Series 2000™ ACS
Operation & Maintenance
Model 2200™ Antenna Control Unit
Model 2048™ Smart Motor Controller
SATELLITE EARTH STATION ANTENNA CONTROL SYSTEMS

Series 2000™ ACS
Operation & Maintenance
Model 2200™ Antenna Control Unit
Model 2048™ Smart Motor Controller

#RL2000ACS, #RL2200ACU, #RL2048SMC

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# Table of Contents

Important Precautions ........................................................................................................... 8

Service and Support ............................................................................................................... 9

1  SETTING UP THE MODEL 2200 ACU ........................................................................... 10

  1.1 Pre-installation checklist ............................................................................................. 11

  1.2 Connect the 2200 Unit .................................................................................................. 12

  1.3 Setup and Configuration .............................................................................................. 13
      1.3.1 Specify the antenna & location ......................................................................... 13
      1.3.2 Antenna Polarization Settings ......................................................................... 14
      1.3.3 Options ............................................................................................................. 16
      1.3.4 Enter the receiver characteristics .................................................................... 17
      1.3.5 Specify the encoders’ offsets ......................................................................... 18

  1.4 Zeroing ......................................................................................................................... 19
      1.4.1 Zero the Axes ................................................................................................. 19
      1.4.2 Force a New “First-Time” Zero .................................................................... 20

2  TYPICAL OPERATIONS ................................................................................................. 21

  2.1 Touchscreen Controls ................................................................................................ 21

  2.2 Start Up, Quit, Shut Down ......................................................................................... 23
      2.2.1 Start the ACU application ............................................................................ 23
      2.2.2 Quit the ACU application ............................................................................ 23
      2.2.3 Power down the ACU ................................................................................. 24

  2.3 Standby ....................................................................................................................... 24

  2.4 Define a New Target Satellite ..................................................................................... 25
CONTENTS

2.4.1 TLE Group targets ................................................................. 32
2.4.2 Track a TLE Group ................................................................. 33
2.4.3 “Default” and “Immediate” targets ........................................ 35

2.5 Edit a Target’s Properties .......................................................... 36

2.6 Pointing Modes ........................................................................... 37
2.6.1 Look angles ............................................................................ 37
2.6.2 Longitude ............................................................................... 37
2.6.3 TLE — NORAD two-line element ......................................... 37

2.7 Tracking Modes ........................................................................... 43
2.7.1 Predictive track ........................................................................ 43
2.7.2 Steptrack ................................................................................ 43
2.7.3 TLE/Steptrack .......................................................................... 43
2.7.4 Manual jog .............................................................................. 44
2.7.5 Track Immediate, Manual Peaking, and Bias Angles ................. 46

2.8 Update the 2200 ACU software .................................................. 48

3 MODEL 2048 SMART MOTOR CONTROLLER (RL2048SMC) ......... 49
3.1 Remote/Local Control ................................................................. 50
3.1.1 Remote = Orange .................................................................... 50
3.1.2 Local = Green .......................................................................... 50

3.2 Jog Controller ................................................................................ 51
3.2.1 Manual Motion with the Jog Controller ................................... 51
3.2.2 Zeroing with the Jog Controller ................................................. 51

3.3 Limits ......................................................................................... 51

4 SYSTEM-FAULT CONDITIONS ...................................................... 52
4.1 Faults and System Standby .......................................................... 53

Series 2000™ O&M Manual
## 4.2 Respond to a Fault Condition

#### 4.3 Fault Messages & Causes

<table>
<thead>
<tr>
<th>Message</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Azimuth CCW soft travel limit&quot;</td>
<td>54</td>
</tr>
<tr>
<td>&quot;Azimuth CW soft travel limit&quot;</td>
<td>54</td>
</tr>
<tr>
<td>&quot;Azimuth motor controller fault&quot;</td>
<td>54</td>
</tr>
<tr>
<td>&quot;Azimuth travel limit switch tripped&quot;</td>
<td>54</td>
</tr>
<tr>
<td>&quot;Azimuth motor communication failure&quot;</td>
<td>54</td>
</tr>
<tr>
<td>&quot;Azimuth not zeroed&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Azimuth motor program downloading&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation lower soft travel limit&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation upper soft travel limit&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation motor controller fault&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation travel limit switch tripped&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation motor communication failure&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation not zeroed&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Elevation motor program downloading&quot;</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Polarization CCW soft travel limit&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Polarization CW soft travel limit&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Polarization travel limit switch tripped&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Polarization motor communication failure&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Polarization not zeroed&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Polarization motor program downloading&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Drive disabled at control panel&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Maintenance override at drive cabinet&quot;</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Drive cabinet door open&quot;</td>
<td>57</td>
</tr>
</tbody>
</table>

**Touch-panel computer (TPC) faults**

---

Series 2000™ O&M Manual 5
4.3.24 "Low tracking signal level" ................................................................. 57
4.3.25 "Unstable tracking signal level" ............................................................. 57
4.3.26 "IOC communication failure" ................................................................. 57
4.3.27 "IOC firmware update failed" ................................................................. 57
4.3.28 "Ephemeris data file needs update” ...................................................... 57
4.3.29 "Receiver communication failure" ......................................................... 58
4.3.30 "Receiver not running" ........................................................................ 58
4.3.31 "Receiver not locked" ........................................................................... 58
4.3.32 "Beacon frequency out of range" ............................................................ 58
4.3.33 "USB I/O interface ID 1 not found" "USB I/O interface ID 2 not found" ..... 59

APPENDICES .................................................................................................. 60

APPENDIX 1: 2200 ACU SPECIFICATIONS .................................................... 61
APPENDIX 2: 2200 REAR PANEL CONNECTIONS ........................................ 63
A-2.1 Pinouts ................................................................................................. 65
APPENDIX 3: 2200 ACU, RS-232 INTERFACE .................................................. 68
APPENDIX 4: RL2048SMC ............................................................................. 69
A-4.1 Operating Environment, Power .............................................................. 69
A-4.2 Mechanical .......................................................................................... 69
APPENDIX 5: RL2048 HARDWARE INTERFACE ........................................... 70
A-5.1 Electrical Interfaces ............................................................................. 70
APPENDIX 6: SETUP: GD MODEL 253 TRACKING RECEIVER ...................... 74
APPENDIX 7: SETUP: DTR ............................................................................ 75
APPENDIX 8: SETUP: IRIG ........................................................................... 76
APPENDIX 9: ADVANCED 2200 CONFIGURATION — ACU.INI ............. 79

A-9.1 Requirements .................................................................................................................. 79
A-9.2 File location .................................................................................................................... 79
A-9.3 Default acu.ini................................................................................................................. 79
A-9.4 Example acu.ini ............................................................................................................... 80
A-9.5 Primary Keys .................................................................................................................. 81
A-9.6 Additional Keys .............................................................................................................. 83

APPENDIX 10: SERIES 2000 ON-SITE TEST PROCEDURE ............... 84

A-10.1 Pre-installation checklist .............................................................................................. 84
A-10.2 Motor Checks .............................................................................................................. 85
    A-10.2.1 Jog Controller Test ............................................................................................... 85
A-10.3 Limit Switch Checks .................................................................................................... 85
A-10.4 Steptrack Test .............................................................................................................. 86

APPENDIX 11: LIST OF FIGURES ..................................................................................... 89

APPENDIX 12: DESCRIPTION OF CE SYMBOLS ......................................................... 92
Important Precautions

This manual is for knowledgeable, qualified personnel able to work safely with electricity, electronics, and electro-mechanical systems. *It does not try to provide complete safety information for all circumstances or for all installations and sites.*

Installation, operation, and maintenance of this device may involve risks to users and property, including the device and any interrelated systems. All procedures are to be carried out by qualified personnel willing and able to employ due diligence and best practices.

Radeus Labs, Inc. shall not be responsible for injury or damage resulting from or associated with improper use of its hardware or software or from its use by improperly trained or inexperienced individuals.

All applicable building codes, fire-related regulations, and other required or advisable safety protocols must be observed at all times.

---

**WARNING**

**ALWAYS DISCONNECT POWER BEFORE SERVICING**

There are electrical shock hazards when installing or servicing electrical equipment. There are mechanical hazards when working around moving parts.

