

## **APPENDIX SAC**

### **Single Axis Compass Option**

Date: 13 February 2008  
Software: 1.59

#### **1.0 INTRODUCTION**

The Single Axis Compass is a smaller, less expensive, and slightly less accurate heading sensor option compared to the original Fluxgate Compass.

#### **1.1 Appendix Organization**

This appendix is provided as a supplement to the baseline RC3000 manual. The unique items relating to the single axis compass option are described via a paragraph numbering scheme that corresponds to the baseline RC3000 manual's paragraph numbering.

#### **1.2 Software Configuration.**

The single axis compass is designated as one of the Navigation options of the RC3000.

| Navigation Option Designation | Description                      |
|-------------------------------|----------------------------------|
| N                             | No Navigation Sensors            |
| G                             | GPS / Fluxgate                   |
| C                             | CSI GPS derived heading          |
| O                             | GPS only                         |
| S                             | <b>GPS / Single Axis Compass</b> |

The software containing the single axis compass would therefore be designated as RC3K-ab-Sxyz.

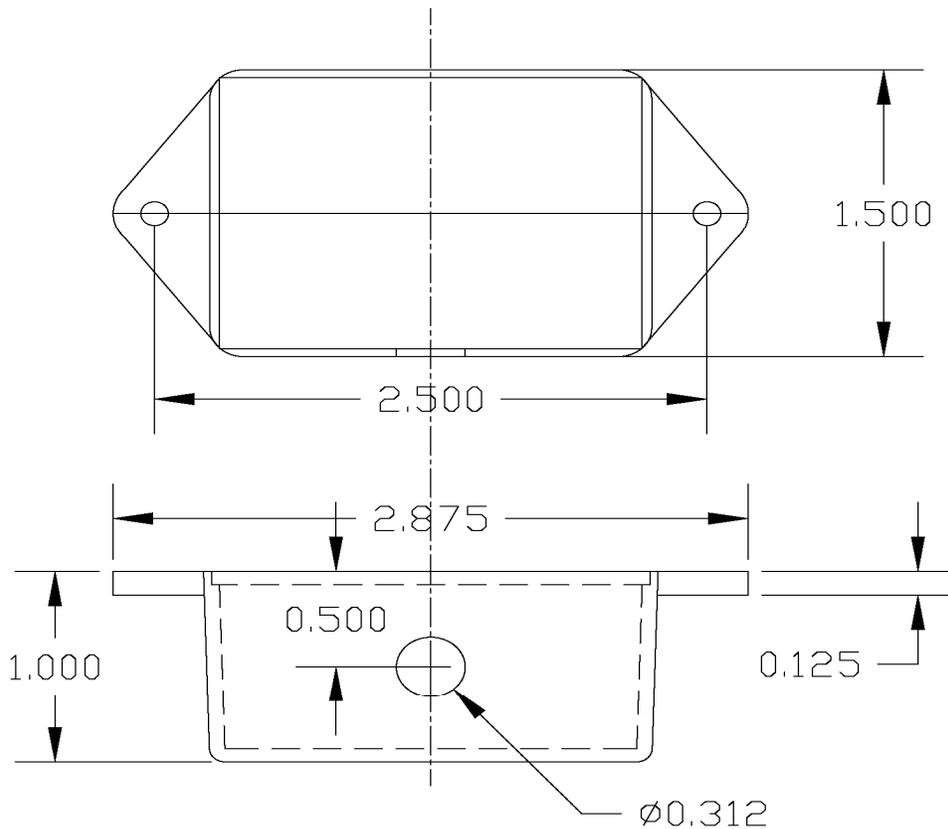
#### **1.3 Theory of Operation**

The single axis compass module contains a magnetoresistive sensor that converts the magnetic field in one direction to a representative voltage. When positioned perpendicular to the earth's gravitational field (level), the sensor can measure the horizontal component of the earth's magnetic field. By rotating the sensor (via rotating the antenna) and measuring the resulting voltages, the RC3000 can derive an estimate of the antenna's magnetic heading.

## 2.0 INSTALLATION

### 2.1.3 Compass Mounting

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



Single Axis Compass Box

The compass box provides 2 mounting holes on end mounting flanges. The part number scheme for the compass is:

FP-CMP1-"direction"-"polarity"-"cable\_length"-"cable\_color"-"box\_color"-"connector"

where:

"direction" - X (horizontally mounted) or Z (vertically mounted)

"polarity" - always P

"cable\_length" - in feet

"cable\_color" - W (white) or B (black)

"box\_color" - W (white) or B (black)

"connector" - N (none), 9 (DB-9) or A (Ampenol CN-MS31161418S)

For determining physical attachment of the compass, the relevant part number item is the "direction" which specifies that the compass can be obtained in either horizontal (X) or vertical (Z) mounting configurations.

A compass box in the horizontal mounting configuration is first shown:



Next a compass box in the vertical mounting orientation is shown:



The user should choose horizontal or vertical mounting orientation according to where it is most convenient to mount the box while satisfying the requirement that the top of the box must be able to be maintained level by moving the elevation axis as the mount is rotated in azimuth. This requirement will typically mean purchasing a horizontal mount box when the unit will be attached to a structure that will be horizontal when the antenna is in the DEPLOY position.

Likewise the vertical orientation box will typically be required when attached to a structure that will be vertical when the antenna is in the DEPLOY position.

