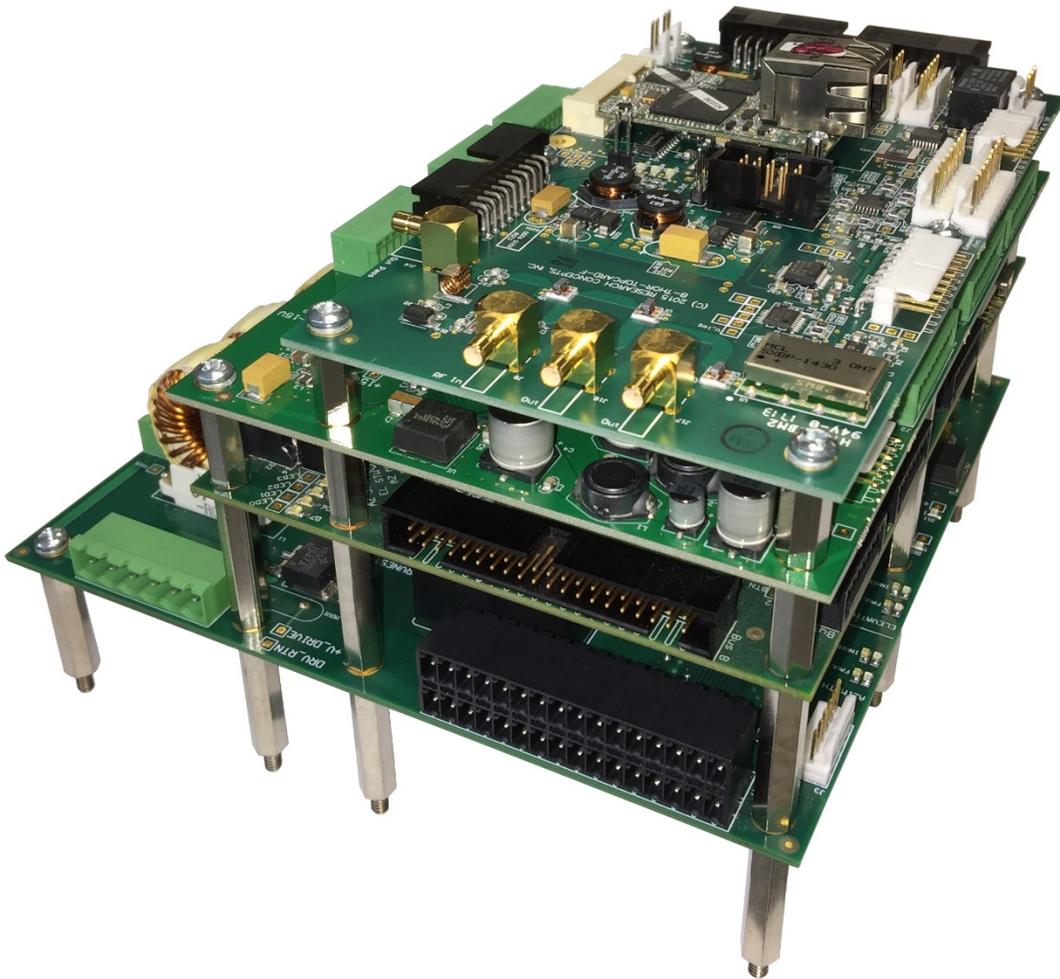
This chapter describes both the RC4600 board set and common external devices that may be used for integrating an antenna system.

4.1 Board Set Devices

This section describes the mechanical and electrical interfaces of the boards that comprise the RC4600 board 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.

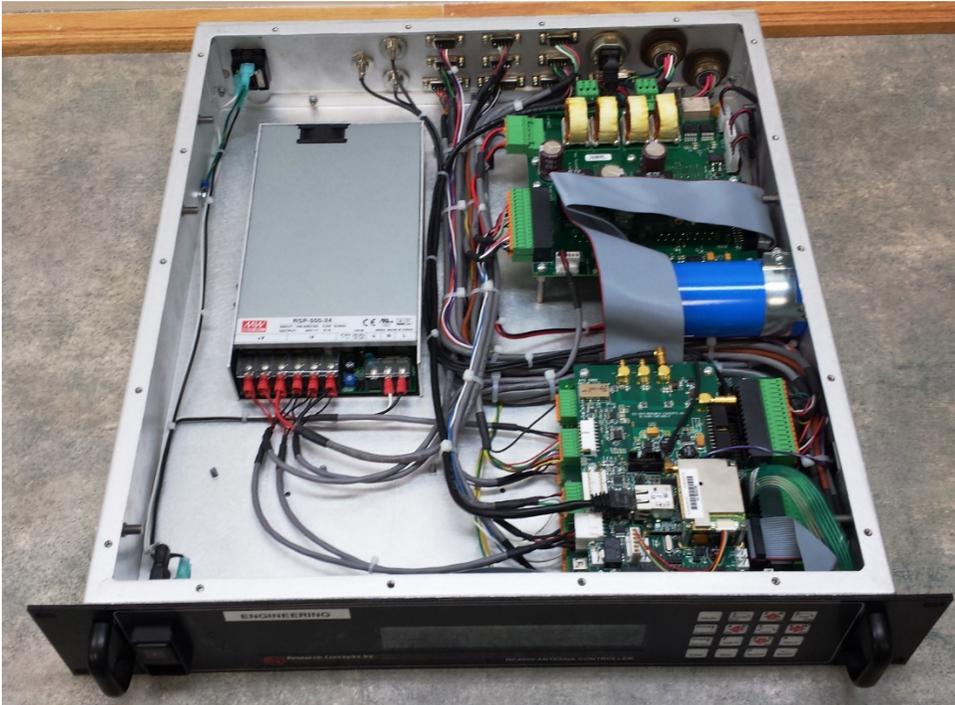
4.1.1 Mechanical Mounting

The following pictures shows an example RC4600 board set with all cards stacked together.

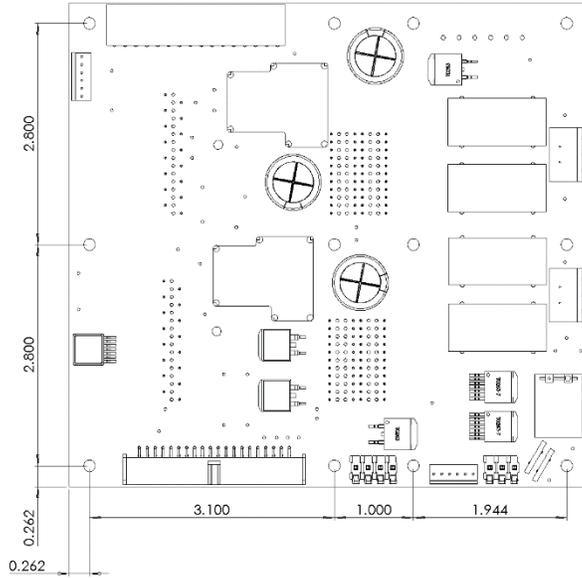


The board set is designed to occupy the minimum volume by placing the servo drive board on the bottom, the computing and servo sensor boards in the middle and the options board on top. In this configuration, the dimensions of the stack are approximately 7" x 7" x 6" (without mating connectors).

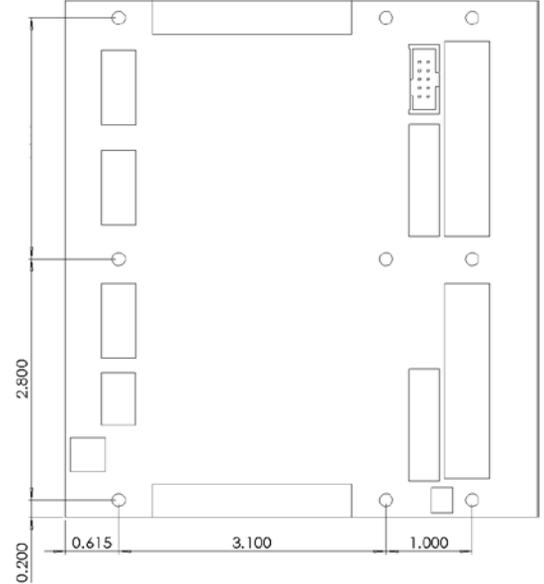
The board set may be laid out in other configurations to accommodate additional components or to minimize height. The following two pictures show possible configurations. The first is a rack mounted example. The second is with the boards installed of an embedded enclosure. Additional information about the enclosure and connectors can be found in Appendix C – Enclosure Specific Data.



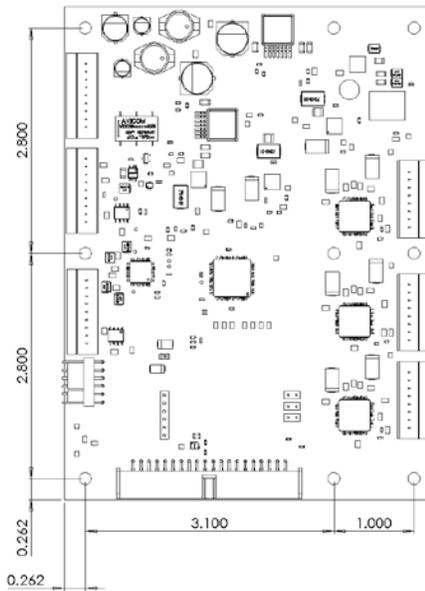
The following drawings show the mounting hole spacing for the Servo Drive Board, Computing Board, Servo Sensor Board and Options Board respectively. The Servo Drive Board uses twelve #6 mounting holes. The Computing Board and Servo Sensor Board use nine #6 mounting holes. The Options Board uses six #6 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.



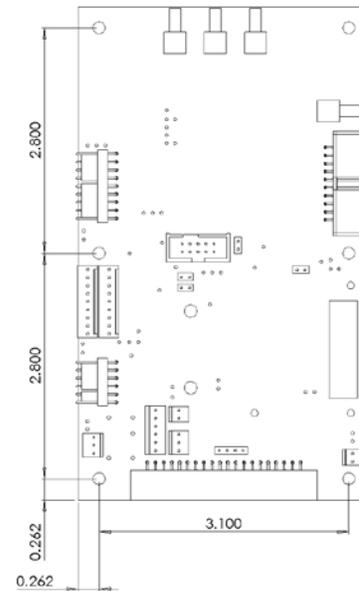
Servo Drive Board



Computing Board



Servo Sensor Board



Options Board

4.1.2 Electrical Interfaces

The interfaces available from each RC4600 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:

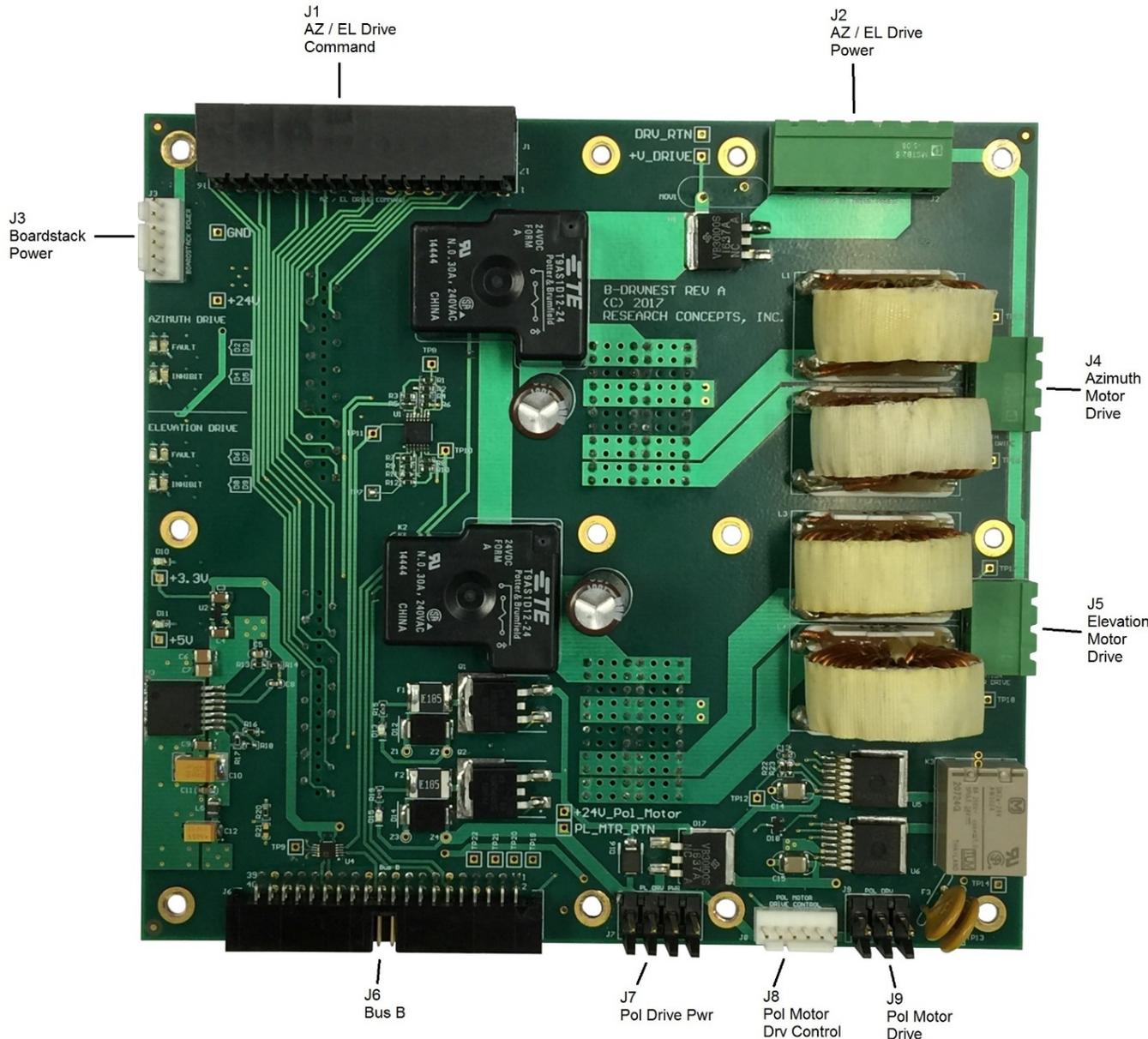
Designation	PCB Marking	Manufacturer	Part Number
J1	AZ/EL Drive Command	Phoenix Contact	1953855

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

4.1.2.1 Servo Drive Board

The servo drive board's main function is to provide drive power to the antenna motors. The board interfaces directly with two drive amplifier modules, one module each for the Azimuth and Elevation axis drive motors. The board also includes an H-Bridge circuit to independently control the Polarization drive motor.

The board has separate power supply inputs for the digital circuits, AZ/EL motor drives and Pol motor drive. There is also support for the control of motor brakes.



Spacers supporting the drive nest board need to be 1.25" between the mounting surface and the bottom of the card. This allows for space to install the drive amplifier cards on the bottom side of the circuit board.

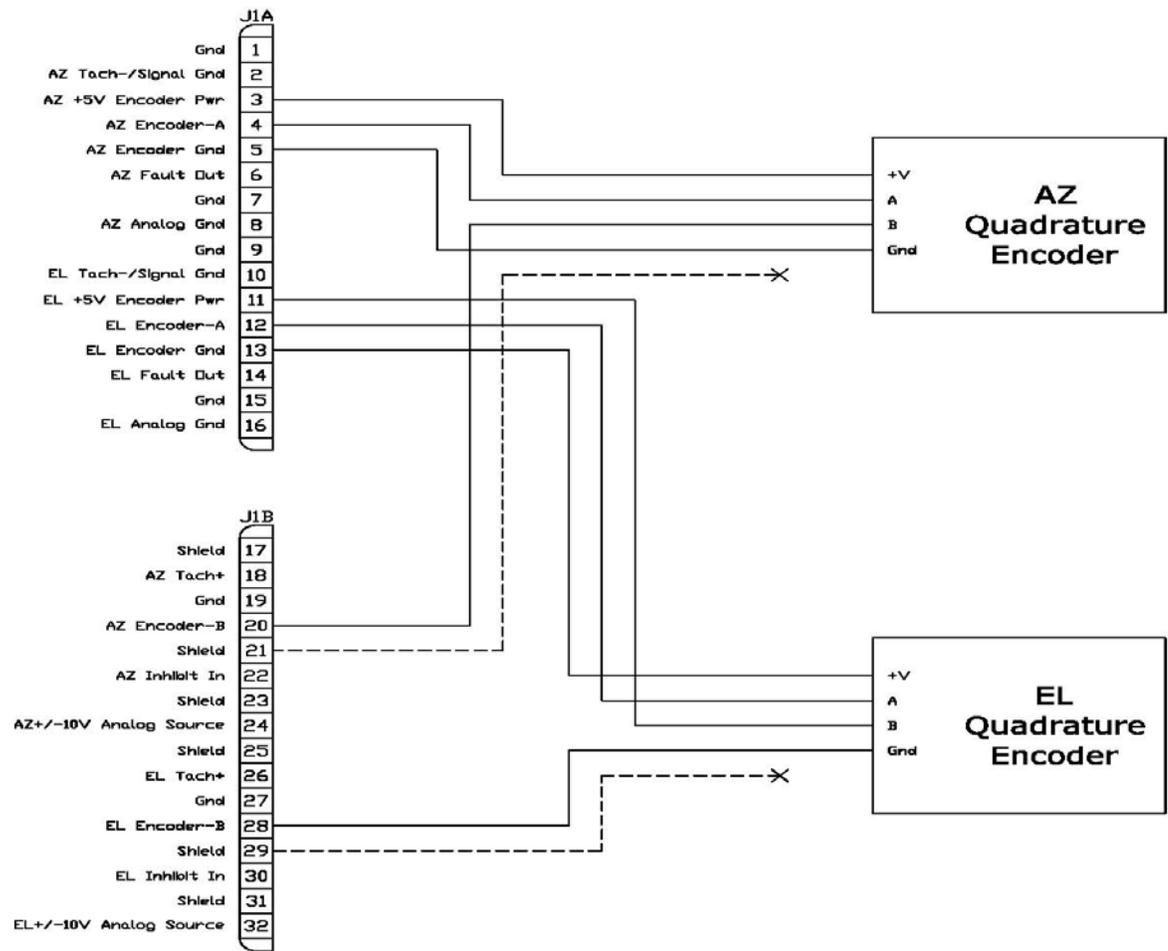
4.1.2.1.1 J1 – AZ/EL Drive Command

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

J1 provides a double row of pins. The pins are grouped for convenience of connections to peripherals or other PCBs in the board stack.

