

APPENDIX B - MOUNT SPECIFIC DATA

For

LNR 2.4 m FTSAT

This appendix details information specific to the LNR 2.4 m FTSAT mount. The corresponding paragraphs in the base RC3000 manual are referred to when data specific to the mount are described.

1.3.3 Operational Overview

The baseline RC3000 operational modes are modified to accommodate the intended operational scenario for the LNR FTSAT mount. The major differences between the baseline RC3000 operation and the LNR operation are:

- 1) continuous compass bearing display instead of mount azimuth angle
- 2) automatic locating of a satellite is not performed
- 3) tracking actuator start and pack functions are performed
- 4) tracking step size and time are fixed

The following provides an overview of a typical operation scenario. Detailed description of each mode's operation will be provided later.

POWER UP. After the mount is assembled and the fluxgate/inclinometer unit is installed, the RC3000 is powered up. The controller enters MANUAL mode and begins displaying compass bearing and RF look angle elevation. The GPS receiver reports latitude and longitude as soon as available and the magnetic variation for the location is calculated. The mount may be moved and the bearing and elevation displays will reflect actual mount orientation.

```
BRG: 141.1(*****) SS2: 50          MANUAL
ELEV:  37.5(*****) SAT:
POS: 38°56N  94°44W  MAGVAR:  3.9      UTC
(BRG/ELEV TARGETS) <MODE>MENU  14:25:47
```

Note that no targets for bearing and elevation are yet shown as this example assumes that a valid satellite pointing solution has not yet been performed. The last pointing solution would have been invalidated at mount disassembly by the PACK mode described later.

SATELLITE POINTING SOLUTION. The user may now enter SATELLITE mode to calculate a pointing solution to the required satellite. The last selected satellite is shown along with the pointing solution required for the current latitude and longitude. The user may select another satellite either manually or from a preset list. Upon selection of another satellite, a new pointing solution will be automatically calculated.

```
38°56N  94°44W          SATELLITE
SAT:BRASIL A1    79.0W    BRG:155.9
<1>MANUAL <2>PRESET      EL: 42.0
SELECT SAT SOURCE      CALC DONE
```

LOCATING THE SATELLITE. After the pointing solution calculation is performed, MANUAL mode will now display the target bearing and elevation. The selected satellite's name will appear in lowercase letters to indicate that the targets refer to that satellite. The user may use the targets as references while positioning

the mount. As in the powerup case, the signal strength indication (SS2:) will provide an aid in positioning the mount on the satellite.

```
BRG: 141.1(155.9) SS2: 50          MANUAL
ELEV:  37.5( 42.0) SAT:brasil a1
POS:38°56N  94°44W  MAGVAR:  3.9      UTC
(BRG/ELEV TARGETS) <MODE>MENU  14:25:47
```

EXTENDING THE TRACKING ACTUATORS. After manually positioning onto the satellite, the tracking actuators will be placed on the mount. The START mode automatically extends the actuators to the “midpoint” position from which they are to be attached to the mount.

```
LH:   750          START
RH:   750
CONFIRM START POSITION
<MODE>RETURN TO MANUAL MODE
```

INCLINED ORBIT TRACKING. After attaching the tracking actuators, TRACK mode may be initiated.

```
BRG: 155.9      750  SS2:735(Ku)  TRACK
ELEV:  42.0     750  SAT:BRASIL A1
                STEP:PEAKING     SIG
JOGGING ANTENNA TO FIND MAXIMUM SIGNAL
```

RETRACTING THE TRACKING ACTUATORS. When it is time to disassemble the mount, the PACK mode automatically retracts the actuators to their storage position in a manner similar to how the START mode initially extended the actuators. PACKing the actuators causes the RC3000 to invalidate the calculated pointing solution and any existing track tables.

SYSTEM CONFIGURATION. The CONFIGURE mode allows the user to reset drive errors if they occur. It also allows the user to turn on and off “expert access .” Expert access enables/disables the ability to enter the controller programming and maintenance modes and it enables/disables the ability to manually jog the tracking actuators. Normally expert access will be disabled.

```
1-AZIM:OK          CONFIGURE
2-ELEV:OK
3-EXPERT:OFF
<1,2>RESET ERRORS <3>TOGGLE <MODE>MENU
```

2.1 Equipment Mounting

The fluxgate compass and the inclinometer are mounted together in a waterproof box. This box is mounted on the antenna's structure in a level position when the antenna's RF look angle is 45 degrees.