Review and use all proper safety procedures.

In the event of emergency, be sure all power is disconnected.
Service and Support

To inquire about support and service options that are beyond the scope of this document:

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www.RadeusLabs.com
1 Setting Up the Model 2200 ACU

Review the safety information in “Important Precautions” before proceeding.

Figure 1-1 The Model 2200 Antenna Control Unit (ACU) from Radeus Labs, Inc.
1.1 Pre-installation checklist

Before installing, ensure all the items in this list are true:

- All wiring has been checked for rodent damage or other signs of deterioration:
  - Motor wiring
  - Emergency-stop wiring
  - All other control system wiring

- The receive RF path, if applicable, has integrity for both horizontal and vertical (or left-hand/right-hand circular.)

- The satellite dish was balanced/focused recently.

**WARNING**

Do not attempt to operate this equipment if there is evidence of shipping damage or you suspect the unit is damaged. Damaged equipment may present additional hazards to you and to property. Contact support for advice before attempting to plug in and operate damaged equipment.
1.2 Connect the 2200 Unit

1. Verify that the unit is connected to power.

2. Turn on the ACU via the power switch on the rear panel. The touchscreen will illuminate when it is ready.

![Figure 1-2](image) Power switch and data connections — specifics vary by system, see Appendix 2: 2200 Rear Panel Connections.
1.3 Setup and Configuration

1.3.1 Specify the antenna & location

Start at the Home screen. It offers access to all system settings and controls:

![Image of the home screen of the Model 2200 ACU.]

**Figure 1-3** The home screen of the Model 2200 ACU.

Tap the Setup button.
On the Setup screen’s Site tab:

1. Enter the antenna’s latitude (degrees north) and longitude (degrees east), using up to six decimal places.

2. Enter the antenna’s altitude (meters).

3. Name the antenna to distinguish it from nearby systems. This name will appear on the touchscreen display.

Continue with the antenna’s POL settings, discussed next:

1.3.2 Antenna Polarization Settings

The Model 2200 supports various polarization capabilities. The axes setting in Setup > Site determines which POL fields appear in the data display and in target-configuration screens. Some systems have no POL fields to display; those with two POL axes will show POL1 and POL2 fields.
Figure 1-5  Indicate how many POL axes this ACU controls.

4. Specify which of the antenna’s axes are under control of the ACU.

5. The *period* determines the maximum interval before getting updated position feedback.

To continue, tap Options.
1.3.3 Options

Fault alerts are displayed on screen (see Figure 2-2). Optional audible alerts can be enabled here.

Choose whether the 8200 ACU will emit audible alert tones, in addition to its visual display, when a fault is detected.
1.3.4 Enter the receiver characteristics

If using a DTR, see Appendix 7: “Setup: DTR.”

If using a GD 253, see Appendix 6: “Setup: GD Model 253 Tracking Receiver.”

1. For the BDC LO frequency, enter the vertical and horizontal values (or left and right, for circular polarization).

2. The receiver attenuation, in dB.

3. Specify the upper and lower limits of the frequency range, in any order.

4. The optional, built-in beacon receiver has a 0–10V analog output. In the next fields, you should set:

5. The reference voltage for the relative power level of 0dB. (A related offset is defined in each target’s settings, as can be seen via Home > Target and inspecting one.)

6. The output’s slope (V/dBm).
1.3.5 Specify the encoders’ offsets

For each axis, the encoder angle plus its offset equals the actual look angle. Those look angles must be entered in the Position (deg) field. The ACU will calculate the appropriate offsets.

1. **Set initial offsets:**
   Pointing the antenna at an actual look angle, measure the angle using an inclinometer, tilt sensor, or level (EL) and a compass (AZ). Enter those values on the Setup > Encoders screen.

2. **Fine-tune the offsets for greater accuracy:**
   (1) Manually peak to a target of known location, e.g., using the manual jog buttons' and the display’s receiver/signal meter or a spectrum analyzer to center the beam. Then…

   (2) …enter that target’s actual look angles for your location into the position fields on the Setup > Encoders screen (**Figure 1-8**). The ACU will populate the offset fields.

![Figure 1-8](image)

**Figure 1-8**  Setup > Encoders
“Position” is null if there are no attached encoders.

---

1 See “Manual jog” (section 2.7.4), and the jog buttons in **Figure 2-26**.
1.4 Zeroing

Before the control system can be used, the axes must be zeroed. Zeroing is a process the ACU uses to find the location of the antenna’s limit switches. Due to the nature of the encoders used, the position of the limit switches cannot be retained through a loss of power.

When zeroing is first performed with a new antenna, it will discover the location of limit switches in both directions of travel for each axis. This enables the ACU to utilize the full range of motion of the antenna.

Subsequent zeroing will only need to find one limit switch per axis (mechanical 0°), in order to determine correct positioning. Additionally, the ACU will display the mechanical position (“mech”) of the limit switches it discovered. (Note: mechanical position is not the same as look angle. Also see section 2.1.)

1.4.1 Zero the Axes

Zeroing the axes may be initiated at the ACU front panel or with the handheld jog controller.

- **To zero with the ACU:**
  When it is safe to do so, on the Setup screen, tap “Zero all” (Figure 1-9).

- **To zero with the jog controller:**
  
  - Local mode must be asserted at the drive cabinet (see section 3.1, “Remote/Local Control”).
  
  - On the jog controller, press the Home button.

When initiated, the ACU will drive the antenna to the end of travel until it encounters the limit switch. It will then drive away from the switch to about 20 degrees as its final position.

The zeroing process may take up to about five minutes but often is much faster.
1.4.2 Force a New “First-Time” Zero

To force the ACU to perform a first-time zeroing of the axes, set the hard limit positions to 0 on the Setup > Limits screen, then initiate zeroing. The ACU will respond by finding the limit switches in both directions for each axis, as described above.
2 Typical Operations

System configuration and all normal operations are carried out via the Model 2200’s touchscreen display and hardware jog buttons.

2.1 Touchscreen Controls

The touchscreen’s upper area is a real-time data display. It identifies the antenna, the targeted object, and position and signal data.

The lower area shows operator controls, system settings, and messages.

![Touchscreen Controls](image)

**Figure 2-1** The Home screen gives access to all operator controls and system options without obscuring the real-time data display.

- The blue status bar is reserved for current system-status information.
• The real-time data display shows…
  - …during tracking or pointing: the antenna’s position, commanded position, and any difference between those values.
  - …if the ACU is not in an active tracking or pointing mode: the antenna’s position and the mechanical position (“mech”) of the limit switches.

• The RECEIVER area shows the target’s relative signal strength. Below that are the target’s beacon frequency and the signal level coming from the receiver.

• The system responds to fault conditions with messages describing the faults (listed in section 4), and with optional audible alert tones. For example:

<table>
<thead>
<tr>
<th>actual</th>
<th>AZ</th>
<th>EL</th>
<th>POL</th>
<th>RECEIVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
</tr>
</tbody>
</table>

**Figure 2-2** The Home screen displays fault messages, listed in section 4.3 “Fault Messages & Causes.” For audible faults, see **Figure 1-6**.

---

2 The mechanical coordinate system is defined only by the mechanics of the antenna, without respect to where the antenna is actually pointing in space. Mechanical zero is defined as the detected location of the positive limit switch (CCW in AZ and Down in EL).
2.2 Start Up, Quit, Shut Down

2.2.1 Start the ACU application

The ACU software starts automatically when the Model 2200 ACU powers on.

If the power is on but the ACU software is not running, you can do either of the following:

- Launch the ACU application via the Radeus Labs desktop shortcut…

- …or, re-launch Windows — e.g., via the Start menu. That will restart the ACU application, too.

2.2.2 Quit the ACU application

If a fault condition or some task requires quitting the ACU software, use the touchscreen’s Home > Setup > About screen and tap “Quit” to exit the ACU application and display a familiar operating system desktop.

To minimize the ACU software without quitting, tap “Desktop.” You’ll see the OS desktop and can find the ACU again in the task bar.
2.2.3 Power down the ACU

Use Home > Setup > About and use the Shut Down button to quit both the application and the operating system (Figure 2-3). Then you may power down the ACU via the power switch on its back panel.

