APPENDIX B - MOUNT SPECIFIC DATA
For
2.4 meter SPAWAR X-Band

This appendix describes RC3000 operations unique to the 2.4 meter SPAWAR X-band mount. Differences between this version and the operation described in the "baseline" RC3000 manual are noted on a paragraph by paragraph basis.

1.1 Manual Organization

This appendix is provided as a supplement to the baseline RC3000 manual. The corresponding paragraphs in the baseline RC3000 manual are referred to when data specific to the 2.4 m. SPAWAR X-band mount are described.

1.2 RC3000 Features

All basic features of the RC3000 are utilized to provide the operations for the SPAWAR mount. Some features have been modified (as described below) to customize operations for this antenna.

Hardware Configuration. A RC3000A version of hardware is utilized for this mount.

Software Configuration. The mount model will be designated as **LX**. Software will be designated as RC3K-LX-xxx.

1.3.2 System Interface Requirements

The LX interface differs from baseline RC3000 interface requirements as follows:

1) No electronic inclinometer is present to provide elevation angle feedback. The only position sensor on the elevation is a resolver.

2) The only azimuth position sensor is a reslover.

3) Azimuth CCW / CW and elevation UP / DOWN limits are implemented via discrete limit switches

4) No azimuth or Elevation stow limit switches are present

6) A master antenna disable discrete input is present

1.3.3 Operational Overview

The baseline RC3000 modes are modified to accommodate the operational scenario for the SPAWAR mount. The following provides an overview of the intended operational sequence. Detailed description of the each mode will be provided in section 3.

POWER UP. After the RC3000 is powered up, the controller enters MENU mode. The MENU selections for the LX mount are shown below:

```
1-MOVETO     2-LOCATE  3-SEARCH     MENU
4-STORE      5-RECALL  6-DELETE
7-SETTINGS                          UTC
<0-9>SELECT <MODE>MANUAL        14:37:23
```

MOVETO. MOVETO mode provides the ability to automatically move the mount in azimuth and elevation to a selected target position.

```
X-EL: -13.4 ( -13.4)              MOVETO
ELEV:  41.5 (  41.5)
                                SPEED:FAST
<1>AZ <2>EL <3>SPEED <4>START MOVE
```

LOCATE. Locate mode automatically calculates and moves the mount to the pointing solution for the selected satellite.

```
POS:   39°01N  94°49W  0.0          LOCATE
SAT:TELSTAR 4   89.0W           AZ: 167.2
1-MANUAL 2-PRESET 3-SATLIST     EL:  44.4
<1-3>SELECT SAT SOURCE   READY TO LOCATE
```

SEARCH. As an aid in finding an inclined orbit satellite, SEARCH mode performs an expanding spiral search pattern.

```
AZIM:10456             SS1:375   SEARCH
ELEV:17429

SPIRAL SEARCH(CCW 12)          <STOP>HALT
```

MANUAL. In MANUAL mode the mount may be manually jogged in the azimuth and elevation axes in order to peak up on the satellite. The relative signal strength indication (SS2:) will provide an aid in positioning the mount on the satellite.

```
AZIM:  20.9        SS2: 50         MANUAL
ELEV:   0.2  DOWN
                   SPD:FAST    SF    UTC
<0-9>JOG ANTENNA   <MODE>MENU   14:39:01
```

STORE. After verifying the antenna is precisely on the intended satellite, the user may STORE the mount's azimuth and elevation angles for subsequent RECALLs. If the satellite has been defined as having an inclined orbit, the TRACK mode will be automatically entered.

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

1.3.7 Drive System

Position Sensing and Limits. Discrete UP/Down/CCW/CW limit switches are provided.

Jam and Runaway Sensing. Jammed and runaway sensing is based on resolver counts.

2.0 INSTALLATION

2.1 Equipment Mounting

No electronic inclinometer, fluxgate compass or GPS receiver are present.

2.2 Electrical Connections

Electrical connections between the RC3000 and the LX mount are made via a user-supplied adapter cable assembly.

Schematics for the adapter cable are shown in section 4.2.

The following subparagraphs describe any unique items with respect to the LX system.