2.2 Electrical Connections

The limit switch inputs are internally jumpered within the RC3000 since no limit switches exist on the mount.

2.3 Initial Configuration

Elevation zero voltage should be set when the RF look angle equals 45 degrees.

The elevation scale factor may be estimated by multiplying the inclinometer's scale factor by 0.8214.

2.4 Final Calibration

The 8 point compass calibration provides better results and will be much easier to perform for the deployable mount.

Section 3 – Detailed Operation

LNR Unique modes

While the basic functionality of the RC3000 is as described in the baseline manual, several modes are customized and several modes are unique for operation with the LNR mount.

MANUAL MODE

In comparison to baseline RC3000 operation, the MANUAL mode is not intended for manually jogging the antenna. Rather it shows the current compass bearing, RF boresight angle, signal strength, lat/lon and magnetic variation.

```
BRG: 141.1(157.6) SS2: 50          MANUAL
ELEV: -67.5( 42.4) SAT:telstar 402
POS:38°56N  94°44W  MAGVAR:  3.9      UTC
(BRG/ELEV TARGETS) <MODE>MENU  14:25:47
```

BRG: 141.1(167.2)

The BRG field shows the current true heading (bearing) of the mount along with the target bearing of the latest pointing solution calculated.

The true heading displayed is derived from the magnetic heading coming from the fluxgate compass added with the calculated magnetic variation. The magnetic heading is reported by the compass once a second. Note that the compass filters (dampens) its output and therefore it may take a few seconds for the bearing value to settle following movement of the mount.

Whenever the RC3000 detects an incorrect data stream from the compass **** is displayed for the bearing. The **** display will usually be displayed for a couple of seconds when Manual mode is first entered. After the data sentence is initially correctly parsed, the valid (numerical) display of bearing should persist. If the invalid display persists, the interface to the compass should be checked.

The target bearing from the latest pointing solution calculation is displayed within parenthesis. If no valid pointing solution exists, ***** will be displayed.

MAG:137.2

When no magnetic variation has been calculated (no valid lat/lon available), the BRG field will change to MAG to display the current magnetic heading being output from the fluxgate compass.

ELEV: 33.1(42.4)

The ELEV field shows the current RF elevation look angle and the target elevation angle from the latest pointing solution calculation.

The displayed RF look angle is derived by continuously reading the inclinometer attached to the mount's backstructure. This reading takes into account the antenna's RF offset angle.

The inclinometer's input to the RC3000 is a voltage that varies with inclination. If this interface is damaged, the likely indication would be an elevation display that does not vary as the mount is moved.

The target elevation from the latest pointing solution calculation is displayed within parenthesis. If no valid pointing solution exists, ***** will be displayed.

POS:38° 56N 94° 44W

The POS field displays either the current latitude and longitude used for the pointing solution or (if no pointing solution is valid) the current latitude and longitude reported by the GPS receiver at a rate of once a second. Note that if no pointing solution is currently valid, this will be signaled by ***** for target bearing and elevation.

When displaying the current GPS data, several status messages may be displayed if correct data from the GPS was not received:

GPS OFFLINE – This message is displayed if no serial data at all is being received from the GPS receiver. The interface to the GPS should be checked.

NO GPS NAV - This message indicates that data is coming from the GPS but that a valid navigation solution (lat/lon) is not currently being calculated. This typically indicates that the GPS receiver cannot “see” enough GPS satellites to form a navigation solution. The placement of the GPS receiver should be checked to confirm that it has a clear view of the sky.

SS2: 50

The SS2 field shows the current value sensed on the signal strength channel 2 input. The current signal strength is displayed as a value between 0 and 999. If the channel 2 input is saturated (value greater than 999), *** will be displayed.

SAT:telstar 402

The SAT field shows the name of the current “active” satellite. Active means that a pointing solution for that satellite has been performed and is still valid. A pointing solution is invalidated when the PACK function is performed signalling the end of current operations.

If there is currently no valid pointing solution, the SAT field will be blank indicating that a pointing solution has to be performed via the SATELLITE mode. If a valid pointing solution exists, the name of the selected satellite will appear in lowercase letters. If a track has been initiated on a satellite, its name will appear in uppercase letters in MANUAL mode.

MAGVAR: 3.9

The MAGVAR: field displays the calculated magnetic variation for the current lat/on. If the RC3000 thinks it needs to recalculate magnetic variation (thinks lat/lon has changed) the MAG VAR: field will flash “CALC”. The magnetic variation calculation may take up to 10 seconds.