2.3 Standby

Home > Standby immediately puts the ACU in Standby mode. While on standby, the ACU will not command the antenna to move. It will remain on standby until an operator’s affirmative action takes it out of standby mode.
2.4 Define a New Target Satellite

To track a satellite, in most cases, the user selects it from a list on the 2200’s touchscreen.

To add a satellite to the list of targets:

1. On the Home screen, tap the Target button.

2. On the resulting “Target options” screen, tap New:

A window appears for entering a satellite’s characteristics. Which fields are shown, and whether it offers one or two screens of options, depends on the Mode selected in the drop-down menu.
3. In the Mode drop-down, select a tracking mode for this target. The available modes, discussed in section 2.6, are:

- Look angles
- Longitude
- Predictive*
- Steptrack*
- TLE (SGP4)
- TLE/Steptrack*
- TLE Group

* Marked tracking modes require the system to have a receiver enabled.

Figure 2-5 Which input fields are displayed depends on the selected mode. Shown here are settings for using look angles mode.

4. Unless you’re using TLE data — see “Pointing Modes,” below — tap the “Target name” field to give a unique name to the satellite, then tap OK. (The name can be edited any time.)
A satellite’s name can be any unambiguous label that is useful at the earth station. It’s often convenient to use the satellite’s common name or other unique identifier from its TLE.

5. When done entering the name, tap “OK” to continue.

**Figure 2-7** Settings for pointing by *longitude*. 

---

**Tip:** Tap “Shift” to toggle between upper-case-with-numerals and lower-case-with-symbols.
Tip
To use the current receive level as relative 0dB, one can click in the "Receive level @ 0dB field" and just press OK without entering a value.

Figure 2-8  Settings for predictive tracking (1 of 2)

Figure 2-9  Settings for predictive tracking (2 of 2)
*Caution
Refer to section 2.7.2, “Steptrack” for an important precaution.
Choosing a TLE mode provides a list of all TLE targets that are within the antenna’s range. TLE satellite names cannot be edited, unlike targets defined by an ACU operator.

Settings for TLE (SGP4) mode.
6. Enter the parameters, if any, required by your new target’s tracking mode, then tap the Save button.
7. The Home > Target screen’s list of targets will now include the new target:

![Target screenshot]

Figure 2-16 Operator-defined targets included in the list at Home > Target.

2.4.1 TLE Group targets

A special target type called *TLE Group* allows the operator to select multiple targets for automatic tracking. This is intended for tracking LEO and MEO (Low Earth Orbit or Medium Earth Orbit) targets continually moving across the sky from horizon to horizon.

1. To create a group, each target that will be part of the group must be defined as a target using *TLE (SGP4)* mode.

2. Choose Target > New and select as the mode TLE Group. After the desired group members have been created, they will appear in the list of available targets on the new-target screen for the TLE Group target type.

3. To select or deselect targets, tap the target name in the list. Targets you select to include in the group are highlighted:
A TLE Group includes all the user-highlighted items in the list of available TLE targets.

2.4.2 Track a TLE Group

To track a TLE Group that has been defined, select it from the list at Home > Target, just like any single target, and tap Track:

TLE Groups appears in the same list as other defined targets.
2.4.2.1 How it works

The ACU uses TLE data for every target in a group to determine which target to track.

1. The first target tracked is either visible or will be the first group member to rise above the Acquisition of Signal position (AOS, see below) position. The ACU will pre-position the antenna at that AOS and wait for the target.

2. While waiting, the ACU shows a countdown in the status bar. When the target crosses AOS, the ACU will track it from there to Loss of Signal (LOS, see next).

3. Once LOS is reached, the ACU will determine the next target to track, based on which member of the group is available next.

![Figure 2-19](image)

**Figure 2-19** The name of a TLE Group being tracked is periodically shown over the current, individual target’s name, a reminder that the ACU is tracking a group.

2.4.2.2 AOS and LOS Determination

The ACU uses the antenna elevation’s lower tracking limit and the target’s TLE data to determine AOS and LOS. The lower elevation tracking limit determines the antenna’s effective horizon.
For example, if the user sets the lower elevation limit to 10°, the ACU will calculate AOS and LOS as the angles and times at which targets rise above and fall below 10°, respectively.

### 2.4.3 “Default” and “Immediate” targets

Two special-purpose items begin the list of targets displayed on the Target Options screen (for example, see Figure 2-4):

- **Reserved**
  - **Defaults**
    - When a user defines a new target (Target > New), a copy of the Defaults values is used for its initial settings. To change those preset values, select this item and tap Edit.
    
    *Edited Defaults do not retroactively apply* to targets already in the system. You may edit those individually, as described in section 2.5.

- **Immediate**
  - Select this, then tap Track to begin tracking at the antenna’s current position (discussed in section 2.7.5, “Track Immediate, Manual Peaking, and Bias Angles”).

![Figure 2-28](image) Settings for driving the antenna manually, these affect the behavior of the hardware jog controls on the front panel.
2.5 Edit a Target’s Properties

To change the settings for any target in the Target Options list:

1. Highlight the target you want to modify.

2. Tap the Edit button to display the selected target’s characteristics.

3. As described in section 2.4, the specific settings shown depend on the tracking or pointing mode in use for that target.

   Also see section 2.7.5, “Track Immediate, Manual Peaking, and Bias Angles.”
2.6 Pointing Modes

A pointing mode directs the antenna to a fixed location and actively holds that position. The mode is set on a per-target basis. (Also see section 2.7, “Tracking Modes”.)

Any saved bias angles are applied to a target’s look angles to produce the commanded position. See section 2.6.3.2, “Bias Angles for TLE” and 2.7.5, “Track Immediate, Manual Peaking, and Bias Angles.”

2.6.1 Look angles

Move to the look angles entered for the target, then actively hold. See Figure 2-5.

2.6.2 Longitude

Like look angles, except the initial angles are computed from antenna data and the satellite’s box center longitude. See Figure 2-7.

2.6.3 TLE — NORAD two-line element

The 2200 ACU supports the TLE data format for locating a target by using the SPG4 simplified perturbation model. (See section 2.6.3.1, “Requirements for TLE” and 2.6.3.2, “Bias Angles for TLE.”)

To point at a TLE object:

1. Choose Target > New (or edit an existing target) and, instead of typing a name, use Mode to select TLE (SPG4).

2. In place of the name-input text field, a drop-down list will present all TLE objects whose orbits will place them within range of the antenna any time in the next sidereal day.

The names of TLE targets are from their data sources and cannot be edited.
Figure 2-21  After choosing a TLE mode, a drop-down list shows all TLE targets that are within the antenna’s range.

3. In the Bias angles fields, enter any known adjustments for TLE tracking due to site calibration; otherwise, use defaults of 0°. See section 2.6.3.2, “Bias Angles for TLE.”

4. After saving the target’s settings, you may Track it normally:
Figure 2-22  An operator confirms before the antenna will move to a new target.

2.6.3.1 Requirements for TLE

The Model 2200 ACU auto-updates its TLE data daily, if it has web access.

- Internet connection to the Network connector (located on the 2200’s back panel; see section 1.2).

If no internet connection is available:

- The data may be updated over internal LAN.
  Exit the ACU’s interface to the OS and ensure the directory at C:\Radeus Labs is shared with write permission. Copy r12200.txt into it, from wherever it’s located on the LAN.

- The data may be transferred via USB drive.
  Insert a USB drive containing the data file into the USB interface located on the 2200’s front panel. Use the ACU’s Windows interface to copy the data into C:\Radeus Labs.

- TLE (SGP4) mode is not available for Default or Immediate targets. To use it, first choose Target > New or edit an existing target.
• Encoder offsets must be set to non-zero values.

• The antenna’s coordinates must be set.

Whenever any of the limits change, the list of available TLE targets will update to include only potential targets within the antenna’s range.

### 2.6.3.2 Bias Angles for TLE

After manual peaking, the new position can be saved as *bias angles* for re-use when visiting the same target later.

![Figure 2-23](image)

**Figure 2-23** When a pointing mode is used, apply any peak adjustments as *bias angles*, they will load when the same target is tracked in the future.

Bias angles can only be updated while...

