1. OVERVIEW

The RC-8097 SATELLITE LOCATOR was developed to address a specific need in the mobile communications industry. This system incorporates the satellite locator and antenna controller functions within one piece of equipment. It was designed to assist both the technically-oriented and the non-technical operator of a mobile satellite news gathering truck by automating the process of locating and locking on to a particular satellite.

Prior to the RC-8097 Satellite Locator, this could be a tedious and time-consuming process, due to several factors. The SNG vehicle is parked in a different location for each shoot, on different terrain with its own local magnetic variation, and oriented in a different direction. Since the beam-width of the antenna is extremely narrow, the elevation and azimuth estimates required a significant degree of accuracy to even be in the neighborhood of the satellite.

In addition, once the elevation and azimuth were determined, the operator had to match these estimates against the actual readings on a separate controller box, and manually drive the antenna to the correct position.

The RC-8097 Satellite Locator combines both these steps into one simple process. First, a calculator provides accurate estimates through a collection of optional sensors and a microcontroller based processor. Through the use of a very sophisticated software program, the time involved in calculating a satellite's relative position is cut dramatically. The RC-8097 uses the data from the sensors to calculate the azimuth and elevation angles that the antenna will be steered to. The azimuth and the elevation estimates are absolutely accurate.

Once the calculations are complete, the control section will Auto Move the antenna to the correct elevation and azimuth with the press of a key. The Autopeak feature, if enabled will scan a narrow region of space near the target point for an RF signal. This feature can compensate for any magnetic deviation at the site. Autopeak is fully explained in sections 4.2.5 and 4.3.4. The system will also correct itself in case the inertia of the antenna causes a small overdrive. The controller is also capable of an Auto Stow function, and allows for manual movement and fine-tuning.

1.1 LOCATOR DESCRIPTION

In the most basic sense, the RC-8097 can be broken down into three sections:

1. A collection of sensors (antenna position sensors, optional Flux detector, optional Global Positioning System (GPS) receiver)

2. A sensor information processing and calculation section (a microcontroller-based processor).

3. A controller that moves the antenna to the calculated elevation and azimuth.

The sensors provide all the information necessary to calculate satellite location. The flux detector is the heart of an electronic compass that provides magnetic heading information. The GPS receiver fixes the exact position of the truck, provided it has a reasonable view of the satellites orbiting overhead. If the optional flux detector or GPS receiver is not present, the operator is prompted for the necessary information.

The processor calculates the truck's magnetic heading and local magnetic variation based on the information above. The magnetic variation is the difference between true north and magnetic north at a given location. This establishes the truck's true heading. The processor receives the input on the heading, truck location, and longitude of the desired satellite, and calculates the antenna azimuth and elevation positions required to intercept the satellite.

Once the satellite is selected and the calculations are complete, the user switches to the controller mode, and the RC-8097 will move the antenna to the calculated elevation, then rotate and scan a defined azimuth range for signal power. It then moves the antenna to the peak power point, or as a default, to the original calculated azimuth, then rechecks the elevation. The user can then manually fine-tune either of these positions, or the polarization. The optional hand-held remote control allows the operator to stand up to 25 feet from the unit and perform manual moves. When the shoot is completed, the controller can be directed to stow the antenna. Both the azimuth and elevation STOW indicators on the front center panel light to signify that the antenna is fully stowed.

1.2 ANTENNA MOUNT DESCRIPTIONS

The RC8097 is designed to be compatible with several different SNG antenna mounts, the VERTEX DMK, (903) 984-0555, (both +/-90° and +/-180° versions), the Prodelin, (704) 464-4141, VMAS mount, the mount from AVL Technologies, (704) 252-9936, marketed by BAF Communications, as well as a Hubcom retrofit performed by Antek, (301) 663-5443.

Separate versions of the 8097 software and hardware have been prepared for each mount type. The software version is displayed on the first screen in the power-on sequence. The last digit in the software version determines which mount type corresponds to the particular RC8097 according to the following table:

Antenna Mount Type	Software Version
Vertex ±90	7.00
Prodelin	7.01
Vertex ±180	7.02
AVL Technologies	7.03
Antek	7.04

Each version uses a different EPROM, U5, located behind the keypad on the digital board. The Antek - Hubcom version also requires a special PLD (U17 on the analog board).

All the compatible mounts are of the Azimuth-Elevation type and use potentiometers to sense position in azimuth and polarization. Elevation position is sensed with an electronic inclinometer. Position limit switches designate the elevation up and down limits as well as the stow positions for azimuth and elevation. An additional limit switch, called the down elevation limit, blocks azimuth and polarization movement when the elevation is below a set angle. Azimuth and polarization limits are set by comparing the position feedback voltages to references. The Vertex and Prodelin mounts use 90VDC motors to move the antenna in azimuth and elevation and 12 VDC for polarization adjustments. The Antek uses 24 VDC for the polarization control.

The major differences in mount type as they pertain to the RC8097 occur with the AVL Technologies and the Antek mounts. The differences are pointed out in the manual in **bold text**.

The **AVL Technologies mount** rotates the entire reflector-feed assembly to control polarization. Because of this, it is necessary to perform a polarization stow during the antenna stow sequence. During the polarization stow the antenna is moved to the predefined stow voltage which also corresponds to vertical polarization. A polarization stow limit switch is on the AVL mount to precisely designate the POL STOW position. Because the motors for all three axes on this mount are nominally 15 VDC, a special low voltage motor drive section is used in place of the KB drive.

The **Antek mount**, a retrofit for the Hubcom mount, has an elevation stow position which corresponds to the elevation up limit (in a “birdbath” position). Therefore the elevation stow limit switch doubles as the elevation up limit. The limit switch used as the up limit on the other mounts is used here to determine whether the hydraulic antenna platform has been deployed. No antenna movement is allowed without the platform being deployed. 28 VDC is used to control polarization movement on the Antek mount.

1.3 PHYSICAL SPECIFICATIONS

INDOOR ENCLOSURE

Construction:	5052-H32 Aluminum Clear anodized finish
Mounting Provisions:	(4) 10-32 screw standard rack mount
Width/Height/Depth:	19" x 5.25" x 16.5"
Weight:	21 lb.
Operating Temperature:	0 to +50 degrees C +32 to +122 degrees F

SENSOR TOWER (optional)

Construction:	5052-H32 Aluminum Clear anodized finish Epoxy paint topcoat
Mounting Provisions:	4 hole flanged base
Width/Height/Depth:	5" x 7" x 6.5" - 4" diameter cover
Weight:	1.5 lb.
Operating Temperature:	-40 to +65 degrees C -40 to +149 degrees F

GPS MODULE (optional)

Mounting provisions:	4 hole flanged base
Width/Height:	5.8" dia. x 3.9" high
Weight:	.9 lb.
Operating Temperature:	-30°C to +71°C

HAND-HELD REMOTE CONTROL (optional)

Width/Length/Depth:	3” x 6” x 1.75”
Weight:	3.5 lb. (with cable)
Cable Length	25 feet.
Operating Temperature:	-20°C to +50°C

INDOOR CONNECTIONS

Connector	Type	Description
J1	DB-15 female	AZ/EL/Pol position
J2	DB-9 male	Optional GPS port
J3	DB-15 female	Limits in
J7	MS3102A22-20S	Motor control
J8	Amphenol 126-218	TWT enable
J9	DB-15 male	Optional flux gate
J10	DB-25 female	Optional Hand-held remote control
J11	BNC female	Autopeak input (950-1450MHz from LNB)

ELECTRICAL SPECIFICATIONS

POWER

AC Power:	115VAC +10%/-13% Optional (220VAC operation) 47-63 Hz 50W (Typical - INDICATOR Mode) 850W (Full - CONTROLLER Mode)
Fuse:	10 Amp Fast Blow

SENSORS

Flux Detector (if present):	+/- 1.5 degrees (maximum) +/-.8 degrees (typical)
GPS (if present):	+/- 100 meters (typical)

SYSTEM ACCURACY

Elevation:	+/-.2 degrees (typical)
Azimuth:	+/- 1.5 degrees (typical)

(Dependent on calibration accuracy and local magnetic anomalies)

1.4 ACCURACY DISCUSSION

In most situations, the calculated positions are correct. Actual results may vary based on the accuracy of the sensor input data.

The largest source of error for the system is due to errors in determining the truck's magnetic heading. Errors in heading primarily affect the accuracy of the antenna's calculated azimuth position. The optional 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 truck itself. This component of the distortion can be largely compensated for during system calibration (Chapter 4).

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.

To date, the largest known azimuth error due to these interactions is less than 10 degrees. To help alleviate this azimuth error, Versions 3.3 and higher contains the Autopeak feature, which scans an azimuth range about the target azimuth and seeks the strongest signal. This feature is explained in full in section 4.2.3. Elevation accuracy is unaffected by these factors and remains in the +/- .2 degrees region.

1.5 FRONT PANEL LAYOUT

The layout and operation of the RC-8097 are designed to be as user-friendly as possible. Almost all functions are menu-driven and self-explanatory.

The RC-8097 utilizes a 4 x 40 Liquid Crystal Display (LCD) with electroluminescent backlighting to enhance visual clarity even in a dark truck. The LCD is of the supertwist type for best resolution. The on/off switch is located below the display screen for easy access.

Data is displayed in the following format:

```
TRUCK HEADING:          SAT          /
LON:         LAT:          ANTENNA
                       ELEVATION:
                       AZIMUTH:
```

The first column contains data relating to the current truck position: the truck heading, latitude, and longitude. In the second column appear the longitude and name of the desired satellite, and below it are the calculated values for the antenna elevation and azimuth angles.

The keypad consists of 24 membrane keys with tactile feedback, arranged in four rows of 6 keys each. A complete description of the function of each key is contained in section 2.1.

2. OPERATION

This section contains instructions for the day-to-day operation of the RC-8097 Satellite Locator. For installation and calibration instructions, refer to sections 3 and 4. It is very important that the unit be properly calibrated to insure the integrity of the results. Once the unit has been calibrated, the day-to-day operation is very simple and accurate.

When the RC-8097 is first turned on, the display will boot up and come back with status messages on the memory integrity and battery level. The main screen will then appear with current readings of the optional flux gate and GPS sensors (if present) and calculations.

Example:

```
TRUCK HEADING:180.5   SAT      /
WAITING FOR GPS DATA    ANTENNA:
                        ELEVATION:
                        AZIMUTH:
```

There are several defaults built into the system. The RC-8097 will automatically use the flux gate data (if present) to determine the truck heading. If the flux gate is not present, the operator enters the heading information from the front panel. The truck location (longitude/latitude) is found through manual keypad entry, stored presets, or automatically by the optional GPS receiver. The GPS is the default if that option is present. When the user manually enters a latitude and longitude, the system default is North for latitude and West for longitude, since these designations are correct for operation in North America.

2.1 KEY FUNCTION

The RC-8097 Satellite Locator basically has two modes of operation, calculator and antenna controller. The mode which is active determines the function of certain keys and nullifies others. While in CALCULATOR mode, the right three columns of keys are used as a number pad, for the entry of data and selection of options from menus. After switching to CONTROLLER mode, these same keys manually direct the movement of the antenna. This is known as a "softkey" concept.

The function of certain keys is exclusive to a particular mode. For instance, if the user presses ***SAT SELECT*** or ***L/L SOURCE*** while in controller mode, their function is not applicable to that mode, and nothing will happen. Likewise, antenna movement keys (***STOW***, ***LOCATE***, etc.) are inactive while in CALCULATOR mode.

MODE (0) - This key is used to toggle between CALCULATOR and CONTROLLER modes. The mode key is only recognized when the main menus for each mode are displayed. These main menus can always be reached by repeatedly pressing the ***ENTER*** key.

BACKSPACE - This key is active in both modes. In CALCULATOR mode it moves the cursor back one space. In CONTROLLER mode it confirms the selection of AUTO STOW and AUTO LOCATE.

2.1.1 CALCULATOR MODE KEY FUNCTIONS

The following keys are active only in the **CALCULATOR** mode.

WEST/SOUTH, EAST/NORTH - These are terminator keys for manual entry of latitude and longitude information. These keys are also used to change the sign during floating point number entry.

SCROLL DOWN, SCROLL UP - These keys allow scrolling through the predefined list of satellites or geographic locations. They are also used for scrolling through the alphanumeric characters when entering satellite names and truck location descriptions.

SETUP - This key is used to enter a list into user-accessible memory of up to eighteen (18) satellites and up to eighteen (18) predefined locations where the truck most frequently operates. It also allows viewing of this information.

TEST - This key accesses the test menu. From this menu, the user may enter system calibration and initialization data, and display controller status data.

L/L SOURCE (LATITUDE/LONGITUDE SOURCE) - Allows the user to choose the source of the latitude/longitude data used in the antenna pointing calculations. The possible choices are:

1. USER entry
2. one of eighteen (18) possible PRESET locations.
3. the on-board GPS receiver (the default if GPS option is present).

SAT SELECT - Allows the user to choose the source of satellite longitude data. The two possibilities are:

1. USER entry of satellite longitude.
2.. select from a PRESET list of up to eighteen (18) satellites

HEADING - (H'ding) Allows the user to select the source of truck heading information used in the antenna pointing calculation. The choices are:

1. the on-board FLUX GATE compass (the default if flux gate option is present)
2. USER entry of truck heading information.

ENTER - A terminator key for any prompt that the RC-8097B gives to the user. This key also bounces the user out of the current menu of the program to the previous menu and eventually out to the main screen.

NUMBER KEYS (0-9), PERIOD (.) - These keys make use of the softkey concept. They are used for the entry of numeric data and in making a selection from a menu.

2.1.2 CONTROLLER MODE KEY FUNCTIONS

The function of the following keys is active only in **CONTROLLER** mode.

STOW - This key instructs the controller to stow the antenna, first to the azimuth stow position, then to the elevation stow position. When the RC8097 is used with the AVL mount, a polarization stow is performed prior to the azimuth and elevation stows.

LOCATE - This key instructs the controller to move the antenna to the calculated elevation and azimuth for the selected satellite.

POL CW, POL CCW (1,3) - These two keys allow the fine-tuning of the polarization.

EL UP, EL DOWN (2,8) - These two keys manually adjust the elevation either up or down.

AZ CW, AZ CCW (4,6) - These two keys manually adjust the azimuth in either a clockwise (positive) or a counterclockwise (negative) direction.

STOP (5) - This key terminates any antenna movement by the controller. If the user selects STOW or LOCATE, the controller will automatically begin moving the antenna. The STOP key will cancel that command. Pressing this key during an auto locate/stow routine will flash an error code ending in three (3) signifying the interruption.

H, V (7,9) - These two keys will instruct the RC-8097 to adjust the polarization to either the horizontal or vertical preset position.

SPEED (.) - This key manually toggles the antenna movement speed between fast and slow. This is only applicable during **manual** movement of the antenna. After choosing STOW or LOCATE, if the antenna has quite a distance to travel, the RC-8097 will **automatically** switch to fast, then into slow as it nears the correct position.

2.1.3 DATA ENTRY OF DESCRIPTIONS

When entering a **DESCRIPTION** of a truck location or a satellite name, each alphanumeric character must be entered through the use of the ***SCROLL UP*** and ***SCROLL DOWN*** keys.

The alphabet is on a continuous "wheel", followed by numbers in ascending order, then by a period, then by a space that is "hidden" behind the asterisk. Holding the key in will cause the letters and numbers to scroll continuously. ***SCROLL UP*** will bring the values up in ascending order, ***SCROLL DOWN*** in descending order. Therefore, if a letter is in the first half of the alphabet, use ***SCROLL UP***. However, if it is in the latter part of the alphabet, it is faster to use ***SCROLL DOWN***. Likewise, if a number is desired, use ***SCROLL DOWN***. If a blank space is desired, press ***SCROLL UP*** once and ***SCROLL DOWN*** once, then press ***ENTER***.

If the desired value is passed up, simply back up by pressing the opposite key. When the desired character is shown, press ***ENTER***, and the cursor will advance one position and the asterisk will prompt for the next character. If a digit saved by pressing ***ENTER*** is incorrect, press ***BACKSPACE*** and reenter the digit. Pressing ***ENTER*** at the asterisk prompt completes the entry and saves the characters to memory.

2.2 SETUP

The RC8097 allows the user to program a number of satellite name/longitude combinations and vehicle location description/vehicle latitude/vehicle longitude combinations into the controller's non-volatile memory. Once this data has been entered into the controller's memory, the user may select this data via the **Sat Select** key menu (for satellite information) or the **L/L Source** key menu (for vehicle location information).

The satellite and vehicle location information is entered into the RC8097's non-volatile memory via the **Setup** key menu. From Calculator mode, hit the **Setup** key to obtain the Setup menu.

Select ***SETUP*** for the following menu:

```
SETUP DATA ENTRY AND EXAMINATION
1..TRUCK LAT/LON
2..SATELLITE LON
<ENTER>..TO EXIT   ENTER SELECTION:
```

2.2.1 TRUCK LAT/LON SETUP

This routine allows the user to enter up to eighteen (18) **locations where the truck most frequently operates.** It is not necessary to enter geographic coordinates of locations within 100 miles of each other, as the accuracy of the calculation is not significantly affected by lat/lon errors of 100 miles (160 Km). This 100 mile accuracy radius corresponds to approximately 1 and 1/2 degrees (or 1 degree 30 minutes) of latitude or longitude.

Select ***1*** **TRUCK LAT/LON** from the **SETUP** menu for the following menu:

```
TRUCK LATITUDE/LONGITUDE SETUP DATA
1..VIEW THE SETUP DATA
2..MODIFY THE SETUP DATA
<ENTER>..TO EXIT   ENTER SELECTION:
```

To **add a new entry**, it must first be determined which index number is available for entry. Likewise, to **modify an entry**, the index number assigned to the location must first be determined.

To **view** the **truck lat/lon positions** that are **currently in memory**, select ***1*** and the screen will display:

```
VIEW TRUCK LAT/LON SETUP DATA
INDEX  DESCRIPTION  LATITUDE  LONGITUDE

USE SCROLL UP,DOWN OR <ENTER> TO EXIT:
```

The screen will show the first location that has been entered. ***SCROLL UP* or *SCROLL DOWN*** will allow the viewing of the next sequential entry. If the sequence skips a number, it means that the index number is available for entry. If there is no preset information entered, the message "*****NO SETUP DATA AVAILABLE*****" will appear.

To **add** or **modify** an entry, select ***2*** **MODIFY THE SETUP DATA** and the screen will display:

```
MODIFY THE TRUCK LAT/LON SETUP DATA
ENTER THE INDEX NUMBER OF THE SETUP DATA
OR <ENTER> TO EXIT WITHOUT ANY CHANGES
TO THE EXISTING DATA. ENTER SELECTION:
```

TRUCK PRESET LOCATIONS

	LOCATION	LATITUDE	LONGITUDE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			

Entering the **index number** of an entry will allow access to this screen:

```
MODIFY THE TRUCK LAT/LON SETUP DATA
INDEX  DESCRIPTION  LATITUDE  LONGITUDE
  1         *
USE UP,DOWN,BKSP,ENTER,2xENTER=EXIT,HELP
```

The index number chosen will be displayed, along with any predefined information. If the index number chosen has not been assigned, the screen will show an **asterisk** in the first space under **DESCRIPTION**.

Enter the **location description** (KC, ST.LOUIS, NY, MIAMI). (Review section 2.1.3, **DATA ENTRY OF DESCRIPTIONS,** for entry assistance if necessary.) Ten characters are allowed for this field.

Once the name is complete, press ***ENTER*** again and the cursor will jump to **LATITUDE**. Use the number pads to enter the **correct location** and the **North/South designation** (North is the default), then press ***ENTER***. Note that vehicle latitude and longitude data is always entered in a degree, minute format (1 minute = 60 minutes).

Do the same for **LONGITUDE** (except that it will be an **East/West designation** - West is the default), and ***ENTER*** to save to memory. Note that the North/South and East/West defaults are appropriate for operation in North America.

Verify the entry through ***1*** **VIEW THE SETUP DATA**.

To avoid having to re-figure the locations in the event of a memory loss, copy the entries onto the worksheet on the preceding page for a permanent record.

2.2.2 SATELLITE LONGITUDE SETUP

This option allows the operator to designate up to **eighteen (18) satellites as presets**. This will eliminate having to enter the satellite longitude for those satellites which are frequently used. It is best to have a list ready when performing this procedure. Page 12 lists many of the available Ku-band satellites.

To **enter** or **view satellite longitude information** select *2* **SATELLITE LON** for the following menu:

```
SATELLITE LONGITUDE SETUP DATA
1..VIEW THE SETUP DATA
2..MODIFY THE SETUP DATA
<ENTER>..TO EXIT   ENTER SELECTION:
```

To **view** the **satellites currently in memory**, or to determine what index numbers are available for entry, select *1* **VIEW THE SETUP DATA** and the screen will display:

```
VIEW SATELLITE LONGITUDE SETUP DATA
INDEX  DESCRIPTION  LONGITUDE

USE SCROLL UP,DOWN OR <ENTER> TO EXIT: _
```

SCROLL UP or ***DOWN*** to review the current entries. If a number in the index sequence is skipped, it means that it is available for entry. If there is no preset satellite information, the message "*****NO SETUP DATA AVAILABLE*****" will appear.

To **add** a new entry, or **modify** an existing entry, select ***2*** **MODIFY THE SETUP DATA** from the initial menu for this screen:

```
MODIFY THE SATELLITE SETUP DATA
ENTER THE INDEX NUMBER OF THE SETUP DATA
OR <ENTER> TO EXIT WITHOUT ANY CHANGES
TO THE EXISTING DATA. ENTER SELECTION: _
```

Enter the **index number** of the entry to be modified or added:

```
MODIFY THE SATELLITE SETUP DATA
INDEX  DESCRIPTION  LONGITUDE
  1    K2
USE UP,DOWN,BKSP,ENTER,2xENTER=EXIT,HELP
```

The **prompt** will appear under the first character of the description. To **change the character**, use ***SCROLL UP*** and ***SCROLL DOWN*** to scroll through the alphanumeric characters available. Press ***ENTER*** to save the desired letter or number. The system will prompt at the second space, etc. For a complete explanation of the key function in entering a description, refer to section 2.1.3.

