

**RC3100**  
**AUTO ACQUISITION ANTENNA CONTROLLER**  
**USER'S MANUAL**  
for Vertex TVSAT Antennas



13 December 2010

**RESEARCH CONCEPTS INC.**

5420 Martindale Road

Shawnee, Kansas 66218-9680 USA

(913) 422-0210

[support@researchconcepts.com](mailto:support@researchconcepts.com)

[www.researchconcepts.com](http://www.researchconcepts.com)

Serial No. \_\_\_\_\_

### REVISION HISTORY

DATE	MODIFICATION	SOFTWARE VERSION
15 December 2009	Preliminary document	1.60
10 February 2010	add AZ SF, GPS and Clock screens	1.60a (K1)
3 June 2010	add Single axis compass documentation	1.60
12 November 2010	add External Receiver documentation	1.60b
13 December 2010	correct pulse scale factor description	1.60b

### WARRANTY INFORMATION

Research Concepts, Inc. (RCI) warrants to the original purchaser, this product shall be free from defects in material and workmanship for one year, unless expressed otherwise, from the date of the original purchase.

During the warranty period, RCI will provide, free of charge, both parts and labor necessary to correct such defects.

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

- (1) Notify RCI as soon as possible after discovery of a possible defect, of:
  - (a) the model and serial number
  - (b) identify of the seller and date of purchase
  - (c) detailed description of the problem, including details on the electrical connection to associated equipment and list of such equipment, and circumstances when problem arose.
- (2) Deliver the product to RCI, or ship the same in its original container or equivalent, fully insured and shipping charges prepaid.

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

- Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts.
- Misuse, abuse, neglect, or improper installation including disregard for installation of backup or safety override equipment.
- Accidental or intentional damage.
- Lightning or acts of God.

There are no implied warranties.

The foregoing constitutes RCI's entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages. Some states do not allow limitations or exclusions of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which may vary from state to state.

RCI retains the right to make changes to these specifications any time, without notice.

Copyright – Research Concepts Inc., 2009

## 1.0 INTRODUCTION

The RC3100 automatic acquisition antenna controller was designed to provide easy control of mobile satellite antennas. The RC3100 provides manual control of azimuth, elevation and polarization axes. Additionally the RC3100 automatically stows the antenna and acquires a single programmed satellite.

**PLEASE READ AND UNDERSTAND THE MANUAL.** Time invested in understanding its installation and operation will be well spent.

### 1.1 Manual Organization

This section (1.1) summarizes the contents of the remainder of the manual and the conventions and notations used throughout the manual. Section 1.2 highlights the functionality and features of the RC3100. Section 1.3 reviews the theory of the RC3100's operation and should be understood before installation and initial use of the RC3100.

Chapter 2 describes the installation and configuration procedures for the RC3100. The rest of the manual should be reviewed prior to installation in order to provide context for the installation procedures.

Chapter 3 provides detailed instructions on the operation of the RC3100. This chapter will describe the data presented and user action required for every operational screen.

Chapter 4 covers RC3100 error conditions and provides help for system troubleshooting.

### MANUAL CONVENTIONS

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

	Az	El	Pol
	-123.4	-12.3	-12
F	CCW	STOW	CCW

Note that the "Az", "El" and "Pol" labels are permanently marked on the faceplate above the LCD screen.

The following table shows typical abbreviations used both on RC3100 screens and in the manual's text.

ITEM	ABBREVIATION(S)
Azimuth	AZ, AZIM, Azim
Elevation	EL, ELEV, Elev
Polarization	POL, Pol
Clockwise	CW
Counter-Clockwise (Anti-Clockwise)	CCW
Down	DN
Longitude	LON

When referring to a particular RC3100 mode of operation that mode's name will be capitalized – ex. AUTO.

## 1.2 RC3100 Features

The RC3100 antenna controller is designed to provide easy operation of mobile (both vehicle mounted and deployable) mounts. Features provided include:

- 3 axes jog operation
- Simultaneous azimuth, elevation and polarization angle display
- Automatic stow and satellite acquisition functions
- Dual speed operation
- Dynamic braking and active IR compensation
- Battery backed-up non-volatile memory for calibration data
- Slim 2U rack mounted unit
- Continuous monitoring of antenna drive status
- 2 row x 16 column Liquid Crystal Display (LCD)
- 8 key keypad

The RC3100 supports mounts from multiple antenna manufacturers and provides optional software configurations. When the RC3100 is powered on, the following identification screen appears for three seconds.

RC3100A	K1-OR
(c)RCI'09	1.60

**Hardware Configuration** There are two basic versions of the RC3100 hardware. The "A" version is configured with circuitry to support mounts with low voltage (12-36 VDC) DC motors. The "B" version supports higher voltage (40-120 VDC) DC motors.

**Software Configuration** The software configuration is presented in the upper right corner:

(Mount Manufacturer)(Model #)-(Nav/Rcv)

Descriptions of the options are provided in the following table:

CATEGORY	DESIGNATION	DESCRIPTION
Hardware	A	Low Voltage DC
	B	High Voltage DC
Mount Manufacturer / Model #	K1	C120M TVSAT
	K9	C135M TVSAT
Nav/Rcv	OR	GPS / DVB Receiver
	SR	GPS / Single Axis Compass / DVB
	SN	GPS / SAC / External Receiver*

\* - signal strength and lock input from external receiver required

The software version number is presented in the lower right corner.

## 2.0 INSTALLATION

### 2.1 Equipment Mounting

This section describes the physical mounting requirements for the RC3100 and optional sensor units. Wiring requirements are discussed in section 2.2.

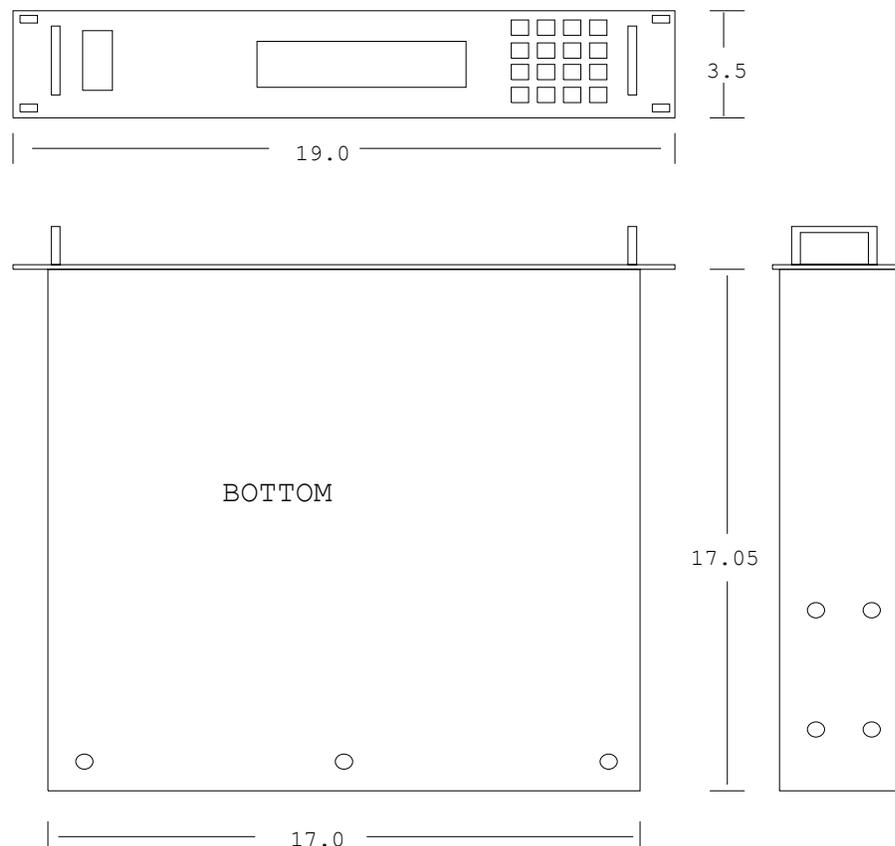
#### 2.1.1 RC3100 Antenna Controller

**NOTE: The RC3100 unit should not be installed in the rack until the final step of the Initial Configuration (section 2.3) because access to the interior of the unit may be necessary prior to that procedure. The cables may be run through the chosen location in the rack and connected to their respective components.**

