RC3000 MOBILE ANTENNA CONTROLLER
USER'S MANUAL

```
AZIM:-123.4  CCW  SS1:125        MANUAL
ELEV:  22.3       SAT:
 POL: -37.2   H   SPD: FAST        UTC
<0-9>JOG ANTENNA  <MODE>MENU  21:43:37
```

Research Concepts, Inc.

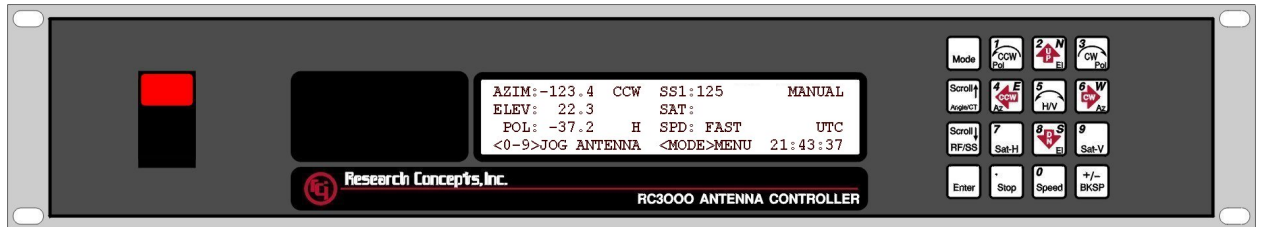**RC3OOO ANTENNA CONTROLLER**

for the
Comtech Transportable Fast Link Antenna (TFLA)

Contents subject to change

17 August 2011

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TFLA Serial No._____

RC3000 Serial No._____

REVISION HISTORY

DATE	MODIFICATION	SOFTWARE VERSION
1 December 2005	Baseline RC3000 Manual	1.55
26 October 2010	TFLA Unique Version	1.60a
8 November 2010	Initial Review	1.60c
23 November 2010	Pre FAT Release	1.60c
15 December 2010	Integration Trip Updates	1.61
26 January 2011	Commercial System Update	1.62
29 June 2011	Azimuth Jam Sensitivity & Drawing Update	1.63
17 August 2011	MANUAL & STOW mode updates, added drawings	1.64

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        (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.

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APPENDIX C - DC MOTOR CONTROLLER

1.0 INTRODUCTION

The RC3000 antenna controller is designed for use with elevation over azimuth antennas on mobile communication uplink vehicles. The RC3000 assists both the technically-oriented and the non-technical operator of a mobile antenna system by automating the process of locating and locking on to a particular target.

The design and function of the RC3000 is derived from two other proven antenna controllers from Research Concepts Inc.: the RC8097 satellite locator and the RC2000C tracking antenna controller. This pedigree allows the RC3000 to automate all operational steps within one piece of equipment. First, a microcontroller based calculator function provides an accurate pointing solution through a collection of sensor data. The RC3000 then uses the data from the sensors to accurately steer the antenna to the calculated azimuth and elevation angles.

PLEASE READ AND UNDERSTAND THE MANUAL. Due to the complexity of the functions performed by the RC3000, time invested in understanding its installation and operation will be well spent.

1.1 Manual Organization

This manual contains five chapters and multiple appendices. Each chapter is divided into multiple sections.

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 RC3000. Section 1.3 reviews the theory of the RC3000's operation and should be understood before installation and initial use of the RC3000.

Chapter 2 describes the installation and configuration procedures for the RC3000. 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 RC3000. This chapter will describe the data presented and user action required for every operational display screen.

Chapter 4 covers RC3000 error conditions and provides help for system troubleshooting.

Chapter 5 provides RC3000 schematics and drawings.

The appendices provide additional support for working with the RC3000:

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.

If applicable, appendix B provides unique information for a specific mount or family of mounts. **NOTE: this manual has been modified to reflect TFLA unique data, therefore no appendix B is generated.**

Appendix C provides information on the applicable motor controller for your mount.

A test data sheet is included with the manual that accompanies a new RC3000 controller. **The mount configuration of a particular controller is noted on the test data sheet.**

MANUAL CONVENTIONS

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

```
AZIM:   0.0 STOW                 MANUAL
ELEV: -67.5 STOW
                    <SPEED>FAST      CST
<2,4,6,8>JOG ANTENNA <MODE>MENU 14:25:47
```

The following table shows typical abbreviations used both on RC3000 screens and in the manual's text.

ITEM	ABREVIATION(S)
Azimuth	AZ AZIM, Azim
Elevation	EL ELEV, Elev
Clockwise	CW
Counter-Clockwise (Anti-Clockwise)	CCW
Down	DN
Latitude	LAT
Longitude	LON
Target	TAR
Global Positioning System	GPS
Liquid Crystal Display	LCD
Automatic Gain Control	AGC

Latitude and longitude of the mount and targets are presented in degree/minute/second (38°56'23 N) format.

When referring to a particular RC3000 mode of operation, that mode's name will be capitalized – ex. LOCATE.

Throughout the RC3000 manual and software, the latitude, longitude and true heading of the mount are collectively referred to as the mount's "position".

1.2 RC3000 Features

The RC3000 antenna controller 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
- Optional fluxgate compass for determination of antenna centerline heading
- Battery backed-up non-volatile memory for storing target locations and configuration data
- Slim 2U rack mounted unit
- Continuous monitoring of antenna drive status
- Optional RS-422/-232 remote control interface
- 4 row x 40 column Liquid Crystal Display (LCD) for user interface
- 16 key keypad for data entry

The RC3000 supports mounts from multiple antenna manufacturers and provides optional software configurations. When the RC3000 is powered on, the following identification screen appears for three seconds.

```
RC3000B MOBILE ANTENNA CONTROLLER
    (c) RESEARCH CONCEPTS INC. 2010
         SHAWNEE, KANSAS    (USA)
SW:RC3K-Q1-GNRN              version 1.60
```

Hardware Configuration. There are two basic versions of the RC3000 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.

The ComTech TFLA system is mechanized using 90 VDC motors for azimuth and elevation. Therefore, a RC3000B version of hardware is used. Also, the TFLA ACU may be implemented in two different configurations characterized in the following table.

CONFIGURATION	- 1	-2
INPUT POWER	115 VAC	230 VAC
DISPLAY	Vacuum Fluorescent Display (VFD)	Liquid Crystal Display (LCD)
REMOTE CONTROL	Serial Hand Held Controller	Hand Held Remote
ENVIRONMENTAL	Military Temperature	Rugged Commercial Temperature
GPS	DAGR	Commercial GPS

Software Configuration. The software configuration (SW:) field is presented in the form RC3K-ab-wxyz:

   RC3K-(Mount Manufacturer/Model #)-(Nav Sensor)(Tracking)(Remote)(Receiver)

Descriptions of the software configuration designations are provided in the following tables:

Mount Manufacturer/Model #

The software within the RC3000 is customized to account for specifics of individual mounts. A particular mount is referred to by a two character designation with the first character typically associated with the mount manufacturer and the second character associated with a specific mount/antenna model from that manufacturer.

CATEGORY	DESIGNATION	DESCRIPTION
Mount Manufacturer / Model Number	Letter / #	Example: V1 – Vertex 2.4m. DMK
		S1 – SweDish 1.5m. DA
		A3 – AVL 1.2m. USA
		Q1 - ComTech 3.0 TFLA (Military)
		Q2 - ComTech 3.0 TFLA (Commercial)

As of October 2010, the RC3000 supported over 120 different mount models. **The Q1/Q2 software is customized for both mount/antenna specifics and for TropoScatter (vs. satellite) operations.**

Navigation Sensor Options The RC3000 may be provided with multiple navigation sensor options. Navigation sensors allow the RC3000 to determine the mount's latitude, longitude and heading. If no navigation sensors are present, estimates of this data may be entered manually.

CATEGORY	DESIGNATOR	DESCRIPTION
Navigation Sensors	N	No Navigation Sensors supported
	G	**GPS & Fluxgate compass supported**
	A	GPS, Fluxgate and integrated DVB receiver supported
	F	GPS and DVB receiver (no compass)
	C	GPS Compass

Tracking Options The RC3000 may provide optional support for tracking inclined orbit satellites. **N/A for TFLA.**

CATEGORY	DESIGNATOR	DESCRIPTION
Inclined Orbit Tracking	**N**	**Tracking not supported**
	T	Step & Memory Track supported
	E	Step & Memory plus Two Line Element set tracking supported

Remote Control Options The RC3000 may provide optional support for controlling the mount from a remote (away from the front panel) location.

CATEGORY	DESIGNATOR	DESCRIPTION
Remote Control	N	No Remote Control Supported
	R	**Serial Remote Monitor & Control Supported**
	I	IP based Remote Control

For TFLA, the serial remote control option is present to support the HandHeld Remote Front Panel Controller supplied with -1 configuration units.

Receiver Options The RC3000 may provide optional support for controlling and monitoring integrated satellite receivers. **N/A for TFLA**

CATEGORY	DESIGNATOR	DESCRIPTION
Receiver Control	**N**	**No Receiver Control Supported**
	D	DVB receiver Supported
	O	Beacon receiver Supported

1.3 Theory of Operation

The RC3000 performs its functions via digital and analog electronic equipment interfaced to the antenna's motor drive and position feedback systems. This equipment is controlled through embedded software algorithms run by the RC3000's microcontroller. This section provides an overview of the equipment, interfaces and major software functions.

1.3.1 Controller Description

The following figure is a block diagram showing the major components of the RC3000 :
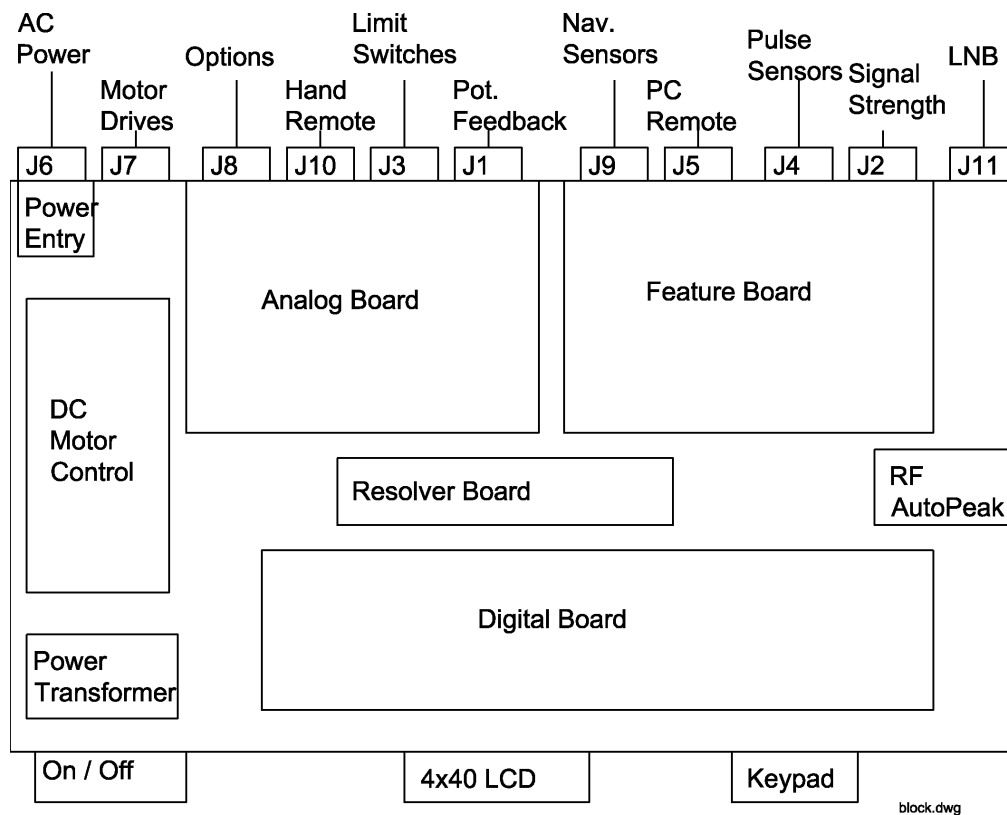
DISPLAY (LCD/VFD). The 4 row by 40 column display provides the user interface for monitoring the status of the RC3000 and for entering data.

KEYPAD. The 4 row by 4 column keypad allows the user to enter data and commands to the RC3000.

DIGITAL BOARD. The digital board is essentially a small computer containing a microcontroller, memory, real-time clock and circuitry to monitor and drive the keypad and LCD. The digital board performs the following major functions:

- monitors user inputs from the keypad
- displays information on the display screen according to controller mode, antenna status and user input
- monitors antenna drive status
- battery backs up non-volatile memory (configuration data, etc.) and the real-time clock

- performs communications between the microcontroller and the three (GPS, compass, remote control) serial channels
- performs analog to digital conversion of drive position and signal strength inputs
- performs automatic antenna movement algorithms (locate, stow, recall, track, etc)

FEATURE BOARD. The feature board contains circuitry to implement many of the optional features of the RC3000. The feature board provides the following major functions:

- signal drivers for PC remote control and navigation sensor serial communication
- circuitry for multiplexing signal strength indications from 1 of 3 sources
- circuitry for conditioning pulse based position feedback signals
- power transformation to supply required voltages to other modules

ANALOG BOARD. The analog board contains circuitry to control the antenna motors and condition antenna feedback signals. The analog board provides the following major functions:

- generation of azimuth limit indications based on sensed potentiometer feedback
- conditioning of elevation inclinometer input
- conditioning of azimuth stow and elevation up/down/stow limit switch inputs
- activation of relays (based on digital board control) to direct motor drive signals from the DC motor control module.

DC MOTOR CONTROL MODULE. The solid state DC motor speed and reversing control module contains circuitry for antenna motor regulation. This module provides:

- acceleration adjustment for smooth motor acceleration
- deceleration adjustment for ramp down time when motor speed lowered
- anti-plug instant reverse, solid state dynamic braking
- current limiting circuitry to protect the motor against overloads and demagnetization and to
 limit inrush current during startup
- IR compensation to improve load regulation

POWER ENTRY MODULE. The power entry module allows the RC3000 to be configured for 115 or 230 VAC operation.

POWER TRANSFORMER. The power supply module transforms AC input voltage to a regulated DC voltage for use by the digital and drive boards.

NOTE: Second Generation RC3000's (serial number > 2000) will have the circuitry of the analog board and the feature board combined. Section 5.0 will contain the appropriate schematics for a particular controller.

1.3.2 System Interface Requirements

The RC3000 is designed to interface with many different mobile antenna mounts. This manual attempts to describe installation and operation in a manner applicable to most mounts.

The interfaces required for the RC3000 to perform all its automatic functions are described in section 2.2 (Electrical Connections).

1.3.3 Operational Overview

The RC3000 allows easy antenna operation via its menu based user interface. The screen displayed to the user is based on the current controller mode. Controller modes are divided into two major groups: operational and programming (see mode map in section 3.1.1). 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 RC3000.

Operational Group Functions

AUTOMATIC TARGET LOCATION. In LOCATE mode, azimuth and elevation pointing angles are automatically calculated based on the trailer's position (lat/lon/true heading) and the selected target. Position is obtained automatically from the GPS. Heading is automatically obtained from the fluxgate compass. Upon power up, the fluxgate compass and GPS receiver initialize and begin providing data. The user selects which target to locate from either a preset user defined list of commonly used targets or by manually entering target data. The RC3000 checks that the calculated pointing solution is within the mount's range of movement and prompts the user to automatically position the antenna.

```
 LS:39°01'47N  94°49'23W 292.9 T  LOCATE
 RS:40°12'34N  95°17'23W 343.2 T
           TRAILER AZIM:  50.2   DIS: 85
<1>SELECT NEW TARGET    READY TO PROCEED
```

MANUAL MOVEMENT. In MANUAL mode the user may jog the antenna in azimuth and elevation in order to peak up the signal.

```
AZIM:  50.2 (  50.2)               MANUAL
ELEV:   0.9 (   0.9) <5>SET REFERENCE
                         <SPEED>FAST    UTC
<2,4,6,8>JOG ANTENNA <MODE>MENU 14:25:47
```

STORING TARGET LOCATION. After verifying the antenna is precisely on the target, the user may STORE the antenna's azimuth and elevation angles. If the antenna is STOWed, these exact antenna angles may be later RECALLed.

```
POS  AZIM  ELEV                     STORE
 1   50.2   0.9
  READY TO STORE AZIM & ELEV POSITION ?
<1>YES <2>NO                     <MODE>EXIT
```

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

```
AZIM: -42.5 (  0.0)                  STOW
ELEV:  23.4 (-90.0)

MOVING TO (STOW)   <STOP> TO HALT MOTION
```

RECALLING STORED TARGET. The user may quickly and precisely move to a previously STOREd target via RECALL mode.

```
                                     RECALL
STORED POSITION: 1


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

EQUIPMENT SAFETY PROMPTS. Throughout the sequence of operations, the user is prompted to confirm that mechanical components are in proper configurations before allowing the controller to automatically move the antenna.

```
A) HIGH WIND SUPPORT REMOVED?       STOW
B) WAVEGUIDES DISCONNECTED?
C) MESSENGER CABLE REMOVED?
READY TO PROCEED?    <BKSP>-YES <MODE>-NO
```

Programming Group Functions

The programming group modes provide for initial configuration of the controller and also provide screens to aid in maintenance and troubleshooting of the controller.

Configuration mode screens allow the user to customize and calibrate the operation of the RC3000 for use with a particular mount. Note that most configuration items will be factory set for correct operation with a particular mount.

```
REF_VOLT:2.50 OFF:  0.0      CONFIG-AZIM
     CCW:180   CW:180   SF:76.35


SET REFERENCE VOLTAGE <2.00 - 3.00>
```

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