2.2.3 Drive Sense. No azimuth, elevation or polarization potentiometers are present.

2.2.4 Limit Switches. The input normally used for Elevation Stow will be used for the Elevation Up limit switch. The input normally used for Elevation Up will be used for the Azimuth CCW limit switch. The input normally used for Azimuth Stow will be used for the Azimuth CW limit switch.

These assignments are reflected on the cabling schematic in section 4.2.

2.2.5 Signal Strength. Connect any signal strength inputs as shown in this section of the baseline manual.

2.2.6 Navigation Sensors. No GPS receiver and Fluxgate Compass are present.

2.2.7 Accessories. HPA disable and Alarm relay outputs are used to activate the azimuth and elevation brakes.

These assignments are reflected on the cabling schematic in section 4.2.

2.2.8 RF Autopeak. This input is available but it is intended to only use the signal strength indication from the tracking receivers.

2.2.9 Hand Held Remote. This option is not available for the LX mount.

2.2.11 PC Remote Control. The remote control interface is wired as shown in the baseline manual.

2.2.12 Waveguide Switch. The optional waveguide switch module is not provided.

2.3 Initial Configuration

Calibration of the LX mount is similar to that described in the baseline manual. Unique Items are described in the following subsections.

2.3.1 Software Initialization. Per baseline manual.

2.3.2 Elevation Calibration.

Since the LX mount does not use an electronic inclinometer, only elevation calibration steps associated with the elevation resolver are performed.

Sensor Polarity. Elevation resolver count should increase as the mount is moved up. NOTE: from MANUAL mode the resolver count may be displayed by pressing the Scroll Up key. If elevation resolver counts decrease as the mount moves up, the elev_resolver_reversed flag (3.3.1.2.2) should be changed.

Elevation Reference Position. Move the antenna until an identifiable reference position (such as face vertical) is achieved. The RF look angle that should be achieved from this reference position will be used next to set the elevation resolver offset.

Elevation Resolver Offset. Go to the Analog to Digital Voltages screen (3.3.2.1) to see the raw elevation resolver angle.

First ensure that this raw angle will allow the antenna to rotate throughout its elevation range of motion without wrapping around (going less than 0 or greater than 360). If wrapping could potentially occur, adjust the elevation resolver until wrapping is no longer possible.

Calculate the difference between the raw resolver angle and the RF look angle of the mount while at the reference position. This difference will be entered as the elevation_resolver_offset (3.3.1.2.2).

With the elevation_resolver_reversed flag and the elevation_resolver_offset entered, MANUAL mode should now indicate the correct RF look angle for elevation.

2.3.3 Azimuth Calibration.

Only azimuth calibration steps associated with the azimuth resolver are performed.

Sensor Polarity. Azimuth resolver count should increase as the mount is moved clockwise. NOTE: from MANUAL mode the resolver count may be displayed by pressing the Scroll Up key. If azimuth resolver counts decrease as the mount moves clockwise, the azim_resolver_reversed flag (3.3.1.2.3) should be changed.

Azimuth Reference Position. Move the antenna until an identifiable true heading (such as due South) is achieved. This true heading will be used next to set the azimuth resolver offset.

Azimuth Resolver Offset. Go to the Analog to Digital Voltages screen (3.3.2.1) to see the raw azimuth resolver angle.

First ensure that this raw angle will allow the antenna to rotate throughout its azimuth range of motion without wrapping around (going less than 0 or greater than 360). If wrapping could potentially occur, adjust the azimuth resolver until wrapping is no longer possible.

Calculate the difference between the raw azimuth resolver angle and the true heading of the mount while at the reference position. This difference will be entered as the azimuth_resolver_offset (3.3.1.2.3).

With the azimuth_resolver_reversed flag and the azimuth_resolver_offset entered, MANUAL mode should now indicate the true heading for azimuth.

2.3.4 Polarization Calibration. Not applicable for the LX mount.

2.3.5 Fast/Slow Motor Speed. Per baseline manual.

2.3.6 Pulse Sensor Checkout. Move the mount to the four limits (AZ CW/CCW, EL UP/DOWN) and record the raw resolver counts near the limits. Enter these values in the Azimuth and Elevation Pulse Drive configuration screens.

