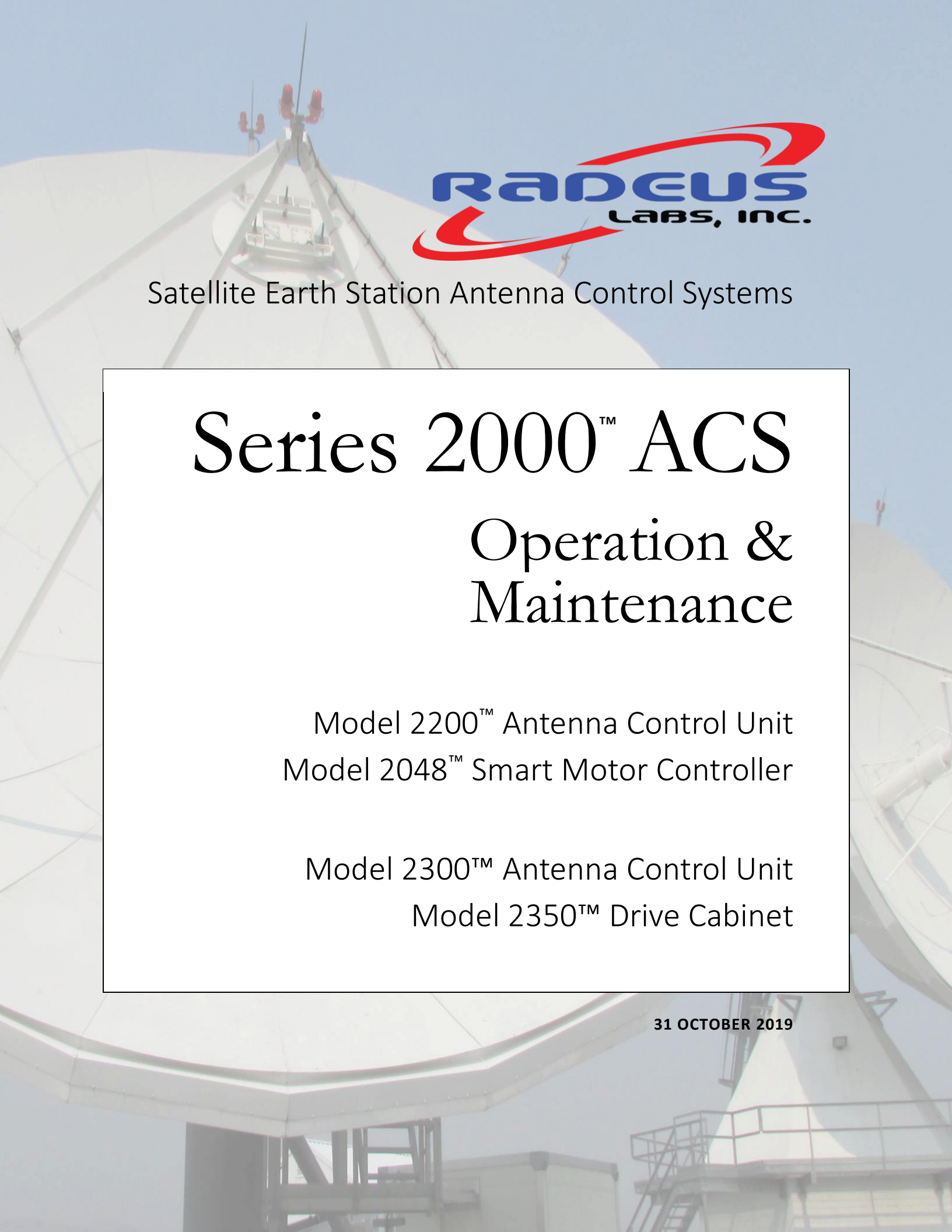

RADEUS LABS, INC.

Satellite Earth Station Antenna Control Systems

# Series 2000™ ACS

## Operation & Maintenance

Model 2200™ Antenna Control Unit
Model 2048™ Smart Motor Controller

Model 2300™ Antenna Control Unit
Model 2350™ Drive Cabinet

**31 OCTOBER 2019**

SATELLITE EARTH STATION ANTENNA CONTROL SYSTEMS

# Series 2000™ ACS
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## Model 2200™ Antenna Control Unit
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#RL2000ACS, #RL2200ACU, #RL2048SMC

#RL2300ACU, #RL2350DC

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Document rev. 20191031-1



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# Table of Contents

# 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.**

## About This Document

Except where noted, illustrations, examples, and instructions are from a Model 2300 system but also apply to the Model 2200. The text notes when the Model 2200 differs in any substantial way.

## Service and Support

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

Radeus Labs, Inc.
+1 858-391-1210

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www.RadeusLabs.com

SECTION 1

# 1 Setting Up the Antenna Control Unit (ACU)


**Figure 1-1** Antenna Control Unit (ACU) from Radeus Labs, Inc.

## 1.1 Before installing the system

⚠ Before proceeding with setup:

- Review the safety information in "Important Precautions."
- Follow all instructions in Appendix 11: "Pre-installation checklist"

**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, to other persons, and to property.**

**Contact support for advice before attempting to plug in and operate damaged equipment.**

## 1.2 Connect the ACU

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** Power switch and data connections — specifics vary by system, see Appendix 2: ACU Rear Panel Connections.

# 1.3 Setup and Configuration

## 1.3.1 Specify the antenna & location

Start at the Home screen for access to all system settings and controls:

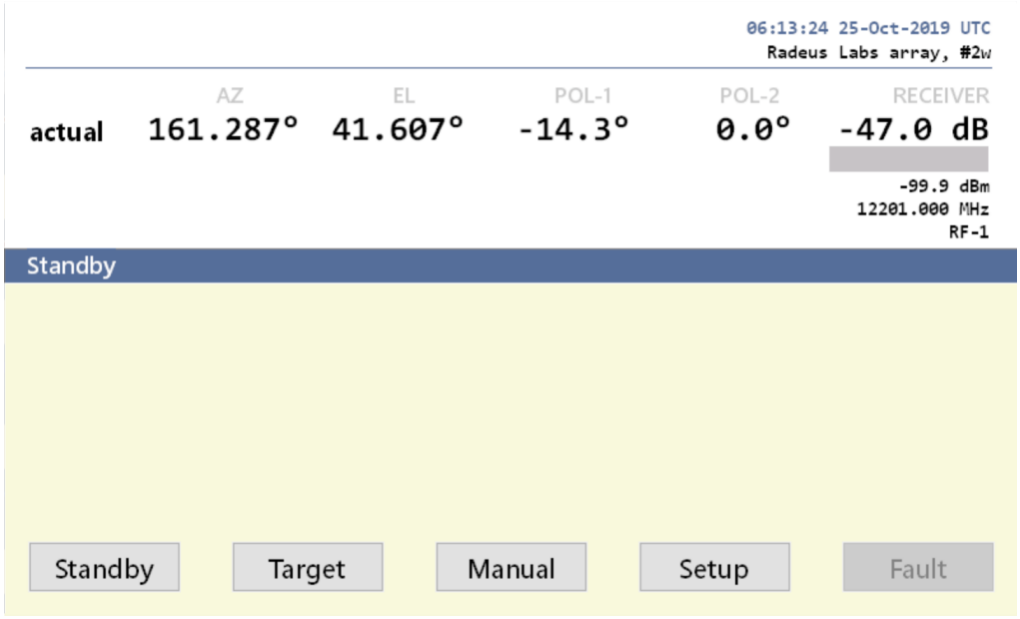



**Figure 1-3** The home screen of the ACU.

Tap the Setup button.

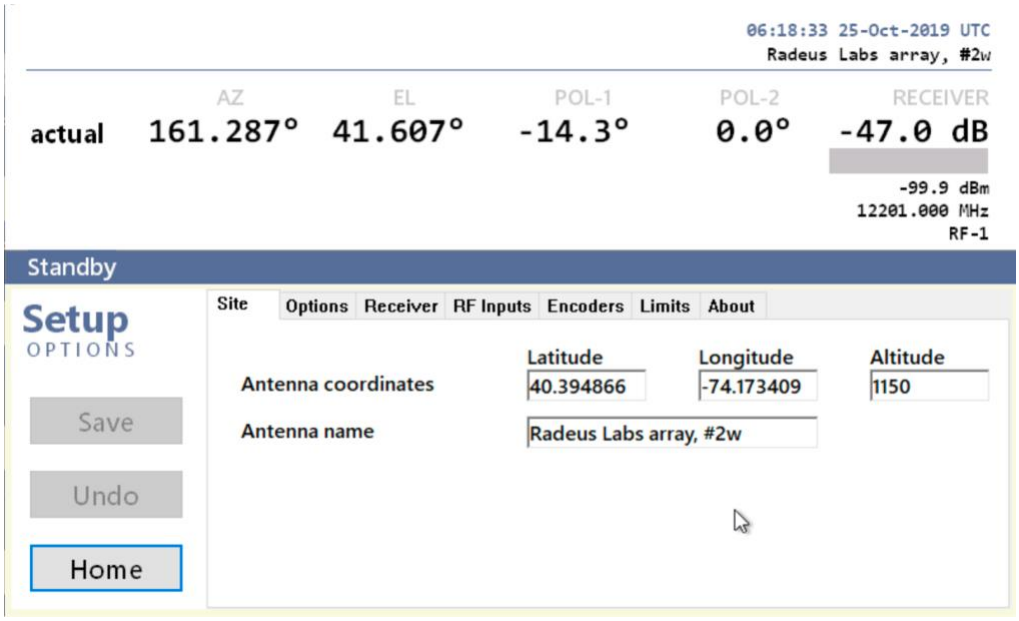



**Figure 1-4** Setup > Site (Model 2300 ACU shown; for Model 2200 see next)
Setup screens for *required settings specific to the antenna.*

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.
4. To continue on the Model 2300, tap Options. *Model 2200 users, continue with the antenna's POL settings, discussed next.*

## 1.3.2 Antenna Polarization Settings

**Note**
In this document, screenshots may illustrate a system with one, two, or no polarization axes.

Some Series 2000™ systems, such as 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.

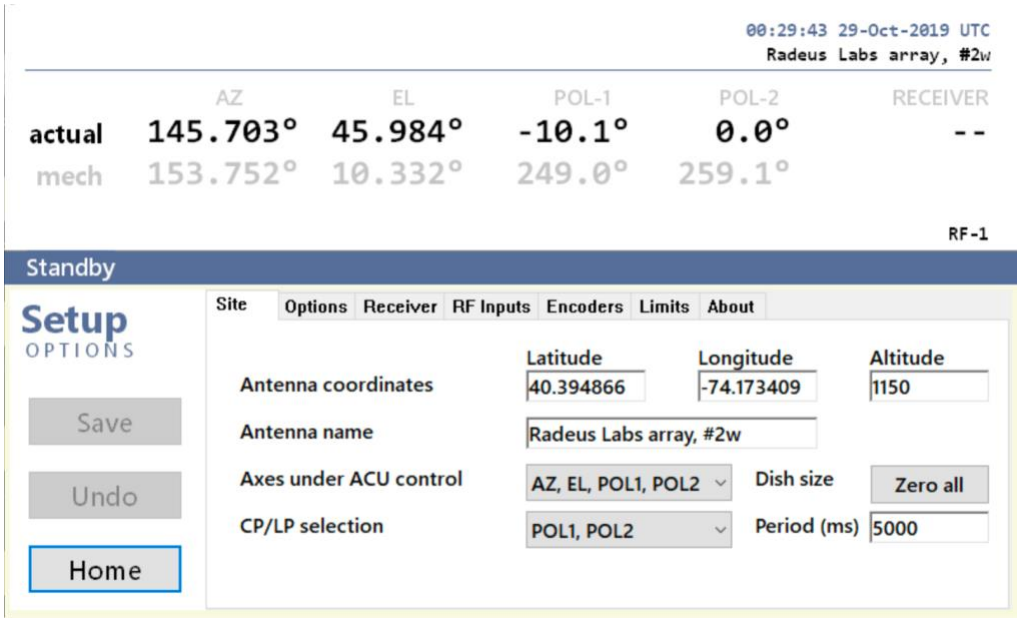



**Figure 1-5** Also indicate how many POL axes the ACU controls. (Model 2200)

5. Specify which of the antenna's axes are under control of the ACU.

6. For CP/LP selection, indicate for which axes the antenna user will be permitted to specify circular or linear polarization.

7. The *period* is the maximum amount of time the ACU will drive the CP/LP axes. This safety feature helps ensure that, in the event of a CP/LP-limits failure, the antenna still is not driven past those limits.

To continue, tap Options.

## 1.3.3 Options

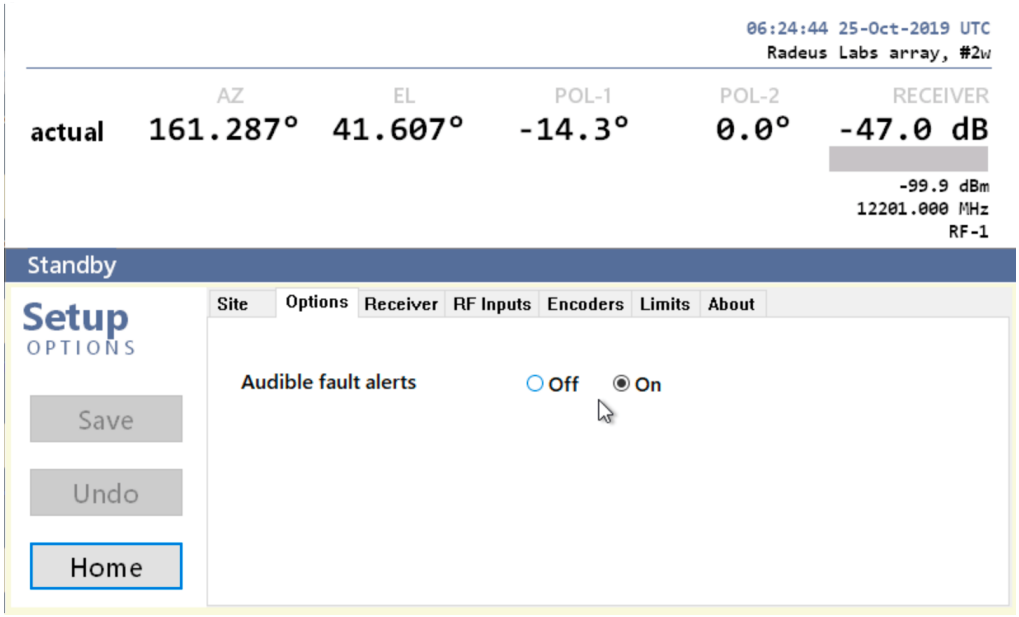



**Figure 1-6** Fault alert messages are always displayed on screen (see **Figure 2-2**). Optional *audible* alerts can be enabled here. Some options only available on the Model 2300.