The AZ/EL Drive Command connector serves two purposes. The first is to provide a connection to the AZ and EL motor velocity feedback sensors, which may be either a tachometer or quadrature pulse encoder. For each axis (AZ or EL) the type of sensor used is mutually exclusive. The motor drive for each axis must be setup appropriately for the type of sensor used.

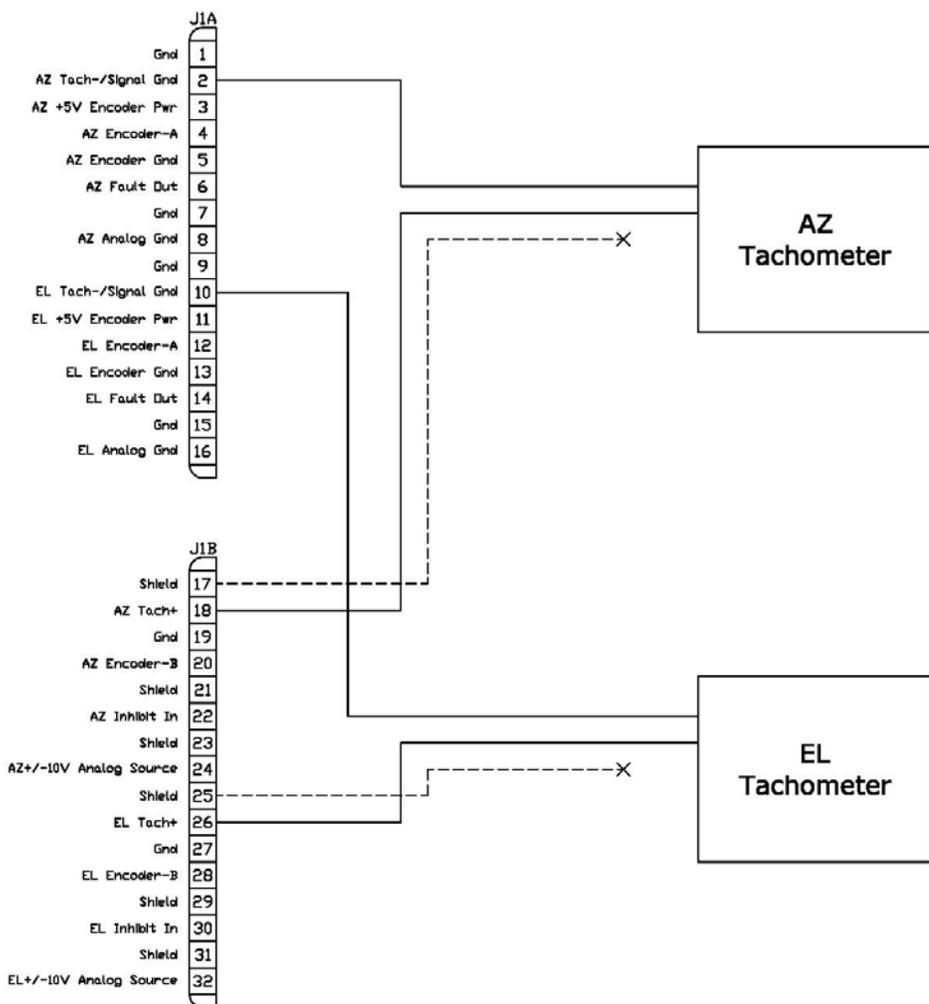
The following diagram shows the connection of motor pulse encoders. The servo drive board can supply +5VDC to power each encoder. Each +5V output may supply up to 0.125A continuous current.



When so configured, the servo drive amplifiers relate the motor velocity pulse feedback to the analog velocity command from the servo control loop. The quadrature pulse encoders should be chosen to

provide as high of a frequency (at maximum motor RPM) as possible without exceeding a frequency of 200 KHz.

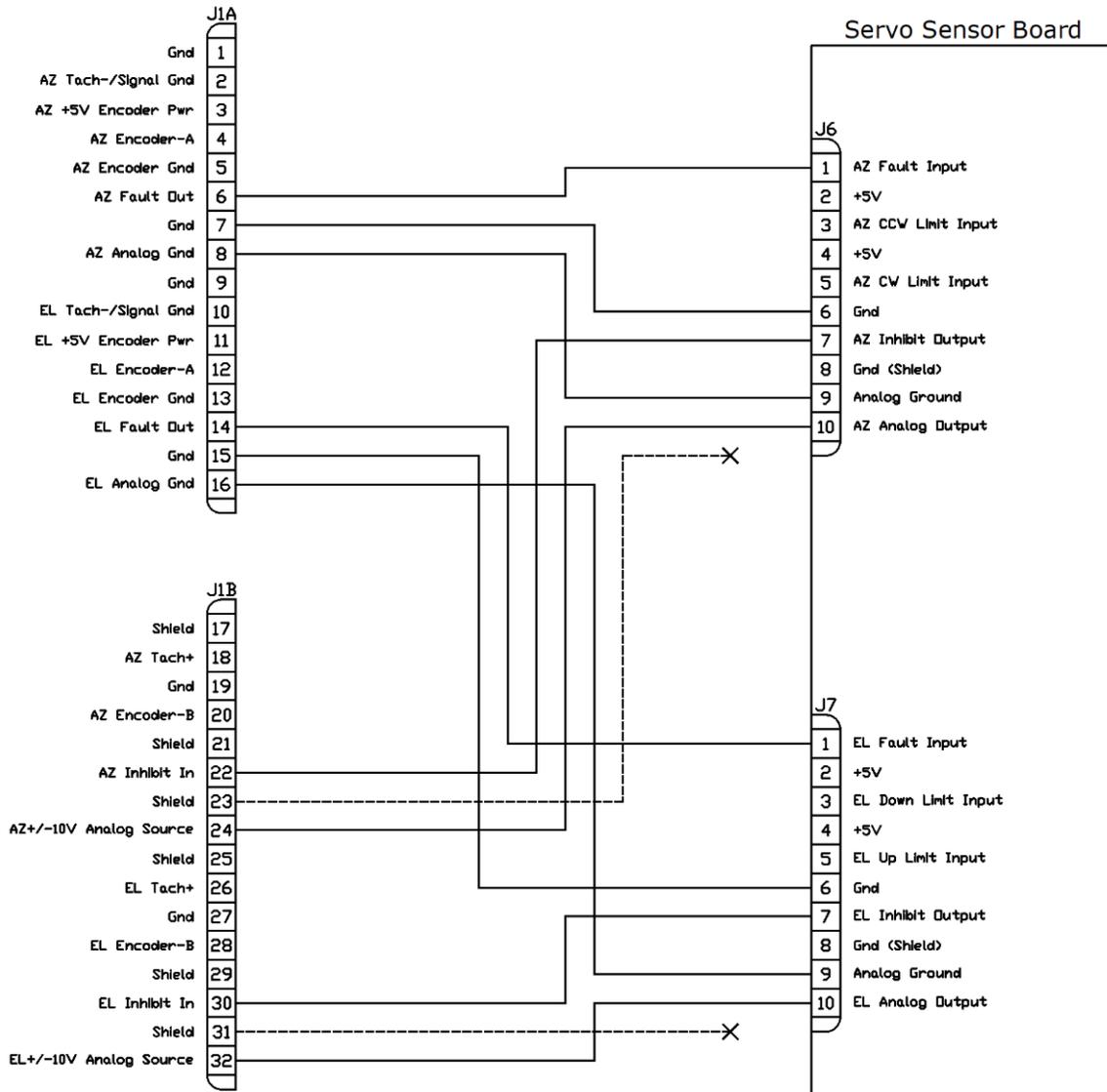
The following diagram shows the connection of motor tachometers to the AZ/EL Drive Command connector.



When so configured, the servo drive amplifiers relate the motor tachometer voltage feedback to the analog velocity command from the servo control loop. The tachometer feedback should be chosen to provide as high of a voltage (at maximum motor RPM) as possible without exceeding a voltage of 60 VDC.

The second purpose of the J1 AZ/EL Drive Command connector is to provide an interconnect to the servo sensor card in the board stack. The servo sensor card may be either resolver-based or ENDAT encoder-based, which are different PCBs that are mutually exclusive, and will be chosen based on the type of position sensors installed on the antenna.

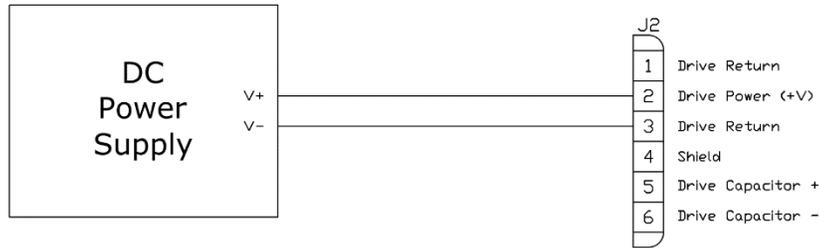
The following diagram shows the connection of the servo sensor board to the AZ/EL Drive Command connector on the Servo Drive Board.



4.1.2.1.2 J2 – Drive Amplifier Power

Designation	PCB Marking	Manufacturer	Part Number
J2	AZ/EL Drive Power	Phoenix Contact	1757284

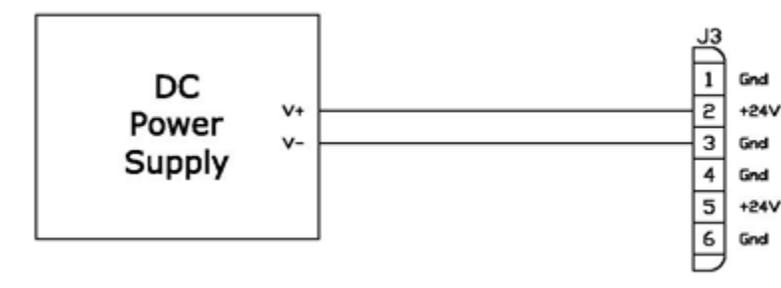
J2 receives power from a DC power supply specifically intended for the motor drive modules. If needed, a drive capacitor will be attached to pins 5 and 6 of J2.



4.1.2.1.3 J3 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J3	Boardstack Power	Molex	22-11-2062

J3 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.1.4 J4 – Azimuth Motor Drive

Designation	PCB Marking	Manufacturer	Part Number
J4	Azimuth Motor Drive	Phoenix Contact	1757255

The J4 connector provides the drive voltage interface to the azimuth motor. The AZ axis should move in the clockwise direction when pin 1 has a higher potential than pin 3.

The voltage and current output capabilities are dependent on the type of DC power supply used and the exact model of servo drive installed. These components are chosen on a case-by-case basis due to unique requirements of the antenna.



4.1.2.1.5 J5 – Elevation Motor Drive

Designation	PCB Marking	Manufacturer	Part Number
J5	Elevation Motor Drive	Phoenix Contact	1757255

The J5 connector provides the drive voltage interface to the azimuth motor. The EL axis should move in the up direction when pin 1 has a higher potential than pin 3.

The voltage and current output capabilities are dependent on the type of DC power supply used and the exact model of servo drive installed. These components are chosen on a case-by-case basis due to unique requirements of the antenna.



4.1.2.1.6 J6 – Inter-board Bus B

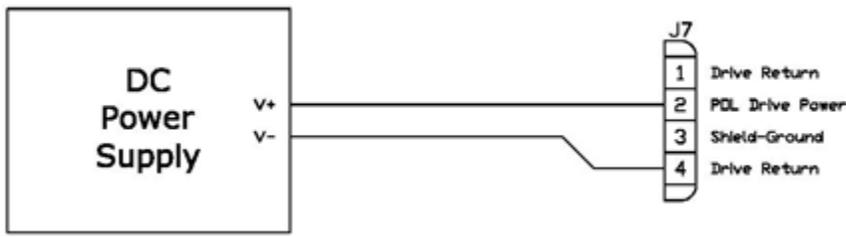
Designation	PCB Marking	Manufacturer	Part Number
J6	Bus B	TE Connectivity	510310-8

Bus B is used to provide an interface between circuit boards in the RC4600.

4.1.2.1.7 J7 – Polarization Drive Power

Designation	PCB Marking	Manufacturer	Part Number
J7	PL DRV PWR	Molex	26-48-2245 (x4)

J7 receives power from a DC power supply specifically intended for the Pol motor drive.

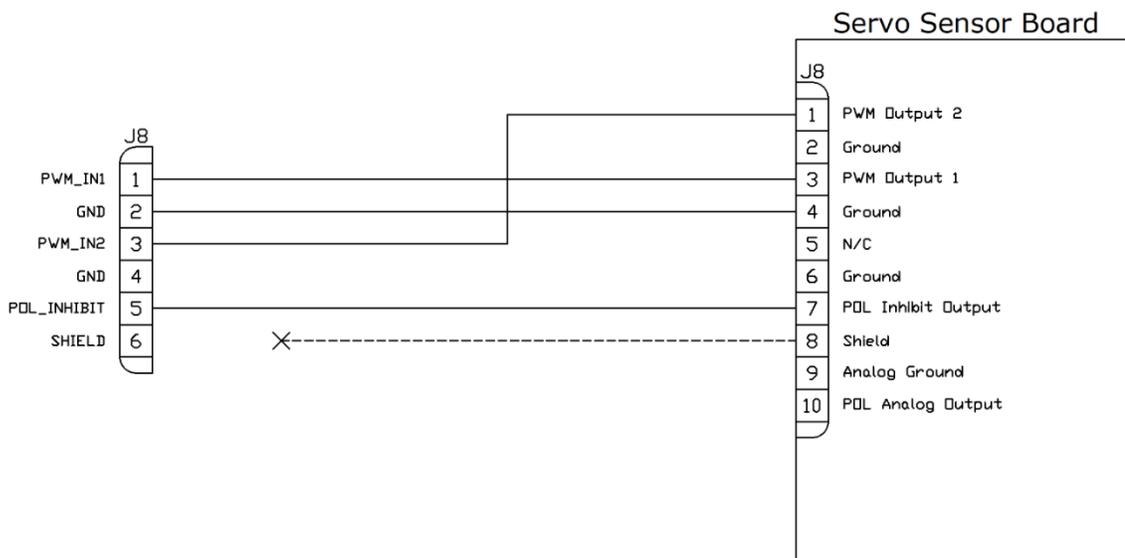


4.1.2.1.8 J8 – Polarization Motor Drive Control

Designation	PCB Marking	Manufacturer	Part Number
J8	POL MOTOR DRIVE CONTROL	Molex	22-11-2062

The J8 connector contains input signals to control the polarization motor drive circuits. It will connect to J8 of the Servo Sensor Board.

The following diagram shows the connection of the J8 - POL Motor Drive Control connector to the Servo Sensor Board.



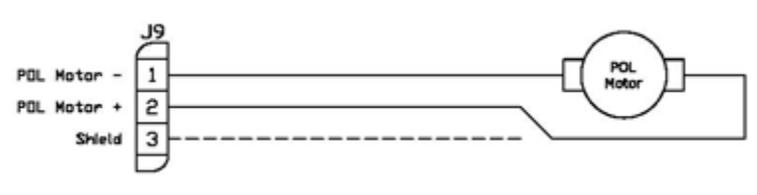
4.1.2.1.9 J9 – POL Motor Drive

Designation	PCB Marking	Manufacturer	Part Number
J9	POL DRV	Molex	26-48-2245 (x3)

The POL motor drive output J9 is designed to drive a polarization motor. The drive circuit is typically powered from a 24VDC power supply.

The output may provide up to 1.1A of current. Each output pin (POL Motor - and POL Motor +) are protected by a resettable fuse that will trip at 2.2A.

The POL motor should move in the clockwise direction when pin 2 has a higher potential than pin 1.