The RC3100 enclosure is a standard rack mount chassis that occupies two rack units (2U). The front panel is mounted via four (4) 10-32 screws. Due to the length and weight of the RC3100, much strain can be put on the faceplate particularly in a mobile unit. To help alleviate stress on the front panel mounting, additional mounting points accepting 10-32 screws are provided on each side, back and bottom of the unit. The user may use any of these additional mounting points to provide support for the RC3100 via strapping, shelving, etc. The additional mounting screws on the back of the unit may be also used to provide strain relief for cabling.

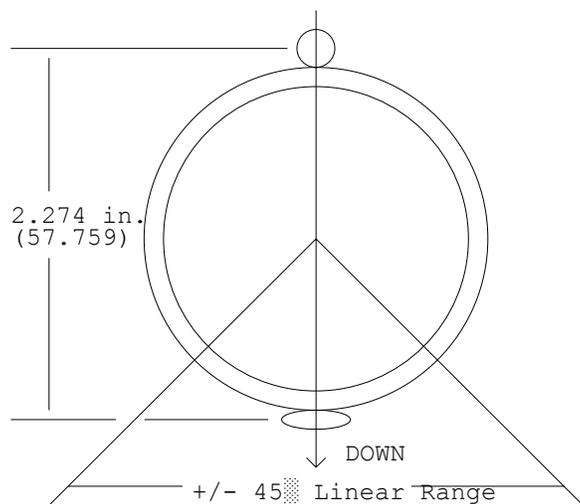
**CAUTION: support of the back of the RC3100 is a requirement. RCI's warranty does not cover repair to units with ripped faceplates.**

The RC3100's LCD is optimized for viewing from a 6 o'clock position. The optimum position to mount the unit would therefore be above the operator's eye level.



## 2.1.2 Electronic Clinometer

The electronic clinometers (also referred to as the inclinometer) should be positioned on the mount structure in an orientation that allows the inclinometer's linear range of movement to rotate through the antenna's RF bore sight operational range.



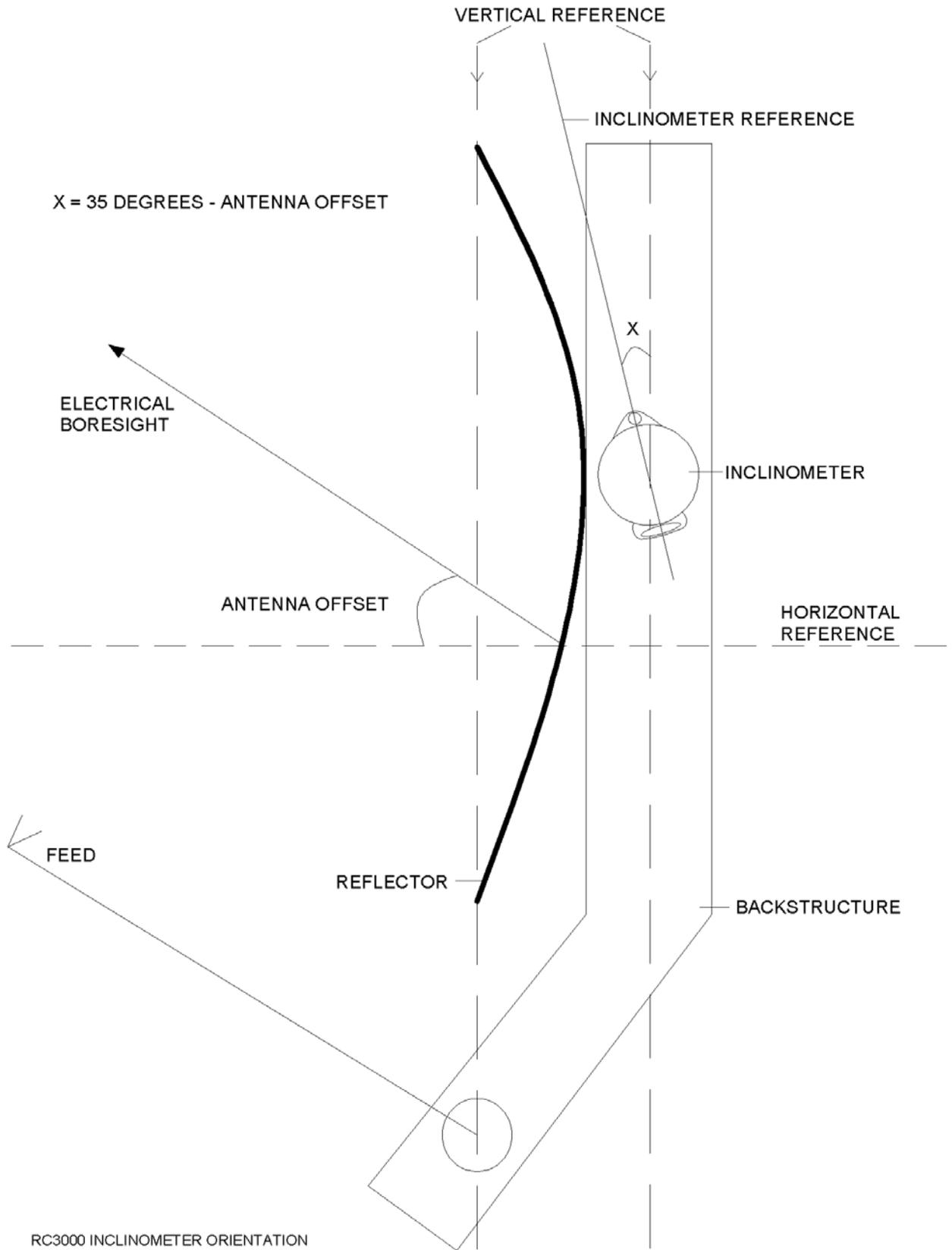
clin1.dwg

Determining the correct orientation of the inclinometer requires knowledge of the mount's mechanical structure and the antenna's RF offset. Typically the mount manufacturer will place the inclinometer in the correct position on the mount.

The elevation position sense circuit of the RC3000 is designed to interface to the Lucas/Schaevitz AccuStar model 0211 1002-000 or 0211 1102-000 inclinometers. The inclinometer's position reference is marked on the body of the inclinometer. The inclinometer should be mounted such that the body of the inclinometer is rotated CW (as viewed by an observer looking at the front of the inclinometer) as the antenna's elevation angle increases. The inclinometer must also be oriented properly on the antenna mount.