- Audible fault alerts
  Choose whether the ACU will emit audible alert tones, in addition to the visual alerts on its display, when a fault is detected.

- Sun outage protection (Model 2300 only)
  Prevents steptrack operation if the beam is pointing within 0.25° of the sun.

- Orbital tracking limit (Model 2300 in GEO tracking only)
  Constrain antenna control maneuvers to match the analemma trajectory of the target satellite (see **Figure 1-7**). When tracking a target whose trajectory brings it close to other satellites, orbital tracking limits can help avoid tracking nearby satellites unintentionally.

  The orbital tracking limit is measured in factors of the antenna 3dB receive beamwidth (n*BW). For example, an orbital tracking limit of factor 2 and receive beamwidth of 0.27°

would constrain tracking maneuvers to a maximum offset of 0.54° from the target trajectory.

Orbital tracking limits is a system-wide option and applies to all tracking modes. They are disabled by default (factor 0) and the maximum value is 9.

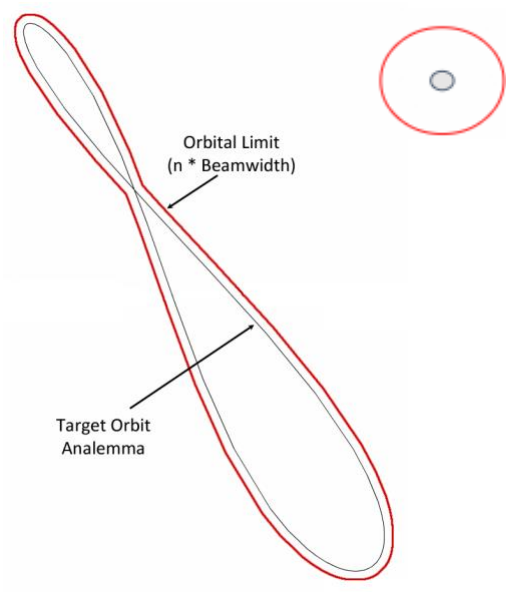



**Figure 1-7** Orbital tracking limits constrain antenna maneuvers to match the *analemma trajectory* of the GEO target satellite. This can help avoid accidentally tracking any other nearby satellites.

## 1.3.4 Enter the receiver characteristics

If using a DTR, see Appendix 6: "Setup: DTR."

If using a GD 253, see Appendix 5: "Setup: GD Model 253 Tracking Receiver."

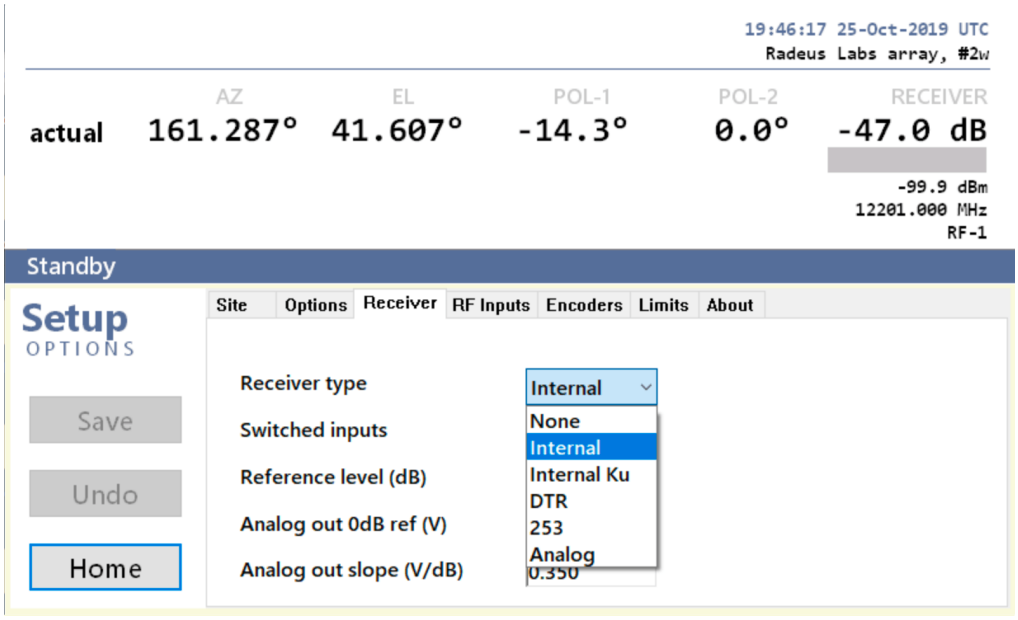
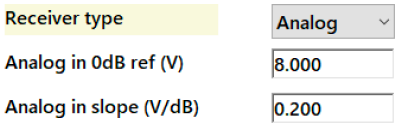


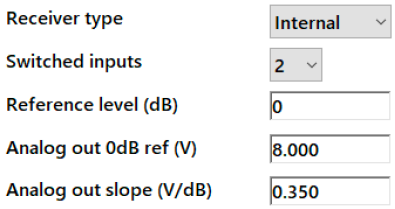

**Figure 1-8** Setup > Receiver
Specify the type of receiver being used, if any.

Analog receivers:



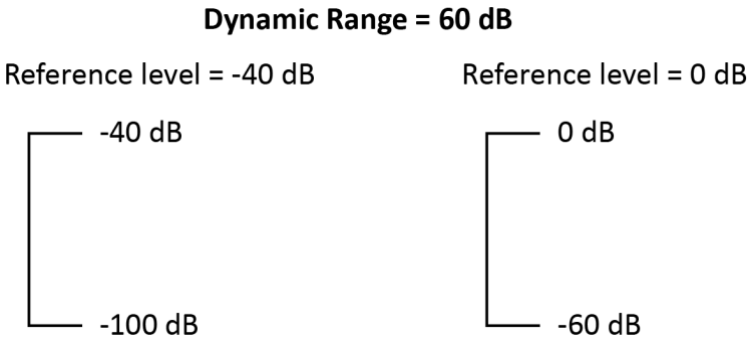

1. The analog input voltage for relative power level 0 dB.
2. The analog input's slope (V/dBm).

*"Internal" and "Internal Ku" receivers:* The same fields are shown, but specify here if the internal receiver uses the Ku band (there is an optional Ku band block-down converter).




1. *Switched inputs* is the number of RF inputs (see below) that can be switched to the receiver.

2. The internal receiver has a dynamic range of 60 dB. The *reference level* sets the top end of that range, from -40 to 0 dB.




3. The analog output voltage for relative power level 0 dB.

4. The analog output's slope (V/dB).

## 1.3.5 RF Inputs

Use the RF Inputs screen to specify which axes are used for which input(s), and how they are labeled on the touchscreen. *This screen is shown only if the selected Receiver Type is Internal or Internal Ku.*

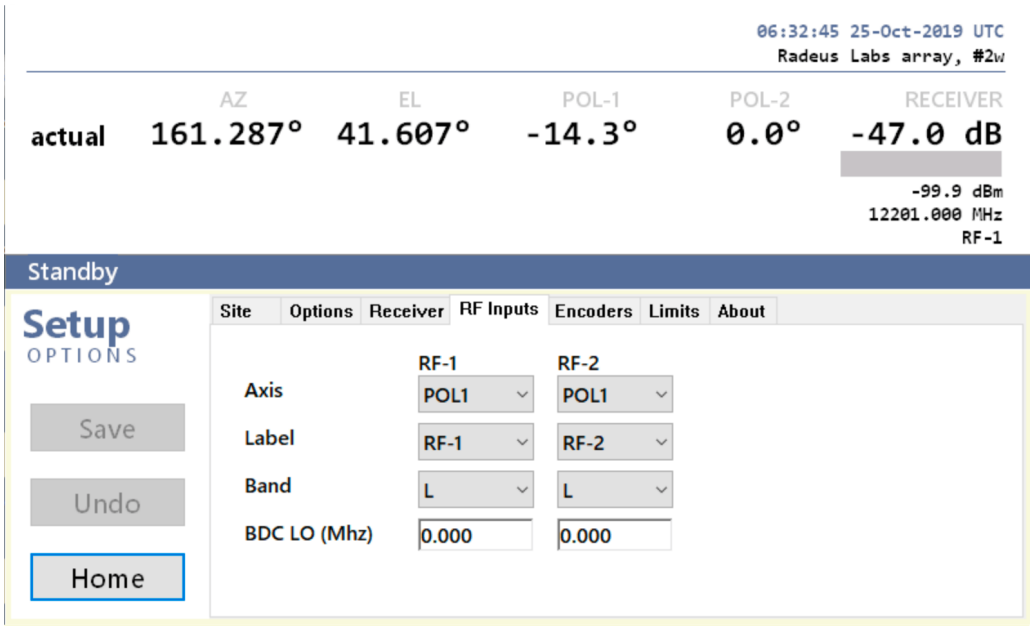



**Figure 1-9** Setup > RF Inputs

1. Assign an axis to each available RF input.
2. For each input, assign a label to show on the touchscreen: LH/V (left-hand/vertical), RH/H (right-hand horizontal), etc.
3. If the receiver type is Internal Ku, the default band is Ku. If the receiver type is Internal, the band must be specified.

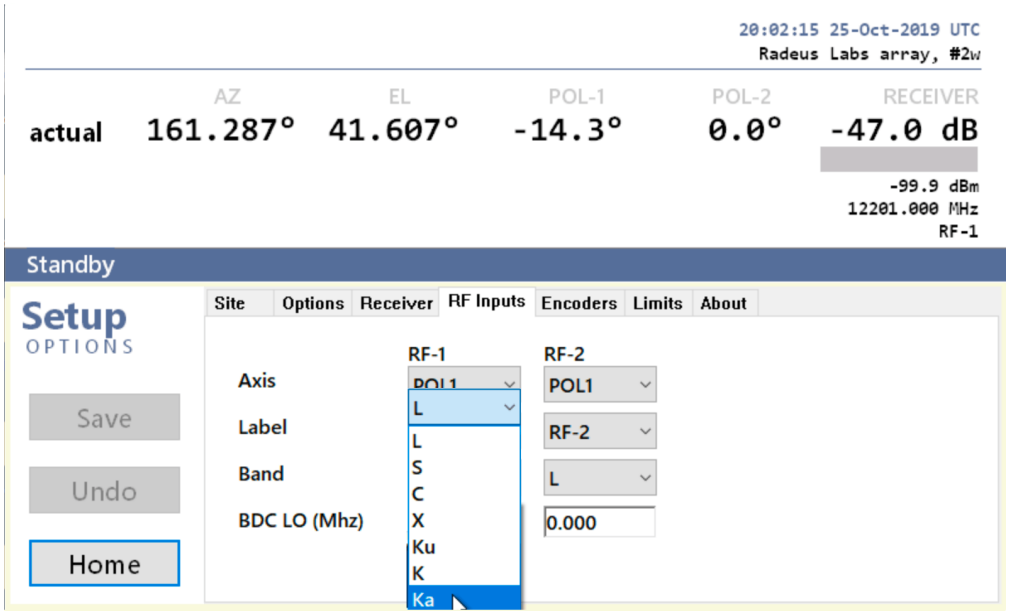



Figure 1-10 If the receiver type is set to Internal (not Internal Ku), specify the band to be used for each RF input.

4. If the receiver type is Internal, the BDC LO ("local oscillator") can be set separately for each input.

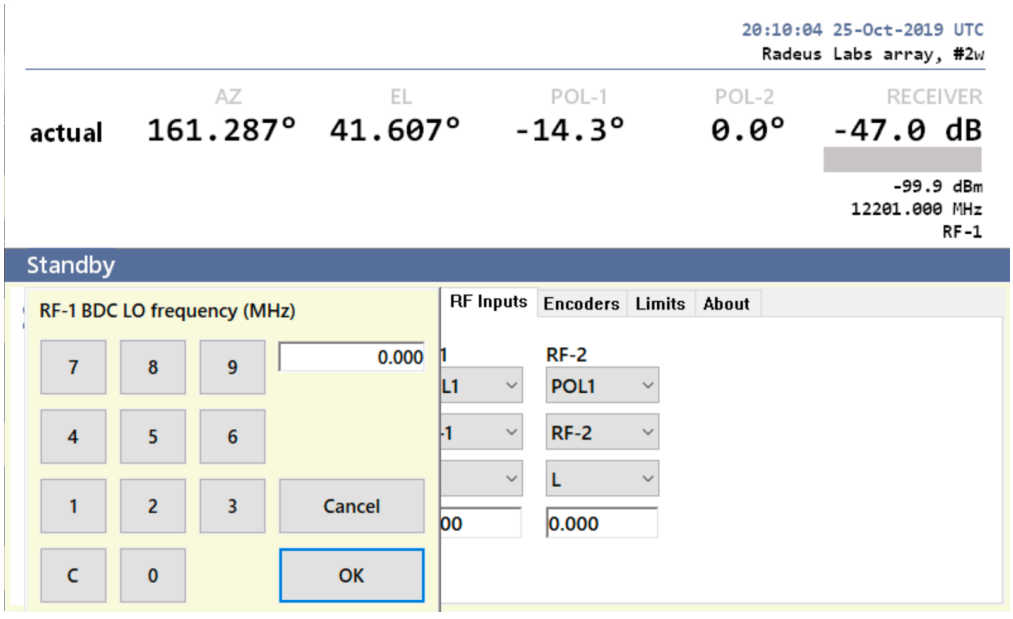



Figure 1-11 Specify the BDC LO frequency for each input.

**Required**
A position and direction must be entered for each encoder.

*Note:* No position values can be entered unless resolvers or encoders are present.

## 1.3.6 Specify the encoders' positions

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.