```
 SYSTEM:11/10/97 22:26:40           TIME
GPS UTC:11/10/97 22:26:40       ZONE:CST
DISPLAY:11/10/97 16:26:40    OFFSET:- 6
1-DATE 2-TIME 3-SYNCH 4-ZONE 5-OFFSET
```

1.3.4 Antenna Pointing Solution

The position (latitude, longitude & true heading) of the mount and the latitude/longitude of a selected target are required to calculate a pointing vector from the mount (local site) to the selected target (remote site).

The azimuth portion of the pointing vector is calculated with respect to local true North. The fluxgate compass is used to determine the heading of the centerline of azimuth travel and the required movement in the azimuth axis is calculated relative to the trailer's reference heading.
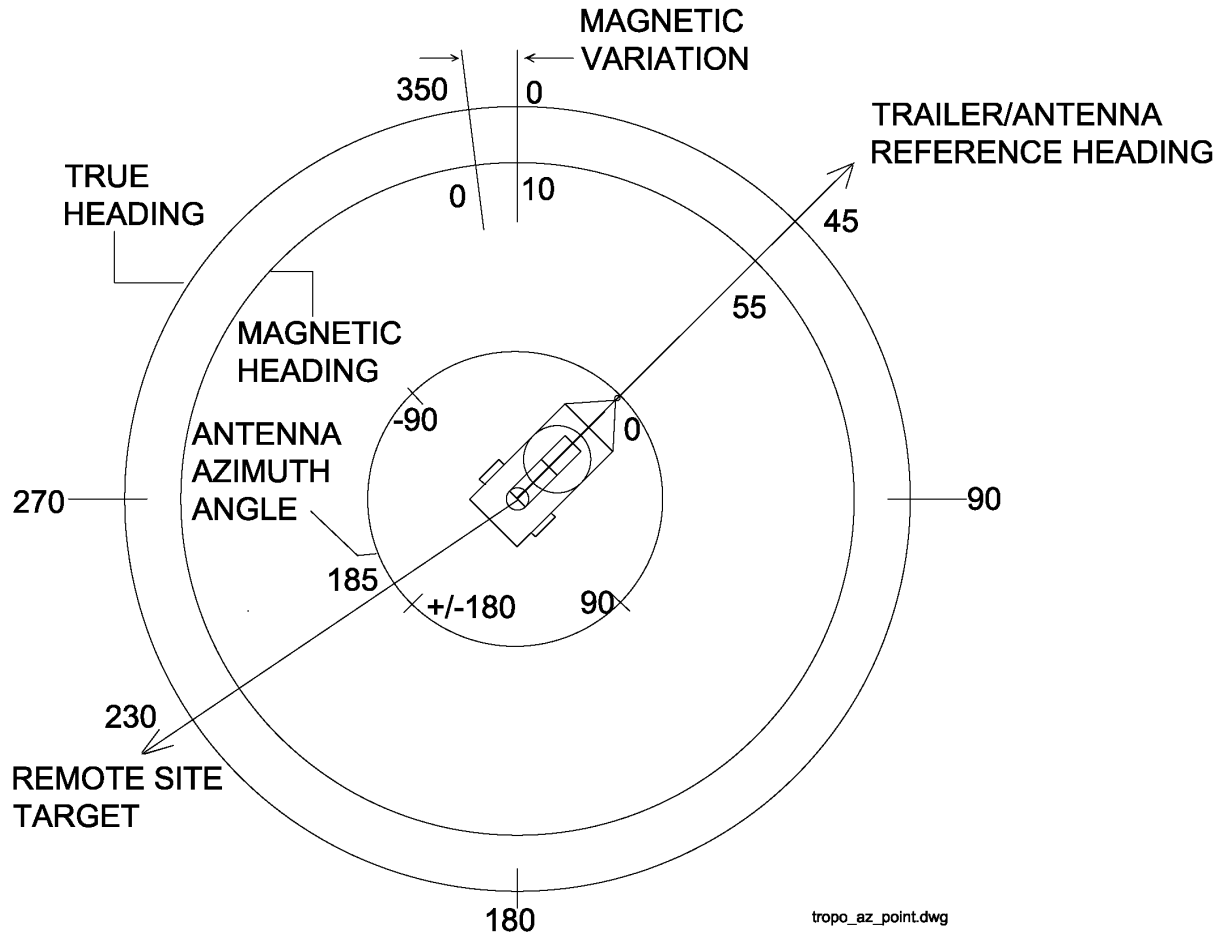
In the above example a true heading of 230 degrees to the target has been calculated. Based on the mount's latitude, longitude and date, a local magnetic variation (see 1.3.8) of 10 degrees is calculated. The compass senses a magnetic heading of 55 for the azimuth reference direction. Applying the magnetic variation, this yields an apparent true heading of 45 degrees for the antenna reference direction. An azimuth movement of 185 (230 – 45) degrees clockwise is therefore needed to point at the target.

Since the position sensor on the azimuth axis is always active, the RC3000's default displayed azimuth value is that of the relative antenna angle. Note that TFLA has mechanical azimuth range of 230 degrees clockwise (+230) and 170 degrees counterclockwise (-170) in order to allow operations around the 180 degree clockwise position (antenna facing backwards).

1.3.5 Timekeeping

There are several versions of time (system, referenced and GPS) discussed within this manual.

System time is maintained by the RC3000's real time clock. The real-time clock is backed up by battery so that system time is available as soon as the RC3000 powers up. The RC3000'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 RC3000 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 RC3000 allows the user to synchronize system time to the UTC reported by the GPS receiver.

In several screens the RC3000 displays a **reference time**. The user may designate a three letter timezone designation and an hourly offset from system time. This allows the user to display local time or some other reference time without modifying system time. If system time is maintained close to UTC, the reference time displayed may be of use to operators for coordinating events.

See section 3.3.2.3 for details on time maintenance.

1.3.6 Drive System

The RC3000 implements several mechanisms for the driving and monitoring of the azimuth and elevation axis.

Position Sensing and Limits

The RC3000 senses absolute axis position using feedback from various sensors (potentiometers, resolvers, inclinometer for elevation, etc). The sensed voltage is scaled appropriately for the particular mount. 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 antennas. Note that elevation movement to the stowed position is limited about a small range of azimuth movement in order to ensure safe stowing of the antenna.
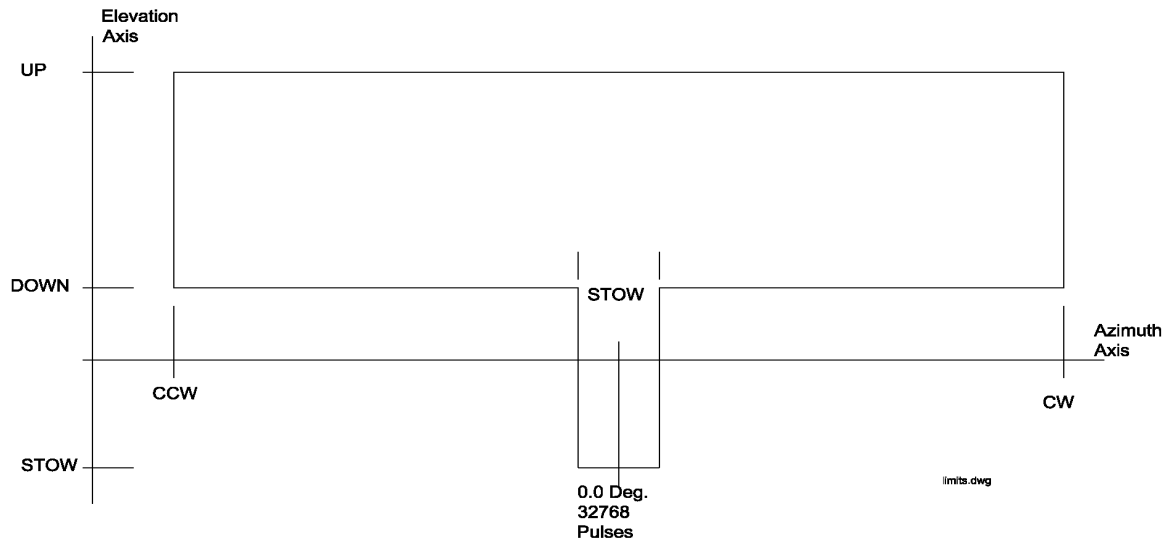
In the azimuth axis, movement in one direction is disabled when clockwise and counterclockwise limit switches are activated. There is also typically a region in the center of azimuth travel indicating that the azimuth axis is in a position that will allow for moving the elevation axis down to the stow position.

For TFLA, there is also an "Azimuth Range Limit" which restricts azimuth movement to a small number of degrees (typically 15) on either side of a dynamically set point.

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.

Jam and Runaway Sensing

The RC3000 continuously monitors the axis positions to detect incorrect movement of the mount. If an axis has been commanded to move and the RC3000 does not detect movement within a prescribed time, the controller will declare a "JAM" condition and not allow further movement in that axis until the condition has been reset.

Similarly if the RC3000 senses movement in an axis when no movement should be occurring, the RC3000 will declare a "RUNAWAY" condition. Like JAM, the RUNAWAY condition must be reset before further movement in the axis may occur.

Anti-Reversal

In order to save wear on the drive motors, the RC3000 limits how fast an axis may reverse its direction. This mechanism prevents a motor from instantly changing direction before coasting to a stop in the original direction. This mechanism is also useful for correct counting of pulses. Since the RC3000 counts a pulse as being in the direction that the controller thinks the axis should be going, it is imperative to stop the motor completely before moving in the opposite direction.

Automatic Movements

In order to provide smooth automatic movement to target positions, the RC3000 utilizes several parameters to account for different mount characteristics.

automove.dwg
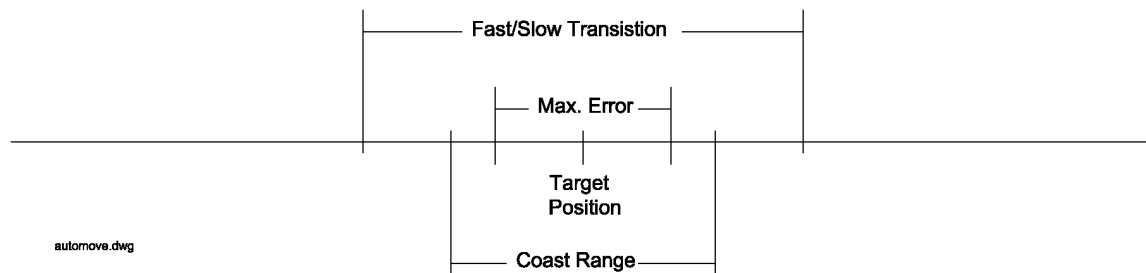
The Fast/Slow Transition parameter defines how far away from a target position the RC3000 will switch from fast to slow motor speed. The Coast Range defines where the RC3000 will de-energize the motor drive to allow the mount's inertia to coast into the target position. The Max Error parameter defines how close to the target position will be considered good enough.

Note that the DC motor control module in the RC3000 provides for smooth acceleration/deceleration, load regulation and dynamic braking of the motors.

1.3.7 Magnetic Variation

In order to calculate target pointing solutions, the mount's orientation with respect to true North must be known. The RC3000 uses the fluxgate 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 diagram from the National Geophysical Data Center.

Magnetic Field of the Earth - 1995
Declination Chart
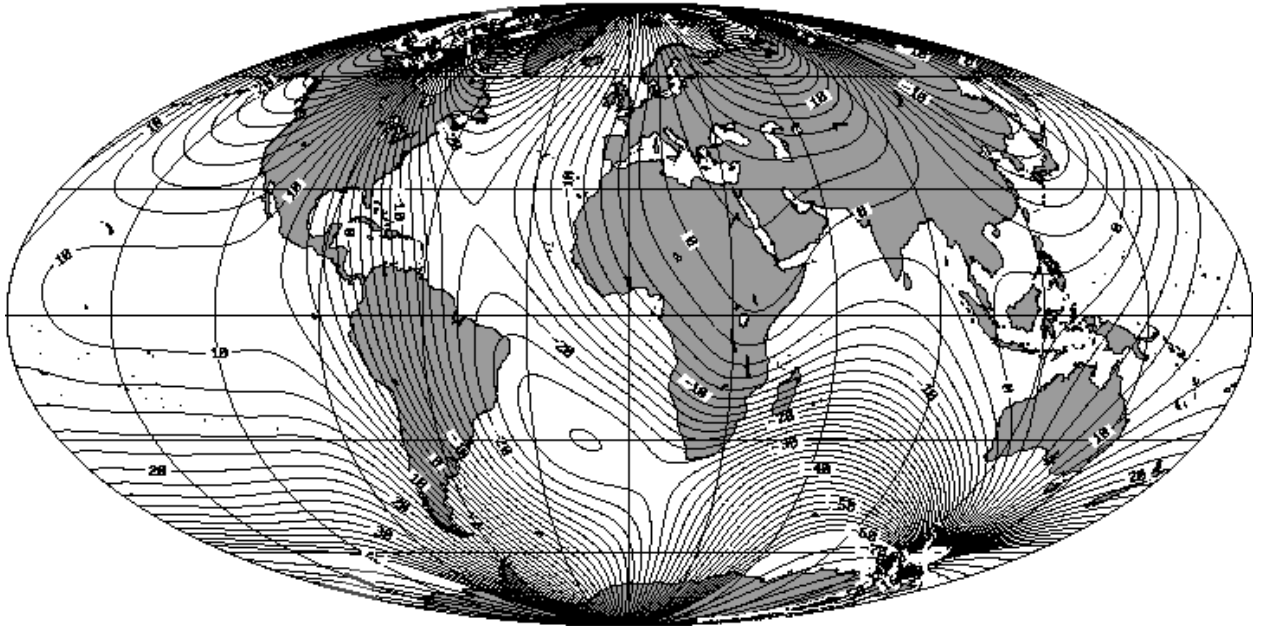
The magnetic field also changes slowly over time. The following table shows how the magnetic variation for Washington D.C. has changed over the last 250 years.

YEAR	MAGNETIC VARIATION
1750	-3.3
1800	-1.0
1850	-2.5
1900	-5.5
1950	-7.5
2000	-10.6

To calculate the local magnetic variation (difference between magnetic North and true North), the RC3000 uses the International Geomagnetic Reference Field (IGRF) model. The IGRF is a mathematical model of 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 mount's latitude, longitude and the current date. The magnetic variation calculation cannot account for isolated local anomalies (typically less then a few degrees). It also cannot account for local external effects (power lines, train tracks, etc).

1.3.8 System Performance

The performance achieved by the RC3000 in locating targets is dependent on the mechanical tolerances of the mount, 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 platform's magnetic heading. Errors in heading primarily affect the accuracy of the antenna's calculated azimuth position. The flux gate determines the magnetic heading by measuring the direction of the magnetic field at the sensor tower. 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, as well as those "worked into" the coach body during manufacturing.

For the flux gate 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 platform 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 truck is being operated. This component of the distortion varies as the truck 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.

The RC3000 uses a 10 bit analog to digital converter for measuring voltages from azimuth, elevation and polarization potentiometers as well as measuring signal strength inputs. In most cases this provides adequate resolution but should be considered. For example, if the azimuth axis has 360 degrees of travel, the resolution achieved is 360 / 1024 (approximately 0.35 degrees).

1.4 Specifications

	-1 Configuration	-2 Configuration
Physical		
Size	19.0 inches x 3.5 inches x 17.5 inches	
Weight	19 lbs	
Input Power	115 VAC 50/60Hz; 50W max Idle;850W max Antenna Moving;	230 VAC 50/60Hz; 50W max Idle;850W max Antenna Moving
Fusing	8Amp Fast-Blow;	8 AMP Fast Blow
Temperature	-40C to +68C	0 C to +50C
Humidity	to 95% non-condensing	
Antenna Drive		
Azimuth/Elevation	90VDC	
Position Sense		
Azimuth	Potentiometer, 10-bit resolution	
Elevation	Inclinometer, 10-bit resolution	
Limit Switch Inputs	Four 12 VDC inputs: EL Up, EL Down, EL Stow, AZ Stow	
Locate Mode		
Elevation Accuracy	0.2 degrees (typical)	
Azimuth Accuracy	0.75 degrees rms (typical)	
Other		
Antenna Size	0.4 – 12.0 meters	
Non-volatile Memory Backup	Duracell DL2450	
Breather/Desiccator (Q1 only)	Brownell # BL/D2037/02 (RCI PN Z-DESICCATOR RXDB2)	

2.0 INSTALLATION

Proper installation is important if the full capability and accuracy of the RC3000 is to be realized. The procedures that follow will insure the optimum level of performance from all sensors and the system in general.

Installation will be more efficient if each step in the physical installation and calibration be performed in the order in which it appears in the following schedule. Each step is referenced to a particular section of this manual, and should be checked off as it is completed. Coordination between the mount manufacturer, vehicle integrator and end user is required. Some steps are applicable only if the tracking or remote control options were purchased with the unit. The installation procedures are written to cover the most common mount installations. Some steps are slightly different according to the type of mount the RC3000 is interfacing to (see appendix B). Installation requires basic operational knowledge of the RC3000. Please review chapter 3 for information on how to navigate the RC3000's screens and how to enter data.

SECTION	ACTION	COMPLETE
2.1 Equipment Mounting		
2.1.1	RC3000 Antenna Controller	
2.1.2	GPS Receiver	
2.1.3	Fluxgate Compass	
2.1.4	Inclinometer	
2.2 Electrical Connections		
2.2.1	Power Entry	
2.2.2	Motor Drive	
2.2.3	Drive Sense	
2.2.4	Limit Switches	
2.2.5	Navigation Sensors	
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2.3.1	Software Initialization	
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2.3.5	Drive System Checkout	
2.3.6	Navigation Sensor Communication	
2.4 Final Calibration		
2.4.1	Compass Calibration	
2.4.2	Azimuth and Elevation Alignment	
2.4.3	Miscellaneous Adjustments	

2.1 Equipment Mounting

This section describes the physical mounting requirements for the RC3000 and optional sensor units. Wiring requirements are discussed in section 2.2.

2.1.1 RC3000 Antenna Controller

NOTE: The RC3000 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 RC3000 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 RC3000, 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 and M4 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 RC3000 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 RC3000 is a requirement. RCI's warranty does not cover repair to units with ripped faceplates.

The RC3000's display 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.

The following diagram shows the approximate dimensions (in inches) of the RC3000. See section 5 for a detailed depiction of the side mounting holes.
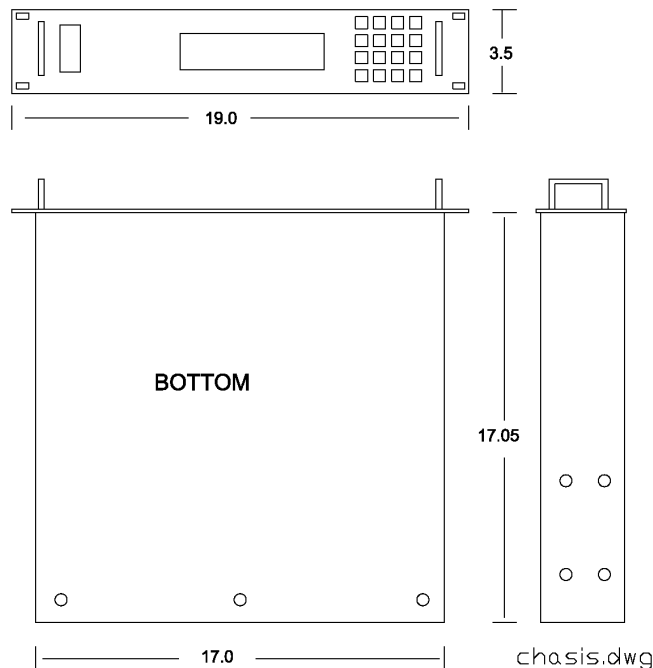
2.1.2 GPS Receiver

TFLA -1 Configuration

The -1 configuration assumes a user supplied Defense Advanced GPS Receiver (DAGR) unit will be plugged into RC3000. The DAGR must be placed in a mode where it is outputting NMEA sentences $GPRMC and $GPGGA at 4800 baud. Refer to separate operating instructions for how to program the DAGR for use with the RC3000.

TFLA -2 Configuration

The commercial GPS receiver (RC3000GPS) should be mounted in a position (such as the truck's roof) where it has an unobstructed view of the horizon and sky. It should be mounted outside of the reflector when in a stowed position, with the connector (on the underside) towards the cable's entry point into the truck. Care should be taken in the routing of the cable to avoid any problems.

The GPS receiver should be mounted at least three feet from other antennas and electrical generating equipment. Strong RF interference from other sources may disrupt the GPS receiver's signal reception. Wiring of the GPS connector is discussed in section 2.2.5.

Recent RC3000s have been supplied with the GPS17 receiver model. The following diagram shows its dimensions.

NOTE: in order to correctly operate with the commercial GPS, the GPS configuration item in the SYSTEM DEFINITION screen (3.3.1.2.1) must be set to 1 "commercial". The default value of this item is 2 "DAGR".

4.44″
[113 MM]

3.58″
[91 MM]

gps17.dwg
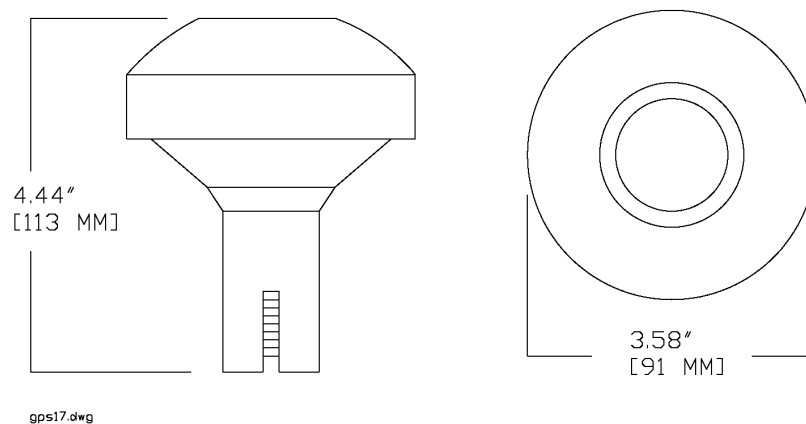
2.1.3 Fluxgate Compass

The optional fluxgate compass unit (RC3000FG) should be placed on the roof of the vehicle away from ferrous metals, electric motors, and any equipment that generates magnetic fields such as air conditioners, generators, and traveling wave tube (TWT) amplifiers.   Experience has shown that the fluxgate performs best when mounted as high as possible on the vehicle. The fluxgate compass must be mounted in an upright position.