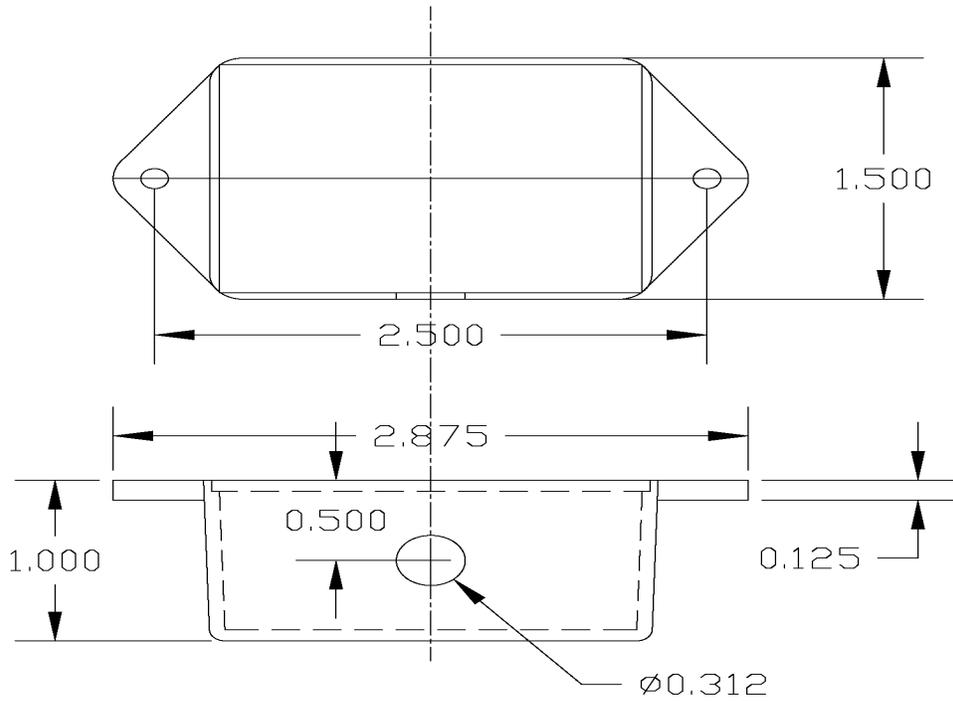
To describe the orientation of the inclinometer, the term 'elevation offset angle' needs to be defined. Elevation offset angle is defined as the antenna's RF elevation pointing angle (relative to horizontal) when a straight edge oriented vertically across the face of the antenna reflector (reflector top to bottom) is plumb. The inclinometer should be oriented so that when the antenna reflector is plumb the reference mark is deflected CCW (from the vertical position) by an amount equal to the 35 degrees minus the 'elevation offset angle'. If the inclinometer is attached as described the sensor will operate in its most accurate region for elevation look angles up to 80 degrees.

The inclinometer mounting flange allows for some adjustment of the device's rotational orientation. The mounting position selected for the inclinometer should allow for adjustment of the inclinometer's orientation. The inclinometer should be mounted in a location such that it is protected somewhat from blowing rain.



### 2.1.3 Single Axis Compass

The single axis compass consists of a 2.875" x 1.500" x 1.000" plastic box with an attached cable.



Single Axis Compass Box

NOTE: The orientation of the compass reference direction should coincide with the antenna centerline.



## 2.2 Electrical Connections

This section provides cabling requirements for interfacing to the RC3100. Note that cables should be made long enough to allow the unit to be open while still connected to the system.

The following sections supply a schedule of connection requirements.

### 2.2.1 Power Entry

J6 is an IEC power connector for supplying AC power to the RC3100.

The RC3100 is shipped from the factory with a line cord appropriate for the line voltage selected. If the line cord received with the unit is not appropriate for the power available at the installation site, the installer should check the controller to ensure that the proper line voltage has been selected.

The RC3100A can be configured to operate on either 115 VAC or 230 VAC. The AC input voltage the unit is currently configured for is displayed in a window located in the fuse holder. To change the AC input voltage selection, remove the fuse holder and reverse the jumper assembly (on which the '115' and '230' labels are located).

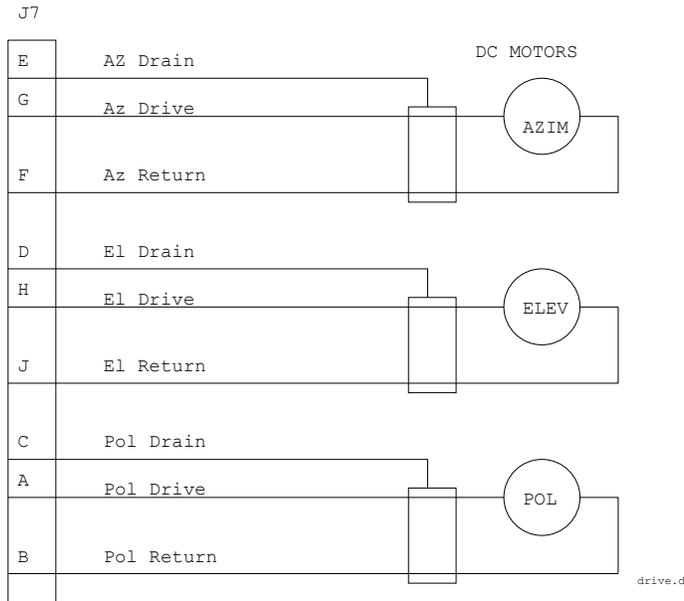
**To convert AC Voltage.** Switch the power off at the front panel. Remove the IEC power cord from the back panel power entry module. With a small straight-blade screwdriver, remove the fuse drawer from the power entry module. With the same tool, remove the small plastic circuit card. Rotate the card so that the desired operating voltage will be displayed through the front of the fuse drawer and reinsert the card so that it firmly seats into the power entry module.

The fuse holder is designed to accommodate 1/4" by 1 1/4" fuses. "Slow Blow" type fuses should be used. The following table shows the appropriate fuse for each model and line voltage combination.

MODEL	LINE VOLTAGE	
	115 VAC	230 VAC
RC3100A	8 Amp.	4 Amp.

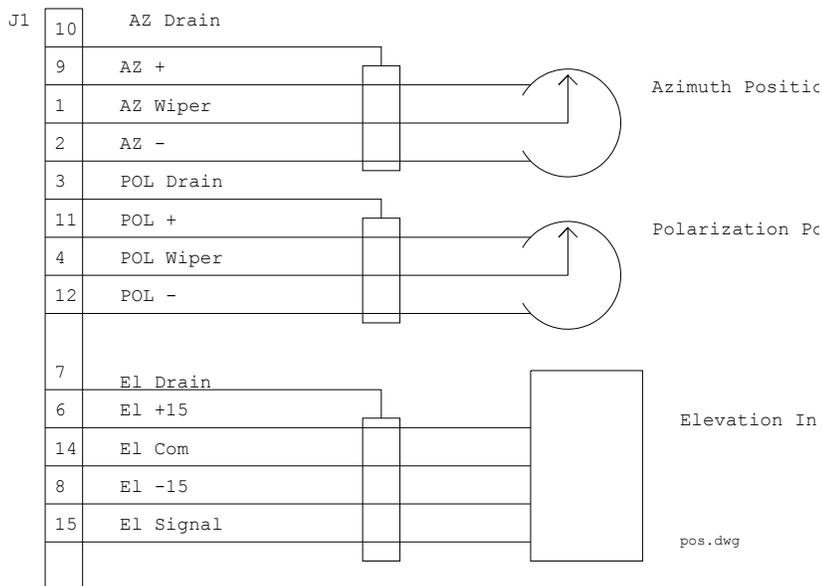
### 2.2.2 Motor Drive

J7 is an MS3102A22-20S connector, which terminates three motor cables. The minimum wire size for these cables is 16AWG.