(BRG/ELEV TARGETS)

FL: 750 R: 750

The display in the lower left hand corner of the MANUAL screen is dependent on whether or not expert access is enabled.

If expert access is disabled, the prompt (BRG/ELEV TARGETS) appears to remind the user that the data in parenthesis for the BRG and ELEV fields reflects the latest calculated pointing solution.

If expert access is enabled, the pulse count for the left (L:) and right (R:) actuators are displayed. When expert access is enabled, the actuators may be manually jogged via the EL UP, EL DN, AZ CCW and AZ CW keys. Also the speed of the jog may be toggled via the SPEED key. The first character on the bottom line reflects the current speed chosen – “F” for fast, “S” for slow.

MENU MODE

MENU mode allows the user to select one of the listed modes. Pressing the Mode key will move to MANUAL mode.

MENU mode will display the local time zone and local time in the lower right hand corner.

1-LAT/LON	2-SATELLITE	MENU
3-START	4-TRACK	5-PACK
6-CONFIGURE		UTC
<1-6>SELECT	<MODE>MANUAL	18:25:14

LAT/LON MODE

When the user chooses to modify latitude and longitude, a screen appears showing the current lat/lon and the source of that value. In the example screen the source shows that the current lat/lon was obtained from the GPS. If the current values had been entered manually "MANUAL" would show for the source. If the current values had come from the preset vehicle location list (see Preset Locations configuration 3.3.1.15), the name (ex. WICHITA) of the preset location would appear. If there is currently no valid lat/lon "NO POS SOURCE" would be displayed.

```
38°56N 94°44W GPS LAT/LON
SELECT LAT/LON SOURCE # MAG VAR:*****
<1>MANUAL <2>PRESET <3>GPS
```

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

The functionality of LAT/LON mode is the same as for the baseline RC3000 operation. For the LNR mount, LAT/LON additionally calculates and displays magnetic variation position changes.

Manual Lat/Lon Entry

```
38°56N 94°44W GPS LAT/LON
LAT: LON:
MANUALLY ENTER LAT/LON <MODE>EXIT
```

The user is provided two fields to manually enter lat and lon. See 3.1.4 (Data Entry) for instructions on how to enter latitude and longitude.

Preset Location List

```
38°56N 94°44W GPS LAT/LON
2 37°36N 97°18W WICHITA
<SCR>THRU LIST <ENTER>SELECT <BKSP>EXIT
```

The user scrolls through the list of preset locations and selects the displayed location by pressing the Enter key. Note that the number within the list (2) is displayed along with the name and lat/lon. Note that the set of preset locations is modified via the LOCATION PRESETS configuration screen.

GPS Lat/Lon

```
37°36N 97°18W WICHITA LAT/LON
GPS:38°56N 94°44W 17:36:59
<ENTER>USE GPS LAT/LON <BKSP>EXIT
```

The current lat/lon the gps has calculated is displayed. The UTC the gps is outputting is also displayed to show that the data is being updated. To select this lat/lon press the Enter key. Note that if the gps is not reporting a valid position fix the message "NO GPS NAV" will appear.

SATELLITE

The SATELLITE mode is used to perform a pointing solution calculation. When the mode is first entered the following screen appears.

38°56N 94°44W	SATELLITE
SAT: GALAXY 6 74.0W	BRG: 149.9
<1>MANUAL <2>PRESET	EL: 40.0
SELECT SAT SOURCE	READY TO LOCATE

Position Display

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

If SATELLITE mode is entered without a valid position source, the data from the GPS receiver will be parsed until a valid latitude and longitude is received.

**SAT: <1>MANUAL <2>PRESET
SELECT SAT SOURCE**

This field displays the name and longitude of the "selected" satellite. When the mode is first entered the name of the last satellite selected will be displayed. The user may select another satellite to locate by <1> manually entering the satellite data or <2> choosing a satellite from the user's preset list of satellites. See 3.2.2.3.1 for further details on the two methods of selecting a satellite.

BRG: / EL:

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

Calculation Readiness Status

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

1)PARAMETER NEEDED. The pointing angle calculation requires 2 sets of data a) mount lat/lon and b)satellite information. If lat/lon is missing/invalid, the user will need to go to POSITION mode to enter valid data. If satellite information is missing/invalid, the user will need to supply that information via the mechanisms described in 3.2.2.3.1.