2.3.7 Drive System Checkout. Per baseline manual

2.3.8 Navigation Sensor Comunication. GPS and compass are not present.

NOTE: The POSITION mode has been moved to the MAINTENANCE menu (see 3.2.2.7). The latitude, longitude of the mount should now be entered along with a true heading of 0.0. Following entering of latitude, longitude and true heading, "save" the position. Since this is a fixed based mount, position should only have to be entered once during installation.

2.4 Final Calibration

2.4.1 Compass Calibration. Not Applicable.

2.4.2 Azimuth and Elevation Alignment. Per baseline manual. Apply any observed offsets via the azimuth and/or elevation resolver offset configuration items.

2.4.3 Signal Strength Adjustment. Calibrate the signal strength input with the tracking receiver's output.

2.4.4 Pulse Scale Factors .

The default AZ and EL pulse scale factors will reflect the correct values for a resolver based system.

3.0 Detailed Operation

3.1.1 Modes

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

3.2.1 Manual Mode

```
AZIM: 141.1          SS2:579          MANUAL
ELEV: -67.5
                     SPD:FAST     SF     UTC
<0-9>JOG ANTENNA     <MODE>MENU    14:25:47
```

SF

This fields displays the state of the antenna safety (SF) interlock input.

SF is displayed when the antenna safety button has not deactivated antenna movement. When the button has been activated, the “SF” will disappear and the ANT SF alarm is flashed as described in section 3.4.

3.2.2 Menu Mode

MENU mode provides a customized selection of functions. As described in the baseline manual, pressing the Mode key will move to MANUAL mode.

```
1-MOVETO      2-LOCATE   3-SEARCH      MENU
4-STORE       5-RECALL   6-DELETE
7-SETTINGS                             UTC
<0-9>SELECT <MODE>MANUAL           14:37:23
```

The following subparagraphs describe how the various modes are customized for the operation of the SPAWAR mount.

3.2.2.1 DEPLOY

3.2.2.2 STOW

The STOW and DEPLOY modes described in the baseline manual are intended for use by vehicle mounted antennas. For the SPAWAR-X mount, STOW and DEPLOY have been replaced by the MOVETO mode.

MOVETO mode operates in the same manner as the AZEL mode described in section 3.3.2.8 of the baseline manual.

3.2.2.3 LOCATE

LOCATE mode will perform as described in the baseline manual. Note that mount latitude, longitude and reference heading are set just once at installation and will not be dynamically updated in LOCATE.

Search

SEARCH mode is provided as an automatic way to search for an inclined orbit satellite. SEARCH mode functions as described in section 3.2.2.4 “Spiral Search Autopeak” of the baseline manual. For the SPAWAR mount, SEARCH mode will implement an expanding spiral search. The spiral search will be initiated from the current azimuth and elevation position.

3.2.2.4 STORE

3.2.2.5 RECALL

3.2.2.6 DELETE

STORE, RECALL and DELETE modes function as described in the baseline manual.

3.2.2.8 SETTINGS

The SETTINGS mode allows the user to 1) select the signal source for tracking, 2) turn on and off the expert access mode and 3) reset any drive errors.

SETTINGS mode is described in section 3.2.2.8 of the baseline manual.

3.2.2.9 TRACK

3.2.2.10 REMOTE

TRACK and REMOTE modes perform as described in the baseline manual.

3.3 Programming Group

All programming group modes described in the baseline manual are provided. Many items are not applicable to the LX version. These will be noted in the table of configuration items shown later.

3.3.1.2.2 Elevation Calibration.

In addition to the normal inclinometer calibration items, two elevation resolver calibration items are included.

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

RES: ELEV RESOLVER OFFSET<+/-300.00 DEGREES>

The elev_resolver_offset configuration item defines the offset to be applied to the angle read directly from the elevation resolver for the purpose of displaying elevation angle. Example: If when at the elevation reference (stow) position the raw elevation resolver angle reads 122.3, a elev_resolver_offset of -100.0 will result in a resolver based elevation angle of 22.3.