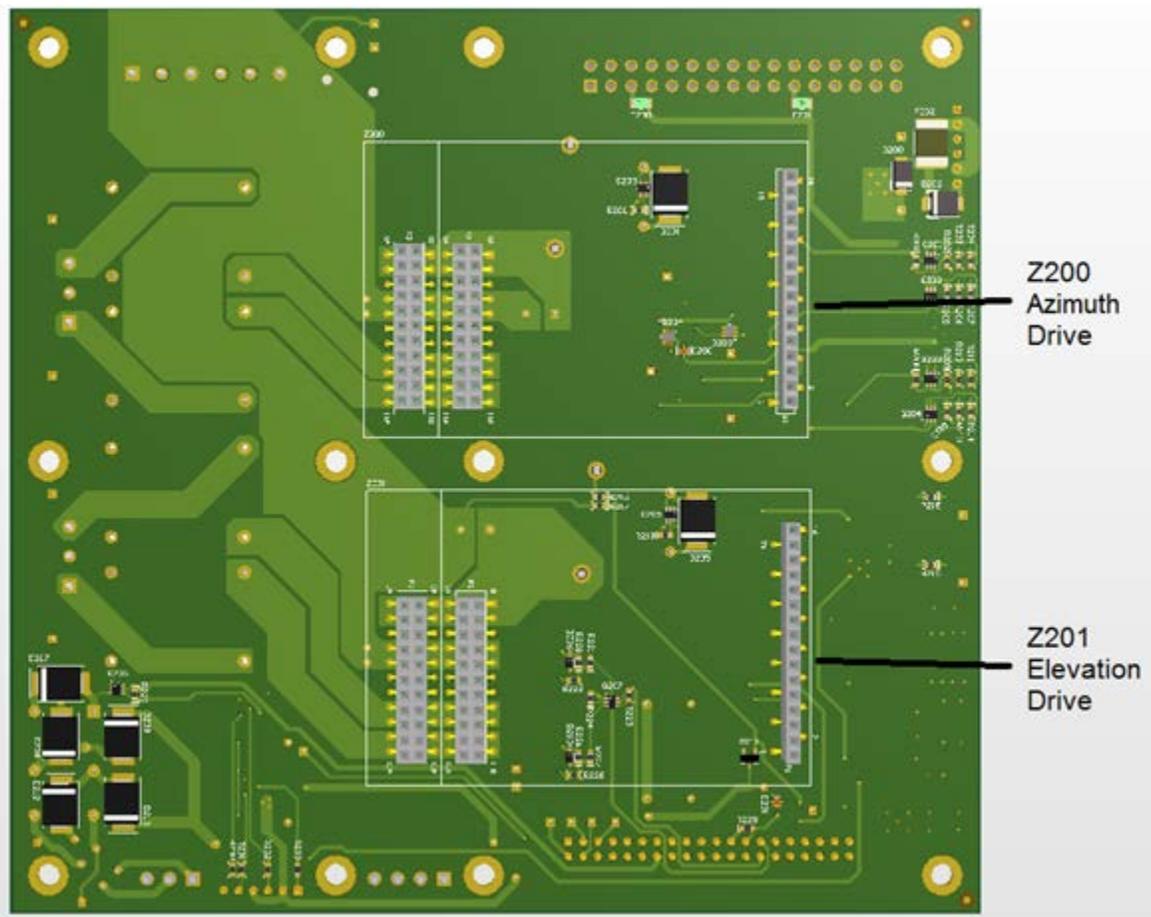


4.1.2.1.10 Z200/201 – AZ & EL Motor Drives

The servo drive board is designed to allow direct connection to the Advanced Motion Controls AxCent™ family of PCB mount servo drives. Position Z200 is the Azimuth axis servo drive, Z201 is the Elevation axis servo drive.

Each servo drive mounting position includes three pin header receptacles. P1 is the Signal Connector. P2 and P3 are the Power Connectors. P3 may not be used with some versions of servo drives.

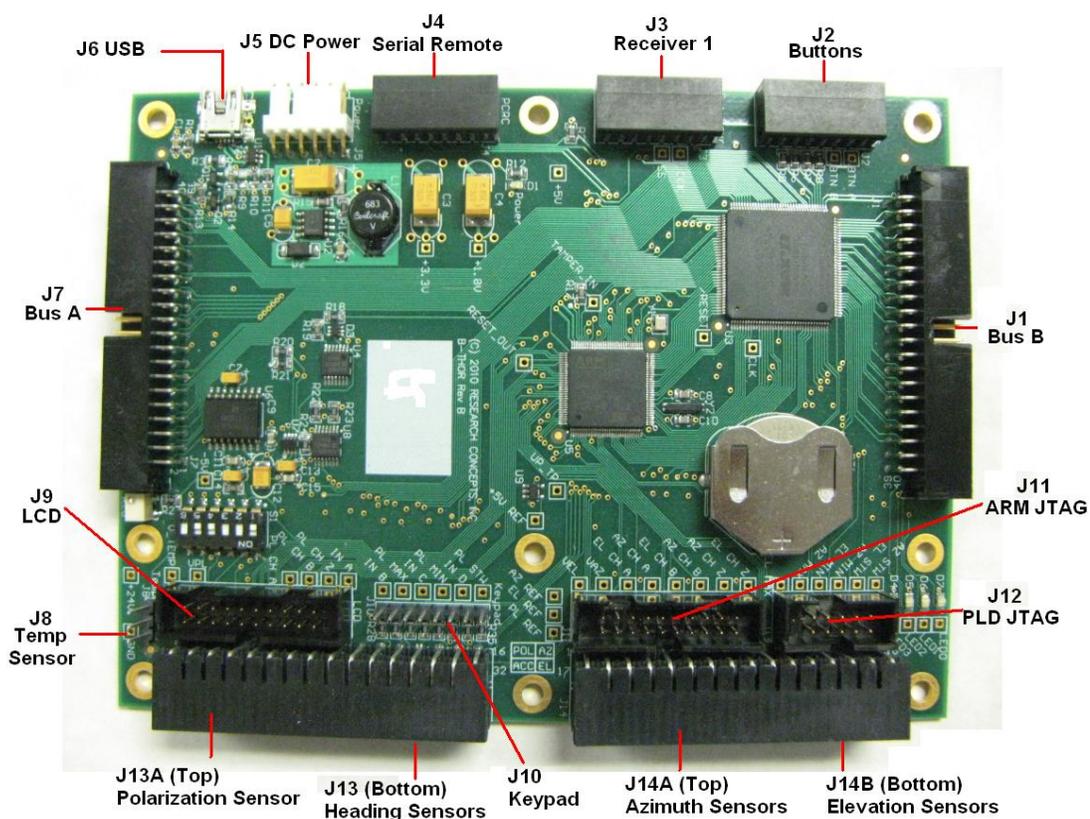
The single-row and dual-row pin header receptacles are installed on the bottom side of the Servo Drive board. This allows the servo drives to mount in between the board and the chassis and provides heat-sinking to the enclosure chassis.



4.1.2.2 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.

4.1.2.2.1 J1 – Inter-board Bus B

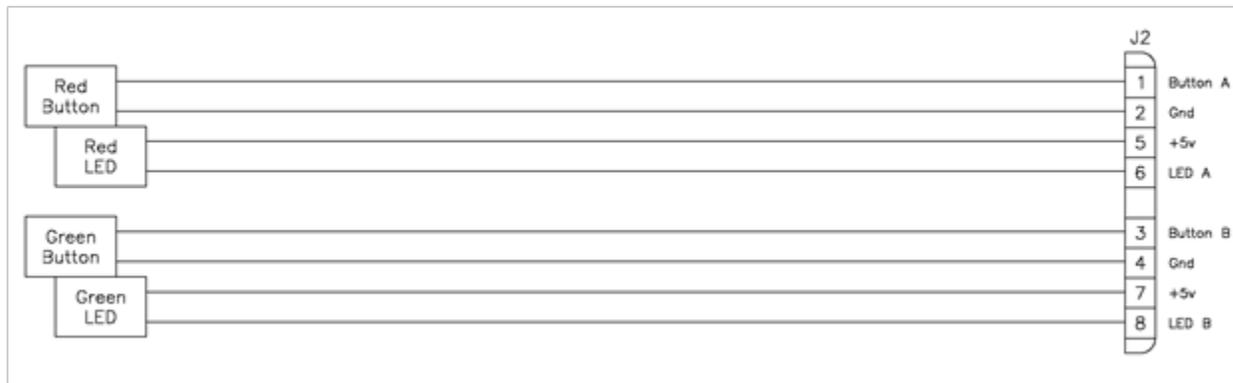
Designation	PCB Marking	Manufacturer	Part Number
J1	Bus B	TE Connectivity	510310-8

Bus B is used to provide an interface between circuit boards in the RC4600.

4.1.2.2.2 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. As an example of this situation, the buttons & LEDs would be positioned on the enclosure itself to allow simple local control of LOCATE & STOW functions.



4.1.2.2.3 J3 – Receiver

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

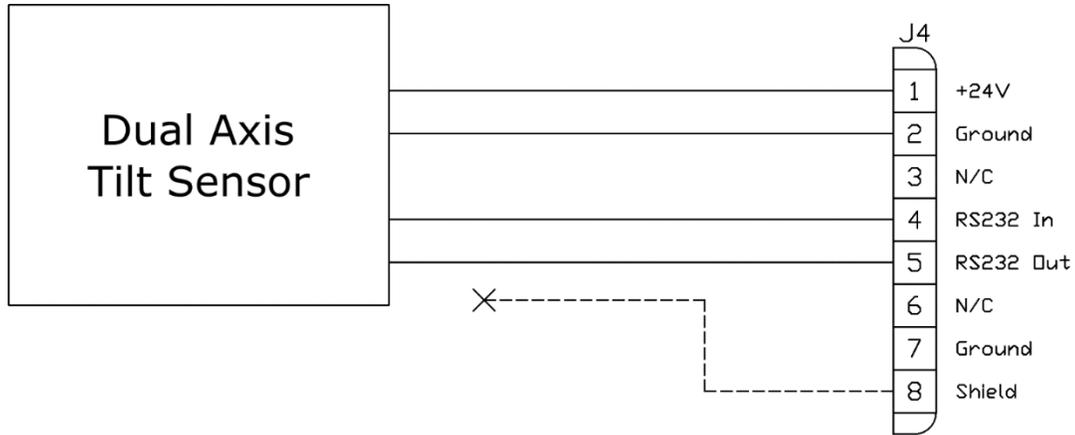
The J3 connector is allocated to support various types of receivers. The receiver that J3 is designed to work with will be specified in the part number found in section 1.7.



4.1.2.2.4 J4 – Dual Axis Inclinometer

Designation	PCB Marking	Manufacturer	Part Number
J4	PCRC	Phoenix Contact	1939303

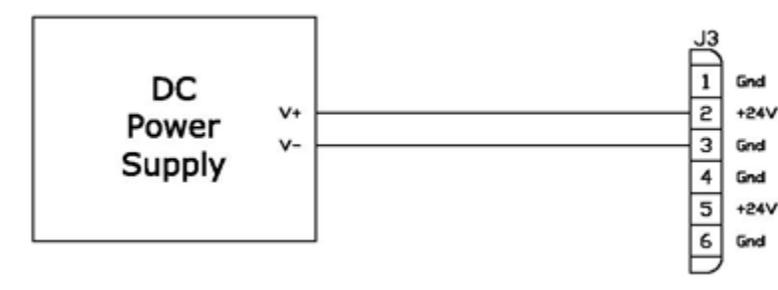
The PCRC connector is a serial port that is used to interface with the dual axis inclinometer required for RC4600 operation.



4.1.2.2.5 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.



4.1.2.2.6 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 RC4600. This is for in factory use only.

4.1.2.2.7 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 RC4600.

4.1.2.2.8 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.

4.1.2.2.9 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 RC4600 controllers and will be unused on embedded versions.

4.1.2.2.10 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 RC4600 controller and will be unused on embedded versions.

4.1.2.2.11 J11 – Processor JTAG

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

Factory use only.

4.1.2.2.12 J12 – PLD JTAG

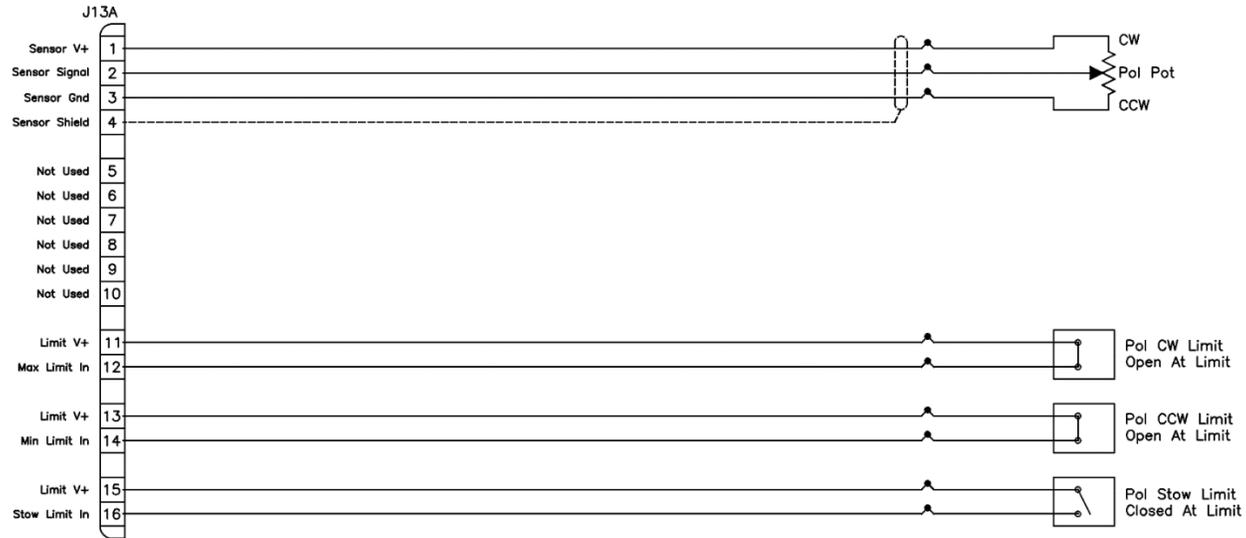
Designation	PCB Marking	Manufacturer	Part Number
J12	Unmarked	TE Connectivity	103308-1

Factory use only.

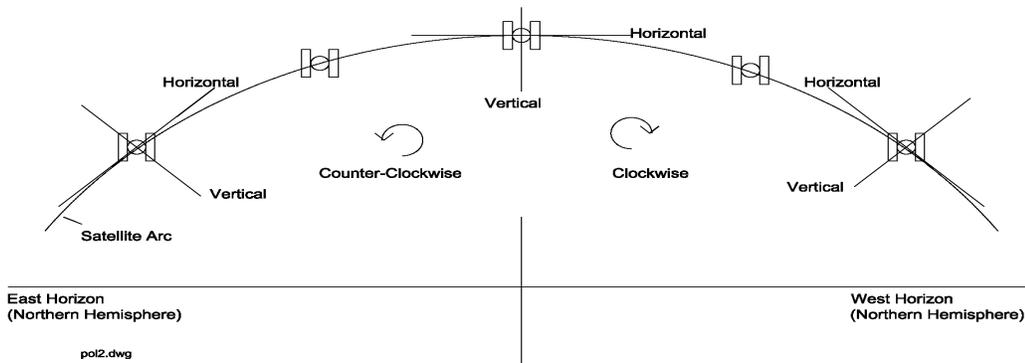
4.1.2.2.13 J13A – Polarization Sensors

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.