- …using a pointing mode (e.g., look angles, longitude, TLE (SGP4), and
- …the antenna is pointing at the target (i.e., not in Standby).
The general procedure is:

1. Acquire a target using a *pointing mode* (section 2.6).

2. Select Home > Manual and peak to optimal signal strength. Your adjustments will be shown in the “Bias angles” fields.

3. Once peaked, tap Apply to save the new bias angles for that target, to use when it is acquired again later.

### 2.6.3.3 TLE/Steptrack

This works like TLE (section 2.6.3), with the added advantage of steptracking\(^3\) periodically to peak the signal and adjust bias angles.

---

\(^3\) See the caution about steptrack in “Tracking Modes.”
The field for “Step below signal (dB)” is used to initiate a steptrack cycle if the signal strength falls below the specified level relative to the current (presumably peaked) signal strength.

For the cycle time, enter the interval (HH:MM:SS) desired between calculations of the antenna’s next position.
2.7 Tracking Modes

If the system has a receiver enabled, the Model 2200 supports several ways to track a target’s signal. As with “Pointing Modes,” tracking modes are set on a per-target basis, such as when defining or editing a target.

2.7.1 Predictive track

*Predictive tracking is the preferred mode for geosynchronous satellites that require periodic re-peaking during the day.* It reduces the frequency of steptrack cycles required to keep the antenna satisfactorily peaked at all times.

Predictive tracking begins by using steptrack to follow the target until one full day’s data is stored.

After that, the stored data is used — and adjusted periodically with fresh steptrack data — to predict the satellite’s peak position.

2.7.2 Steptrack

*Predictive track should be preferred over steptrack.* Steptrack periodically re-peaks the antenna by using small movements to re-calculate the peak position. In general, Radeus Labs doesn’t recommend it.

2.7.3 TLE/Steptrack

Steptracking TLE targets is discussed in section 2.6.3.3, “TLE/Steptrack.” General TLE considerations are found in section 2.6.3, “TLE — NORAD two-line element.”
2.7.4 Manual jog

The ACU front panel provides user-configurable, manual jog controls:

Caution

On move the antenna when you are certain it is safe to do so.

Note

Hardware jog buttons are disabled unless the user selects Manual operation.

The Home > Manual button, along with the 2200’s hardware jog buttons, allows the operator to manually peak the antenna and, optionally, to save that adjustment as bias angles. This may be referred to as “manually biasing the target.”

Limits when jogging: The ACU will not allow the antenna to move past its travel limits. If the antenna exceeds its limit along any axis, the ACU will allow the user to drive the antenna back only — not further beyond the limit.

Hard limits: Depending on the installation, the ACU might have per-axis, hard-limit faults or only a summary hard-limit fault from the drive cabinet. The drive cabinet should inhibit motion that drives the antenna.
past its hard limits, but the ACU does not inhibit motion due to a hard-limit fault. Just as when exceeding soft limits, the drive cabinet and limit switches allow the user to drive back into the permitted range of motion, but not further out of it.

Figure 2-27 Settings for driving the antenna manually, these affect the behavior of the hardware jog controls on the front panel.
2.7.5 Track Immediate, Manual Peaking, and Bias Angles

The manual controls enable the user to move the antenna to any arbitrary position within its limits, either...

• …without selecting a target satellite, or

• …while tracking a target, in order to peak the antenna.

Also see:
Section 2.6.3.2, “Bias Angles for TLE.”

Figure 2-28  Home > Manual. Touchscreen settings adjust how the hardware jog controls work.
The Momentary/Toggle choice determines whether the hardware buttons will move the antenna...

- only while the operator is actively depressing a button ("momentary"), or
- if pressing a button starts the antenna moving on that axis until the same button is pressed again ("toggle").

⚠️ Never leave the antenna unattended when it’s moving in Toggle mode.

2.7.5.1 Resume tracking after manual peaking

After peaking, tracking can be (re)initiated:

1. Select a current tracking mode.
   Use Home > Target > Immediate > Edit to select a mode.

   The selected tracking mode (see sections 2.6 and 2.7) will determines the antenna’s behavior while you’re using Immediate tracking, e.g., holding a static position or peaking.

2. Position the antenna.
   Tap the Home > Manual button, adjust those settings as desired via the touchscreen, then use the 2200’s hardware jog buttons (Figure 2-26).

3. Commence tracking.
   After a desired position is achieved, select Home > Target > Immediate > Track.

---

**Tip**
If using the jog controls to peak the antenna: Upon leaving the Manual screen, the system will offer to, “Save target bias angles before returning to the Home screen?” If you agree, the newly peaked position will be used when that target is tracked again.
2.8 Update the 2200 ACU software

Any installed and properly licensed Radeus Labs ACU system can be updated to a newer version of the software.\footnote{Subject to standard licensing.}

Where it is installed:
Starting with version 2.2.0, each version installs to its own C:\Radeus Labs\<subdirectory>, where it stores a copy of the database file (acu.dbf).

How to update:
To update from 2.2.0 or newer:

1. Make sure the ACU application is closed. If it is running, choose Setup > About > Quit.

2. Launch the installer:\footnote{To update earlier versions to version 2.2.0 or greater, first manually back up acu.dbf to an alternate location — the installer will not create a backup of it. Then you may run the installer normally.}
   RL2200-base-setup-X.X.X.exe
3 Model 2048 Smart Motor Controller (RL2048SMC)

The Model 2048 Smart Motor Controller is specifically designed to allow the ACU to control Moog Animatics SmartMotors on the AE2000 antenna. It is mounted in the drive cabinet and has the power supplies, I/O controller, and PMCU.

Interfaces:
For connection details, see Appendix 5: “RL2048 Hardware Interface.”
3.1 Remote/Local Control

The top of the RL2048SMC has a Local/Remote button-indicator. Pressing it toggles control mode between Remote and Local.

3.1.1 Remote = Orange

This button lights orange when the system is in Remote mode, meaning it is controlled by the ACU. The antenna may move unexpectedly.

3.1.2 Local = Green

This button lights green when the system is in Local mode, controlled by the hand-held jog controller. In Local mode, the antenna will only move when commanded by the jog controller.
3.2 Jog Controller

The RL2048SMC interfaces with the hand-held jog controller provided with the AE2000 antenna. The jog controller is only active when the RL2048SMC is in Local mode. The jog controller provides manually controlled motion on each axis and the axis-zeroing function.

3.2.1 Manual Motion with the Jog Controller

For manual motion, press and hold the jog controller’s momentary switch in the desired direction for the intended axis. The motion will start in slow speed, for four seconds, then accelerate to slew speed. It will stop when the switch is released.

For manual control using the ACU’s front panel controls, see section 2.7.4, “Manual jog” and 2.7.5, “Track Immediate, Manual Peaking, and Bias Angles.”

3.2.2 Zeroing with the Jog Controller

Care must be taken to ensure the antenna is safe for fast motion before initiating the zeroing function. This will cause high-speed motion along each axis, and it is vital to be familiar with all safety protocols and the information in section 1.4, “Zeroing.”

- Pressing the jog controller’s Home button will initiate the zeroing function for all axes.
- Pressing the Home button again, while zeroing is in process, will stop the motion and the zeroing function.

To initiate zeroing from the ACU, see section 1.4.

3.3 Limits

The zeroing function discovers the positions of the hard limit switches. Once the locations are found, the system sets a soft limit that is 1° from each limit switch in order to protect the mechanical system from damage. This soft limit may not be changed by the user.
4 System-Fault Conditions

See the safety information in “Important Precautions” before proceeding.

![WARNING]

Disconnect power in case of any emergency.

The Model 2200™ ACU notifies users visually and with an optional audio tone if it detects a fault condition. The audio can be enabled and disabled via the Home > Setup > Options screen.

![Figure 4-1]

A warning and fault description(s) are displayed, and a warning tone can be issued, if the ACU detects a fault condition.

- Controller communication failure
4.1 Faults and System Standby

Any of the following fault conditions may force the ACU immediately into standby mode:

- Drive disabled at control panel (pg. 56)
- Maintenance override at drive cabinet (pg. 56)
- ...motor communication failure (pg. 54)
- ...not zeroed (pg. 55)
- ...motor program downloading (pg. 55)
- Polarization travel limit switch tripped (pg. 56)
- Elevation travel limit switch tripped (pg. 55)
- Azimuth travel limit switch tripped (pg. 54)
- Azimuth motor controller fault (pg. 54)
- Elevation motor controller fault (pg. 55)

4.2 Respond to a Fault Condition

When the system reports a fault, you may:

1. **Mute the fault alert:**
   
   On the Home screen, tap Fault once to mute the alert.