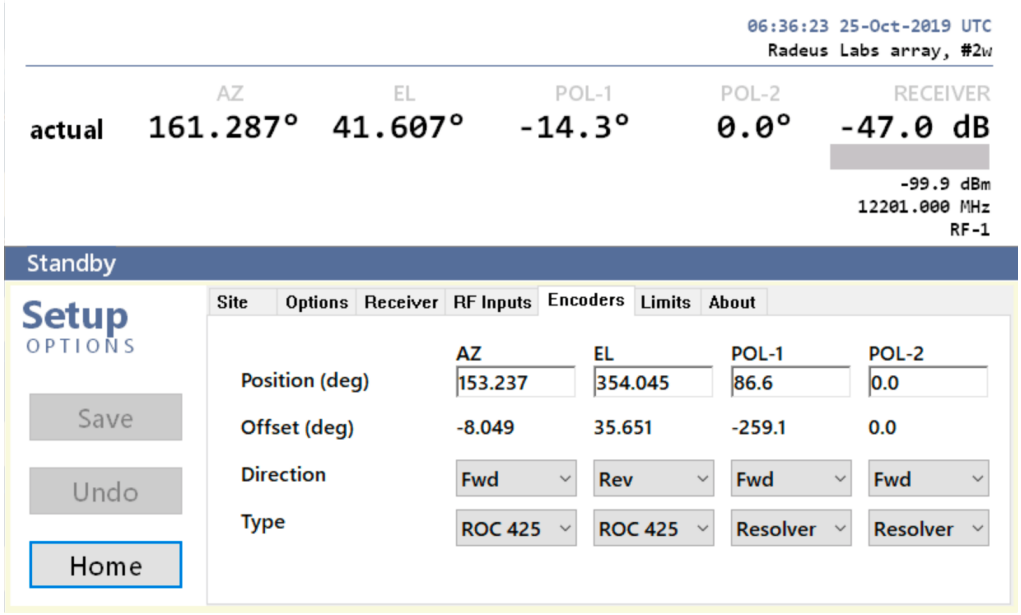



**Figure 1-12** Setup > Encoders (Model 2300; for Model 2200, see next)
"Position" is null if there are no attached encoders.


**Figure 1-13** Setup > Encoders (Model 2200)
"Position" is null if there are no attached encoders.

*Set initial positions*:
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 in the Position fields on the Setup > Encoders screen.

5. *Fine-tune the offsets for greater accuracy*:
   (1) Manually peak to a target of known location, e.g., using the manual jog buttons[1] 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 1-12**, **Figure 1-13**). The ACU will populate the offset fields.[2]

[1] See "Manual jog" (section 2.7.4), and the jog buttons in **Figure 2-27**.

[2] The Offset field is not directly editable by operators. Its value is calculated by the ACU when the Position field is updated.

**⚠ Warning**
Do not perform zeroing without working limit switches in place on every axis. Otherwise, *the antenna will drive into its hard stops and damages and/or injury may occur.*

**⚠ Caution**
*Only perform this task when it is safe to do so.* While zeroing, the ACU drives the antenna at high speeds to determine the location of the limit switches along each axis.

The antenna will be in motion a number of times during this operation — *even if it pauses, motion may resume until the zeroing concludes.*

# 1.4 Zeroing

*Applies only to the Model 2200 ACU,* not *to the Model 2300.*

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 antenna and 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 1-14**).

- To zero with the jog controller:
  - Local mode must be asserted at the drive cabinet (see section 4.1, "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 roughly 20 degrees as its final position.

The zeroing process may take up to about five minutes but might be much faster.

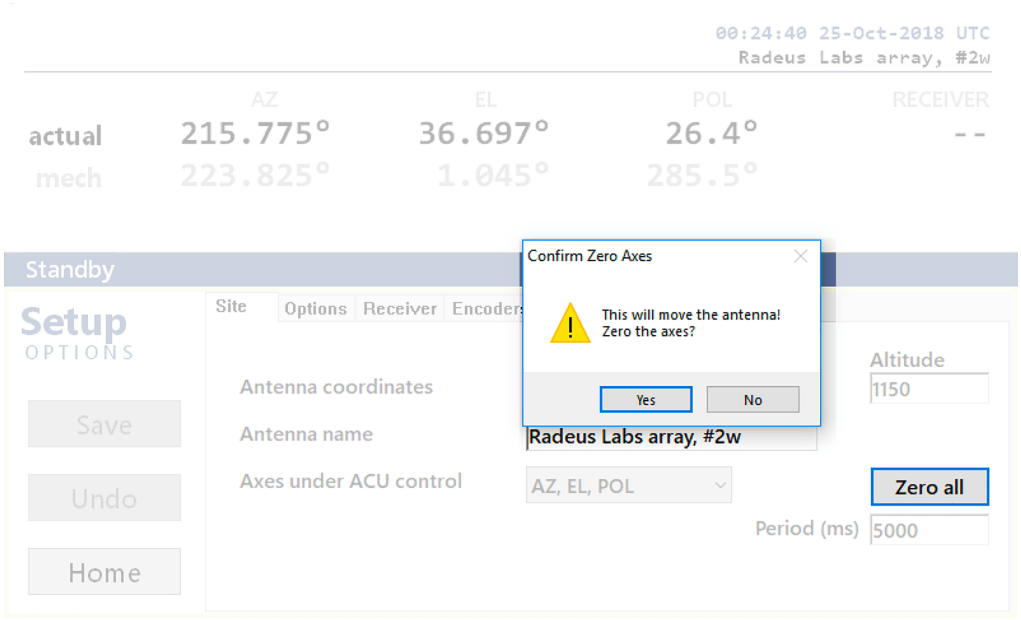
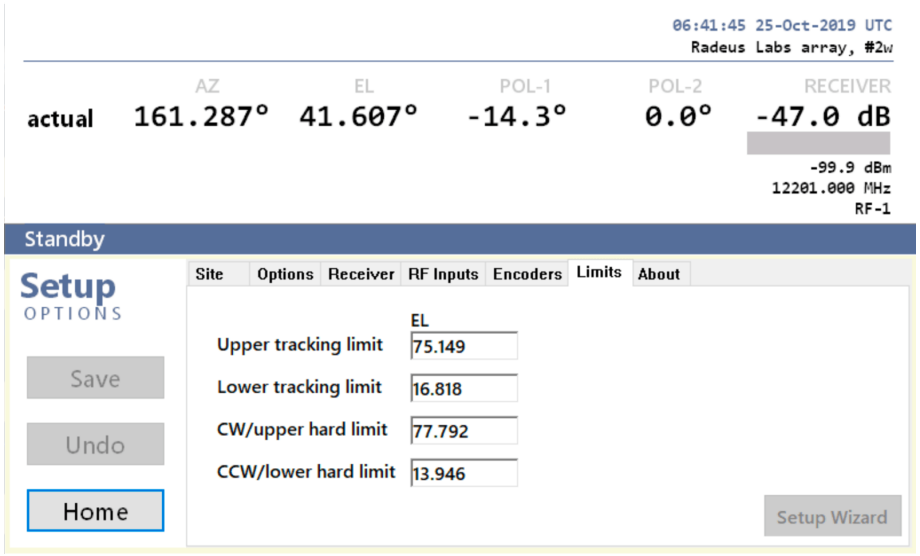



**Figure 1-14** Setup > Site > Zero all — see cautions, antenna may move quickly when zeroing. (Model 2200 only.)

## 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.




# 1.5 Setup Wizard

*Applies only to the Model 2300 ACU.* If using a Model 2200, see Section 1.4, "Zeroing."

The Setup Wizard (see warning notes) is used to discover the position of the limit switches on limited motion axes.

**⚠ Warning**

Do not run the Setup Wizard without working limit switches in place on every limited-motion axis. *Otherwise, the antenna will drive into its hard stops and damages and/or injury may occur.*

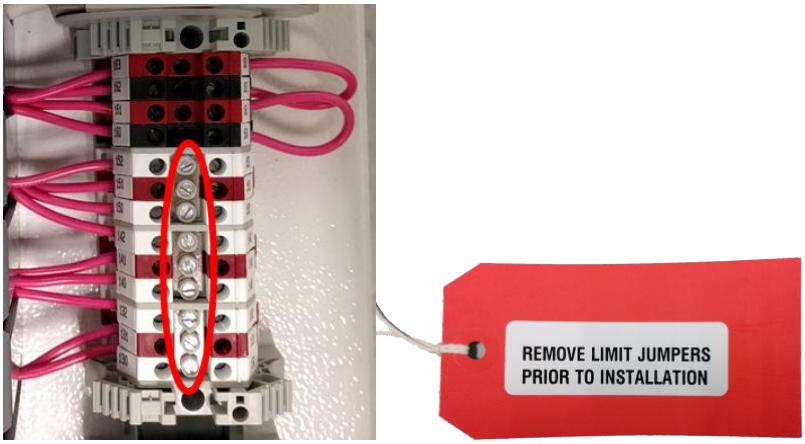
**⚠ Caution**

While the wizard runs, the ACU drives the antenna through its full range of motion. The antenna will be in motion a number of times during this operation. *Even if it pauses, motion may resume until the Setup Wizard concludes.*

## 1.5.1 Requirements, before the Setup Wizard

- The ACU must be installed and connected properly.
- BE SURE ALL LIMIT SWITCHES ARE TESTED AND WORKING CORRECTLY — ON EVERY LIMITED-MOTION AXIS.
- The antenna must not be tripping any limit switches.
- The motors and feedback must be functioning properly.

- Any limit jumpers need to be removed.




- Encoder offsets must be established for each axis (see section 1.3.6 about Setup > Encoders).

## 1.5.2 How the wizard works

**Setup details**
To view or edit settings determined by the Setup Wizard, browse the ACU's Home > Setup tabs. They are described in the next sections.

*All limit switches must be in place before running the Setup Wizard.* The Setup Wizard will move the antenna through its full range of motion — in both directions, along each limited-motion axis — until it has hit all the hardware limit switches.

When the system detects a limit switch, it performs the following:

- Backs away from the switch by two degrees;
- Sets the soft final limit in the motor drive based on deceleration values; this is distinct from the soft limits shown on the ACU Setup > Limits screen and cannot be changed by the user;
- Sets the *default soft limit* for that direction on that axis. *Soft limits can be edited or even disabled on the Setup > Limits screen.*

After the Setup Wizard establishes soft limits for each axis, it moves the antenna back to center and is complete.

## 1.5.3 Run the wizard

**How long will it take?**
Expect the Setup Wizard to take the time needed to exercise the antenna fully, along each axis, and to perform any other tasks as described. Precise times depend on site-specific factors.

After you complete the Setup screens for Site, Receiver (if present), RF Inputs, and Encoders, *and verify the wizard requirements,* above, you may run the Setup Wizard:

1. Start at Setup > Limits.
2. Tap the Setup Wizard button and confirm, when prompted:

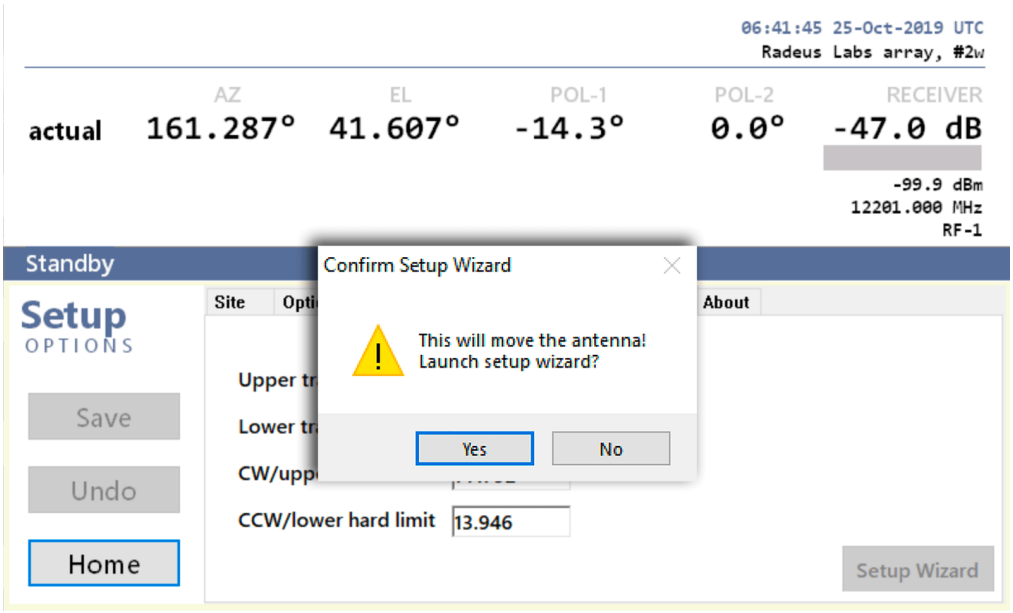



**Figure 1-15** An ACU operator must confirm before the Setup Wizard will run.

The wizard will exercise the antenna's full range of motion along each limited-motion axis. It will report in the blue status bar, for example:

"Running setup wizard — Seeking AZ CW limit"

When the Setup Wizard has finished, the system will go into Standby.