2)AZIM/ELEV LIMIT. If the pointing solution calculation yields an azimuth angle that is outside the clockwise or counter-clockwise azimuth limit (see 3.3.1.4) or outside the up or down elevation limit, one these messages will be displayed to indicate that the RC3000 does not think it can move the antenna to the correct position to acquire the satellite. The user may have to move the vehicle to place it in an orientation that will allow the mount to move to the required position. Note that this message may indicate that the current position data is incorrect (example: wrong heading).

3)CALC DONE / PRESS <ENTER>. This alternating message indicates that the RC3000 considers the calculated pointing solution valid. Pressing the Enter key will return the RC3000 to MANUAL mode where the pointing solution targets will be displayed.

START MODE

The Start mode automatically moves the tracking actuators to their “midpoint” position in preparation for attaching the actuators to the mount.

The opening screen of the Start mode asks the user to confirm that the actuators are detached. If the actuators are not in a safe position for them to be extended, they should be put in a safe position before pressing the Enter key which will start the movement.

```
START
<MODE>RETURN TO MANUAL

<ENTER>CONFIRM ACTUATORS DETACHED
```

When the Start movement is initiated, the first action is to move the left hand actuator to the fully compressed position. During this movement the message “RETRACTING LEFT ACTUATOR <STOP>HALT” is displayed.

NOTE: During all movements the name of the actuator (LH/RH) that is currently being commanded to move will flash. At the beginning of the Start function the pulse count value for both left and right hand actuators is set to 32768.

Several seconds after becoming fully compressed, the controller will sense that movement has “jammed” and will begin extending the actuator to the Start position. After sensing the “jammed” condition the number of counts is reset to 50. The number of counts the actuator extends to is set by the START_CNTS item.

```
LH: 31456          START
RH: 32768

RETRACTING LEFT ACTUATOR    <STOP>HALT
```

When both actuators have been extended to their start position the following screen appears.

```
LH: 750          START
RH: 750

CONFIRM START POSITION
<MODE>RETURN TO MANUAL MODE
```

PACK MODE

The PACK mode automatically moves the tracking actuators to their storage position.

PACK mode operates much in the same way the START mode does. The number of counts the actuators extend to after jamming is set by the PACK_CNTS configuration item.

As soon as the user initiates PACK movement, several items are invalidated to signal that the current pointing solution, mount position and track tables can no longer be considered proper.

TRACK MODE

TRACK mode performs as described in section 3.2.2.9 of the baseline manual. Note that for the LNR system the time the controller waits to enter the search sub-mode following a signal lost condition has been set at 30 minutes rather than 5 minutes.

When TRACK is entered initially for the selected satellite, the STORE mode screen will momentarily appear while data structures are being initialized for tracking.

When TRACK mode is entered and a track has already been initiated on the selected satellite, the RECALL screen will briefly appear.

```
BRG: 123.4      745  SS1:735(Ku)  TRACK
ELEV: 12.3      765  SAT:BRASIL A1
                        STEP:IDLE    20:36
WAITNG TO PERFORM NEXT PEAKUP  <0>MENU
```

Confirmation is required to exit TRACK mode via the MODE key.

CONFIGURE MODE

The CONFIGURE mode allows the user to reset drive error conditions and to toggle the expert access flag on and off.

```
1-AZIM:OK                CONFIGURE
2-ELEV:JAMMED
3-EXPERT:OFF
<1,2>RESET ERRORS <3>TOGGLE <MODE>MENU
```

The AZIM and ELEV fields provides away to reset drive system errors (JAMMED / RUANAWAY / DRIVE) for each axis. An axis' drive status may be reset by pressing the corresponding key.

The EXPERT field allows the user to toggle expert access on and off by entering the five digit expert access code shown in appendix A of the baseline manual. With expert access OFF the user will not be allowed to the programming group of screens when the Mode switch is held down for five seconds. Expert access must be on to enable manual jogging of the actuators via the MANUAL mode.

CONFIG-LNR

The only mode in the programming group of modes unique to the LNR mount is the CONFIG-LNR screen. The CONFIG-MENU screen that allows you to enter CONFIG-LNR appears following RESET DEFAULTS in the configuration menu.

```
LNR                        CONFIG-MENU
SETUP FIXED STEP SIZE/TIME

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

The CONFIG-LNR screen allows the user to set fixed tracking parameters and to set the target positions for the START and PACK modes.