2. **Investigate and resolve:**
   
   Resolve any issue indicated by a fault message. The meaning of each fault message is discussed in section 4.3.

3. **Clear the fault(s) and resume:**
   
   Press the Fault button again to clear the fault status.

   If a fault condition is still detected, the system will re-assert the alert message.
4.3 Fault Messages & Causes

System fault messages are described below, with some potential causes and remedies. (Also see “Faults and System Standby.”)

4.3.1 "Azimuth CCW soft travel limit"
The axis drove past a software-defined travel limit. It may be driven only in a direction that brings it back within its soft limits.

4.3.2 "Azimuth CW soft travel limit"
See preceding.

4.3.3 "Azimuth motor controller fault"
The motor controller has faulted and must be reset to resume operations. May put system in standby.

Common cause:

- Misconfiguration of the motor controller, resulting in exceeding its operational limits.

4.3.4 "Azimuth travel limit switch tripped"
The travel-limit switch has been engaged. The drive cabinet interface does not tell which limit was exceeded; however, that should be obvious from observing the antenna’s position. Because the ACU doesn’t know which limit was exceeded, it does not inhibit motion in either direction as a result of this error. May put system in standby.

This shouldn’t happen after the ACU is properly configured, because a soft limit should be reached before the limit switch is engaged.

4.3.5 "Azimuth motor communication failure"
May put system in standby.
4.3.6  "Azimuth not zeroed"
See section 1.4, “Zeroing.” May put system in standby.

4.3.7  "Azimuth motor program downloading"
May put system in standby.

4.3.8  "Elevation lower soft travel limit"
The axis drove past its software-defined tracking limits. Now it may be
driven only in the direction that brings it within its limits.

4.3.9  "Elevation upper soft travel limit"
See preceding.

4.3.10  "Elevation motor controller fault"
See section 4.3.3, "Azimuth motor controller fault". May put system in
standby.

4.3.11  "Elevation travel limit switch tripped"
See section 4.3.4, "Azimuth travel limit switch tripped". May put
system in standby.

4.3.12  "Elevation motor communication failure"
See section 4.3.5, "Azimuth motor communication failure". May put
system in standby.

4.3.13  "Elevation not zeroed"
See section 1.4, “Zeroing.” May put system in standby.

4.3.14  "Elevation motor program downloading"
See section 4.3.7, "Azimuth motor program downloading" May put
system in standby.
4.3.15  "Polarization CCW soft travel limit"
See section 4.3.1, "Azimuth CCW soft travel limit".

4.3.16  "Polarization CW soft travel limit"
See section 4.3.2, "Azimuth CW soft travel limit".

4.3.17  "Polarization travel limit switch tripped”
See section 4.3.4, "Azimuth travel limit switch tripped". May put system in standby.

4.3.18  "Polarization motor communication failure"
See section 4.3.5, "Azimuth motor communication failure". May put system in standby.

4.3.19  "Polarization not zeroed"
See section 1.4, “Zeroing.” May put system in standby.

4.3.20  "Polarization motor program downloading"
See section 4.3.7, "Azimuth motor program downloading". May put system in standby.

4.3.21  "Drive disabled at control panel"
The drive was disabled via the drive-enable switch on the ACU’s front panel. Use that switch to re-enable the drive. May put system in standby.
4.3.22 "Maintenance override at drive cabinet"
Someone engaged the maintenance-override switch in the drive cabinet. The ACU cannot command the antenna until the maintenance override has been de-asserted. May put system in standby.

4.3.23 "Drive cabinet door open"
This fault is simply informative, it does not affect normal operations.

Touch-panel computer (TPC) faults

4.3.24 "Low tracking signal level"
The tracking-signal level is too low to perform steptrack operations.
Common causes:
- Not starting on the satellite’s main lobe.
- Incorrect tracking receiver frequency.
- Incorrect tracking receiver source selected.

4.3.25 "Unstable tracking signal level"
The tracking signal is varying too rapidly to steptrack.

4.3.26 "IOC communication failure"
The link between the touch-panel computer’s I/O controller and the drive cabinet has been severed. The system will de-assert the drive-enable line.

4.3.27 "IOC firmware update failed"
The automatic installation of new firmware on the I/O controller did not complete successfully. Contact supplier for service or support.
4.3.28  "Ephemeris data file needs update"

The ephemeris data for the selected target is older than 170 hours. This happens if the ACU loses its internet connection or if ephemeris data for a target is no longer reliable. To clear the fault:

- Restore the network connection, which will cause the ACU to update the data. Or…

- Double-tap the Home > Fault button to simply clear the fault alert — if the issue isn’t addressed, the system may report the fault again.

4.3.29  "Receiver communication failure"

The ACU application cannot communicate with the tracking receiver.

Possible remedies:

- Check all internal connections.

- It might be necessary to restart the receiver with a power cycle.

4.3.30  "Receiver not running"

The beacon receiver has not entered the run state after having been commanded to do so.

Possible remedy:

- It may be necessary to restart the receiver with a power cycle.

4.3.31  "Receiver not locked"

The signal level is too low. Move the antenna closer to beam center.

4.3.32  "Beacon frequency out of range"

The beacon frequency specified for the selected target is not within the range of the beacon receiver. Check the beacon frequency and the LO settings (via Home > Setup > Receiver).
4.3.33 "USB I/O interface ID 1 not found"
"USB I/O interface ID 2 not found"

The internal USB I/O interface for the front-panel buttons and status LEDs was not found when the ACU application started.

Possible remedies:

- Exit the ACU application and re-check the internal USB connections.
- It may be necessary to replace the USB I/O interface.*

*Note
Interfaces ID 1 and ID 2 are not interchangeable without being reprogrammed by the factory.
APPENDICES

APPENDIX 1: 2200 ACU SPECIFICATIONS .................................................. 61
APPENDIX 2: 2200 REAR PANEL CONNECTIONS ...................................... 63
APPENDIX 3: 2200 ACU, RS-232 INTERFACE ........................................... 68
APPENDIX 4: RL2048SMC .................................................................... 69
APPENDIX 5: RL2048 HARDWARE INTERFACE ......................................... 70
APPENDIX 6: SETUP: GD MODEL 253 TRACKING RECEIVER .................... 74
APPENDIX 7: SETUP: DTR ..................................................................... 75
APPENDIX 8: SETUP: IRIG .................................................................... 76
APPENDIX 9: ADVANCED 2200 CONFIGURATION — ACU.INI ............... 79
APPENDIX 10: SERIES 2000 ON-SITE TEST PROCEDURE ..................... 84
APPENDIX 11: LIST OF FIGURES ............................................................ 89
APPENDIX 12: DESCRIPTION OF CE SYMBOLS ..................................... 92
Appendix 1: 2200 ACU Specifications

Subject to change. Details may vary between units. Always refer to specs current at the time the unit being used was manufactured. Also see the documentation for any specific system or custom configuration.

Controls, Interfaces

Front-panel touch screen and hardware jog buttons

Figure 1-2 shows the connectors on the back panel

<table>
<thead>
<tr>
<th>System</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote</td>
<td>Ethernet, SNMP</td>
</tr>
<tr>
<td>Serial</td>
<td>USB, RS-232 (x2 each)</td>
</tr>
<tr>
<td>Receiver</td>
<td>Analog 0–10 VDC interface</td>
</tr>
<tr>
<td></td>
<td>Serial DTR interface</td>
</tr>
<tr>
<td></td>
<td>Optional internal L-band receiver</td>
</tr>
<tr>
<td>ADU</td>
<td>Ethernet interface</td>
</tr>
<tr>
<td>Alarm</td>
<td>Summary output</td>
</tr>
<tr>
<td></td>
<td>Audible tone for fault conditions</td>
</tr>
</tbody>
</table>

Tracking Accuracy

Better than 10% receive 3dB beamwidth RMS in steptrack.

Nominally 5% receive 3dB beamwidth RMS with predictive track.