Some mounts position the compass on the mount so that the compass may be lifted well above the top of the vehicle. If the compass is attached to the mount, the compass configuration item (3.3.1.2.1) must be set to the "antenna mounted" value.

The RC3000 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 azimuth offset configuration item (3.3.1.2.3). Some operators prefer to mount the compass pointing forward on the vehicle. If the mount faced rearward, an azimuth offset of 180 degrees would need to be input.

Refer to the drawing of the fluxgate enclosure to verify the proper orientation of the fluxgate. NOTE: An unhoused version of the compass is available for use in a user-designed enclosure.
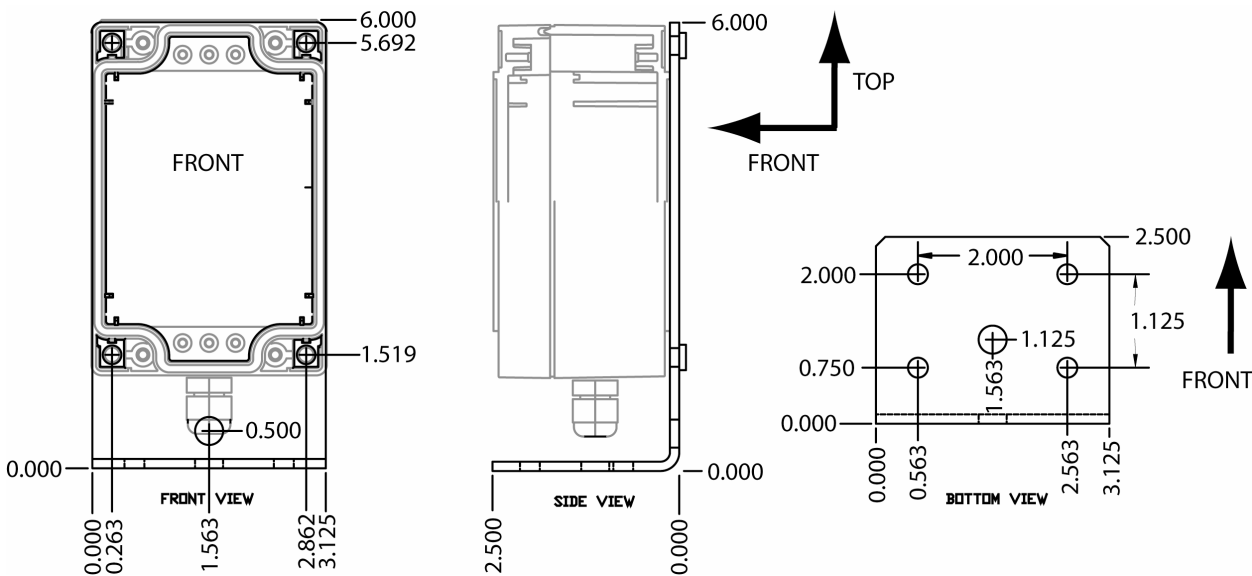
The following method may be used to determine the best location for the compass.

Park the vehicle in a location that is away from large metal objects or sources of magnetic fields**.** NOTE: for best results, the vehicle should be parked facing in an easterly or westerly direction. The vehicle's generator should be running, as well as all electrical equipment on the vehicle that generates magnetic fields.

Stand on the roof of the vehicle with a standard magnetic compass. Slowly lower the compass to the proposed fluxgate mounting location on the vehicle 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 vehicle, or magnetic fields generated by the vehicle.

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.

2.1.4 Electronic Clinometer

The electronic clinometer (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 boresight operational range.

2.274 in.
(57.759)

DOWN

+/- 45° Linear Range

clin1.dwg
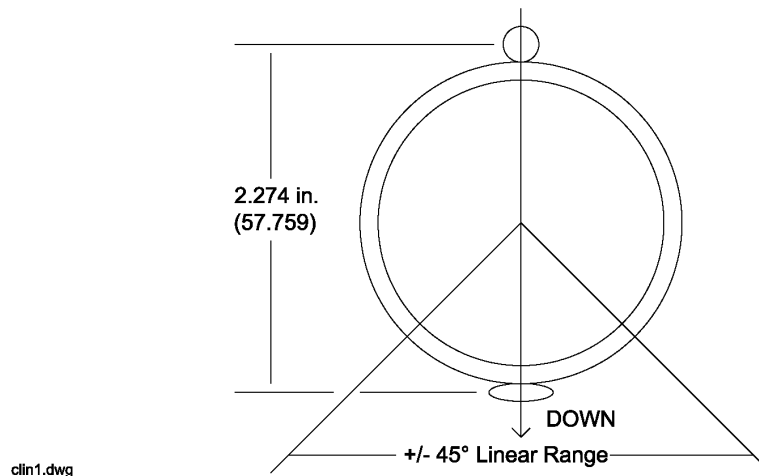
Determining the correct orientation of the inclinometer requires knowledge of the mount's mechanical structure and the antenna's RF offset. Typically the mount manufacturer will place the inclinometer in the correct position on the mount. See appendix B for the correct orientation for a particular mount.

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.

The optimum orientation for the TFLA system will be where the inclinometer is vertical when the dish is at the -35 degree look angle point. This orientation will allow elevation sensing down to the stow position (-90 degrees) and linear sensing up to the highest expected operational elevation (+ 10 degrees).

See section 2.2.3 for wiring of the inclinometer.

VERTICAL REFERENCE

INCLINOMETER REFERENCE

X = 35 DEGREES - ANTENNA OFFSET

X

ELECTRICAL
BORESIGHT

INCLINOMETER

ANTENNA OFFSET

HORIZONTAL
REFERENCE

FEED

REFLECTOR

BACKSTRUCTURE

RC3000 INCLINOMETER ORIENTATION
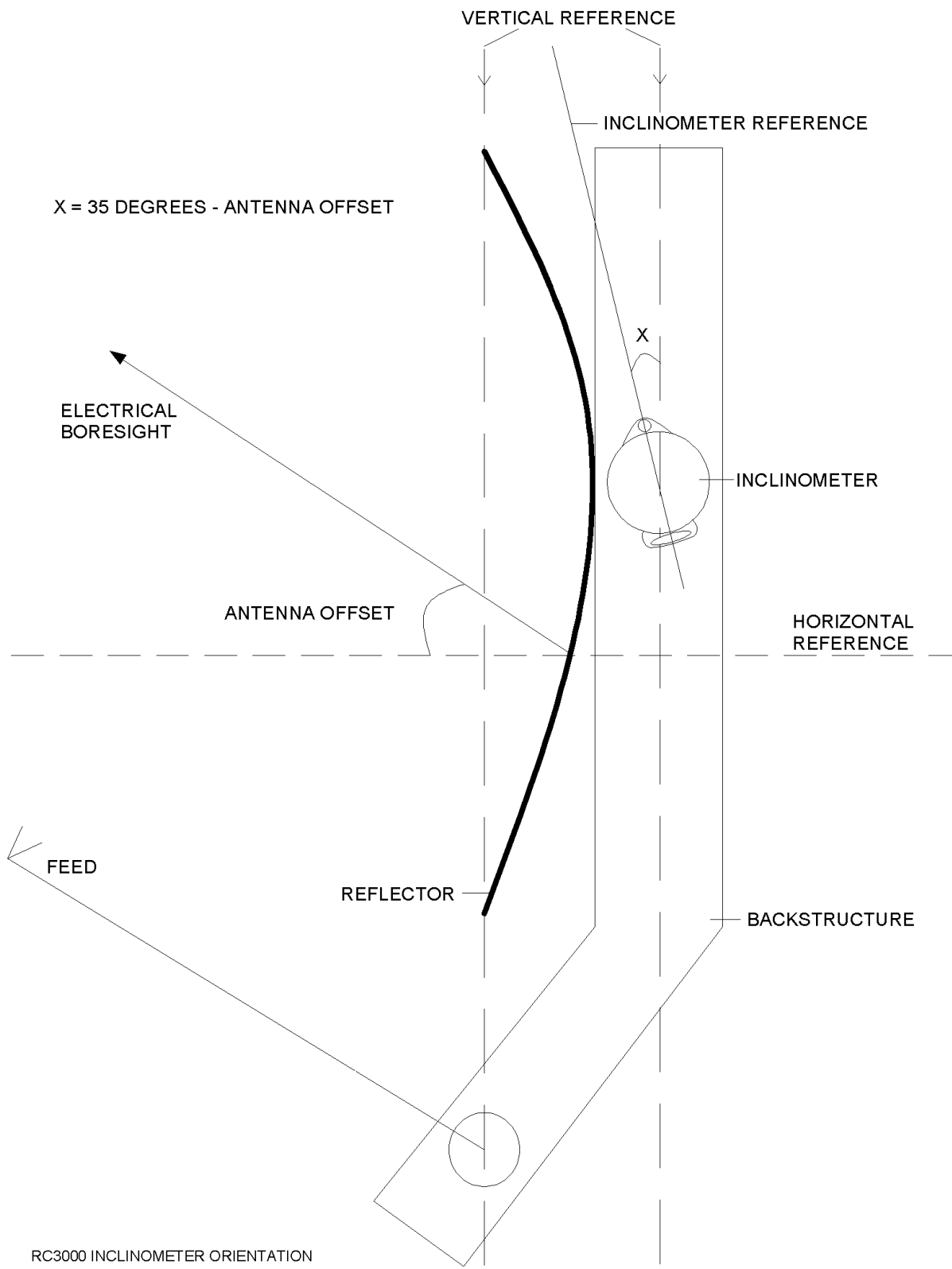
2.2 Electrical Connections

This section provides cabling requirements for interfacing to the RC3000. Note that cables should be made long enough to allow the unit to be open while still connected to the system.

The following diagram shows the position of interface connectors on the backpanel of the RC3000. Interface details for each applicable connector will be presented in the following subparagraphs.
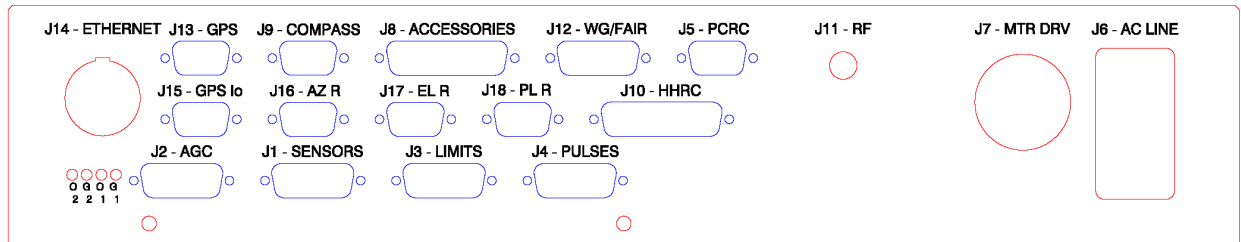
NOTE: multiple connectors shown above are not used for the TFLA application. Unused connectors will be terminated to facilitate sealing of the ACU.

2.2.1 Power Entry

J6 is an IEC male power connector on the backpanel for supplying AC power to the RC3000.

The RC3000 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 RC3000A 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).

NOTE: The RC3000B can only be configured for 115 or 230 VAC since the internal DC motor controller module is different for each voltage. The fuse holder is glued into the correct voltage position and cannot be modified as in the RC3000A case.

The fuse holder is designed to accommodate 1/4" by 1 1/4" fuses. "Fast Blow" (8 Amp.) type fuses (such as LITTLEFUSE 314008 or BUSSMAN ABC-8) should be used.

2.2.2 Motor Drive

J7 is an MS3102A22-20S (Female on backpanel) connector, which terminates three motor cables. The minimum wire size for these cables is 16AWG.
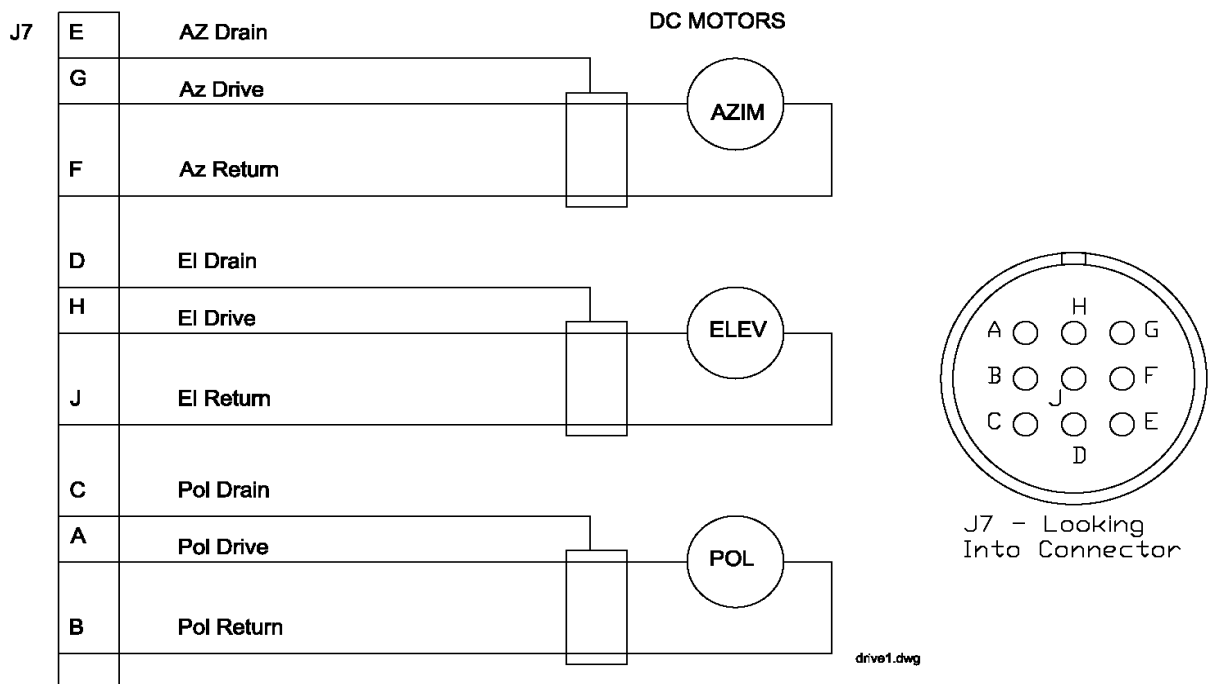
The following table describes the polarity of the RC3000's motor drive output signals.

Axis	RC3000 Connector J7 Terminals	Polarity
Azimuth	G, F	Azimuth CW – G has higher potential
Elevation	H, J	Elevation UP – H has higher potential
Polarization	A, B	RC3000A:Polarization CW – B has higher potential RC3000B:Polarization CW – A has higher potential

2.2.3 Drive Sense

J1 (DB-15 Female on backpanel) receives position sense from the azimuth and polarization potentiometers and the elevation inclinometer.
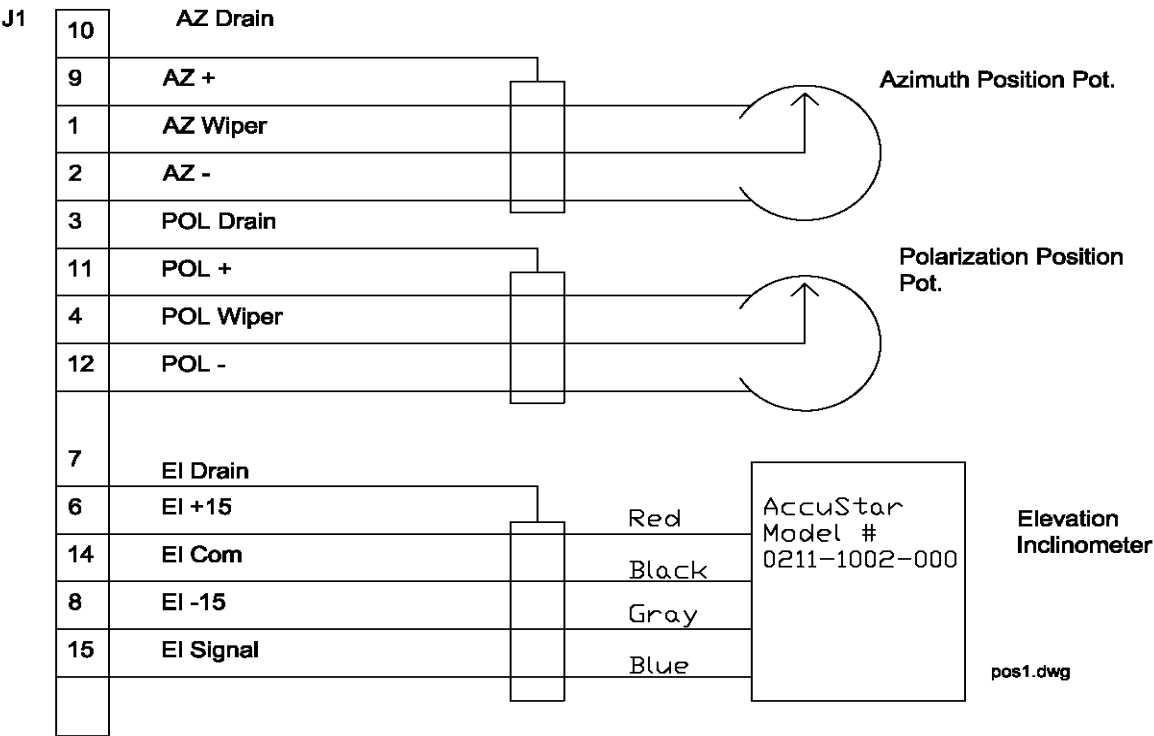
Normally, it is not necessary to modify the sensors on the antenna. The antenna manufacturer should insure that the antenna is compatible with the RC3000. This information is provided for informational purposes only.

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.

The directional sense of elevation movement is defined as UP when the RF look angle of the antenna is increasing.

2.2.4 Limit Switches

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

J3				LIMIT SWITCHES
	15	AZ Stow +		
	2	AZ Stow -		Azimuth Stow
	14	EL Up +		
	10	EL Up -		Elevation Up
	4	EL Down +		
	3	EL Down -		Elevation Down
	13	EL Stow +		
	11	EL Stow -		Elevation Stow
	7	Pol Stow +		
	8	Pol Stow -		Polarization Stow
	5	Drain		

Switch Annotations are for the Limit Condition

tropo_limit_sw.dwg
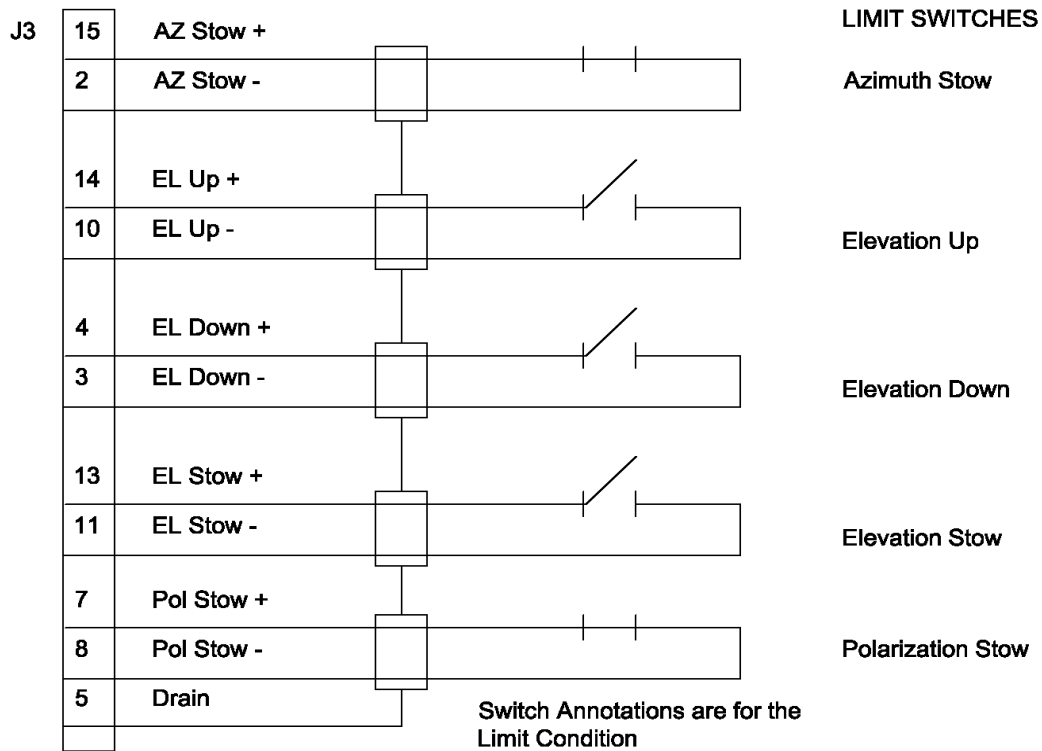
The + side of each limit switch circuit supplies 12 VDC. This 12 VDC supply is protected by a resettable fuse rated at 250 mA.

The azimuth stow switch must be closed when at the azimuth stow position. If the azimuth stow limit switch cable is severed, the RC3000 will think that the azimuth axis is not at the stowed position. Logic within the RC3000 will not allow elevation to move below the elevation down limit switch if an azimuth stowed condition is not recognized.

The elevation up switch must be open when the elevation axis has reached the up limit. If the elevation up limit switch cable is severed, the RC3000 will think that the elevation axis is at the up limit. Logic within the RC3000 will not allow the elevation axis to move up if an up limit condition is recognized. The elevation down switch must open when the elevation axis has reached the down limit. If the elevation down limit switch cable is severed, the RC3000 will think that the elevation axis is below the down limit. Logic within the RC3000 will not allow the azimuth axis to move when the elevation down condition is recognized. The elevation stow switch must open when the elevation axis has reached the stow position. If the elevation stow limit switch cable is severed, the RC3000 will think that the elevation axis is at the stow position. Logic within the RC3000 will not allow the elevation axis to move down when the elevation stow condition is recognized.

2.2.5 Navigation Sensors

J9 (DB-9 Female on backpanel) connects to the fluxgate compass .

J13 (DB-9 Male on backpanel) connects to the GPS Receiver .

1			
6			GPS Receiver
2	White	TXD1	
7			
3	Blue	RXD1	
8			
4	Red	Vin	
9			
5	Black	GND	
	J13 - DB9 male		
5	Black	GND	
9			Fluxgate Compass (Housed)
4	White	Vin	
8	Shield	GND	
3	Red / Black	RS232 IN	
7			
2	Blue / Black	RS232 OUT	
6			
1			

tropo_j9.dwg   **J9 - DB9 female**
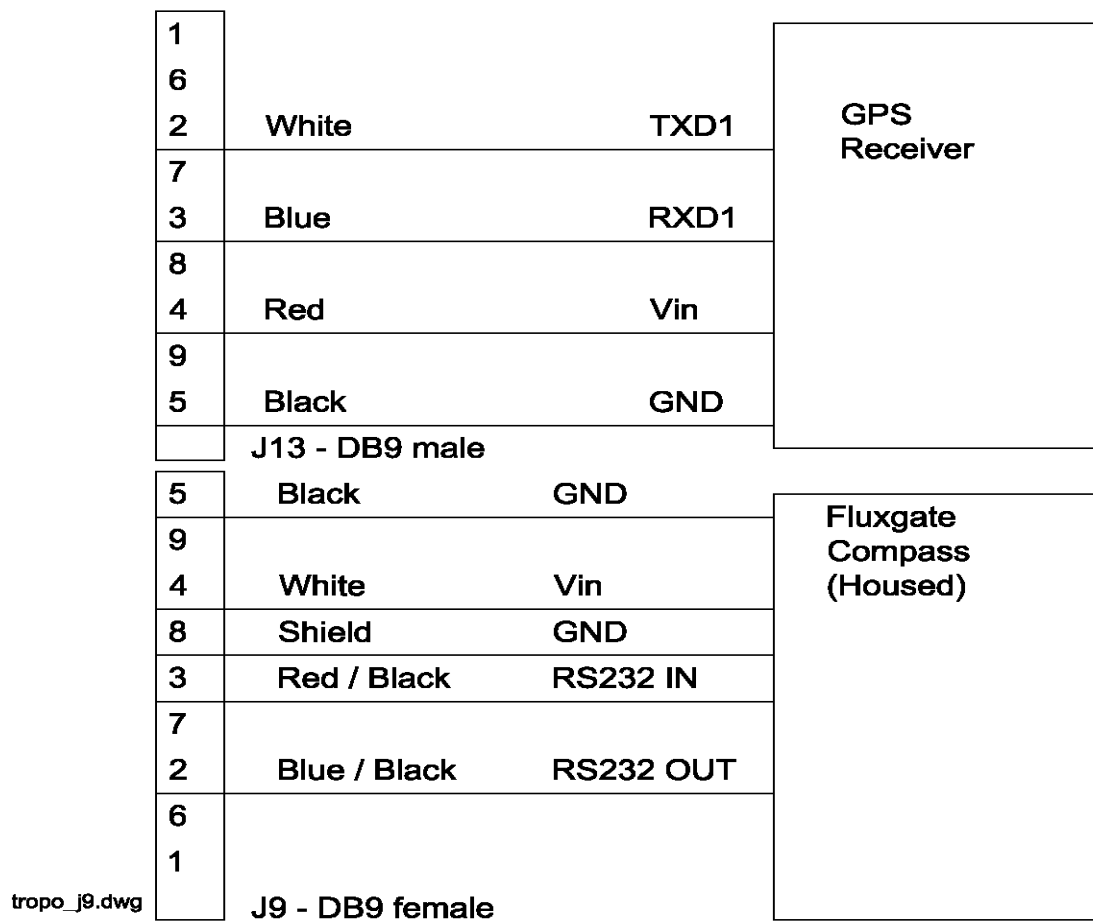
NOTE: for the -1 configuration GPS Receiver (DAGR), only pins 2, 3 and 5 (RX, TX & GND) are required.

2.2.6 Hand Held Remote

J10 (DB-25 Female on backpanel) connects to the optional hand-held remote control (RC3000HRC) which allows antenna jog operations independent of the front panel. The remote control is housed in a 3" x 6" x 1.75" aluminum case. The remote control should be connected to the RC3000 with a 25' multi-conductor cable.

P10 - Hand Held Remote Control

DB25 male

Pin	Wire
1	Black w/ White Stripe
2	Red w/ Black Stripe
3	Orange w/ Black Stripe
14	Black w/ Red Stripe
4	Orange w/ Red Stripe
17	Blue w/ Red Stripe
5	Red w/ White Stripe
15	Blue w/ White Stripe
6	Green w/ White Stripe
19	Green
7	Orange
20	Red
8	Blue w/ Black Stripe
21	White
9	Green w/ Black Stripe
22	Blue
16	White w/ Red Stripe
23	Black w/ Red & White Stripe
11	Green w/ Black & White Stripe
24	Red w/ Green Stripe
12	White w/ Red & Black Stripe
25	Orange w/ Green Stripe
13	Red w/ White & Black Stripe

(Optional)
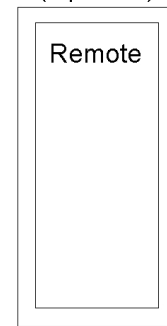
Remote

NOTE: the RC3000HRC is utilized with -2 configuration ACUs.

The RC3000HRC places all of the antenna move functions and antenna limit indicators into the operator's hand. The LEDs on the remote switch-pad indicate the antenna limit status:

Azimuth Axis: STOW, CCW Limit, CW Limit.
Elevation Axis: STOW, Up Limit, Down Limit.
Polarization Axis: CCW Limit, CW Limit.
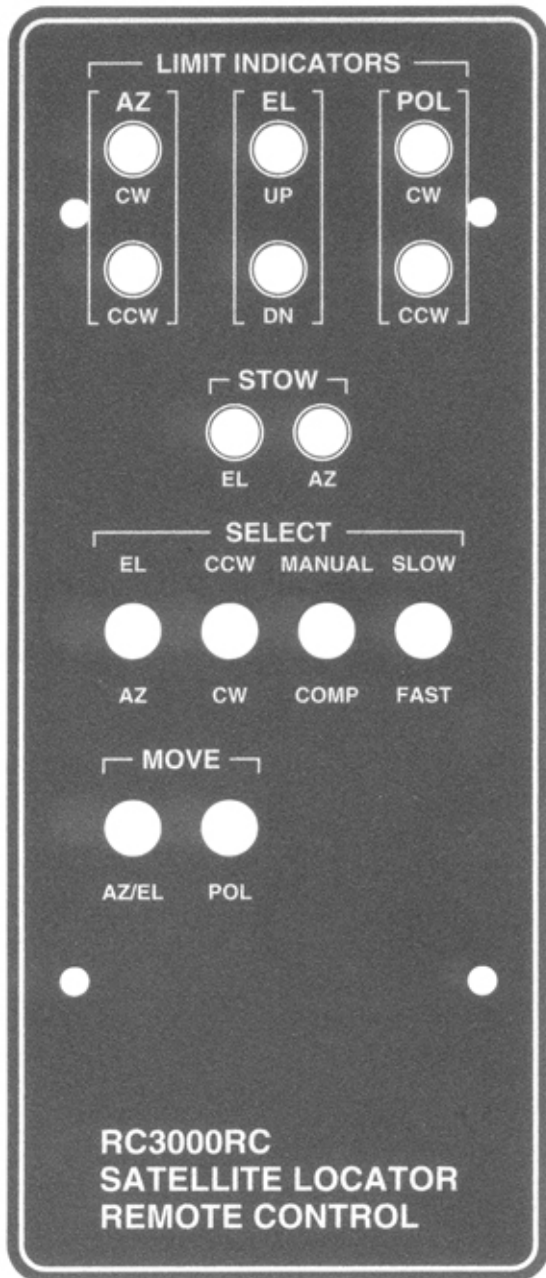
When the COMP/MANUAL SELECT switch is at MANUAL, control of the azimuth, elevation and polarization axes is via the handheld remote panel. The SELECT and MOVE switches may then be used to configure and initiate movement of one of the three (azimuth, elevation or polarization) axes. Moving the switch back to the COMP position returns control to the RC3000's frontpanel.

2.2.7 Remote Control

J5 (DB-9 Female on backpanel) allows for optional remote control (RC3000CRC) of the RC3000. The RC3000 may be configured to communicate either by the RS-232 or the RS-422 / RS-485 standards.

TFLA ACUs in the -1 configuration will have a separate handheld remote front panel (HHRFP) attached to J5. The HHRFP provides a full display and keypad just as is available at the front panel of the RC3000.

The RC3000 is shipped from the factory configured for RS-422/RS-485 operation along with power for the HHRFP device.

3	TXD	Handheld
9	TXD/	Remote
4	RXD	Front
6	RXD/	Panel
1	VDC	
2,5,7	GND	
8	SHIELD	
	J5	
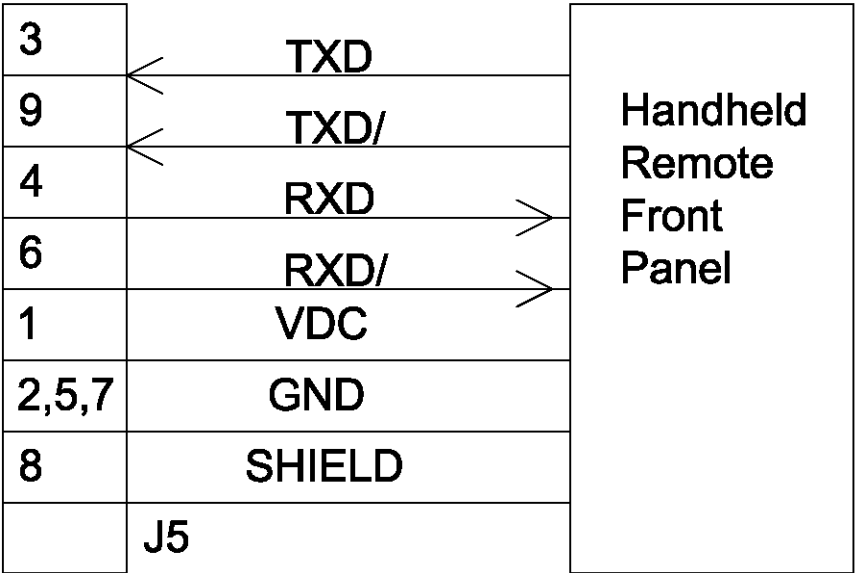
To configure the RC3000 for RS-422 or RS-485, set the J12 jumper on the analog board to the -422 position and set jumpers X1 through X5 to the -422 position. To configure the RC3000 for RS-232, set the J12 jumper on the analog board to the -232 position and set jumpers X1 through X5 to the -232 position. RC3000s also allow for the remote control to interface with an optional internal card hosting a web page. To configure the RC3000 for this, set the J12 jumper to the "RABBIT" position.

2.3 Initial Configuration

Whereas Final Calibration (section 2.4) requires an open area with an unobstructed view of the target, initial configuration 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 RC3000 from the front panel. Section 3 will need to be reviewed to perform the steps described below.

2.3.1 Software Initialization

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. See section 2.2.1.

Software Version Verification. When the RC3000 is turned on, a power up banner appears for 3 seconds. This banner indicates the software options enabled in the RC3000's EPROM and PLD. The software option data shown should be checked to confirm that all desired options are available. See 1.2 (Controller Features) for a description of the various software options.

Enable Expert Access. To perform RC3000 programming steps described below, expert access permission must be enabled. Expert access permission is enabled as the factory default, but may have been turned off if this is not the initial system configuration attempt. See 3.3.1.1.1 (Expert Access Permission) for description of how to view/modify the expert access configuration item.

TFLA software automatically disables expert access at power up. Expert access must be enabled via the SETTINGS mode (3.2.2.7).

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.

Reset System Defaults. The RC3000 is shipped with the default parameters set for the particular mount and software options. Most of the default values stored in non-volatile memory should be applicable. A few items (antenna size, etc) may not be initially set to values appropriate for a particular installation. Setting these values will be described next.

If the RC3000 has previously been configured, the installer may want to reset the system defaults as described in 3.3.1.3.1. **NOTE: the current value of all configuration items should be recorded prior to resetting system defaults.**

System Definition. The SYSTEM DEFINITION configuration screen (3.3.1.2.1) allows the user to indicate whether or not the optional GPS receiver is present, if and how the fluxgate compass is mounted, whether or not the optional waveguide switch module is present, the size of the reflector in use and what mode the user prefers the RC3000 to go to upon power up. The user may also enter the unit's serial number for later reference.