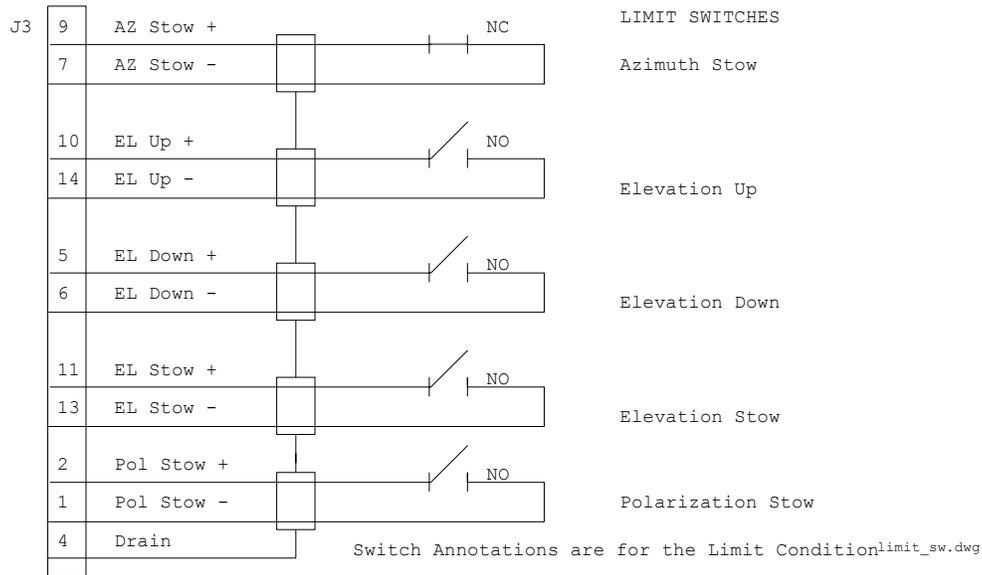
### 2.2.3 Drive Sense

J1 (DB-15 Female) receives position sense from the azimuth and polarization potentiometers and the elevation inclinometer.



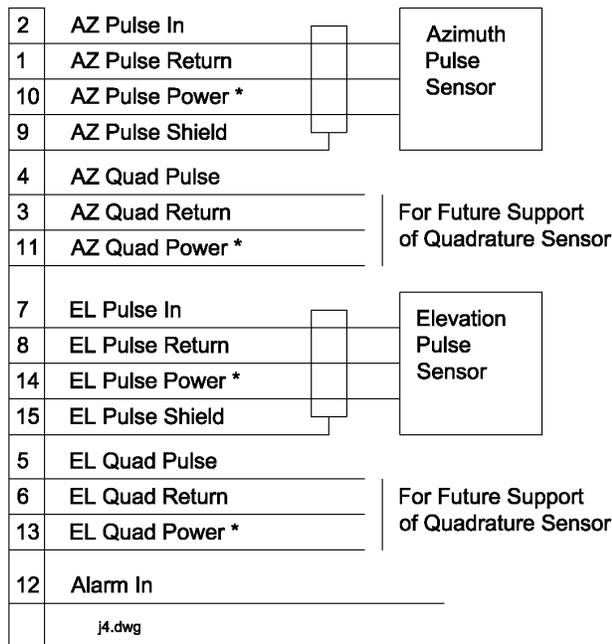
### 2.2.4 Limit Switches

J3 (DB-15 Female) connects to the azimuth stow, elevation stow, elevation up and elevation down limit switches.



### 2.2.5 Azimuth & Elevation Pulse Sensors

J4 (DB-15 Male on backpanel) connects to the pulse sensors.



### 2.2.6 GPS Receiver

DB9 pin #	SIGNAL	
2	TXD	
3	RXD	
4	Power	
5	Ground	

### 2.2.7 Single Axis Compass

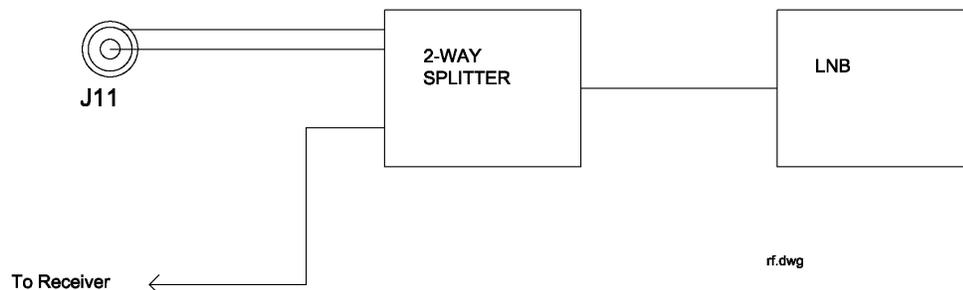
The Single Axis Compass allows for the compass cable to be terminated by three different connectors. The following chart shows the pin numbers for the three connectors and wire color when left unterminated.

DB9	AMP "1418"	AMP "1626"	COLOR	SIGNAL DESCRIPTION
7	S	U	Brown	Voltage Output
5	K	B	Black	Ground
4	J	A	Red	+ 12 VDC
3	T	C	Orange	Sensor Reset
8	L	T	Clear	Drain Shield

### 2.2.8 LNB Interface (DVB )

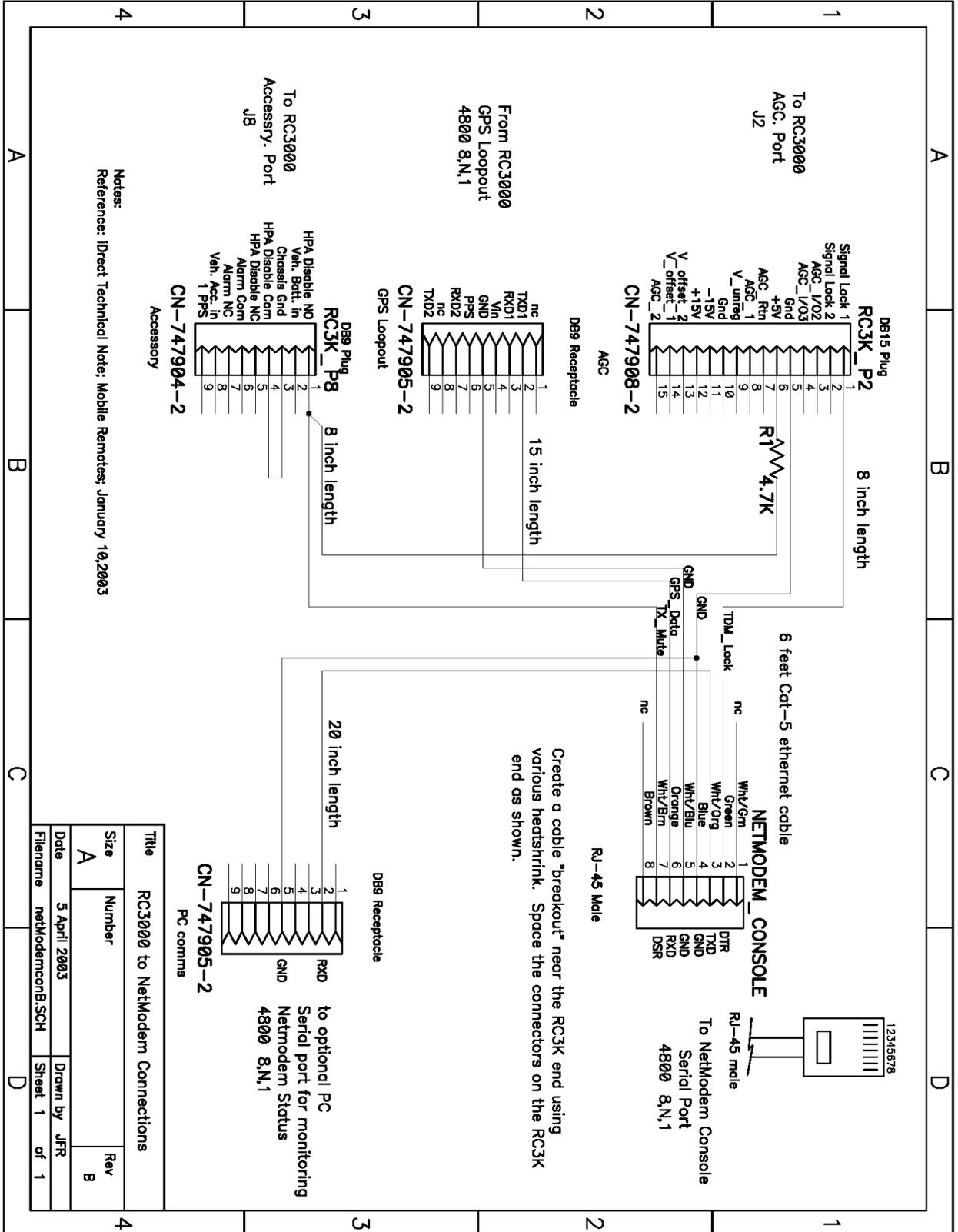
J11 (Type F Female connector on the backpanel) is the interface to the integrated L-Band power detector and DVB receiver. This input accepts the output of an LNB (950-2150MHZ, -50 to -5dBm.)