The rest of this section describes settings the Setup Wizard can manage. Such values can be edited manually, with or without running the wizard; *but running the wizard might overwrite settings that have been applied manually.*

## 1.5.4 Antenna Travel Limits

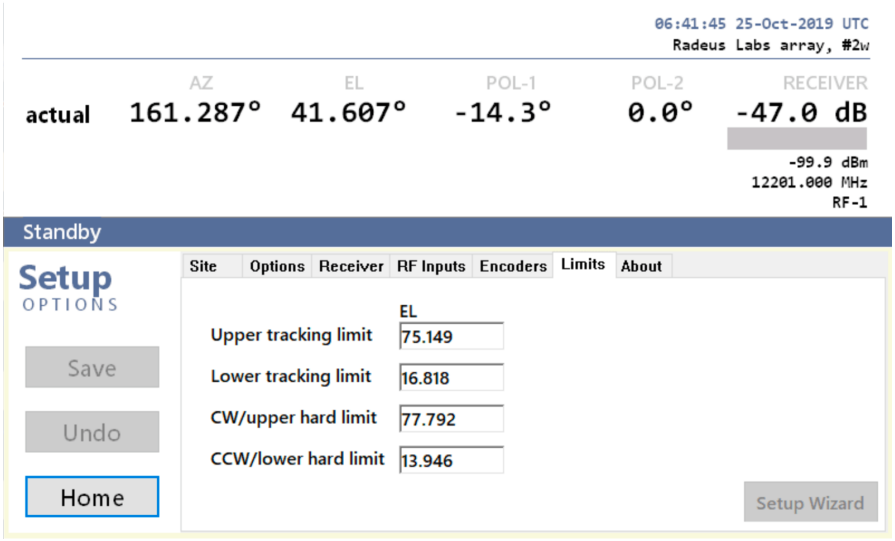



**Figure 1-16** Setup > Limits, and the Setup Wizard (Model 2300)

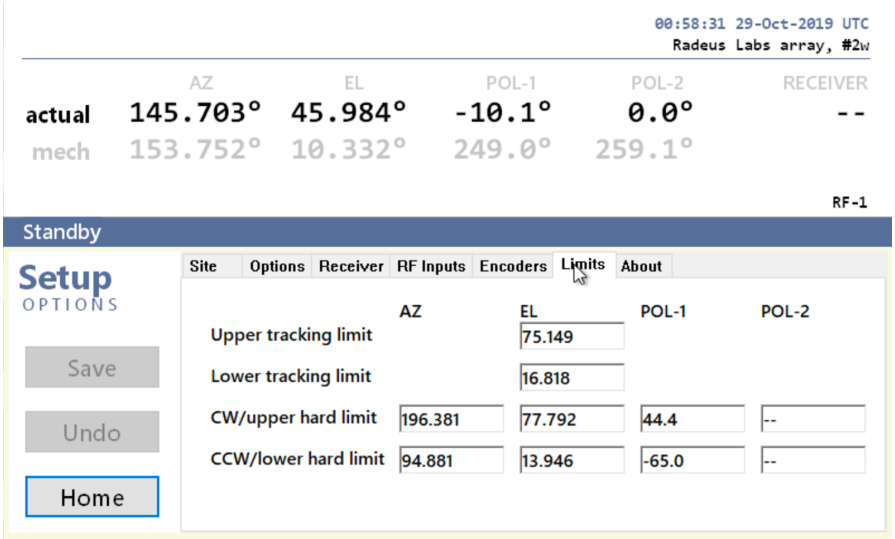



**Figure 1-17** Setup > Limits (Model 2200)

This screen gives access to the system's *soft travel limits*. Among its tasks, the Setup Wizard sets a soft limit at 2° before each limit switch, but those values can be edited.

⚠ Hard-limit values are determined by the placement of the actual hardware limit switches. *Model 2300 users run the Setup Wizard after any change to the limit switches in order to update the limit settings.*

SECTION 2

# 2 Typical Operations

System configuration and all normal operations are carried out via the ACU'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.

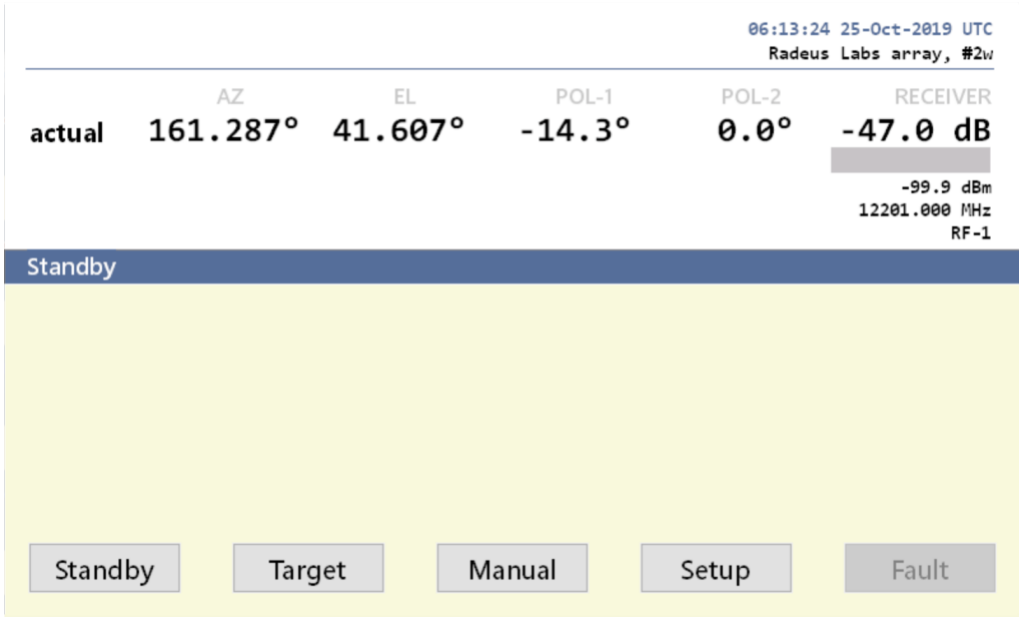



**Figure 2-1** The Home screen gives access to all operator controls and system options without obscuring the real-time data display.

- 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*[3] ("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 5), and with optional audible alert tones. For example:

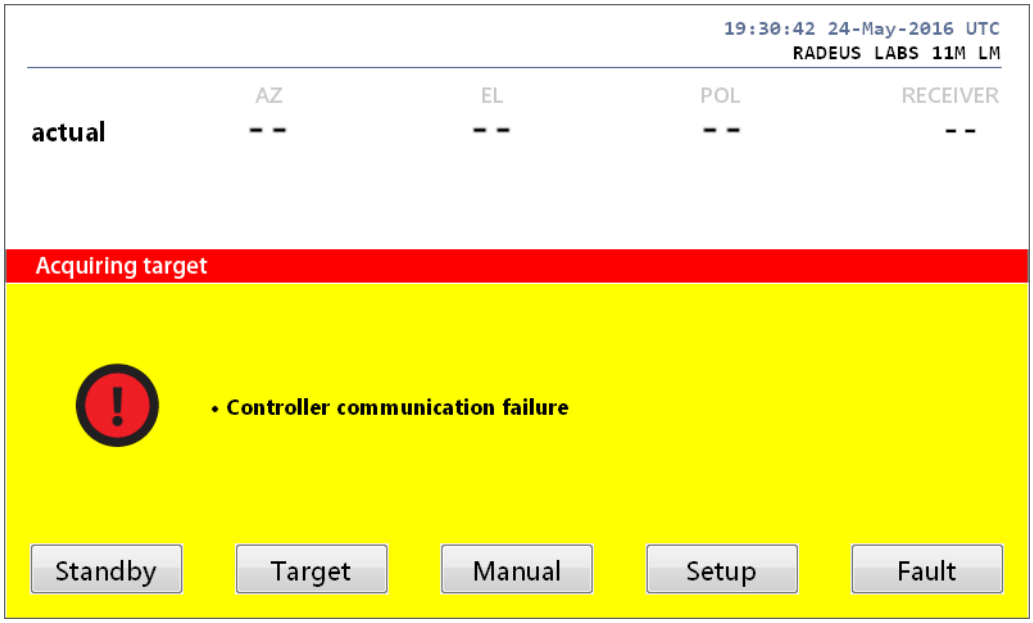



**Figure 2-2** The Home screen displays fault messages, listed in section 5.3 "Fault Messages & Causes." For audible faults, see **Figure 1-6**.

[3] 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 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 quit the ACU and display a familiar operating system desktop.

To *minimize* the ACU software without quitting, tap Home > Setup > Desktop. You'll see the OS desktop and can find the ACU again in the task bar.

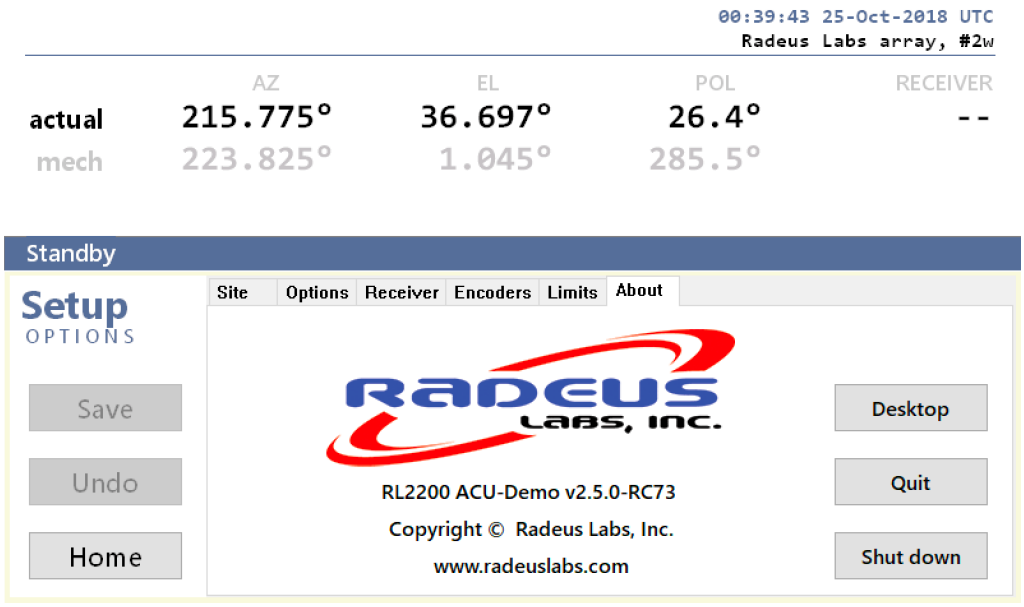



**Figure 2-3** Quit the ACU software or Shut Down *both* the ACU and Windows.

### 2.2.3 Power down the ACU and Operating System

⚠ To quit both the ACU application and the operating system, it is preferable to do so in an orderly manner:

1. Go to the Home > Setup > About screen.
2. Tap the Shut Down button.
3. Wait for the touchscreen to power off — it goes black.
4. 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

**Tip**
The process of defining a target does not interfere with any tracking in progress.

To track a satellite, in most cases, the user selects it from a list on the ACU'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:

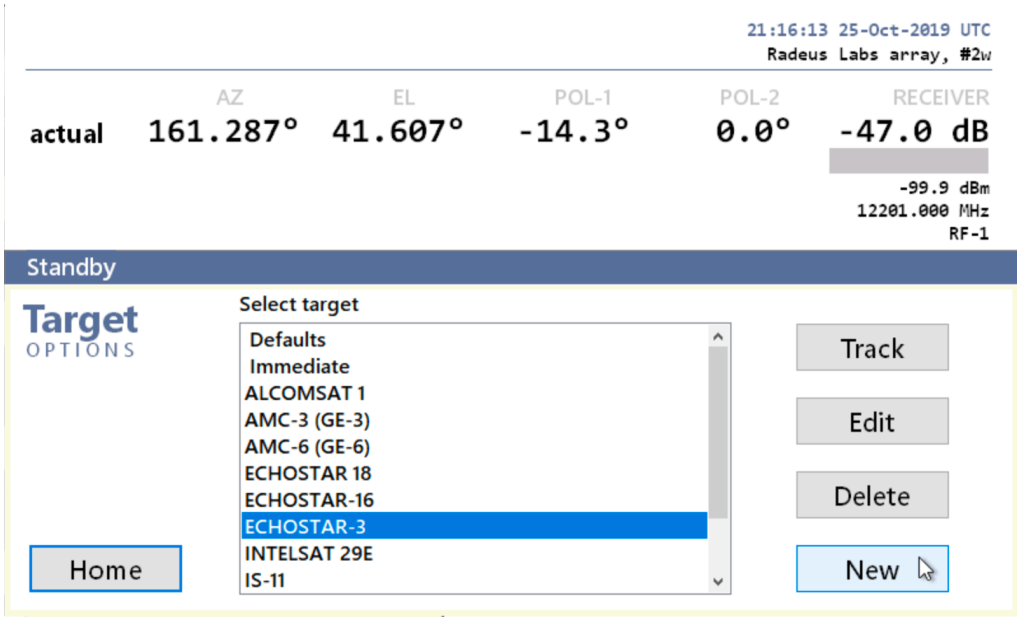



**Figure 2-4** Home > Target

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. Use the Mode drop-down to select a tracking mode for this target. The available modes, discussed in section 2.6, are:

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

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

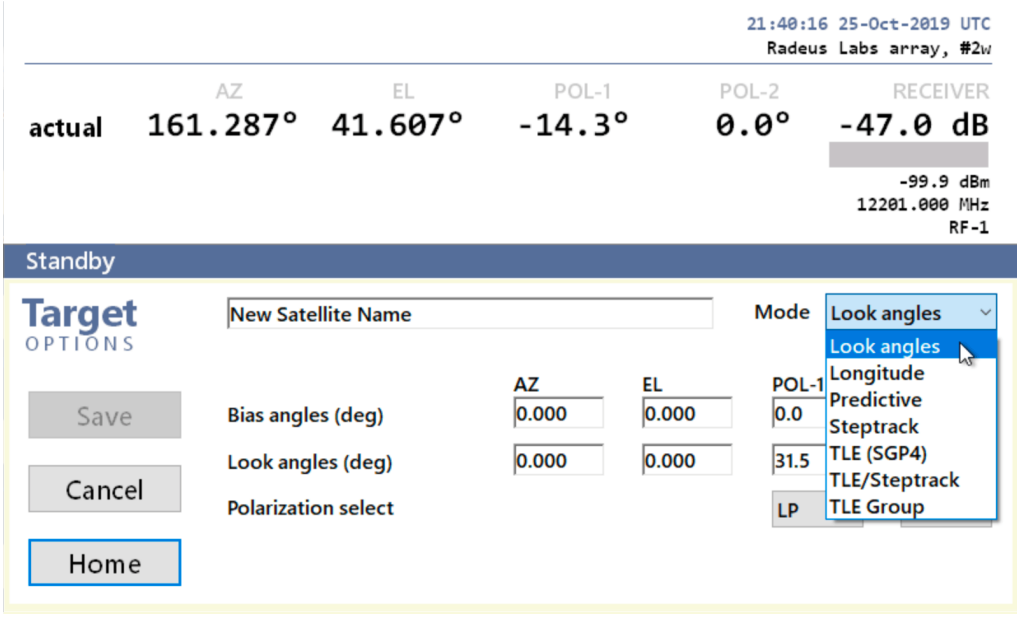



**Figure 2-5** Which input fields are displayed depends on the selected mode. Shown here are settings for using *look angles* mode.

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.)