```
    GPS: 1                    CONFIG-SYSTEM
COMPASS: 1        SN:1234   WAVEGUIDE:0
   MODE: 2 ANT_SIZE: 120
<1>GPS PRESENT <0>NOT PRESENT
```

Follow the description in section 3.3.1.2.1 and set the SYSTEM DEFINTION items to the correct value for this installation.

Azimuth and Elevation Calibration. The next two steps calibrate the mount's elevation and azimuth axes. Place the RC3000 in MANUAL mode. Values for the azimuth and elevation axes should be displayed, though they may not be reasonable since calibration has not yet been performed.

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

NOTE: be careful when initially moving a mount since limit switches may not yet be configured correctly. In MANUAL mode, movement will stop whenever a particular jog key is released. The RC3000 may also always be turned off to stop movement.

Throughout the calibration procedures, two MAINTENANCE screens will be used extensively.

One of the MAINTENANCE screens used is the Analog to Digital Voltage screen (see 3.3.2.1). This screen shows raw data coming from antenna position sensors (potentiometers and resolvers).

```
AZ: 1.114   181.30 33004    AD VOLTAGES
EL: 1.143 1 122.30 22264    22.3   L1:1
POL:2.237   181.30 33044           L2:1
SIG: 3.756(1) <1>RF <2>SS1 <3>SS2 <4>GND
```

Another MAINTENANCE screen that will be used is the Limits Maintenance screen (see 3.3.2.5). This screen shows the current sensed state of limit switches for all three axes.

```
AZIM CW:0   CCW:1   STOW:0 (0-OFF)   LIMITS
ELEV UP:1    DN:1   STOW:1 (1- ON)   ACTIVE
 POL CW:0   CCW:1   STOW:0
<BKSP>MAKE LIMITS INACTIVE     <MODE>EXIT
```

Before beginning axes calibration, the installer should become familiar with accessing these screens.

2.3.2 Elevation Calibration

Steps to perform elevation calibration will be described starting with the elevation axis in the stowed position.

STEP 1.- STOW Limit Confirmation

With the elevation axis in the stowed position, go to the Limits Maintenance screen (3.3.2.5) to confirm that the ELEV STOW and Down (DN) limits are active.

Also confirm that the elevation UP limit is inactive. If the UP limit is active, the RC3000 will be prevented from moving the elevation axis up from the stowed position.

If the initial state of the elevation STOW, DOWN and UP limits is not correct, check the limit switches and wiring (2.2.4).

STEP 2. – Initial Movement

The next action is to raise the antenna in elevation. Push the UP key from MANUAL mode. The antenna should rise. If not, check the polarity of the motor drive lines (section 2.2.2).

As the elevation axis comes out of the stow position, the STOW limit should inactivate but the DOWN limit should remain active. This may be observed from the MANUAL screen by seeing the elevation "STOW" indication change to a "DOWN" indication.

The elevation sensor should be mounted on the antenna so that the sense voltage produced at the sensor increases as the antenna is jogged upward. In MANUAL mode, when the EL UP (2) key of the RC3000 is depressed (and if the antenna moves up) the elevation position should increase (see section 2.2.3).

Note that the elevation position seen in the MANUAL screen might not initially change if the inclinometer is still outside of its operational range or if the inclinometer is mounted on a feedboom that doesn't rise until the reflector has moved up a certain distance.

The following steps will require values to be entered in the ELEVATION CALIBRATION configuration screen (see 3.3.1.2.2).

```
REF_V:1.69 OFF:  0.0          CONFIG-ELEV
 DOWN:  0   UP: 90.0   SF:50.00
 LOOK:1
SET REFERENCE VOLTAGE <0.50 – 3.50>
```

NOTE: the elevation offset item should be set to 0.0 before any further elevation calibration is performed. Any required elevation offset will be determined during the azimuth and elevation alignment step as part of the final calibration steps. The LOOK configuration item is meaningful for only a small number of mounts and this item is not applicable.

STEP 3 – Inclinometer Reference Voltage

To perform this step, raise the antenna until the reflector is in the reference position appropriate for this mount (see Appendix B). For the majority of mounts, the reference position corresponds to having the reflector's face vertical. This angle can be confirmed by use of a level or digital inclinometer placed on a correct portion of the antenna structure.

The elevation voltage shown on the AD VOLTAGES screen (3.3.2.1) should be near the target value for your mount as noted in appendix B. For the majority of mounts, this target voltage will be around 1.69 volts. This voltage allows for the greatest range of linear feedback from the elevation inclinometer throughout the mount's operational range. If not, loosen the elevation sense restraining plate and rotate the inclinometer until the elevation voltage is as near to the target voltage as possible. Secure the restraining plate and record the voltage.

Recorded Elevation Reference Voltage _____V

Move to the Elevation Calibration configuration screen and enter the recorded value in the REF_V item. This will define to the RC3000's software the voltage that should be seen when the elevation axis is in its reference position. To verify that data has been entered correctly, return to the MANUAL mode screen. The displayed elevation angle should be near the RF look angle offset of the reflector (see appendix B).

STEP 4. Elevation Scale Factor Calibration

This step is performed to characterize the output signal from the elevation inclinometer.

physical
angle_1

physical
angle_2

el_sf.dwg

Horizontal
Reference
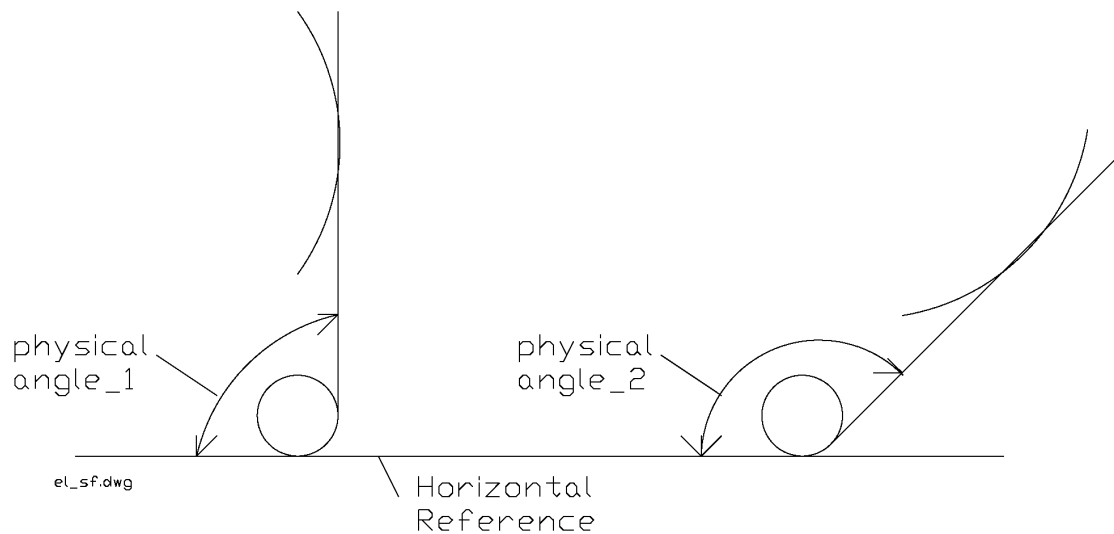
1) With the elevation axis in the reference position, note the angle **(using an accurate inclinometer placed on the mount itself not the angle displayed on the RC3000)** and the A/D voltage at that point.

     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.

    Degrees/Volt = (Voltage_2 – Reference Voltage) / (Physical_Angle_2 – Reference_Angle)

    MilliVolts/Degree = Volts/Degree * 1000

4) Enter the mV./deg. in the SF field of the configuration screen.

NOTE: an alternate method for calculating the output signal from the inclinometer is to use the data supplied by the inclinometer manufacturer for each individual inclinometer and multiply by the gain (0.823) in the RC3000's circuitry. (example: 59.27 mV/deg * 0.823 = 48.78)

STEP 5. Up Limit Confirmation

Move the elevation axis to the UP physical limit and confirm that the "UP" limit is displayed in the MANUAL mode.

Go to the Limits Maintenance screen (3.3.2.5) to confirm that the ELEV STOW and Down (DN) limits are inactive.

If the state of the elevation STOW, DOWN and UP limits is not correct, check the limit switches and wiring (2.2.4).

STEP 6. Software Elevation Limits

The DOWN and UP elevation limit values in the configuration screen should be set to reflect the physical limits of elevation travel. Note that these limits don't actually limit the elevation travel but are used by software during the LOCATE function to determine if a calculated pointing solution is outside of the mount's range of movement. If a calculated pointing solution is beyond these limits, the message "ELEV RANGE ERROR" will be displayed in the LOCATE screen.

2.3.3 Azimuth Calibration

Steps to perform azimuth calibration will be described starting with the azimuth axis in the stowed position and the elevation axis above the DOWN limit. Movement in the azimuth axis is not allowed until the elevation DOWN limit switch is inactive.

The mount should be moved to the exact azimuth position that it will be stowed. Typically this is near the midway point of its range of movement in azimuth. Also, the azimuth stow limit switch should be in the center of its activation region. It is very important that this position be confirmed in this manner or problems could be encountered during the automatic stow function.

The following steps will require values to be entered in the AZIMUTH CALIBRATION configuration screen (see 3.3.1.2.3).

```
REF_V:2.50  FG: 0.0            CONFIG-AZIM
  CCW:180    CW:180     SF:65.62


SET REFERENCE VOLTAGE <2.00 – 3.00>
```

STEP 1. Azimuth Potentiometer Reference Voltage.

This step is applicable if the mount is fitted with a potentiometer to sense azimuth position. If the mount is fitted with a resolver, go to step 1b.

Move to the MAINTENANCE MENU screen and select the AD VOLTS item. Voltage values read from the azimuth potentiometer can be read from the AD VOLTS screen (3.3.2.1).

The azimuth voltage shown on the screen should be 2.5 +/- 0.1 volts (Since 5 volts is sent to the sensor, if the pot is adjusted at the center tap position correctly, the reading should be half). If the value is within this range, record it for later entry in the configuration items. If not, loosen the potentiometer restraining collar and rotate the shaft such that the displayed value is as near 2.50 volts as possible. Secure the collar and record the voltage.

RECORDED AZIMUTH CENTER VOLTAGE_____ V.

Move to the Azimuth Calibration screen and enter the recorded value in the REF_V item. This will define to the RC3000's software the voltage that should be seen when the azimuth axis is in its centerline position. . To verify that data has been entered correctly, return to the MANUAL mode screen. The displayed azimuth angle should be 0.0 +/- 0.1 degrees.

STEP 2. Initial Movement.

The next step is to move the azimuth axis to confirm drive and sensor polarity. Azimuth clockwise and counterclockwise is defined as seen by an observer located above the antenna looking down on the antenna.

In MANUAL mode, when the AZ CW (6) key of the RC3000 is depressed the antenna motors must be wired (see 2.2.2) so that the antenna moves clockwise.

The azimuth potentiometer or resolver should be wired so that clockwise movement results in a higher azimuth position.   When moving clockwise, the displayed azimuth position should increase.

STEP 3. Stow Limit Confirmation.

Move the azimuth axis clockwise and counterclockwise through the stow limit switch's area of activation. Confirm that the STOW indication appears and disappears in MANUAL mode.

Failure of the stow switch to deactivate would allow the reflector to potentially move below the elevation DOWN limit in an unsafe manner. If the initial stow limit does not function correctly, check the limit switch and wiring (2.2.4).

STEP 4. Clockwise and Counterclockwise Limits.

Discrete Limit Switches. Some mounts may mechanize azimuth clockwise and counterclockwise limits via actual limit switches. If this is the case, move the azimuth axis through its range of motion and verify that the CW and CCW limit indications appear in the MANUAL screen. After confirming these indications move on to the next step.

Azimuth Electrical Limits. Other mounts may not have azimuth limit switches.   In this case, the RC3000 allows for the CW and CCW limits to be set based on the azimuth potentiometer voltage.

In this case, the antenna's azimuth electrical limits must be set. These limits are set using two potentiometers on the controller's analog board and thus it will be necessary to remove the controller's top cover. These two pots are labeled A-CW (azimuth clockwise) and A-CCW (azimuth counter-clockwise). These 2 pots on the analog board are accessed via holes in the feature board. Note that the Azimuth range limits specified below merely trigger the azimuth limit message and do not set the azimuth motion limits for the antenna.

To set the azimuth clockwise limit, go to MANUAL mode and jog the antenna in azimuth to the desired azimuth clockwise limit. If the controller indicates that the azimuth clockwise limit is reached before the antenna reaches the desired position for that limit, the A-CW pot may have to be adjusted to allow the antenna to move.   Adjust the A-CW pot until the azimuth limit indication flickers between CW and blank. To verify that the A-CW has been adjusted properly, verify that the antenna cannot move clockwise in azimuth but can move counter-clockwise.

A similar procedure is used to set the azimuth counter-clockwise limit.

STEP 5. Azimuth Scale Factor.

NOTE: in most cases the default azimuth scale factor for a mount will be correct and should not be changed. Perform this substep only if appendix B suggests that the azimuth scale factor for your mount should be characterized.

To calculate the azimuth scale factor, move the dish between two known physical azimuth positions and note the difference in the sensed azimuth voltage between the two locations.   If definite reference points are available on the mount (+/-90 degree positions for example), these may be used. Example: at +90 degree reference position the azimuth voltage is 3.86. At the –90 degree reference position the azimuth voltage is 1.14. The azimuth scale factor is calculated as:

180 degrees / (3.86 –1.14) = 66.16 degrees / volt.

66.16 would be entered as the scale factor.

STEP 6. Azimuth Software Limits.

The CCW and CW configuration item values should be set to reflect the physical limits of azimuth travel. Note that these limits don't physically limit azimuth travel but are used by software to determine if a calculated pointing solution is outside of the mount's range of movement. If a calculated pointing solution is beyond these limits the message "AZIM RANGE ERROR" will be displayed in the LOCATE screen.

STEP 7. Fluxgate Offset.

NOTE: this item defines the difference in orientation (in the azimuth axis) between the fluxgate compass (2.1.3) and the azimuth reference (displayed 0.0) position. This value should initially be set to the apparent difference between the compass' and azimuth axis orientations. For example, if the compass is placed on the vehicle facing forward and the dish actually faces backward, an azimuth offset of 180 would be entered. It is recommended that the compass be placed facing in the same direction as the azimuth centerline thus requiring an offset of 0.0.

2.3.4 Fast/Slow Motor Speed

The fast and slow output voltages for your particular mount will be set at the factory and typically will not need to be adjusted. On RC3000B models, there is only one fast/slow adjustment potentiometer on the analog board. On RC3000A models, there are fast/slow adjustment potentiometers for each axis on the auxiliary relay board next to the digital board.

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

2.3.5 Drive System Checkout

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

Perform the STOW and LOCATE functions and confirm the mount correctly moves.

2.3.6 Navigation Sensor Communication

If the optional GPS receiver and/or fluxgate compass are present, confirm that valid serial data is coming from the unit(s). See the GPS COMM (3.3.2.6) or FLUX COMM (3.3.2.7) maintenance screen descriptions.

2.4 Final Calibration

The final calibration steps tune up the system for performing automatic location of targets.

2.4.1 Compass Calibration

Ferrous metal on the vehicle distorts the earth's magnetic field in the vicinity of the vehicle. The flux gate indicates the direction of the distorted magnetic field. The flux gate calibration procedure provides a method to correct for this distortion (caused by the vehicle/platform) of the earth's magnetic field and obtain the vehicle's actual magnetic heading.

Review the discussion of system accuracy in Chapter 1. Since the flux gate calibration only corrects for distortion of the magnetic field caused by the vehicle itself, 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.

mag.dwg
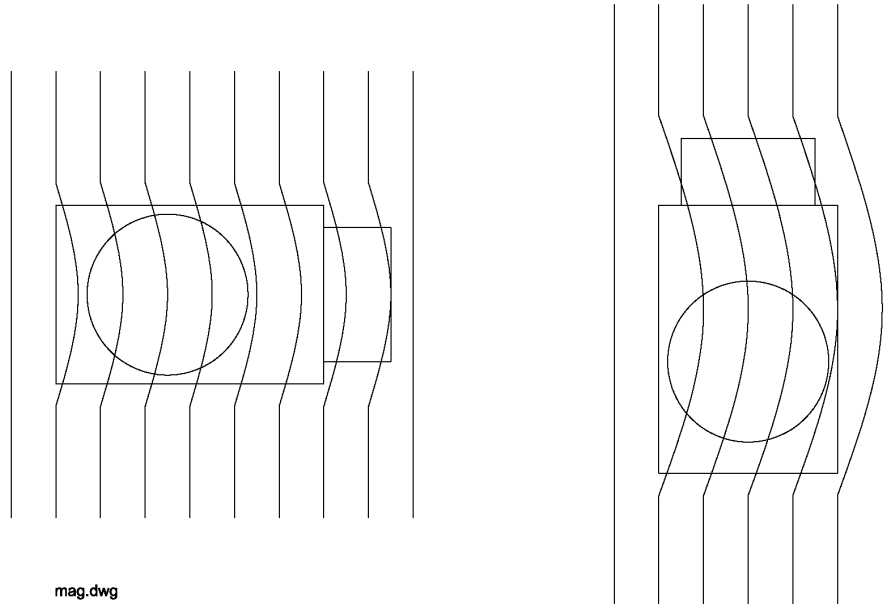
3. Trees and wooden objects pose no problem for calibration.

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 particular 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 Locator is only as good as its calibration.

Section 3.3.2.9 describes how to perform the compass calibration procedure.

2.4.2 Operational Presets

This section has been included in the outline because it may simplify the user's day-to-day operation. The user cannot make use of preset targets if they are never entered into the memory. This is a straightforward procedure, but one which can be overlooked once the system is installed, since the RC3000 functions perfectly well without the presets. However, the presets streamline the operation by allowing the user to tell the program very quickly what target is desired, without entering the data each time.

If a list of user preferred targets is available, they may be entered as described in sections 3.3.1.1.2.

2.4.3 Miscellaneous Adjustments

LCD Contrast (-2 configuraitons). An LCD contrast potentiometer (P2) is located on the RC3000 digital board. This potentiometer will be set at the factory, but the user may want to adjust its setting for a particular installation's lighting conditions.

Setting Time. Set the time, specify local time zone and offset per instructions for Time Maintenance (3.3.2.3.)

3.0 DETAILED OPERATION

3.1 Operation Overview

3.1.1 Modes

The functionality of the RC3000 is achieved by placing the controller in the desired mode of operation. The figure shows the hierarchy of the RC3000's modes. Each mode has a unique display screen that presents the information applicable to that mode's operation.

As the figure shows, 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.

← Transistion between groups by →
holding MODE key 3 seconds

| MANUAL 3.2.1 | MENU 3.2.2 |

| LOCATE 3.2.2.1 |
| STOW 3.2.2.2 |
| AZ LIMIT 3.2.2.3 |
| STORE 3.2.2.4 |
| RECALL 3.2.2.5 |
| DELETE 3.2.2.6 |

← →
Move between ↑
modes via
MODE key ↓

| SETTINGS 3.2.2.7 | POSITION 3.2.2.8 |

OPERATING GROUP

tropo_mode_map.dwg

| CONFIG MENU 3.3.1 | MAINTENANCE 3.3.2 |

| EXPERT ACCESS 3.3.1.1 to REMOTE CONTROL 3.3.1.19 |

| VOLTS 3.3.2.1 |
| DRIVE 3.3.2.2 |
| TIME 3.3.2.3 |
| SIG ADJ 3.3.2.4 |

AZEL 3.2.2.8	LIMITS 3.3.2.5
FLUX CAL 3.3.2.9	GPS 3.3.2.6
SHAKE 3.3.2.10	FLUXGATE 3.3.2.7

PROGRAMMING GROUP

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.

The rest of section 3.1 introduces common elements of all modes.

3.1.2 Keypad Usage

The keypad provides a flexible method of controlling the functionality of the RC3000. While each
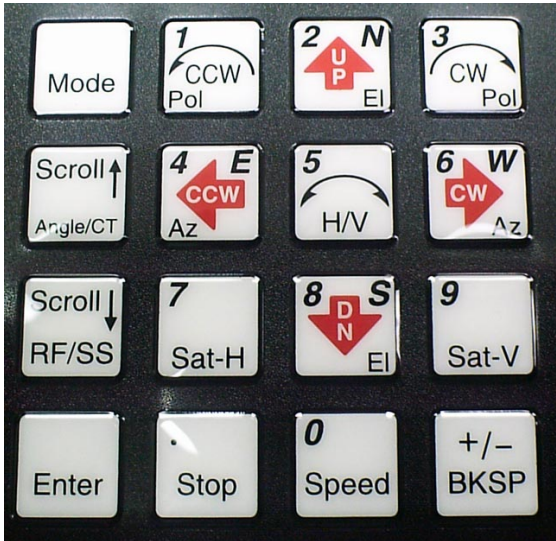
RC3000 mode has different requirements for user input, the use of the keypad remains consistent throughout all modes.

The keypad provides for both specific actions and general data input. As an example, the UP_2_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 following table describes both the specific action and general data entry function of each key.

KEY LABEL	SPECIFIC FUNCTION	GENERAL FUNCTION
Mode	no specific function	momentary push switches between modes within group button held for 3 seconds switches between operational and programming groups
Scroll Up/ Angle CT	no specific function	scrolls forward through lists provides YES answer to some prompts
Scroll Dn / RF/SS	no specific function	scrolls backward through lists provides NO answer to prompts
Enter	no specific function	complete entry of data select entry from list
1 Pol CCW	no specific function	supplies 1 for numeric entry *
2 N El UP	jogs elevation axis up when in MANUAL mode	supplies 2 for numeric entry * supplies NORTH for latitude entry
3 Pol CW	no specific function	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	no specific function	supplies 5 for numeric entry *
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	no specific function	supplies 7 for numeric entry *
8 S El DN	jogs elevation axis down when in MANUAL mode	supplies 8 for numeric entry * scrolls down during alphanumeric entries
9 Sat-V	no specific function	supplies 9 for numeric entry *
0 Speed	toggles motor drive speed between FAST and SLOW in MANUAL	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 (3.15) degree sign for lat/lon entry (38°56N) colon for time entry (12:34:56) slash for date entry (10/11/97)
+/- BKSP	provides way to exit out of certain conditions	toggles sign of numeric data entry when cursor at beginning of entry field backspaces one field to the left during data entry

* - numbered keys may also be used to select from a set of choices such as <1>LOCATE <2>STOW

3.1.3 Data Entry

Many RC3000 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:SATCOM K2)

To manually enter the name of a target or location, the user scrolls through the list of characters (A-Z, 0-9 and blank) and selects the character by pressing the Enter 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.

Note: scrolling through the alphanumeric characters is not implemented via the Scroll Up/Yes or Scroll Dn/No keys since these keys will typically be used to move forward or backward through other fields from the field requiring alphanumeric input.

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 Enter for a second time. The user may backup through the string by using the BKSP 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. When the input has been backed up past the first entry, the current value of the item will again be displayed. 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 (decimal pt.) Stop key.

Degree/Minute/Second Latitude/Longitude Entry (TRUCK LAT:38°56'27N)

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

Time/Date

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

3.1.4 Display Layout

The following screen shows many elements common to RC3000 mode displays.