Environmental

Temperature: 0–50°C
### Humidity:
95% non-condensing

### Electrical

<table>
<thead>
<tr>
<th>Power:</th>
<th>100–240 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>47–63 Hz</td>
<td></td>
</tr>
<tr>
<td>100 W typical</td>
<td></td>
</tr>
</tbody>
</table>

**Motor:** Moog Animatics SmartMotor Series

### Mechanical

<table>
<thead>
<tr>
<th>Height: 7” (four-rack units)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width: 19”</td>
<td></td>
</tr>
<tr>
<td>Depth: 19”</td>
<td></td>
</tr>
<tr>
<td>Weight: 20 lbs.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2: 2200 Rear Panel Connections

Also see: Appendix 3: “2200 ACU, RS-232 Interface”

Below is an example configuration. Refer to the documentation that shipped with the unit you are using.

**Figure 4-2** Actual rear panels vary depending on the configuration.

**E1 — NETWORK**

RJ45 Ethernet connection for providing internet access, TeamViewer remote connection, etc.

**E2 — DRIVE CABINET**

RJ45 Ethernet connection for interfacing with the RL2048SMC.

**F1 — DRIVE CABINET**

LC/LC fiber-optic connector for interfacing with the RL2048SMC (fiber-optic package only).

**RF-1**

N-Type female connector for RF Input 1 (vertical polarization) to internal RF switch (system defaults to RF-1, user selectable)
RF-2
N-Type female connector for RF Input 2 (horizontal polarization) to internal RF switch

J1 — IRIG
BNC female 75 Ω connector for IRIG timekeeping

J2 — UPC
Uplink power control. Analog output from internal receiver.

J4 — RS-232
DB25F connector for RS-232C communication with GD DTR, M&C system, etc. (See Appendix 3: 2200 ACU, RS-232 Interface.)

J5 — RS-232
DB25F connector for RS-232C communication with GD DTR, M&C system, etc. (See Appendix 3: 2200 ACU, RS-232 Interface.)

J6 — ANALOG RECEIVER
DB9M connector for internal receiver analog output.
## A-2.1 Pinouts

### RF-1
- **J1** — IRIG
- **J2** — UPC

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>center</td>
<td>positive (+, signal)</td>
</tr>
<tr>
<td>shield</td>
<td>negative (−)</td>
</tr>
</tbody>
</table>

### J4
- **J5** — RS-232

*Also see: Appendix 3: “2200 ACU, RS-232 Interface”*

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N.C.</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
</tr>
<tr>
<td>4</td>
<td>N.C.</td>
</tr>
<tr>
<td>5</td>
<td>N.C.</td>
</tr>
<tr>
<td>6</td>
<td>N.C.</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>N.C.</td>
</tr>
<tr>
<td>9</td>
<td>N.C.</td>
</tr>
<tr>
<td>10</td>
<td>N.C.</td>
</tr>
<tr>
<td></td>
<td>N.C.</td>
</tr>
<tr>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
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<td></td>
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<tr>
<td>24</td>
<td></td>
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<tr>
<td>25</td>
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</tr>
</tbody>
</table>
### J6 — ANALOG RECEIVER

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>FAN PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>2</td>
<td>AD1+</td>
<td>J14-1</td>
</tr>
<tr>
<td>3</td>
<td>AD1 GND</td>
<td>NC</td>
</tr>
<tr>
<td>4</td>
<td>AD2-</td>
<td>J15-2</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>7</td>
<td>AD1-</td>
<td>J14-2</td>
</tr>
<tr>
<td>8</td>
<td>AD2+</td>
<td>J15-1</td>
</tr>
<tr>
<td>9</td>
<td>AD2 GND</td>
<td>NC</td>
</tr>
</tbody>
</table>
Appendix 3: 2200 ACU, RS-232 Interface

The serial interface can be used to connect equipment such as a DTR.

The 2200 ACU supports RS-232 serial communication via DB25F serial ports J4 and J5 on the rear panel. These are direct connections to the touchscreen computer.

**Pinout details:** see A-2.1 “Pinouts” and Appendix 2: “2200 Rear Panel Connections”
Appendix 4: RL2048SMC

A-4.1 Operating Environment, Power

<table>
<thead>
<tr>
<th>Temperature:</th>
<th>-40 to 50°C (low-temp package necessary below -10°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity:</td>
<td>100% condensing</td>
</tr>
<tr>
<td>Electrical:</td>
<td>200 and 400 Volt Class, 50–60 Hz, 5-wire WYE</td>
</tr>
</tbody>
</table>

Electrical-current requirements are determined by motor horsepower.

A-4.2 Mechanical

<table>
<thead>
<tr>
<th>Height: 36” (legs 18”H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width: 30”</td>
</tr>
<tr>
<td>Depth: 10”</td>
</tr>
<tr>
<td>Weight: 100 lbs.</td>
</tr>
</tbody>
</table>

Motor size: 1–5 HP standard. Larger sizes available.
Appendix 5: RL2048 Hardware Interface

With the exception of mechanical drawings, this appendix duplicates the content of Radeus Labs’ “RL2048 Hardware Interface Control Document (ICD),” revision date: 9/6/2018.

A-5.1 Electrical Interfaces

<table>
<thead>
<tr>
<th>CONNECTOR (MATING PN)</th>
<th>PIN</th>
<th>DESCRIPTION</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>J1 – POWER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2002004 – D031B01LF)</td>
<td>1</td>
<td>+5V DC POWER</td>
<td>Requires +/- 5% Power Input; 0.25A max</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>+5V SENSE</td>
<td>Optional 5V return for power supply sense input</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>GROUND</td>
<td>Return for Unit Power</td>
</tr>
<tr>
<td><strong>J2 – JOG</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONTROLLER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2002004 - D121B01LF)</td>
<td>1</td>
<td>NOT CONNECT</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>POL LED COMMAND</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>POL CCW COMMAND</td>
<td>BLACK</td>
</tr>
</tbody>
</table>

Pins listed top to bottom, here, are located left to right in the above image.
<table>
<thead>
<tr>
<th>CONNECTOR (MATING PN)</th>
<th>PIN</th>
<th>DESCRIPTION</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>POL CW COMMAND</td>
<td>BLUE</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>AZ LED COMMAND</td>
<td>RED</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>EL LED COMMAND</td>
<td>PINK</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>GROUND</td>
<td>DARK GREEN</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>AZ CCW COMMAND</td>
<td>ORANGE</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>AZ CW COMMAND</td>
<td>YELLOW</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>EL DOWN COMMAND</td>
<td>WHITE</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>EL UP COMMAND</td>
<td>GRAY</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>HOME COMMAND</td>
<td>BROWN</td>
<td></td>
</tr>
</tbody>
</table>

**J3 – SPARE INPUTS AND OUTPUTS**

(20020004 – D081B01LF)