**Tip:** Tap "Shift" to toggle between upper-case-with-numerals and lower-case-with-symbols.

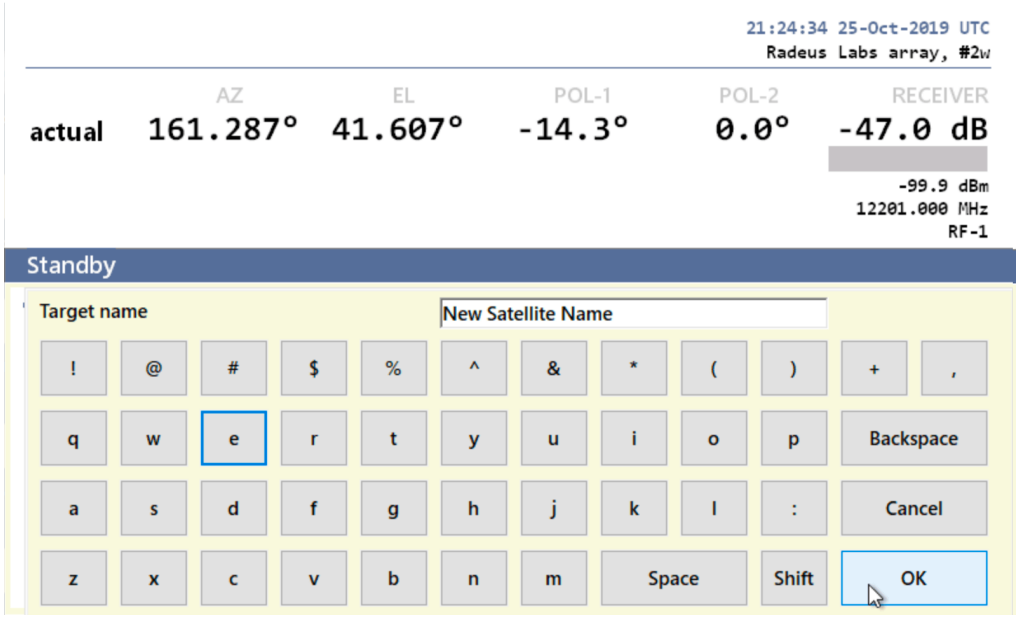



**Figure 2-6** A satellite's name can be any unambiguous label that is useful at the earth station. It's often convenient to use the satellite's common name or other unique identifier from its TLE.

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

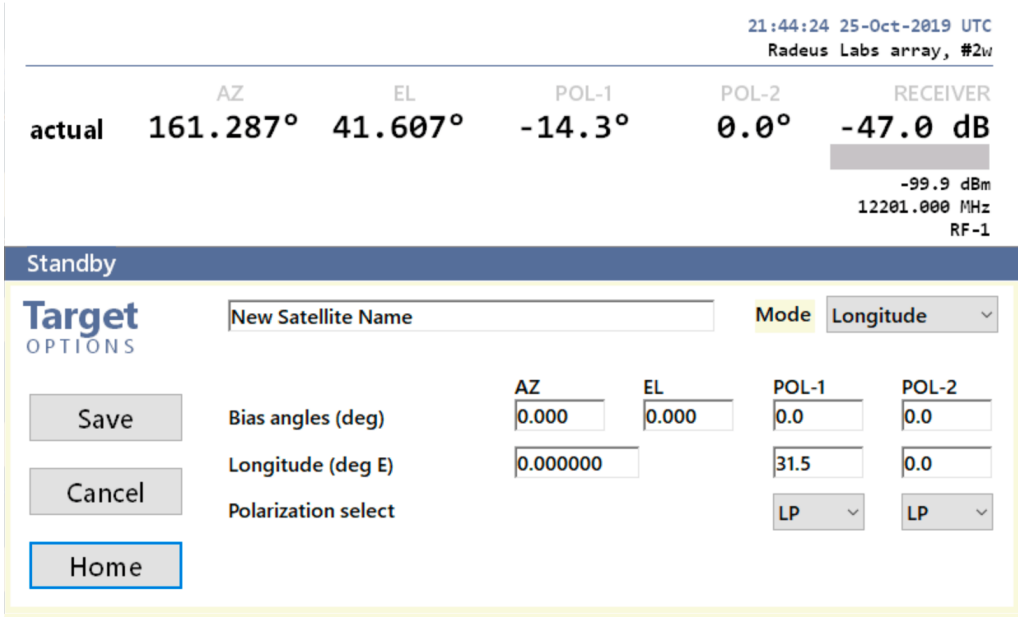



**Figure 2-7** Settings for pointing by *longitude*.

**Tip**

To use the *current* receive level as *relative 0dB*, tap the "Receive level @ 0dB" field and, in the popup keypad, just press OK without entering a value.

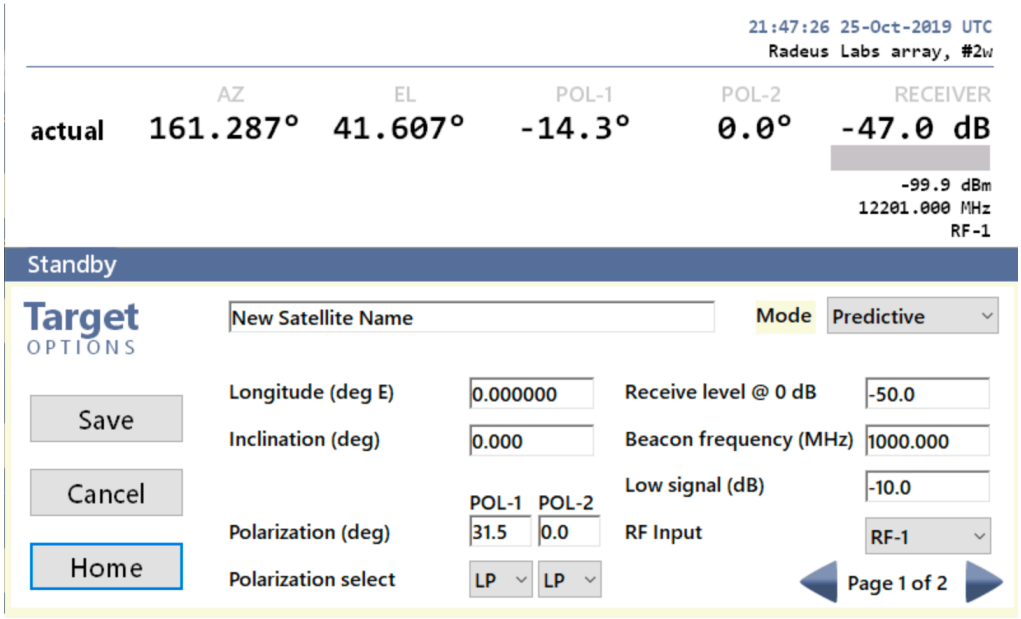



**Figure 2-8** Settings for *predictive tracking* (1 of 2)

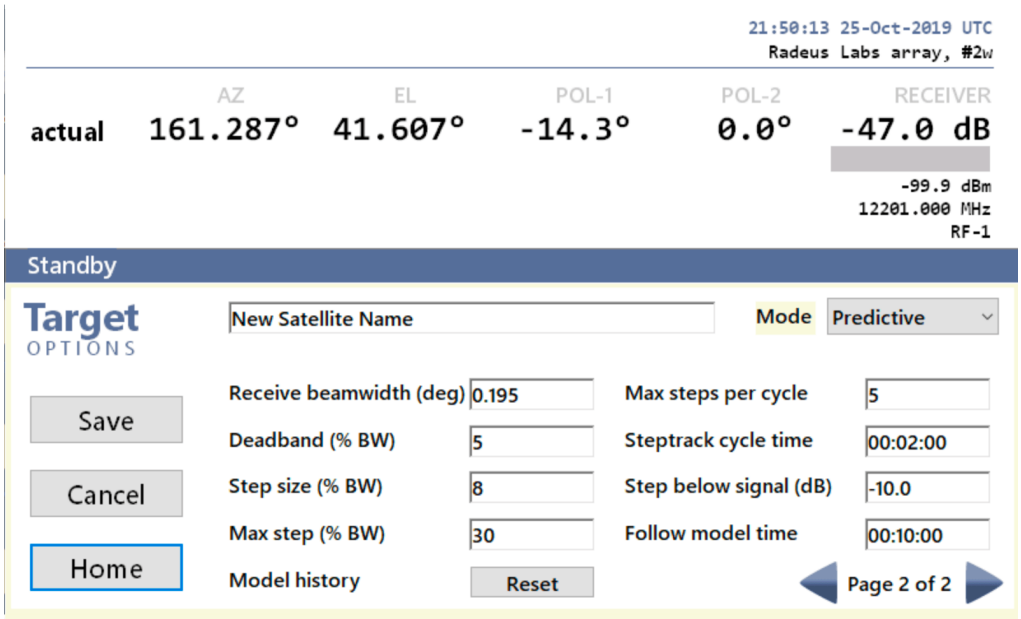



**Figure 2-9** Settings for *predictive tracking* (2 of 2)

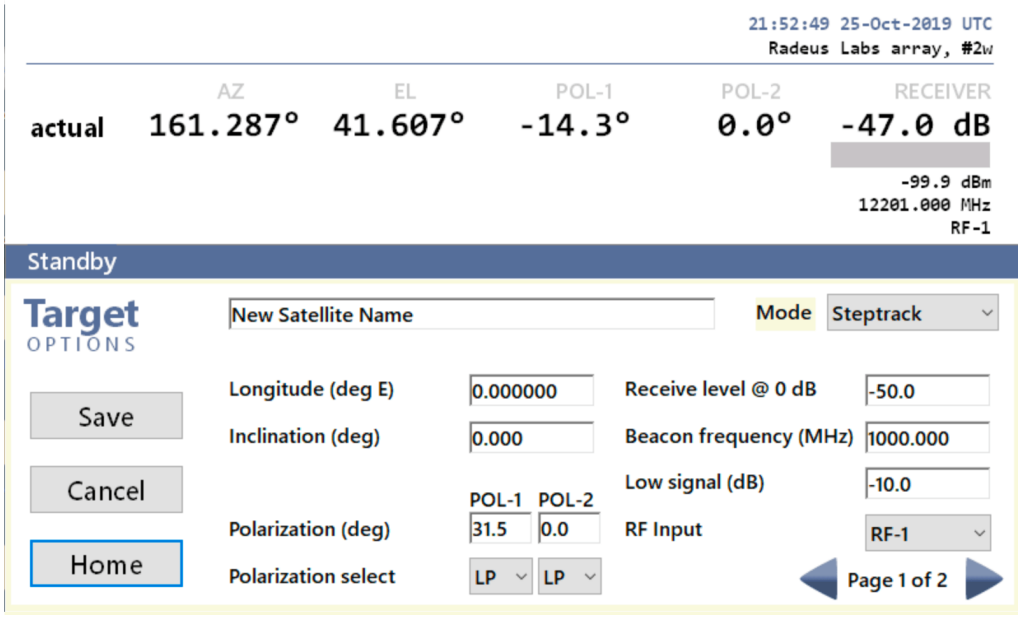



**Figure 2-10** Settings for *steptracking** (1 of 2)

***Caution**
Refer to section 2.7.2, "Steptrack" for an important precaution.

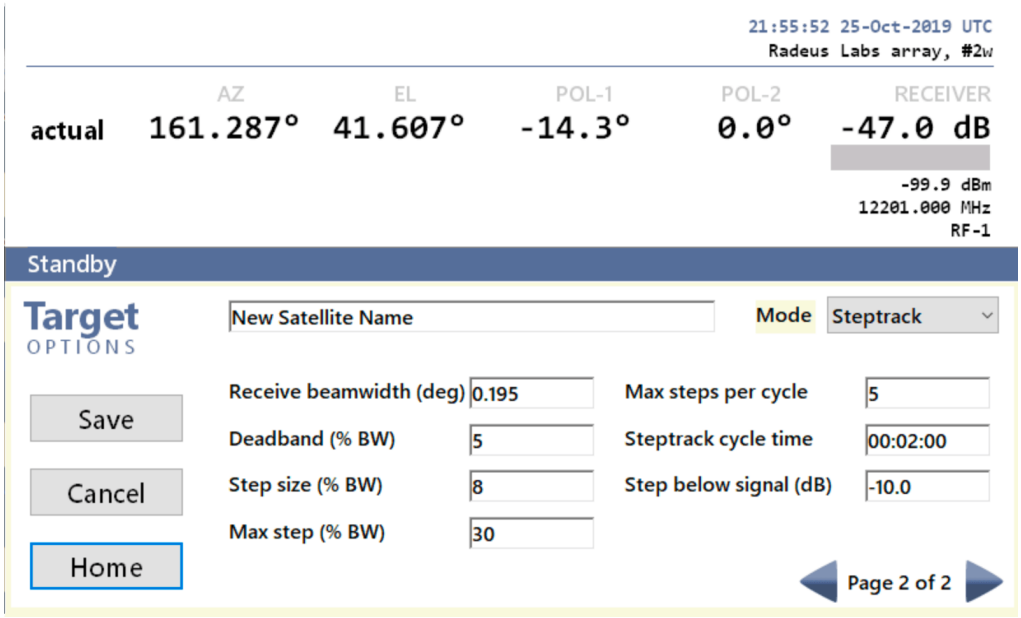



**Figure 2-11** Settings for *steptracking** (2 of 2)

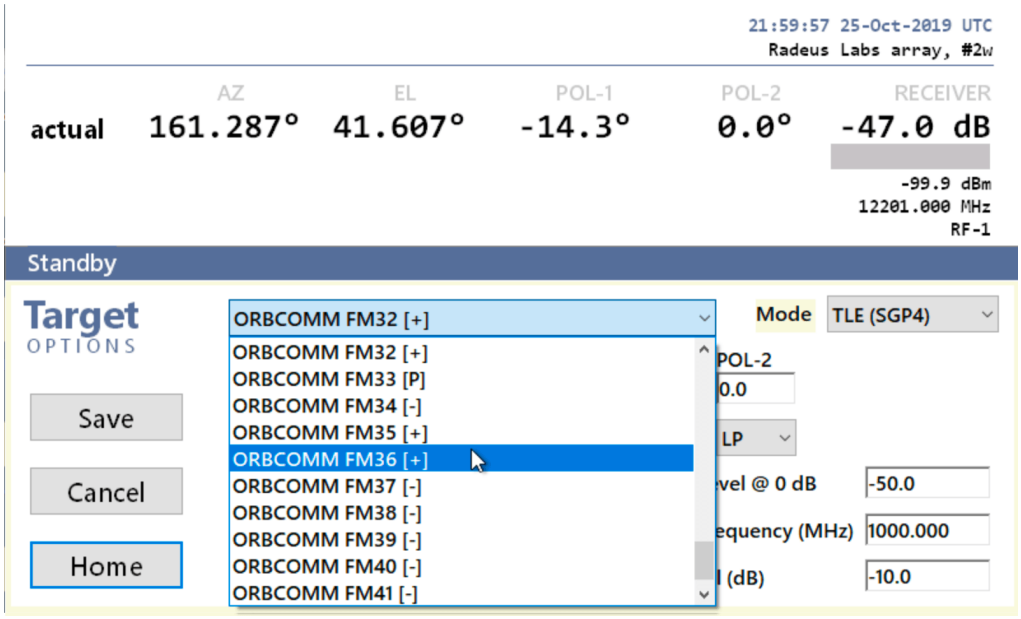



**Figure 2-12** Choosing a TLE mode provides a list of all TLE targets that are within the antenna's range. TLE satellite names cannot be edited, unlike targets defined by an ACU operator.