REV: ELEV RESOLVER<0-NORMAL 1-REVERSED>

The elev_resolver_reversed configuration item defines whether the polarity of the elevation resolver matches that of the RC3000 resolver circuitry. If the raw elevation resolver angle decreases as the mount moves up, the elev_resolver_reversed item must be described as reversed.

3.3.1.2.3 Azimuth Calibration

In addition to the normal azimuth calibration items, two azimuth resolver calibration items are included. No azimuth reference_voltage item is displayed since no azimuth potentiometer is present.

```
           OFF: 0.0          CONFIG-AZIM
  CCW:180   CW:180
  RES: 0.0 REV:0
SET REFERENCE VOLTAGE <2.00 – 3.00>
```

RES: AZIM RESOLVER OFFSET<+/-300.00 DEGREES>

The azim_resolver_offset configuration item defines the offset to be applied to the angle read directly from the azimuth resolver for the purpose of displaying azimuth angle. Example: If when at the azimuth stow position the raw azimuth resolver angle reads 181.3, a azim_resolver_offset of –181.3 will result in a resolver based azimuth angle of 0.0.

REV: ELEV RESOLVER<0-NORMAL 1-REVERSED>

The elev_resolver_reversed configuration item defines whether the polarity of the elevation resolver matches that of the RC3000 resolver circuitry. If the raw elevation resolver angle decreases as the mount moves up, the elev_resolver_reversed item must be described as reversed.

3.3.1.3.2 Azimuth Pot Drive

3.3.1.3.5 Elevation Pot Drive

Since no potentiometer exists on the azimuth and elevation axes, these items actually are used to tune movements (such as LOCATE and MOVETO) based on angles derived from the resolver feedback.

3.3.1.3.3 Azimuth Pulse Drive

3.3.1.3.6 Elevation Pulse Drive

The items on the Pulse Drive screens are actually used to tune drive movements based on resolver “counts”. The resolver counts are used in the same fashion as pulse counts are used for making precise movements (during tracking, recall) of the mount.

NOTE: the azimuth and elevation pulses_per_radian values are set to 10,431. This is the number of resolver counts per radian.

360 degrees / 65536 total counts = 0.005493164 degrees/count or 182.044 counts/degree.

182.044 counts/degree * 57.29 degrees/radian = 10431 counts/radian

3.3.1.3.4 Azimuth Drive Monitoring

3.3.1.3.7 Elevation Drive Monitoring

The items on the Drive Monitoring screens are actually used to tune runaway and jam monitoring based on resolver “counts”. The resolver counts are used in the same fashion as pulse counts to monitor movements of the mount.

3.3.2.1 Analog to Digital Voltages

In addition to the normal voltages displayed this screen also shows “raw resolver” angles and counts and the state of the feed type signal.

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

The azimuth and elevation resolver angles and counts displayed are read directly from the resolvers without being biased by offset terms. The displayed values will reflect if the azimuth or elevation resolver polarity has been reversed.

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	LX	COMMENTS	INSTALL VALUE
SYSTEM DEFINITION			
GPS_present	0		
Compass_present	0		
Initial_mode	2		
antenna_size_cm	240		
Waveguide_present	0		
ELEVATION CALIBRATION			
Zero Voltage	2.50	N/A	
Elev_offset	0.0	N/A	
Up_elev_limit	90		
Down_elev_limit	0		
Elevation_Scale_Factor	55.55	N/A	
Elevation_look_configuration	1	(0 will disable SF alarm)	
Resolver_Offset	0.0		
Resolver_Reversed_Flag	0		
AZIMUTH CALIBRATION			
Azim_offset	0.0	N/A	
ccw_azim_limit	0		
Cw_azim_limit	360		
Resolver_Offset	0.0		
Resolver_Reversed_Flag	0		
POLARIZATION CALIBRATION			
Zero Voltage	2.50	N/A	
Polarization_Offset	0.0	N/A	
CW Polarization Limit	90.0	N/A	
CCW Polarization Limit	90.0	N/A	
Pol_Scale_Factor	31.11	N/A	
Polarization_type	1	CIRCULAR-Do not change	
H/V_Reference	1	N/A	
Default Horizontal Position	-45.0	N/A	
Default Vertical Position	45.0	N/A	
Pol_Automove_Enable	1	N/A	
SIGNAL PARAMETERS			
RF Lock	0		
RF Time	0.1		
Channel 1 Polarity	1		
Channel 1 Threshold	100		
Channel 1 Delay	0.1		
Channel 1 Lock Type	0		
Channel 2 Polarity	1		
Channel 2 Threshold	100		
Channel 2 Delay	0.1		
Channel 2 Lock Type	0		
AUTOPEAK			
Autopeak Enabled	0		
Signal Source	3	3=SS2	
RF Band	4	4=X	
Spiral Search AZ Limit	3		
Spiral Search EL Limit	3		