<table>
<thead>
<tr>
<th>J3 – SPARE INPUTS AND OUTPUTS</th>
<th>PIN</th>
<th>DESCRIPTION</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPARE OUT 1 N.O.</td>
<td>OPTIONAL RELAY NORMALLY OPEN</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SPARE OUT 1 COM</td>
<td>OPTIONAL RELAY COMMON</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SPARE OUT 2 N.O.</td>
<td>OPTIONAL RELAY NORMALLY OPEN</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>SPARE OUT 2 COM</td>
<td>OPTIONAL RELAY COMMON</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SPARE IN 1 SIGNAL</td>
<td>OPTIONAL OPTO-ISOLATED 0V TO 24V</td>
<td></td>
</tr>
<tr>
<td>CONNECTOR (MATING PN)</td>
<td>PIN</td>
<td>DESCRIPTION</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>SPARE IN 1 RETURN</td>
<td>OPTIONAL</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>SPARE IN 2 SIGNAL</td>
<td>OPTIONAL OPTO-ISOLATED 0V TO 24V</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>SPARE IN 2 RETURN</td>
<td>OPTIONAL</td>
</tr>
<tr>
<td><strong>J4 – DRIVE ENABLE</strong> (20020004 – D021B01LF)</td>
<td>1</td>
<td>ENABLE N.O.</td>
<td>SOLID STATE OPTO-ISOLATED RELAY NORMALLY OPEN SEE CONNECTION DIAGRAM</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>ENABLE COM</td>
<td>SOLID STATE OPTO-ISOLATED RELAY COMMON SEE CONNECTION DIAGRAM</td>
</tr>
<tr>
<td><strong>J5 – MAINTENANCE</strong> (20020004 – D021B01LF)</td>
<td>1</td>
<td>DOOR OPEN SWITCH</td>
<td>GROUND</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>DOOR OPEN SWITCH</td>
<td>+5V PULL-UP</td>
</tr>
<tr>
<td><strong>J6 – AZ MOTOR CONTROL</strong> (20020004 – D031B01LF)</td>
<td>1</td>
<td>RS-232 RX</td>
<td>DTE INPUT</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RS-232 TX</td>
<td>DTE OUTPUT</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>GROUND</td>
<td></td>
</tr>
<tr>
<td><strong>J7 – EL MOTOR CONTROL</strong> (20020004 – D031B01LF)</td>
<td>1</td>
<td>RS-232 RX</td>
<td>DTE INPUT</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RS-232 TX</td>
<td>DTE OUTPUT</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>GROUND</td>
<td></td>
</tr>
<tr>
<td><strong>J8 – POL MOTOR CONTROL</strong> (20020004 – D031B01LF)</td>
<td>1</td>
<td>RS-232 RX</td>
<td>DTE INPUT</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RS-232 TX</td>
<td>DTE OUTPUT</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>GROUND</td>
<td></td>
</tr>
<tr>
<td>CONNECTOR (MATING PN)</td>
<td>PIN</td>
<td>DESCRIPTION</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>E1 - ACU</td>
<td>NA</td>
<td>RJ-45</td>
<td>STANDARD RJ-45 ETHERNET FOR ACU CONNECTION</td>
</tr>
</tbody>
</table>

![Diagram showing connector pins and connections](image_url)
Appendix 6: 

Setup: GD Model 253 Tracking Receiver

1. Power-off the Model 253 and set its internal switch S1 to position 1.


3. Set the 253 to REMOTE mode — on the Summary screen, CONTROL: REMOTE will be indicated.

4. Set the 253’s SERIAL PORT 1 settings to:
   a) BAUD: 19200
   b) PARITY: NONE
   c) DATA: 8
   d) STOP: 1

5. Connect the Model 253’s port J1 DATA LINK 1 to the 2200’s port J4 RS-232.

6. If replacing an existing 7200 unit, use the supplied null modem and the existing wiring.

7. If installing a new 2200, use a straight-through serial cable (i.e., no null modem required).

8. On the 2200 ACU, ensure that 253 is selected as the Setup > Receiver > Receiver type.

9. Verify that the frequency set at the 253 is shown on the 2200’s data display.
Appendix 7: Setup: DTR

1. Set the DTR to its remote mode using SHIFT+HELP

2. Set DTR settings for PORT 1 as follows:
   a) BPS: 57600
   b) NEWLINE: DISABLED
   c) ECHO: DISABLED
   d) SHELL: M&C SHELL

3. Select RESET PORT on DTR

4. Connect the DTR’s PORT 1 RS-232 to the 2200’s port J4 RS-232
   a) If replacing an existing 7200, use the supplied null modem and the existing wiring.
   b) If installing a new 2200, use a straight-through serial cable (no null modem).

5. On the 2200 ACU, ensure that DTR is selected as the Setup > Receiver > Receiver type.

Verify that the frequency set at the DTR is shown on the 2200’s data display.
Appendix 8: Setup: IRIG

If the 2200 ACU is configured for IRIG-B, it supports IRIG-B sources that output one of the following:

- IRIG–B122/B123
- B002/B003
- B126/B127
- B006/B007

If local time is needed, set it through the Windows time manager. (Quit the ACU application, or minimize it, to access OS functions.) If the time does not update within the first five minutes of using the ACU, follow the instructions below.

1. Open the IRIG monitoring software, “MbgMon v3.06.99.13,” via the Start menu.

---

5 IRIG-A is an option, but it must be configured before shipment. Inquire with Radeus Labs.
2. Right-click on the program and choose to “Run as administrator”:

3. When the program opens:
   a) Make sure the signal is 100%.
   b) Check that the clock is synchronized.
   c) Check that the Reference time is correct.
4. If those three are correct, choose Setup > Stop time service.

5. Then choose Setup > Start time service and the system time should update.
Appendix 9: Advanced 2200 Configuration — acu.ini

Important

The acu.ini file is for advanced users only. Misconfiguration may lead to unintended behavior.

acu.ini is a text file of key-value pairs. It can be used to configure ACU options not exposed by the application’s GUI.

A-9.1 Requirements
Radeus Labs ACU application version 2.2.0 or greater

A-9.2 File location
In the ACU’s host OS, the file is located at:

C:\Radeus Labs\acu.ini

A-9.3 Default acu.ini

Caution: Use extreme caution when making any change to this file. The current, default contents are:

PORT=161
[OPTIONS]
LOOKANGLES=1
LONGITUDE=1
PREDICTIVE=1
STEPTRACK=1
TLE=1
IESS=1
[EPHEMERIS]
A-9.4 Example acu.ini

*Caution:* Use extreme caution when making any change to acu.ini.

PORT=161

[OPTIONS]
LOOKANGLES=1
LONGITUDE=1
PREDICTIVE=0
STEPTRACK=1
TLE=1
IESS=1

[EPHEMERIS]
TLEPATH=http://...[path to].../geo.txt*

*Connection must be over HTTP, not HTTPS.*
A-9.5 Primary Keys

[OPTIONS]

Used in acu.ini to show (value=1) or hide (0) the various modes in the ACU application. This is for operator accessibility: it only controls whether the mode is selectable when editing targets. Targets previously defined with a certain mode will still be available even if it isn’t among the current options.

---

**LOOKANGLES**

*Type:* Boolean  
*Range:* 0, 1  
*Examples:* LOOKANGLES=0  
LOOKANGLES=1

**LONGITUDE**

*Type:* Boolean  
*Range:* 0, 1  
*Examples:* LONGITUDE=0  
LONGITUDE=1

**PREDICTIVE**

*Type:* Boolean  
*Range:* 0, 1  
*Examples:* PREDICTIVE=0  
PREDICTIVE=1
**STEPTRACK**

_Type_: Boolean

.Range: 0, 1

_Examples_: STEPTRACK=0

STEPTRACK=1

---

**TLE**

_Type_: Boolean

.Range: 0, 1

_Examples_: TLE=0

TLE=1

---

**TLE/STEPTRACK**

_Type_: Boolean

.Range: 0, 1

_Examples_: TLES_STEPTRACK=0

TLE_STEPTRACK =1
A-9.6 Additional Keys

[EPHEMERIS]

TLEPATH

Used to specify an alternate web location for the ACU to request TLE ephemeris data. An Ethernet cable must be connected to the rear panel port labeled as:

E1 NETWORK

The web server must not be password protected and must be accessible by the ACU over HTTP (not HTTPS). The file must follow the NORAD Two-Line Element Set Format.6

The ACU will check this location every 24 hours for updated ephemeris data, making a local copy. The ephemeris file served does not need to be named geo.txt.

Type: string, unquoted

Example TLE path:

Any space characters must be %-encoded, as shown:
TLEPATH=http://the.domain.com/
file%20repository/ ... [more path] ... /
geo.txt

Appendix 10: Series 2000 On-Site Test Procedure

Radus representative: (1) Check each item’s checkbox, where shown below, after it has been completed successfully. (2) Fill in the required information everywhere a place to “record” is provided.

**WARNING**

Do not attempt to operate this equipment if there is evidence of shipping damage or you suspect the unit is damaged. Damaged equipment may present additional hazards to you and to property. Contact support for advice before attempting to plug in and operate damaged equipment.

**WARNING**

To avoid electric shock, connect the instrument to properly grounded electrical sources that meet all the equipment’s specifications. Failure to observe this precaution can result in severe injury.

### A-10.1 Pre-installation checklist

- Ensure that all recommended maintenance has been performed on the antenna and it is in working order according to the manufacturer’s instructions.