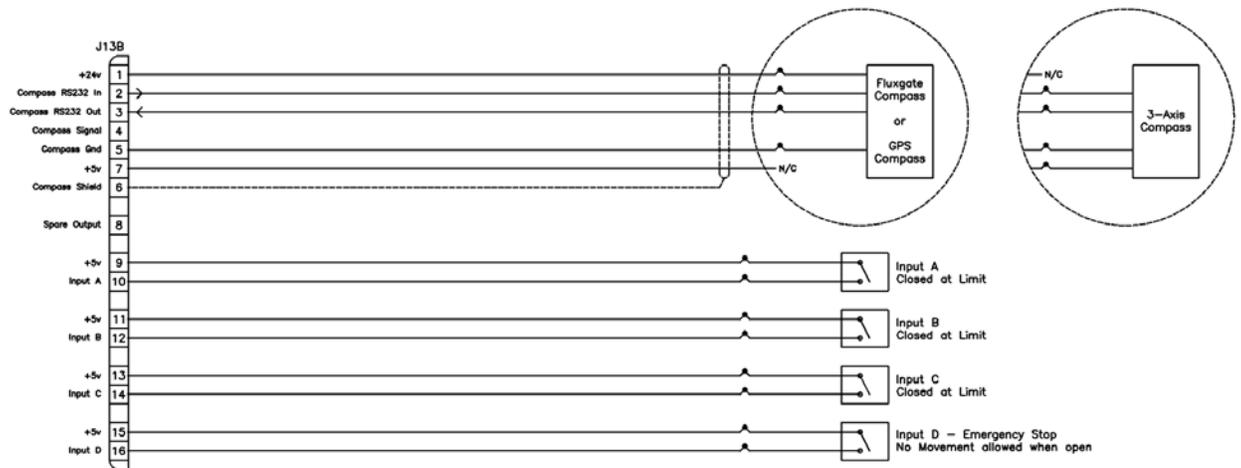
The directional sense of polarization movement is defined as CW or CCW, as seen by an observer standing behind the antenna reflector looking 'through' the reflector at the satellite. **See diagram below.** The reference position for the polarization position angle is vertical polarization for a satellite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



4.1.2.2.14 J13B – Accessories and Compass

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

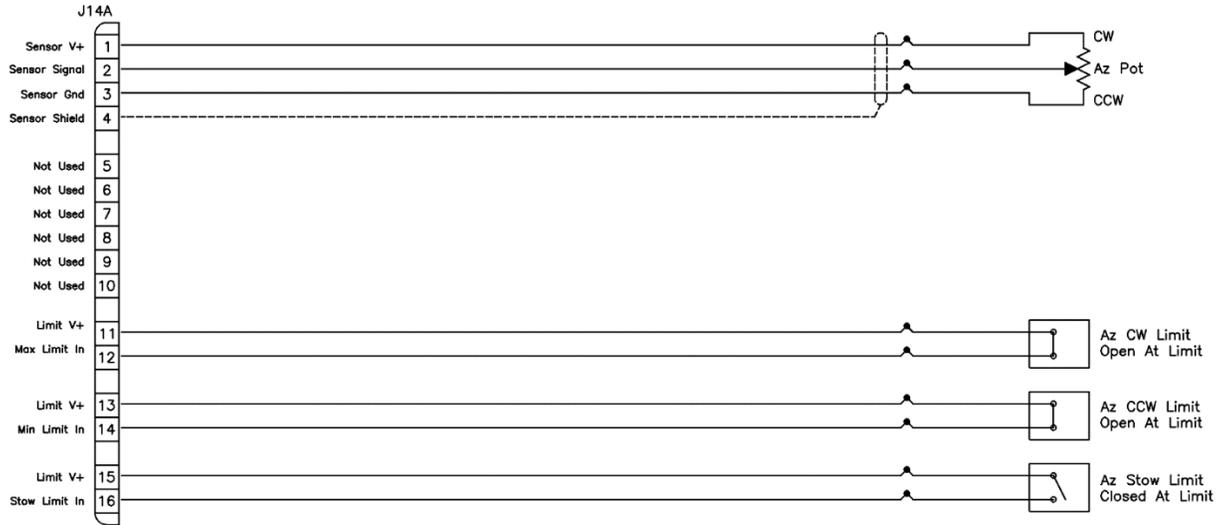
J13 provides a double row of pins. The bottom 16 pins are designated "J13B" and are typically allocated for interfacing to various compass options (Fluxgate Compass Shown). Additionally, inputs A, B, C and D are routed to this connector. On the RC4600 input D is always used as emergency stop, with the other inputs allocated as needed for a specific application.



4.1.2.2.15 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.

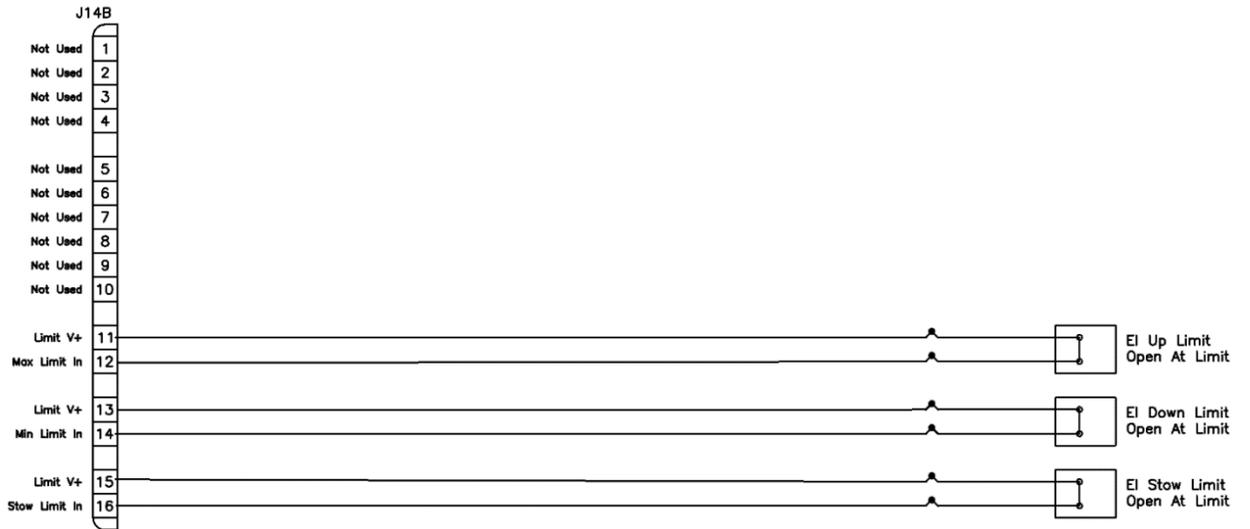


The directional sense of azimuth movement is defined as clockwise (CW) or counter-clockwise (CCW), as viewed by an observer located above the antenna. On the controller, CW movement results in a greater sensed azimuth position.

4.1.2.2.16 J14B – Elevation Sensors

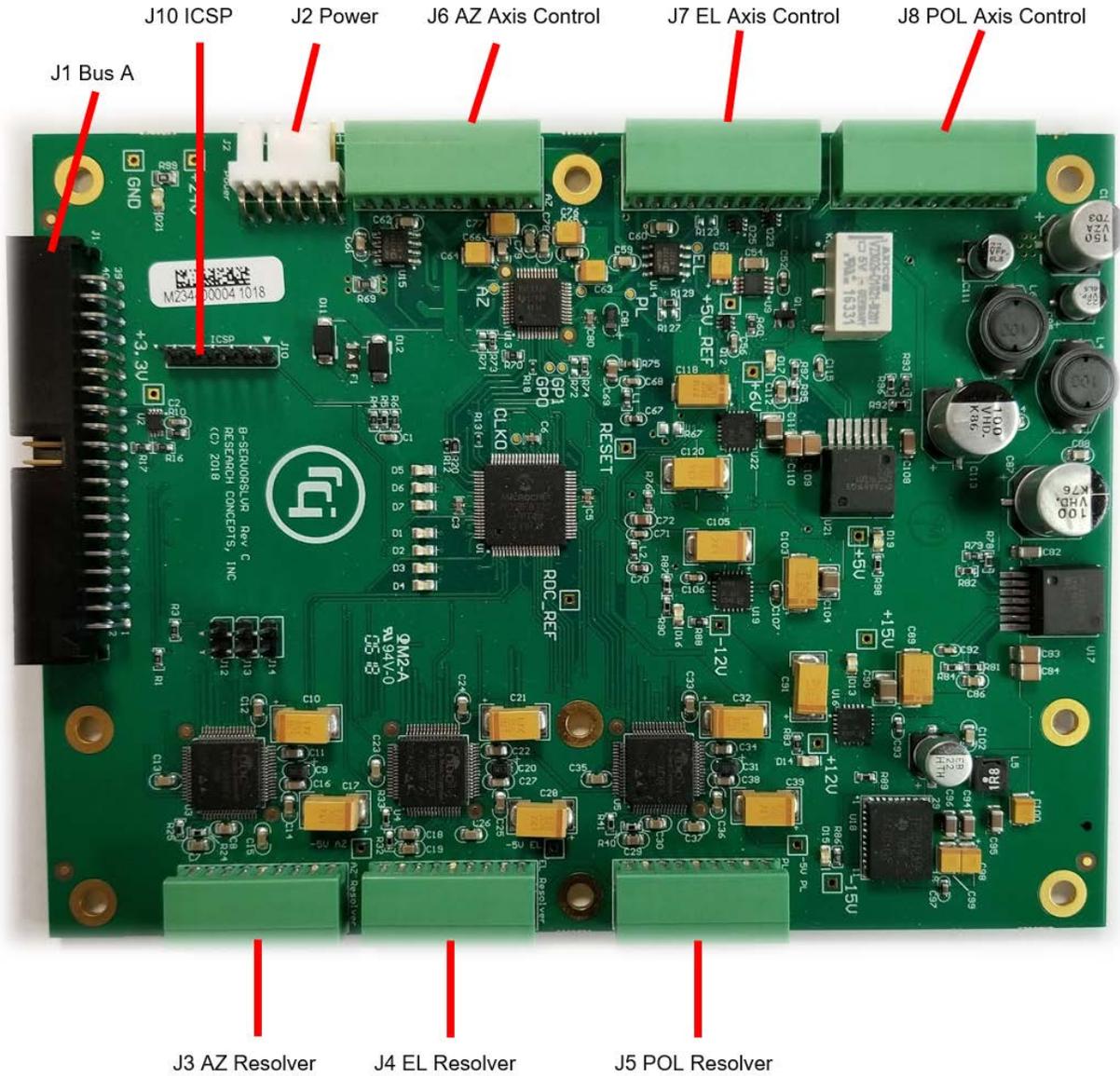
Designation	PCB Marking	Manufacturer	Part Number
J14B	EL	Phoenix Contact	1953855 (Bottom Row)

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.



4.1.2.3 Servo Resolver Board

The Servo Resolver Board allows an RC4600-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.



4.1.2.3.1 J1 – Inter-board Bus A

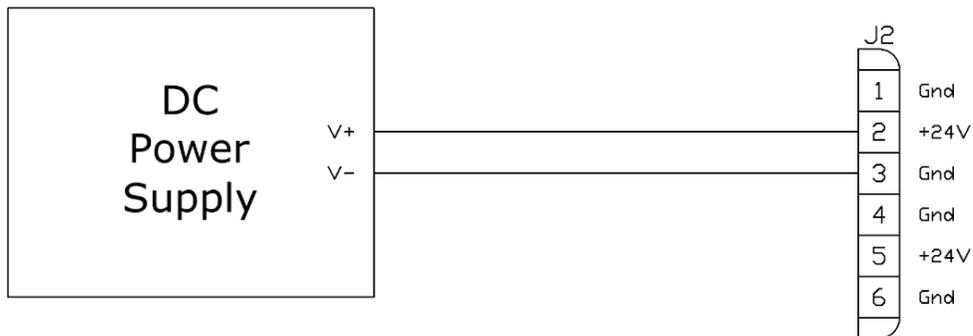
Designation	PCB Marking	Manufacturer	Part Number
J1	Unmarked	TE Connectivity	510310-8

Bus A is used to provide an interface between circuit boards in the RC4600.

4.1.2.3.2 J2 – DC Power

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

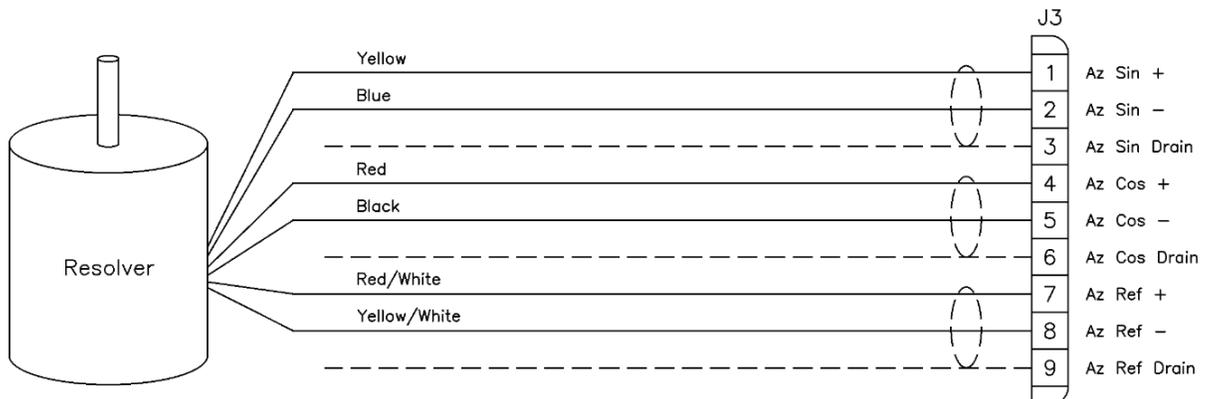
J2 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.3.3 J3 – AZ Resolver

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

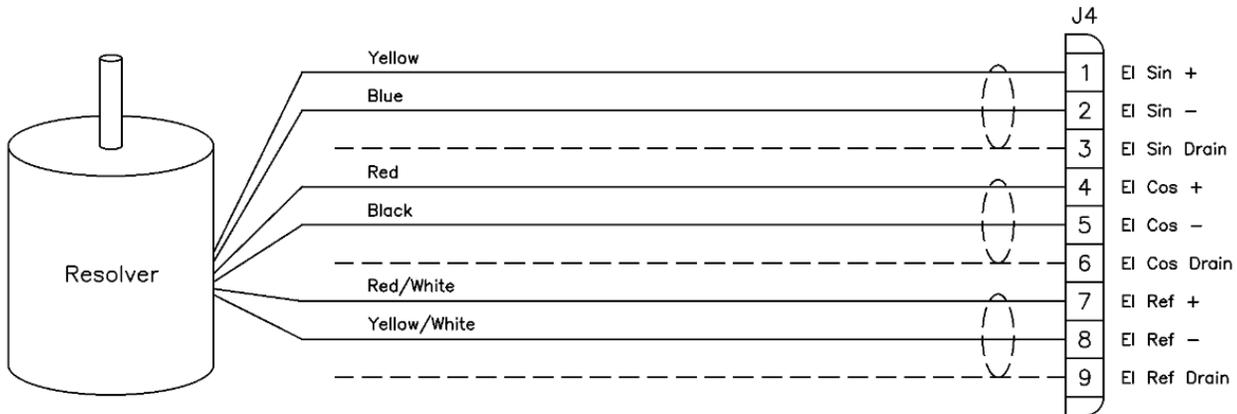
J3 is dedicated to the Azimuth Axis Resolver.



4.1.2.3.4 J4 – EL Resolver

J4 is dedicated to the Elevation Axis Resolver.

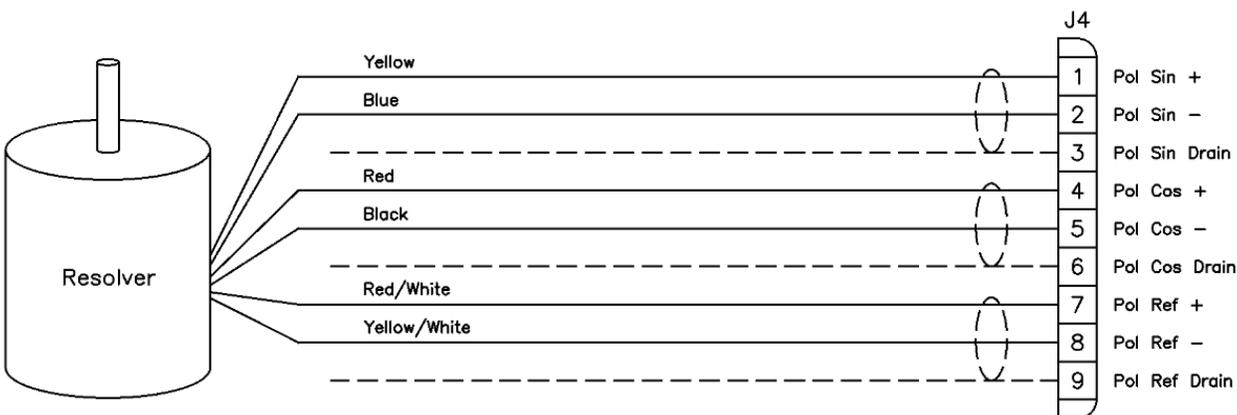
Designation	PCB Marking	Manufacturer	Part Number
J4	EL Resolver	Phoenix Contact	1881516



4.1.2.3.5 J5 – POL Resolver

J5 is dedicated to the Polarization Axis Resolver.

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



4.1.2.3.6 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	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.

4.1.2.3.7 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	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.

4.1.2.3.8 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.