Spiral Signal Threshold	200		
Scan Range Limit	8		
Scan Signal Threshold	200		

CONFIGURATION ITEM	LX	COMMENTS	INSTALL VALUE
AZIMUTH POT DRIVE	**ANGLE-BASED MOVEMENTS**		
Fast/Slow Threshold	2.5		
Maximum Position Error	0.20		
Coast Threshold	0.1		
Maximum Retry Count	3		
AZIMUTH PULSE DRIVE	**PULSE-BASED MOVEMENTS**		
Pulse Scale Factor	10431	Do Not Change	
CW Pulse Limit	65535		
CCW Pulse Limit	0		
Fast/Slow Threshold	50		
Maximum Position Error	0		
Coast Threshold	3		
Maximum Retry Count	3		
AZIM DRIVE MONITORING			
Jam Slop	1		
Runaway Slop	1023		
Fast Deadband	1000		
Slow Deadband	500		
ELEV POT DRIVE	**ANGLE-BASED MOVEMENTS**		
Fast/Slow Threshold	3.0		
Maximum Position Error	0.2		
Coast Threshold	0.4		
Maximum Retry Count	3		
ELEV PULSE DRIVE	**PULSE-BASED MOVEMENTS**		
Pulse Scale Factor	10431	Do Not Change	
UP Pulse Limit	65535		
Down Pulse Limit	0		
Fast/Slow Threshold	50		
Maximum Position Error	0		
Coast Threshold	3		
Maximum Retry Count	3		
ELEV DRIVE MONITORING			
Jam Slop	1		
Runaway Slop	1023		
Fast Deadband	1000		
Slow Deadband	500		
POL POT DRIVE			
Fast/Slow Threshold	2.0	N/A	
Maximum Position Error	0.5	N/A	
Coast Threshold	0.3	N/A	
Maximum Retry Count	3	N/A	
POL DRIVE MONITORING			
Jam Slop	1	N/A	
Runaway Slop	200	N/A	
Fast Deadband	1000	N/A	
Slow Deadband	500	N/A	

CONFIGURATION ITEM	VC	COMMENTS	INSTALL VALUE
TRACK			
Search Enable	0		
Max Track Error	3		
Search Width	4		
Peakup Holdoff Time	120		
Track Signal Source	2	2=SS1	
Signal Sample Time	2		
REMOTE CONTROL			
Remote Enabled	1		
Bus Address	50		
Baud Rate	6		
Jog	20		
STOW / DEPLOY			
AZ STOW	0.0	N/A	
EL STOW	-67.5	N/A	
PL STOW	0.0	N/A	
AZ DEPLOY	0.0	N/A	
EL DEPLOY	20.0	N/A	
PL DEPLOY	0.0	N/A	
PL ENABLED	1	N/A	

3.3.2 Maintenace Items

3.2.2.7 POSITION

NOTE: Since the SPAWAR mount is effectively a fixed-based (non-mobile) mount, the “heading” of the antenna will be fixed at 0.0 degrees true heading. Fixing the “heading” at 0.0 true allows the SATELLITE mode calculations to display the true heading to the selected satellite.

3.4 Alarm Displays

In addition to the alarms described in the baseline manual, the following unique alarm is provided for the LX mount.

ANT SF INTRLK

The antenna safety interlock input is activated by the antenna safety button. When this condition exists, the “ANT SF INTRLK” alarm message will be displayed.

When this alarm condition is active, all azimuth and elevation movement will be disabled.

4.2 Schematics

- Adapter cabling

- Internal wiring implementing brakes