The RF autopeak module inside the RC3000 produces an output proportional to the broadband energy received. The RF autopeak circuitry includes a "DC block". When this input is being used, it is indicated on RC3000 screens as the "RF" signal source.



### 2.2.9 iDirect Modem (External Receiver)

The RC3100 provides GPS data and a transmit enable signal to an iDirect modem and receives signal strength and signal lock data from the modem per the following wiring diagram.



## 2.3 Calibration

Calibration may be done in any area (possibly a shop environment) where the antenna may be moved throughout its entire range of travel. At this point, the installer will have to start operating the RC3100 from the front panel. Section 3 will need to be reviewed to perform the steps described below.

### 2.3.1 Elevation Calibration

#### Elevation Reference Voltage

Move the reflector to the face vertical position and set the elevation reference voltage as described in 3.3.4.

#### Elevation Scale Factor

- 1) With the elevation axis in the reference position, note the angle (**using an accurate inclinometer placed on the mount itself not the angle displayed on the RC3100**) and the A/D voltage at that point.

Physical\_Angle\_1 (Reference) \_\_\_\_\_ Degrees

Voltage\_1 (Reference) \_\_\_\_\_ Volts

- 2) Raise the antenna approximately 30 to 50 degrees and note the angle and voltage.

Physical\_Angle\_2 \_\_\_\_\_ Degrees

Voltage\_2 \_\_\_\_\_ Volts

- 3) Calculate the output signal from the elevation inclinometer.

$$\text{Millivolts/degree} = \left( \frac{(\text{Voltage}_2 - \text{referenceVoltage})}{(\text{Physical\_Angle}_2 - \text{reference\_angle})} \right) * 1000$$

- 4) Enter the mV/deg in the EL SF field of the configuration screen described in 3.3.5

#### Elevation Limits

Move the reflector to the desired UP, DOWN and STOW positions and adjust the corresponding limit switch to activate at the correct position.

#### Elevation Pulse

Toggle the displayed sensor to "PUL" as described in 3.3.1 and verify that the elevation pulse count is changing correctly from the MANUAL mode.

## 2.3.2 Azimuth Calibration

### Azimuth Reference

Move the azimuth axis to the centerline (stow) position and set the azimuth reference voltage as described in 3.3.3.

### Azimuth Limits

Move the azimuth axis to the desired CW and CCW positions and adjust the internal AZ CW and AZ CCW potentiometers.

### Azimuth Pot Scale Factor

Move the azimuth axis to a known physical position such as -180.0 degrees and note the current azimuth voltage from the AZIM VOLT screen (3.3.3). Next move to another known physical position such as +180.0 degrees and note the voltage. Determine the azimuth pot scale factor by dividing the difference in angle by the difference in voltage.

Example:  $360 \text{ degrees} / 4.32 \text{ volts} = 83.3 \text{ degrees/volt}$

Enter this value as described in 3.3.4.

### Azimuth Pulse

Toggle the displayed sensor to "PUL" as described in 3.3.1 and verify that the azimuth pulse count is changing correctly from the MANUAL mode.

### Azimuth Pulse Scale Factor

With pulses displayed in the MANUAL mode, move the antenna exactly to the physical -180.0 position. Note the pulse count at that position. Next move exactly to the physical 180.0 azimuth position and note the count. Calculate the azimuth pulse scale factor per the following:

$(\text{pulse\_count\_at\_180} - \text{pulse\_count\_at\_}-180) / 6.2827$

Enter the resulting integer value in the Azimuth Pulse Scale Factor screen (3.3.5).

### 2.3.3 Polarization Calibration

#### Polarization Reference

**NOTE: To calibrate the polarization axis the entire mount must be setting level.**

Move the polarization axis to approximately midrange of its travel. Next adjust the polarization position until the LNB is perfectly level. The displayed voltage for polarization should be close to 2.5 V. If not, adjust the polarization potentiometer to achieve this value and secure the pot.

Store the polarization reference voltage as described in 3.3.8.

#### Polarization Limits

Move the polarization axis to the desired CW and CCW positions and adjust the internal POL CW and POL CCW potentiometers.

#### Polarization Scale Factor

Move the polarization axis to the physical -90 degree position and note the current voltage from the polarization reference screen (3.3.7). Next move the polarization axis to the +90 position and note the voltage. Calculate the polarization scale factor per the following:

$$180.0 / (\text{volts\_at\_+90} - \text{volts\_at\_ -90})$$

Enter the resulting value in the Polarization Scale Factor screen ( 3.3.9).

### 2.3.4 Target Satellite

Enter the longitude, receive polarization orientation and polarization offset of the target satellite as described in 3.3.2.

### 2.3.5 Signpost Satellite Setup (DVB)

Enter the longitude and polarization data for the "signpost" satellite as described in 3.3.10.

Enter the signpost DVB tuning data as described in 3.3.11.

Use the DVB Receiver Monitor screen (3.3.12) to verify that the DVB receiver can lock onto the signpost satellite.

### 2.3.6 GPS and Real Time Clock

Confirm operation of the GPS receiver and real time clock as described in 3.3.13 and 3.3.14.

### 2.3.7 iDirect Modem (External Receiver)

The iDirect Maintenance screen (3.3.15) may be used to verify that the signal lock and signal strength voltage are being input correctly from the iDirect Modem. Manually position the antenna on the satellite and move on and off the satellite in azimuth and elevation to confirm the presence of the lock and signal strength inputs.

## 3.0 DETAILED OPERATION

### 3.1 Operation Overview

The functionality of the RC3100 is achieved by placing the controller in the desired mode of operation. Each mode has a unique display screen that presents the information applicable to that mode's operation.