```
AZIM:  50.2 (  50.2)                    MANUAL
ELEV:   0.9 (   0.9) <5>SET REFERENCE
                     <SPEED>FAST     UTC
<2,4,6,8>JOG ANTENNA <MODE>MENU 14:25:47
```

MODE TITLE: in the upper right corner the title of the current RC3000 mode is displayed – in this example MANUAL designates that the RC3000 is currently in manual mode.

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, AZIM: is the label for the current azimuth angle.

DATA VALUES: the current value of relevant data for the mode is displayed following the appropriate data label. In the example, the current azimuth angle (AZIM:) is 50.2.

USER PROMPTS: since each mode requires unique (but similar) keypad inputs, prompts for relevant user action are included to the extent possible. In the above example, <5> tells the user that pushing the 5 key will reset the displayed reference angles. There are several types of user data inputs as described in 3.1.3.

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 RC3000 is functioning. In the above example, the current system time (14:25:47) is displayed and changes once per second.

ALARM STATUS: while not shown in the above example, row 4 is used to display any alarm conditions the RC3000 has detected. The alarm message will alternate with the text normally on row 4. See section 3.4 for more description of the alarm system.

3.2 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 RC3000's automatic movement features. While in either one of these modes, a momentary push of the Mode key will transition the RC3000 to the other mode.

POWER ON

Upon powering up the RC3000, an identification screen is displayed for five seconds. The software version data is discussed in 1.2 (Controller Features).

```
  RC3000A MOBILE ANTENNA CONTROLLER
    (c) RESEARCH CONCEPTS INC. 2010
        SHAWNEE, KANSAS    (USA)
SW:RC3K-Q1-GNRN            version 1.60
```

Also at power up, "expert access" permission is disabled in order to keep operators from automatically having the ability to change ACU programming values. If required, expert access will have to be enabled via the SETTINGS mode described in section 3.2.2.7.

TRAILER POSITION CONFIRMATION

Following the power on screen, the RC3000 transitions to the appropriate screen based on whether or not a mount position (latitude/longitude/true heading) has been "saved".

If the mount's position has been previously saved due to a LOCATE operation (3.2.2.1) or via the POSITION mode (3.2.2.8) or the STORE (3.2.2.4) mode, the following screen appears at power up requesting that the user confirm that this position is correct (i.e. the mount hasn't moved since the position was saved). The SAVED MOUNT POSITION screen shows the position and the date and time that the position was saved.

```
19OCT10 15:47     SAVED TRAILER POSITION
39°01'47N  94°49'23W 292.9 T
          HAS TRAILER MOVED?
<BKSP>YES                  <SCROLL UP>NO
```

If the saved position is still appropriate, pressing the Scroll Up/Yes key will instruct the RC3000 to continue to use that position. The RC3000 will use the saved position rather than attempting to automatically determine position.

Note that using a saved position may be desirable because the ACU may have been powered off but not physically moved. Also the saved position may have been manually determined and inserted due to a possible navigation sensor (GPS receiver or fluxgate compass) malfunction. Using a saved position also allows the LOCATE mode to instantly begin calculating pointing solutions rather than waiting for the GPS receiver to form a navigation solution.

If the user determines that the saved mount position is no longer appropriate (the trailer has moved), pressing the BKSP key will invalidate the saved position. The RC3000 will then proceed to MENU mode. The LOCATE mode will automatically attempt to determine latitude/longitude from the GPS receiver and heading from the fluxgate compass.

3.2.1 Manual Mode

In MANUAL mode, the user may jog the antenna in azimuth and elevation. Since the RC3000 has no electrical feedback with respect to the state of various mechanical components (stow latches, feedboom pins, high wind supports, messenger cables, etc.), anytime MANUAL mode is entered the following warning screen is displayed.

```
**** CAUTION - ENTERING MANUAL MODE ****
WHEN JOGGING ANTENNA, ENSURE MECHANICAL
    COMPONENTS ARE IN SAFE POSITION
<3>PROCEED                    <MODE>EXIT
```

By pressing the 3 key to enter MANUAL mode, the operator is taking responsibility to safely move the antenna.

MANUAL mode will typically be entered following a LOCATE operation. At that time the azimuth and elevation will be have automatically moved to their calculated positions. 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.

```
AZIM: 181.2 (181.2)                 MANUAL
ELEV:   0.7 (  0.7)   <5>SET REFERENCE
                      <SPEED>FAST      UTC
<2,4,6,8>JOG ANTENNA <MODE>MENU 14:25:47
```

AZIM:
MAG:

The azimuth field shows a current position value of the azimuth axis. 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 antenna angle (AZIM) or magnetic heading (MAG) values.

If antenna position is available when entering MANUAL mode, the field will be initialized in the display mode selected by the initial_azimuth_display configuration item (3.3.1.2.3) (typically "MAG").

If antenna position is not available when entering MANUAL mode, the field will initially display antenna position ("AZIM").

The magnetic heading (and target) value is derived by taking the current heading estimate of the mount (see the LOCATE function) and adding the antenna angle. If there is currently no mount heading estimate, the field will display "-------".

The status of "hard" azimuth limits (STOW, CCW, CW) take precedence to target position. The software derived azimuth range limits (cw, ccw) will also take precedence.

ELEV:

The ELEV field shows a current position value of the elevation axis. It also shows the status of elevation limits (STOW, DOWN, UP). The elevation axis may be moved by pressing the El Up or El DN keys.

<5>SET REFERENCE

After the operator has manually peaked the antenna, he may have the previous reference azimuth and elevation positions (in parenthesis) updated by pressing the 5 key. When pressed, the current azimuth and elevation angles will be displayed within parenthesis.

<SPEED>

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

<MODE>MENU

A momentary push of the Mode key will move the controller from the MANUAL mode to the MENU mode.

TIME DISPLAY

MANUAL mode will display the reference time (1.3.5) and time zone in the lower right hand corner.

3.2.2 Menu Mode

MENU mode allows the user to select one of listed modes. Pressing the Mode key will move to MANUAL mode. Note: RECALL and DELETE will not be displayed if no targets are currently STOREd. Also note that POSITION will not be available unless expert access has been enabled via the SETTINGS screen.

```
1-DEPLOY/LOCATE 2-STOW 3-AZ LIMIT   MENU
4-STORE    5-RECALL 6-DELETE
7-SETTINGS 8-POSITION               UTC
<0-9>SELECT <MODE>MANUAL       14:37:23
```

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

3.2.2.1 Deploy/Locate

The DEPLOY/LOCATE mode performs a calculation of the pointing angle (1.3.4) to a selected target based on the RC3000's estimate of where the antenna is located (lat/lon) and oriented (true heading). After the calculation is performed the user may initiate an automatic sequence of antenna movements to the calculated antenna position.

Typically, LOCATE mode will be first entered after the trailer has been repositioned and the antenna is still stowed. When LOCATE is first entered the following screen appears.

```
                                         DEPLOY
         * ANTENNA DEPLOYMENT REQUIRED *
         VERIFY STRAPS & LATCHES REMOVED
    READY TO PROCEED?   <ENTER>-YES <MODE>-NO
```

After confirming that all stowing gear has been unlatched by pressing ENTER, the antenna will be automatically moved to the "SETUP" position. The SETUP position is a defined elevation angle where the user can access the collapsible feed spars. NOTE: the SETUP elevation position may be programmed in the STOW/DEPLOY configuration screen (3.3.1.3.6).

```
    AZIM:   0.0 (   0.0)                  DEPLOY
    ELEV: -90.0 ( -65.0)


    MOVING TO (SETUP POS) <STOP>HALT MOTION
```

After reaching the SETUP position, the user is prompted to lock in the feedhorn's pins.

```
    AZIM:   0.0 (   0.0)                  DEPLOY
    ELEV: -65.0 ( -65.0)
     INSERT HIGH WIND FEEDHORN SUPPORT PINS
    READY TO PROCEED?   <ENTER>-YES <MODE>-NO
```

After confirming the feedhorn support pins have been locked, the antenna will move to the defined deploy position and switch mode annotation from DEPLOY to LOCATE.   At this reference antenna position, the ACU will pull in data from the GPS and compass. During the time that the data is being obtained, the message "DETERMINING ANTENNA LAT/LON/HDG" will be displayed on the bottom line.

The current latitude, longitude and true heading where the RC3000 believes the antenna is positioned will be displayed on the top line. The position data obviously affects the pointing angle that the RC3000 calculates and is displayed as a crosscheck for the user in case the vehicle has been moved and the RC3000's position has not been updated.   If the lat/lon or heading data is not considered valid by the RC3000, asterisks will be displayed in the appropriate field and the "PARAMETER NEEDED" message will be triggered in the location readiness field.

The RC3000 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 RC3000 and the GPS receiver would need to be checked. If the RC3000 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 not last for more than a minute. If it does, then investigate whether or not 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 RC3000 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 RC3000 will poll the fluxgate 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 (3.2.2.8).

When antenna position data is obtained, LOCATE mode calculates the pointing solution to the last selected target location.

```
 LS:39°01'47N  94°49'23W 292.9 T   LOCATE
 RS:40°12'34N  95°17'23W 343.2 T
             TRAILER AZIM:  50.2   DIS: 85
<1>SELECT NEW TARGET   READY TO PROCEED?
```

NOTE: this screen is slightly different when a magnetic heading (vs. lat/lon) target has been selected (see 3.2.2.3.2 below).

LS: 39°01'47N 94°49'23W 292.9 T

The LS: (Local Site) field shows the RC3000's estimate of antenna position (lat/lon/T(rue) heading).

RS:40°12'34N 95°17'23W 343.2 T

The RS: (Remote Site) field shows the lat/lon of the currently selected target along with the calculated true heading to the target.

NOTE: if a target magnetic heading has been selected, this field will be different as described in 3.2.2.3.2 below.

TRAILER AZIM: 50.2   DIS: 85

The third line of the display shows the antenna azimuth angle required to point towards the target along with the calculated distance (statute miles) to the target.

NOTE: if the calculated distance is greater than 999 miles, then "***" will be displayed.

<1>SELECT NEW TARGET   READY TO PROCEED? / PRESS <ENTER>

With all the information present to generate a pointing solution, the LOCATE mode alternately flashes the messages "READY TO PROCEED" and "PRESS <ENTER>". At this time the user should cross-check the displayed local site, remote site and calculated azimuth pointing angle for sanity.

If the user requires selecting new target data, pressing "1" will enter into the target selection screen described in 3.2.2.1.1 below. Pressing <ENTER> will continue the automatic LOCATE sequence by entering the target elevation screen.

```
TARGET ELEVATION:  0.0              LOCATE

<1>CHANGE TARGET ELEVATION
<BKSP>CONTINUE LOCATE          <MODE>EXIT
```

The default target elevation of 0.0 will initially be displayed.   If path analysis or some other form of data indicates that an elevation other than 0.0 would be optimum, then the user may press "1" and enter a target elevation between -5.0 and 10.0.

When the desired target elevation has been entered, the automatic LOCATE process may be continued by pressing "ENTER". A screen appears showing the current antenna angles and the target azimuth and elevation angles in parenthesis. The first automatic movement will be in the elevation axis and the user is requested to confirm that all mechanical components are in a safe configuration for movement.

NOTE: this confirmation of movement safety may appear redundant but is included in case the LOCATE sequence was begun from a non-stowed antenna position. The ACU does not have electrical feedback with respect to the state of mechanical latches, etc. and the user is required to confirm that the antenna system is in a safe configuration for movement.

```
AZIM:    0.0 (  50.2)                    LOCATE
ELEV:    0.0 (   0.9)
   AUTOMATIC ELEVATION MOVEMENT PENDING
SAFE TO PROCEED?   <2>YES        <MODE>EXIT
```

After pressing "2" the elevation axis will be moved to the selected target elevation angle.

The next automatic movement will be in azimuth. For a similar reason as with elevation, the user is prompted to confirm azimuth movement is safe.

```
AZIM:    0.0 (  50.2)                    LOCATE
ELEV:    0.0 (   0.9)
   AUTOMATIC AZIMUTH MOVEMENT PENDING
SAFE TO PROCEED?   <7>YES        <MODE>EXIT
```

Following the azimuth movement, the LOCATE mode will switch to MANUAL mode (see 3.2.1). Note that the center of the azimuth range limit (typically +/- 15 degrees) will be automatically set at the azimuth target position.

3.2.2.1.1 Target Selection

Information must be provided to describe a target to the RC3000 before a pointing solution may be calculated.

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

```
1-MANUALLY ENTER TARGET LAT/LON    LOCATE
2-CHOOSE TARGET FROM PRESET LIST
3-MANUALLY ENTER TARGET MAG HEADING
<1-3>SELECT DATA SOURCE         <BKSP>EXIT
```

manual target entry

When the user chooses to manually enter the target data, a screen appears with fields to enter the lat/lon of the target.

```
                                   LOCATE
LAT:            LON:


ENTER LAT <DD.MM.SS>FORMAT THEN <ENTER>
```

Preset target list

```
                                        LOCATE
#  NAME            LAT            LON
 1 A          45°00'00N   44°59'00W
<SCR>THRU LIST <ENTER>SELECT <BKSP>EXIT
```

When the user chooses to select from the user programmed list of targets, a screen appears allowing the user to scroll through the list and select a target by pressing the Enter key. The preset list contains data for 20 targets programmed by the user via the Preset Target configuration mode (3.3.1.1.2).

Magnetic Heading

When the user chooses to select a magnetic heading for a target, the following screen appears.

```
TARGET MAGNETIC HEADING:   0.0

<1>CHANGE TARGET HEADING
<BKSP>CONTINUE LOCATE            <MODE>MENU
```

An initial heading of 0.0 is displayed. After pressing "1", the user may enter a target heading between 0.0 and 359.9. Pressing <BKSP> will return to the main LOCATE screen as described in the next paragraph.

3.2.2.1.2 Magnetic Target Heading

When a magnetic target heading has been selected, LOCATE mode calculates the trailer azimuth pointing angle as the difference between the local site magnetic angle and the target.

```
 LS:39°01'47N  94°49'23W 123.4 M  LOCATE
 RS: MAGNETIC HEADING      90.3 M
           TRAILER AZIM:  33.1   DIS:???
<1>SELECT NEW TARGET   READY TO PROCEED?
```

Notice that the DIS: field shows "???". When a magnetic heading is supplied, no distance to the target can be calculated.

3.2.2.2 Stow

The STOW mode automatically moves to the mount's predefined "stow" position. STOW requires an explicit confirmation to initiate movement.

```
A) HIGH WIND SUPPORT REMOVED?        STOW
B) WAVEGUIDES DISCONNECTED?
C) MESSENGER CABLE REMOVED?
READY TO PROCEED?    <BKSP>-YES <MODE>-NO
```

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

```
AZIM:-123.4 (   0.0)                 STOW
ELEV:  55.1 ( -35.0)


MOVING TO (SETUP POS)  <STOP>HALT MOTION
```

The following describes a typical sequence of movements:

- the azimuth axis is initially moved to 5 degrees clockwise from the stow position in order to ensure that the final azimuth stow move is always accomplished from the same direction for consistency.

- the azimuth axis is then moved to its stow position (typically AZIM:0.0). After moving to this indicated position, the RC3000 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 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 the azimuth movement completes successfully, then the elevation axis will move to its "SETUP" position. When elevation reaches the SETUP position, the following prompt occurs:

```
AZIM:-123.4 (   0.0)                 STOW
ELEV:  55.1 ( -35.0)
       UNLOCK FEED SPARS FOR STOWAGE
READY TO PROCEED?   <ENTER>-YES <MODE>-NO
```

The user is required to confirm the feed spars have been unlocked. After confirmation, elevation will again go down and movement ends when the elevation stow limit is encountered.

Following completion of movement to the stow position, the RC3000 will return to MANUAL mode. The automatic movement may be terminated anytime by pressing the Stop key.

3.2.2.3 Azimuth Range Limit Control

This mode allows the user to enable or disable the dynamically set "azimuth range limit".

The displayed prompt on the MENU mode will depend on the current state of the azimuth range limit.

If the azimuth range limit is currently disabled, the MENU screen will display "3-AZ LIMIT ON" prompting the user that pressing the "3" key will initiate enabling the azimuth range limit. If "3" is pressed, the following screen appears.

```
** NOTE **                 ENABLE LIMITS
 COMMAND WILL SET AZIMUTH RANGE LIMITS
        AROUND CURRENT POSITION
READY TO PROCEED?    <BKSP>-YES <MODE>-NO
```

This prompt reminds the user that azimuth movement will be restricted ----

If the azimuth range limit is currently enabled, the MENU screen will display "3-AZ LIMIT OFF" prompting the user that pressing the "3" key will initiate disabling the azimuth range limit. If "3" is pressed, the following screen appears.

```
** WARNING **              DISABLE LIMITS
COMMAND WILL DISABLE AZIMUTH RANGE LIMIT
   INJURY OR EQUIPMENT DAMAGE MAY OCCUR
READY TO PROCEED?    <BKSP>-YES <MODE>-NO
```

Disabling the azimuth range limit implies that the ability to move in azimuth will not be restricted when in the MANUAL mode. If the limit is disabled, the alarm "* AZIMUTH RANGE LIMIT DISABLED *" will be flashed on the bottom line during MANUAL mode. In this condition the user is required to ensure that any azimuth movements are safe both from a mechanical and radiation emission pattern perspective.

3.2.2.4 Store

The STORE mode saves the current azimuth and elevation positions for use in later RECALLing the antenna positon.

When the STORE mode is entered, it is assumed that the user has peaked up on the target. The first screen that appears asks the user to confirm the data for the position to be stored. The POS(ition) displayed initially begins with "1" and increments every time another position is stored.

```
POS  AZIM  ELEV                       STORE
 1   50.2   0.9
   READY TO STORE AZIM & ELEV POSITION ?
<1>YES <2>NO                 <MODE>EXIT
```

If the user selects "1", the following screen will appear momentarily and the RC3000 will return to MENU mode.

```
                                      STORE
*** AZIM/ELEV DATA STORED ***
RETURNING TO MENU MODE
RECALL AZIM/ELEV VIA MENU-RECALL
```

If the STORE function is completed correctly, the mount's position will be saved (see POSITION 3.2.2.8). If the position is saved, the user will be asked to verify the position upon power up of the RC3000. If the mount has moved, STORED'd data will no longer be valid since the azimuth and elevation angles will no longer be correct.

3.2.2.5 Recall

NOTE: RECALL and DELETE modes will not be available from MENU if no targets are currently "STOREd".

Targets which have been stored in the controller's non-volatile memory (via STORE) can be recalled from the RECALL mode.

```
                                          RECALL
STORED POSITION: 1


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

Use the Scroll Up and/or Scroll Dn keys to scroll through the list of antenna positions stored in non-volatile memory. Press the ENTER key to select the desired position.

Antenna movement to the stored position will proceed similar to the STOW and LOCATE automatic movements. The user will be prompted to confirm all mechanical components are in safe configurations for movement. Antenna movement can be stopped at any time by pressing the Stop key.

3.2.2.6 Delete

The DELETE mode allows a stored target to be removed from non-volatile memory.

```
# OF STORED POSITIONS: 2          DELETE
DELETE: 1


<SCR>THRU LIST <ENTER>DELETE <MODE>EXIT
```

The user may scroll through the list of stored positions and delete the displayed position by pressing the Enter key. Note that at the end of the list is a delete all stored positions option. If no positions are stored, the message "RETURNING TO MENU" will momentarily appear and control will return to the MENU mode.

3.2.2.7 Settings

The SETTINGS mode provides a way to change expert access permission. It also provides a way to reset a drive error without going to the DRIVE RESET maintenance screen.

```
1-EXPERT ACCESS:OFF             SETTINGS


                             <0>RESET DRIVE
<1>CHANGE SETTING              <MODE>MENU
```

1-EXPERT ACCESS:OFF/ON
<5 DIGIT CODE>TOGGLE ON/OFF

In order to toggle expert access permission from OFF to ON or ON to OFF, the expert access code contained in appendix A must be entered.

At power up expert access permission will set to OFF thus requiring the user to enter the 5 digit code in order to access any functions described in the programming group of modes.

<0>RESET DRIVE

This selection is only available if an azimuth or elevation or polarization drive error (jam or runaway) is active. Selecting 0 will attempt to clear the error.

3.2.2.8 Position

The POSITION mode allows the user to set the latitude, longitude and heading of the vehicle for subsequent use in calculating pointing angles to targets. The first screen that appears shows the current mount position used in the RC3000. Note: Mount "position" consists of the mounts latitude, longitude and true heading of the azimuth centerline.

```
39°27'43N  94°47'23W GPS          POSITION
BRG:292.2.0 FLUXGATE             NOT SAVED


<1>LAT/LON <2>HEADING        <MODE>EXIT
```

3.2.2.8.1 LAT/LON

When the user chooses to modify latitude and longitude, a screen appears showing the current lat/lon and the source of that value. In the example screen the source shows that the current lat/lon was obtained from the GPS. If the current values had been entered manually "MANUAL" would show for the source. If there is currently no valid lat/lon "NO POS SOURCE" would be displayed.

```
     38°56N  94°44W GPS           LAT/LON

SELECT LAT/LON SOURCE #
<1>MANUAL <2>PRESET <3>GPS
```

The user is prompted to select what type of source (manual entry or gps) to use to modify lat/lon.

Manual Lat/Lon Entry

```
     38°56N  94°44W GPS           LAT/LON
LAT:       LON:

MANUALLY ENTER LAT/LON   <MODE>EXIT
```

The user is provided two fields to manually enter lat and lon. See 3.1.3 (Data Entry) for instructions on how to enter latitude and longitude.

GPS Lat/Lon

```
37°36N  97°18W WICHITA        LAT/LON
GPS:38°56N  94°44W 17:36:59


<ENTER>USE GPS LAT/LON     <BKSP>EXIT
```

The current lat/lon the gps has calculated is displayed. The UTC the gps is outputting is also displayed to show that the data is being updated. To select this lat/lon press the Enter key. Note that if the gps is not reporting a valid position fix the message "WAITING FOR GPS" will appear.