NOTE: the compass box may be mounted with the "top of unit" facing down. \*\*\*\*\*

## OTHER MOUNTING CONSIDERATIONS

When deciding on where to mount the compass box on the antenna structure, the following other factors should be considered:

- 1) The box should be mounted as high on the antenna structure as feasible. When the antenna is deployed, the higher the compass can be mounted the "cleaner" the sensed earth's magnetic field will be.
- 2) The box should be mounted as close to the azimuth axis' center of rotation as possible. This means that preferably the box would rotate about a point when the antenna is rotated in azimuth (while at the elevation deploy position). If this is not achievable, minimize the distance from the center of rotation as much as possible.
- 3) The ability to run the compass cable in an orderly fashion should also be considered.

NOTE: The orientation of the compass reference direction with respect to the antenna's reference direction may be accounted for by software configuration discussed later.

## 2.2 Electrical Connections

The "connector" part number item allows for the compass cable to be terminated with a DB-9 (9) connector, an Ampenol CN-MS31161418S (A) connector or to have no connector (N). The following chart shows the pin numbers for the two connectors and wire color when left unterminated.

| DB9 | AMP | COLOR  | SIGNAL DESCRIPTION |
|-----|-----|--------|--------------------|
| 7   | S   | Brown  | Voltage Output     |
| 5   | K   | Black  | Ground             |
| 4   | J   | Red    | + 12 VDC           |
| 3   | T   | Orange | Sensor Reset       |
| 8   | L   | Clear  | Drain Shield       |

## 2.3 Initial Configuration

There are two configuration items that must be programmed to correctly describe the installation of the single axis compass:

### **DEPLOY Position**

The elevation deploy position should describe the elevation angle that places the single axis compass box level. Enter this value in the EL\_DEP configuration item in the Stow & Deploy Positions configuration screen (see 3.3.1.3.10 of the baseline manual.)

### **Compass Offset**

The angular difference between the compass' reference direction (arrow) and the antenna's reference direction (center of beam) should be entered in the FG: field of the Azimuth Calibration configuration screen (see 3.3.1.2.3 of the baseline manual.)

This value should describe how the antenna's reference is oriented with respect to the compass' reference when looking from above the antenna. For example, if the antenna is pointed North and the compass's reference arrow is pointed East, a compass offset of -90 degrees should be entered.

### **\*\*\* Sanity Check \*\*\***

If desired, the single axis compass maintenance mode (3.3.3.2) may be performed to establish confidence that the sensor has been properly installed.

### 3.0 Operation Overview

#### 3.2.2.3 LOCATE

The LOCATE mode will sequence through operations as described in the baseline manual except during the time when a heading estimate is determined. The LOCATE function initially gets lat/lon from the GPS, synchronizes time and calculates a local magnetic variation value. Following this a series of antenna movements must be performed in order to derive a magnetic heading estimate from the single axis compass.

NOTE: The three positions the antenna is required to move to for deriving magnetic heading are very similar to positions required to characterize platform tilt. Therefore the characterization of heading and tilt will be performed during the same sequence.

|                                     |        |
|-------------------------------------|--------|
| AZIM: 0.0                           | LOCATE |
| ELEV: 22.3                          |        |
| MOVING ANTENNA TO DETERMINE HEADING |        |

<BKSP> to confirm

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

Following this sequence of movements, the magnetic variation and any programmed compass offset will be applied to the derived magnetic heading in order to determine a true heading estimate for the antenna. This true heading estimate will be displayed on the top line of the display and the LOCATE mode will proceed as described in the baseline manual.

### 3.3.3.2 Maintenance Items

When the single axis compass option is present, the choice "7-COMPAS" is presented on the maintenance menu screen.

|          |           |                 |             |
|----------|-----------|-----------------|-------------|
| 1-VOLTS  | 2-DRIVE   | 3-TIME          | 4-SIG MAINT |
| 5-LIMITS | 6-GPS COM | <b>7-COMPAS</b> | 8-MOVETO    |
|          | 0-SHAKE   |                 | .-CI RECORD |
|          |           |                 | Z1-STRN1.59 |

Pressing the "7" key will select the Single Axis Compass Maintenance screen.

### 3.3.2.7 Single Axis Compass Maintenance

This maintenance screen allows the user to initiate the antenna movements required to sample the compass sensor data, displays the data and displays the resulting derived heading.

|                              |       |    |   |         |
|------------------------------|-------|----|---|---------|
| AZIM:                        | 0.0   | 1: | / | COMPASS |
| ELEV:                        | -67.5 | 2: | / |         |
|                              |       | 3: | / | HDG:    |
| <BKSP>START ANTENNA MOVEMENT |       |    |   | <MODE>  |

After the user has verified that the antenna is in a safe position to move, pressing the BKSP key will initiate movement to three positions where compass sensor data is sampled. At each position, the elevation angle will be adjusted to the DEPLOY position. The azimuth angle where the sample happened and the resulting voltage read will be displayed in the 1:, 2: and 3: fields.

|       |      |    |            |           |
|-------|------|----|------------|-----------|
| AZIM: | 90.0 | 1: | 0.0/1.234  | COMPASS   |
| ELEV: | 22.3 | 2: | 45.0/1.234 |           |
|       |      | 3: | 90.0/1.234 | HDG:123.4 |
|       |      |    |            | <MODE>    |

- allows monitoring of voltage
  - all 3 voltages should be > x.y and < a.b
  - over/undersaturated
- shows magnetic heading derived