When the **description is complete**, press ***ENTER*** at the prompt, and it will move to **LONGITUDE**. The current longitude for this index will appear, and the system will prompt for a different entry.

To **keep the current entry**, press ***ENTER***. To **change** the longitude, use the numeric keypad and the ***West/South***, ***East/North*** keys to designate a new location, then press ***ENTER***. Satellite longitude data is always entered in degrees and tenths of degrees (as opposed to the degree, minute format used for vehicle latitude and longitude data). If the entry does not specify a direction, West is used as the default. This is appropriate for those satellites which are visible from North America.

Verify the entry through *1* **VIEW THE SETUP DATA**.

SATELLITES

SATELLITE	POSITION	
GSTAR 2	125	W
SBS 5	123	W
MORELOS 2	116.8	W
ANIK C3	114.9	W
SOLIDARIDAD 2	113	W
ANIK E1	111.1	W
SOLIDARIDAD 1	109.2	W
ANIK E2	107.3	W
GSTAR 4	105	W
GSTAR 1	103	W
DBS 1	101.2	W
SPACENET 4	101	W
DBS 2	100.8	W
GALAXY 4	99	W
TELSTAR 401	97	W
SBS 6	95	W
GSTAR 3	93	W
GALAXY 7	91	W
SPACENET 3	87	W
SATCOM K1	85	W
SATCOM K2	81	W
SBS 4	77	W
SBS 3	74	W
SBS 2	71	W
SPACENET 2	69	W

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2.3 SELECTING LATITUDE & LONGITUDE SOURCE

When the GPS option is present, the RC-8097 offers **three options** in selecting the **source** of **latitude/longitude data**.

Press ***L/L SOURCE*** for the following display:

```
SELECT THE SOURCE OF TRUCK LAT/LON DATA
1..USER ENTRY      2..PRESET DATA
3..GPS NAVIGATION RECEIVER
<ENTER> TO EXIT    ENTER SELECTION:_
```

When the GPS receiver is not present the RC-8097 offers **two options** in selecting the **source** of **latitude/longitude data**. After pressing ***L/L SOURCE*** the display is:

```
SELECT THE SOURCE OF TRUCK LAT/LON DATA
1..USER ENTRY      2..PRESET DATA

<ENTER> TO EXIT    ENTER SELECTION:_
```

2.3.1 GPS NAVIGATION RECEIVER

This is the default choice if the GPS option is installed in the 8097. The GPS (Global Positioning System) works by monitoring an overhead constellation of satellites that are transmitting reference signals from which the GPS derives a position fix. If the vehicle is parked in a location where a part of the sky is blocked by some obstruction, the GPS operation may be intermittent.

2.3.2 USER ENTRY

If the GPS option is not present or is slow to lock up (as evidenced by the display of the "Waiting for GPS Data" message in the main screen of Calculator mode), and the current location of the truck is not entered as one of the presets, the user can **manually enter** the latitude and longitude from maps or air navigation charts. This information can also be obtained by calling a local airport. The latitude/longitude must be entered in a degrees, minutes format (one degree = 60 minutes). The data does not have to be extremely accurate - the RC-8097 will have negligible error if the latitude or longitude is within a **100 mile radius**. However, the longitude value must be in the **range of 0-180 degrees East or West**, as the system will not allow a variable over 180. Note that if the East/North and West/South keys are not used when entering latitude/longitude data, the default is **North** for **latitude** and **West** for **longitude**. These are correct for operation in North America.

Select ***2*** **USER ENTRY** for the following screen:

```
USER ENTRY OF TRUCK LAT/LON DATA
TRUCK LATITUDE:  _
TRUCK LONGITUDE:
USE 1-9,".",BKSP,W/S,E/N,ENTER,HELP
```

Enter the latitude and longitude of the current truck location and press ***ENTER***. The system will use this data for calculation until instructed to do otherwise. However, once the unit is turned off, **this data is lost**, and when the system is powered up again, it will return to the default option (which is the GPS Navigation Receiver if it is present). To save the information, it must be entered as a preset location through **TRUCK LAT/LON SETUP**, section 2.2.1.

2.3.3 PRESET DATA

This option allows the user to select from up to eighteen (18) **preset truck locations** described by user-assigned names. It is not necessary to program a new location unless the truck has been moved **more than 100 miles** away from an existing preset latitude/longitude entry.

To select from the preset data, press ***3*** **PRESET DATA** for the following screen:

```
1.                 2.                 3.
4.                 5.                 6.
7.                 8.                 9.
USE SCROLL ^v,1-9,<ENTER>,BS   INDEX?:_
```

Use the ***SCROLL UP*** and ***SCROLL DOWN*** keys to view entries 10-18. Enter the number of the **current** location in a 2-digit manner (1=01), and press ***ENTER***. The system will return to the master screen with the preset latitude and longitude displayed.

```
TRUCK HEADING:        SAT             /
LON:101.00 W LAT:36.00 N      ANTENNA:
                              ELEVATION:
                              AZIMUTH:
```

2.4 SATELLITE SELECTION

Press ***SAT SELECT*** for the following display screen:

```
SELECT THE SOURCE OF SATELLITE LON DATA
1..USER ENTRY
2..PRESET DATA
<ENTER> TO EXIT    ENTER SELECTION:_
```

2.4.1 USER ENTRY

This selection allows the user to enter a satellite location **not listed in the presets**. Refer to the satellite list on page 12. This is a list of all the major satellites and their longitudes as of 4/95. Since the designation of all major North American satellites is West, the default is West. Note that satellite longitude data is entered in a degree, tenths of a degree format.

Select ***1*** USER ENTRY for the following screen:

```
USER ENTRY OF SATELLITE LONGITUDE DATA
SATELLITE LONGITUDE: _

USE 1-9,".",BKSP,W/S,E/N,ENTER,HELP
```

Use the numeric keypad to enter the satellite longitude desired, and press ***ENTER***. The system will return to the main screen with the satellite data displayed in the upper right hand corner.

If the main screen also displays the message "REPOSITION TRUCK", then the designated satellite is out of the physical range of the antenna with the truck at its current heading. The limits entered during installation will prevent the controller from moving the antenna if the satellite is out of range. Once the heading has been adjusted, the elevation and azimuth can be recalculated and the antenna positioned.

2.4.2 PRESET DATA

This option allows the user to choose from a list of eighteen (18) preset **user-designated satellites** most frequently desired. These satellites are entered through the **SATELLITE LONGITUDE SETUP** function, section **2.2.2.**

To choose from the preset data, select ***2*** **PRESET DATA** from the satellite selection menu for the following example screen:

```
1 K2          2 SBS4        3 SBS3
4 GSTAR1      5 GSTAR2      6 ANIK C3
7 SBS1        8 SBS2        9 K1
USE SCROLL ^v,1-9,<ENTER>,BS   INDEX?:_
```

Use the ***SCROLL UP*** and ***SCROLL DOWN*** keys to view entries 10-18. Enter the **index number** of the desired satellite. The system will pause while calculating the correct azimuth and elevation necessary for the antenna, then return to the main screen with the selected satellite longitude and name displayed in the upper right hand corner. If the truck heading and lat/lon data is available, the calculated elevation and azimuth angles will be displayed in the lower right hand corner.

If the main screen also displays the message "REPOSITION TRUCK", then the designated satellite is out of the physical range of the antenna with the truck at its current heading. The limits entered during installation will prevent the controller from moving the antenna if the satellite is out of range. Once the heading has been adjusted, the elevation and azimuth can be recalculated and the antenna positioned.

2.5 HEADING

The truck heading is entered relative to north. North is considered zero (0) degrees, 90 degrees due east, 180 degrees due south, and 270 degrees due west.

Press ***H'DING*** for the following display screen when the optional electronic compass is present:

```
SELECT THE SOURCE FOR TRUCK HEADING DATA
1..FLUX GATE COMPASS
2..USER ENTRY      <ENTER> TO EXIT
WITHOUT CHANGES    ENTER SELECTION:_
```

When the flux gate compass option is not present, the 8097 immediately proceeds to the user entry heading screen. See Section 2.5.2 below.

2.5.1 ONBOARD ELECTRONIC COMPASS

This is the default choice when the flux gate compass option is present. The flux gate compass is accurate to within +/- 1.5 degrees AFTER CALIBRATION. This variation is caused by the interaction of the flux gate with ferrous metal in the vicinity of the truck plus inherent sensor accuracy limitations. The value displayed for truck heading will be the value read from the flux gate corrected by the calibration data. See section 4.2 for an explanation of flux gate calibration.

2.5.2 USER ENTRY

This option allows the user to manually enter the truck magnetic heading when the flux gate option is not installed, or in case of compass failure. The RC8097 proceeds to this screen immediately when the flux gate option is not installed.

Press ***2*** **USER ENTRY** for the following screen:

```
USER ENTRY OF TRUCK HEADING DATA
TRUCK HEADING:   +_
ENTER A NUMBER BETWEEN 0 AND 359
USE 0-9,".",BKSP,ENTER,HELP
```

The current truck heading will be displayed. The system will prompt for a different entry if desired. Press ***ENTER*** to exit without changes.

The vehicle's magnetic heading must be entered in degrees. The value can range from 0-359 (refer to chart on previous page).

The RC8097 uses the magnetic heading to calculate the vehicle's true heading. The true heading is obtained by adding the magnetic variation (the difference between true and magnetic north) to the magnetic heading. The RC8097 has an algorithm which calculates magnetic variation given the vehicle's latitude and longitude.

2.6 CONTROLLER OPERATION

Once the antenna elevation and azimuth angles required to intercept the satellite have been determined, the antenna may be commanded to move to that position.

From the main CALCULATOR screen, push ***MODE*** for the following display:

POSITION	LIMITS	TARGET	SPEED:SLOW
ELEV: 54.4			
AZIM: 39.1			
POL: -23.2		SAT:	

The current readings for elevation, azimuth, and polarization appear in the **POSITION** column. In the **LIMITS** column, warnings will flash when the antenna reaches a limit.

In the **TARGET** column appear the calculated elevation and azimuth for the satellite named in the lower right corner. In the upper right corner is the current motor speed (**FAST** or **SLOW**.)

From this screen, the user can manually move the antenna through the use of the ***AZ CW, AZ CCW, EL UP, EL DN,*** and ***POL*** keys. (Refer to section 2.1.2.) While manually moving the antenna, the appropriate axis designation on the display will flash on and off to verify antenna movement.

As an additional safeguard, in the unlikely event of microprocessor failure, it is possible to manually move the antenna through the use of switches protruding from the rear of the indoor enclosure. By switching from COMP (computer) to MAN (manual) the user can then position the antenna as desired. A diagram of the rear panel can be found on the following page. Note that there are also indicator lights on both the rear panel and remote control, to denote when the antenna has reached a limit or a stow position.

The primary features of the RC-8097 are the two **automatic CONTROLLER** commands:

1. **STOW** the antenna.

2. **LOCATE** the selected satellite.

2.6.1 STOWING THE ANTENNA

To **STOW** the antenna, press ***STOW*** and confirm your selection by pressing ***BACKSPACE***. The controller will first rotate the antenna to the azimuth stow position, then down to the elevation stow position. As it is doing this, the readings in the position column will reflect the movement. In the case of the **AVL Technologies mount**, the controller will perform a *polarization stow* prior to the azimuth stow. In the case of the **Antek mount**, the antenna will move *up* in elevation to the elevation stow position. When it reaches each **STOW** position, the word **STOW** will flash next to the applicable designation, and, for azimuth and elevation, an indicator light to the lower right of the display will illuminate. The **STOW** command can be canceled at any time by pressing ***STOP***.

2.6.2 LOCATING A SATELLITE

To **LOCATE** a designated satellite, press ***LOCATE*** and answer the query by pressing ***BACKSPACE***. The controller will first drive the antenna to the target elevation position, then to the target azimuth position. If the Auto-Peak system is enabled, the controller will scan in azimuth about the target azimuth position, recording received signal strength and readjusting the elevation to the elevation target value. If a signal is found, the antenna will be positioned at the azimuth angle associated with the strongest signal. Following a complete sweep over +/- scan range, if a signal is not detected, the antenna will be positioned at the target azimuth position. See section 4.2.5 for information on the Autopeak system.

Any time the controller is instructed to move the antenna about a particular axis, the description (ELEV, AZIM, POL) for that axis will **flash on and off** on the display screen. When none of the descriptions are flashing, the antenna is positioned as calculated, and the user can manually adjust the azimuth and elevation positions for best signal strength.

The polarization can be adjusted next by pressing ***H*** or ***V*** to choose a preset. Once the preset position is reached, manually fine-tune the polarization with the use of the ***POL CW*** and ***POL CCW*** keys. Any of the above commands can be canceled at any time by pressing ***STOP***. If any error messages appear, refer to the troubleshooting section in the back of this manual to determine their meaning and make any adjustments necessary for operation.

To return to the **CALCULATOR** mode, simply press ***MODE*** for the main screen. It is best to return to the CALCULATOR mode so that the antenna is not accidentally moved during transmission by an errant press of a key.

2.6.3 OPTIONAL HAND-HELD REMOTE CONTROL

The Hand-held remote control option RC8097RC allows antenna jog operations independent of the front panel or back panel controls. The remote control is housed in a 3” x 6” x 1.75” aluminum case. The remote control should be connected to the RC8097 Satellite Locator through the "AUX" connector, (J10) located on the back panel in the upper left with a 25’ multi-conductor cable.

The RC8097RC places all, of the back panel antenna move functions and antenna position status indicators into the operators hand.

The LEDs on the remote switch-pad indicate the antenna status:
Azimuth Axis: STOW, CCW Limit, CW Limit.
Elevation Axis: STOW, Up Limit, Down Limit.
Polarization Axis: CCW Limit, CW Limit.

Switchable settings on the RC8097 back panel and remote control allow the user to control antenna movement from the back panel, the remote switch-pad, or the front panel according to the following criteria:

For proper operation of the hand-held remote control, all non-momentary contact toggle switches on the back panel **must be in the "UP" position**. The switches are labeled: **EL/AZ, CCW/CW, MAN/COMP, and SLO/FST**.

To control the antenna from the front panel, flip the MAN/COMP switch on the remote switch-pad to **COMP** and the MAIN/REMOTE switch on the switch-pad to **REMOTE**.

To control the antenna from the remote control, flip the MAN/COMP on the remote switch-pad to **MAN** and the MAIN/REMOTE switch on the switch-pad to **REMOTE**.

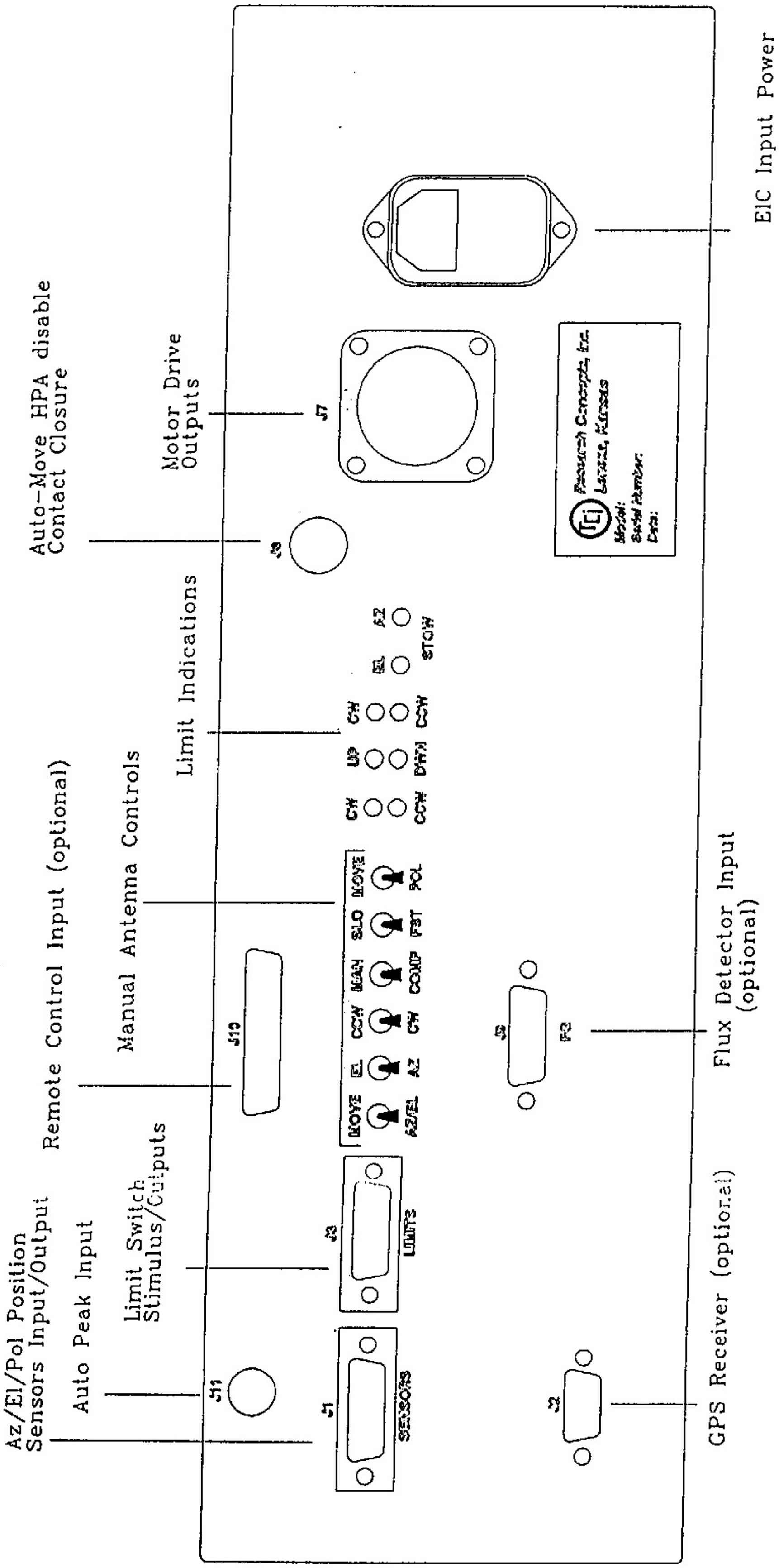
To control the antenna from the back panel switches, flip the MAIN/REMOTE switch to **MAIN** and the COMP/MAN switch on the back panel to **MAN**

Remember, when completing a move from the back panel, leave the non-momentary contact toggle switches in the "**UP**" position.

2.6.4 OPTIONAL INCLINED ORBIT TRACKING REMOTE CONTROL

The Tracking remote control option RC8097RC allows antenna jog operations independent of the front panel using a specially RC2000 Series Inclined orbit tracker. The Tracker housed in a 2-unit tall rack enclosure and mounts above or below the RC8097 indoor unit. The Tracker should be connected to the RC8097 Satellite Locator through the "AUX" connector, (J10) located on the back panel in the upper left with a 25-conductor cable. Please refer to the RC2000E manual for details and interconnects.

RC-8097 Back Panel Drawing



2.7 QUICK START

This outline covers the basic day-to-day operation of the RC-8097 Satellite Locator after installation and setup is complete. Combined with the OPERATING TIPS in section 2.8, it is a quick start guide for a novice user.

1. Turn the system on.

2. Select Truck Lat/Lon source -Press ***L/L SOURCE*** (if other than the GPS is desired or if no GPS is installed)

   a. User Entry - Select ***1*** **USER ENTRY** - Enter Lat/Lon from number pad
   b. Preset location - Select ***2*** **PRESET DATA -** Select from list
   a. ***3*** **GPS** (default if the GPS option is installed - no choice necessary)

3. Select Satellite - Press ***SAT SELECT***

   a. User Entry - Select ***1*** **USER ENTRY** - Enter satellite longitude
   b. Preset - Select ***2*** **PRESET DATA** - Select from list

4. After the RC-8097 has calculated azimuth and elevation estimates, press ***MODE*** to switch to CONTROLLER mode.

5. Press ***LOCATE***. Confirm selection by pressing ***BACKSPACE***.

6. Controller will move antenna to target position and search for the strongest signal within the range specified for Autopeak. Fine-tune the position as necessary using the antenna direction keys after the antenna has halted.

7. When transmission is complete, press ***STOW***, and confirm the selection by pressing ***BACKSPACE***.

2.8 OPERATING TIPS

Since the elevation accuracy is typically within +/-.2 degrees, and the azimuth to within +/- 1.5 degrees, locating the satellite is easier if the antenna is **first steered to the proper elevation, and then the azimuth**. It is much easier to fine-tune the azimuth and lock onto the satellite if the antenna is at the correct elevation.

*

If the truck cannot be operated in an area free of large metal structures, it is best to have the truck as **high as possible with respect to the local topology**. Azimuth errors as much as ten (10) degrees have been found to occur in areas where the earth's magnetic field is severely distorted.

*

An error code ending in 3 simply means the STOP key was pressed before the controller could finish the current movement requested by the user. No action is necessary on the part of the operator.

*

If the system appears to **hang up** (pressing buttons has no effect), it could be caused by an error in the flux gate offsets. When the memory is corrupted, the system tries to take a reading of the flux gate, and if the offsets are invalid, it could lock the unit up. Turn the system off and back on, and immediately begin depressing and releasing the ***TEST*** key. The screen should come up in the **TEST** mode. **Check the system constants**, particularly the **flux gate offsets**, and correct them if necessary. The constants can be found on the RC-8097 Data Sheet on the last page of this manual.

*

The RC-8097 should be recalibrated after six months to one year, or any time the system accuracy has noticeably degraded. This can happen due to a dissipation of the residual magnetism in the truck. This magnetism is introduced through the working of the metal during the manufacturing process. The calibration procedure allows for this magnetic variance, and as it dissipates, the calibration becomes less accurate.

*

After locating a satellite and fine-tuning, return to the CALCULATOR mode by pressing ***MODE*** so that inadvertently pressing a key will not move the antenna.

