APPENDIX B - MOUNT SPECIFIC DATA
For
CPS150

This appendix describes RC3000 operations unique for the CPS150 1.5m. 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.

1.2 RC3000 Features – Configuration

A RC3000A version of hardware is required for this mount.

The mount model will be designated as C1 for the configuration that implements azimuth CW and CCW limits via the J4 connector.

The mount model will be designated as C2 for the configuration that implements azimuth CW and CCW limits via the J1 connector.

Software will be designated as RC3K-C1-GNN or RC3K-C2-GNN

1.3.1 Controller Description

RESOLVER BOARD. A resolver to digital conversion board has been added to the baseline RC3000A hardware. A schematic of this board is shown in section 4.2.

1.3.2 System Interface Requirements

The C1 interface differs from baseline RC3000 interface requirements as follows:

- No azimuth potentiometer exists, a resolver is used for sensing azimuth position and for performing STOW and DEPLOY movements in azimuth.

- A resolver is used for STOW and DEPLOY movements in elevation. The elevation inclinometer will be used for LOCATEs to account for platform tilt.

- Additional limit switches are mechanized for confirming proper azimuth, elevation and polarization positions during STOW and DEPLOY sequences.

1.3.3 Operational Overview

The operation of the RC3000 is very similar to that described in the baseline manual with the following exceptions:

1) unique DEPLOY and STOW sequences are provided

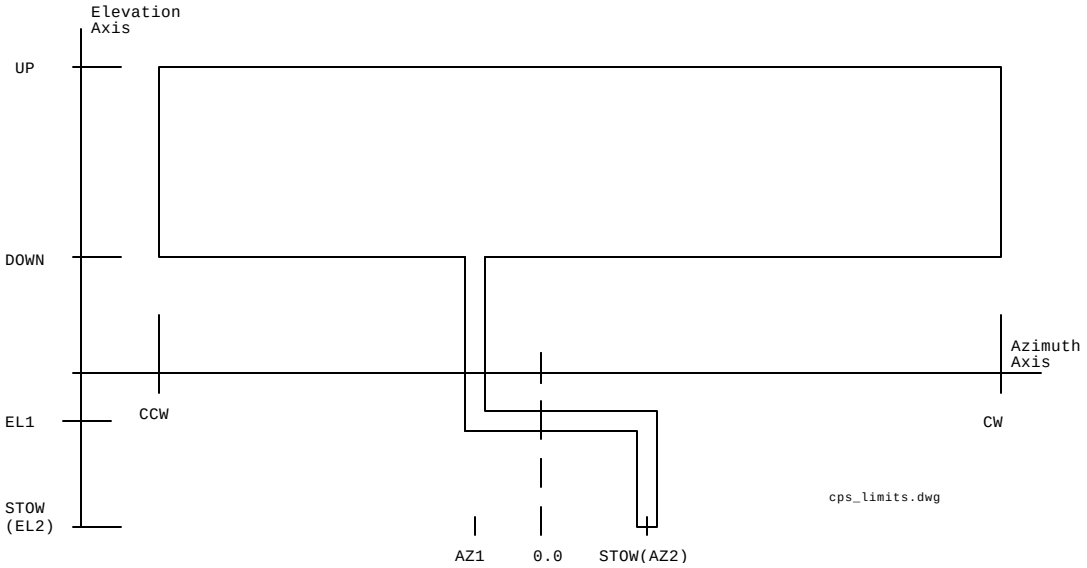
2) LOCATE, STORE and RECALL functions may only be initiated when the elevation axis is above the DOWN limit.

3) AZEL and SHAKE modes are not supported

1.3.7 Drive System

Position Sensing and Limits. The CPS mount requires that the dish move in only in a defined region when doing a DEPLOY or STOW.

The following diagram describes this region of movement.



Jam and Runaway Sensing. The jam and runaway sensing functions will be based on feedback from the azimuth and elevation resolvers.

2.1.3 Fluxgate Compass

The compass should be positioned such that it is parallel with the azimuth centerline (0.0 degrees azimuth). The heading derived from the compass will be referenced to the azimuth centerline for calculation of satellite pointing solutions.