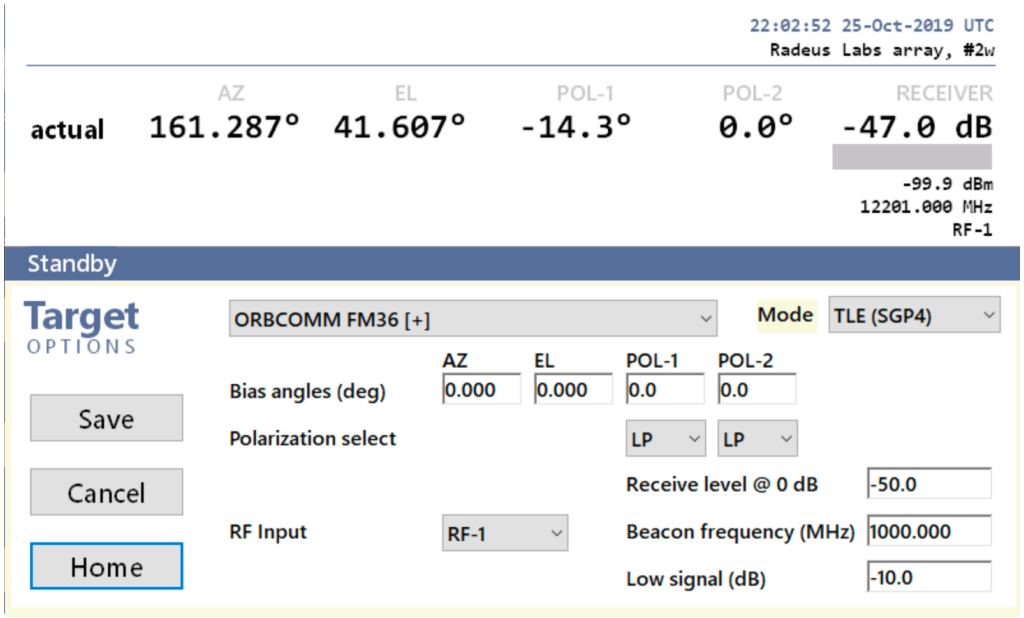



**Figure 2-13** Settings for TLE (SGP4) mode.

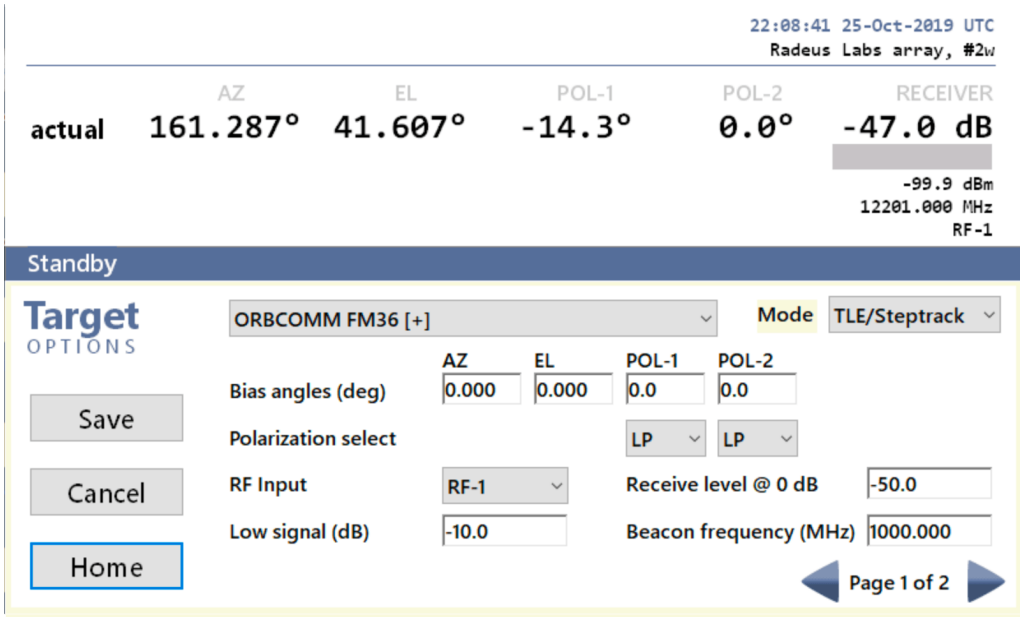



**Figure 2-14** Settings for TLE/Steptrack mode (1 of 2).

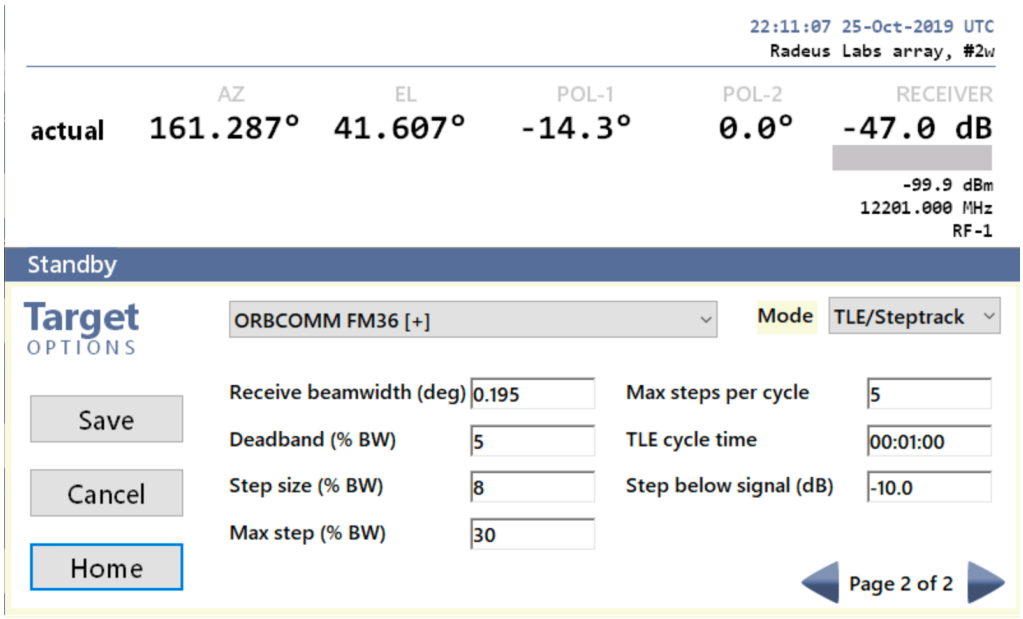



**Figure 2-15** Settings for TLE/Steptrack mode (2 of 2).

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 new targets that have been defined:

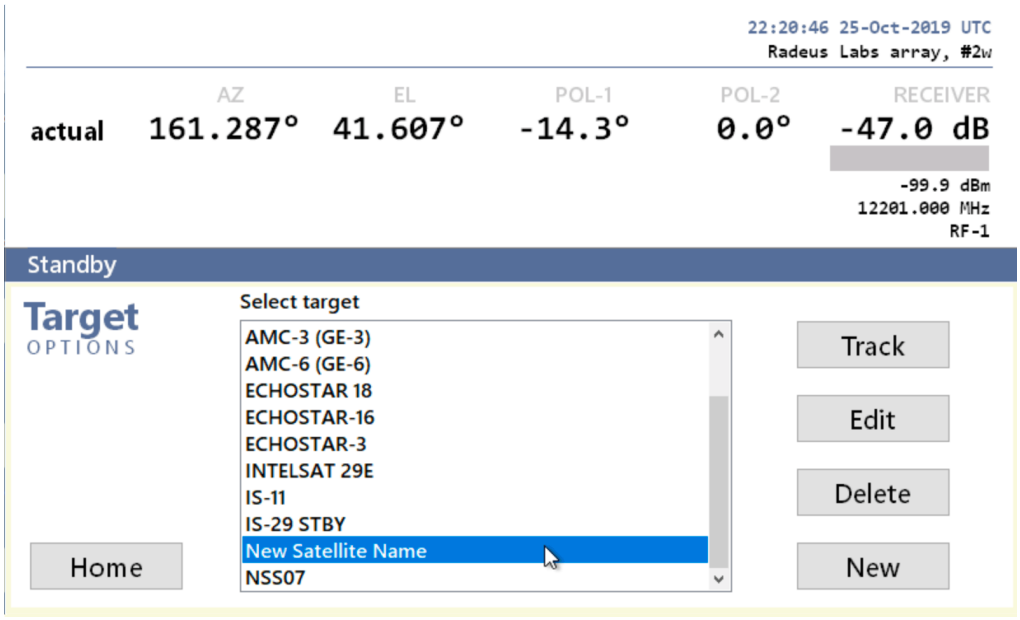



**Figure 2-16** Operator-defined targets included in the list at Home > Target.

## 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:

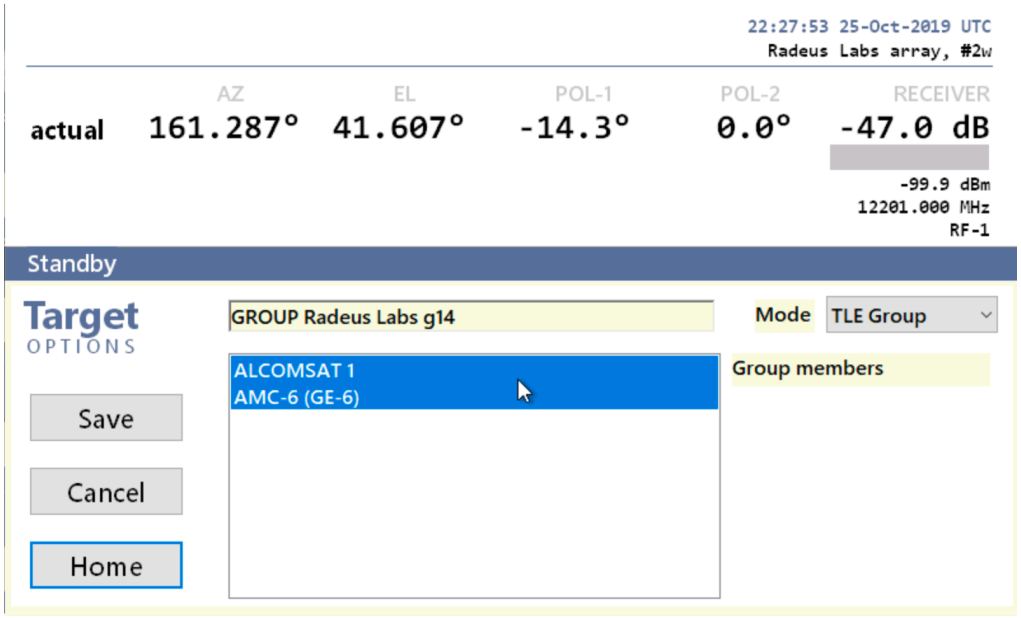



**Figure 2-17** A TLE Group includes all the user-highlighted items in the list of available TLE targets.

## 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:

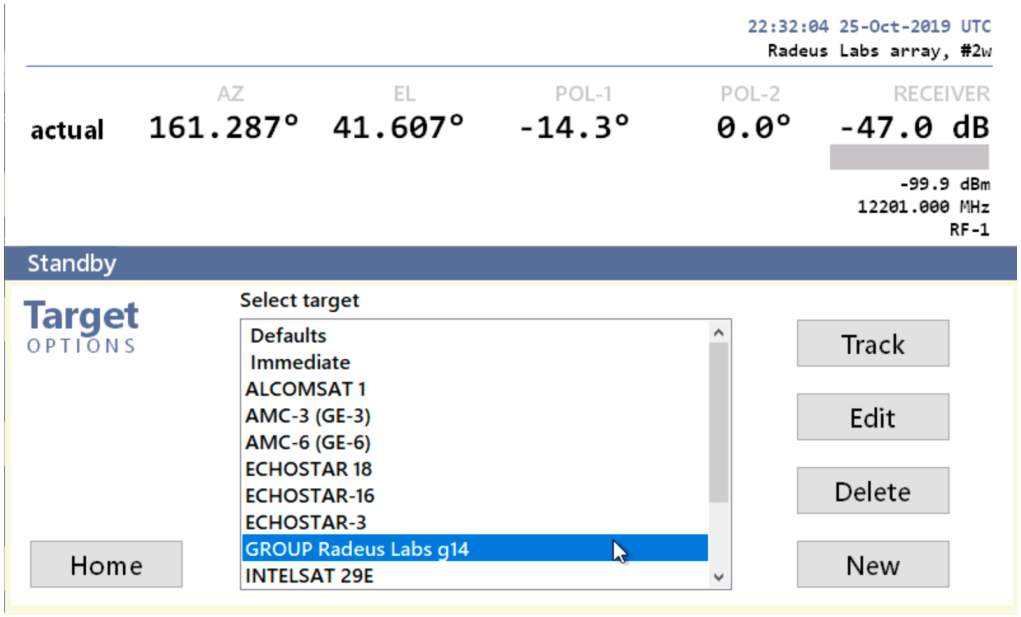



**Figure 2-18** TLE Groups appears in the same list as other defined targets.

### 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.

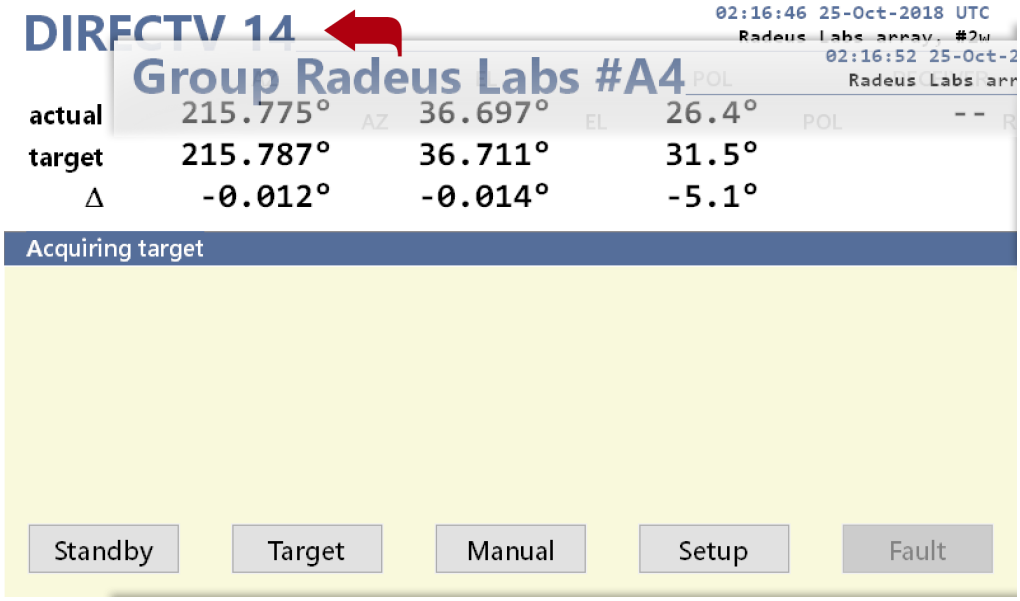



**Figure 2-19** The name of a TLE Group being tracked is periodically shown over the current, individual target's name, a reminder that the ACU is tracking a group.