*

When using the Autopeak feature, it is a good policy to always check that the desired satellite was found. Sometimes a stronger signal coming in from a more powerful satellite through a sidelobe of the antenna will be found by the Autopeak, and the Controller will move the antenna to that point. Keep in mind that at some longitudes, there will be two satellites located at the same elevation within a given scan range. If this happens, simply press LOCATE to initiate a new scan. Watch the spectrum monitor for an indication of the desired satellite. Press STOP to halt the movement of the antenna, and fine-tune manually.

3. INSTALLATION

Proper installation is of paramount importance if the full capability and accuracy of the RC-8097 is to be realized. The prescribed procedures that follow will insure the optimum level of performance from all sensors and the system in general.

It is very important that each step called out in the physical installation and calibration be performed in the order in which it appears in the following outline. Each point is referenced to a particular section of this manual, and should be checked off as it is completed. Be sure to perform the correct calculator calibration. Perform steps 12 through 20 if the flux gate is installed, or steps 21 through 27 if the flux gate is not installed.

The SETUP section is not a requirement, but has been included in the outline because it simplifies the day-to-day operation. The user cannot make use of preset truck locations or preset satellites 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 RC-8097 Satellite Locator functions perfectly well without the presets. However, the presets streamline the operation by allowing the user to tell the program very quickly where the truck is, and what satellite is desired, without entering the data each time.

			SECTION
		PHYSICAL INSTALLATION	
____	1.	DETERMINE LOCATION OF OPTIONAL FLUXGATE TOWER	3.1
____	2.	INSTALL OPTIONAL GPS RECEIVER/ANTENNA MODULE	3.2
____	3.	INSTALL INDOOR ENCLOSURE	3.3
____	4.	INSTALL INTERCONNECTS	3.4
		CONTROLLER CALIBRATION	
____	5.	POSITION SENSOR POLARITY	4.1.1
____	6.	SET THE ZERO VOLTAGE FOR AZIMUTH	4.1.2
____	7.	SET THE ELEVATION VOLTAGE	4.1.2
____	8.	SET THE ZERO VOLTAGE FOR POLARIZATION	4.1.2
____	9.	SET AZIMUTH ELECTRICAL LIMITS	4.1.3
____	10.	SET POLARIZATION ELECTRICAL LIMITS	4.1.3
____	11.	SET PREDEFINED HORIZONTAL & VERTICAL POLARIZATIONS	4.1.4

CALCULATOR CALIBRATION (with optional flux gate compass)
perform steps 12 through 20 only if the flux gate is installed.

____	12.	CHOOSE CALCULATOR CALIBRATION SITE	4.2
____	13.	SET AZIMUTH SWEEP LIMITS	4.2.1
____	14.	SET ELEVATION SQUINT & SCAN RANGE TO ZERO	4.2.1
____	15.	CLEAR FLUX GATE CAL CONSTANTS - VERIFY	4.2.1
____	16.	VERIFY FLUX GATE OFFSETS	4.2.1
____	17.	DATA COLLECTION FOR CALIBRATION	4.2.2
____	18.	ENTER ELEVATION SQUINT & SCAN RANGE	4.2.3
____	19.	ENTER AZIMUTH CALIBRATION CONSTANTS	4.2.4
____	20.	VERIFY CALIBRATION CONSTANTS AND OFFSETS	4.2.4

CALCULATOR CALIBRATION (without optional flux gate compass)
perform steps 21 through 27 only if the flux gate is not installed.

____	21.	SET AZIMUTH SWEEP LIMITS	4.3.1
____	22.	SET ELEVATION SQUINT & SCAN RANGE TO ZERO	4.3.1
____	23.	CLEAR FLUX GATE CAL CONSTANTS - VERIFY	4.3.1
____	24.	VERIFY FLUX GATE OFFSETS	4.3.1
____	25.	DATA COLLECTION FOR CALIBRATION	4.3.2
____	26.	ENTER ELEVATION SQUINT & SCAN RANGE	4.3.3
____	27.	VERIFY CALIBRATION CONSTANTS AND OFFSETS	4.3.4

SETUP

____	28.	BLANK SETUP	5.1.2
____	29.	VERIFY	5.1.2
____	30.	CHOOSE TRUCK LAT/LON PRESETS	2.2.1
____	31.	ENTER TRUCK LAT/LON PRESETS	2.2.1
____	32.	VERIFY	2.3.3
____	33.	CHOOSE SATELLITE PRESETS	2.2.2
____	34.	ENTER SATELLITE PRESETS	2.2.2
____	35.	VERIFY PRESETS	2.4.2

3.1 OUTDOOR SENSOR TOWER

This section describes the placement of the flux gate assembly. This is an option that is normally called out during 8097 manufacture but can be added later in the life of the unit. **If you do not have the flux gate option installed, please skip this section.**

The outdoor sensor tower houses the flux gate. The flux gate sensor tower should be placed on the roof of the vehicle away from ferrous metals, electric motors, and any equipment which generates magnetic fields such as air conditioners, generators, and traveling wave tube (TWT) amplifiers. Experience has shown that the flux gate performs best when mounted as high as possible on the vehicle. The flux gate compass must be mounted in an upright position, and must be oriented properly with respect to the front of the vehicle. Refer to the drawing of the flux gate enclosure to verify the proper orientation of the flux gate.

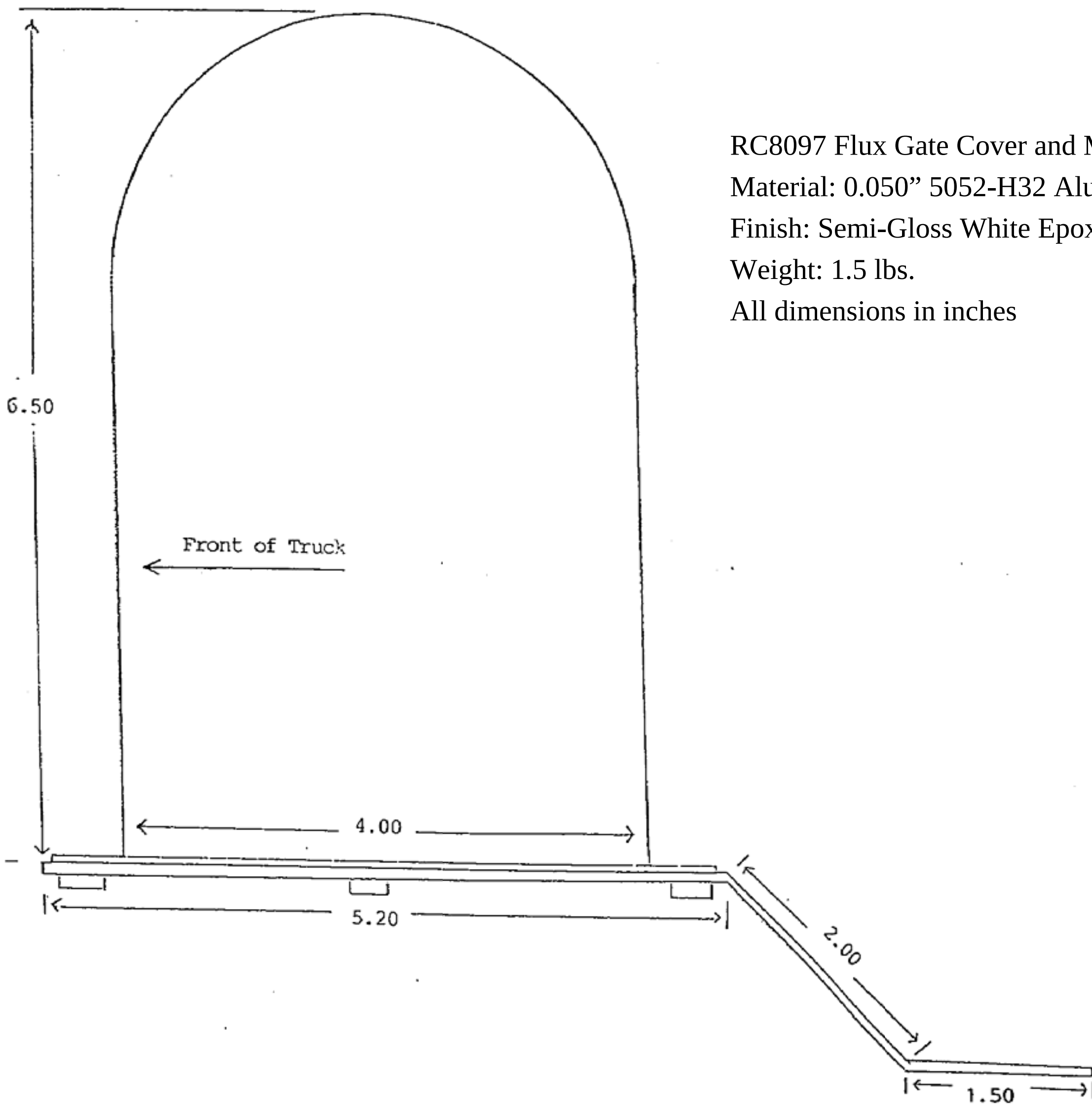
The following method may be used to determine the best location for the compass.

Park the vehicle in a location which is away from large metal objects or sources of magnetic fields. The vehicle's generator should be running, as well as all electrical equipment on the vehicle which generates magnetic fields.

Stand on the roof of the vehicle with a standard magnetic compass. Slowly lower the compass to the proposed flux gate 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.

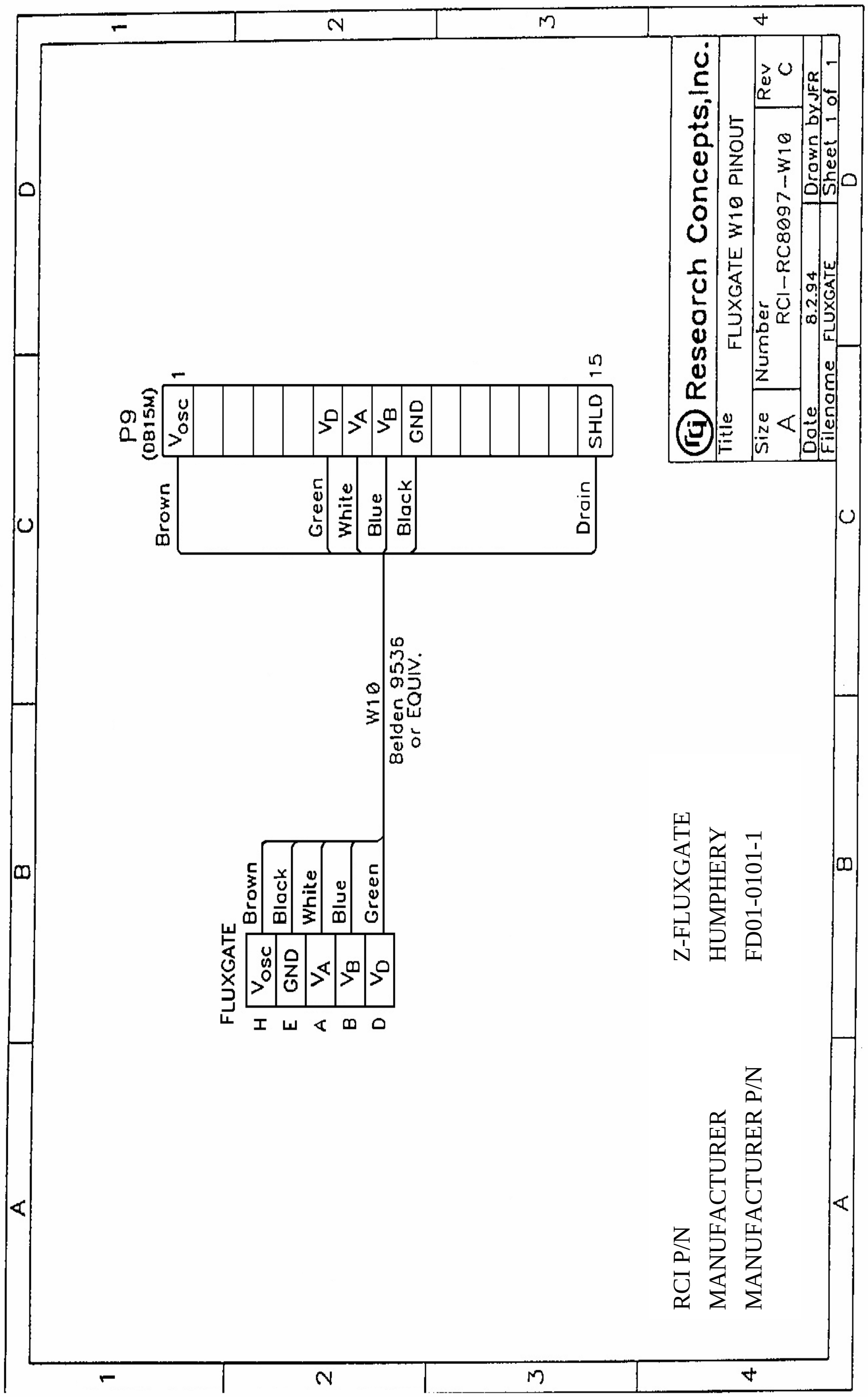
The flux gate should be mounted in the location where the needle of the compass experiences the minimum amount of swing as the compass is lowered to the proposed mounting location.

Fluxgate drawing



RC8097 Flux Gate Cover and Mounting Bracket
Material: 0.050” 5052-H32 Aluminum
Finish: Semi-Gloss White Epoxy Base
Weight: 1.5 lbs.
All dimensions in inches

W-10 Pinout


P9
(DB15M)
Vosc
VD
VA
VB
GND
SHLD
1
15
Brown
Green
White
Blue
Black
Drain
W10
Belden 9536
or EQUIV.
FLUXGATE
H
E
A
B
D
Vosc
GND
VA
VB
VD
Brown
Black
White
Blue
Green
Research Concepts, Inc.
Title FLUXGATE W10 PINOUT
Size A
Number RCI-RC8097-W10
Rev C
Date 8.2.94
Drawn by JFR
Filename FLUXGATE
Sheet 1 of 1
RCI P/N Z-FLUXGATE
MANUFACTURER HUMPHERY
MANUFACTURER P/N FD01-0101-1

3.2 GPS RECEIVER/ANTENNA MODULE

This section describes the placement of the GPS receiver assembly. This is an option that is normally called out during 8097 manufacture but can be added later in the life of the unit. **If you do not have the GPS option installed, please skip this section.**

The GPS receiver/antenna module should be mounted to the roof of the truck via (4) 1/4 x 20 flat head bolts. It should be positioned ahead of the reflector when in a stowed position, with the connector (on the underside) towards the back of the truck. Care should be taken in the routing of the cable to avoid any problems. The GPS should be located in a position such that it has an unobstructed view of the full sky.

3.3 INDOOR ENCLOSURE

The indoor enclosure should not be installed in the rack until the final step of the CONTROLLER CALIBRATION, because access to the interior is necessary prior to that procedure. However, the cables should be run through the chosen location in the rack, and connected to their respective components.

The indoor enclosure is a standard rack mount chassis that occupies three (3) rack units. It is mounted via four (4) 10-32 screws.

3.4 INTERCONNECTS

All power for the RC8097 is derived from the mains supply which enters the unit at the back right corner through an IEC power entry module. The RC8097 is wired for single-ended power, either 230VAC or 115VAC. The operating voltage is selectable via a circuit plug that is accessable when the fuse drawer is removed. The currently set operating voltage is visable through a window in the fuse drawer. To change the operating voltage, remove the power cord from the power entry module, using a small straight-blade screwdriver, remove the fuse drawer with the installed fuse. The voltage selector card is now visable and can be removed with the aforementioned screwdriver. Rotate the circuit card for the desired voltage level and replace it in the socket. Note the different fusing requirements for either 115 VAC or 230VAC.

for 115VAC operation:
6 Amp Slow-Blow, 250V
T6A, 250V

for 230VAC operation:
3 Amp Slow-Blow, 250V
T3A, 250V

Three cables from J3 connect to the Azimuth Stow, Elevation Stow, Elevation Up, and Elevation Down limit switches. These are all terminated in a DB-15 male connector at the rear of the RC-8097. The Antek Hubcom/Retrofit uses the same Azimuth Stow, Elevation Stow, and Elevation Down Limit switches but, since the Elevation Stow position also corresponds to the Elevation Up Limit. The extra limit switch is used to monitor the extension of the hydraulic platform.

Likewise, three additional cables transmit azimuth, elevation, and polarization sense information to the RC-8097 via J1. These cables are also terminated in a DB-15 male connector.

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

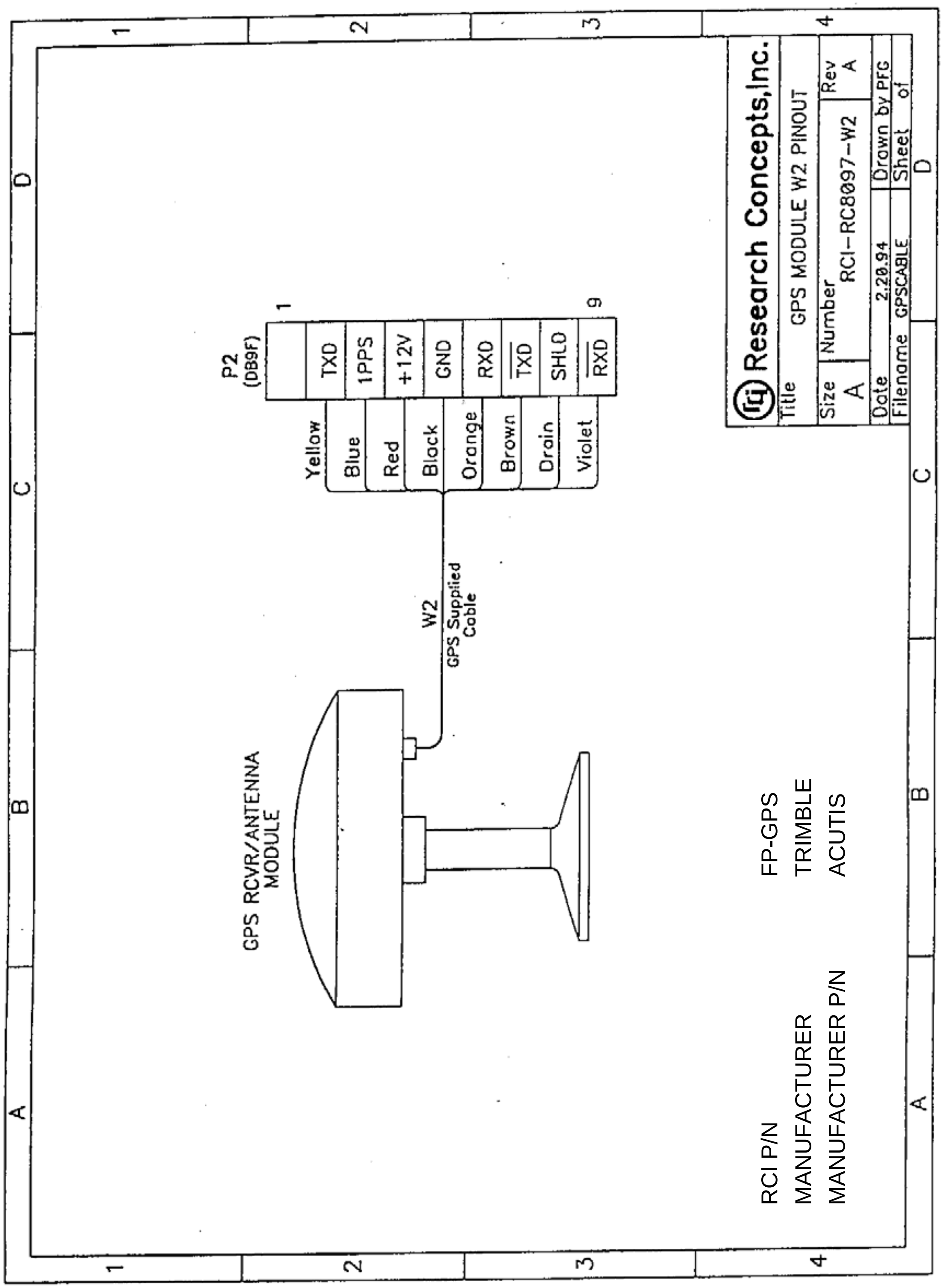
Cable W10 connects the indoor and optional fluxgate units and carries all sensor stimulus and output signals*. This will not be present unless the flux gate option is installed*. (Refer to the Flux Gate W10 Pinout on the preceding page.) Cable material is Alpha 5466C or Belden 9536, and the supplied length is 25'. Although the cable is shielded, routing near electrically noisy sources such as switching power supplies, unshielded diesel generator compartments, etc., should be avoided.

J2 connects the GPS receiver to the indoor enclosures via a DB-9 connector and supplied shielded cable. *This will not be present unless the GPS option is installed*. Route the W2 cable away from electrically noisy devices (motors, air-conditioners, etc.) to avoid unnecessary problems.