3.2.2.8.2 HEADING

When the user chooses to modify heading, a screen appears showing the current heading (HDG:) and source (SRC:) of heading. If valid heading data is coming from the fluxgate, this data will appear in the FLUX HDG: field. The MAG VAR: field displays the calculated magnetic variation for the current lat/lon/date. If the RC3000 thinks it needs to recalculate magnetic variation (thinks lat/lon has changed) the MAG VAR: field will flash "CALC". The magnetic variation calculation may take up to 10 seconds.

```
FLUX HDG:214.3     HDG:180.0     HEADING
 MAG VAR:  3.8      SRC:MANUAL
  AZ OFF:  0.0 <1>MAG <2>TRU <3>COMPASS
TRUE HDG:218.1 SELECT SOURCE <MODE>EXIT
```

To modify the heading to the value determined via the fluxgate (flux heading + azimuth offset +mag var) press the 3 key.

If the user wishes to enter a magnetic heading of the vehicle press 1.

```
MAG HDG=>          HDG:180.0     HEADING
 MAG VAR:  3.8      SRC:MANUAL
  AZ OFF:  0.0 <1>MAG <2>TRU <3>COMPASS
TRUE HDG: **** SELECT SOURCE <MODE>EXIT
```

After the magnetic heading is entered, the RC3000 will apply the magnetic variation and azimuth offset to generate the true heading of the mount's azimuth centerline.

 If the user wishes to manually enter true heading press the 1 key and the prompt to enter heading will appear on line 3 as shown below.

```
FLUX HDG:214.3     HDG:180.0     HEADING
 MAG VAR:  3.8      SRC:MANUAL
  AZ OFF:  0.0     ENTER HDG=>
TRUE HDG:218.1 SELECT SOURCE <MODE>EXIT
```

3.3 Programming Group

The programming group has two high-level modes (CONFIG-MENU and MAINTENANCE). Both of these 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.

3.3.1 Configuration Mode

The CONFIG mode allows users to view and/or modify various controller parameters and to enable or disable certain features. Many configuration items are used to customize the RC3000 to work with a particular installation.

The CONFIG mode groups configuration items into screens containing between 1 to 10 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:

```
REF_V:2.50 OFF: 0.0          CONFIG-AZIM
  CCW:180    CW:180    SF:65.62


SET REFERENCE VOLTAGE <2.00 - 3.00>
```

In this example there are nine 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 3.1.3. 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 (3.3.1.1.1) is set.

Additional configuration item screens may appear if they are unique to an optional feature (inclined orbit tracking, remote control, 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	3.3.1.1.1
TARGET PRESETS	LIST OF PRESET TARGETS	3.3.1.1.2
INSTALLATION ITEMS		
SYSTEM DEFINITON	DEFINE SYSTEM OPTIONS	3.3.1.2.1
ELEVATION CALIBRATION	EL REFERENCE VOLTAGE/LIMITS/SCALE FACTOR	3.3.1.2.2
AZIMUTH CALIBRATION	AZ REFERENCE VOLTAGE/LIMITS/SCALE FACTOR	3.3.1.2.3
SUPER-USER ITEMS		
RESET DEFAULTS	RESTORES PROGRAMMING TO FACTORY DEFAULTS	3.3.1.3.1
AZIMUTH POT DRIVE	AZIMUTH POT-BASED DRIVE PARAMETERS	3.3.1.3.2
AZIMUTH DRIVE MONITORING	AZIM ANTI-REVERSE/JAM/RUNAWAY SENSING	3.3.1.3.3
ELEVATION POT DRIVE	ELEVATION POT-BASED DRIVE PARAMETERS	3.3.1.3.4
ELEVATION DRIVE MONITORING	ELEV ANTI-REVERSE/JAM/RUNAWAY SENSING	3.3.1.3.5
STOW & DEPLOY	AZ/EL STOW & DEPLOY POSITIONS	3.3.1.3.6
SHAKE	SETUP SHAKE MOVES/CYCLES/DELAY	3.3.1.3.7

3.3.1.1 NORMAL ACCESS ITEMS

The three configuration groups contained in the "Normal" access items allow the user to change items that would typically be required to be changed following system configuration.

3.3.1.1.1 Expert Access Permission

```
EXPERT ACCESS:      0        CONFIG-EXPERT



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

Expert Access Permission is used to control access to installation specific items. When the expert_mode_active_flag is set to SUPER-USER level(2), the user has access to all controller modes and all CONFIG mode items. When the expert_mode_active_flag is set to INSTALL level (1), the user has access to all controller modes and the most typically used CONFIG mode items. When the expert_mode_active_flag is set to NORMAL level(0), the user is locked out of several modes and most CONFIG mode items. The purpose of this feature is to keep an operator away from the modes and CONFIG mode items which can change the contents of the controller's non-volatile memory.

When the Expert Access screen is displayed, the present state of the expert_mode_active_flag is displayed in the data entry field. A display value of 2 indicates that the expert_mode_active_flag is set to SUPER-USER level, a value of 1 indicates that the flag is set to INSTALL level and a value of 0 indicates that the flag is set to NORMAL level. To toggle the state of the flag, the user must key in a 5 digit code at the prompt followed by the ENTER key. This code is found in a removeable Appendix A at the end of this manual. If the information is lost, call the factory for assistance.

<u>3.3.1.1.2 Preset Targets</u>

This group allows the user to customize a list of 20 commonly used targets. The LOCATE mode allows the user to select a target (3.2.2.1.1) from this "preset" list.

```
     #: 1                     CONFIG-TARGETS
NAME:A           LAT: 45°00'00N
                 LON: 44°59'00W
<SCR> THRU LIST, <ENTER> TO SELECT
```

#:   **<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: **ENTER <ALPHANUMERIC> TARGET NAME**

This field allows a user to enter a name (up to 10 characters). See section 3.1.3 for instructions on how to enter alphanumeric data. After the name is entered, the cursor will move to the LAT field.

If you do not wish to change the current name, pressing the Scroll Up key will move to the LAT field. Scroll Dn will move back to the # field.

LAT: **ENTER LAT IN <DD.MM.SS> FORMAT**

This field allows a user to enter a target's latitude in deg/min/sec format. See section 3.1.3 for instructions on how to enter target latitude. After the lat is entered, the cursor will move to the LON field.

If you do not wish to change the current latitude, pressing the Scroll Up key will move to the LON field. Scroll Dn will move back to the NAME field.

LON: **ENTER LON IN <DDD.MM.SS> FORMAT**

This field allows a user to enter a target's longitude in deg/min/sec format. See section 3.1.3 for instructions on how to enter target longitude. After the lon is entered, the cursor will move to the LON field.

If you do not wish to change the current longitude, pressing the Scroll Up key will move to the # field. Scroll Dn will move back to the LAT field.

NOTE: the preset list only contains data about a target. With respect to the RC3000, there is sometimes confusion between the preset list and the list of STOREd target data (3.2.2.4). STOREd data contains mount (azimuth & elevation) position data.

3.3.1.2 INSTALLATION ACCESS ITEMS

This set of configuration groups allows the user to modify parameters that are most typically changed for a particular installation.

3.3.1.2.1 System Definition

```
     GPS: 2                    CONFIG-SYSTEM
 COMPASS: 1          SN:1234     WAVEGUIDE:0
    MODE: 2   ANT_SIZE: 120
<0>NONE <1>COMMERCIAL <2>DAGR
```

The CONFIG-SYSTEM screen allows the user to indicate the existence of optional equipment. Indicating that the item is not present will keep the controller from waiting for a valid response from the item in various modes. For example, if the GPS receiver is not present, the RC3000 will simply report "NO GPS PRESENT" vs. waiting for a period of time to decide that it is not receiving data from the GPS.

GPS :   <0>NONE <1>COMMERCIAL <2>DAGR

This item specifies what type of GPS receiver is present. If specified as NONE (0), the "NO GPS PRESENT" message will be displayed in various RC3000 screens.

For TFLA, the default value is 2 (DAGR).

COMPASS: <0>NONE <1>TRUCK MOUNT <2>ANTENNA MOUNT

This item specifies whether or not the optional fluxgate compass is present and how the compass is mounted if it is present. If the compass is specified as "antenna mounted", the RC3000 will require that the dish be moved to the DEPLOY position to obtain magnetic heading information.

If the compass option was not purchased, this field will always remain at 0.

SN: SERIAL NUMBER<1-9999> (0=NOT ENTERED)

The serial number of the controller may be entered in this field for easy reference later. The value of this field does not affect of the controller's functions.

MODE: INITIAL MODE <1-LOCATE 2-MENU 3-MANUAL 4-VSAT 5-POS>

This item specifies to which of the modes listed the RC3000 will go to upon power up.

Selections 1, 2, 3 or 5 will direct the RC3000 to go to LOCATE, MENU, MANUAL or POSITION mode upon power up. For example, if the controller does not have the GPS and compass options, the user may want to power on to the POSITION mode.

ANT_SIZE: ANTENNA SIZE <1-9999 CM>

This item specifies the size of the reflector in centimeters. For example, a 5.9 ft. diameter reflector (1.8 m.) would require a value of 180 (cm.) be specified.

The antenna_size_cm is used by inclined orbit tracking algorithms to characterize the antenna's beamwidth thus affecting timing of various tracking movements. The value is also used by autopeak algorithms to determine the size of autopeak step movements.

WAVEGUIDE: WAVEGUIDE SWITCH <1>PRESENT <0>NOT PRESENT

This item specifies whether or not the optional waveguide switch control module is present.

3.3.1.2.2 Elevation Calibration

```
REF_V:1.69 OFF:  0.0          CONFIG-ELEV
 DOWN:  0   UP: 90.0   SF:50.00
 LOOK:1
SET REFERENCE VOLTAGE <0.50 – 4.50>
```

REF_V: **SET REFERENCE VOLTAGE <0.50 - 4.50>**

The elev_zero_voltage defines the voltage present when the elevation axis is at its reference position .
See the elevation zero voltage installation step.

OFF: **ELEVATION OFFSET <-25.0/+25.0 DEGREES>**

The elev_squint_factor configuration item corrects for discrepancies between the antenna's electrical and
mechanical bore sight alignment. The squint factor also compensates for errors in the attachment of the
elevation position sensor. The elevation squint factor is the difference between the antenna's theoretical
and actual elevation pointing angle. The value for this constant is determined during the elevation
alignment calibration procedure (2.3.2). The VALUE OF THIS CONSTANT MUST BE SET TO 0.0
BEFORE THE ELEVATION CALIBRATION OCCURS. The nominal value of this constant is 0.0.

DOWN: **SET DOWN LIMIT <0-90 DEGREES>**
UP: **SET UP LIMIT <0-90 DEGREES>**

The down_elev_limit and up_elev_limit configuration items specify the valid elevation operating range in
degrees. If the LOCATE mode calculates a target elevation outside of this range, an elevation range
error will be triggered.

The spiral search algorithm (when based on pot-based movements) also uses these values to limit the
area that may be searched.

SF: **SCALE FACTOR <30.00 – 60.00 mV/deg>**

The elev_scale_factor_mv_deg configuration item specifies the observed output of the elevation
inclinometer.

EL_LAT: **ELEV LOOK CONFIGURATION <1>HIGH <0>LOW**

The elevation_lat_configuration item is used for mount types that have different feed boom configurations
to achieve different elevation pointing angles. The reported elevation angle will be offset by different
values according to whether the high or low elevation configuration is specified. Other elevation related
items such as stow and deploy positions will also be affected. **NOTE: for mounts that have only one
feed boom configuration, this configuration item may be set to either value with no consequence.**

3.3.1.2.3 Azimuth Calibration

```
REF_V:2.50   FG: 0.0             CONFIG-AZIM
   CCW:180    CW:180     SF:65.62
                                     DISP:1
SET REFERENCE VOLTAGE <2.00 - 3.00>
```

REF_V: SET REFERENCE VOLTAGE <1.00 - 4.00>

The azim_zero_voltage defines the voltage present when the azimuth axis is in its center of motion. See the azimuth zero voltage installation section 2.3.3.

CCW: SET CCW LIMIT <0 TO 360 DEGREES>
CW: SET CW LIMIT <0 TO 360 DEGREES>

These items specify the antenna's azimuth range of travel relative to the antenna's center azimuth (0.0) position. These positions are used to trigger the display of the Reposition Truck message. When the RC3000 calculates an antenna pointing solution in LOCATE mode, it checks these values to see if the dish can be physically moved to that position. Thus the Reposition Truck message is displayed when the antenna is incapable of moving to the azimuth position required to intercept the desired target. These values are also used by autopeak algorithms to limit the area the autopeak movements will search.

Note that these values are not used to actually limit the motion of the antenna. The antenna's azimuth limits are set using potentiometers inside the controller (see 2.3.1.4 - Azimuth and Polarization Electrical Limits). The CW Range should be set to the azimuth position which is displayed when the antenna is at the CW limit. In a similar manner, the CCW Range should be set to the azimuth position which corresponds to the controller's azimuth counter-clockwise limit. Note that the values are entered as a positive value, the controller will adjust the sign of the entered quantity internally.

FG: FLUXGATE OFFSET <-180.0/+180.0 DEGREES>

The azim_cal_offset 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. A value other than 0 may need to be entered to correct for some mechanical misalignment in the system (see Azimuth and Elevation Alignment 2.5.2).

This value will also need to be set if there is an intentional difference between the alignment of the compass and the centerline of azimuth movement.

SF: SCALE FACTOR <1.00 – 90.00 deg/volt>

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.

DISP: INITIAL AZIM DISPLAY<1-ANT 3-MAG 4-TRUE>

This value allows the user to select what format (antenna angle, magnetic heading or true heading) the azimuth position is initially displayed in the MANUAL and LOCATE modes. Traditionally, the antenna angle derived from the mount position sensor is the format displayed by the RC3000.

3.3.1.3 Super-User Access Items

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

3.3.1.3.1 Reset Defaults

```
RESET CODE:      0        CONFIG-DEFAULTS



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

The CONFIG-DEFAULTS screen is used to reset the controller's non-volatile memory. When this occurs, the various CONFIG mode items are initialized to a default value. This operation is usually performed at the factory. Access to this item is allowed only when the *Expert Access* flag is set. To reset the system memory, the user must key in the same 5 digit code used for Expert Access, followed by the ENTER key.

Sections 3.3.1.1, 3.3.1.2 and 3.3.1.3 explain the items covered by the three levels of access: normal, installation and super-user.

NOTE: the two expert access codes are contained in appendix A. This appendix may have been removed by a system manager to limit use of the codes.

Appendix B provides tables of factory defaults for each mount type supported. It is strongly suggested that the appropriate table be used to record installation specific data should this data somehow become corrupted in the controller.

3.3.1.3.2 Azimuth Pot Drive

The CONFIG-AZ POT screen contains configuration items for calibrating large automatic azimuth movements based on angle (potentiometer or resolver-based) position feedback. See the Drive System theory section 1.3.7.

```
                          CONFIG-AZ POT
FAST/SLOW:  0.5     COAST: 0.0
MAX ERROR: 0.01     TRIES:  3
SET ZERO VOLTAGE <2.00 - 3.00>
```

FAST/SLOW: **SET THRESHOLD <0.0-10.0 DEGREES>**

During an automatic move, the azim_fast_slow_threshold configuration item is used to set the number of degrees before a target position is reached, when the controller switches the speed of the drive from fast to slow.

MAX ERROR: **SET MAXIMUM ERROR <0.01 - 1.00 DEGREES>**

The azim_max_position_error configuration item sets the maximum acceptable error between the final resting position and a target position during an automatic move.

COAST: **SET COAST RANGE <0.0 - 2.0 DEGREES>**

During an automatic move, the azim_coast_threshold configuration item sets the number of degrees before the target position is reached where the drive will be deactivated. The idea is to deactivate the drive and let the antenna coast into position. If prior to the initiation of the move operation, the total number of degrees that the actuator has to move to reach the target position is less than the *'Coast Threshold*, the drive will be deactivated when its position is within *'Max Position Error* of the target position.

TRIES: **SET MAX NUMBER OF TRIES <0-10>**

The azim_auto_move_max_retry_cnt configuration item sets the maximum number of attempts which will be made to hit a target position (within **Max Error** - described above) during an automatic move based on angle feedback.

<u>3.3.1.3.3 Azimuth Drive Monitoring</u>

The items on this screen deal with the background checking performed on the azimuth drive system. Note that in this context "slop" may be typically considered relating to mechanical hysteresis.

```
                              CONFIG-AZ MON
JAM SLOP:     1      FAST DEADBAND: 1000
RUN SLOP:    50       SLOW DEADBAND:  500
SET JAM SLOP <0 - 1023>
```

JAM SLOP: **SET JAM SLOP <0 - 1023>**

The azim_jam_pot_slop item specifies the amount of sensed movement the controller wants to see before declaring a jam condition. See the Drive System theory section.

The entered value is in units of the resolution the RC3000's analog to digital conversion system. This resolution will depend on a particular mount's range of movement, etc. See appendix B for details for a particular mount.

The value should be set to avoid nuisance jams but allow a jam to be declared within a reasonable amount of time to avoid damage to the system. Too high of a value will trigger false jam conditions since the mount may sometimes not be able to move that far in the required interval. Too low of a value may allow mechanical slop in the system to appear as valid movement thus never triggering a jam.

Setting the value to 0 will disable the jam sensing since no movement will be required to be sensed to make the jam system think the mount has moved when it should. This may be a useful thing to do in emergency situations to alleviate unwanted jam declarations but should only be done temporarily vs. having an active jam sensing system.

RUN SLOP: **SET RUNAWAY SLOP <0-1023>**

The azim_runaway_pot_slop item specifies the amount of movement that may be sensed before a runaway condition is declared when the antenna is not supposed to be moving.

The entered value is in units of the resolution the RC3000's analog to digital conversion system. This resolution will depend on a particular mount's range of movement, etc. See appendix B for details for a particular mount. If the installation has pulse-based sensing this value will indicate the number of pulses the system may see before declaring a runaway.

If the entered value is too low, normal noise from the potentiometer or slight movement due to wind may trigger a runaway. If the value is too high, it may take a long time to generate a runaway. To essentially disable runaway sensing, set the value to 1023.

FAST DEADBAND: **SET FAST DEADBAND <0 - 9999 MSEC>**
SLOW DEADBAND: **SET SLOW DEADBAND <0 - 9999 MSEC>**

The azim_fast_deadband_msec and azim_slow_deadband_msec items are used for the anti-reversal system. To understand the purpose of these parameters, it is necessary to consider how position counts are accumulated. The feedback from the azimuth and elevation position sensors is pulses. When a pulse is received, the controller checks to see which way the antenna was last commanded to move. If the antenna is moving, or last moved, east (down), the azimuth (elevation) position count is decremented. If the antenna is moving, or last moved, west (up) the azimuth (elevation) position count is incremented.

In MANUAL mode, the user can jog the antenna. If the UP arrow key is depressed, the antenna will move up. If the user suddenly depresses the DOWN arrow key and the antenna drive signals were instantaneously reversed, the antenna continues to move up for some small period of time, then the antenna reverses direction and starts to move down. This can cause position count errors. When the antenna drive signals are configured for down movement but the antenna is still moving up, pulses which

are received would cause the elevation position count to decrement when the count should really be incremented because the antenna is really still moving up.

The anti-reversal system keeps the antenna from rapidly changing direction. If the antenna has been moving in a given direction, the *'Deadband* CONFIG mode items specify the amount of time that the system will wait before asserting the antenna drive lines to move the antenna in the opposite direction. There are 2 different *'Deadband* values specified - there are unique fast and slow speed values. If the antenna has been moving fast, the *'Fast Deadband* parameters specify the wait interval; if the antenna has been moving slow, the *'Slow Deadband* parameters specify the wait interval. Both *'Deadband* values are given in milliseconds.

3.3.1.3.4 Elevation Pot Drive

```
                          CONFIG-EL POT
FAST/SLOW:  0.5     COAST: 0.3
MAX ERROR: 0.01     TRIES:  3
SET THRESHOLD <0.0-10.0 DEGREES>
```

The CONFIG_EL POT screen contains configuration items for calibrating elevation movements based on potentiometer position feedback. See the Drive System theory section 1.3.6.

FAST/SLOW: SET THRESHOLD <0.0-10.0 DEGREES>

During an automatic move, the elev_fast_slow_threshold configuration item is used to set the number of degrees before a target position is reached, when the controller switches the speed of the drive from fast to slow.

MAX ERROR: SET MAXIMUM ERROR <0.01 - 1.00 DEGREES>

The elev_max_position_error configuration item sets the maximum acceptable error between the final resting position and a target position during an automatic move.

COAST: SET COAST RANGE <0.0 - 2.0 DEGREES>

During an automatic move, the elev_coast_threshold configuration item sets the number of degrees before the target position is reached where the drive will be deactivated. The idea is to deactivate the drive and let the antenna coast into position. If prior to the initiation of the move operation, the total number of degrees that the actuator has to move to reach the target position is less than the *'Coast Threshold*, the drive will be deactivated when its position is within *'Max Position Error* of the target position.

RETRY: SET MAX NUMBER OF TRIES <0-10>

The elev_auto_move_max_retry_cnt configuration item sets the maximum number of attempts which will be made to hit a target position (within **Max Error** - described above) during an automatic move based on potentiometer feedback.

3.3.1.3.5 Elevation Drive Monitoring

This group performs the same functions for the elevation axis as described in 3.3.1.3 (Azimuth Drive Monitoring)

<u>3.3.1.3.6 Stow & Deploy Positions</u>

The STOW & DEPLOY group allows the user to change the target positions for STOW and DEPLOY movements.

```
AZ_STW:   0.0  AZ_DEP:   0.0 CONFIG-STOW
EL_STW: -67.5  EL DEP:   0.0 EL_TIME: 0
AZ_RNG:  15.0   SETUP: -65.0 PL_ENABLE:0
AZIMUTH STOW <-180.0/180.0>
```

AZ_STW: 　　　　　**AZIMUTH STOW <-180.0/180.0>**
EL_STW: 　　　　　**ELEVATION STOW <-90.0/90.0>**

These items define the STOW position.

AZ_DEP: 　　　　　**AZIMUTH DEPLOY<-180.0/180.0>**
EL_DEP: 　　　　　**ELEVATION DEPLOY <-90.0/90.0>**

These items define the DEPLOY position. For TFLA this will be the position that the LOCATE mode moves to before gathering data from the GPS and compass (i.e. the "antenna reference" position.)

AZ_RNG: 　　　　　**AZIM RANGE LIMIT <0.0 - 30.0>**

This item defines the number of degrees clockwise and counterclockwise that azimuth may move after the azimuth range limit has been set.

SETUP: 　　　　　**SETUP ELEVATION <-90.0 - 0.0>**

This item defines the elevation at which the LOCATE and STOW sequences will automatically stop at so that the TFLA's feedboom pins may be put in their proper position.

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

This item defines whether or not 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.

EL_TIME: 　　　　　**ELEV STOW TIMER<0-DISABLE, 1-99 SECONDS>**

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 deenergized. For mounts where this is not the case, this item is ignored.

<u>3.3.1.3.7 SHAKE</u>

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

AZ #:   **MOVE # AZIM <-180.0/180.0>**

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

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

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

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

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".

3.3.2 Maintenance Items

```
1-VOLTS    2-DRIVE    3-TIME          MAINT
5-LIMITS   6-GPS COM 7-FG COM 8-MOVETO
9-FG CAL   0-SHAKE              .-CI RECORD
                               Z1-GTRv1.55
```

This screen provides a menu system for selecting the various maintenance screens described in the following paragraphs. Pressing the Mode key from this screen will return the controller to the CONFIG-MENU screen. The software options and version are displayed in the lower right corner.

Note that if expert access is not enabled, selections 9 (fluxgate calibration) and 0 (shake) are not made available.

3.3.2.1 Analog to Digital Voltage

The AD VOLTAGES maintenance screen shows the current voltage levels sensed at the microcontroller's 4 analog to digital inputs. The voltage will be displayed in the 0.001 to 5.000 range. If the microcontroller sees less than 0.001, it will display "UNDER".