```
STEP_SIZE: 5  START_CNTS: 750  CONFIG-LNR
STEP_TIME:600  PACK_CNTS: 100

STEP SIZE <1-999 PULSES>
```

STEP_SIZE: 5

STEP SIZE <1-999 PULSES>

This field allows the user to set the number of counts (pulses) to be made when step tracking.

STEP_TIME:600

STEP TIME <1-999 SECONDS>

This field allows the user to set the amount of time (in seconds) between step track movements.

START_CNTS: 750

START COUNTS<100-9999>

This field allows the user to set the target position that the START mode extends the tracking actuators to.

PACK_CNTS: 100

PACK COUNTS<30-999>

This field allows the user to set the target position that the PACK mode extends the tracking actuators to.

3.3.1.2 Reset Defaults

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

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

CONFIGURATION ITEM	DEFAULT VALUE	UNITS	INSTALLATION UNIQUE VALUE
Antenna Data			
antenna_size_cm	240	cm.	
ccw_azim_limit	0	Deg.	
Cw_azim_limit	360	Deg.	
Up_elev_limit	90	Deg	
Down_elev_limit	0	Deg	
Azim_offset	0.0	Deg	
Elev_offset	0.0	Deg	
Elevation_look_configuration	1		
Polarization Configuration			
Polarization_type	Circular		
Default Horizontal Position	-45.0	Deg	
Default Vertical Position	45.0	Deg	
CW Polarization Limit	90.0	Deg	
CCW Polarization Limit	90.0	Deg	
Azimuth Pot Drive			
Zero Voltage	2.50	V.	N/A for LNR
Fast/Slow Threshold	2.5	Deg	N/A for LNR
Maximum Position Error	0.20	Deg	N/A for LNR
Coast Threshold	0.1	Deg	N/A for LNR
Maximum Retry Count	3		N/A for LNR
Azimuth Pulse Drive			
Pulse Scale Factor	2406	Pulses/Radian	N/A for LNR
CW Pulse Limit	64000		
CCW Pulse Limit	100		
Fast/Slow Threshold	50		
Maximum Position Error	0		
Coast Threshold	3		
Maximum Retry Count	3		
Azimuth Drive Monitoring			
Jam Slop	1	Pulse	
Runaway Slop	1023		
Fast Deadband	1000		
Slow Deadband	500		
Elevation Pot Drive			
Zero Voltage	2.50	V.	
Fast/Slow Threshold	3.0	Deg	
Maximum Position Error	0.2	Deg	
Coast Threshold	0.4	Deg	
Maximum Retry Count	3		

Elevation Pulse Drive			
Pulse Scale Factor	1646	Pulses/radian	N/A for LNR
UP Pulse Limit	64000		
Down Pulse Limit	100		
Fast/Slow Threshold	50		
Maximum Position Error	0		
Coast Threshold	3		
Maximum Retry Count	3		
Elevation Drive Monitoring			
Jam Slop	1		
Runaway Slop	1023		
Fast Deadband	1000		
Slow Deadband	500		
Polarization Drive			
Zero Voltage	2.50		N/A for LNR
Fast/Slow Threshold	2.0		N/A for LNR
Maximum Position Error	0.5		N/A for LNR
Coast Threshold	0.3		N/A for LNR
Maximum Retry Count	3		N/A for LNR
Polarization Drive Monitoring			
Jam Slop	1		N/A for LNR
Runaway Slop	200		N/A for LNR
Fast Deadband	1000		N/A for LNR
Slow Deadband	500		N/A for LNR
Track Factors			
Search Enable	Disabled(0)		
Max Track Error	3	1/10 db	
Search Width	4		
Peakup Holdoff Time	120	seconds	
Track Signal Source	SS2		
Signal Sample Time	2	Seconds	
Signal Strength Parameters			
Channel 1 Polarity	Positive		
Channel 1 Threshold	100		
Channel 2 Polarity	Positive		
Channel 2 Threshold	100		
Autopeak			
Autopeak Enabled	True (1)		N/A for LNR
Signal Source	RF		N/A for LNR
RF Band	Ku (1)		N/A for LNR
Spiral Search AZ Limit	5	Deg	N/A for LNR
Spiral Search EL Limit	5	Deg	N/A for LNR
Spiral Signal Threshold	200		N/A for LNR
Scan Range Limit	10	Deg	N/A for LNR
Scan Signal Threshold	200		N/A for LNR
LNR			
Step Size	5	Pulses	
Step Time	90	Seconds	
Start Cnts	750	Pulses	
Pack Cnts	100	Pulses	