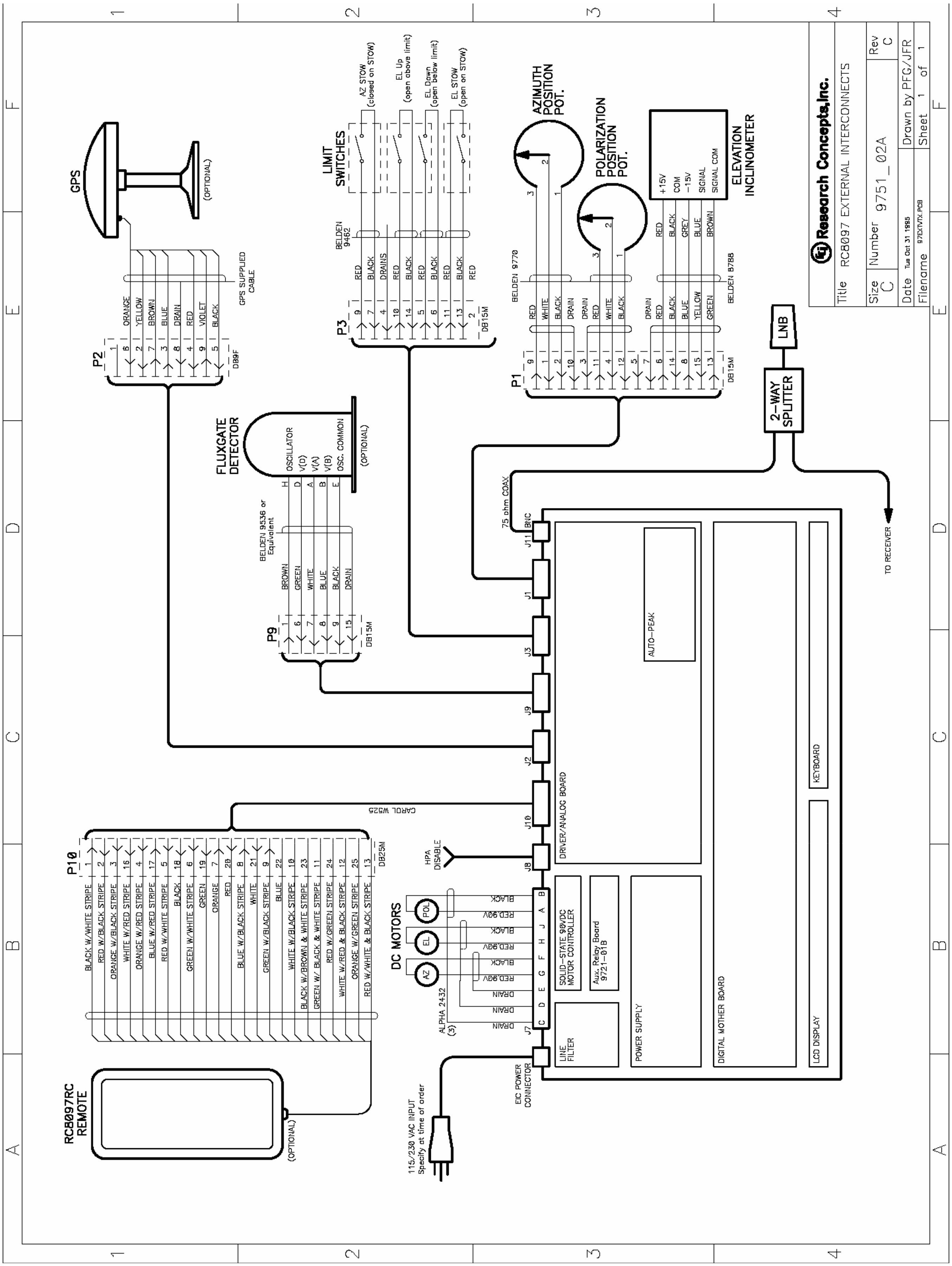
Refer to Drawing # 9751 on page 31 for a diagram of the external interconnects. Refer to Drawing # 9753 on page 32 for the internal interconnects for the indoor enclosure.

J11 is the input to the Autopeak circuit. This input accepts the output of the LNB (950-1450MHz, -50 to -5dBm).

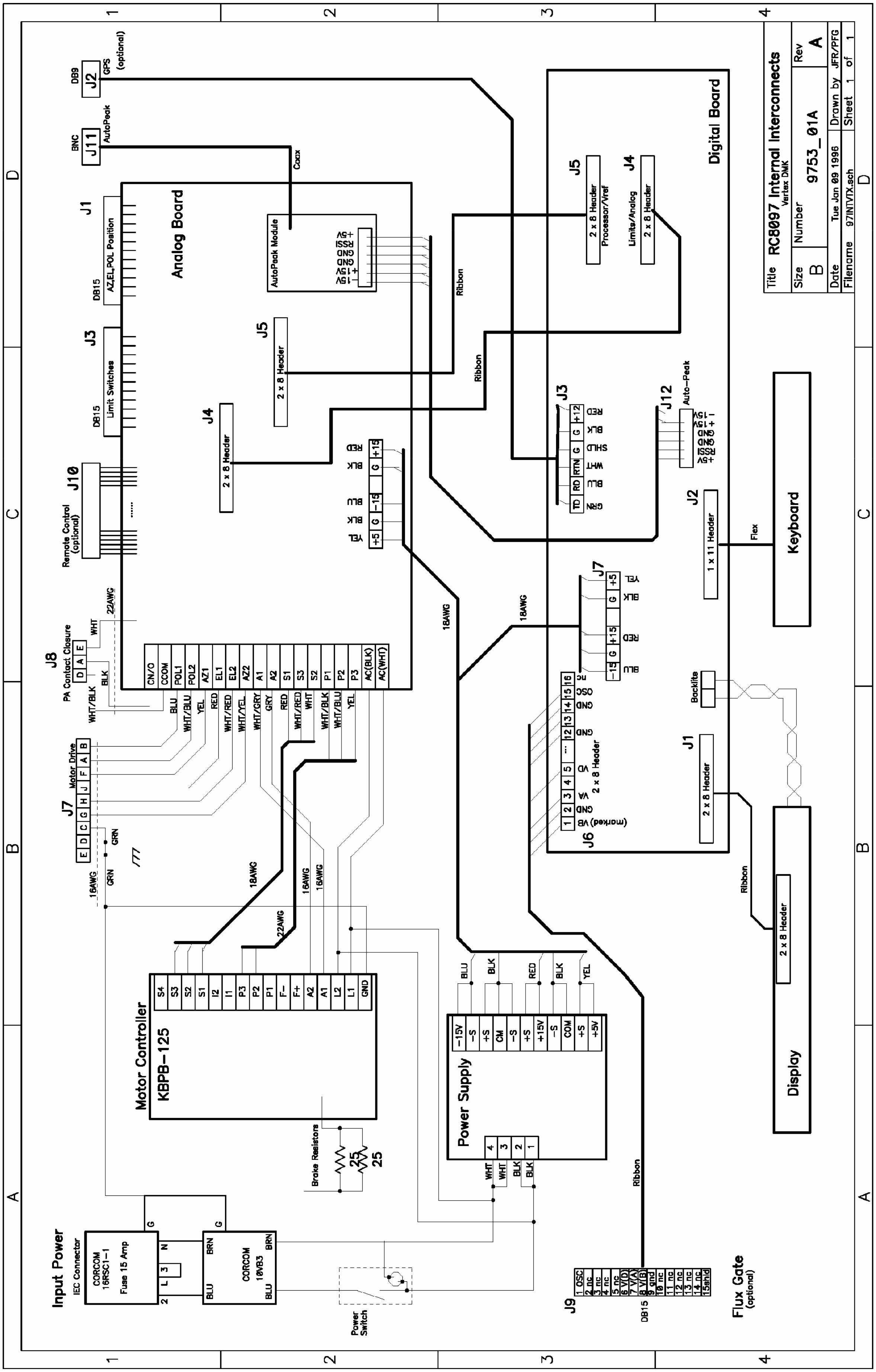
GPS PINOU


P2
(DB9F)
1
TXD
1PPS
+12V
GND
RXD
TXD
SHLD
RXD
9
Yellow
Blue
Red
Black
Orange
Brown
Drain
Violet
W2
GPS Supplied
Cable
GPS RCVR/ANTENNA
MODULE
Research Concepts,Inc.
Title
GPS MODULE W2 PINOUT
Size
A
Number
RCI-RC8097-W2
Rev
A
Date
2.20.94
Drawn by PFG
Filename
GPSCABLE
Sheet of
RCI P/N FP-GPS
MANUFACTURER TRIMBLE
MANUFACTURER P/N ACUTIS

EXTERNAL INTERCONNECTS



INTERNAL INTERCONNECTS



4. CALIBRATION

Through the use of current microcontroller technology, instrument reliability and precision have been dramatically improved. The RC-8097 takes advantage of these benefits by incorporating calibration routines for any interaction that takes place between the optional electronic compass and the truck body as well as antenna beam squint. These routines are important if optimum performance is to be achieved by the RC-8097.

The calibration procedure is divided into two sections, the controller calibration and the calculator calibration. The controller calibration aligns the antenna position sensors, sets the limit voltages which confine antenna motion as well as sets predefined polarization voltages. The calculator calibration uses known satellite positions and the calibration site location to compensate for flux gate compass error (if present) and for elevation pointing variation.

Section 4.1 is the controller calibration. Sections 4.2 and 4.3 are the calculator calibration. **If the flux gate option is present, the installer should perform the calculator calibration in Section 4.2**. **If the flux gate option is not present, the installer should skip section 4.2 and perform the calculator calibration described in Section 4.3.**

For the Calculator calibration *with the optional FLUX GATE installed (**Section 4.2**),* two different satellites are found at each of 18 different truck headings (with the cal constants and the elevation squint factor set to zero.) At each heading, the actual antenna position where the satellite was found is compared to the predicted position. The resultant differences, however slight, are entered into the system as the flux gate cal constants and the elevation squint factor. After the unit has been calibrated, these constants are used to correct the predicted antenna locations to take into account the discrepancies. It is important that the calibration be performed correctly, for all 18 positions, since this will affect every antenna pointing calculation performed thereafter.

For the Calculator calibration *without the optional FLUX GATE installed (**Section 4.3**),* two different satellites are found at two different truck headings (with the cal constants and the elevation squint factor set to zero.) At each heading, the actual antenna elevation where the satellite was found is compared to the predicted elevation. The resultant differences, are entered into the system as the elevation squint factor. After the unit has been calibrated, this constant is used to correct the target antenna elevation to take into account any discrepancies. It is important that the calibration be performed correctly, for both truck headings, since this will affect every antenna pointing calculation performed thereafter.

4.1 CONTROLLER CALIBRATION

The CONTROLLER calibration involves determining zero voltages for azimuth, elevation, and polarization. Then the azimuth and polarization electrical limits must be set. This calibrates the actual physical limits of the antenna with the readings taken by the RC-8097.

The RC8097 is designed to be compatible with several different antenna mounts as described in section 1.2. While all of the mounts are similar in that they are of the Az/El type, differences in their construction necessitate variations in the calibration procedure. Instructions to be performed in situations specific to a mount type will begin with the mount name in **boldface** type.

4.1.1 POSITION SENSOR POLARITY

The RC8097 interfaces with position sensors mounted on the antenna. The RC8097 is designed for use with antennas which use potentiometers for azimuth and polarization position sensing and a Lucas AccuStar Clinometer (with analog output) for elevation sensing.

The Azimuth potentiometer should be wired so that clockwise movement results in a higher azimuth position sense voltage. Clockwise and counterclockwise are defined as seen by an observer located above the antenna looking down on the antenna. In the controller mode, when the CW key of the RC8097 is depressed, the antenna motors must be configured so that the antenna moves clockwise.

The sense of polarization movement is somewhat arbitrary. The potentiometer must be wired so that the sensed polarization position increases as the Pol CW key is depressed.

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.

Normally, it is not necessary to modify the sensors on the antenna. The antenna manufacturer will insure that the antenna is compatible with the RC8097. This information is provided for informational purposes only.

4.1.2 ZERO VOLTAGES

Turn the RC-8097 Locator on. When the system has booted up and the main screen appears, push ***MODE*** to switch to CONTROLLER mode. Raise the antenna by pressing ***EL UP***, until the reflector face is perpendicular to the horizon (for **all mounts *except* the Antek-Hubcom mount**). This may be determined by placing an inclinometer or bubble level on a vertical surface on the back of the antenna (e.g. the AVL 1.5m mount or the Vertex DMK) or by placing an inclinometer against a straight edge laid across the face of the antenna (e.g. the Vertex SMK). If the RC8097 is being used **with the Antek-Hubcom mount**, perform this step with the antenna face tilted 45 degrees back from vertical. This angle can be confirmed by the use of a level or dial inclinometer. Be sure the azimuth stow interlock is enabled by checking the indicator lights on the front panel. (The light for Azimuth Stow will be lit, but the Elevation Stow will not.) At this point, it is necessary to check the physical antenna position from the top of the truck. The azimuth stow limit switch plunger arm on the antenna should be seated squarely in the center of the azimuth detent notch. It is VERY IMPORTANT that this position be confirmed in this manner, or else problems could be encountered during the AUTO STOW routine.

Press ***MODE*** again to return to CALCULATOR mode. Press ***TEST***. Select ***4*** **ANTENNA**, then ***1*** **VOLTAGES**. The azimuth sense voltage shown on the display should be 2.5 volts +/-.1 volts. (Since 5 volts is sent to the sensor, if the pot is adjusted at the center tap position correctly, then the reading should be half, 2.5 volts.) If the value is within this range, write it down on the worksheet on the following page. If not, loosen the pot restraining collar and rotate the shaft such that the displayed value is as near 2.50 volts as possible. Secure collar.

When using the RC8097 with the ***Vertex DMK, AVL Technologies, or SAMART*** mount, loosen the elevation sense restraining plate on the left side of the antenna and rotate the inclinometer until the first elevation voltage reads 1.690V. Secure the restraining plate. Note if there is any change of the voltage after the plate has been tightened. Copy the elevation voltage shown on the screen onto the worksheet on the following page.

When using the RC8097 with the ***Vertex 1.5m SMK*** mount, loosen the elevation sense restraining plate on the left side of the antenna and rotate the inclinometer until the first elevation voltage reads 1.372V. Secure the restraining plate. Note if there is any change of the voltage after the plate has been tightened. Add 0.318 to the measured voltage and copy this value onto the worksheet on the following page.

When using the RC8097 with the ***Vertex 1.2m SMK*** mount, loosen the elevation sense restraining plate on the left side of the antenna and rotate the inclinometer until the first elevation voltage reads 1.221V. Secure the restraining plate. Note if there is any change of the voltage after the plate has been tightened Add 0.468 to the measured voltage and copy this value onto the worksheet on the following page.

When using the RC8097 with ***the Antek-Hubcom retrofit***, loosen the elevation sense restraining plate on the left side of the antenna and rotate the inclinometer until the first elevation voltage reads 2.58. Secure the restraining plate. Note if there is any change of the voltage after the plate has been tightened. Copy the elevation voltage shown on the screen onto the worksheet on the following page.

When using the RC8097 **with the AVL Technologies** mount, observe the Polarization Stow indication in the lower right of the Test-Antenna-Voltages screen (bottom of the STOW column). A “1” here indicates the antenna is in the polarization stow position. Rotate the antenna in polarization until the Polarization Stow Limit indicates a 1. Verify that the antenna is in polarization stow position. The polarization stow limit switch plunger arm on the antenna should be seated squarely in the center of its actuating cam. It is VERY IMPORTANT that this position be confirmed in this manner, or else problems could be encountered during the AUTO STOW routine. The polarization sense voltage shown on the display should be 2.5 volts +/-.1 volts. If the value is within this range, write it down on the worksheet on the following page. If not, loosen the pot restraining collar and rotate the shaft such that the displayed value is as near 2.50 volts as possible and re-secure the collar. Note the value on the worksheet.

Depress ENTER to exit the Antenna-Voltages screen. Press 2 for SET ZERO, and enter the values recorded for the azimuth and elevation zero voltages.

When operating with the AVL technologies mount also enter the recorded polarization sense voltage at the POL: prompt *and at the STOW/VPOL prompt*. At this time enter 2.5 for the HPOL as well.

When operating with mounts **other than the AVL Technologies mount**, enter 2.5 for the zero voltage as (POL: prompt) well as the VPOL and HPOL presets at this time.

To verify the accuracy of the azimuth zero voltage, go to the controller main screen and check that the azimuth angle is 0.0 +/- 0.1 degrees. The elevation zero voltage accuracy can be verified on the same screen. When the RC8097 is used with the **Vertex and Prodelin mounts,** the elevation angle should be 22.3 +/- 0.1 degrees. When the RC8097 is used with **AVL technologies mount,** the elevation angle should be 20.0 +/- 0.1 degrees. When the RC8097 is used with **Antek mount,** the elevation angle should be 67.3 +/- 0.1 degrees.

4.1.3 AZIMUTH AND POLARIZATION ELECTRICAL LIMITS

In this step, the antenna's azimuth and polarization electrical limits are set. These limits are set using four potentiometers on the controller's analog power board. To access these pots, it is necessary to remove the controller's top cover. These four pots are labeled A-CW (azimuth clockwise), A-CCW (azimuth counter-clockwise), P-CW (polarization clockwise), P-CCW (polarization counter-clockwise). Note that the Azimuth Sweep Range limits specified in section 4.2.1 and 4.3.1, item 2, merely trigger the Reposition Truck message and do not set the azimuth motion limits for the antenna.

To set the azimuth clockwise limit, go the Controller 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. Once the desired azimuth clockwise limit is reached, switch the controller to Calculator mode. From the main screen of Calculator mode, depress the Test key to activate the test menu, then 4 to select Antenna, and 1 to select Voltages.

On the left side of the display the position sense voltages for azimuth, elevation, and polarization will be displayed. On the right side of the display, the antenna limit conditions are displayed (a zero indicates that a limit is active). Adjust the A-CW pot until the azimuth clockwise limit indication flickers between 0 and 1. The azimuth clockwise limit indication will be in the row labeled AZIM: and the column labeled CW/UP. Record the azimuth sense voltage next to the A-CW label on the Controller Calibration Worksheet on the following page.

To verify that the A-CW has been adjusted properly, go to Controller mode and 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, polarization clockwise limit, and polarization counter-clockwise limit. Once the limits have been set, replace the cover of the controller and install the controller in the instrument rack.

4.1.4 PREDEFINED POLARIZATIONS

The controller allows the operator to specify a horizontal and vertical polarization position. When the H or V key is pressed, the controller will position the polarization at the position associated with the key which was pressed.

To specify the polarization position associated with the H key, from Controller mode, jog the polarization to the desired position. Then go to Calculator mode, hit the Test key to activate the test menu, press 4 for Antenna, then 1 for Voltages. Record the polarization sense voltage on the Controller Calibration Worksheet in the Horizontal Preset position. Go to the Test-Antenna-Set Zero screen and enter the recorded voltage at the "Preset Pols - Hpol:" prompt. Whenever the Controller mode is active and the H key is pressed, the controller will position the polarization to the voltage specified.

The position associated with the V key is set in a similar manner. When using the RC8097 with the mount from AVL Technologies, the VPOL preset corresponds to the polarization stow position as determined in section 4.1.2.

****

AZIMUTH SENSE VOLTAGE ___________

ELEVATION SENSE VOLTAGE___________

POLARIZATION SENSE VOLTAGE ___________

A-CW ___________

A-CCW ___________

P-CW ___________

P-CCW ___________

VERTICAL PRESET ___________

HORIZONTAL PRESET ___________

CONTROLLER CALIBRATION WORKSHEET

4.2 CALCULATOR CALIBRATION WITH FLUX GATE OPTION INSTALLED

If the flux gate option is present, the installer should perform the calculator calibration in this section. If the flux gate option is not present, the installer should skip this section and perform the calculator calibration described in Section 4.3.

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 truck 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 which contain a large amount of ferrous metal. It is of key importance to avoid areas adjacent to multi-story buildings, railroad tracks, bridges, truck yards, parking lots full of cars, and high voltage power lines.
3. Trees and wooden objects pose no problem for calibration.
4. Asphalt parking lots can provide a good calibration site. Care should be taken, though, in that asphalt is often laid over concrete which may contain reinforcing rod.

If a 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 Satellite Locator is only as good as its calibration.

4.2.1 INITIALIZATION

Before collecting data for calibration of the RC-8097 Satellite Locator, certain system and flux gate constants must be initialized. This preliminary setup involves seven basic steps that are explained in this section. The actual procedure is outlined step by step in the INITIALIZATION ROUTINE on the following page.

1. ANTENNA CODE.

This item specifies whether the antenna, when in the azimuth stow position, points off of the back of the vehicle or the front of the vehicle. This information is specified from Calculator mode via the Test-System-System Constants screen. At the Antenna Code prompt, hitting the Scroll Down or Scroll Up key will toggle the value for this item between "F" (for Front of vehicle) or "B" (for Back of vehicle).

2. FLUX GATE and GPS CODE.

These items specify whether the system has the Flux Gate compass or GPS receiver options are present. This information is specified from Calculator mode via the Test-System-System Constants screen. At each prompt, hitting the Scroll Down or Scroll Up key will toggle the value for this item between "Y" (for option present) or "N" (for option not present).

3. AZIMUTH CW RANGE and CCW RANGE

These items specify the antenna's range of travel relative to the antenna's stow position. These positions are only used to trigger the display of the Reposition Truck message. This message is displayed when the antenna is incapable of moving to the azimuth position required to intercept the desired satellite. The CW Range and CCW Range are specified from Calculator mode via the Test-System-System Constants screen.

Note that these values are not used to limit the motion of the antenna. The antenna's azimuth limits are set using potentiometers inside the controller (see section 4.1.3 - 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 CW Range may be entered as either a positive or negative value, the controller will adjust the sign of the entered quantity internally.

4. SET ELEVATION SQUINT TO 0.0.

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 flux gate calibration. The VALUE OF THIS CONSTANT MUST BE SET TO 0.0 BEFORE THE FLUX GATE CALIBRATION OCCURS. The nominal value of this constant is 0.0. The elevation squint factor is specified in Calculator mode via the Test-System-System Constants screen. The elevation squint factor is described in section 4.2.3.

5. SCAN RANGE.

The scan range specifies whether or not the Autopeak system is enabled and if enabled, the range of azimuth values over which the scan occurs. The Autopeak system is described in section 4.2.5. For the flux gate calibration, this constant should be set to 0. The Scan Range is specified from Calculator mode via the Test-System-System Constants screen.

6. CLEAR FLUX GATE CAL CONSTANTS.

The Flux Gate Cal (Calibration) Constants are determined during the flux gate calibration. FOR THIS REASON, THE FLUX GATE CAL CONSTANTS MUST BE CLEARED BEFORE THE FLUX GATE CALIBRATION OCCURS. The Flux Gate Cal Constants are cleared from Calculator mode via the Test-Flux Gate-Cal Const screen by selecting item 4 - Clear All Entries, and then pressing the 1 key when the warning message is displayed.

7. VERIFY THAT THE FLUX GATE OFFSETS ARE CORRECT.

The RC-8097 should be shipped with the flux gate offsets already entered. However, it is best to verify the entry of this information. The offsets for this particular unit can be found on the RC-8097 Data Sheet on the last page of this manual. Copy the offsets from the data sheet to step 17 in the following routine.