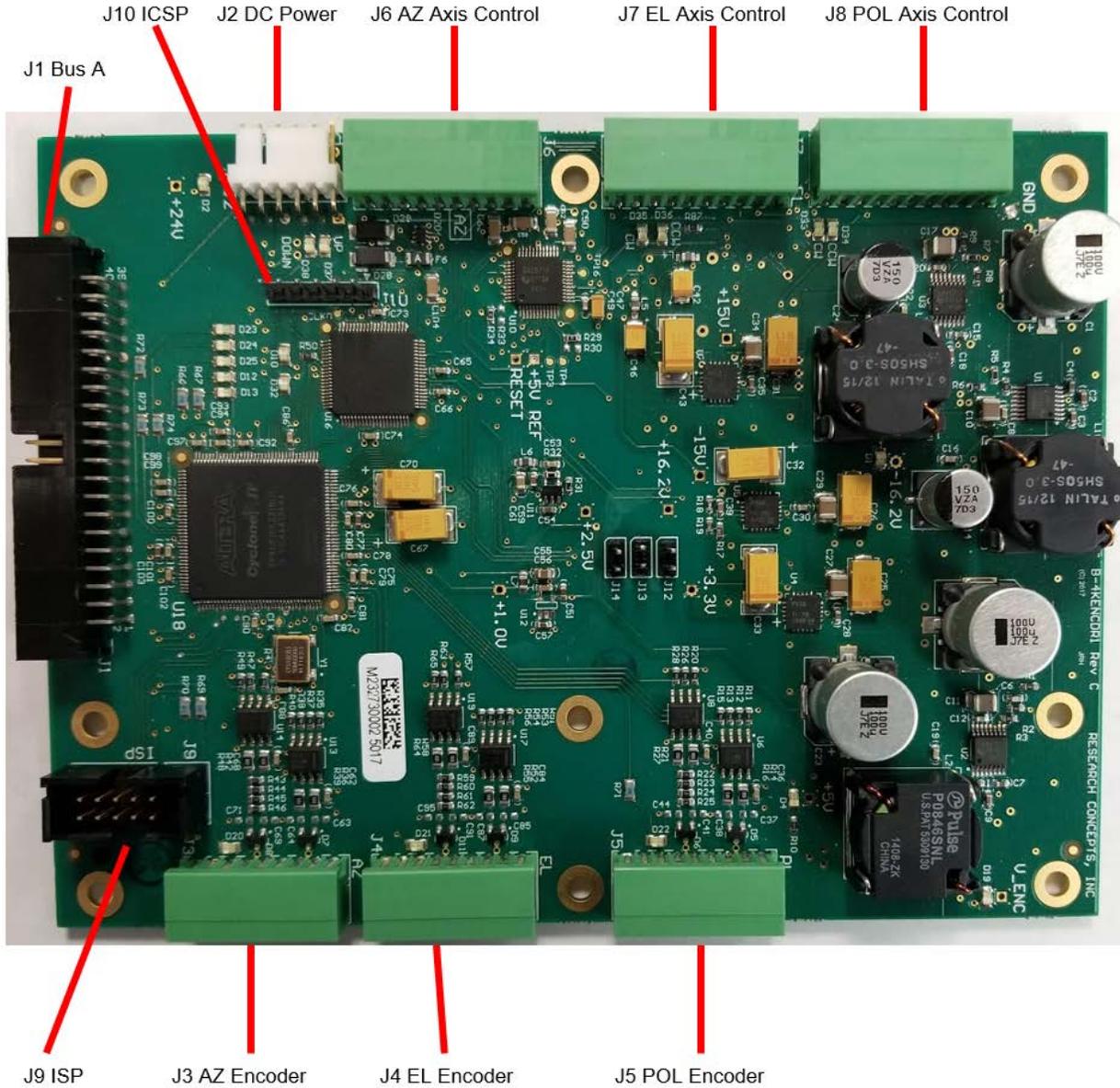
4.1.2.3.9 J10 - ICSP

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

Factory use only.

4.1.2.4 Servo Encoder Board

The Servo Encoder Board allows an RC4600-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.



4.1.2.4.1 J1 – Inter-board Bus A

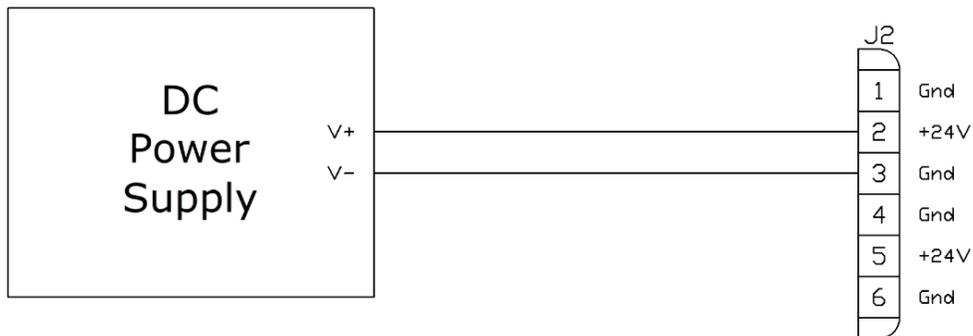
Designation	PCB Marking	Manufacturer	Part Number
J1	Unmarked	TE Connectivity	510310-8

Bus A is used to provide an interface between circuit boards in the RC4600.

4.1.2.4.2 J2 – DC Power

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

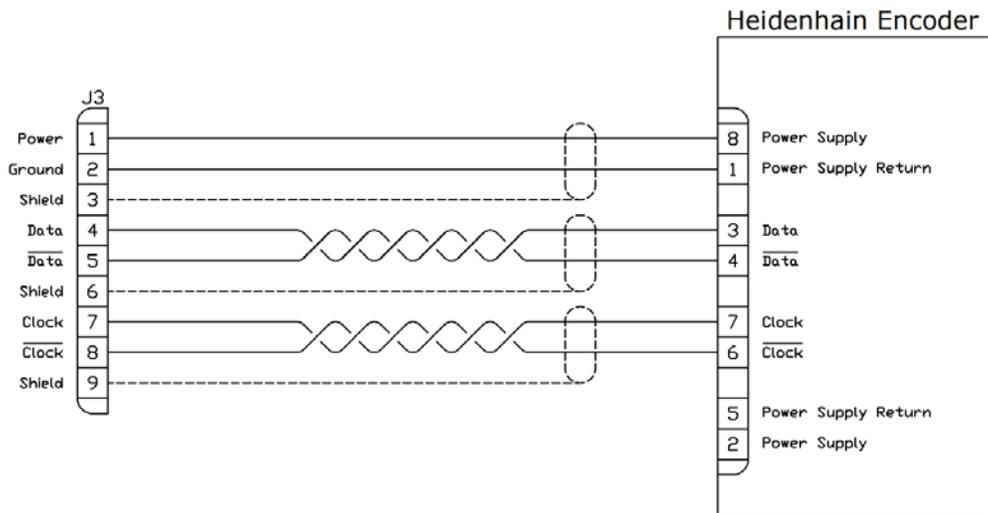
J2 receives 24VDC from a DC power supply typically located within the ACU's enclosure.



4.1.2.4.3 J3 – AZ Encoder

Designation	PCB Marking	Manufacturer	Part Number
J3	AZ	Phoenix Contact	1881516

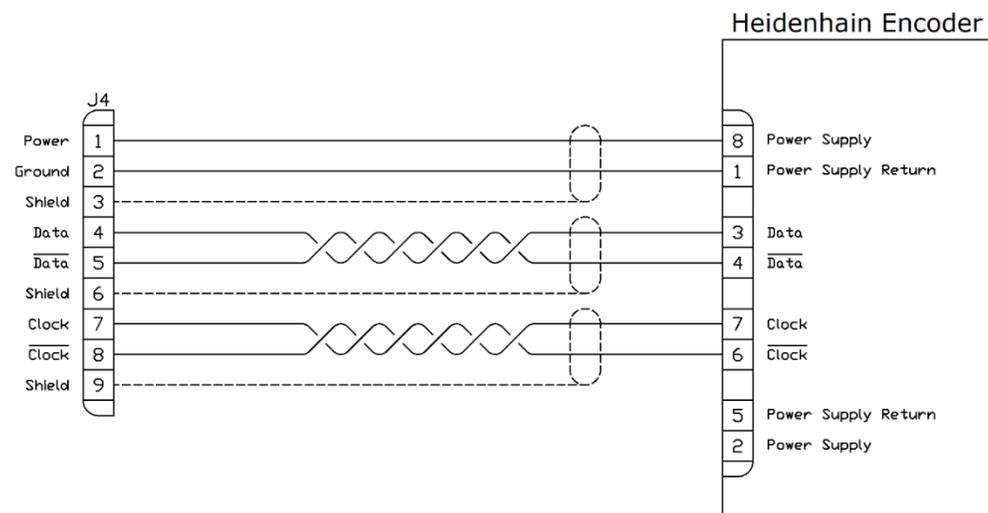
J3 is dedicated to the Azimuth Axis Optical Encoder.



4.1.2.4.4 J4 – EL Encoder

Designation	PCB Marking	Manufacturer	Part Number
J4	EL	Phoenix Contact	1881516

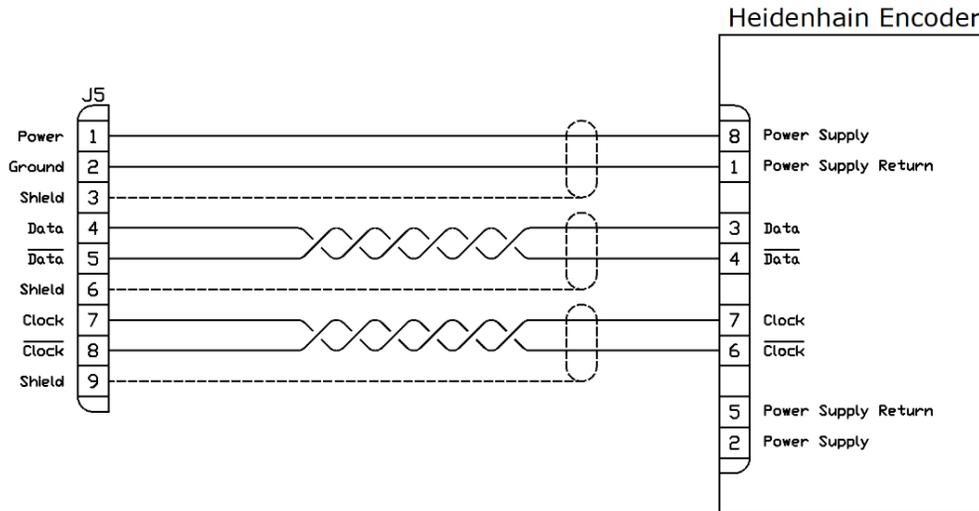
J3 is dedicated to the Elevation Axis Optical Encoder.



4.1.2.4.5 J5 – POL Encoder

Designation	PCB Marking	Manufacturer	Part Number
J5	PL	Phoenix Contact	1881516

J5 is dedicated to the Polarization Axis Optical Encoder.



4.1.2.4.6 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.

4.1.2.4.7 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.

4.1.2.4.8 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.

4.1.2.4.9 J9 – ISP

Designation	PCB Marking	Manufacturer	Part Number
J9	ISP	TE Connectivity	103308-1

Factory use only.

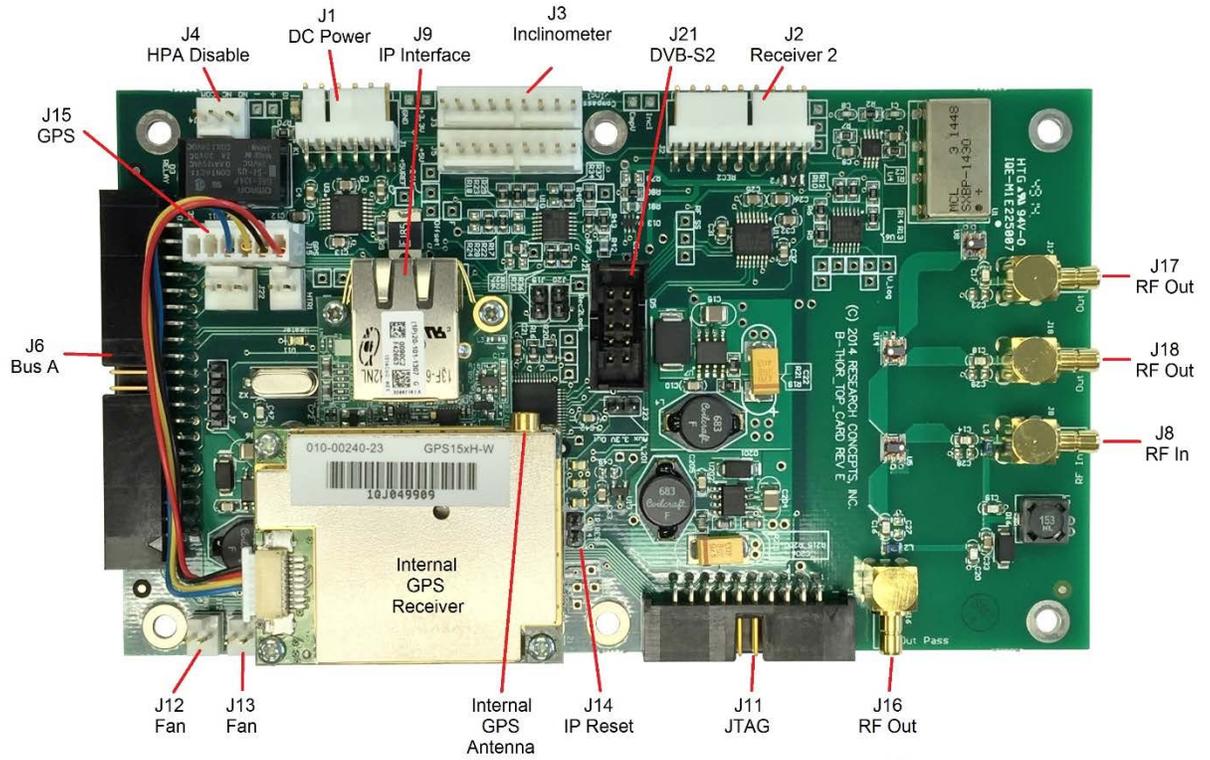
4.1.2.4.10 J10 – ICSP

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

Factory use only.

4.1.2.5 Options Board

The Options Board allows an RC4600-based ACU to be customized with the desired set of optional features such as GPS, DVB, Beacon and Spectrum Analyzer.

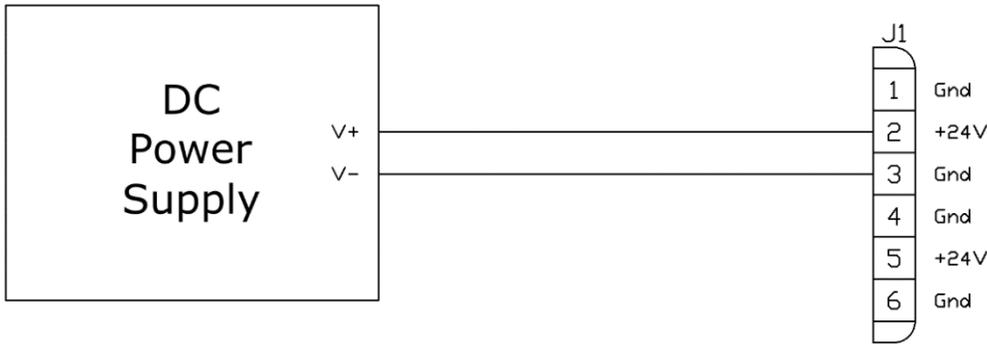


Spacers supporting the options board need to be greater than 0.437".

4.1.2.5.1 J1 – DC Power

Designation	PCB Marking	Manufacturer	Part Number
J1	Power	Molex	22-11-2064

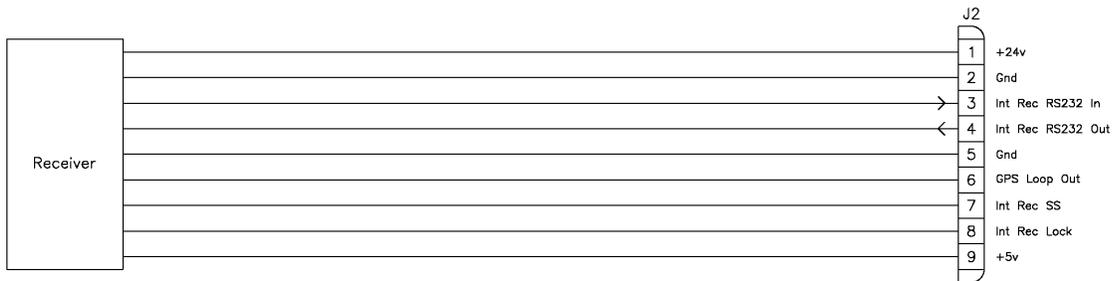
J1 receives 24VDC from a DC power supply typically located within the ACU’s enclosure.



4.1.2.5.2 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.

4.1.2.5.3 J3 – Inclinometer

Designation	PCB Marking	Manufacturer	Part Number
J3	Compass/Incl	Molex	22-11-2092

This connector is not utilized for standard RC4600 applications.

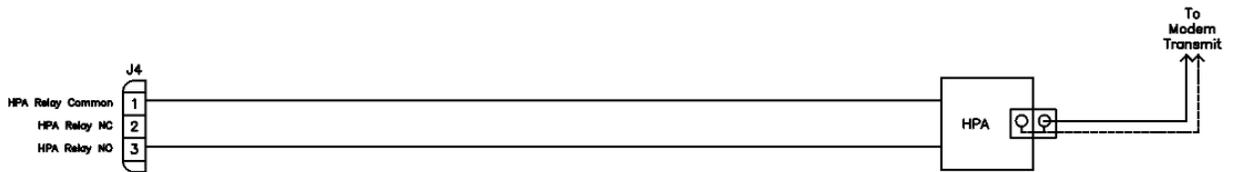
4.1.2.5.4 J4 – HPA Disable

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:

4.1.2.5.5 J5 – Bar LEDs

Designation	PCB Marking	Manufacturer	Part Number
J5	Unmarked	Molex	22-11-2092

This connector is not utilized for standard RC4600 applications.