### 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**):

- **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").

  Note that the Immediate target profile cannot be used with TLE or IESS pointing modes, because those modes associate the satellite name with the target profile name. The Immediate and Default profile names cannot be modified; separate, new target profiles must be created for these modes.

## 2.5 Edit a Target's Properties

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

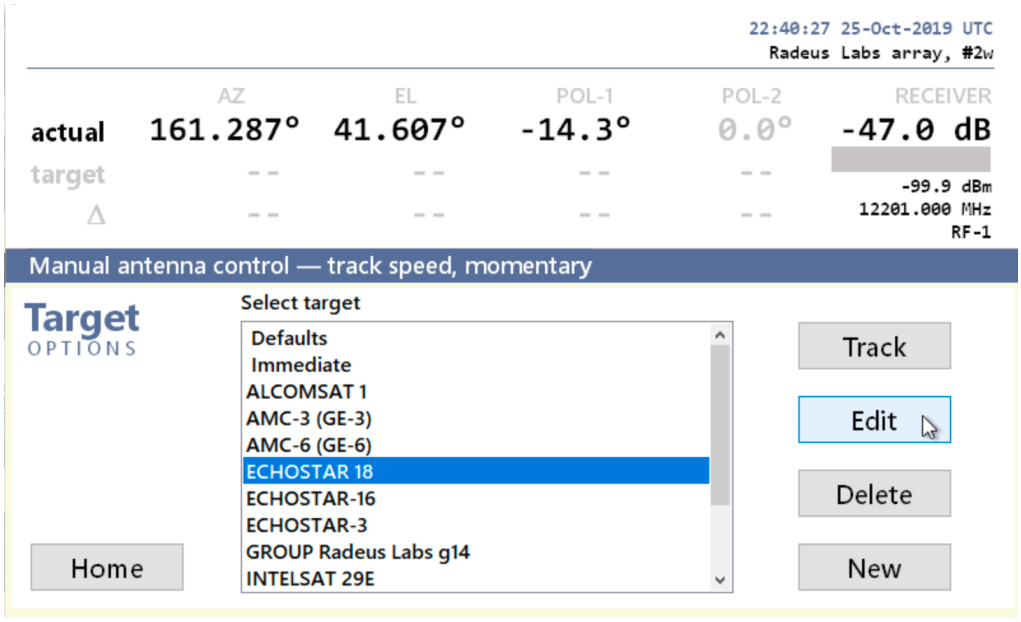



**Figure 2-20** The characteristics of any target can be edited.

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:

**TLE target missing?**
If a desired target is not listed, check the ACU's Setup > Site > Antenna coordinates and Setup > Limits to confirm the target is within the antenna's range of motion.

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.

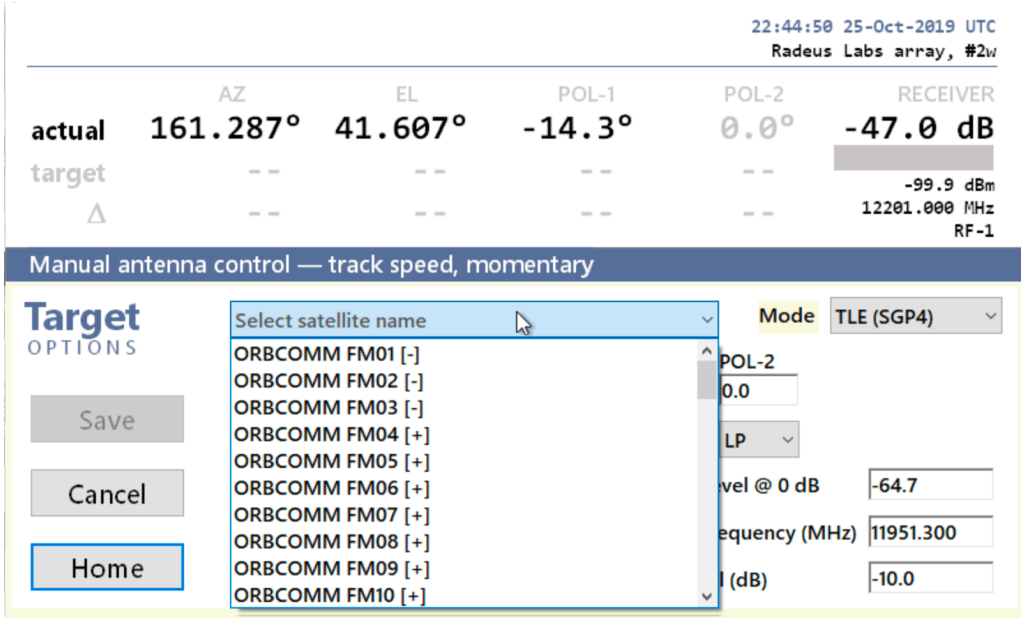



**Figure 2-21** After choosing a TLE mode, a drop-down list shows all TLE targets *that are within the antenna's range*.

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."*

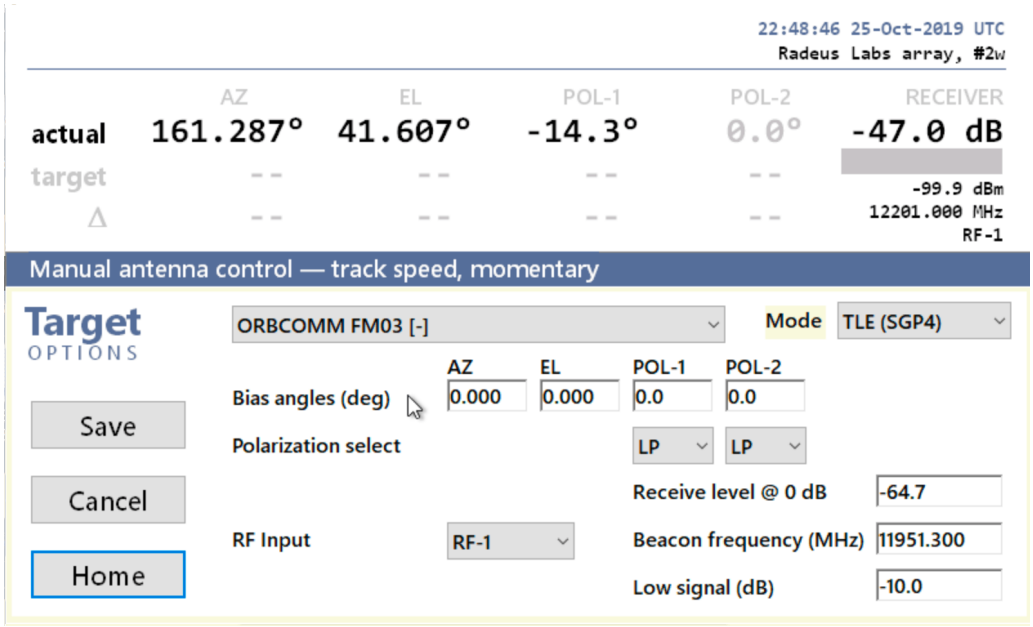



**Figure 2-22** Edit a TLE target's settings to make any site-specific adjustments.

4. After saving the target's settings, you may Track it normally:

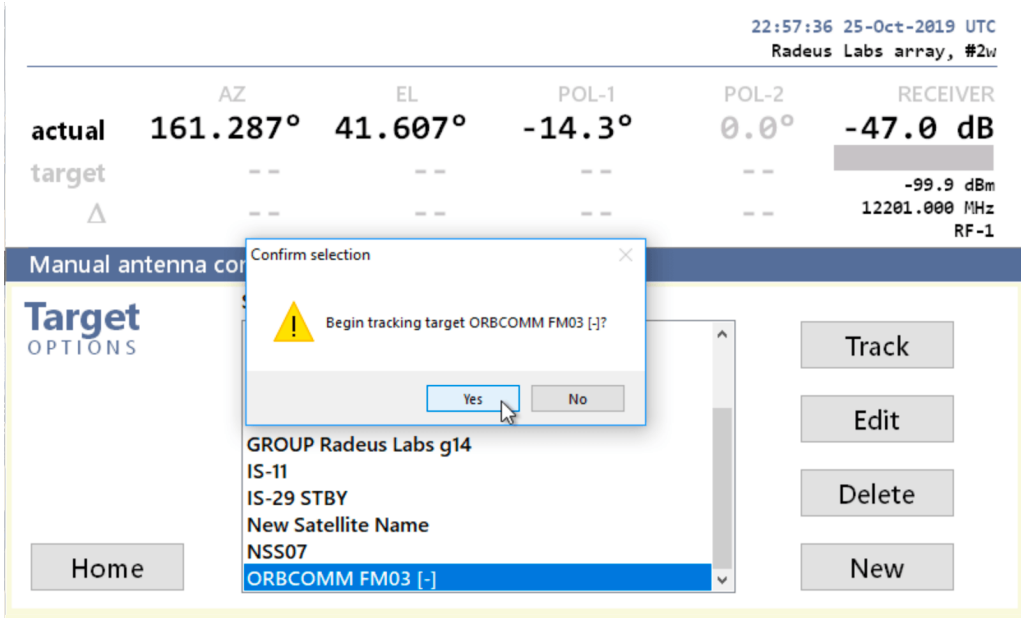



**Figure 2-23** An operator confirms before the antenna will move to a new target.

### 2.6.3.1 Requirements for TLE

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

- Internet connection to the Network connector (located on the ACU's back panel; see section 0). If no internet connection is available:

  - *The data may be updated over internal LAN.*
    Choose Setup > About > Desktop to access Windows and ensure the directory at C:\Radeus Labs is shared with write permission. Copy rl2300.txt (or rl2200.txt for the Model 2200) 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 ACU's front panel. Use the ACU's Windows interface (Setup > About > Desktop) 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.

⚠ When providing custom TLE data, the ACU should be configured to disable automatic TLE download. Otherwise, any custom TLE data will be overwritten. See Appendix A-9.5.1, "Disable automatic TLE download" for details.

Whenever any limit changes, 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.

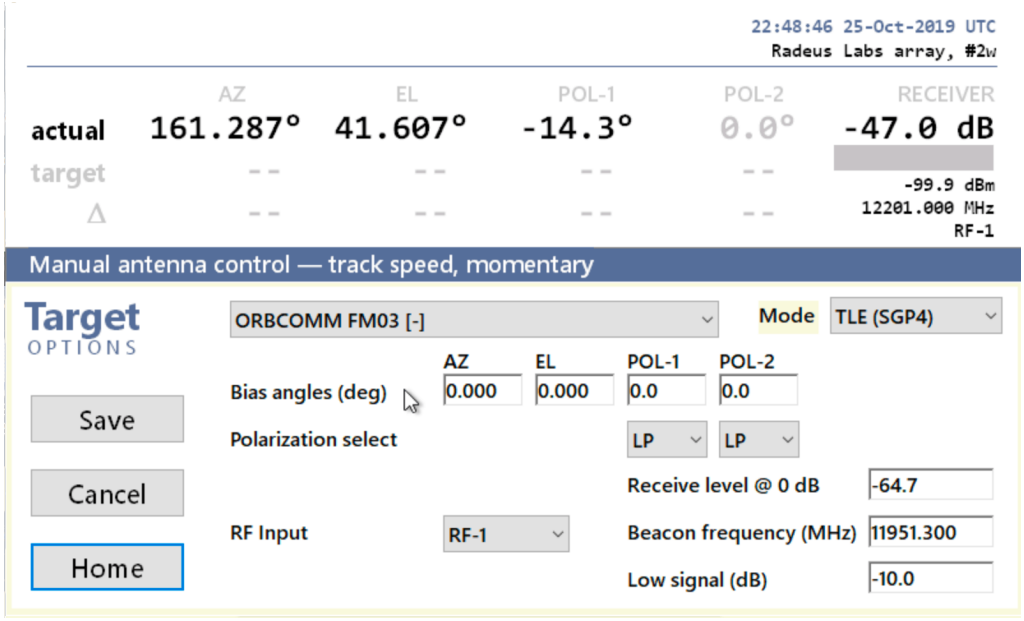



**Figure 2-24** When a pointing mode is used, apply any peak adjustments as *bias angles*, they will load when the same target is tracked in the future.

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[4] periodically to peak the signal and adjust bias angles.