INITIALIZATION ROUTINE

1. Press ***TEST*** (from the main **CALCULATOR** screen.)
2. Press ***1*** (for **SYSTEM** menu.)
3. Press ***1*** (for **CONSTANTS**.)
4. Specify the Antenna Code. Use ***SCROLL UP*** or ***DOWN*** to select either "F" or "B".
5. Specify the Azimuth CW Range and CCW Range.
6. Enter 0.00 in the Elevation Squint field and the Scan Range field, then press ***ENTER***.
7. Enter 0 in the Scan Range field, then press ***ENTER***.
8. Press ***1*** (for CONSTANTS).
9. Verify the values entered. Press ***ENTER*** to skip through each field until exiting the screen.
10. Press ***ENTER*** (to return to **TEST** menu.)
11. Press ***3*** (for **FLUX GATE** menu.)
12. Press ***2*** (for **CAL CONST.** menu.)
13. Press ***4*** (for **CLEAR ALL ENTRIES**.)

14. Press ***1*** (to proceed.)

15. Press ***ENTER*** (to return to **FLUX GATE** menu.)

16. Press ***3*** (for **SET OFFSETS**.)

17. Verify values entered against those entered here: **1**________ **2**________ **3**________
Press ***ENTER*** to move to second and third offset.

18. Press ***ENTER*** three times to return to main CALCULATOR screen.

4.2.2 DATA COLLECTION FOR FLUX GATE 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 of the earth's magnetic field and obtain the vehicle's actual magnetic heading. The following paragraphs describe the theory behind the calibration procedure. The installer may skip the Theory section and proceed directly to the Flux Gate Calibration Routine which follows the Theory section.

THEORY

The calibration procedure is based on the fact that is it possible to determine the vehicle's actual heading based on the actual antenna azimuth angle required to intercept a satellite at a given longitude when the vehicle's latitude and longitude are known. A flux gate calibration constant entry consists of the vehicle's indicated flux gate heading and the difference between the indicated heading and the vehicle's actual magnetic heading. Up to 18 flux gate calibration constants may be entered into the controller's memory.

To calibrate the flux gate and determine the elevation squint factor, the vehicle is positioned at a number of different headings. At a given heading, the operator allows the controller to calculate the azimuth and elevation positions required to intercept a pair of satellites. These calculated positions are recorded. The operator then manually jogs the antenna to align the antenna with the satellites. The azimuth and elevation angles where the satellites are actually found are recorded. The difference between the calculated (or target) positions and the positions where the satellites were actually found are determined.

The difference between the target elevation and actual elevation values for both satellites at all of the calibration headings are averaged together to calculate the Elevation Squint Factor. The Elevation Squint Factor is independent of heading.

The Flux Gate Cal Constants are heading dependent. At a given heading, the difference between the calculated (or target) azimuth heading and the azimuth heading where the satellite was actually found is calculated for each of the two satellites found at that vehicle heading. The two differences are averaged together to form the Flux Gate Cal Constant for that heading. The Flux Gate Cal Constant and vehicle heading are entered into the controller. Once the Cal Constant has been entered, whenever the vehicle is at that measured heading the heading is adjusted by adding the Flux Gate Cal Constant to the measured heading, to arrive at the vehicle's actual magnetic heading.

FLUX GATE CALIBRATION ROUTINE

For the flux gate calibration, the vehicle is positioned at up to 18 different headings. At each of the headings the user has the antenna controller predict the antenna azimuth and elevation headings which will be required to intercept a pair of geostationary satellites. For each satellite the user manually jogs the antenna to align the antenna with the satellite. The predicted and actual azimuth and elevation values are recorded. The flux gate calibration constants are determined from this information. If two satellites are not available, it is acceptable to use just one satellite.

1. The first step of the calibration procedure is to determine which vehicle headings will be used to gather the calibration data. The vehicle should be positioned at the vehicle headings which will be encountered in normal operation of the vehicle.

This is determined by three factors -

i) the orientation of the antenna on the vehicle (does the antenna point off of the front of the truck or the back of the truck?);

ii) the range of antenna azimuth movement relative to the antenna's azimuth stow position (+/- 90 degrees or +/- 180 degrees, for example);

iii) which hemisphere will the vehicle be operated in (northern hemisphere or southern).

If the antenna has +/- 180 degrees of azimuth movement, the 18 calibration headings should be evenly distributed over the entire possible range of vehicle headings, 0 to 360 degrees, or every 20 degrees.

If the antenna has +/- 90 degrees of azimuth movement, the antenna points off of the front of the vehicle when in the azimuth stow position, and the vehicle is operated in the northern hemisphere, the vehicle will generally be parked at a southerly heading. For this case, the vehicle headings should be evenly distributed between 90 degrees (east) and 270 degrees (west). For example, calibration data should be taken at vehicle headings of 90 degrees, 100 degrees... 260 degrees, and 270 degrees.

2. The next step of the calibration procedure is to pick a pair of geostationary satellites to perform the calibration on. These satellites should be easy to identify, and their longitude must be known.

3. Position the truck at one of the headings determined in step 1. It is not necessary that the exact vehicle heading determined in that step be used. In the example of step 1, vehicle headings of 90 degrees, 100 degrees, ... were selected. The vehicle does not have to be positioned at these exact headings, just somewhere close. For the example case, vehicle headings of 86.5 degrees, 97.1 degrees, and 112.4 degrees could be used.

The vehicle heading can be determined by using the heading display provided by the flux gate. Record the truck heading as indicated by the flux gate in the worksheet provided, in the column labeled HEADING.

4. From the RC8097's Calculator mode, press the SAT SELECT key.

5. Press the 1 key to select USER ENTRY.

6. Enter in the longitude of the first satellite selected in step 2 above. Be sure to use the EAST or WEST keys to complete the entry of the satellite's longitude.

7. *If the GPS receiver option is not present*, the installer must enter the truck position. From the RC8097's Calculator mode, press the L/L Source key. Select USER ENTRY and enter the truck's latitude and longitude being sure to observe the sign of the angles.

8. When the RC8097 calculates the azimuth and elevation angles required to intercept the satellite, press the MODE key to activate the RC8097's Controller mode. Then press the LOCATE key. At the LOCATE key prompt, enter 1 to initiate the automatic satellite locate function.

9. When the antenna quits moving, manually jog the antenna in azimuth and elevation to align the antenna with the satellite. Jog the antenna to obtain maximum signal strength. Record the TARGET and ACTUAL elevation positions on the worksheet in columns A and B, respectively. Also record the TARGET and ACTUAL azimuth positions in columns D and E. Note that in the RC8097's Controller mode, the actual antenna position is displayed next to the AZIM and ELEV banners in the column labeled POSITION and the target positions predicted by the RC8097 are displayed in the column labeled TARGETS.

10. Calculate the following differences:
A - B = C, record this result in column C.
D - E = F, record this result in column F.
Be sure to perform this subtraction exactly as shown, and properly record the sign (+/-) of the result.

11. Hit the MODE key to return to the main Calculator screen.

12. Repeat steps 4 through 11 for the other satellite selected in step 2. It is not necessary to re-enter the truck latitude and longitude.

13. Calculate the average value of the two elevation differences (in column C) for this heading and record the result in column C to the right of the banner labeled AVERAGE. Next, calculate the average value of the two azimuth differences (in column F) and record the result in column F next to the banner labeled AVERAGE. These averages represent the calibration constants for this heading.

14. Repeat steps 3 through 13 at each of the other vehicle headings determined in step 1 above.

A sample calibration worksheet is included. For this example, the target vehicle headings were 120 degrees, 130 degrees, ..., 290 degrees. For this calibration, the elevation squint factor was 0.08. The flux gate calibration constants are:

Index	**Heading**	**Calibration Constant**
1	121.5	0.8
2	130.6	2.4
3	139.4	3.8
4	149.0	7.9
5	161.1	11.6
6	170.6	13.25
7	182.4	16.15
8	189.6	16.0
9	198.7	16.6
10	210.3	15.55
11	219.7	14.15
12	231.3	10.3
13	241.6	8.35
14	249.7	5.15
15	260.7	4.25
16	270.6	2.9
17	280.9	-1.0
18	289.8	-1.7

RC8097 CALIBRATION DATA

Date Calibrated:______________________ Calibration Site:______________________

****

HEADING (TARGET) ACTUAL	SAT. LONG.	ELEVATION TARGET A	-	POSITION B	=	DIFF. C	AZIMUTH TARGET D	-	POSITION E	=	DIFF. F	
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*
( )	______	______	-	______	=	______	______	-	______	=	______	
______	______	______	-	______	=	______	______	-	______	=	______	
				Average	=	______			Average	=	______	*

! EXAMPLE USE ONLY - DO NOT USE FOR DATA ENTRY !

Table 4.2ex

Calibration Data - Page 2

****

HEADING	**SAT. LONG.**	**ELEVATION**					**AZIMUTH**					
(TARGET) ACTUAL		TARGET A	-	POSITION B	=	DIFF. C	TARGET D	-	POSITION E	=	DIFF. F	
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*
( )			-		=			-		=		
			-		=			-		=		
				Average	=				Average	=		*

Add Elevation Averages Together (C) ________

Divide Total By # of Headings = ________

Table 4.2ex

! EXAMPLE USE ONLY - DO NOT USE FOR DATA ENTRY !

RC8097 CALIBRATION DATA

Date Calibrated:________________________ Calibration Site:________________________

****

HEADING (TARGET) ACTUAL	SAT. LONG.	ELEVATION TARGET A	-	POSITION B	=	DIFF. C	AZIMUTH TARGET D	-	POSITION E	=	DIFF. F	
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*
( )	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
_______	______	_______	-	_______	=	_______	_______	-	_______	=	_______	
				Average	=	_______			Average	=	_______	*

Table 4.2

Calibration Data - Page 2

****

HEADING	**SAT. LONG.**	**ELEVATION**					**AZIMUTH**					
(TARGET) ACTUAL		TARGET A	-	POSITION B	=	DIFF. C	TARGET D	-	POSITION E	=	DIFF. F	
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*
( )	______	________	-	________	=	________	________	-	________	=	________	
________	______	________	-	________	=	________	________	-	________	=	________	
				Average	=	________			Average	=	________	*

Add Elevation Averages Together (C) ________

Divide Total By # of Headings = ________

Table 4.2

4.2.3 ELEVATION SQUINT FACTOR

The elevation squint factor corrects for discrepancies between the antenna's electrical and mechanical bore sight alignment. The squint factor also allows for errors in the attachment of the elevation position sensor.

To obtain the elevation squint factor, simply sum the average elevation differences in the boxes in column C of **Table 4.2** and divide by the number of headings used. The elevation squint factor is simply the negative of this value. For example, if the average of the elevation differences is .1, then the elevation squint factor is -.1. From Calculator mode, the following procedure is used to enter the value:

1. Press ***TEST***.
2. Press ***1*** (for **SYSTEM**.)
3. Press ***1*** (for **CONSTANTS**.)
4. Press ***ENTER*** to skip to the **EL SQUINT** field, and enter the value, then press ***ENTER*** to move to the **SCAN RANGE** field.
5. Enter the **SCAN RANGE** selected after reading section 4.2.5.
6. Press ***ENTER*** (to fix in memory.)

Check to be sure the values were stored properly by pressing ***1*** again and verifying the values shown.

4.2.4 FLUX GATE CALIBRATION CONSTANTS

These calibration factors are used to correct for the distortion of the earth's magnetic field caused by the truck itself. These factors are highly heading-dependent, as should be clear from the values derived in Example 4.3.

To enter the constants, follow the procedure listed below:

1. Press ***TEST***.
2. Press ***3*** (for **FLUX GATE**.)
3. Press ***2*** (for **CAL CONST**.)
4. Press ***2*** (for **ADD ENTRY**.)

At this point, sequentially enter the data from **Table 4.2**. Starting with Index 1, enter the recorded heading from the number pad, followed by ***ENTER***. Enter the average azimuth difference for the first heading located in column F, terminated by ***ENTER***. Repeat this for all headings. After all data has been entered, examine the entries by selecting **VIEW** from the Flux Gate Calibration Constants menu. Verify that all data was correctly entered and stored.

The unit should now be fully calibrated and ready for accurate satellite position prediction. Test the unit at various random headings to insure the quality of the calibration data.

4.2.5 AUTO-PEAK SCAN RANGE

The scan range is a user-defined angular value that determines the range to be scanned by the RC-8097 during the Auto Peaking routine. This value can be zero (which disables the routine) or from 3 degrees to 15 degrees. The autopeak circuitry is not available on RC8097 serial numbers 001 through 027.

The Autopeak routine runs in conjunction with Auto Locate. The controller first moves the antenna to the calculated elevation, then moves it to the calculated azimuth position, plus or minus the scan range value, whichever is closer. For instance, if the calculated azimuth is 85 degrees and the scan range is 10 degrees, the controller will move the antenna to 75 degrees and begin monitoring the signal power across the specified range to 95 degrees. If part of this range is outside the physical limits of the antenna, the controller will ignore it and stop at the outer limit.

Once the controller has completed its sampling of power readings, if the unit determines a satellite was found by comparing the peak power to the background noise, it will position the antenna at the point of greatest power, then check and correct the elevation. If the unit does not have a clear indication of a satellite, it will move the antenna to the original calculated position. This routine enables the RC-8097 to self-correct any azimuth inaccuracy caused by truck heading calculation errors.

Since this angular range is user-definable, there are several factors to take into consideration. If the range is too narrow, it might not be able to compensate for a heading error. In this case, the RC-8097 will move the antenna to the calculated azimuth. If the range is too wide, it will take the unit slightly longer to lock up, although this is usually not a significant amount of time. There might also be certain situations in which two satellites will be at a given elevation within that specified wider range, and the RC-8097 will position the antenna at the point of the strongest signal, even though it is not the desired satellite. Therefore, when using Auto Peaking, IT IS BEST TO ALWAYS VERIFY THAT THE SATELLITE IS CORRECT.

This value can be changed at any time. It is recommended that the narrowest scan range that results in consistently locating the desired satellites be used. This value is entered via the Test-System-System Constants screen (see section 4.2.3, Elevation Squint Factor).

This completes the calculator calibration with the flux gate option installed**. The installer should now skip section 4.3** which is valid only for the RC8097 without the flux gate option.

4.3 CALCULATOR CALIBRATION WITHOUT OPTIONAL FLUX GATE

If the flux gate option is not present, the installer should perform the calculator calibration in this section. If the flux gate option is present, the installer should skip this section and go back to perform the calculator calibration described in Section 4.2.

4.3.1 INITIALIZATION

Before collecting data for calibration of the RC-8097 Satellite Locator, certain system and flux gate constants must be initialized. This preliminary setup involves seven basic steps that are explained in this section. The actual procedure is outlined step by step in the INITIALIZATION ROUTINE on the following page.

1. ANTENNA CODE.

This item specifies whether the antenna, when in the azimuth stow position, points off of the back of the vehicle or the front of the vehicle. This information is specified from Calculator mode via the Test-System-System Constants screen. At the Antenna Code prompt, hitting the Scroll Down or Scroll Up key will toggle the value for this item between "F" (for Front of vehicle) or "B" (for Back of vehicle).

2. FLUX GATE and GPS CODE.

These items specify whether the system has the Flux Gate compass or GPS receiver options are present. This information is specified from Calculator mode via the Test-System-System Constants screen. At each prompt, hitting the Scroll Down or Scroll Up key will toggle the value for this item between "Y" (for option present) or "N" (for option not present).

3. AZIMUTH CW RANGE and CCW RANGE

These items specify the antenna's range of travel relative to the antenna's stow position. These positions are only used to trigger the display of the Reposition Truck message. This message is displayed when the antenna is incapable of moving to the azimuth position required to intercept the desired satellite. The CW Range and CCW Range are specified from Calculator mode via the Test-System-System Constants screen.

Note that these values are not used to limit the motion of the antenna. The antenna's azimuth limits are set using potentiometers inside the controller (see section 4.1.3 - 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 CW Range may be entered as either a positive or negative value, the controller will adjust the sign of the entered quantity internally.

4. SET ELEVATION SQUINT TO 0.0.

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 calculator calibration. The VALUE OF THIS CONSTANT MUST BE SET TO 0.0 BEFORE THE CALCULATOR CALIBRATION OCCURS. The nominal value of this constant is 0.0. The elevation squint factor is specified in Calculator mode via the Test-System-System Constants screen. The elevation squint factor is described in section 4.3.3.

5. SCAN RANGE.

The scan range specifies whether or not the Autopeak system is enabled and, if enabled, the range of azimuth values over which the scan occurs. The Autopeak system is described in section 4.3.4. For the calculator calibration, this constant should be set to 0. The Scan Range is specified from Calculator mode via the Test-System-System Constants screen.

6. CLEAR FLUX GATE CAL CONSTANTS.

The Flux Gate Cal (Calibration) Constants are not used in the RC8097 when the flux gate option is not installed. During the unit's initial power-up test sequence however, all memory is tested, including the flux gate cal constants. FOR THIS REASON, THE FLUX GATE CAL CONSTANTS MUST BE CLEARED BEFORE PROCEEDING WITH THE CALCULATOR CALIBRATION. The Flux Gate Cal Constants are cleared from Calculator mode via the Test-Flux Gate-Cal Const screen by selecting item 4 - Clear All Entries, and then pressing the 1 key when the warning message is displayed.

7. VERIFY THAT THE FLUX GATE OFFSETS ARE ZERO.

When the flux gate option is not installed, the RC-8097 should be shipped with the flux gate offsets already set to zero. However, it is best to verify the entry of this information.

INITIALIZATION ROUTINE

1. Press ***TEST*** (from the main **CALCULATOR** screen.)
2. Press ***1*** (for **SYSTEM** menu.)
3. Press ***1*** (for **CONSTANTS**.)
4. Specify the Antenna Code. Use ***SCROLL UP*** or ***DOWN*** to select either "F" or "B".
5. Verify that the FLUX GATE Flag is "N". Use ***SCROLL UP*** or ***DOWN*** to select "N". Press enter to Confirm.
6. If the GPS is present, verify that the GPS Flag is Y. Use ***SCROLL UP*** or ***DOWN*** to select either "Y" or "N". If the GPS is not present, select "N". Press enter to Confirm.
7. Specify the Azimuth CW Range and CCW Range.
8. Enter 0.00 in the Elevation Squint field and the Scan Range field, then press ***ENTER***.
9. Enter 0 in the Scan Range field, then press ***ENTER***.
10. Press ***1*** (for CONSTANTS).
11. Verify the values entered. Press ***ENTER*** to skip through each field until exiting the screen.
12. Press ***ENTER*** (to return to **TEST** menu.)
13. Press ***3*** (for **FLUX GATE** menu.)
14. Press ***2*** (for **CAL CONST.** menu.)
15. Press ***4*** (for **CLEAR ALL ENTRIES**.)
16. Press ***1*** (to proceed.)
17. Press ***ENTER*** (to return to **FLUX GATE** menu.)
18. Press ***3*** (for **SET OFFSETS**.)
19. Verify that the 3 values are <u>0.0</u> Press ***ENTER*** to move to second and third offset.
20. Press ***ENTER*** three times to return to main CALCULATOR screen.

4.3.2 DATA COLLECTION FOR ELEVATION SQUINT FACTOR CALIBRATION

The elevation squint factor calibration procedure provides a method to correct for any difference between the antenna's theoretical and actual elevation pointing angle. The following paragraphs describe the theory behind the calibration procedure. The installer may skip the Theory section and proceed directly to the Elevation Squint Factor Calibration Routine which follows the Theory section.

THEORY

The calibration procedure is based on the fact that is it possible to determine the antenna's elevation pointing angle based on the actual antenna elevation angle required to intercept a satellite at a given longitude when the vehicle's latitude and longitude are known. The elevation squint factor is the difference between the displayed angle and actual angle.

To determine the elevation squint factor, the vehicle is positioned at four different headings. At each heading, the operator allows the controller to calculate the azimuth and elevation positions required to intercept a pair of satellites. The calculated elevation positions are recorded. The operator then manually jogs the antenna (both in azimuth and elevation) to align the antenna with the satellites. The elevation angles where the satellites are actually found are recorded. The difference between the calculated (or target) positions and the positions where the satellites were actually found are determined.

The difference between the target elevation and actual elevation values for both satellites at the two calibration headings are averaged together to calculate the Elevation Squint Factor. The Elevation Squint Factor is independent of heading.

ELEVATION SQUINT FACTOR CALIBRATION ROUTINE

For the elevation squint factor, calibration, the vehicle is positioned at 4 different headings. At each of the headings, the user has the antenna controller predict the antenna azimuth and elevation headings which will be required to intercept a pair of geostationary satellites. For each satellite the user manually jogs the antenna to align the antenna with the satellite. The predicted and actual elevation values are recorded. The elevation squint factor is determined from this information. If two satellites are not available, it is acceptable to use just one satellite.

1. The first step of the calibration procedure is to determine which vehicle headings will be used to gather the calibration data. The vehicle should be positioned at vehicle headings which will be encountered in normal operation of the vehicle.

This is determined by three factors -

i) the orientation of the antenna on the vehicle (does the antenna point off of the front of the truck or the back of the truck?);

ii) the range of antenna azimuth movement relative to the antenna's azimuth stow position (+/- 90 degrees or +/- 180 degrees, for example);

iii) which hemisphere will the vehicle be operated in (northern hemisphere or southern).

If the antenna has +/- 180 degrees of azimuth movement, the 4 calibration headings should be evenly spaced over the range of vehicle headings, 0 to 360 degrees, at 0, 90, 180, and 270 degrees, for example.

If the antenna has +/- 90 degrees of azimuth movement, the antenna points off of the front of the vehicle when in the azimuth stow position, and the vehicle is operated in the northern hemisphere, the vehicle will generally be parked at a southerly heading. For this case, the vehicle headings should be evenly distributed between 90 degrees (east) and 270 degrees (west). For example, calibration data should be taken at vehicle headings of 90, 150, 210, and 270 degrees.