There are two main groups of modes – operating and programming. Transitions between modes within a group are initiated via a momentary press of the Mode key while a transition between the two groups requires the Mode key to be held down for three seconds.

After installation the programming group of modes will typically not be used for day to day operations. Sections 3.2 (operating modes) and 3.3 (programming modes) detail each mode.

### 3.2 Operating Group

Within the operating group of modes there exist two high level modes – MANUAL and AUTO. The MANUAL mode allows the user to jog the antenna while the optional AUTO mode allows the user to select the modes that implement the RC3100's automatic movement features. While in either one of these modes, a momentary push of the Mode key will transition the RC3100 to the other mode.

Upon powering up the RC3100, an identification screen is displayed for five seconds. The software version data is discussed in 1.2 (Controller Features).

RC3100B	V2S
(c) RCI '99	1.03

Following this screen the AUTO mode is entered.

### 3.2.1 Manual Mode

Az	El	Pol
180.0	-12.3	-90
FV CW	DOWN	CCW

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

#### Az

#### El

The Az column shows the current angular value of the azimuth axis. It also shows the status of azimuth limits (STW, CCW, CW). The azimuth axis may be moved by pressing the Az CCW or Az CW keys.

The El column shows the current angular value of the elevation axis. It also shows the status of elevation limits (STW, DOWN, UP). The elevation axis may be moved by pressing the El Up or El DN keys.

#### Pol

This field shows the current angular value of the polarization axis along with its limits (CCW, CW). Some mounts may also have a polarization stow switch indicated by "STW". The polarization axis may be moved manually by pressing the Pol CCW or Pol CW keys.

#### Speed

The lower left corner of the display shows the selected drive speed. The speed may be toggled between F(ast) and S(low) by pressing the Fast/Slow key.

### 3.2.2 Auto Mode

The AUTO mode allows the user to initiate automatic acquisition of a satellite or stowing of the antenna.

```
^-ACQUIRE 12.3W
v-STOW
```

Associated with the ACQUIRE function is a "target" satellite programmed via the Target Satellite screen (3.3.2).

Pressing the Elevation UP key (^) will initiate the ACQUIRE mode of operation and pressing the Elevation DOWN (v) key will initiate the STOWing mode. These two automatic modes of operation are described next.

#### 3.2.2.1 Stow

```
      Az      El  Pol
180.0 -12.3 -90
<ANY KEY>STOP
```

The STOW mode automatically moves to the mount's predefined "stow" position. The stowing sequence will initially move in the azimuth axis followed by the polarization (if enabled for a particular mount) axis and finally in the elevation axis. During the stow sequence, the position of azimuth, elevation and polarization will be displayed.

The automatic movement may be terminated anytime by pressing any key. Following completion of movement to the stow position, the RC3100 will return to MANUAL mode.

### 3.2.2.2 Acquire

After pressing the UP key in AUTO mode, the ACQUIRE mode is initiated. Multiple steps will be automatically be performed to acquire (i.e. find or locate) the specified target satellite.

#### Lat/Lon Determination

Initially the ACU will query the GPS receiver in order to determine the latitude and longitude of the antenna.

```
0.0 17.7 0
STARTING GPS
```

After receiving a valid lat/lon, the ACU will momentarily display the lat/lon. During this time the ACU will also synchronize its internal clock to GPS time (UTC) and calculate a magnetic variation as a function of lat, lon, date and time. During those short operations "UTC" and "MAGVAR" will flash on the top line.

```
MAGVAR
39.01N 94.49W
```

#### Heading & Tilt Determination

The ACQUIRE sequence will next move the antenna in order to derive an estimated heading and characterize the tilt (pitch and roll) of the antenna.

```
CALC HDG/TILT
```

MOVE #	AZIM	ELEV	Description
1	0.0	17.0	Move to the azimuth reference position and level the single axis compass box. Take initial magnetic reading from compass and initial tilt reading from inclinometer.
2	45.0	no move	Take second tilt reading from inclinometer.
3	90.0	no move	Take third tilt reading from inclinometer.
4	90.0	17.0	Level the compass and take second magnetic reading.
5	45.0	17.0	Level the compass and take third magnetic reading.

Following this sequence of movements, the magnetic variation and any programmed compass offset will be applied to the derived magnetic heading in order to determine a true heading estimate for the antenna. This true heading estimate will be displayed on the bottom f the display and the ACQUIRE mode will proceed to the next step.

```
HDG: 162.5
```

### Pointing Solution

With the lat/lon of the antenna determined, the ACU will calculate the true heading, elevation and polarization pointing solutions to the signpost satellite. The calculated targets will be momentarily displayed.

123.4 38.9 -55
TARGETS

### Elevation Positioning (DVB)

After positioning to the -180.0 azimuth position, the antenna will make several moves in elevation to first determine a "noise floor" for the L-band power of the open sky. These moves will typically be around the 45 to 50 degree elevation position. If an abnormal L-band power is detected (such as if the LNB were not powered up) the ACQUIRE operation would stop and display ? **NO RF ? <MODE>** on the bottom line.

If an RF noise floor is correctly characterized the ACQUIRE sequence will next move to the signpost satellite's target elevation in preparation for beginning of a scan in azimuth.

-180.0 38.9 -55
MOVE TO SP ELEV

Before starting the azimuth scan, the DVB receiver will be tuned. If an error is detected the ACQUIRE operation would stop and display ! **NO INIT <MODE>** on the bottom line.

### Azimuth Scan (DVB)

After positioning to the signpost elevation and polarization, the mount will begin moving in the clockwise azimuth direction scanning for indication of the signpost satellite.

-180.0 38.9 -55
SCAN SP 143

The azimuth scan will begin in fast speed. If L-band power is detected above the characterized noise floor, the azimuth will change to slow speed in order to better detect lock from the DVB receiver. If lock is not detected (indicating a satellite other than the signpost was encountered), the scan will resume in fast speed until another apparent satellite is encountered.

Also during an azimuth scan, the azimuth movement may be temporarily stopped if the elevation needs to be adjusted.

When a lock is encountered from the signpost satellite, the scan will continue several degrees beyond the lock area and then return to the center of lock (in azimuth).

GO TO LOCK CENTER
-------------------

### Azimuth Scan (External Receiver)

After calculating the nominal pointing solution, the ACU will move to the target azimuth and polarization positions and the closest position in azimuth that is 20 degrees away from target.

```
MOVE TO TARGET
```

After moving 20 degrees from the target azimuth, a scan in azimuth will begin. The progress of the scan will be shown within parenthesis.

```
SCAN ( 1/45) 531 L
```

If modem signal lock is found during the scan the ACU will display "PEAK FOUND" and return to the azimuth position of highest signal strength.

If no signal lock was found during the scan, the ACU will display "NO PEAK FOUND".

### Azimuth/Elevation Peak Up

After returning to the center of lock position, the ACU will perform a high resolution peakup in azimuth and elevation. During this peakup the azimuth and elevation pulse counts will be displayed.

```
32768 35423  
653 L
```

### Move to Target

After peaking up on the signpost satellite, the ACU will internally "fix" its apparent heading and then be able to move to the target satellite's calculated position.

```
MOVE TO TARGET
```

### Polarization Tilt Compensation

The final movement of the ACQUIRE sequence will be a polarization adjustment in order to compensate for any platform pitch and roll sensed during the "Tilt Determination" phase.

```
ADJUST POL TILT
```

### 3.3 Programming Group

The programming group has multiple screens. Momentarily pressing the Mode key will switch between these screens in a similar fashion as the MANUAL and AUTO modes switched in the operating group.