4.1.2.5.6 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 RC4600.

4.1.2.5.7 J7 – LEDs

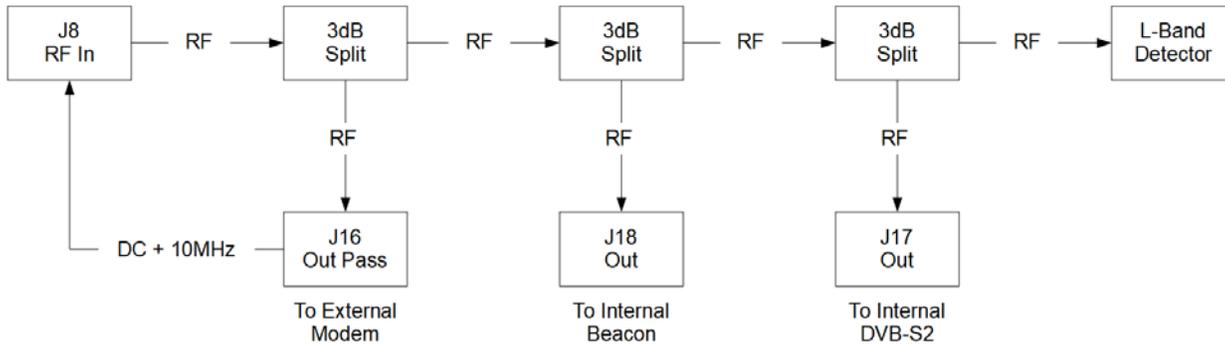
Designation	PCB Marking	Manufacturer	Part Number
J7	Unmarked	TE Connectivity	9-146274-0 (x4)

This connector is not utilized for standard RC4600 applications.

4.1.2.5.8 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 RC4600.



4.1.2.5.9 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.

4.1.2.5.10 J11 – JTAG

Designation	PCB Marking	Manufacturer	Part Number
J11	JTAG	TE Connectivity	103308-1

Factor use only

4.1.2.5.11 J12 – Fan1

Designation	PCB Marking	Manufacturer	Part Number
J12	FAN1	Molex	22-11-2022

Interface for internal cooling fan.

4.1.2.5.12 J13 – Fan2

Designation	PCB Marking	Manufacturer	Part Number
J13	FAN2	Molex	22-11-2022

Interface for internal cooling fan.

4.1.2.5.13 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).

4.1.2.5.14 J15 – GPS

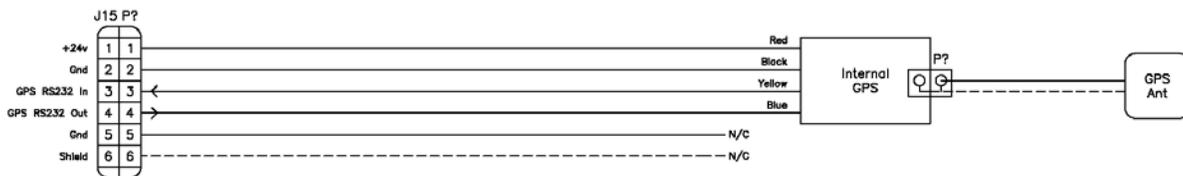
Designation	PCB Marking	Manufacturer	Part Number
J15	GPS	Molex	22-11-2062

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.



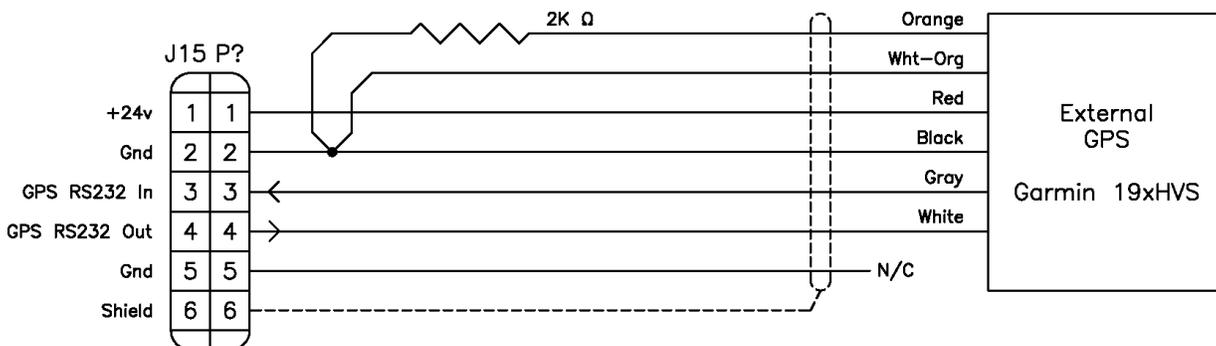
The connection to an active GPS antenna is provided through an MCX RF connector, the antenna should have a male connector installed on the end of its cable. The antenna must provide between 10dB to 30dB net gain between the antenna feed point and the connection to the GPS.

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.

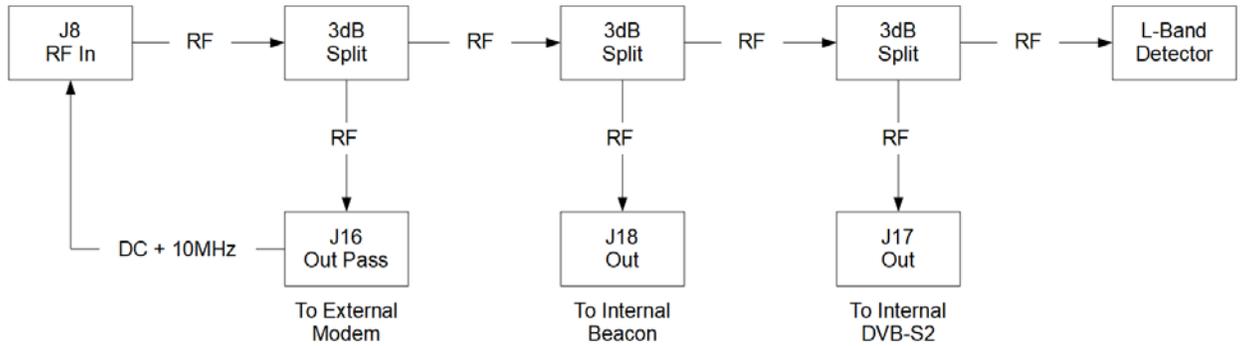
The diagram below shows the wiring connections for a Garmin 19xHVS.



4.1.2.5.15 J16 – RF Pass

Designation	PCB Marking	Manufacturer	Part Number
J16	Out Pass	Amphenol RF	142146

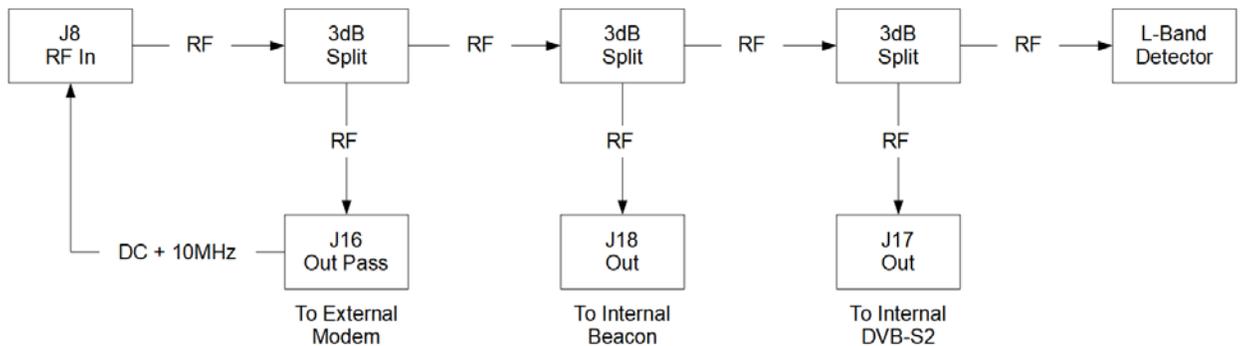
The block diagram below shows the RF path for the RC4600.



4.1.2.5.16 J17 – RF Out

Designation	PCB Marking	Manufacturer	Part Number
J17	Out	Amphenol RF	142146

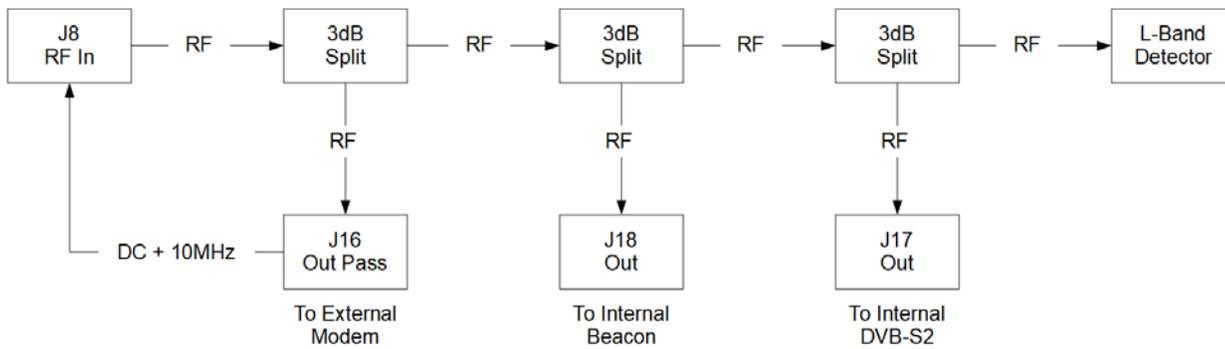
The block diagram below shows the RF path for the RC4600.



4.1.2.5.17 J18 – RF Out

Designation	PCB Marking	Manufacturer	Part Number
J18	Out	Amphenol RF	142146

The block diagram below shows the RF path for the RC4600.



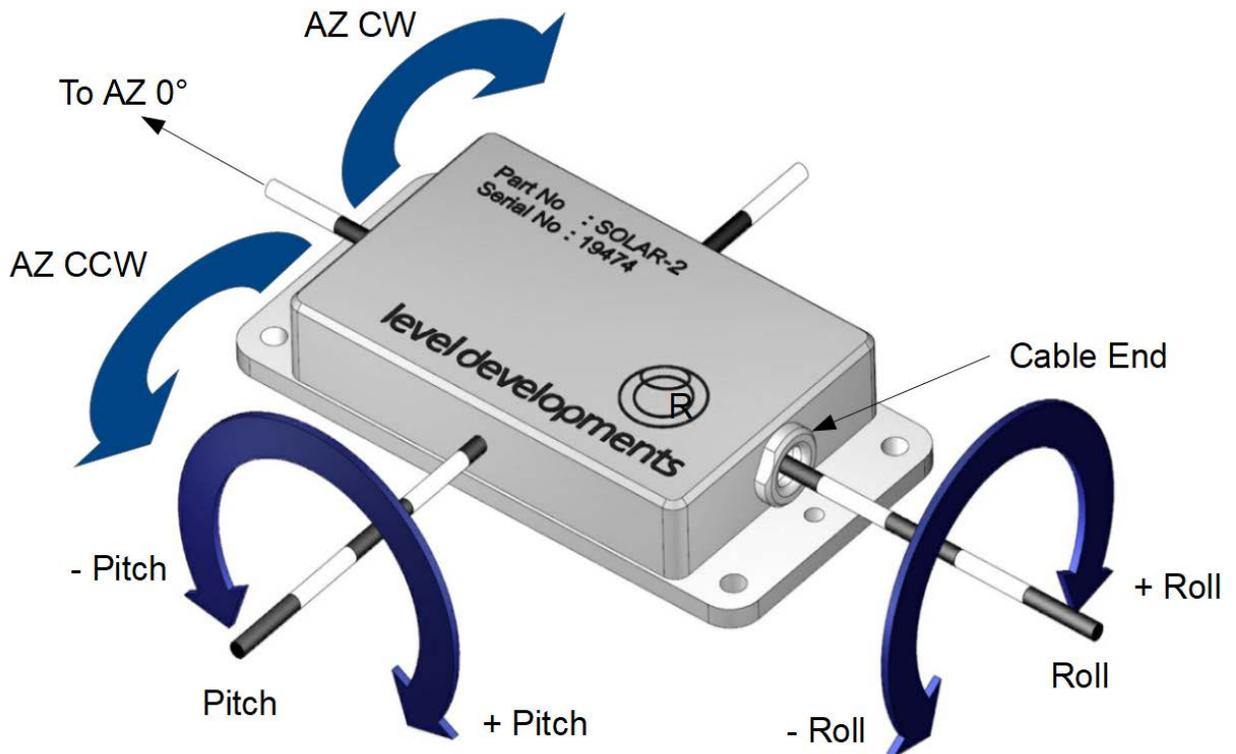
4.1.2.5.18 J21 – DVB-S2

Designation	PCB Marking	Manufacturer	Part Number
J21	Unmarked	TE Connectivity	103308-1

4.2 External Equipment

4.2.1 Dual Axis Inclinometer

To properly calculate pointing angles for the antenna, pitch and roll of the antenna base is required. The RC4600 uses a dual axis inclinometer to sense pitch and roll of the platform. The dual axis inclinometer must be mounted orthogonal to the antenna platform as shown in the image below.



See section 4.1.2.2.4 for wiring of the dual axis inclinometer to the board stack. See Appendix C – Enclosure Specific for information on how to wire the dual axis inclinometer to a board stack inside of an enclosure.

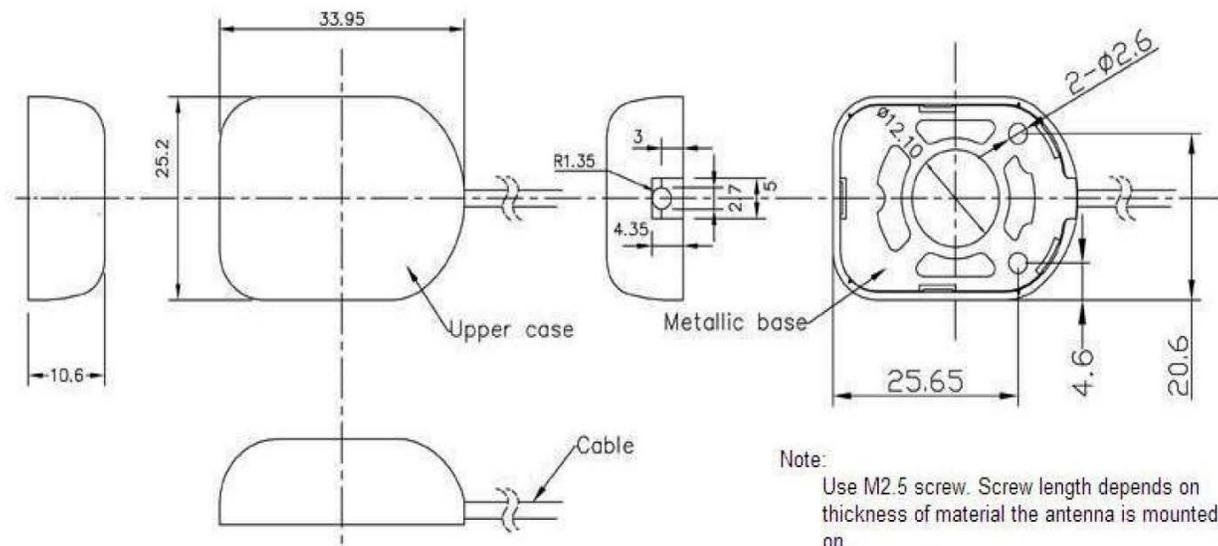
4.2.2 External GPS

The GPS option requires the installation of either a GPS antenna or GPS module in such a position that it has an unobstructed view of the horizon and sky. Care should be taken in the routing of the cable to avoid any problems.

The GPS antenna or module should be mounted at least three feet away from other antennas and electrical generating equipment. Strong RF interference from other sources may disrupt the GPS receiver's signal reception.

4.2.2.1 External GPS Antenna

Mounting dimensions for the external GPS antenna are shown in the image below. This GPS option will only be compatible with GPS satellites and does not provide GLONASS functionality.