2. The next step of the calibration procedure is to pick a pair of geostationary satellites to perform the calibration on. These satellites should be easy to identify, and their longitude must be known.

3. Position the truck at one of the headings determined in step 1. It is not necessary that the exact vehicle heading determined in that step be used. In the example of step 1, vehicle headings of 90, 150, 210 and 270 degrees were selected. The vehicle does not have to be positioned at these exact headings, just somewhere close. For the example case, vehicle headings of 97.1, 151, 205, and 262.4 degrees could be used.

The vehicle heading can be determined by using the heading provided by a truck mounted compass or a hand-held compass. Record the truck heading as indicated by the compass in the worksheet provided, in the column labeled HEADING.

4. From the RC8097's Calculator mode, press the SAT SELECT key.

5. Press the 1 key to select USER ENTRY.

6. Enter in the longitude of the first satellite selected in step 2 above. Be sure to use the EAST or WEST keys to complete the entry of the satellite's longitude.

7. From the RC8097's Calculator mode, press the H'ding key.

8. Select USER ENTRY.

9. Enter in the Heading of the truck as indicated on the compass.

10. *If the GPS receiver option is not present*, the installer must enter the truck position. From the RC8097's Calculator mode, press the L/L Source key. Select USER ENTRY and enter the truck's latitude and longitude being sure to observe the sign of the angles.

11. When the RC8097 calculates the azimuth and elevation angles required to intercept the satellite, press the MODE key to activate the RC8097's Controller mode. Then press the LOCATE key. At the LOCATE key prompt, enter 1 to initiate the automatic satellite locate function.

12. When the antenna quits moving, manually jog the antenna in azimuth and elevation to align the antenna with the satellite. Jog the antenna to obtain maximum signal strength. Record the TARGET and ACTUAL elevation positions on the worksheet in columns A and B, respectively. Note that in the RC8097's Controller mode, the actual antenna position is displayed next to the AZIM and ELEV banners in the column labeled POSITION and the target positions predicted by the RC8097 are displayed in the column labeled TARGETS.

13. Calculate the elevation angle difference:

A - B = C, record this result in column C.

Be sure to perform this subtraction exactly as shown, and properly record the sign (+/-) of the result.

14. Hit the MODE key to return to the main Calculator screen.

15. Repeat steps 4 through 14 for the other satellite selected in step 2.

16. Calculate the average value of the two elevation differences (in column C) for this heading and record the result in column C to the right of the banner labeled AVERAGE. This average represents the calibration constant for this heading.

17. Repeat steps 3 through 17 at the other vehicle heading determined in step 1 above.

A sample calibration worksheet is included. For this example, the target vehicle headings were 90, 150, 210 and 270 degrees. For this calibration, the elevation squint factor was 0.08.

RC8097 CALIBRATION DATA

Date Calibrated:________ Calibration Site:________

****

HEADING	**SATELLITE LONGITUDE**	**ELEVATION**				
(TARGET) ACTUAL		TARGET A	-	POSITION B	=	DIFF. C
( )	______	______	-	______	=	______
______	______	______	-	______	=	______
				Average	=	______ *
( )	______	______	-	______	=	______
______	______	______	-	______	=	______
				Average	=	______ *
( )	______	______	-	______	=	______
______	______	______	-	______	=	______
				Average	=	______ *
( )	______	______	-	______	=	______
______	______	______	-	______	=	______
				Average	=	______ *

Add Elevation Averages Together (C) ______

Divide Total By # of Headings = ______

Table 4.3ex

! EXAMPLE USE ONLY - DO NOT USE FOR DATA ENTRY !

RC8097 CALIBRATION DATA

Date Calibrated:________________ Calibration Site:________________

****

HEADING	SATELLITE LONGITUDE	ELEVATION				
(TARGET) ACTUAL		TARGET A	-	POSITION B	=	DIFF. C
( )	_______	_______	-	_______	=	_______
_______	_______	_______	-	_______	=	_______
				Average	=	_______ *
( )	_______	_______	-	_______	=	_______
_______	_______	_______	-	_______	=	_______
				Average	=	_______ *
( )	_______	_______	-	_______	=	_______
_______	_______	_______	-	_______	=	_______
				Average	=	_______ *
( )	_______	_______	-	_______	=	_______
_______	_______	_______	-	_______	=	_______
				Average	=	_______ *

Add Elevation Averages Together (C) _______

Divide Total By # of Headings = _______

Table 4.3

4.3.3 ELEVATION SQUINT FACTOR

The elevation squint factor corrects for discrepancies between the antenna's electrical and mechanical bore sight alignment. The squint factor also allows for errors in the attachment of the elevation position sensor.

To obtain the elevation squint factor, simply sum the average elevation differences in the boxes in column C of **Table 4.3** and divide by the number of headings used. The elevation squint factor is simply the negative of this value. For example, if the average of the elevation differences is .1, then the elevation squint factor is -.1. From Calculator mode, the following procedure is used to enter the value:

1. Press ***TEST***.
2. Press ***1*** (for **SYSTEM**.)
3. Press ***1*** (for **CONSTANTS**.)
4. Press ***ENTER*** to skip to the **EL SQUINT** field, and enter the value, then press ***ENTER*** to move to the **SCAN RANGE** field.
5. Enter the **SCAN RANGE** selected after reading section 4.3.4.
6. Press ***ENTER*** (to fix in memory.)

Check to be sure the values were stored properly by pressing ***1*** again and verifying the values shown.

4.3.4 AUTO-PEAK SCAN RANGE

The scan range is a user-defined angular value that determines the range to be scanned by the RC-8097 during the Auto Peaking routine. This value can be zero (which disables the routine) or from 3 degrees to 15 degrees. The autopeak circuitry is not available on RC8097 serial numbers 001 through 027.

The Auto Peaking routine runs in conjunction with Auto Locate. The controller first moves the antenna to the calculated elevation, then moves it to the calculated azimuth position, plus or minus the scan range value, whichever is closer. For instance, if the calculated azimuth is 85 degrees and the scan range is 10 degrees, the controller will move the antenna to 75 degrees and begin monitoring the signal power across the specified range to 95 degrees. If part of this range is outside the physical limits of the antenna, the controller will ignore it and stop at the outer limit.

Once the controller has completed its sampling of power readings, if the unit determines a satellite was found by comparing the peak power to the background noise, it will position the antenna at the point of greatest power, then check and correct the elevation. If the unit does not have a clear indication of a satellite, it will move the antenna to the original calculated position. This routine enables the RC-8097 to self-correct any azimuth inaccuracy.

Since this angular range is user-definable, there are several factors to take into consideration. If the range is too narrow, it might not be able to compensate for a heading error. In this case, the RC-8097 will move the antenna to the calculated azimuth. If the range is too wide, it will take the unit slightly longer to lock up, although this is usually not a significant amount of time. There might also be certain situations in which two satellites will be at a given elevation within that specified wider range, and the RC-8097 will position the antenna at the point of the strongest signal, even though it is not the desired satellite. Therefore, when using Auto Peaking, IT IS BEST TO ALWAYS VERIFY THAT THE SATELLITE IS CORRECT.

This value can be changed at any time. It is recommended that the narrowest scan range that results in consistently locating the desired satellites be used. This value is entered via the Test-System-System Constants screen (see section 4.3.3, Elevation Squint Factor). This completes the calculator calibration with the flux gate option not installed.

5. DIAGNOSTICS & TROUBLESHOOTING

TEST is the system diagnostic and initialization key. When properly interpreted, this function can yield insight into the relative health of the system and allow for the display and modification of system constants.

Press ***TEST*** from the main display for the following menu:

```
DIAGNOSTIC AND INITIALIZATION MENU
1..SYSTEM    3..FLUX GATE
2..GPS          4..ANTENNA
ENTER SELECTION (1-4),<ENTER> TO EXIT:_
```

5.1 SYSTEM CONSTANT TEST

Selecting ***1*** **SYSTEM** at the initial test menu displays the following menu:

```
SYSTEM CONSTANT INITIALIZATION MENU
1.SYSTEM CONSTANTS
2.BLANK SETUP
ENTER SELECTION (1-2), <ENTER> TO EXIT:_
```

5.1.1 CONSTANTS

Selecting *1* **CONSTANTS** displays the following screen:

```
SYSTEM  ANT CODE:FRONT FLUX GATE:  GPS:
CW RANGE:                  CCW RANGE:
EL SQUINT:                 SCAN RANGE:
SCROLL ^v TO TOGGLE, ENTER TO CONTINUE
```

The Antenna Code, ”ANT CODE” tells the controller whether the antenna points off of the back of the truck (B) or the front of the truck (F). Press the SCROLL UP or SCROLL DOWN key to toggle between F and B. Press enter to select the item and move on to the next field.

The “FLUX GATE” and “GPS” items are yes “Y” - no “N” items that tell the processor whether the flux gate compass system or GPS receiver are installed. Press the SCROLL UP or SCROLL DOWN key to toggle between Y and N. Press enter to select the item and move on to the next field.

The CW Range and CCW Range items control the display of the "REPOSITION TRUCK" message. This message is displayed if the predicted antenna azimuth and elevation angles required to intercept a satellite are not within the antenna's range of azimuth. The CW Range item should be set to the number of degrees which correspond to the antenna's azimuth CW limit. The CCW Range item should be set to the number of degrees which correspond to the antenna's CCW limit. Note the azimuth clockwise and counter-clockwise orientation are as seen by an observer located above the vehicle looking down on the vehicle.

The Elevation Squint Factor is the difference between the antenna's actual and theoretical elevation pointing angles. This elevation squint factor is determined during the flux gate calibration procedure.

The Scan Range item controls the Autopeak system. This system is described in sections 4.2.5 and 4.3.4. When the Scan Range is set to zero, the Autopeak system is disabled. If the Scan Range is set to a value between 3 and 15, the Auto-Peak system is enabled. When Auto-Peak is enabled, after an automatic satellite locate occurs, the controller will perform an azimuth scan while monitoring the received signal strength. If a signal is found, the antenna will return to the azimuth position where the strongest signal was received. The width of the azimuth scan is +/- Scan Range degrees.

5.1.2 BLANK SETUP

This routine will **erase** all the setup truck and satellite data with **no chance of recovery**. This should be used initially to make sure the memory is clear of any test data before any **SETUP** data is entered.

The following procedure is used to blank the setup:

1. Press ***TEST***.
2. Press ***1*** (for **SYSTEM**.)
3. Press ***2*** (for **BLANK SETUP**.)

The system will ask the user to confirm this choice, since this routine will erase all the setup truck and satellite data with no chance of recovery. Press ENTER to escape without any changes, or press 1 to continue.

5.2 GPS TEST

This screen is active only when the optional GPS receiver has been installed in the system. The GPS receiver/antenna module operates in a talk mode only. It will typically lock on to a signal and offer a solution within 2 1/2 to 3 1/2 minutes, possibly quicker. The DUMP screen available in GPS test mode allows the factory to diagnose problems in operation. To reach the GPS dump:

1. Press ***TEST***.
2. Press ***2*** (for **GPS**).

5.3 FLUX GATE TEST

This screen is active only when the optional flux gate compass has been installed in the system. Selecting ***3* FLUX GATE** from the initial TEST menu displays the following menu:

```
FLUX GATE DIAGNOSTIC AND INIT. MENU
1.VOLTAGES     3.SET OFFSETS
2.CAL CONST
ENTER SELECTION (1-3), <ENTER> TO EXIT:_
```

5.3.1 VOLTAGES

These are measurements of the flux gate voltages. The magnetic variation is calculated from the truck's latitude and longitude and the current date.

```
FLUX GATE VOLTAGES GAIN:   HEADING:
V0:            V1:            V2:       ERROR:
                                        PHASE:
MAGVAR:                          (ENTER> TO EXIT
```

If an error code other than zero (no error) is displayed, refer to the Error Message section at the rear of this manual.

The phase (1-7) and gain (0-2) are used primarily for diagnostic purposes at the factory. Gain codes 0, 1, and 2 equate to low, nominal and high gain, respectively. The SCROLL UP and SCROLL DOWN keys may be used to change the gain. Note that in normal operation the controller automatically adjusts the flux gate gain.

5.3.2 CAL CONST

The flux gate calibration constants are only used in conjunction with the optional flux gate compass. When the flux gate is not installed in the 8097, the constants should be zero. This section contains four options:

1. Viewing of the eighteen calibration constants and headings.

2. Adding an entry.

3. Deleting an entry.

4. Clearing all entries.

The first option displays a screen listing the first nine headings and the calibration constant at each particular heading. Press ***SCROLL UP*** or ***SCROLL DOWN*** to view entries 10 through 18.

The second and third option allow the user to edit the entries in case of an entry error. Option 4 under this menu allows all entries to be cleared. This fourth option is usually chosen only at the time of shipping, to clear out all testing data, and during preliminary setup before calibration (section 4.3.1.)

5.3.3 SET OFFSETS

The flux gate offsets are only used in conjunction with the optional flux gate compass. When the flux gate is not installed in the 8097, the offsets should be zero. These offsets account for unit to unit manufacturing variability in the flux gate sensors. If the memory is lost, these offsets must be reentered. A positive number is assumed, but pressing East/North or West/South will change the sign to a negative (or back to a positive.) These constants are programmed in at the factory, and can be found on the RC-8097 Data Sheet on the last page of this manual.

5.4 ANTENNA DIAGNOSTICS

The Antenna Diagnostics section allows the user to enter and view data relating to the function and data setup of the antenna. This portion of the program is used primarily during the installation procedure.

Selecting ***4*** **ANTENNA** from the initial **TEST** menu displays the following menu:

```
ANTENNA DIAGNOSTICS MENU
1.VOLTAGES
2.SET ZERO
ENTER SELECTION <1-2>, <ENTER> TO EXIT:_
```

5.4.1 VOLTAGES

This option allows the viewing of the antenna position sense voltages and the status of limit switches.

Selecting ***1*** **VOLTAGES** from the **ANTENNA** menu displays the following screen:

```
ANT. VOLTAGES LIMS CW/UP CCW/DWN STOW
AZIM:   2.923            1        1        0
ELEV:  1.701 1           1        1        0
POL:    2.165            1        1  <ENTER>:
```

The values listed in the VOLTAGES column are the voltages presented by the azimuth, elevation, and polarization position sensor scaling circuits. The input to the position sensor scaling circuits is the signal from the position sensors. For the elevation axis, there are two of these circuits. The first is designated EL1 and provides elevation position sensor information to the microprocessor when the antenna is in it's operating region (above the lower elevation limit). The second circuit, designated EL2, provides elevation position information when the antenna is in the stow region. The stow region is the region below the lower elevation limit. A 0 or a 1 will be displayed to the right of elevation voltage. A zero indicates the EL2 is displayed, and a 1 indicates that EL1 is displayed. The **Antek mount** uses only elevation region EL1.

The three **LIMIT** columns on the right side of the display screen will contain either a **0** or a **1**. If there is a **zero**, it denotes that the **antenna has reached the limit associated with that field**. Multiple limits can be reached at one time; for instance, the antenna can be at the elevation down limit at the same time it is at the azimuth clockwise limit and the polarization counterclockwise limit.

When using an RC8097 set up for use with the **AVL Technologies** mount, the third column, bottom row location is used to display the Polarization STOW bit as shown on the following screen:

```
ANT. VOLTAGES LIMS CW/UP CCW/DWN STOW
AZIM:   2.923            1        1        0
ELEV:  1.701 1           1        1        0
POL:    2.165            1        1        0
```

5.4.2 SET ZERO

Selecting ***2*** **SET ZERO** will display the following screen:

```
ANTENNA POSITION ZERO VOLTAGES
AZIM:            ELEV:            POL:
PRESET POLS  VPOL:                HPOL:
USE <0-9>, <BCKSPC>, <.>, OR <ENTER>
```

The cursor will flash at the first digit of the field for azimuth zero voltage. Press ***ENTER*** to retain any current data, or use the number keys to enter new data. Press ***ENTER*** at the cursor to save the value to memory. The cursor will jump to the next voltage to be entered, then to the preset polarizations.

The azimuth, elevation, and polarization voltages contained on the second line correspond to the mechanical or physical zero (0) positions about each of these axis. They are determined during the CONTROLLER CALIBRATION in section 4.1.2.

The polarization presets on the third line are designated by the user to provide a quick adjustment of the horizontal or vertical polarization. The reception can then be fine-tuned manually. These presets are arrived at during the CONTROLLER CALIBRATION in section 4.1.4 .

When using an RC8097 set up for use with the **AVL Technologies** mount, the third line of the display has a STOW/VPOL item rather than simply VPOL. The STOW/VPOL item is the target voltage for the Polarization STOW. This display is shown below:

```
ANTENNA POSITION ZERO VOLTAGES
AZIM:            ELEV:            POL:
POL       STOW/VPOL:              HPOL:
USE <0-9>, <BCKSPC>, <.>, OR <ENTER>
```

5.5 ERROR MESSAGES

MEMORY CHECK-SUM ERRORS

The RC8097 uses checksums to insure the integrity of data stored in non-volatile memory. When the RC8097 powers up, the controller checks the contents of non-volatile memory. If errors are found, they are reported to the user and the user is prompted to press the ENTER key to continue. If an error occurs, the user should check the data values associated with the error reported. In some cases it may be necessary to clear a portion of the controller's memory and re-enter the data. Five categories of non-volatile memory errors are reported: flux gate, truck presets, sat presets, system, and antenna. The following describes the data items associated with each type of checksum error. The information in parentheses after each data item is the Test key screen where the data item is either cleared or specified. All Test key screens are accessed from Calculator mode. Here is a description of the data items which can cause each type of checksum error.

Flux Gate - This message indicates that either the Flux Gate Offsets (Test - Flux Gate - Set Offsets) or Flux Gate Calibration Constants (Test - Flux Gate - Cal Const) are corrupt. The offsets may be found on the controller data sheet (last page of the manual) and the Calibration Constants should be recorded on the worksheet found in section 4.2 if the flux gate option is installed in the 8097. When the flux gate option is not installed, the calibration constants and flux gate offsets should be set to zero.

Truck Presets and Sat Presets - This message indicates that the vehicle location and satellite setup data has been corrupted. All preset data may be cleared via the Test - System - Blank Setup screen. Vehicle location and satellite preset information may be entered via the Setup key menu.

System - This message indicates that one of the following data items is corrupt: Antenna Code, FLUXGATE, GPS, CW Range, CCW Range, El Squint, and Scan Range. All of these data items may be viewed and re-initialized from the Test - System - System Constants screen.

Antenna - This message indicates that the antenna azimuth, elevation, and polarization zero voltages are corrupt or that the Preset Vpol or Preset Hpol data items are in error. These data items may be examined and modified via the Test - System - Set Zero screen. The values for these items may be found on the Controller Calibration Worksheet in section 4.1

ELECTRONIC COMPASS ERROR - This message*, valid only when the optional flux gate is installed*, is displayed in the upper left hand corner of the display when Calculator mode is active. It indicates that the RC8097 has detected a fault with the flux gate compass. This is usually caused by a loose connection either at the back of the RC8097 or in the sensor tower on the top of the vehicle. There is a flux gate error code which is displayed on the Test - Flux Gate - Voltages screen. This error code can be used by factory technicians to diagnose the most likely cause of the problem.

The error code will have one of the following values ....

0 ... no error
1 ... invalid phase
2 ... at least two of the flux gate voltages are zero
4 ... at least two of the flux gate voltages are greater than 4.95 volts

If the flux gate error is caused by anything other than a loose connection, contact the factory @ (913) 469-4125.

REPOSITION TRUCK - This message is displayed when Calculator mode is active on the second line of the display on the far right. It indicates that the antenna does not have a sufficient range of azimuth movement to allow the antenna to be aligned with the satellite specified by the user. When this message occurs, the truck should be repositioned at a different heading. Note that this message is triggered by the CW Range and CCW Range data items.

*****ANTENNA JAMMED***** - This message is displayed when the antenna controller has been commanded to move the antenna but movement has not been detected. If the unsuccessful movement was part of an automatic move (stow or locate) an error code will be displayed. The error codes are described in the following section.

LOW BATTERY - The battery condition is checked upon each power up. If this message appears, the user is prompted to 'Hit any key to continue'. When the display flashes this warning, a new battery should be installed to eliminate memory loss in case of power failure. NOTE: The RAM battery backup circuit is designed to avoid loss of memory if the proper procedure is followed when changing the battery. The two key elements in this procedure are: (1) actual time spent in changing the battery and (2) keeping the battery holder positive tab from touching the negative contact on the inside of the holder. If the tab is kept isolated from the negative terminal of the holder, changing time is extended to approximately 30 seconds. However, if the tab is allowed to short against the negative terminal, this time is reduced to approximately 10 seconds. Therefore, if it is at all possible, care should be taken during this procedure to hold the tab away from the negative terminal.

1. With the power cord unplugged, remove the screws that hold the enclosure lid on.

2. The battery is located on the vertically mounted PC board located behind the keypad. Carefully remove the by lifting up on the holder tab that keeps the battery in place. Care must be taken in this procedure to prevent damage to any of the surrounding components.

3. Replace with a Duracell # DL2450 lithium coin cell. They can be obtained from your RC-8097 distributor.

   AS YOU INSTALL THE NEW BATTERY BE SURE THAT THE POSITIVE SIDE IS FACING UP AND IS IN DIRECT CONTACT WITH THE HOLDER TAB.

4. Replace the enclosure lid, and reinstall it in the rack.

5. Plug the unit back in and turn the power on. Check to see if the memory is still intact. If not, it will be necessary to reprogram the memory.

ANTENNA MOVEMENT ERROR CODES

When an error occurs during an automatic antenna stow or automatic satellite locate operation, an error code will be displayed. Here is a description of all possible codes.

The **first digit** in the error code tells the user which error **group** to look under - **Antenna Stow** or **Antenna Locate**.

The **second digit** is the **phase** the error occurred in. This lets the user know what the controller was attempting to do when the error occurred.

The **third and last digit** of the error code tells the user what **type** of error occurred.

Error codes ending in a (**1**) denote that a **limit** was reached, causing the controller to stop the movement.