#### 3.3.1 Drive Error Resets

The RESET DRIVE screen provides the way to reset drive system errors JAMmed or RUNaway.

The screen shows the error condition for each axis.

Az	El	Pol
JAM	RUN	OK
F/S-RESET v-ANG		

Pressing the Fast/Slow key resets all three axes to the OK condition.

Az	El	Pol
OK	OK	OK
F/S-RESET v-ANG		

Additionally the ELEVATION DOWN key (v) may be pressed to toggle whether angles or pulse counts are displayed for azimuth and elevation in MANUAL mode.

OK	OK	OK
F/S-RESET v-PUL		

The ability to display pulse counts in MANUAL mode is intended as a mechanism for confirming that pulse counting is working and will typically not be required for normal mount operation.

### 3.3.2 Target Satellite Definition

The TARGET screen allows the user to program the longitude, polarization and polarization offset for the target satellite of the ACQUIRE mode.

LON: -123.4 POL:H
OFF: 0.0 TARGET

#### LON: -123.4

To enter the longitude of the target satellite, the user scrolls through the list of characters ( 0-9, "-" and blank) and selects the character by pressing the AZ CW key. To scroll forward through the list of characters use the UP key and use the DN key to scroll backward.

After selecting one character, the flashing cursor is placed in the next space awaiting character selection. To complete the entry of the alphanumeric string, press AZ CW for a second time.

NOTE: West longitudes are denoted as negative numbers and East longitudes as positive.

For example: -123.4 will appear as 123.4W in the ACQUIRE screen and 123.4 will appear as 123.4E.

#### POL:H

This field allows the user to toggle the receive downlink polarization between H(orizontal) or V(ertical). Use the UP key to toggle this value.

#### OFF: 0.0

This field allows the user to define the target satellite's polarization offset. Use the scrolling technique described for longitude to change this value.

NOTE: typically most satellites maintain their polarization orientation parallel to the equatorial plane which relates to an offset of 0.0. Any polarization offset in the CCW direction (as seen from earth) should be described as negative.

To move on to the next programming mode (AZIM VOLT) press the MODE key.

### 3.3.3 Azimuth Reference Voltage

The AZIM VOLT screen allows the user to set the reference voltage that defines the centerline of azimuth travel. When this voltage is seen the RC3100 will generate an azimuth position of 0.0 degrees.

```
AZIM VOLT:2.500
<UP>SET (2.482)
```

#### AZIM VOLT: stored voltage

The first line shows the stored value for azimuth reference voltage. The default value is 2.500 volts for case where the azimuth potentiometer is perfectly centered.

#### <UP>SET (current voltage)

The second line shows the azimuth voltage currently read by the RC3100's microcontroller. If this represents the desired reference voltage (see installation step 2.3.3), press the UP key to store the value.

If the MODE key is pressed while in this mode, the screen will change to the elevation voltage screen. The stored azimuth reference voltage will remain.

If the UP key is pressed to store the value, the following screen will appear asking for confirmation that the stored reference voltage is to change.

```
<MODE>EXIT AZIM
<DN>CONFIRM SET
```

Pressing the DN key will confirm that the azimuth reference voltage is to be changed. Pressing the Mode key will keep the reference voltage from being changed and will advance the screen to the elevation voltage screen.

### 3.3.4 Azimuth Pot Scale Factor

This screen allows the user to enter the azimuth pot scale factor value determined during the azimuth calibration procedure.

```
AZ SF : 83.3
<UP/DN> <F/S>SET
```

The value may be changed by 1 pulse per degree increments and set in the same fashion as described for the Elevation Scale Factor (3.3.7).

### 3.3.5 Azimuth Pulse Scale Factor

This screen allows the user to enter the azimuth pulse scale factor value determined during the azimuth calibration procedure.

```
AZ PULSE: 4716
<UP/DN> <F/S>SET
```

The value may be changed by 1 pulse per degree increments and set in the same fashion as described for the Elevation Scale Factor (3.3.7).

### 3.3.6 Elevation Reference Voltage

```
ELEV VOLT:1.690
<UP>SET (1.582)
```

The ELEV VOLT screen performs in the same manner as described for the AZIM VOLT screen.

### 3.3.7 Elevation Scale Factor

The EL SF screen shows the current state and allows the user to set the scale factor for the elevation axis.

```
EL SF:      49.1
<UP/DN> <F/S>SET
```

#### EL SF: stored scale factor

The first line shows the state of elevation scale factor. This displayed value will change as the user sets a new scale factor.

#### <UP/DN> <F/S>SET

The second line allows two operations. The UP and DN keys allow the user to increment or decrement the scale factor to the desired value.

If the MODE key is pressed while in this mode, the screen will change to the reset drive screen. The stored elevation scale factor will remain.

If the FAST/SLOW key is pressed to store the value, the following screen will appear asking for confirmation that the stored scale factor is to change.

```
<MODE>EXIT  UP
<DN>CONFIRM SET
```

Pressing the DN key will confirm that the elevation scale factor is to be changed. Pressing the Mode key will keep the scale factor from being changed and will advance the screen to the reset drive screen.

### 3.3.8 Polarization Reference Voltage

```
POL VOLT:2.500  
<UP>SET (2.482)
```

The POL VOLT screen performs in the same manner as described for the AZIM VOLT screen.

### 3.3.9 Polarization Scale Factor

The PL SF screen shows the current state and allows the user to set the scale factor for the polarization axis.

```
EL SF:      49.1  
<UP/DN> <F/S>SET
```

#### **PL SF: stored scale factor**

The first line initially shows the polarization scale factor. This displayed value will change as the user sets a new scale factor.

### 3.3.10 Signpost Satellite (DVB)

This screen allows the user to define the longitude, receive polarization and polarization offset of the signpost satellite.

```
LON: -123.4 POL:H
OFF:  0.0 SP_SAT
```

Data entry in this screen is the exact same as described for the target satellite (3.3.2)

### 3.3.11 Signpost DVB Tuning (DVB)

This screen allows the user to tune the DVB receiver.

```
FR:1150 SR:20000
FEC:3      SP_DVB
```

When the screen is first entered the current tuning i.e. frequency (FR), symbol rate (SR) and Forward Error Correction (FEC) of the DVB receiver is shown. Each of these tuning components may then be individually modified.

FR: 1150

The L-Band frequency (950 - 2150) that the DVB should be tuned to is set in this field. The number is entered using the scrolling technique described previously.

NOTE: after any of the tuning components is entered the field will show "LOAD" while attempting to tune the DVB receiver. After a successful tuning, the field will reflect the newly entered value. If the tuning was unsuccessful the field will show " \*\* 5".

SR: 20000

The symbol rate (xxx - yyyy) that the DVB should be tuned to is set in this field. The number is entered using the scrolling technique described previously.

FEC: 3

The Forward Error Correction value that the DVB should be tuned to is set in this field. The entered number represents the first number of the desired FEC. Example: enter 3 for a FEC of 3/4. The number is entered using the scrolling technique described previously.

### 3.3.12 DVB Receiver Monitor (DVB)

This screen allows the user to verify the signal strength and signal lock inputs from the DVB receiver are functioning. The azimuth, elevation and polarization movement keys are active in this mode allowing the user to move the antenna in order to watch the signal strength and lock status change dynamically.

```
-123.4  45.6  33
F  R:155 S:123 L
```

The function of the mode is very similar to MANUAL mode, but instead of displaying axis limit conditions on the bottom line signal feedback is displayed

F/S: toggle FAST/SLOW

R: L-Band (RF) power level (0-999)

S: signal strength level (0-999) from the DVB

L - signal lock status "L" displayed when DVB is locked and blank when unlocked.