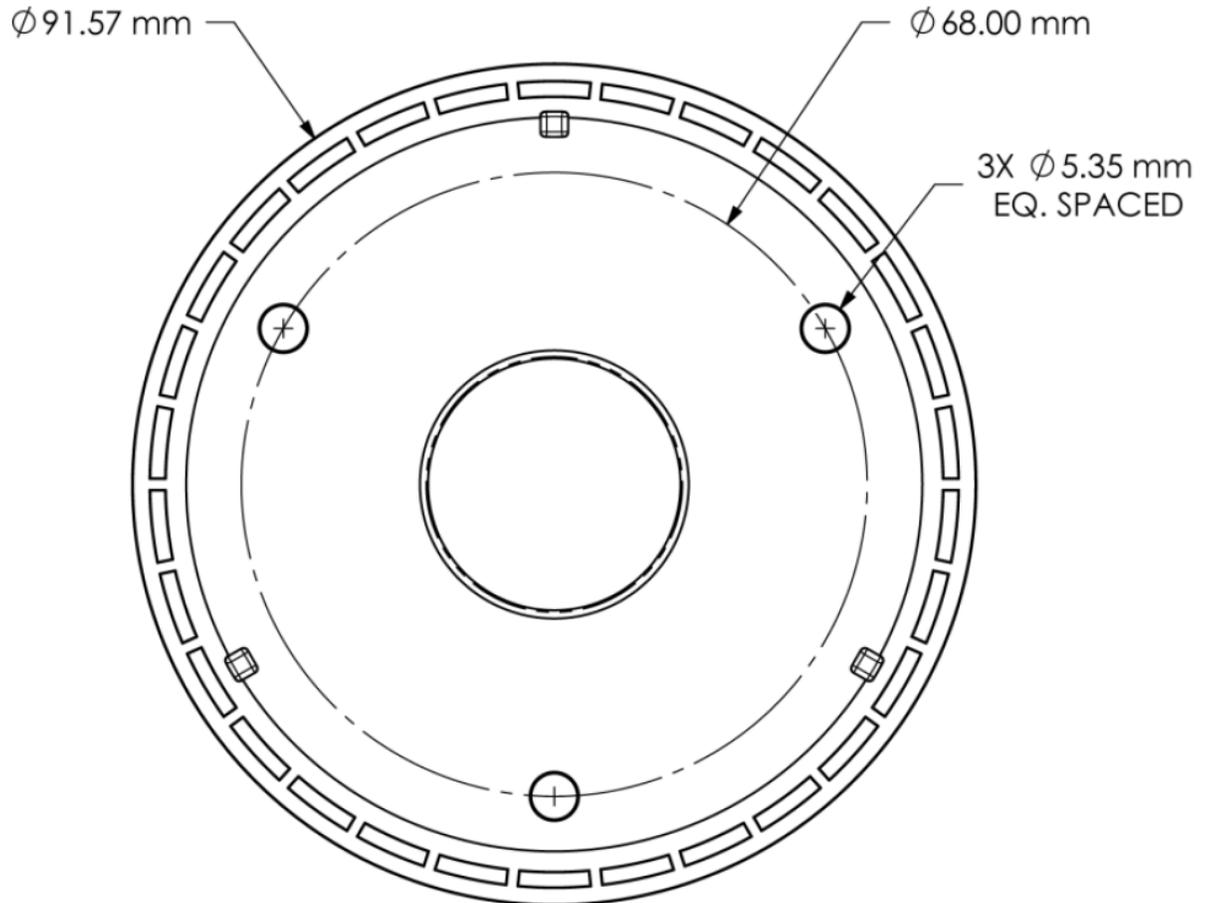
Note:
Use M2.5 screw. Screw length depends on thickness of material the antenna is mounted on.

Mounting Hole Depth is 2.24 mm

The external GPS antenna will come with 5m of cable.

4.2.2.2 External GPS Receiver

Mounting dimensions for the external GPS receiver are shown in the image below. This GPS option will be compatible with GPS and GLONASS satellites.



The external GPS receiver will come with 30 feet of cable. The cable will connect to the center point of the image above.

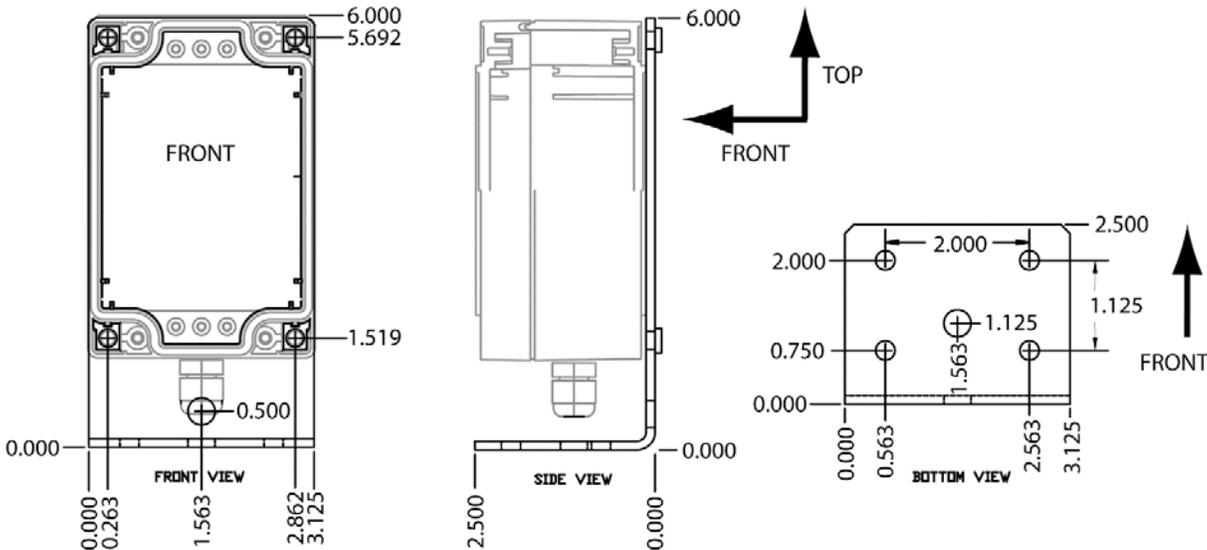
4.2.3 Compass

The RC4600 will be available with two standard compass options. The Fluxgate Compass and the smaller form factor 3-axis compass available for fly-away style antennas. Additionally, there is a GPS compass option. The GPS compass provides the most accurate heading, but also requires an environment with nothing blocking the view of the horizon for the GPS antennas. Details of the GPS compass are described in the HGPS appendix.

4.2.3.1 Fluxgate Compass

The optional fluxgate compass unit should be placed on the antenna away from ferrous metals, electric motors, and any equipment that generates magnetic fields such as air conditioners, generators, and amplifiers. Experience has shown that the fluxgate performs best when mounted as high as possible on the antenna. The fluxgate compass must be mounted in an upright position.

The RC4600 uses the fluxgate to determine the true heading of the mount's azimuth centerline (0.0 degrees azimuth). If the compass is not aligned in the direction of the azimuth centerline, that difference must be described in the compass offset configuration item (2.1.1.3.1.3.1).



Refer to the drawing of the fluxgate enclosure to verify the proper orientation of the fluxgate.

The Fluxgate Compass box may be either bracket mounted or flush mounted. Without the bracket it may be attached to a flat surface by four 10-32 screws from inside or outside the box through the four corner holes shown in the FRONT view diagram above. When using the bracket mount, it may be mounted with four 1/4 inch bolts using the holes shown in the bottom view of the bracket in the above diagram. The cable may be routed through either hole in the bracket.

The following method may be used to determine the best location for the compass.

Position the antenna in a location that is away from large metal objects or sources of magnetic fields. Any electrical equipment near the antenna that generates magnetic fields during normal operation should be powered on.

Using a magnetic compass, slowly move the compass to the proposed fluxgate mounting location on the antenna without changing the orientation (or heading) of the compass body. If the needle of the compass swings as the compass is lowered to the mounting location, it is due to distortion of the earth's magnetic field by ferrous metals on the antenna, or magnetic fields generated by additional electronic devices.

The fluxgate should be mounted in the location where the needle of the compass experiences the minimum amount of swing as the compass is lowered to the proposed mounting location.

4.2.3.2 3-Axis Compass

The optional 3-axis compass unit should be placed on the antenna away from ferrous metals, electric motors, and any equipment that generates magnetic fields such as air conditioners, generators, and amplifiers. Experience has shown that the 3-axis compass performs best when mounted as high as possible on the antenna. The 3-axis compass can be mounted in any of 6 orientations as shown below.



Orientation #1 "Top"



Orientation #2 "Front"



Orientation #3 "Left"



Orientation #4 "Bottom"



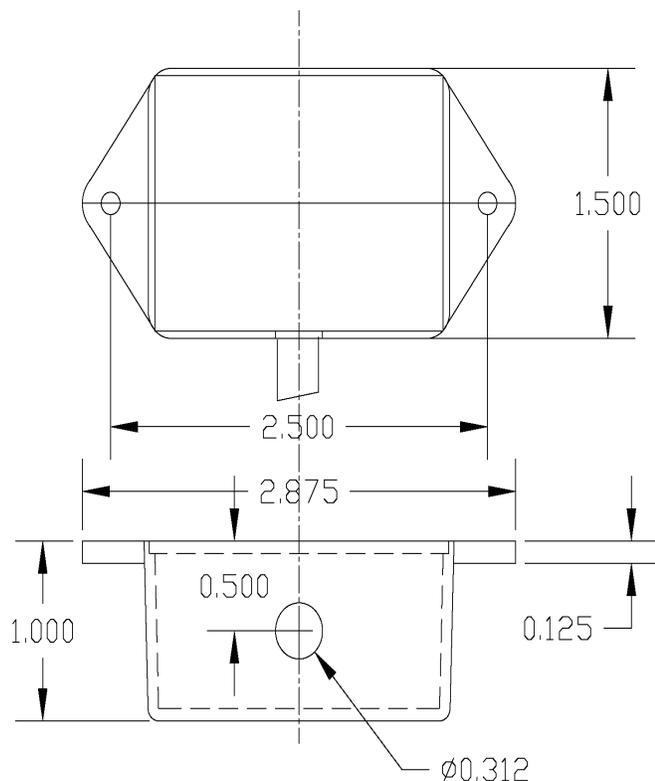
Orientation #5 "Back"



Orientation #6 "Right"

The RC4600 uses the 3-axis compass to determine the true heading of the mount's azimuth centerline (0.0 degrees azimuth). If the compass is not aligned in the direction of the azimuth centerline, that difference must be described in the compass offset configuration item (2.1.1.3.1.3.1).

The 3-axis compass is permanently sealed within a 2.875" x 1.500" x 1.000" plastic box. The box provides two mounting holes on end flanges. The cable extends from the middle of the box length side.



4.2.3.2.1 Mounting Considerations

- 1) The box should be mounted as high on the antenna structure as feasible. In general, the sensed magnetic field will be cleaner and the heading more accurate when positioned far from the antenna base. **Poor performance is almost always due to nearby metal structures, motors, or high-current conductors.**
- 2) The box should be mounted such that the distance from the azimuth axis center of rotation is as small as possible. Preferably, with the elevation at deploy, the box would spin about a single point when the antenna is rotated in azimuth. Position the antenna in a location that is away from large metal objects or sources of magnetic fields. Any electrical equipment near the antenna that generates magnetic fields during normal operation should be powered on.

4.2.4 Local Jog Panel

The local jog control panel provides a simple keypad that includes the essential keys necessary for manual jog control and for automatic locate and stow routines. The jog panel is typically used on embedded controllers to locally jog the antenna. This option is not available on rackmount RC4600 units.



4.2.5 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.
STOW, stow	Antenna is at the azimuth hardware limit (STOW) or azimuth software limit (stow), this is part of normal operation.

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.
STOW, stow	Antenna is at the elevation hardware limit (STOW) or elevation software limit (stow), this is part of normal operation.

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.
STOW, stow	Antenna is at the azimuth hardware limit (STOW) or azimuth software limit (stow), this is part of normal operation.

5.1.1.5 GPS

Warning	Description/Recommended Action
No GPS Present	GPS is disabled in the system definition screen
Initializing	RC4600 has sent a message to the GPS to start communication.
GPS Offline	RC4600 is not receiving information from the GPS receiver
Waiting For GPS	RC4600 is waiting for the GPS to report that it has a valid Lat/Lon

5.1.1.6 Compass

Warning	Description/Recommended Action
No Compass Present	Compass is disabled in the system definition screen
Compass Offline	RC4600 is not receiving information from the compass
Waiting for Compass	RC4600 is waiting for the compass to report that it has a valid heading

5.1.1.7 Dual Axis Inclinometer

Warning	Description/Recommended Action
No Tilt Sensor Detected	RC4600 is unable to communicate with the dual axis inclinometer
Inconsistent Sensor Data	RC4600 is receiving invalid data from the dual axis inclinometer
Waiting for Tilt	RC4600 is waiting for the dual axis inclinometer to provide pitch and roll

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.

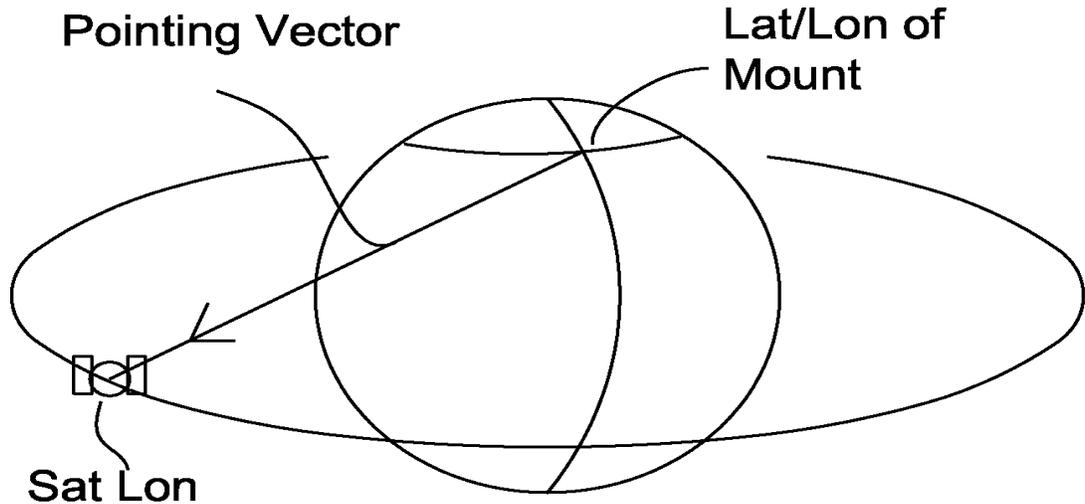
5.1.2.4 Polarization

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 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.

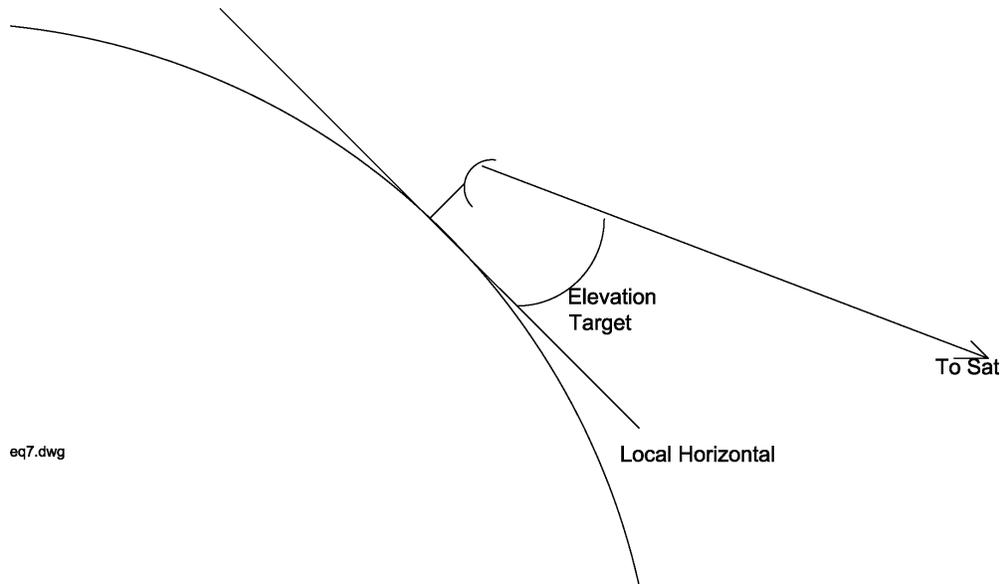
5.2 ACU Topics

5.2.1 Antenna Pointing Solution

The position (latitude/longitude, heading, pitch/roll) of the antenna and the longitude of a selected satellite are required to calculate a pointing vector from the antenna to the selected satellite.