Action:

This could indicate that the limits are not set correctly. Verify the limits (refer to section 4.1.3)

Compare the azimuth CW Range and CCW Range (found in section 4.2.1 if the fluxgate option is present or 4.3.1 if the fluxgate option is not present) with the physical azimuth limits (in section 4.1.3.)

If these numbers are compatible, try to manually move the antenna with the keypad.

If unsuccessful, try the manual controls on the back of the RC-8097. (Switch from COMP to MAN.)

Check the limit lights on the back panel to determine which limit was reached - match these to the TEST/ANTENNA/VOLTAGES screen (see section 5.4.1).

Check the DB-15 limit connector (J3) to make sure the connection is secure.

If the RC-8097 was attempting an AUTO STOW, and the antenna was just barely in the azimuth stow position, and then bumped out, the controller would cease movement. Try selecting AUTO STOW again. If that is not successful, use the manual keys to move the antenna to the azimuth stow position. If the antenna is below the elevation down limit (the down indicator would be flashing), the antenna must first be moved up, then the azimuth adjusted, and then lowered.

If none of these suggestions clear up the problem, it is possible that there is an error in a mechanical limit switch on the antenna. In this case, it will be necessary to call the vendor.

Error codes ending in a (**2**) denote a **motion detect** error. This indicates that the controller was attempting to move the antenna about an axis, and no motion was detected.

Action:

The user should first check for any physical obstruction outside the truck. If there is no obstruction, try again.

If unsuccessful, try moving the antenna with the switches on the back of the unit.

Caution should be observed in that there are no safeguards in this mode.

Check connections on the back panel - make sure the switch is not in manual mode. Try again.

Error codes ending in a (**3**) denote that the ***STOP*** key was pressed before the controller could finish the requested movement.

No action necessary on the part of the user.

ERROR GROUP 1 - ANTENNA STOW ERRORS

Error Code Description

Error codes 101 through 106 pertain only to the case of the **AVL Technologies** mount.

101 Polarization CW or CCW limit encountered before the stow position was reached.

103 The stop key was depressed.

104 The POL STOW VOLTAGE has an invalid value. (should be >0.0 Volts and <5.0 Volts).

105 The antenna is at or below the down elevation limit. The antenna must be above the down elevation limit for the automatic stow to run to completion.

106 The position associated with the POL STOW VOLTAGE has been reached but stow limit switch did not activate.

111 The azimuth clockwise or counterclockwise limit was reached as the controller attempted to move the antenna to the azimuth stow position. Recheck the zero voltage for azimuth.

112 A motion detect error occurred while the controller was moving the antenna to the azimuth stow position.

113 The user pressed STOP as the controller was attempting to move the antenna to the azimuth stow position.

121 ANTENNA ALREADY STOWED -

Or: The controller had received a reading that indicated the antenna was at the azimuth stow position, and tried to lower elevation. The reading then changed to indicate that the antenna had somehow strayed from the azimuth stow position.

122 Jammed error in elevation during auto-stow after AZ stow limit is reached.

123 The STOP key was pressed while the controller was attempting to reach the elevation stow position.

124 (126) The Elevation Stow timeout period has expired, increase El motor speed

131 The controller made an unsuccessful attempt to move the antenna to the azimuth stow position.

ERROR GROUP 2 - ANTENNA LOCATE

211 Invalid data - the calculation for azimuth and elevation was not complete yet. This code is not used for firmware versions 7.5x or greater.

221 The controller reached an up elevation limit while trying to reach the elevation down limit.

223 The STOP key was pressed after the controller was instructed to locate a satellite.

231 An up elevation limit was reached as the controller was moving the antenna to the target elevation.

232 This motion detect error occurred as the controller was moving the antenna to the target elevation.

233 The STOP key was pressed as the controller was moving the antenna to the target elevation.

241 The clockwise or counterclockwise azimuth limit was reached before the antenna arrived at the target azimuth or the target scan point.

242 This motion detect error occurred as the controller was attempting to move the antenna to the target azimuth or the target scan point.

243 The STOP key was pressed before the antenna reached the target azimuth or the target scan point.

251 An azimuth limit was reached before the controller could complete its auto scan.

252 A motion detect error occurred as the controller was performing the auto scan.

253 The STOP key was pressed during the auto scan.

261 An elevation limit was reached before the controller could adjust the target elevation during the auto scan.

262 This motion detect error occurred as the controller was attempting to adjust the target elevation during the auto scan.

263 The STOP key was pressed before the controller could recheck the elevation to adjust for tilt during the auto scan.

271 The clockwise or counterclockwise limit was reached before the antenna arrived at the peak position or the calculated azimuth.

272 This motion detect error occurred as the controller was moving the antenna to the peak power point, or if a peak wasn't found, to the calculated azimuth.

273 The STOP key was pressed while the controller was moving the antenna to the peak power point or to the calculated azimuth.

281 A limit was reached as the controller was moving the antenna to the final elevation point.

282 This motion detect error occurred as the controller was correcting the elevation after the scan.

283 The STOP key was pressed while the controller was correcting the elevation after the scan.

5.6 TROUBLESHOOTING

SOFTWARE LOCKUP - If the RC8097's memory is corrupted, the software may hang up or lock up in Calculator mode. This is generally due to the flux gate offsets not being initialized properly. If this occurs, power down the controller, power the controller up, and rapidly depress and release the TEST key several times. This should bring up the Test key menu after the controller performs its memory and battery checks. From the Test key menu, select 3 for Flux Gate, then 3 for Set Offsets. The user should then key in the proper offset values found on the data sheet on the last page of the manual. When setting the offsets, the RC8097 will prompt the user with the existing value of the offset. Normally, the user can hit the Enter key to accept the existing value of the offset. If the user is prompted with a value of 0.0, the user should not hit the Enter key to accept the existing value, but should key in 0.0 followed by the Enter key. The reason for this is that an invalid floating point number in the RC8097's memory will display as 0.0. If the user simply hits the Enter key in response to a prompt of an invalid number which displays as 0.0, the invalid number in memory is not changed. Keying in a value of 0.0 actually loads a new number into the controller's memory.

Auto Stow - In controller mode the RC8097 can automatically stow the antenna. When an Auto Stow occurs, the controller will first move the antenna in azimuth to the Azimuth Antenna Position Zero voltage. This voltage is specified from Calculator mode via the Test - Antenna - Set Zero screen. When the antenna gets in the vicinity of the Zero Voltage, the controller starts looking for the azimuth stow switch indication. If the stow indication is not found, an error 131 will occur. If this occurs, it may indicate that the azimuth position sense pot has slipped, or that the azimuth zero voltage need to be reset. See section 4.1.

When the RC8097 is being used with the AVL Technologies mount, prior to the azimuth stow, a polarization stow will be performed. The controller will first rotate the antenna in polarization to the Polarization Zero voltage. This voltage is specified from Calculator mode via the Test -

Antenna - Set Zero screen. When the antenna gets in the vicinity of the Zero Voltage, the controller starts looking for the polarization stow switch indication. If the stow indication is not found, an error 106 will occur. If this occurs, it may indicate that the azimuth position sense pot has slipped, or that the azimuth zero voltage need to be reset. See section 4.1

Limit Switches - The RC8097 relies on a number of limit switches on the antenna. Some controller problems may really be limit switch problems. The RC8097 is designed to interface with the following limit switches on the antenna.

Limit Switch	**Switch Contact State** when the Antenna is in the Limit or Stow Position
Azimuth Stow	Closed
Elevation Stow	Open
Elevation Down	Open
Elevation Up	Open

For the **AVL Technologies mount**, a polarization stow switch is used with the following logic:

Polarization Stow	Closed

For the **Antek mount**, the Elevation Up limit and the Elevation Stow limit are coincident and use the same switch. The limit switch used formerly for the elevation up limit is used to determine whether the hydraulic system has deployed the antenna to the operate position. No antenna movement is allowed without this hydraulic "deploy" limit active. The deploy limit switch has the following logic:

Antenna Deploy	Closed

The user may examine the state of the limit switches from Calculator mode via Test - Antenna - Voltages screen.

Motor Drive Module - 90 volt drive versions of the RC8097 use a 90 volt motor drive module (model # KBPB-125) manufactured by Penta Power. The versions include the **Vertex, Prodelin, and Antek** mounts. The operator's manual for the drive is included with this manual. To adjust the azimuth and elevation motors' fast speed, use the potentiometer on the KBPB labeled 'MAX'. At the factory, the fast speed motor voltage is adjusted to 90 volts (DC). The motor voltage is available at the A1 and A2 terminals on the top of the KBPB module. The slow speed of the azimuth and elevation motors is adjusted using the potentiometer FAST/SLOW ADJUST found on the back circuit board of the RC8097, near the large relays. The slow speed motor drive voltage is adjusted to 25 volts at the factory. The speed controls are interrelated and require an iterative procedure for proper adjustment

The KBPB motor drive module has an adjustable current limiting feature. The current limit value may be adjusted via the pot labeled CL on the KBPB. If the current limit is set too low, the antenna may jam. Some users of the RC8097 report that the current limit may need to be adjusted when the weather turns colder.

The **AVL Technologies** mount uses a modified PWM motor drive from Dart Controls (model #65DDC). This motor drive produces a variable voltage output for driving the three antenna axes. The operator's manual is included with this manual., To adjust the azimuth and elevation motors' fast speed, *only for 8097s S/N 35,42,47, and 49*, use the potentiometer on the Dart labeled 'MAX'. At the factory, the fast speed motor voltage is adjusted to 18 volts (DC) when moving in AZ or EL and to 7.5 volts (DC) for polarization. The offset between EL and AZ speed and the POL speed (both fast and slow) is controlled by the Pol. Speed Reduction POT located on the Aux. Relay board #9721. The motor voltage is available at the MOT+ and MOT- terminals on the Aux Relay Board. The slow speed of the azimuth and elevation motors is adjusted using the potentiometer FAST/SLOW ADJUST found on the back circuit board of the RC8097, near the large relays. The slow speed motor drive voltage is adjusted to 5.0 volts at the factory for AZ and EL axes and 2.4 Volts for the POL axis. The speed controls are interrelated and require an iterative procedure for proper adjustment.

To adjust motors' fast speeds for RC8097s **AVL Technologies** *with serial numbers greater than 49*, use the potentiometer on the Dart labeled 'MAX' and the pot labeled “Az/El Fast” located on the Aux. Relay board #9721. At the factory, the fast speed motor voltage is adjusted to 18 volts (DC). (The ‘MAX” pot on the Dart controller is normally set fully CW). The Polarization Fast speed is set to 7.5 volts (DC) with the pot labeled “Pol Fast.” Motor slow speed is adjusted by the pots labeled Az/El Slow and Pol Slow” located on the Aux. Relay board #9721. The slow speed drive voltage is adjusted to 5.0 volts at the factory for AZ and EL axes and 2.4 Volts for the POL axis. The motor voltage can be measured at the MOT+ and MOT- terminals on the Aux Relay Board.

IF the motor speeds need to be readjusted complete the following procedure:

1) Set all pots on the Aux. Relay Board to minimum (fully CCW). On the DDC module, set the MIN Speed pot to ~10% of full CW, the ACCEL pot to 50% of full CW, the MAX Speed pot to 80% of full CW, and the Current Limit pot to 75% of full CW. Refer to the DDC manual for pot locations.

2) Using a 2-channel oscilloscope in differential mode, measure the output voltage waveform between terminals MT+ and MT-.

3) Set the Speed on the front panel of the 8097 to *FAST*.

4) While commanding the antenna to move Upwards in Elevation, (e.g. pressing “UP” on the keypad), adjust the MIN Speed pot on the Dart controller for the narrowest but consistent pulse width. This has been found experimentally to be about a 7% duty cycle. The pulse width here can be made arbitrarily narrow but the oscillator in the DDC module has difficulty starting with very narrow pulse-widths. Release the “UP” key.

5) Turn the “Az/El Fast” Pot on the aux. relay board to maximum (fully CW). While pressing the “UP” key, adjust the MAX Speed pot on the DDC module to the point where the duty cycle of the PWM just becomes 100%.

6) Disconnect the scope probes. Increase the “Az/El IR Comp” pot on the aux. relay board to 60% of full CW. While moving up in elevation, adjust the “Az/El Fast” pot for an appropriate fast speed. Using a combination of the Az/El Fast pot and the Az/El IR Comp pot, make the speed going up the same as the speed moving down. The Az/El Fast pot sets the basic speed while the IR Comp pot attempts to increase the speed when the motor is under a heavy load (moving upward)

7) Set the Speed on the front panel of the 8097 to “*SLOW*.”

8) While moving the antenna in elevation, adjust the Az/El Slow pot for an appropriate slow speed. The IR compensation need not be adjusted again.

9) Set the “Pol Fast” speed pot to 40% of full CW, the “Pol slow” pot to 10% of full CW and the “Pol IR Comp” pot to 20% of full CW.

10) When the antenna in up and in the normal operational movement range, Set the Speed on the front panel of the 8097 to "*FAST*." While moving in polarization, adjust the "Pol Fast" pot for an appropriate fast speed. Using a combination of the "Pol Fast" pot and the "Pol IR Comp" pot, make the speed going up the same as the speed moving downward. The "Pol Fast" pot sets the basic speed while the "IR Comp" pot attempts to increase the speed when the motor is under a heavy load (moving upward)

11) Set the Speed on the front panel of the 8097 to "*SLOW*."

12) While moving the antenna in elevation, adjust the Pol Slow pot for an appropriate slow speed. The IR compensation need not be adjusted again.

COMPUTER/MANUAL SWITCH - The RC8097 has toggle switches on the back of the chassis which can control the movement of the antenna. The switch labeled COMP/MAN must be in the MAN position to allow the switches on the back of the chassis to control the antenna. The switch must be in the COMP position to allow control of the antenna via the keypad on the front of the controller.

NON-VOLATILE MEMORY LOSS - It is possible (although unlikely) that a power transient could cause the RC8097 to lose the contents of its non-volatile memory. If the memory is lost, the user should consult the manual to restore the non-volatile memory. If the calibration constants and setup data are not readily available, the contents of the memory can be set to nominal values to allow the controller to operate until the user can restore the non-volatile memory to the proper values. Here are the nominal values for the non-volatile memory data items:

Data Item	**Nominal Value**	**Data Entry Screen**
Antenna Code	'F' or 'B'	Test - System - System Constants (set the antenna code to 'F' if the antenna points off of the front of the vehicle in the azimuth stow position or 'B' if the antenna points off of the back of the vehicle in the azimuth stow position)
CW Range	90	Test - System - System Constants
CCW Range	90	Test - System - System Constants
El Squint	0.0	Test - System - System Constants
Scan Range	0	Test - System - System Constants
Az Zero Voltage	2.50	Test - Antenna - Set Zero
El Zero Voltage	1.69 2.58 (for the **Antek mount**)	Test - Antenna - Set Zero
Pol Zero Voltage	2.50	Test - Antenna - Set Zero
Vpol	2.50	Test - Antenna - Set Zero
Hpol Voltage	2.50	Test - Antenna - Set Zero
(note; the VPOL and Pol Stow are the same with the **AVL mount**)		
Flux Gate Cal Const	Clear All	Test - Flux Gate - Cal Const Clear All Entries
Flux Gate Offset 1	0.0	Test - Flux Gate - Set Offsets
Flux Gate Offset 2	0.0	Test - Flux Gate - Set Offsets
Flux Gate Offset 3	0.0	Test - Flux Gate - Set Offsets
Truck Presets/ Satellite Presets	Clear All	Test - System - Blank Setup

TERMS USED

FLUX GATE - On-board electronic compass sensor that interacts with the earth's magnetic field to produce outputs from which the truck's magnetic heading can be obtained.

GPS - A Global Positioning System navigation device designed to determine the latitude and longitude of the truck. It represents an improvement over the Loran C system previously used.

AZIMUTH - A term used to describe the relative direction of the antenna movement when facing the same heading and looking down on the truck from above, as from a helicopter. Clockwise movement is a positive angle, and counterclockwise movement is a negative angle.

ELEVATION - Angle of the dish relative to the local horizontal vector.

FERROUS & NON-FERROUS METALS - Ferrous metals, such as iron and steel, interfere with the magnetic field and cause variations in the flux gate readings. Non-ferrous metals, such as aluminum, do not interfere with the magnetic field.

Appendix A - Research Concepts RC8097 Antenna Controller Upgrade to Correct Trimble GPS Receiver Date Error

1.0 Introduction

Most RC8097 Satellite Locating Antenna Controllers equipped with Trimble GPS receivers will experience a date error due to the GPS Week Number Rollover (WNRO) event. On August 22, 1999 these affected receivers will report the date as Jan 6, 1980. On subsequent days the date reported by the GPS receiver will progress forward from Jan 6, 1980. For example, on August 23, 1999 the date reported by these receivers will be Jan 7, 1980. The date read by the controller from these GPS receiver's will be considered invalid. The controller uses date in the calculation of magnetic variation (the difference between true north and magnetic north). With an invalid date the controller will not calculate magnetic variation. Without magnetic variation the controller will not calculate an antenna pointing solution (the azimuth and elevation angle required to align the antenna with the satellite). If the user manually enters the vehicle latitude and longitude (via the L/L Source key) the controller will use a default date (usually the date the controller software version was introduced) to calculate the magnetic variation and the antenna azimuth/elevation pointing solution.

The following Trimble GPS receivers will experience the WNRO problem: 18636-21, 26203-62, and 28515-62. These receivers were used in controllers equipped with software versions 3.5, 3.6, 3.7, 7.0x, 7.1x, 7.2x, 7.3x, and 7.5x (x = 0..9). Note that the Trimble model 37486-62 GPS receiver will not experience the WNRO problem. Only 3 of these receivers were used in controllers – Serial Numbers (S/N) 171, S/N 175, and S/N 176 (running the 7.5x software). The controller software version number is displayed when the controller powers up. The serial number is located on the back panel of the controller.

2.0 Software Upgrades

A controller software upgrade is available that will allow controllers equipped with the affected GPS receivers to calculate the correct magnetic variation based on the erroneous date reported by the GPS. To upgrade the software the user simply replaces a socketed EPROM (28 pin integrated circuit) located on the controllers digital board.

The upgrade kit includes …

1. EPROM,

2. IC puller,

3. Upgrade instructions, and

4. A manual (if the user's current manual has been superceded by a newer release) or appendices for the user's existing manual (if available to supplement the information in the user's current manual).

A number of upgrade software versions are available. The upgrade that a given customer receives is dependent on the version of the software that the user is currently running and the type of antenna that the controller is interfaced to. If possible, the user will receive a version of the upgrade software that will minimize the amount of non-volatile data items that will have to be keyed into the controller. Note that before performing an upgrade a user should always record the contents of the controller's non-volatile memory. Upgrade instructions are given below.

Current users of controllers equipped with software versions 3.5 and 3.7 will be upgraded to version 3.8x (3.80, 3.81, or 3.82). Version 3.8x is derived from version 3.7. The value of 'x' is determined by the antenna that the controller is interfaced with. See the table below.

Current users of controllers equipped with software versions 3.6 and 7.1x will be upgraded to version 7.9x (7.90 and 7.92). Version 7.9x is derived from version 7.1x. The value of 'x' is defined below.

Current users of controllers equipped with software versions 7.0x, 7.2x, 7.3x, and 7.5x will be upgraded to version 7.8x (7.80, 7.81, 7.82, 7.83, 7.86, 7.87, and 7.89). Version 7.8x is derived from the version 7.5x software. The value of 'x' is defined below.

Value of 'x' (as in v7.1x)	Antenna Description
'0'	Vertex +/- 90 degree antenna mount (discontinued in 1994)
'1'	Versions 3.51, 7.01, 7.21, 7.31, – Prodelin mobile mounts manufactured in 1994. Versions 7.51, 7.61, 7.71, 7.81 – AVL mount with ERA 1.2 meter antenna (diamond shaped)
'2'	Vertex +/- 180 degree mount (manufacturing began in 1995).
'3'	AVL mount with ERA 1.5 meter antenna (diamond shaped).
'6'	Prodelin mobile mounts manufactured from 1998 on.
'7'	AVL mount with USA 1.8 meter antenna.
'9'	AVL mount with USA 1.2 meter antenna.

3.0 Software Versions

This section describes the various versions of the RC8097 software that employ the Trimble GPS receivers that will be affected by the WNRO bug. This information is included for users whose controllers will be upgraded to a newer version of the software. For example, a customer using the version 7.2x software will be upgraded to the 7.8x software. The 7.8x software is derived from the 7.5x software. The version 7.2x user that is upgraded to version 7.8x will also get the modifications performed for the version 7.3x and 7.5x software.

Version 3.5

This is the first version of the RC8097 software that supported the Trimble GPS receiver. Two digit version numbers were used (e.g. all versions display '3.5' on power up). Versions were created for the Vertex +/- 90 degree mount, a Prodelin mobile mount, and the Vertex +/- 180 degree mount. The various versions can be identified by the checksum and date written on the sticker that covers the window of the EPROM.

The following table describes the various versions of the 3.5 software …

Antenna Type	Checksum	Date
Vertex +/- 90 degree azimuth movement mount	'14'	6/9/94
Prodelin mobile mount (manufactured in 1995)	'1E'	2/15/94
Vertex +/- 180 degree azimuth movement mount	Unknown	8/11/94

User's of controllers currently running version 3.5 of the software will be upgraded to the version 3.8x software. The version 3.8x software also contains the modifications of the version 3.7 software. Check the version 3.7 section of document for changes introduced in that version of the software.

Version 3.6

This version was created to add GPS support to the controllers that originally ran version 3.2 software. This includes controllers with serial numbers 17 through 26. Controllers running version 3.6 will be upgraded to the version 7.9x software that includes the version 7.0x and 7.1x modifications. Check those sections of this document for changes introduced in those versions of the software.

Version 3.7

This version of the software was derived from the version 3.5 software. Only a Vertex +/- 180 degree azimuth movement mount version of the software was produced. The date is 1/29/95 and the checksum is 'EF'.

Here are the major modifications performed to the software …

References to the front to back, side to side, and rack position code have been removed from the software. Early versions of the controller were equipped with inclinometers that measured the truck attitude.