### 3.3.13 GPS Communications

This screen allows the user to verify that the communications with the GPS receiver is functioning. When first entered, this screen will display "INITIALIZING GPS" for approximately three seconds as programming commands to the GPS receiver are transmitted.

```
INITIALIZING GPS
```

After initialization, a steady stream of characters should scroll across the screen indicating that the RC3100 is receiving data from the GPS receiver.

```
$GPRMC,133544,A,  
3856.0856,N,0944
```

A correct stream of data will contain text such as "\$GPRMC" shown above.

### 3.3.14 Real Time Clock

This screen allows the user to verify that the internal real time clock is functioning. When first entered, the internal clock will be set to a date of 1/1/81 and a time of 00:00:00.

```
01/01/81  CLOCK  
00:00:01
```

Correct functioning of the clock will be indicated by the date 1/1/81 being displayed along with the time incrementing from 00:00:00.

NOTE: during an ACQUIRE operation the real time clock will be synchronized to the date/time obtained from the GPS data stream in order to calculate the correct local magnetic variation.

### 3.3.15 Signal Strength Feedback Monitor (External Receiver)

This screen allows the user to verify the signal strength and signal lock inputs from the modem are functioning. The azimuth, elevation and polarization movement keys are active in this mode allowing the user to move the antenna in order to watch the signal strength and lock status change dynamically.

```
-123.4  45.6  33  
S          S:123 L
```

The function of the mode is very similar to MANUAL mode, but instead of displaying axis limit conditions on the bottom line signal feedback is displayed

S: signal strength level (0-999) from the modem

L - signal lock status "L" displayed when modem is locked and blank when unlocked.

### 3.4 Alarm Displays

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

#### **LOW BATTERY**

The RC3100 constantly monitors the level of the lithium battery. When the power level is low, this error code will appear. Replace the battery with a Duracell DL2450. Make sure that the unit is unplugged from the AC power before removing the cover to change the battery. Take care to hold the battery tab away from the battery housing while replacing the battery, and it will not be necessary to reprogram the memory. Since there is a chance that the non-volatile memory will be corrupted when the battery is changed, please refer to chapter 5 concerning restoring the Non-Volatile Memory before changing the battery.

#### **ANT AZIM, ANT ELEV, ANT POL**

These alarm messages indicate that an error has been detected for the axis referenced in the alarm message. When one of these alarms are detected, the axis is disabled. Go to DRIVE RESET mode (section 3.3.1) to view the actual fault condition which was detected and to clear the fault.

## 4.0 TROUBLESHOOTING

### Limit Switches

The various limit switches serve as safety interlocks to prevent mount damage. The RC3100 checks for limit conditions via both software and a Programmable Logic Device on the analog board. The following table summarizes the interlock logic employed:

LIMIT	INTERLOCK LOGIC
Azimuth STOW	Elevation movement below the Elevation DOWN position is not allowed unless the Azimuth STOW condition is active.
Azimuth CCW	CCW movement in azimuth is not allowed when the azimuth CCW condition is active.
Azimuth CW	CW movement in azimuth is not allowed when the azimuth CCW condition is active.
Elevation DOWN	No azimuth movement is allowed when the Elevation DOWN condition is active.
Elevation STOW	No further elevation down movement is allowed when the Elevation STOW condition is active. NOTE: when the Elevation STOW condition is active, the RC3000 internally also generates an Elevation DOWN condition.
Elevation UP	No further elevation up movement is allowed when the Elevation UP condition is active.
Polarization CCW	CCW movement in polarization is not allowed when the polarization CCW condition is active.
Polarization CW	CW movement in polarization is not allowed when the polarization CW condition is active.
Polarization STOW	Elevation movement below the Elevation DOWN position is not allowed unless the Polarization STOW condition is active. NOTE: only certain mounts mechanize the Polarization STOW limit switch – check appendix B for your mount.

Many problems are caused by limit switches either activating incorrectly or the RC3000 not sensing the limit switch's state correctly. Some examples of problems caused by limit switch sensing follow:

**Mount will move down in elevation but not up.** Check that the Elevation UP limit switch is not stuck in the active state.

**Mount will not move below the DOWN elevation limit.** Check that the Azimuth STOW limit switch has activated correctly. Also check the polarization STOW limit switch if the mount is so equipped.

**Mount will only move up in elevation.** Check that the Elevation STOW limit switch is not stuck in the STOW condition.

**Mount is above the Elevation DOWN position but will not move in azimuth.** Check that the Elevation DOWN limit switch is not active.

Failure of a limit switch to activate properly may be due to the limit switch mechanism itself, cabling to the limit switch or failure of the RC3100 to sense the limit switch correctly. Isolating the problem to the RC3100 or switch/wiring may be accomplished by jumpering the appropriate pins on the J3 connector. NOTE: only the Elevation STOW/DOWN/UP, Azimuth STOW and Polarization STOW (if applicable) are mechanized via discreet limit switches – Azimuth CW/CCW and Polarization CW/CCW limits are mechanized differently and will be discussed later.

After removing the wiring harness from J3, the first thing to check is that 12 VDC is present at the "+" pin of each limit switch. Pins 2,5,9,10 and 11 should have +12 VDC present (see 2.2.4 – J3 wiring diagram). If +12 VDC is not present, there is a power supply failure within the RC3100. Contact your vehicle integrator, mount manufacturer or RCI for further instructions on how to proceed.

If +12 VDC is present, the limit switch sensing logic may be checked by jumpering between the appropriate pins and noting if the limit switch condition is sensed correctly by the RC3100. The state of the limit switches should be monitored via the Limit (3.3.5, 6) screens. The following table shows which pins to jumper and state that should be seen via the Limits Maintenance screen.

LIMIT	J3 PINS	JUMPERED	OPEN
Azimuth STOW	9,7	1	0
Elevation DOWN	5,6	0	1
Elevation STOW	11,13	0	1
Elevation UP	10,14	0	1
Polarization STOW	1,2	0	1

The azimuth CW/CCW and polarization CW/CCW limit conditions are mechanized by potentiometers inside the RC3000 that should be set to correspond to the axis voltage at the limit conditions. If any of these limits appear to be activating at the wrong time, check the setting of the potentiometers as described in the azimuth and polarization calibration procedures.

### **STOW OPERATION WILL NOT PROCEED BELOW THE DOWN ELEVATION LIMIT**

The Stow operation first tries to achieve an azimuth position of 0.0 degrees. It then confirms that the azimuth stow switch is activated. If the azimuth stow switch is not activated, the stow operation will begin moving down in elevation but the normal safety logic will not allow the elevation axis to go below the DOWN limit switch position.

If this condition occurs, verify the action of the azimuth stow switch.

Some mounts also have a polarization stow switch. If this switch is not activated, movement below the DOWN switch position is also inhibited.

### **A JAMMED CONDITION OCCURS FREQUENTLY**

A "JAM" condition occurs when the RC3100 thinks the mount should be moving but there is no indication of changing movement from the particular axis.

Several situations may cause a JAM condition:

- the mount truly has a mechanical condition preventing it from moving when commanded
- the motor drive lines have been disconnected or the motor failed. Check that voltage is appearing at the motor when the axis is being commanded to move.
- a problem has forced the axis feedback potentiometer from moving. Conditions such as a failed potentiometer or stripped gears to the pot may cause this case. Check that a changing voltage is output from the potentiometer while the axis move