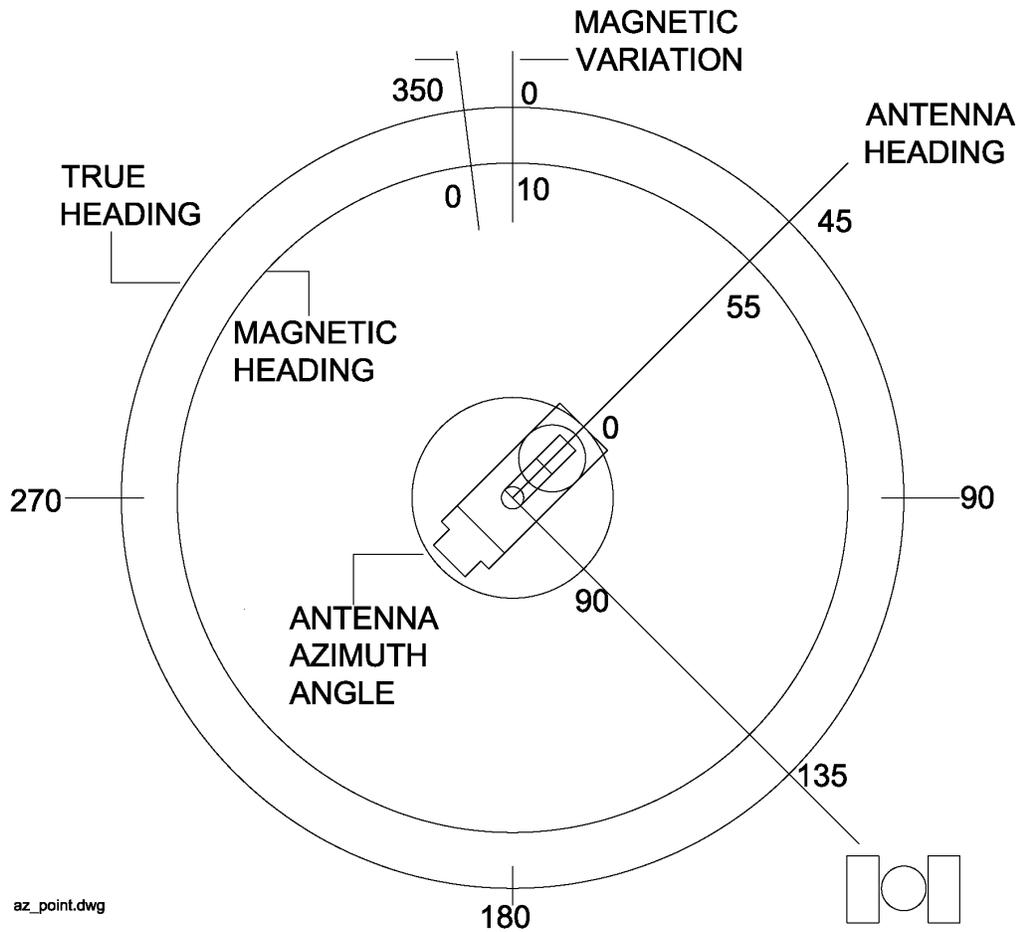
eq6.dwg



eq7.dwg

Given the antenna's latitude and longitude and the pointing vector to the satellite, the RC4600 calculates the elevation (with respect to local horizontal) required. Feedback from the antenna on the elevation axis will be used to move the mount to the required elevation.

The azimuth portion of the pointing vector is calculated with respect to local true North. The compass is used to determine the heading of the centerline of azimuth travel and the required movement in the azimuth axis is calculated.

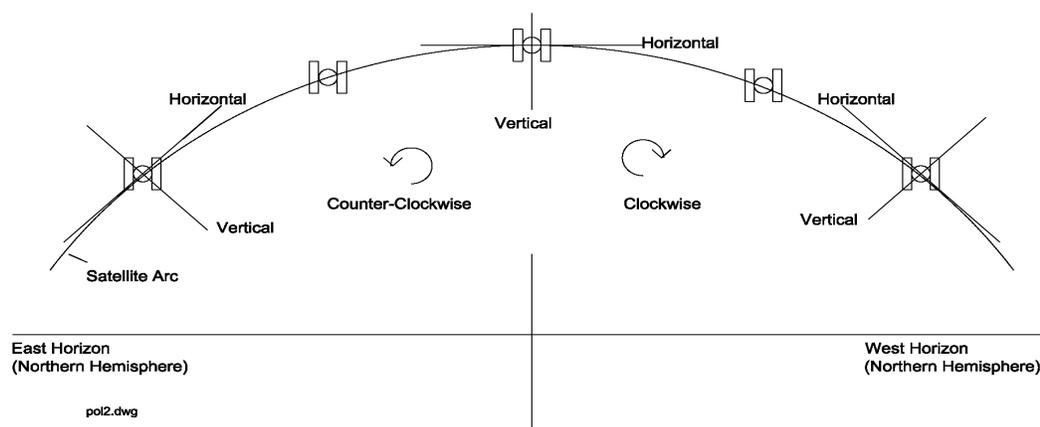


In the above example a true heading of 135 degrees to the satellite has been calculated. Based on the mount's latitude, longitude and date, a local magnetic variation (0) of 10 degrees is calculated. The compass senses a magnetic heading of 55 for the azimuth reference direction. Applying the magnetic variation, this yields an apparent true heading of 45 degrees for the antenna reference direction. An azimuth movement of 90 (135 – 45) degrees clockwise is therefore needed to point at the satellite.

Since a position sensor on the azimuth axis is always active, the RC4600's default displayed azimuth value is that of the antenna angle. Derived estimates of the magnetic and true heading of the mount may be selected in the MANUAL (2.1.1.2.1) and LOCATE (2.1.1.2.2.3) modes.

5.2.2 Polarization Control

The RC4600 calculates the required position and automatically moves the polarization axis as part of the satellite LOCATE 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 RC4600 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. If a linear polarized feed is present, the RC4600 will calculate the theoretical position as a function of the antenna position (latitude/longitude, heading, pitch/roll) and satellite longitude.

5.2.3 Drive System

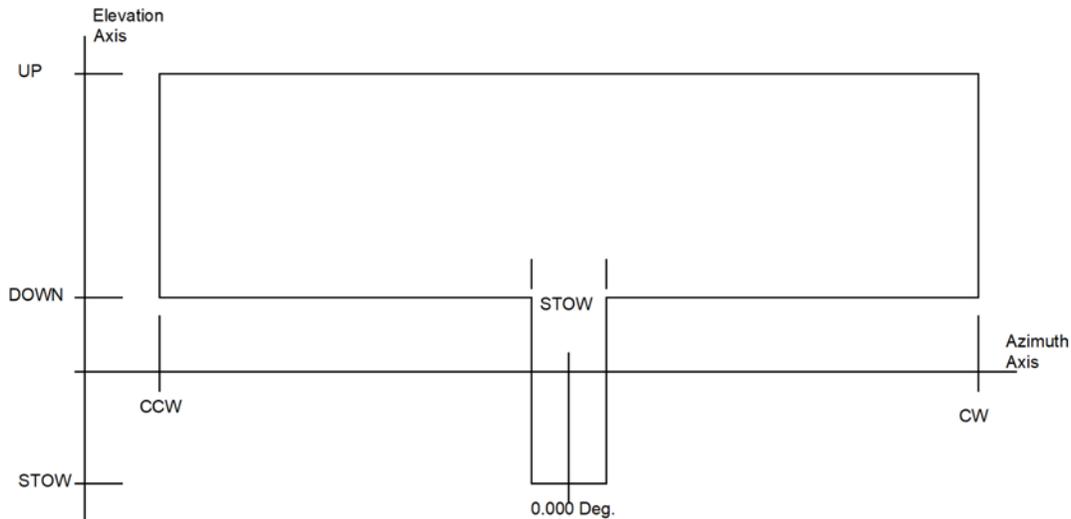
The RC4600 implements several mechanisms for the driving and monitoring of the azimuth, elevation and polarization axis.

5.2.4 Position Sensing and Limits

The RC4600 senses absolute axis position using feedback from various sensors (potentiometers, resolvers, encoders, etc). The sensed information is scaled appropriately for the particular 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 is with respect to the centerline of azimuth travel.

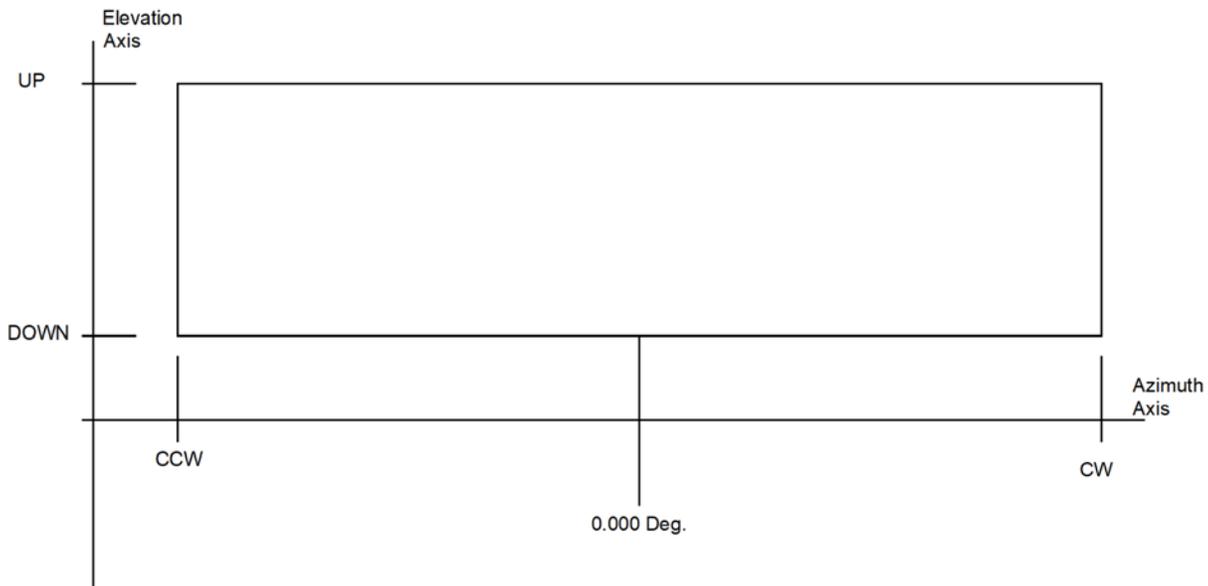
The following diagram shows a typical range of movement for mobile satellite antennas. Note that elevation movement to the stow position is limited about a small range of azimuth movement in order to ensure safe stowing of the antenna.



In the azimuth axis, movement in one direction is disabled when clockwise and counterclockwise limit switches are activated. There is also typically a region in the center of azimuth travel indicating that the azimuth axis is in a position that will allow for moving the elevation axis down to the stow position.

In the elevation axis, there are typically three limit switches. The UP switch prevents further movement up. The "DOWN" switch delimits the elevation the mount may not move further downward unless it has been placed in the azimuth stow region. The STOW switch indicates when the mount has reached its furthest down position which is typically where the dish is stowed for travel.

The following diagram shows a typical range of movement for fly-away satellite antennas. Note that elevation movement below the down limit is prohibited at all points in azimuth.



5.2.4.1 Follow, Drift, and Drive Error Sensing

The RC4600 continuously monitors the axis positions to detect incorrect movement of the antenna. If an axis has been commanded to move and the RC4600 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 RC4600 is holding position in an axis and the position “drifts” away from the held position and the controller cannot correct it out, the RC4600 will declare a “DRIFT” condition and not allow further movement until the condition has been reset.

The RC4600 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 RC4600 will declare a “DRIVE” condition and not allow further movement until the condition has been reset.

5.2.5 Timekeeping

There are several versions of time (system, sidereal, display and GPS) discussed within this manual.

System time is maintained by the RC4600’s real time clock. The real-time clock is backed up by battery so that system time is available as soon as the RC4600 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 RC4600’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.

If the optional GPS receiver is installed, the RC4600 parses 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 RC4600 allows the user to synchronize system time to the UTC reported by the GPS receiver.

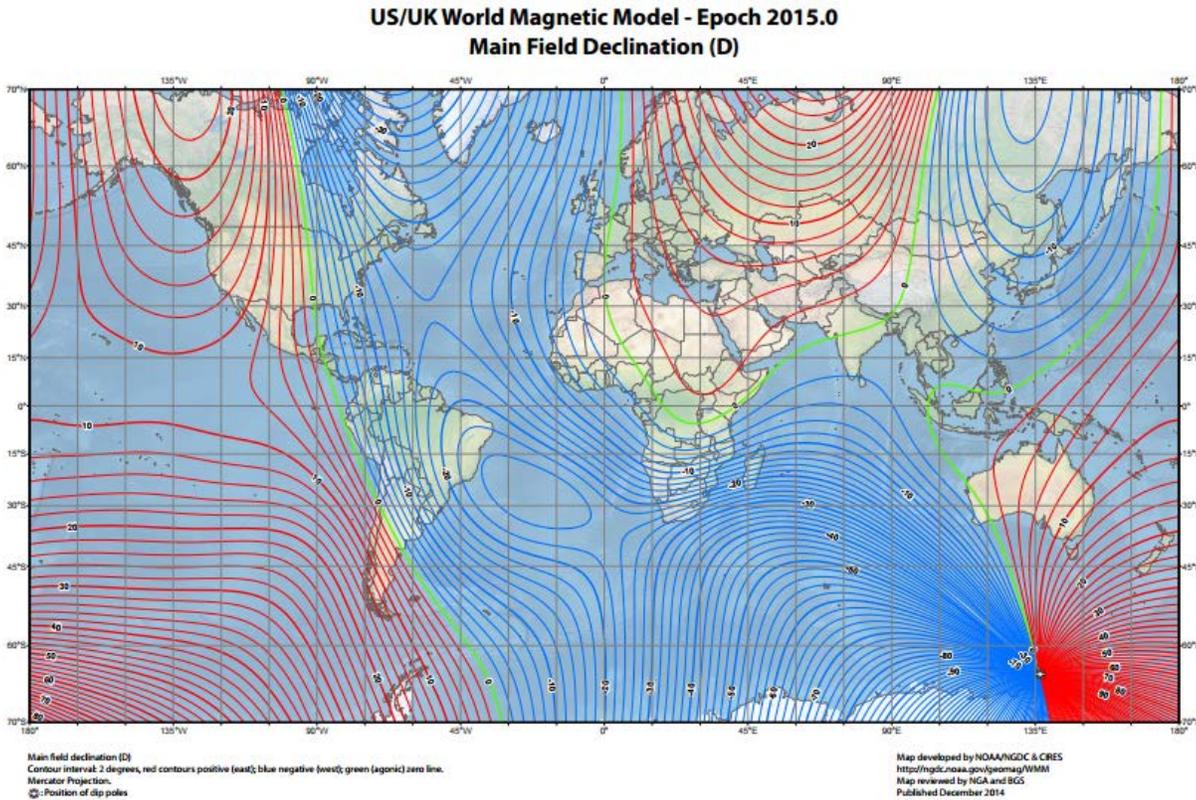
The period of a satellite’s motion is one sidereal day (approximately 23 hours 56 minutes 4 seconds). Entries in the track table for an inclined orbit satellite are stored at intervals of 1/48th of a sidereal day. The RC4600 determines at what point in a sidereal day (with respect to the RC4600 reference) it is by calculating how many sidereal days have passed from January 1, 1992 until the present system time.

In several screens the RC4600 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.

5.2.6 Magnetic Variation

In order to calculate satellite pointing solutions, the antenna’s orientation with respect to True North must be known. The RC4600 uses a compass to measure the local horizontal component of the earth’s magnetic field. The earth’s magnetic field is very irregular as shown in the following map.



The magnetic field also changes slowly over time. The following table shows how the magnetic variation for Washington D.C. has changed over the last 250 years.

Year	Magnetic Variation
1750	-3.3
1800	-1.0
1850	-2.5
1900	-5.5
1950	-7.5
2000	-10.6

The RC4600 uses the International Geomagnetic Reference Field (IGRF) model to determine the local magnetic variation (difference between Magnetic North and True North). This model demonstrates how the earth’s magnetic field and how it is changing. The IGRF is based on world-wide observations and is updated every five years. The IGRF model cannot account for short term effects such as magnetic storms, etc.

Local magnetic variation is calculated given the antenna’s latitude, longitude and the current date. The magnetic variation calculation cannot account for isolated local anomalies or external effects (power lines, train tracks, etc). The azimuth scanning functions (2.1.1.2.2.3.3 and 2.1.1.2.2.3.6) are used to compensate for these heading calculation errors.

5.2.7 System Performance

The performance achieved by the RC4600 in locating and tracking satellites is dependent on the mechanical tolerances of the antenna, the correctness of the installation and the accuracy of the various sensors.

The largest source of error for the system is due to errors in determining the antenna's magnetic heading. Errors in heading primarily affect the accuracy of the antenna's calculated azimuth position. The compass determines the magnetic heading by measuring the direction of the magnetic field at the sensor. Problems arise because the earth's magnetic field can be distorted by ferrous metals (such as steel and iron; aluminum is a non-ferrous metal) and man-made magnetic fields. These man-made fields can be generated by electric motors, generators, and transformers.

For the compass sensor, there are two unique categories of objects that distort the magnetic field in the vicinity of the truck. Some of the distortion is due to objects and electrical devices on the antenna itself. This component of the distortion can be largely compensated for during system calibration.

The other component of the distortion is due to large metal objects and man-made magnetic fields around the site where the antenna is being operated. This component of the distortion varies as the antenna moves from one location to another, and it affects the accuracy of the calculated azimuth position. Environments which typically produce the largest errors include railroad yards, areas around electrical substations, and sites near structures containing large amounts of steel or iron, such as bridges or large buildings.

To help alleviate this azimuth error, the azimuth scan feature scans an azimuth range about the target azimuth and seeks the strongest signal. This feature is explained in full in section 2.1.1.2.2.3.3.

The RC4600 uses 16-bit resolvers, or 25-bit optical encoders to sense azimuth and elevation position. The 16-bit sensors offer a resolution of 0.0055° , where the 25-bit optical encoders offer a resolution of 0.00001° . It is important to make sure that the proper sensor is used for the application.