Note that all of the analog to digital channels have some associated scaling and conditioning circuitry in the RC3000. Therefore the voltages seen at this screen will not be exactly the same as the input voltages external to the RC3000.

```
 AZ: 1.114                    AD VOLTAGES
 EL: 1.143 1                         L1:1
POL: UNDER                           L2:0
SIG: 3.756(1) <1>RF <2>SS1 <3>SS2 <4>AUX
```

AZ: / EL: / POL:

The first three A/D channels are dedicated to the azimuth, elevation and polarization position sensing inputs.

Next to the elevation voltage is displayed a 0 or 1. 0 means the elevation sensor circuit is currently operating in the "low" region while 1 indicates it is operating in the "high" region.

SIG:

The fourth channel (signal strength) is multiplexed between four sources (autopeak RF, signal strengths 1 and 2 and an auxiliary input).   Pressing keys 1-4 allow selecting of one of the signal source inputs for display.

On first generation controllers, the signal source # 4 is tied to ground and should indicate a value close to 0.000 (maybe UNDER). On second generation controllers, this input may be used for other signals (see your appendix B).

L1: / L2:

These fields show the status of the signal lock 1 and 2 inputs. A logic high signal is indicated by a "1".

3.3.2.2 Drive Error Resets

```
1-AZIM: JAMMED                    DRIVE RESET
2-ELEV: RUNAWAY      4-RESET PULSE  COUNT
3- POL: OK                  (AZ/EL AT STOW)
RESET <1-3>AXIS <4>PULSES      <MODE>EXIT
```

The DRIVE RESET maintenance screen provides the way to reset drive system errors (JAMMED / RUNAWAY / DRIVE) for each axis. See the drive system theory section (1.3.6) for description of these conditions. An axis' drive status may be reset by pressing the corresponding key.

These screen also provides for resetting the azimuth and elevation pulse counts to their reset state of 32768 (middle of azimuth range) and 100 (bottom of elevation range).

3.3.2.3 Time Maintenance

The Time Maintenance screen allows the user to set the system and reference (see section 1.3.5) time.

Note that all dates are displayed and entered in day/month/year (DD/MM/YY) format. All times are displayed and entered in hour/minute/second (HH:MM:SS) format. Refer to section 3.1.3 for instructions on entering date and time.

```
 SYSTEM:11/10/97 22:26:40            TIME
GPS UTC:*GPS OFFLINE*           ZONE:CST
DISPLAY:11/10/97 16:26:40     OFFSET:- 6
1-DATE 2-TIME 3-SYNCH 4-ZONE 5-OFFSET
```

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

Current date and time as maintained by the RC3000's real-time clock.

GPS UTC:

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.

DISPLAY:

Current "reference" 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.

ZONE:

A three character alphanumeric timezone 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 next.

1-DATE   **ENTER DATE DD.MM.YY**

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

2-TIME   **ENTER 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-SYNCH

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

    4-ZONE   ENTER 3 LETTER TIME ZONE

The user may enter three alphanumeric characters (ex. CST) for a timezone 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.

3.3.2.5 Limits Maintenance

```
AZIM CW:0  CCW:1  STOW:0 (0-OFF)  LIMITS
ELEV UP:1   DN:1  STOW:1 (1- ON)  ACTIVE
 POL CW:0  CCW:1  STOW:*
<BKSP>MAKE LIMITS INACTIVE    <MODE>EXIT
```

The limits maintenance screen shows the current state of each limit switch as sensed by the RC3000's microcontroller. The state of each limit is shown as 0 if off or 1 if on. An * is displayed if the particular limit switch is not relevant for the particular mount (there is no POL STOW switch in the above example).

<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.

Note that even if software limit sensing is made "INACTIVE", there are cases where movement of an axis may still be inhibited by hardware logic (sensing the state of limit switches) on the analog drive board. Good knowledge of how the various limit switches in a system are mechanized is required to determine if the limits inactive state will help in debugging any problems.

3.3.2.6 GPS Serial Port Diagnostics

This screen allows the user to ascertain if the GPS receiver is communicating correctly with the RC3000.

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

The screen shows the raw ASCII data coming from the GPS receiver. 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,133544,V,3856.0856,N,09444.8377, W,000.0,000.0,080499,003.6,E*7B

NOTE: nine characters 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. A "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.

Another sentence "$PGRMT" is transmitted once a minute.

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 10 seconds of entering this mode.

3.3.2.7 Fluxgate Serial Port Diagnostics

This screen allows the user to ascertain if the fluxgate compass is communicating correctly with the RC3000.

```
                                 FLUXGATE
$HCHDM,266.1,M*2A≡≡≡$HCHDM,266.0,M*2B≡≡
HCHDM,266.0,M*2B≡≡≡$HCHDM,266.0,M*2B≡≡$
$HCHDM,266.0,M*2B≡≡  HCHDM,266.0,M*2B≡≡
```

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.

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.

3.3.2.8 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.

```
AZIM:-123.4 ( 123.4)                MOVETO
ELEV:  41.5 (  41.5)  <5>SENSOR:PRIMARY
                      <3>SPEED:FAST
SET <1>AZ <2>EL<6>POL <4>START MOVE
```

The current azimuth and elevation angles are displayed. When the mode is first entered, the current positions are shown as the target positions. After setting target positions and setting the desired speed, the automatic movement may be initiated by pressing the 4 key.

<5>SENSOR:PRIMARY

The state of this field when this mode is entered will be "PRIMARY". This means that the displayed angles and entered targets are generated and referenced to the axis sensor that generates angles. For instance, the typical primary elevation sensor is the electronic inclinometer.

If the mount is equipped with higher resolution sensors such as resolvers or pulse sensors, toggling the field to "SECONDARY" will cause the display and target to change to an integer representative of the high resolution sensor. This mode of operation allows actions such as the small movements made during inclined orbit tracking to be simulated.

3.3.2.9 Fluxgate Calibration Procedure

The fluxgate 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 the calibration in section 2.4.1.

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 procedure may be exited by hitting the Mode key.

```
                    8 PT COMPASS CAL



<ENTER> TO BEGIN CAL <MODE> TO 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 PREFFERRED)
MAG ENVIRON:7       (0-9,>5 PREFFERRED)
CALIBRATION FINISHED, <MODE> TO EXIT
```

COMM ERROR

At any time during the calibration procedures the RC3000 detects an abnormal response from the fluxgate, the communication error message is displayed. Exit the procedure by pressing the mode key.

3.3.2.10 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 is only available if expert access is enabled.

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. NOTE: if polarization movement is not desired, set the polarization type (see polarization configuration) to "circular". When SHAKE is selected, the following screen appears.

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

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.
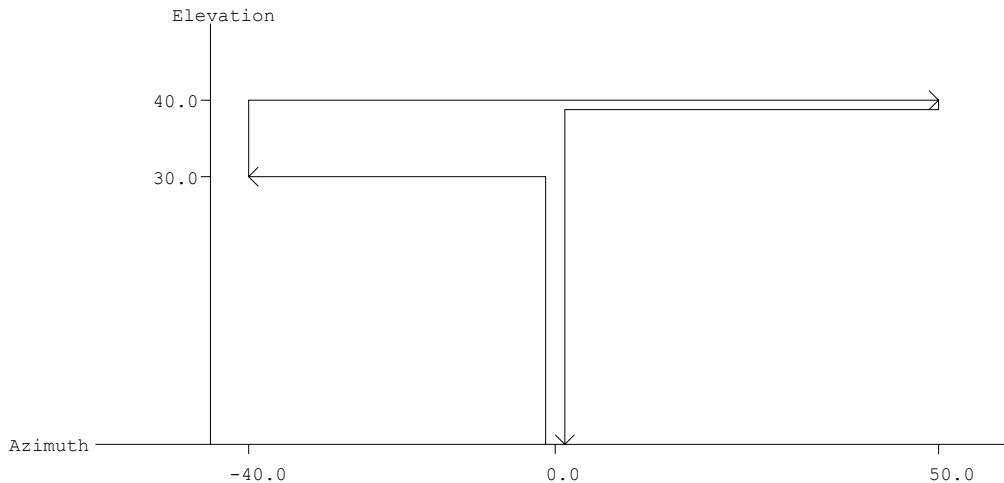
The programming of the targets, cycles and delay is accomplished via the SHAKE configuration screen (3.3.1.17). To initiate the SHAKE sequence, press the Pol CCW/1 key. If you wish to modify the SHAKE parameters go to the CONFIG-SHAKE mode. To exit out of SHAKE press the Mode key.

When SHAKE is started the following screen appears:

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

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

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

3.3.2.11 Configuration Item Record

Selecting the Stop/. key from the MAINTENANCE screens triggers a process that will transmit the current configuration item values via the remote control port.

If the controller has the remote control option, the values will be transmitted at the baud rate set in the Remote configuration screen. Otherwise the default rate of 9600 baud will be used. The data will be sent out as 7 data bits with even parity. The data is sent out as a simple set of ASCII characters with each line terminated by a linefeed and carriage return. It is intended that a simple program such as HyperTerminal be used to pull in the data.

The output's first three lines will contain date, time, mount type, software version number, etc. Next the configuration items will be sent out per configuration screen. For each configuration item, the field shown on the screen, the item value and the bottom row prompt associated with the item will be sent on one line. The following is an example output showing the first two configuration screens.

```
                RC3000 CONFIGURATION ITEMS
20OCT05   20:49:21
V1-GTR  1.54


SYSTEM DEFINITION
             SN:    1234    SERIAL NUMBER<1-9999> (0=NOT ENTERED)
            GPS:       1    <1>GPS PRESENT <0>NOT PRESENT
        COMPASS:       1    <0>NONE <1>TRUCK MOUNT <2>ANTENNA MOUNT
           MODE:       2    <1-LOCATE 2-MENU 3-MANUAL 4-VSAT 5-POS>
       ANT SIZE:     244    ANTENNA SIZE <1-9999 CM>
      WAVEGUIDE:       0    WAVEGUIDE SWITCH <1>PRESENT <0>NONE
ELEVATION CALIBRATION
          REF V:    1.69    SET ZERO VOLTAGE <0.50 - 4.50>
            OFF:     0.0    ELEVATION OFFSET <-25.0/+25.0 DEGREES>
             UP:      90    SET UP LIMIT <0-90 DEGREES>
           DOWN:       0    SET DOWN LIMIT <0-90 DEGREES>
             SF:   50.00    SCALE FACTOR <30.00 - 60.00 mV/deg>
           LOOK:       1    ELEV LOOK CONFIGURATION <1>HIGH <0>LOW
```

NOTE: During the time (up to 15 seconds) its takes to output all configuration item values, there will be no action apparent at the RC3000's front panel. The user should monitor his recording program to determine when the process is finished. Note also that this process will disrupt normal remote control actions so any other monitor and control applications should be paused during this process.

The intent of this feature is to provide a convenient way to record configuration item values following the calibration of the controller. Before contacting RCI for technical support, it would also be useful to record the current configuration items status and send the file to RCI.

The following table supplies the default configuration item values for these mount models.

NOTE: All configuration item values will be shown in the Q1 (military) mount column. For ease of recognition, only the default values that are unique for the Q2 (commercial) mount will be listed.

Space has also been provided to record installation specific changes to the configuration items. Note: recording of installation specific changes to defaults may prove valuable when trying to restore system configuration.

CONFIGURATION ITEM	Q1	Q2					INSTALL VALUE
SYSTEM DEFINITION							
antenna_size_cm	300						
compass	2						
GPS	2	1					
AZIMUTH CALIBRATION							
Zero Voltage	2.50						
Fluxgate_offset	0.0	-150.0					
ccw_azim_limit	120						
Cw_azim_limit	120						
Azim_Scale_Factor	85.4						
ELEVATION CALIBRATION							
Zero Voltage	4.30						
Elev_offset	0.0						
Up_elev_limit	10						
Down_elev_limit	0						
Elevation_Scale_Factor	41.45						
Elevation_look_configuration	1						
POLARIZATION CAL							
Zero Voltage	2.50						
Polarization_Offset	0.0						
CW Polarization Limit	95.0						
CCW Polarization Limit	95.0						
Pol_Scale_Factor	41.67						
Polarization_type	1						
H/V_Reference	1						
Default Horizontal Position	-45.0						
Default Vertical Position	45.0						
Pol_Automove_Enable	1						
SIGNAL PARAMETERS							
Channel 1 Polarity	1						
Channel 1 Threshold	100						
Channel 1 Delay	0.1						
Channel 1 Lock Type	0						
Channel 2 Polarity	1						
Channel 2 Threshold	100						
Channel 2 Delay	0.1						
Channel 2 Lock Type	0						
AUTOPEAK							
Autopeak Enabled	0						
Signal Source	1						
RF Band	1						
Spiral Search AZ Limit	3						
Spiral Search EL Limit	3						
Spiral Signal Threshold	200						
Scan Range Limit	10						
Scan Signal Threshold	200						

CONFIGURATION ITEM	Q1	Q2						INSTALL VALUE
AZIMUTH POT DRIVE								
Fast/Slow Threshold	1.0							
Maximum Position Error	0.10							
Coast Threshold	0.2							
Maximum Retry Count	2							
AZIMUTH PULSE DRIVE								
Pulse Scale Factor	2406							
CW Pulse Limit	64000							
CCW Pulse Limit	100							
Fast/Slow Threshold	50							
Maximum Position Error	0							
Coast Threshold	3							
Maximum Retry Count	3							
AZIM DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	1000							
Slow Deadband	1000							
ELEV POT DRIVE								
Fast/Slow Threshold	2.0							
Maximum Position Error	0.2							
Coast Threshold	0.2							
Maximum Retry Count	2							
ELEV PULSE DRIVE								
Pulse Scale Factor	1646							
UP Pulse Limit	64000							
Down Pulse Limit	100							
Fast/Slow Threshold	50							
Maximum Position Error	0							
Coast Threshold	3							
Maximum Retry Count	3							
ELEV DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	2400							
Slow Deadband	1200							
POL POT DRIVE								
Fast/Slow Threshold	2.0							
Maximum Position Error	0.50							
Coast Threshold	0.3							
Maximum Retry Count	3							
POL DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	1000							
Slow Deadband	500							

CONFIGURATION ITEM	Q1	Q2					INSTALL VALUE
REMOTE CONTROL							
Remote Enabled	1						
Bus Address	50						
Baud Rate	6						
Jog	40						
STOW / DEPLOY							
AZ STOW	0.0						
EL STOW	-95.0						
SETUP	-65.0						
AZ DEPLOY	180.0	-30.0					
EL DEPLOY	45.0						
AZ Range	15.0						
PL ENABLED	3						

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.

Many of the alarm messages described in this section are caused by corrupt CONFIG mode items. Note that access to certain CONFIG mode items is controlled by the value of other CONFIG mode items. See the first few paragraphs of section 3.3.1 for an explanation of the role of controlling CONFIG mode items. If the value of a controlling CONFIG mode item is such that access to other CONFIG mode items is restricted, corrupt values of those other CONFIG mode items can still generate an alarm message. Access to the corrupted item is only available if the controlling item is changed to allow it.

All of the CONFIG mode items must be initialized to a valid value, even if the feature associated with that CONFIG mode item is disabled. For example, even if REMOTE mode is disabled, the *Comm Port Baud Rate* and *Comm Port Address* CONFIG mode items must still be initialized properly.

* AZIMUTH RANGE LIMIT DISABLED *

This TFLA unique alarm will flash when in MANUAL mode if the Azimuth Range Limit is currently disabled (see 3.2.2.3).

LOW BATTERY

The RC3000 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.

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 the DRIVE ERROR RESET mode (section 3.3.2.2) to view the actual fault condition which was detected and to clear the fault.

AZ/EL OPTIONS

This error (caused by an incorrect checksum) indicates that the value of at least one of the following CONFIG mode items has been corrupted: *Az/El Drive Options Enable, Az/El Fast Slow Threshold*, *Az/El Retry Attempts*, *Az/El Fast Deadband, Az/El Slow Deadband*, *Azim Coast Threshold*, *Elev Max Position Error*, or *Simultaneous Az/El Enable*. The *Az/El Drive Options Enable* CONFIG mode item is the controlling item for most members of this group of CONFIG mode items - it must be enabled to allow access to the other items. See sections 3.3.1.2.3 and 3.3.1.2.4.

TIME/DATE

This alarm code indicates either the *Time* or *Date* is corrupt. The time and date are entered via the Time Maintenance mode. See section 3.3.2.3.

4.0 TROUBLESHOOTING

This section provides tips for debugging typical problems. There are many interfaces between the RC3000 and position sensors, limit switches, mechanical components of the mount, other receiving equipment, etc. Some problems are due to interactions that are not readily apparent. Review all of the troubleshooting sections to see if a situation similar to yours is described.

4.1 Limit Switches

The various limit switches serve as safety interlocks to prevent mount damage. The RC3000 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 CW 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 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. The following are some examples of problems caused by limit switch sensing:

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 RC3000 to sense the limit switch correctly. Isolating the problem to the RC3000 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 2,9,10 and 11 should have +12 VDC present (see 2.2.4 – J3 wiring diagram.) NOTE: pin 5 should also have +12 only if pins 11 and 13 are jumpered.   If +12 VDC is not present, there is a power supply failure within the RC3000. 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 RC3000. The state of the limit switches should be monitored via the Limits Maintenance (3.3.2.5) screen. 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

* - To test Elevation DOWN, pins 11 & 13 must be jumpered to simulate elevation not stowed

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 (2.3.3 and 2.3.4.)

4.2 Motor Drive

Axis JAMMED error displayed. A jammed error indicates that the axis was commanded to move, but the RC3000 did not sense any movement within several seconds. A jammed condition may indicate one of several conditions:

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

The mount's position is not being sensed correctly by the RC3000. After resetting the drive error, go to MANUAL mode and attempt to jog the axis in question. If the axis does move, check to see if the axis' displayed position is updating. If the RC3000 doesn't sense movement, it will declare a jam even though the axis is moving.

The RC3000's motor drive is failing to output the required voltage to move the axis. Attempt to move the axis in question via the MANUAL mode. There are several things to note:

1) When a jog key is pushed, can relays inside the RC3000 be heard activating? If no relays are heard, a limit switch condition may be present that disallows movement in the axis in question. Review the above limit switch discussion.

2) Can the axis move in slow speed but not in fast? If this is the case, the fast voltage setting or current limit setting of the motor drive may need to be adjusted.

3) Is there voltage present at the appropriate J7 pins when the axis jog is attempted? If no voltage is present, there's the possibility that a fuse inside the RC3000 has blown (take care inside unit => must disconnect power, etc.)

If a fuse is blown, replace with the appropriate fuse. Reconnect J7 and remove the drive wires at the motors. Attempt to jog the axis. If the fuse blows again, the drive cables should be checked for a short. If the fuse does not blow, the motor should be checked.

The axis' motor is damaged. If possible, attempt to apply DC voltage to the motor from an external source such as a series of batteries. If the motor will not move, the motor is probably damaged.

When a manual jog key is released, the axis continues moving for about 5 seconds. This condition is indicative of a drive relay failure inside the RC3000. The RC3000 has a "safety" relay in series with the normal drive relays that opens 5 seconds after any commanded movement is stopped.

4.3 Automatic Movements

The mount does not go below the elevation DOWN limit when stowing. To proceed below the DOWN limit, the azimuth stow limit must be active. The RC3000 drives to the azimuth stow position and checks to confirm that the azimuth stow switch is active. If the azimuth stow limit is not active, the controller will make several attempts to find the stow switch in the immediate vicinity.

If the azimuth stow switch is not sensed in the correct position, check that the limit switch is working properly. There is also the possibility that the azimuth potentiometer has slipped causing the sensed stow position not to be in the same place the stow switch is active.

On some mounts, the polarization stow switch must also be active before movement below the DOWN limit may occur.

When stowing, the mount reaches the elevation stow position but the elevation motor continues to run. The stow routine does not stop until the elevation stow switch has been activated. If the elevation stow switch is faulty, the controller will continue to drive down. The RC3000 does implement a 5 minute "timeout" of the elevation axis drive in an attempt to prevent elevation motor "meltdown".

The mount begins an automatic movement (stow, deploy, etc.) but generates an "axis jammed" error. All automatic movements move to a "target" location. If far enough away from the target, the move will initially be done in the FAST speed for the axis and then switch to SLOW when close to the target. If the SLOW speed has been set too low, the axis may jam. Attempt to move the axis in SLOW speed from the MANAUL mode to duplicate the situation. If SLOW speed seems to be the problem, adjust the drive voltage up as discussed in 2.3.5.

4.4 GPS

The interface between the RC3000 and the optional GPS receiver is via an RS-232 serial port. The data stream from the GPS receiver is parsed in multiple places in order to receive latitude, longitude and time data. The following messages may be displayed when the RC3000 is attempting to receive data from the GPS:

** NO GPS PRESENT **. This message indicates that the gps_present item in the System Components (3.3.1.2.1) configuration item as been set to 0 indicating that no GPS is attached to the RC3000. No attempt will be made to parse GPS data in this state. If a GPS is truly attached, set the gps_present item to 1 or 2. Note that if the GPS option was not purchased with the controller, the gps_present item will not be allowed to be set to 1.

INITIALIZING or STARTING GPS. This message indicates that the RC3000 has sent a command to the GPS receiver to start communication. Normally this message should only appear momentarily until the first response from the GPS has been received.

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

To check that communication with the GPS is occurring, move to the GPS Serial Port Diagnostics (3.3.2.6) screen. The data on the screen should update approximately once a second. If no data is being displayed or the GPRMC data stream described in 3.3.2.6 is unrecognizable, the integrity of the cabling between the RC3000 and the GPS receiver should be checked.

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

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

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

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

4.5 Fluxgate Compass

The interface between the RC3000 and the optional fluxgate compass is via a RS-232 serial port.

NO COMPASS. This message indicates that the compass_present item in the System Components (3.3.1.2.1) configuration item has been set to 0 indicating that no compass is attached to the RC3000. No attempt will be made to parse compass data in this state. If a compass is truly attached, set the compass_present item to 1 or 2. Note that if the compass option was not purchased with the controller, the compass_present item will not be allowed to be set to a value other than 0.

"*****" in compass data field. The "*****" string in a position where compass data should normally appear indicates that the RC3000 cannot parse a valid heading string from the compass. Use the Fluxgate Serial Port Maintenance screen (3.3.2.7) to see if data from the compass is arriving at the RC3000.

If the heading string within the compass data shows "800.0" instead of a valid heading value (0.0 to 359.9), the compass is reporting that the magnetic field it is sensing is either too high or too low. Usually this means that another strong magnetic field is close to the compass. Try to relocate the compass away from any sources of magnetic fields (generators, air conditioners, etc.) Sometimes equipment that normally doesn't generate a magnetic field may become magnetized by some event such as a nearby lighting strike.

COMM ERROR during compass calibration. During a compass calibration procedure, the RC3000 sends commands to the compass and checks for correct replies. The COMM ERROR message indicates that a) a response from the compass was not received correctly or b) the calibration command from the RC3000 was not received by the compass. First check communication from the compass as above. If correct data is coming from the compass, then inspect the wiring to determine if the transmit (from RC3000 to compass) line is correct.

5.0 DRAWINGS & SCHEMATICS

DRAWING CATEGORY	# OF PAGES
SYSTEM INTERCONNECTS	4
HAND HELD REMOTE FRONT PANEL ENCLOSURE	4
HAND HELP REMOTE FRONT PANEL SCHEMATICS	2
DIGITAL BOARD	3
HIGH VOLTAGE DRIVE INTERFACE	4
ANALOG BOARD	13

Z-RG60U
MINARIK

Z-KBRF-200

PS-REL-70-1006-WT

LCD#CLI40045-UWJ1

FC#3K-HVDINT-B-1-CMT

CBL-3KB_COMTECH-INT2

CBL-3KB_COMTECH-INT4

MOTOR DRIVE INTERFACE

WAVEGUIDE
SWITCH

24V BRK

RC3KANS CONTROL

J15 24V

J13 POWER BOARD

J11 PCRC

J9 HHRC

J7 FG

J6 GPS

J5 ACCESSORY

J5 PCRC

J8 COMMS

Digital board modifications:
The display interface is modified. Remove BN4 near
the display connector D/g board connector J5 terminals
11 thru 14 are grounded via a zero ohm resistor on
the bottom of the board. Tie one end of the zero ohm
cable to the R12 pad closest to the display connector.
Snake the other end of the zero ohm resistor around
J5 terminals 11-14.