2.1.4 Inclinometer Orientation

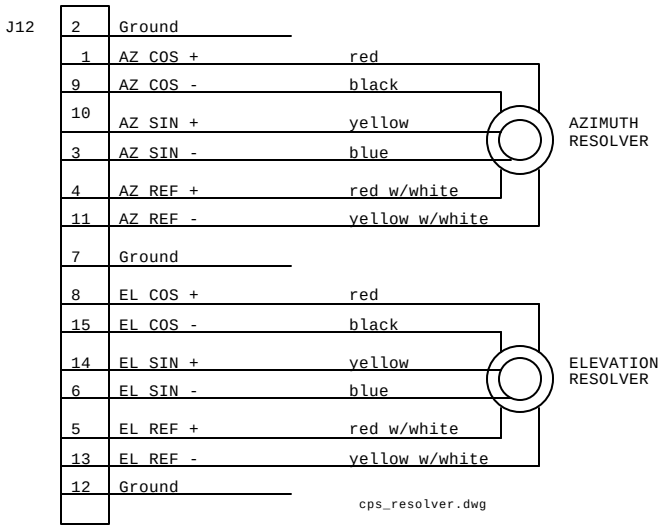
The inclinometer should be rigged with the face of the dish vertical. With the face vertical, the inclinometer should be mounted so that it is about 15 (35 - 20) degrees from vertical in the direction described in the baseline manual's section 2.1.4.

2.2.10 Pulse Sensors

Inputs normally used for pulse sensing via J4 will be used to sense five additional limit switches required for the CPS mount. These additional limit switches are for AZ CCW, AZ CW, AZ1, EL1 and PL1. Wiring of these limit switches is shown in the schematic "CPS-Audrit Limit Switch Inputs".

2.2.12 Waveguide Switch

J12 is used for the resolver interface.



2.3.1 Reset Defaults

The table at the end of the document supplies the default configuration item values for this mount.

2.3.2 Elevation Calibration

Sensor Polarity. The inclinometer should increase in voltage when going up, elevation resolver count should also increase.

Elevation Reference Position. Both the inclinometer and elevation resolver should be calibrated while the backstructure is vertical (i.e. the elevation reference position).

With the inclinometer oriented as described in 2.1.4 the elevation reference voltage should be approximately 1.3 volts.

Rotate the elevation resolver until a raw resolver angle of approximately 120.0 degrees in seen in the MAINTENANCE-VOLTS screen. Lock the elevation resolver in place and observe the raw resolver angle. Subtract 20.0 from this observed angle and enter it as the elevation resolver offset (see 3.3.1.2.2).

With the elevation resolver rigged and calibrated as described above, the elevation angle shown from the inclinometer and from the resolver should be almost the same when the platform is level.

Elevation UP Software Limit. Move the elevation axis to the desired position before the hardware elevation UP limit has activated. Note the elevation resolver count via the AD-VOLTS maintenance screen (3.3.2.1). Enter that value in the Elevation Pulse Drive configuration screen (3.3.1.3.6).

2.3.3 Azimuth Calibration.

The only position sensor on the azimuth axis is the resolver.

Sensor Polarity. Azimuth resolver angle should increase as the mount rotates clockwise. If it does not, the polarity may be changed by setting the azimuth resolver reverse flag.

Azimuth Reference Position. - Position the mount at the azimuth centerline position as exactly as possible. Loosen and adjust the azimuth resolver to be as close to 180 degrees (seen at a/d volts screen 3.3.2.1) as possible. The azimuth resolver offset will be 0.0 – "raw resolver angle".

Azimuth CW/CCW Software Limits. Move the axis axis to the desired positions before the hardware azimuth limits activate. Note the azimuth resolver counts via the AD-VOLTS maintenance screen (3.3.2.1). Enter that value in the Azimuth Pulse Drive configuration screen (3.3.1.3.3).

3.2.1 Manual Mode.

RES

The scroll up key will switch the display between elevation angle derived from the inclinometer to an elevation angle based on feedback from the elevation resolver.

The elevation angle from the resolver should be used when manually moving the dish below the DOWN limit. The inclinometer-based elevation will not be accurate enough in this region to safely move the dish.

AZ1, EL1, PL1

In addition to the normal azimuth, elevation and polarization limit indications (STOW, UP, DOWN, CW, CCW), indications of when the mount is in the CPS-unique limit positions will be displayed.

3.2.2.1 Deploy

Since the CPS deploy movement requires two phases of azimuth, elevation and polarization movements, it may only be initiated when all three axis' are in the STOW position. If all three axes are not in their STOW positions, the following screen will appear for five seconds.

```
                                    DEPLOY
** AZIMUTH & ELEVATION MUST BE AT STOW**
**          TO INITIATE DEPLOY          **
-------  RETURNING TO MENU MODE --------
```

When the DEPLOY sequence is initiated it will perform the following sequence of movements:

1) raise the elevation axis to the EL1 position and confirm that the EL1 limit switch is active

2) move in azimuth to the AZ1 position and confirm that the AZ1 limit switch is active

3) rotate polarization to the PL1 position and confirm that the PL1 limit switch is active