The System Constants Az Range prompt has been replaced with a CW Range and CCW Range prompts. These prompts specify the range of azimuth movement. This information is used to control generation of the REPOSITION TRUCK message. With the Az Range prompt the controller assumed that the antenna had symmetrical movement about the azimuth stow position. With the CW Range and CCW Range prompts the controller supports a non-symmetrical movement range. Note that a bug in the software limits the maximum clockwise or counter-clockwise movement to 180 degrees. This limitation was removed in the version 7.0x software.

The non-volatile memory map was changed.

A new users manual was produced.

Controllers currently running version 3.7 software will be upgraded to the version 3.8x software to correct the GPS WNRO problem.

Version 3.8x

Users of controllers currently running software versions 3.5 and 3.7 software will be upgraded to the 3.8x software. The version 3.8x software was derived from version 3.7 software.

The following modifications were performed to the version 3.7 software …

1. The GPS sentence parse routines have been modified to accept a date with a year between 1980 and 1999.

2. The magnetic variation routines have been modified to use the 1995 epoch magvar model and to work with the dates produced by the GPS.

3. The default date (used when the GPS is not specified) is modified to be compatible with the magnetic variation routine.

4. The software version displayed on powerup was changed to 3.8x and the copyright was changed to 1999. Version 3.80 was produced for use with Vertex antennas with +/- 90 degrees of azimuth movement. Version 3.82 was produced for use with Vertex antennas with +/- 180 degrees of azimuth movement. Version 3.81 was produced for use with early model Prodelin mobile mounts (manufactured in 1994).

Version 7.0x

The version 7.0x software was a significant upgrade derived from the version 3.7 software.

Here are the major modifications performed to the software …

5. One version of the software supports all flavors of the RC8097 product. Prompts were added to specify whether or not a flux gate compass and GPS receiver are included with the controller. Previously, the RC8097B product supported the optional flux gate compass and GPS receiver, the RC8097C supported a flux gate compass but no GPS, and the RC8097BW supported neither a GPS nor a flux gate compass.

6. Conditional compilation was used to produce versions of the software appropriate for a number of different antenna mounts. The last digit of the version number denoted the mount type. See the version numbers defined in the Software Upgrades section of this document.

7. The CW Range/CCW Range bug described for the version 3.7 code was corrected.

Controllers currently running version 7.0x software will be upgraded to the 7.8x software. 7.8x includes the software modifications of the 7.2x, 7.3x, and 7.5x software releases. Check the 7.2x, 7.3x, and 7.5x sections of this document for changes that were introduced in those versions of the software.
Version 7.1x
This version was derived from the version 7.0x software to upgrade controllers originally equipped with the version 3.2 software (s/n 17 through s/n 26). Only 7.10 and 7.12 versions were created. Users currently using 7.1x will be upgraded to version 7.9x.
Version 7.2x
This version was derived from the version 7.0x code.
Here are the modifications included with this release …

8. A sticky key feature has been included to support cutting antenna patterns. With sticky key enabled, an azimuth or elevation manual jog operation that persists for more than 5 seconds will result in the antenna continuing to move until either the Stop key is depressed or a limit is reached. Sticky key is disabled on power up. To enable sticky key specify a Scan Range (Test – System – System Constants menu) of 58. Antenna jammed sensing is disabled when the sticky key feature is enabled.

9. There is a limit on the time that it can take for an elevation stow operation to complete. Jammed sensing is suspended when the antenna is below the down elevation limit. If the elevation stow limit switch fails this will limit the time that the elevation motor is activated. The time limit was initially set at 130 seconds.

Current users of the version 7.2x software will be upgraded to the version 7.8x software. Version 7.8x includes the modifications of versions 7.3x and 7.5x. Check the sections of this document covering the 7.3x and 7.5x versions for modifications to the software introduced in those versions of the software.
Version 7.3x
The version 7.3x software was derived from the version 7.2x software.
The 7.2x software was modified in the following manner to create version 7.3x

10. The antenna azimuth stow region was narrowed. During an automatic stow, the antenna has to be within +/- 0.5 degree of the azimuth zero voltage position and the stow switch has to be active for the elevation stow to proceed.

11. A version of the software (7.36) was produced to support a new Prodelin mobile mount. For the Prodelin mobile mount the elevation stow timeout limit is set to 480 seconds.

The tighter azimuth stow region may cause problems for customers upgrading from earlier versions. If after installing the upgrade the controller produces an error when attempting to stow the antenna in azimuth the Azimuth Zero Voltage may have to be adjusted (this is the sensor voltage that corresponds to an azimuth position of 0.0 degrees). The Azimuth Zero Voltage should be set to correspond exactly to a value in the middle of the azimuth limit switch stow region. The Azimuth Zero Voltage data item is entered by the user via the Test – Antenna – Set Zero menu. Move the antenna to the middle of the stow region, read the azimuth sensor voltage (via the Test [key] – Antenna – Voltages menu), and enter that voltage for the Azimuth Zero Voltage.
Current users of the version 7.3x software will be upgraded to the 7.8x software. Version 7.8x includes the modifications of the 7.5x software. Check the section of this document on the 7.5x software for modifications introduced with that version of the software.
Version 7.4x
This was an internal test version of the software that was not released.
Version 7.5x
The version 7.5x software was derived from the 7.3x software. Here are the modifications that were performed …

12. The software was modified to give the user the option of attaching the flux gate compass to the antenna

reflector. Placing the compass at the top of the reflector allows a more accurate heading measurement. Note that the compass can only be read when the antenna is deployed and the flux gate is oriented within +/- 10 degrees of vertical. The Flux Gate prompt (on the Test – System – System Constants menu) allows the user to enter Y (yes, flux gate present), N (flux gate not present), and A (flux gate on antenna reflector). An addendum to the controller manual describes placement of the flux gate on the antenna.

13. Support was added for three new AVL antenna mounts. Version 7.57 supports the 1.8 meter USA mount. Version 7.59 supports the 1.2 meter USA mount. Version 7.51 supports the AVL mount with the ERA 1.2 meter antenna. Note that previously 7.x1 software supported the old style Prodelin mobile mount.

Users of the 7.5x software will be upgraded to the 7.8x version. Users of previous versions of the 7.yx (7.0x, 7.2x, and 7.3x) software that are upgraded to the 7.8x software should check the value of the Flux Gate item (Test – System – System Constants menu) to insure that it is set to either ‘Y’ or ‘N’.

Version 7.8x

Current users of versions 7.0x, 7.2x, 7.3x, and 7.5x software will be upgraded to the version 7.8x software.

Version 7.8x was derived from 7.5x.

The only modifications that have been performed to the version 7.5x software are …

14. The GPS sentence parse routines have been modified to accept a date with a year between 1980 and 1999.

15. The magnetic variation routines have been modified to use the 1995 epoch magvar model and to work with the dates produced by the GPS.

16. The default date (used when the GPS is not specified) is modified to be compatible with the magnetic variation routine.

17. The software version displayed on powerup was changed to 7.8x and the copyright was changed to 1999.

18. The polarization scale factor (that maps polarization sense voltage to polarization angle) was changed slightly to provide better polarization position accuracy for the AVL Technologies USA 1.8 (version 7.57) and USA 1.2 (version 7.59) mounts.

Version 7.9x

Users of controllers currently running software versions 3.6 and 7.1x will be upgraded to the 7.9x software.

The version 7.9x software was derived from version 7.1x software.

The following modifications were performed to the version 7.1x software …

19. The GPS sentence parse routines have been modified to accept a date with a year between 1980 and 1999.

20. The magnetic variation routines have been modified to use the 1995 epoch magvar model and to work with the dates produced by the GPS.

21. The default date (used when the GPS is not specified) is modified to be compatible with the magnetic variation routine.

22. The software version displayed on powerup was changed to 7.9x and the copyright was changed to 1999.

4.0 Upgrade Instructions

The controller upgrades have been designed to minimize the number of non-volatile memory data items that have to be re-initialized by the user after the upgrade. Any time that the controller’s EPROM is replaced there is a chance that the contents of non-volatile memory will be corrupted. For that reason the contents of the controller’s non-volatile memory should be recorded (on paper) before the upgrade is performed. This will allow the user to restore the contents of non-volatile memory if necessary.

4.1 Upgrade Procedure Summary

Here is the upgrade procedure. Some steps are described in more detail in later sections.

23. Record the contents of the controller’s non-volatile memory. Section 4.2 describes the data items stored in controller’s non-volatile memory. A worksheet is provided at the end of this document to record the contents of non-volatile memory.

24. Unplug the controller’s AC power cord. The controller uses an IEC type AC power connector that can be disconnected at the back of the controller.

25. Remove the controller’s top cover.

26. Use the IC puller included in the upgrade kit to remove the controller’s EPROM. The EPROM is located on the controller’s digital circuit board. The digital board is mounted to the controller’s face plate. On most versions of the controller (maybe all versions) the EPROM socket is labeled ‘U5’. The EPROM is a 28 pin IC with a label giving the software version, checksum, and date. The EPROM is located at one end of the digital board near the lithium battery. Note the orientation of the controller’s current EPROM. The EPROM has a notch on one end. The notch on the EPROM must be aligned with the notch depicted on the circuit board silkscreen. When the EPROM is correctly installed the end of the IC with the notch will be closest to the controller’s top cover.

27. Install the EPROM. Try not to touch the metal legs of the IC. Before handling the IC touch the side of the controller’s chassis to discharge any static electricity. Make sure that the EPROM is oriented properly as described in step 4.

28. Check the orientation of the EPROM and replace the controller’s top cover.

29. Reconnect the controller to AC power.

30. Power up the controller. The first screen will display the software version and copyright date. The next screen will display the results of the system memory checksum test. If no errors are detected the controller will briefly display a ‘MEMORY OK’ message before displaying the status of the non-volatile memory battery and then displaying the controller’s Calculator screen. If memory errors are detected note the error code. The user will be prompted to hit any key to proceed. If the controller hangs on power up (does not respond to any key) please refer to section 4.3.

31. Regardless of whether or not memory errors were detected the user should verify the contents of non-volatile memory. Refer to section 4.2 for more information on verifying and restoring non-volatile memory.

4.2 Non Volatile Memory Data

The system maintains five categories of non-volatile data. The following sections refer to menu and data prompt screens that are accessible from the controller’s calculator mode screen. The controller’s calculator mode is active on powerup (after the memory and battery screens) and is where the controller calculates the antenna pointing solution. The controller’s ‘mover’ mode is where all antenna movement occurs.

4.2.1 Truck Presets

This category consists of preset vehicle positions (position description, latitude, and longitude). Preset vehicle positions allow the user to rapidly initialize the controller's latitude/longitude value. This is useful in systems that are not equipped with a GPS receiver or when the GPS is unable to determine its position such as in an urban canyon or in the presence of radio frequency interference.

To clear all vehicle (and satellite) preset data go to the Test (key) – System – Blank Setup screen and follow the prompts. If the memory test displayed on power up indicated that the Truck Presets were corrupt the blank setup procedure should be invoked. Note that this will also blank the satellite preset data.

To view the existing truck preset data, use Setup (key) – Truck Lat/Lon – View The Setup Data. Use the Scroll Up/Down keys to view the current Truck Preset entries.

To store (or restore) truck preset data, use Setup (key) – Truck Lat/Lon – Modify The Setup Data. Enter an index (1 through 18), key in a description of the location (such as the city) (using the Scroll Up/Down and Enter keys), enter the latitude and longitude using the numeric keys, the decimal point, and the West/South and East/North keys. Note that all locations in North America have north latitude and west longitude.

To select a truck preset, use L/L Source (key) – Preset Data.

4.2.2 Satellite Presets

This category consists of preset satellite data (name and longitude). Preset satellites allow the user to rapidly specify a satellite when calculating the antenna pointing solution.

To clear all satellite (and vehicle) preset data go to the Test (key) – System – Blank Setup screen and follow the prompts. If the memory test displayed on power up indicated that the Sat Presets were corrupt the blank setup procedure should be invoked. Note that this will also blank the truck preset data.

To view the existing satellite preset data, use Setup (key) – Satellite Lon – View The Setup Data. Use the Scroll Up/Down keys to view the current Sat Preset entries.

To store (or restore) satellite preset data, use Setup (key) – Satellite Lon – Modify The Setup Data. Enter an index (1 through 18), key in the satellite name (using the Scroll Up/Down and Enter keys), enter the longitude using the numeric keys, the decimal point, and the West or East keys. Note that nearly all satellites that are visible from North America have westerly longitude values.

To select a preset satellite entry, use Sat Select – Preset Data

4.2.3 Flux Gate Compass

The controller maintains two sets of flux gate compass related data items. One set consists of three offset values and the other consists of up to 18 calibration constants.

4.2.3.1 Flux Gate Offsets

The flux gate offsets are constants that are determined at the factory at the time the controller is manufactured. They characterize the errors in the actual flux gate sensing element. A data sheet containing the offsets is included in the manual that is sent out with each controller. Research Concepts maintains a record of the offsets for each controller that has been produced.

The values of the flux gate offsets are both viewed and initialized via the Test (key) – Flux Gate – Set Offsets menu. To view the offsets just use the Enter key to move to each of the data fields. Do not enter numeric values when viewing the data, just hit the Enter key. When entering data be sure to key in a numeric value and hit the Enter key in each field. Corrupt flux gate offsets are the most frequent cause of the controller hang condition described in section 4.3. For example, for nearly all flux gate compasses used with the RC8097, the value of Offset(1) is 0.0. Even if the OFFSET(1) field displays 0.0 when the user wants to initialize that data field, the user should still key in '0.0' followed by the Enter key.

4.2.3.2 Flux Gate Calibration Constants

The flux gate calibration constants compensate for the distortion of the earth's magnetic field due to magnetic fields and ferrous metals located on the vehicle. The flux gate calibration procedure is described in the manual. Each calibration constant really consists of a truck heading and an error value.

The flux gate calibration constants are viewed via the Test (key) – Flux Gate – Cal Const – View screens. To initialize the flux gate constants use the Test (key) – Flux Gate – Cal Const – Add an Entry menu. The controller can accommodate up to 18 calibration constants.
To delete all flux gate calibration constants use Test (key) – Flux Gate Cal Const – Clear All Entries.

4.2.4 System Constants

The system constants are initialized and viewed via the Test (key) – System – System Constants screen. To view the system data use the Enter key to cycle through the various items on the System Constants screen.
Some system constants data items are initialized using the Scroll Up/Down keys and other items are initialized using the numeric, decimal point, and backspace keys. For numeric fields that accept negative values the West/South and East/North keys toggle the sign of the value being entered.
When initializing the system constants, to avoid the problems described in section 4.3, the user should enter a value for each field on the System Constants screen. This implies that the user should not accept the value present in the data field by just hitting the Enter key. For data fields initialized using the Scroll keys use the Scroll Up and Scroll Down keys to select a value before hitting the Enter key. When initializing numeric data fields key in a numeric value and terminate the entry by hitting the Enter key. This is especially true for data fields that are to be initialized to a value of ‘0.0’.

4.2.4.1 System Constants Upgrade Notes

Some users installing the upgrade will find that certain items on the System Constants screen have changed relative to their controller’s original software.
Current user’s of version 3.5 and 3.6 software that upgrade will find that the following items have been removed from the System Constants screen: Rack Code, Az Range, FB 0, and SS 0.
Version 3.5 user’s that are upgraded to version 3.8x will find that the CW Range and CCW Range System Constant data items have been added to their systems. Both of these items can be initialized to the value of the Az Range item in the version 3.5 software.
Version 3.6 users that are upgraded to version 7.9x will find the CW Range, CCW Range, Flux Gate, and GPS data items present on the System Constants menu. The CW/CCW Range items can be initialized to the value of the Az Range item in the version 3.6 software. The Flux Gate and GPS items can be initialized to either ‘Y’ (yes) or ‘N’ (no) via the Scroll Up/Down keys. ‘Y’ indicates that the device is present in the system. For most users both fields will be initialized to ‘Y’.
Version 7.0x, 7.2x, and 7.3x users that are upgraded to the 7.8x software will find that Flux Gate data item can assume the values ‘Y’ (yes), ‘N’ (no), or ‘A’ (flux gate on antenna reflector). The controller checks this data item to determine whether or not a flux gate is present in the system. The value of this data item is selected with the Scroll Up/Down keys. ‘A’ indicates that a flux gate is present and the flux gate is attached to the antenna reflector. ‘Y’ indicates that a flux gate is present and it is mounted to the vehicle body. ‘N’ indicates that a flux gate is not present in the system. For user’s upgrading from 7.0x, 7.2x, or 7.3x this field should be initialized to ‘Y’ or ‘N’. Even if ‘Y’ or ‘N’ is displayed in this field use the Scroll Up or Scroll Down keys followed by the Enter key to explicitly initialize this field.

4.2.5 Antenna

The Antenna data items are viewed and initialized via the Test (key) – Antenna – Set Zero menu. All of these item nominally have non-zero values. The considerations outlined in section 4.3 apply to the antenna related data items.

4.3 Controller Hang-up Condition

When the controller non-volatile memory is corrupt, sometimes the microprocessor in the controller can hang. A hang condition is when the controller does not respond to keypad inputs. The hang condition results from the processor trying to perform numeric calculations on floating point values that do not contain valid floating point numbers.
On powerup the controller will usually detect corrupted non-volatile memory items. If the controller detects the presence of corrupted non-volatile data items the user is presented with a list of corrupt data

categories and prompted to 'HIT ANY KEY' to continue. In some cases, however, the controller will not detect corrupted data items.
If the hang condition occurs perform the following procedure …

1. Power the controller off.

2. Power the controller up. As the controller is performing the memory check and the battery check, rapidly depress and release the Test key several times. This will result in the controller entering the Diagnostic and Initialization Menu.

3. From here re-initialize the flux gate compass offsets via the Flux Gate – Set Offsets menu. The problem is usually due to corrupted flux gate offsets that display as 0.00 at the initialization prompt. When re-initializing non-volatile memory data items be sure to key in a value using the numeric and decimal point keys (terminate the entry with the Enter key) even if the data field displays what appears to be the correct value for the data item. For example, the flux gate Offset(1) data item usually has a value of 0.00 (determined by calibration at the factory when the unit was manufactured). If this is the case the and the data item is corrupt the current value of the Offset(1) data item may display as 0.0. If the user simply hits the Enter key to accept the default value the corrupt value stored in memory is not changed. The proper course of action here is to key in '0.0' followed by the Enter key. This will initialize the data item to a value of 0.0.

4. If re-initializing the flux gate Offset(x) data items (x = 1, 2, or 3) does not fix the hang problem, go through each non-volatile memory category and re-initialize each data item in the category. As described in step 3, when re-initializing non-volatile memory data items be sure to explicitly key in a value using either the numeric keys or the Scroll Up/Down keys (whichever is appropriate for the particular data item being entered). Terminate each entry by hitting the Enter key.

5.0 Documentation

This section describes the documentation that is included with the upgrade kits. The documentation included with an upgrade kit is dependent on the version of the software that is currently installed in the user's controller. Customers that receive the upgrade will also receive the latest documentation that is available for the upgrade version. In some cases the user will receive a new user's manual, in other cases the user will receive an addendum for use with the existing manual, and in some cases the user will not receive any additional documentation.
Note that if a new manual is included with the upgrade kit the controller calibration data sheet from the original manual supplied with the controller should be inserted in the new manual. Calibration sheets will not be included in manuals supplied with the upgrade kits.
The following table describes the documentation included with the upgrade kits …

Original Controller Software Version	Original Documentation	Upgrade Software Version	Documentation Included With Upgrade
V3.5	Version 3.5 manual	V3.8x	Version 3.7 manual
V3.6	Version 3.5 manual	V7.9x	Version 7.1 manual
V3.7	Version 3.7 manual	V3.8x	No documentation update
V7.0x	Version 7.5 manual	V7.8x	Version 7.1x manual with the version 7.2x and version 7.5x.
V7.1x	Version 7.1 manual	V7.9x	No documentation included.
V7.2x	Version 7.1 manual with version 7.2 addendum	V7.8x	Version 7.5 addendum.
V7.3x	Version 7.1 manual with version 7.2 addendum	V7.8x	Version 7.5 addendum
V7.5x	Version 7.1 manual with version 7.2 and 7.5 addendum’s	V7.8x	No documentation included.

Non-Volatile Memory

Truck Presets

Index	Location	Latitude	Longitude
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Satellite Presets

Index	Satellite Name	Satellite Longitude
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

Flux Gate Compass

Flux Gate Offsets

Offset(1)	Offset(2)	Offset(3)

Flux Gate Calibration Constants

Index	Heading	Calibration Constant
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

System Constants

Versions 3.5 and 3.6

Rack Code	Antenna Code	Az Range	FB0 (Front Back Zero)	SS0 (Side Side Zero)	El Squint	Scan Range

Versions 3.7 and 3.8x

Antenna Code	CW Range	CCW Range	El Squint	Scan Range

Versions 7.0x, 7.1x, 7.2x, 7.3x, 7.5x, 7.8x, and 7.9x

Ant Code	Flux Gate	GPS	CW Range	CCW Range	El Squint	Scan Range

Antenna

Azim	Elev	Pol	Vpol (may also be labeled Stow/Vpol)	Hpol

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SCHEMATICS

Analog Circuit Board
Digital Circuit Board
Auto-Peak Circuit Board where applicable
Hand-held Remote where applicable
Aux. Relay Circuit Board (for **AVL Mounts** only)

REVISION HISTORY

v 3.5 - The Loran receiver was replaced with the GPS receiver. The calibration of azimuth sense voltages was slightly modified to support different antenna types.

v 3.6 - This modification allowed older controllers to use the GPS.

v 3.7 - All references to the front-to-back and side-to-side sensors were removed from the code. The AZ Range system constant was replaced by a pair of constants, CW Range and CCW Range. This allows for non-symmetrical azimuth sweep ranges.

v 7.0 - revision that brings together multiple mount types and allows the flux gate and GPS options to be used with any mount.

v 7.1 – covers CE approval items. Appendix A was added to assist in the upgrade for the Trimble GPS receivers.

RC-8097 SATELLITE LOCATOR

v 7.1

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