- For older systems, all wiring has been checked for rodent damage or other signs of deterioration.
  - Motor wiring
  - Limit switches, emergency stop wiring
  - All other control system wiring

- The receive RF (if applicable) path has integrity for both horizontal and vertical (or left-hand/right-hand circular.)
A-10.2 Motor Checks

A-10.2.1 Jog Controller Test

- Jog the Azimuth CW and verify that the antenna moves *clockwise*.
- Jog the Azimuth CCW and verify the antenna moves *counter-clockwise*.
- Jog the Elevation Up and verify the antenna moves *up*.
- Jog the Elevation Down and verify the antenna moves *down*.
- Jog the Polarization CW and verify the polarization moves *clockwise* (when observed from the rear of the antenna).
- Jog the Polarization CCW and verify the polarization moves *counter-clockwise* (when observed from the rear of the antenna).

A-10.3 Limit Switch Checks

- *At the ACU*, go to *Home > Setup and choose Limits*. Enter 0 in the CW/upper hard limit *and* CCW/lower hard limit fields, for both AZ and EL. This will signal the ACU that a full discovery of limits is required.

- *Ensure that it is safe for the antenna to make fast motions through its entire range of motion along each axis*. Go to Home > Setup and choose Site. This will cause the antenna to drive to the hard limit switch in each axis: tap *Zero all*.

- Verify that the zeroing function completes successfully, with no faults displayed, and that the fields on the limits tab (Home > Setup > Limits) are populated with new values.
WARNING

The equipment operator must be observant of, and responsible for, the antenna motion at all times.

When operating jog buttons in Manual mode and set to Toggle, whether at the ACU or at the drive cabinet, the motors will keep driving until the jog button is pressed again.

Do not run the antenna unsupervised when in toggle mode. Damage to property and/or persons may result.

A-10.4 Steptrack Test

Point the antenna at a geostationary satellite and observe the receive signal level for 1–2 minutes. Record the signal variation (in dB) here: ____________________

Note: if the observed variation is more than 0.1dB, it will be difficult to evaluate the steptrack performance, because signal variation affects performance.

Set up a new target satellite in steptrack mode* and record the settings in the table below:

<table>
<thead>
<tr>
<th>Longitude (deg E)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclination (deg)</td>
<td></td>
</tr>
<tr>
<td>RF Input</td>
<td></td>
</tr>
<tr>
<td>POL (deg)</td>
<td></td>
</tr>
<tr>
<td>Receive level @ 0dB (see 6.3 note above)</td>
<td></td>
</tr>
<tr>
<td>Beacon frequency (MHz)</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Click in the "Receive level @ 0dB field" and just press OK. This tells the ACU to use the current receive level as relative 0dB.
In manual mode, move the antenna off beam center, in the direction indicated in the following table, so the signal level is -2dB.

Track the steptrack target created previously to cause the system to peak the antenna. Record the signal level in the Steptrack Level column below.

In manual mode, manually peak the antenna again. Record the signal level in the Manual Level column below.

Repeat these steps for each axis-direction listed in the following table:

<table>
<thead>
<tr>
<th>Direction</th>
<th>Steptrack Level</th>
<th>Manual Level</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azimuth CW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azimuth CCW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation UP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation DOWN</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calculate the RMS tracking accuracy

\[ \text{TrackingError}_{\text{RMS}} = \left( \frac{1}{2} \left( \sqrt{(AZ_{CW})^2 + (AZ_{CCW})^2 + (EL_{UP})^2 + (EL_{DOWN})^2} \right) \right) / 2 \]

Record TrackingError\(_{\text{RMS}}\): _______________
Appendix 11: List of Figures

Figure 1-1  The Model 2200 Antenna Control Unit (ACU) from Radeus Labs, Inc.  ................................................................. 10

Figure 1-2  Power switch and data connections — specifics vary by system, see Appendix 2: 2200 Rear Panel Connections. ................................................................. 12

Figure 1-3  The home screen of the Model 2200 ACU. .......................... 13

Figure 1-4  Setup > Site Setup screens for required settings specific to the antenna. ................................................................. 14

Figure 1-5  Indicate how many POL axes this ACU controls. .................. 15

Figure 1-7  Fault alerts are displayed on screen (see Figure 2-2). Optional audible alerts can be enabled here. .................. 16

Figure 1-8  Setup > Receiver Specify the type of receiver being used, if any. ................................................................. 17

Figure 1-9  Setup > Encoders “Position” is null if there are no attached encoders. ................................................................. 18

Figure 1-10 Setup > Site > Zero all — see cautions, antenna may move quickly when zeroing. ................................................................. 20

Figure 2-1  The Home screen gives access to all operator controls and system options without obscuring the real-time data display................................................................. 21

Figure 2-2  The Home screen displays fault messages, listed in section 4.3 “Fault Messages & Causes.” For audible faults, see Figure 1-7. ................................................................. 22

Figure 2-3  Quit the ACU software or Shut Down both the ACU and Windows. ................................................................. 24

Figure 2-4  Home > Target................................................................. 25
Figure 2-5  Which input fields are displayed depends on the selected mode. Shown here are settings for using *look angles* mode.

Figure 2-6  A satellite’s name can be any unambiguous label that is useful at the earth station. It’s often convenient to use the satellite’s common name or other unique identifier from its TLE.

Figure 2-7  Settings for pointing by *longitude*.

Figure 2-8  Settings for *predictive tracking* (1 of 2).

Figure 2-9  Settings for *predictive tracking* (2 of 2).

Figure 2-10  Settings for *steptracking* (1 of 2).

Figure 2-11  Settings for *steptracking* (2 of 2).

Figure 2-12  Choosing a TLE mode provides a list of all TLE targets that are within the antenna’s range. TLE satellite names cannot be edited, unlike targets defined by an ACU operator.

Figure 2-13  Settings for TLE (SGP4) mode.

Figure 2-14  Settings for TLE/Steptrack mode (1 of 2).

Figure 2-15  Settings for TLE/Steptrack mode (2 of 2).

Figure 2-16  Operator-defined targets included in the list at Home > Target.

Figure 2-17  A TLE Group includes all the user-highlighted items in the list of available TLE targets.

Figure 2-18  TLE Groups appears in the same list as other defined targets.

Figure 2-19  The name of a TLE Group being tracked is periodically shown over the current, individual target’s name, a reminder that the ACU is tracking a group.
Figure 2-28  Settings for driving the antenna manually, these affect the behavior of the hardware jog controls on the front panel. .................................................................35

Figure 2-20  The characteristics of any target can be edited. ..................36

Figure 2-21  After choosing a TLE mode, a drop-down list shows all TLE targets *that are within the antenna’s range*. .................38

Figure 2-23  An operator confirms before the antenna will move to a new target. .................................................................39

Figure 2-24  When a pointing mode is used, apply any peak adjustments as *bias angles*, they will load when the same target is tracked in the future. ..................................................40

Figure 2-25  Settings for TLE/Steptrack (1 of 2) ........................................41

Figure 2-26  Settings for TLE/Steptrack (2 of 2) ........................................42

Figure 2-27  The 2200’s hardware jog buttons include LEDs that show what the controller is doing. See Figure 2-29 to adjust button behaviors. .................................................................44

Figure 2-28  Settings for driving the antenna manually, these affect the behavior of the hardware jog controls on the front panel. .................................................................45

Figure 2-29  Home > Manual. Touchscreen settings adjust how the hardware jog controls work. .................................................................46

Figure 4-1  A warning and fault description(s) are displayed, and a warning tone can be issued, if the ACU detects a fault condition. .................................................................52

Figure 4-2  Actual rear panels vary depending on the configuration. .................................................................................63
Appendix 12: Description of CE Symbols

Certain symbols important to the European Union CE mark are used in this manual and may be placed on equipment.

**General Warning or Caution:**

The Exclamation Symbol designates an area where personal injury or damage to equipment is possible.

**Electrical Shock:**

The Electrical Shock Symbol indicates a hazard arising from dangerous voltage. Any mishandling could result in irreparable damage to equipment, and personal injury or death.

**European Union CE Mark:**

The presence of the CE Mark on our equipment indicates it has been designed, tested, and certified as complying with all applicable European Union (CE) regulations and recommendations.

**Waste Electrical and Electronic Equipment (WEEE):**

This symbol indicates it is the user's responsibility to dispose of waste equipment according to local laws. The separate collection and recycling of waste equipment at the time of disposal will help conserve natural resources and ensure it is recycled in a manner that protects human health and the environment.