4) raise the elevation axis to the elevation deploy (EDP) position

5) move the azimuth axis to the azimuth deploy (ADP) position

If the proper limit switch condition is not confirmed at the end of steps 1, 2 or 3 the deploy sequence will be terminated and a screen like the following example will be displayed:

```
                                    DEPLOY
** EL1 LIMIT SWITCH NOT SATISFIED     **
**            DEPLOY STOPPED           **
<MODE>EXIT
```

NOTE: The DEPLOY and STOW functions should not be attempted until the azimuth and elevation resolvers have been calibrated. DEPLOY and STOW will not be allowed until the elevation_look_configuration item (3.3.1.2.2) has been set to 0. If a STOW or DEPLOY is attempted prior to setting this item, the following screen will appear:

```
                                        DEPLOY
**       DEPLOY MUST BE ENABLED          **
**         TO INITIATE DEPLOY            **
-------  RETURNING TO MENU MODE --------
```

Since there is potential for damaging the mount by doing STOW or DEPLOY functions, the user should guarantee that the resolvers are calibrated and all limit switches are functioning correctly before enabling these functions.

3.2.2.2 Stow

The CPS STOW sequence may be initiated only when the elevation axis is above the DOWN limit. If elevation is below the DOWN limit, the following screen will appear for five seconds.

```
                                        STOW
** ELEVATION MUST BE ABOVE DOWN LIMIT **
**          TO INITIATE STOW            **
-------  RETURNING TO MENU MODE --------
```

When the STOW sequence is initiated it will perform the following sequence of movements:

1) rotate polarization to the PL1 position and confirm that the PL1 limit switch is active

2) move azimuth to the AZ1 position and confirm that the AZ1 limit switch is active

3) lower elevation to the EL1 position and confirm that the EL1 limit switch is active

4) rotate polarization to the stow position and confirm that the polarization stow switch is active

5) move azimuth to the stow position and confirm that the azimuth stow switch is active

6) lower elevation until the stow switch is active

If the proper limit switch condition is not confirmed at the end of steps 1 through 5, the stow sequence will be terminated and a screen like the following example will be displayed:

```
                                        STOW
** EL1 LIMIT SWITCH NOT SATISFIED       **
**             STOW STOPPED             **
<MODE>EXIT
```

As with the DEPLOY function, the elevation_look_configuration must be set to 0 to enable STOW.

3.2.2.3 Locate

3.2.2.4 Store

3.2.2.5 Recall

All three of these functions may only be initiated when the elevation axis is above the DOWN limit. If elevation is below the DOWN limit, a screen like the following example will be displayed for five seconds:

```
                                        STORE
** ELEVATION MUST BE ABOVE DOWN LIMIT **
**          TO INITIATE STORE           **
-------  RETURNING TO MENU MODE --------
```

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 position (face vertical) the raw elevation resolver angle reads 122.3, a elev_resolver_offset of –102.3 will result in a resolver based elevation angle of 20.0.

NOTE: the resolver-based angle is displayed when the Scroll Up key is pushed when in MANUAL mode.

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 or scale_factor items are 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.

3.3.1.3.1 Reset Defaults

The table at the end of the appendix 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.

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 of the mount.

NOTE: the azimuth and elevation pulses_per_radian values are set to 10,423. 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 drive movements based on resolver "counts". The resolver counts are used in the same fashion as pulse counts are used for making precise 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.

```
AZ: 1.114   181.30 33004    AD VOLTAGES
EL: 1.143 1 122.30 22264
POL:2.237 0
SIG: 3.756(1) <1>RF <2>SS1 <3>SS2 <4>GND
```

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

3.3.1.3.10 Stow & Deploy Positions

The CPS mount requires two sequences of azimuth, elevation and polarization movements in order to perform a STOW or DEPLOY. This screen allows the user to define the target positions for these movements. Refer to the diagram in 1.3.7.

```
PL1:  0.0  PST:  45.0        CONFIG-STOW
AZ1: -7.0  AST:  14.0 ADP:   0.0
EL1: -47.0 EST: -70.0 EDP:  20.0
```

AZ1: **AZIMUTH STOW 1 <-180/180>**
EL1: **ELEVATION STOW 1 <-90/90>**
PL1: **POL STOW 1 <-180/180>**

These items define the target positions for the first sequence of the STOW movement.

AST: **AZIMUTH STOW 2 <-180/180>**
EST: **ELEVATION STOW 2 <-90/90>**
PST: **POL STOW 2 <-180/180>**

These items define the final STOW positions.