FC#3KDIG-1

J17 COMMS

J18 SSP

J21 POSITION SENSE

J12 POSITION SENSE

J19 RCI BUS

J4 DRIVE COMMAND

J1 BUS-BUS

3K-A2 RBBN 25

3K-A2 RBBN 26

3K-A2 RBBN 27

3K-A2 RBBN 28

J15 RCVR

FC#3KAN5-B

J4 PULSES

J3 LIMITS

J1 SENSORS

J2 AGC

J9 COMPASS

J13 GPS

RF

DB-15
MALE

DB-15
FEMALE

DB-15
FEMALE

DB-15
FEMALE

DB-9
FEMALE

DB-9
MALE

3K-A2 RBBN 22

3K-A2 RBBN 23

CBL-3KB_COMTECH-INT8

Analog board modifications:
To support FP+HHC1-CT Serial Handheld Remote. This requires
that 12 VDC be jumpered to the PCRC serial port
via a resettable fuse. For instructions see ...
\\Guru\engineering\RC3K\Handheld Remote Front
Panel\3KAN5_mod\RC3000_3KANS_mod 083110.pdf
The resettable fuse is RCI p/n: F4PS-RXE050, it is included in the
top level BOM

The sex of the D15 J3 limits connector needs to be changed. On
a standard RC3000, ACU J3 is a D15 female. For the Comtech
tropo ACU's,
RCI p/n CN#747941-3 (D15 male, 90 deg, PCB mount) needs to
be installed in the board.

On the analog board, tie header J11-6 and J11-4 to ground. Also
tie analog board jumper X1-3 to ground. Tying J11-6 to ground
will ground the handheld remote cable shield. The other ground
connections are made to tie terminals B and F of the interface
cable to ground. These are defined in the drawings as ground
are not tied to ground. These additional ground should reduce
ground bounce on the serial handheld circuit board.

Endplate Assembly

Left Endplate

1.0000

Ø0.8750

1.7500

.8000

Z-FOAM-TAPE

Install assembly
WH-A2R3R6008-x

Right Endplate

2.000

0.817

Z-FOAM-TAPE

Ø0.5000

Install Z-GOREVENT2
and Z-GORENUT

Research Concepts, Inc.

TITLE FA-HHRFP-A2 Assembly				
SIZE A	DRAWN BY ECG	PAGE NUM	DATE	REV A

Ref Des	Connector	Inserts	Dust Cap
A2	CN-UT0W71210S	CN-SM20WL3S25 (10x)	CN-MS3181-12NA
R3	CN-22-01-2037	None	None
R6	CN-22-01-2067	CN-08-56-0110 (3x)	None
	CN-08-56-0110 (5x)		

Notes:
(1) RXD/TXD as seen by 3KHHRFP.
(2) Dust cap(s) to be attached in place during initial assembly.

Remove and discard outer jacket and foil shield. Cover stranded shield wire with appropiate heat shrink.

CBL-8X24SHLD-DATATUF
Length: 8in

Research Concepts, Inc.

SIZE	TITLE		
A	WH-A2R3R6008-x		
DRAWN BY	PAGE NUM	DATE	REV
ECG			0

Ref Des	Connector	Inserts	Back Shell	Dust Cap
P1, P2	CN-MS31161210S	CN-SM20WL3S26 (10x)	CN-UT0121CS	CN-MS3180-12CA

12-10P
(from behind)

P1
A — White/Blue
B — Brown
C — White/Brown
D — White/Orange
E — Orange
F — Blue
G — Green
H — White/Green
J — Shield
K

Cover all exposed wires
with heat shrink tubing.

CBL-8X24SHLD-DATATUF
Length: 50ft

Cover all exposed wires
with heat shrink tubing.

P2
A
B
C
D
E
F
G
H
J
K

Notes:
(1) Dust caps to be
attached using key ring
TBD.

Research Concepts, Inc.

TITLE				
FB-CBL-HHRFP-AB50				
SIZE A	DRAWN BY ECG	PAGE NUM	DATE	REV A

Ref Des	Connector	Inserts	Back Shell	Dust Cap
P1	CN-UT0W71210S	CN-SM20WL3S25 (10x)	CN-UT012AC	CN-MS3181-12NA
P2	CN-747904-2	Solder (9x)	CN-5207908-1, CN-5206942-1	TBD

12-10S (from behind)

P1
A	Gnd	White/Blue
B	+12-24v	Brown
C	RXD	White/Brown
D	/RXD	White/Orange
E	RXD	Orange
F	Gnd	Blue
G	/TXD	Green
H	TXD	White/Green
J	Shield	Shield
K	N/C	

Cover all exposed wires with heat shrink tubing.

CBL-8X24SHLD-DATATUF
Length: 4ft

Cover all exposed wires with heat shrink tubing.

P2
5	Gnd
1	+12-24v
2	Gnd
4	/RXD
6	RXD
7	Gnd
9	/TXD
3	TXD
8	Shield

Notes:
(1) RXD/TXD as seen by 3KHHRFP.
(2) Dust cap(s) to be attached in place during initial assembly.

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TITLE: FB-CBL-3K2HHC1-CT

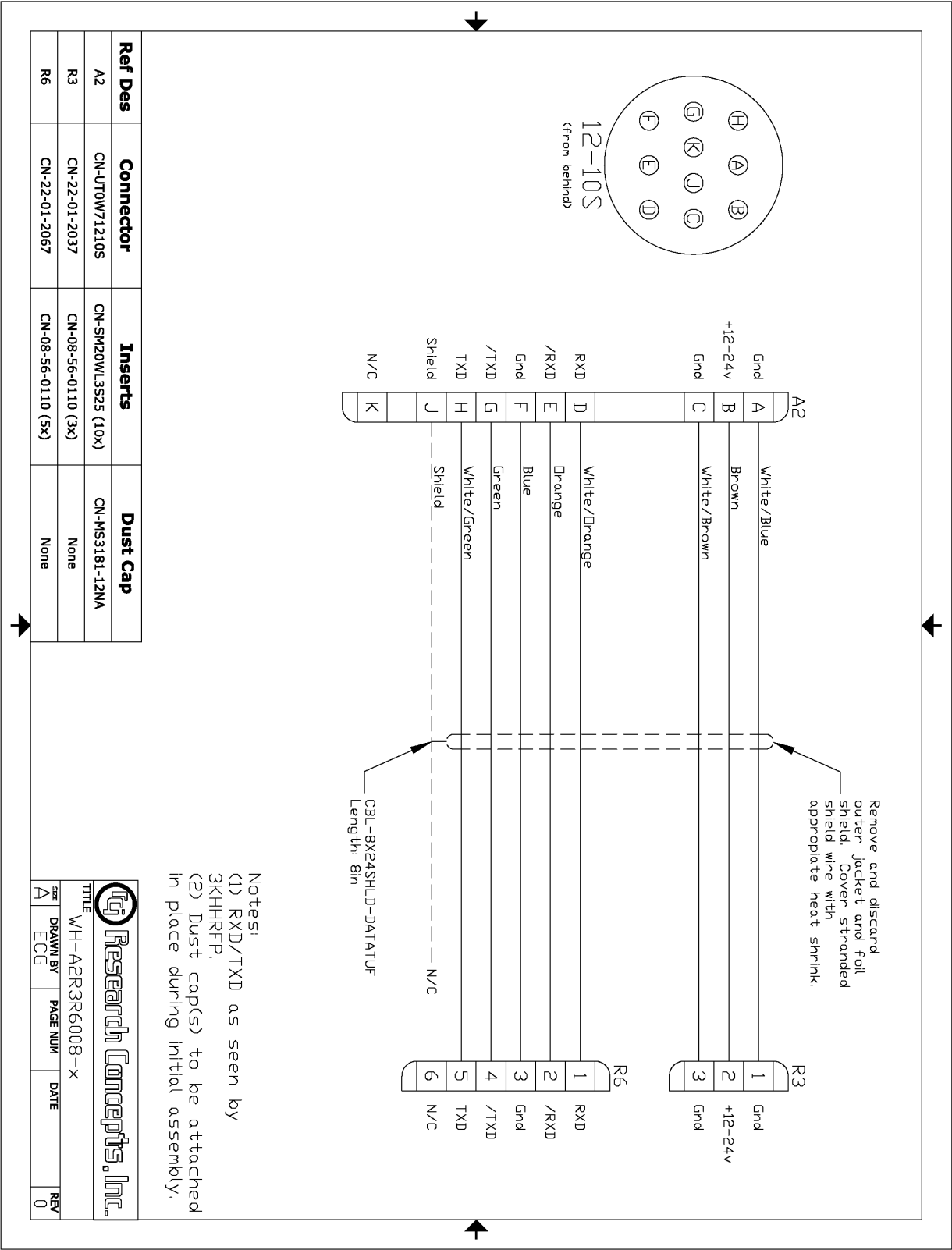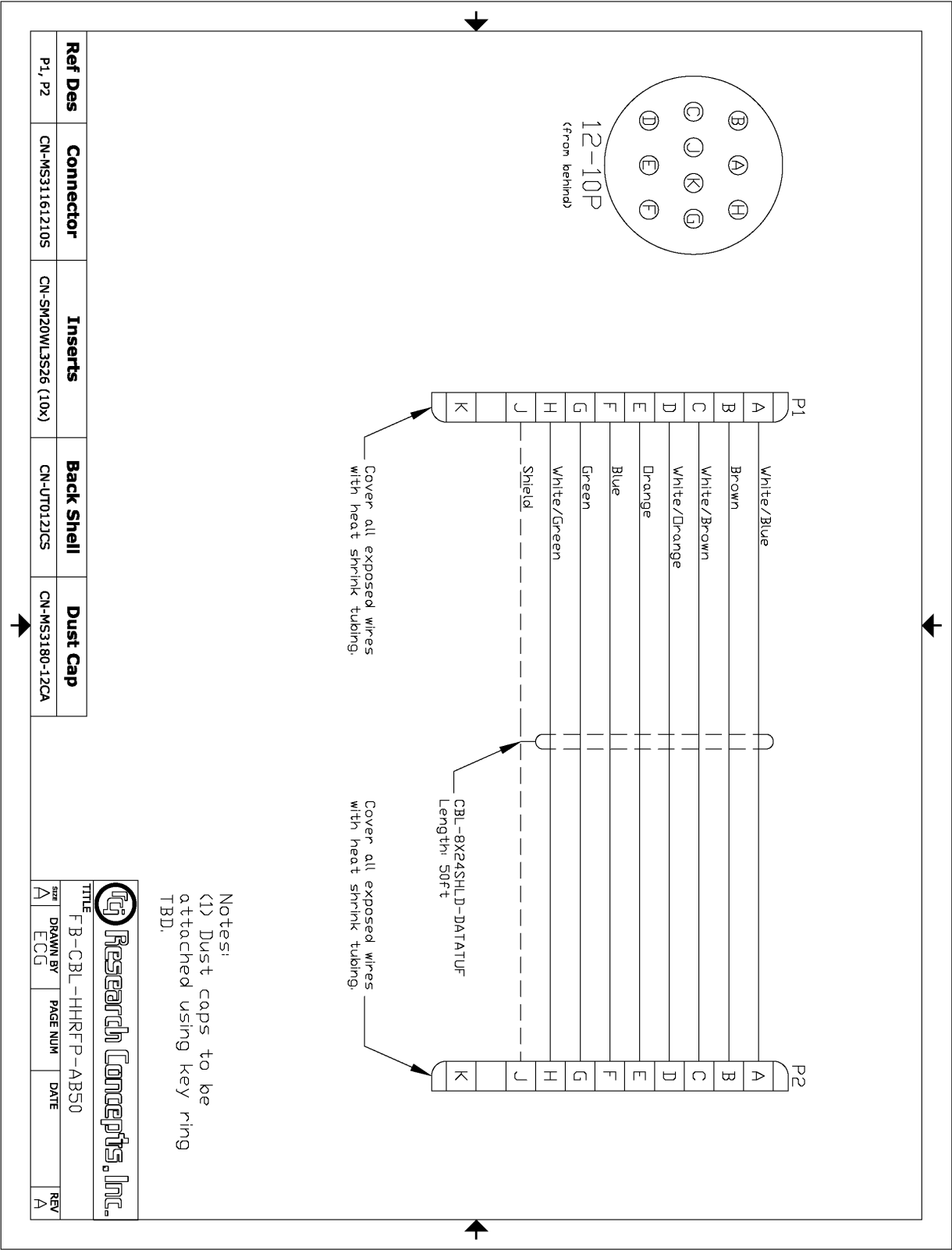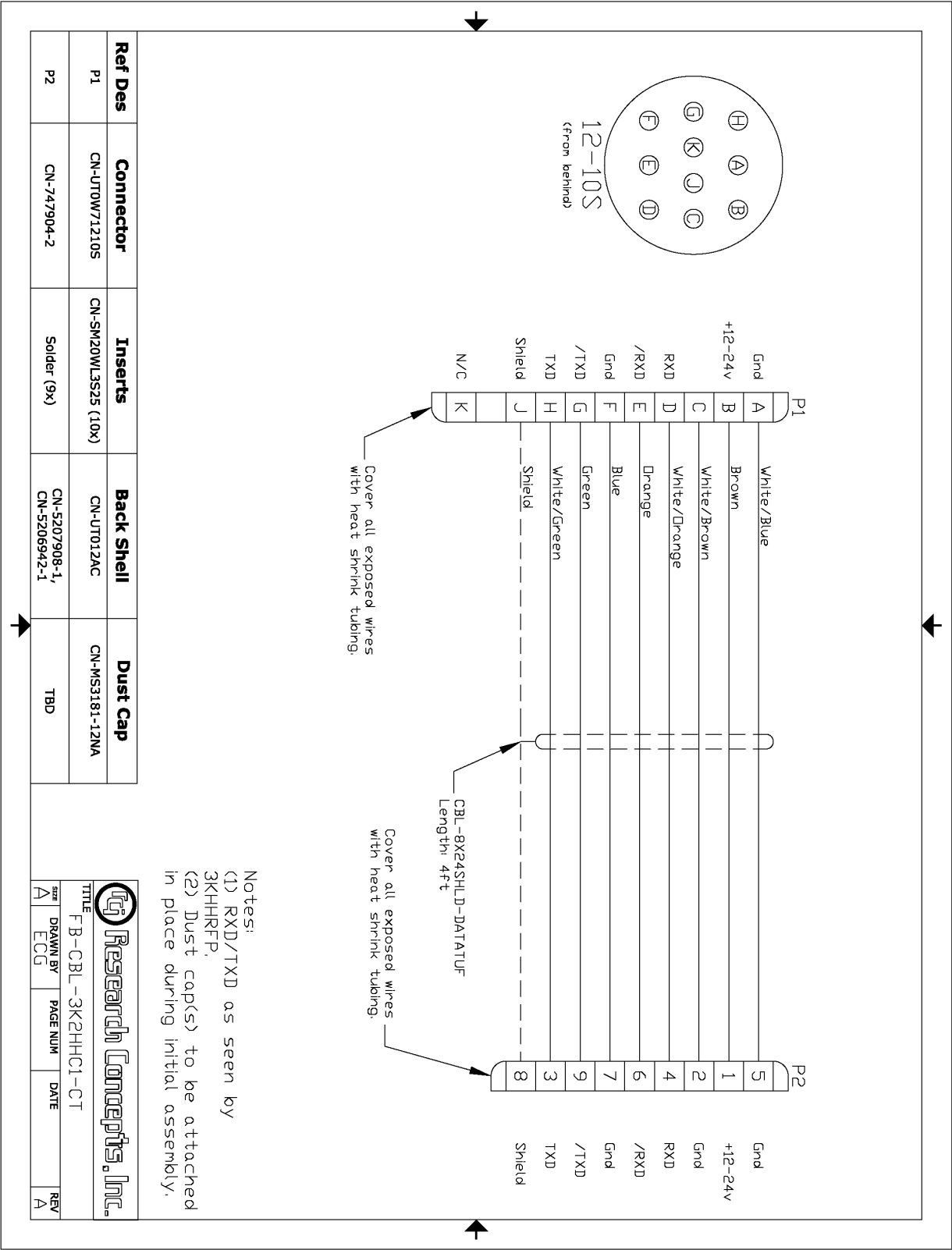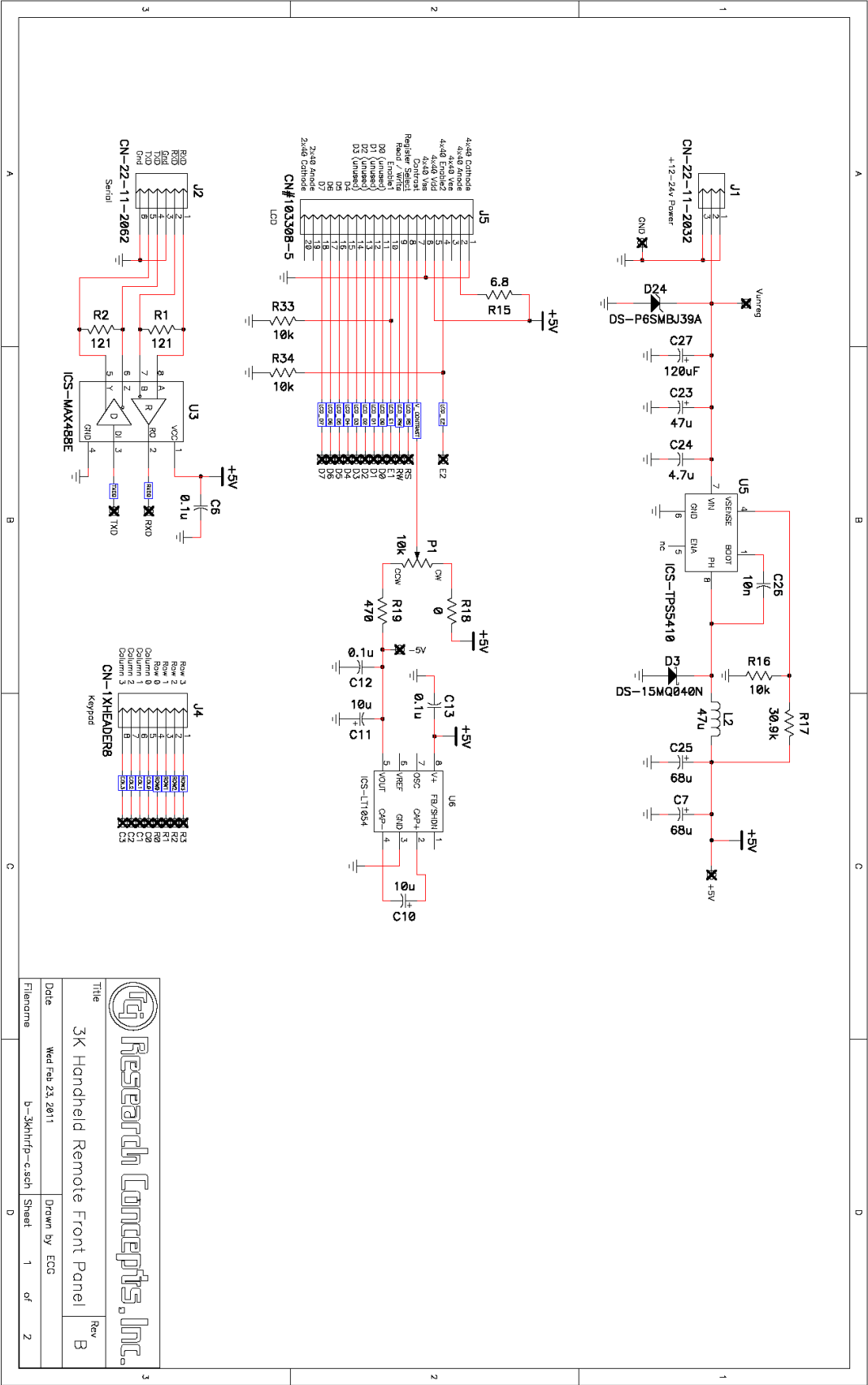| SIZE	DRAWN BY	PAGE NUM	DATE	REV
A	ECG			A

3K Handheld Remote Front Panel

Research Concepts, Inc.

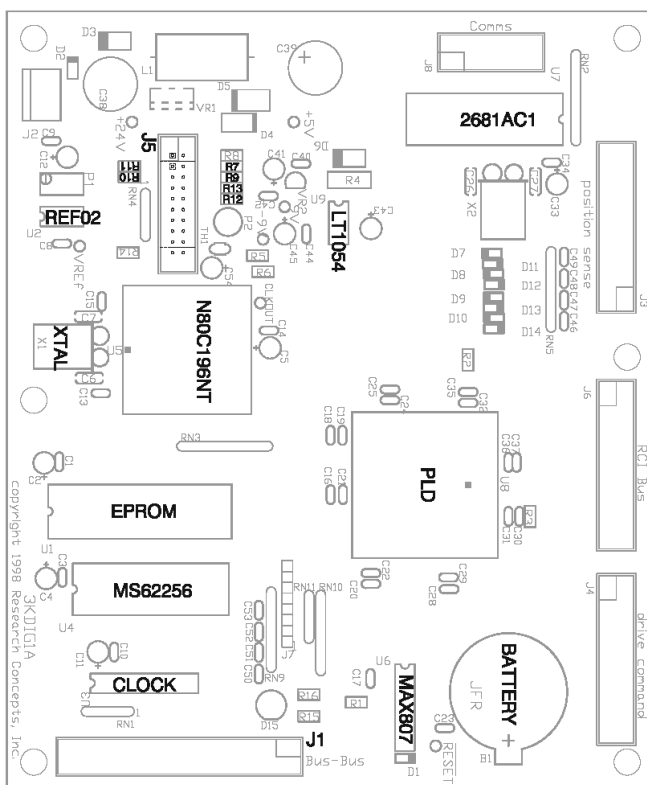Title: 3K Handheld Remote Front Panel
Date: Wed Feb 23, 2011
Filename: b-3khrfp-c.sch
Drawn by ECG
Sheet 2 of 2
Rev B

High Voltage Drive Interface

Research Concepts, Inc.

Title: High Voltage Drive Interface

Rev B

Date: Thu Feb 18, 2010

Drawn by JDK

Filename: B#3K-HVDINT-B.sch

Sheet 1 of 4

Title: High Voltage Drive Interface

Research Concepts, Inc.

Date: Thu Feb 18, 2010
Filename: B#3K-HVDINT-B.sch
Drawn by JDK
Sheet 2 of 4
Rev B

High Voltage Drive Interface

Research Concepts, Inc.

Rev B

High Voltage Drive Interface

POLARIZATION MOTOR DRIVE

IC-LM18293

DRIVE TRUTH TABLE

EN	IN3	IN4	RESULT
H	H	L	TURN CW
H	L	H	TURN CCW
H	IN3 = IN4		BRAKE
L	X	X	COAST

Research Concepts, Inc.

Title	High Voltage Drive Interface		Rev
Date	Thu Feb 18, 2010	Drawn by JDK	B
Filename	B#3K-HVDINT-B.sch	Sheet 4 of 4	

Research Concepts, Inc.

Title: RC3KAN5 ANALOG BOARD

Size: B   Number: B-3KAN5-REVC   Rev: C

Date: SEPT 23, 2004   Drawn by LBM

Filename: RC3KAN5_REVC_092304.SCH   Sheet 4 of 12

Title: RC3KAN5 ANALOG BOARD

Number: B-3KAN5-REVC

Research Concepts, Inc.

Size: B   Rev: C

Date: SEPT 23, 2004

Filename: RC3KAN5_REVC_092304.SCH

Drawn by: LBM

Sheet 8 of 12