ADP: **AZIMUTH DEPLOY <-180/180>**
EDP: **ELEVATION DEPLOY <-90/90>**

These items define the DEPLOY positions.

NOTE: all elevation angles refer to angles derived from the elevation resolver.

3.3.2 Maintenance Items

For the CPS150 mount, the AZEL and SHAKE functions are disabled in order to avoid the possibility of incorrect movement below the DOWN elevation limit.

4.2 Schematics

Attached are schematics for the resolver board and for the CPS unique limit switches.

CONFIGURATION DEFAULTS - reset defaults for the CPS150 version of the RC3000.

CONFIGURATION ITEM	**C1**	**C2**						**INSTALL VALUE**
SYSTEM DEFINITION								
antenna_size_cm	150	150						
GPS	1	1						
COMP	1	1						
MODE	2	2						
WAVE	0	0						
AZIMUTH CALIBRATION								
Azim_offset	0.0	0.0						
ccw_azim_limit	180	180						
Cw_azim_limit	180	180						
Res	0	0						
Rev	0	0						
ELEVATION CALIBRATION								
Zero Voltage	1.69	1.69						
Elev_offset	0.0	0.0						
Up_elev_limit	90	90						
Down_elev_limit	0	0						
Elevation_Scale_Factor	50.00	50.00						
Elevation_look_configuration	1	1						
Res	0	0						
Rev	0	0						
POLARIZATION CAL								
Zero Voltage	2.50	2.50						
Polarization_Offset	0.0	0.0						
CW Polarization Limit	90.0	90.0						
CCW Polarization Limit	90.0	90.0						
Pol_Scale_Factor	20.83	20.83						
Polarization_type	2	2						
H/V_Reference	1	1						
Default Horizontal Position	-45.0	-45.0						
Default Vertical Position	45.0	45.0						
Pol_Automove_Enable	1	1						
SIGNAL PARAMETERS								
Channel 1 Polarity	1	1						
Channel 1 Threshold	100	100						
Channel 1 Delay	0.1	0.1						
Channel 1 Lock Type	0	0						
Channel 2 Polarity	1	1						
Channel 2 Threshold	100	100						
Channel 2 Delay	0.1	0.1						
Channel 2 Lock Type	0	0						
AUTOPEAK								
Autopeak Enabled	0	0						
Signal Source	1	1						
RF Band	1	1						
Spiral Search AZ Limit	3	3						
Spiral Search EL Limit	3	3						

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

CONFIGURATION ITEM	**C1**	**C2**						**INSTALL VALUE**
AZIMUTH POT DRIVE								
Fast/Slow Threshold	2.5	2.5						
Maximum Position Error	0.20	0.20						
Coast Threshold	0.1	0.1						
Maximum Retry Count	3	3						
AZIMUTH PULSE DRIVE								
Pulse Scale Factor	10431	10431						
CW Pulse Limit	64000	64000						
CCW Pulse Limit	100	100						
Fast/Slow Threshold	50	50						
Maximum Position Error	0	0						
Coast Threshold	3	3						
Maximum Retry Count	3	3						
AZIM DRIVE MONITORING								
Jam Slop	1	1						
Runaway Slop	200	200						
Fast Deadband	1000	1000						
Slow Deadband	500	500						
ELEV POT DRIVE								
Fast/Slow Threshold	3.0	3.0						
Maximum Position Error	0.2	0.2						
Coast Threshold	0.4	0.4						
Maximum Retry Count	3	3						
ELEV PULSE DRIVE								
Pulse Scale Factor	10431	10431						
UP Pulse Limit	64000	64000						
Down Pulse Limit	100	100						
Fast/Slow Threshold	50	50						
Maximum Position Error	0	0						
Coast Threshold	3	3						
Maximum Retry Count	3	3						
ELEV DRIVE MONITORING								
Jam Slop	1	1						
Runaway Slop	200	200						
Fast Deadband	1000	1000						
Slow Deadband	500	500						
POL POT DRIVE								
Fast/Slow Threshold	2.0	2.0						
Maximum Position Error	0.5	0.5						
Coast Threshold	0.3	0.3						
Maximum Retry Count	3	3						
POL DRIVE MONITORING								
Jam Slop	1	1						
Runaway Slop	200	200						
Fast Deadband	1000	1000						
Slow Deadband	500	500						

CONFIGURATION ITEM	**C1**	**C2**						**INSTALL VALUE**
STOW / DEPLOY								
PL1	0.0	0.0						
AZ1	-7.0	-7.0						
EL1	-47.0	-47.0						
PST	45.0	45.0						
AST	14.0	14.0						
EST	-70.0	-70.0						
ADP	0	0						
EDP	20.0	20.0						