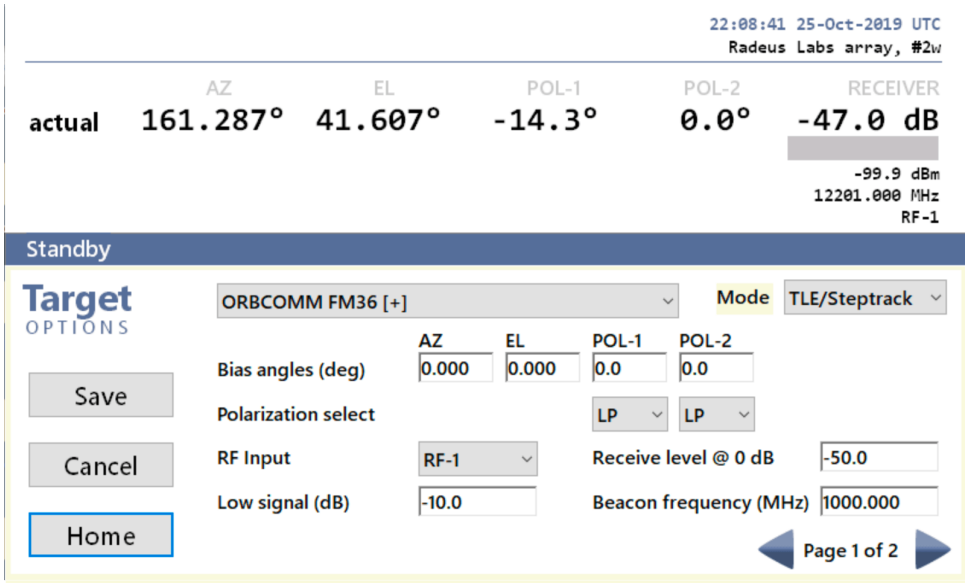



**Figure 2-25** Settings for TLE/Steptrack (1 of 2)

[4] See the caution about steptrack in "Tracking Modes."

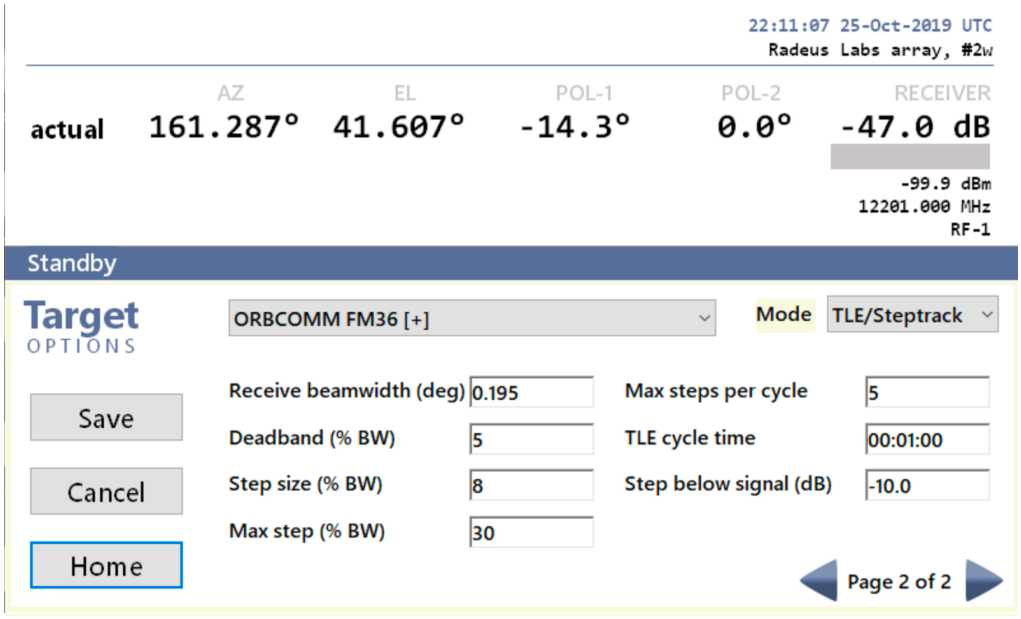



**Figure 2-26** Settings for TLE/Steptrack (2 of 2)

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 ACU 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

**Caution**
Only 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 ACU front panel provides user-configurable, manual jog controls:


**Figure 2-27** The ACU's hardware jog buttons include LEDs that show what the controller is doing. See section 2.7.5, "Track Immediate, Manual Peaking, and Bias Angles" to adjust button behaviors.

The Home > Manual button, along with the 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.*

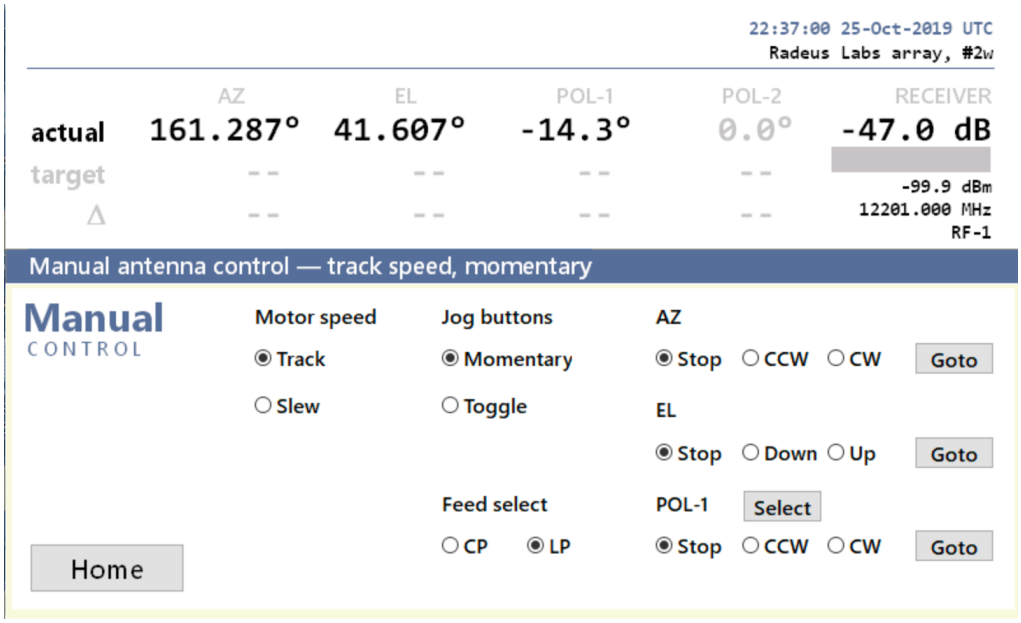



**Figure 2-28** Home > Manual
Settings for driving the antenna manually. These affect the behavior of the hardware jog controls on the front panel.

## 2.7.5 Track Immediate, Manual Peaking, and Bias Angles

**Also see:**
Section 2.6.3.2, "Bias Angles for TLE."

- …without selecting a target satellite, *or*
- …while tracking a target, in order to peak the antenna.

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.*

**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.

### 2.7.5.1 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) 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 ACU's hardware jog buttons (**Figure 2-27**).

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

## 2.8 Update the ACU software

**Note**
The ACU software is not intended to be *downgraded* to previous versions. Call Customer Support for details.

Any installed and properly licensed Radeus Labs ACU system can be updated to a newer version of the software.[5]

*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 for the ACU model being used, e.g.:*
   RL2200-base-setup-X.X.X.exe
   *or*
   RL2300-base-setup-X.X.X.exe

* 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.

[5] Subject to standard licensing.

SECTION 3

# 3 Model 2350 Drive Cabinet

*Complementing the Model 2300 ACU…*

**Figure 3-1** The Model 2350 drive cabinet from Radeus Labs. Shown with optional display panel. For the standard version, see **Figure 3-2**.

## 3.1 Jog Controls at the Cabinet

The Model 2350 drive cabinet has a *jog panel* with antenna jog controls similar to those on the front of the 2300 ACU.


**Figure 3-2** Standard jog panel shown

The Polarization, Elevation, and Azimuth controls are the same as on the ACU. When the antenna is in motion, LEDs on those controls light up blue, *whether the ACU or the drive cabinet initiated the motion.*

Three additional jog-panel buttons allow the 2350's operator to move the antenna without the ACU:

• **Local.** When *local* is selected, the operator can control the antenna from the drive cabinet's jog panel and this LED will be illuminated green.

• **Slew.** If *slew* is selected, the cabinet's jog controls will move the antenna at its slew speed and this LED will be illuminated green.

• **Toggle.** When this is not selected, the antenna moves only while the operator is actively depressing a jog button. When toggle is selected, the antenna starts moving at a button press *and keeps moving until an operator presses the same button again* (LED is illuminated green). Either way, limit switches are still in effect.

### 3.1.1 Jog panel with display option


**Figure 3-3** Model 2350's jog panel inside the cabinet largely duplicates the jog panel of the ACU. Jog panel with optional display shown.

Upon drive cabinet power on, all displays will briefly show "88.88".

When the drive cabinet is disconnected from the ACU, the displays will show "-ACU".

When there is no encoder or resolver reading to display (due to disconnection or failure), the displays will show "--". The ACU must be connected to the drive cabinet, and have its position and offset parameters configured, for the drive cabinet jog panel to show position data. After the ACU has been connected to the drive cabinet once, with position and offset configured, *the displays will continue to indicate position even if the ACU is disconnected later.*

In the case of ACUs without receivers, or upon losing receiver communication, the Frequency and dB displays will indicate "--".

## 3.2 Power, Breakers, E-Stop

In addition to the jog panel and optional display, above, more drive cabinet controls are shown in **Figure 3-4**. The E-Stop switch works by de-asserting the drive-enable line.

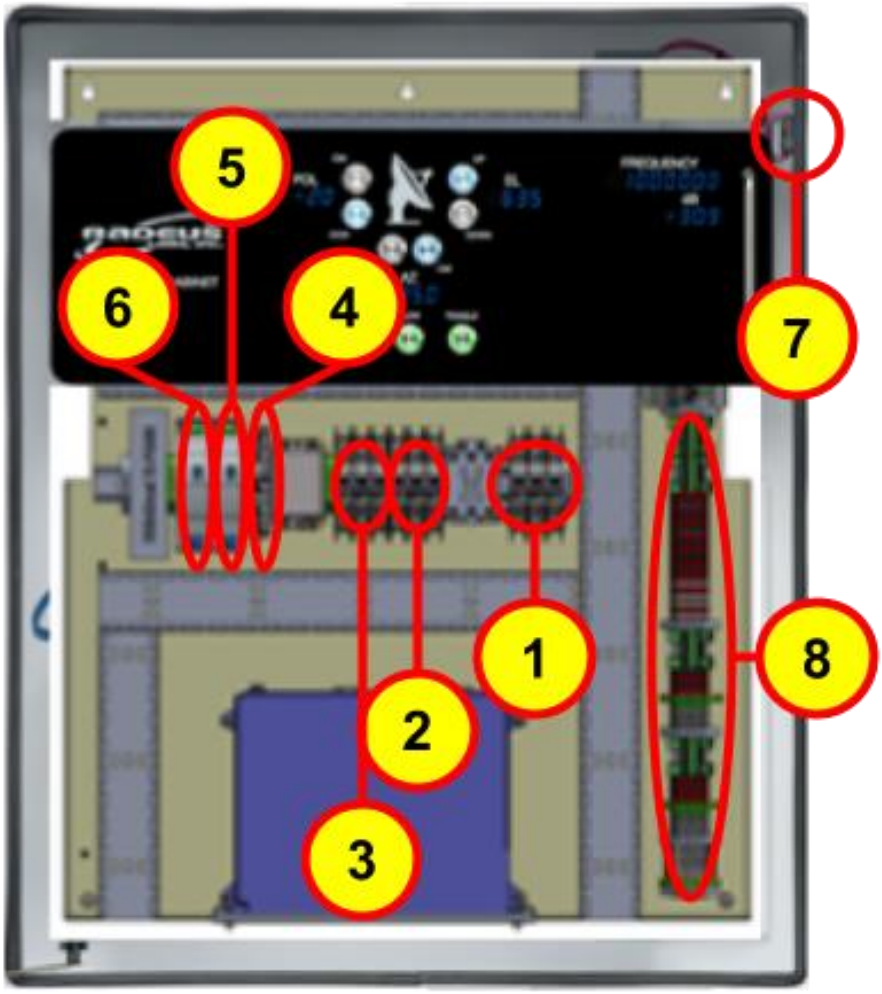
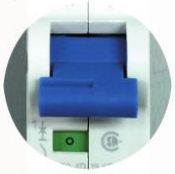



**Figure 3-4** Model 2350 power mains, breakers, and emergency stop

1. Main breaker
2. EL drive breaker
3. AZ drive breaker
4. Power supply breaker
5. 48V power supply
6. 12V power supply
7. E-Stop switch
8. Customer Interface Block (CIB)

**All circuit breakers:**

Down = OFF
green, finger-safe



Up = ON
red, hot, not safe

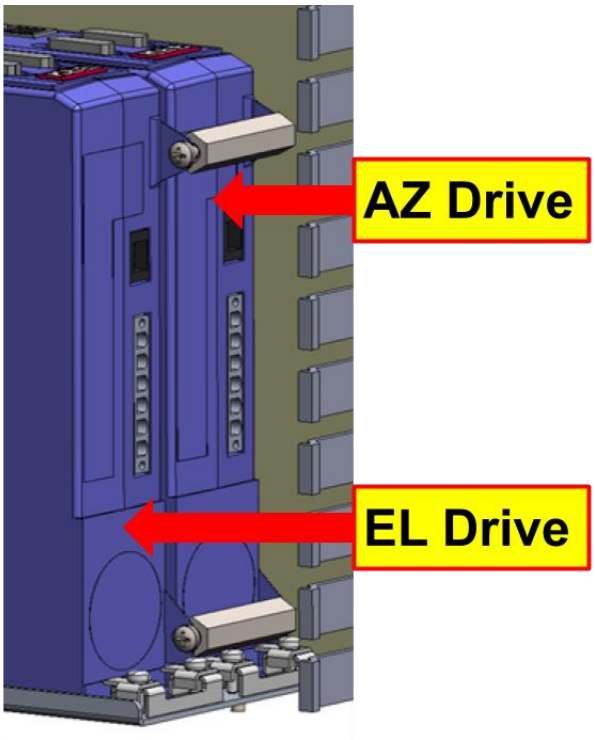



**Figure 3-5** AZ and EL drive orientation.

## 3.2.1 Emergency Stop


- To stop all antenna motion as quickly as possible, push the red e-stop switch.

- The e-stop stops the motor and engages brakes (if available).
- Activating the e-stop does not remove electrical power from the drive cabinet.
- During an emergency, disconnect all power sources.
- To release the e-stop, twist the knob clockwise.

## 3.2.2 Safety Interlocks

### 3.2.2.1 Safe Torque Off (STO) Interlocks

The motor drives used in the 2350 provide a Safe Torque Off (STO) function. During normal operation the STO pins see 24V which enables the drive to power the motors. If the 24V is lost due to a break in the wire or activation of the driving circuit, the drive's hardware prevents power to the motor.

*Caution:* Activation of the STO inputs (0V on the input) prevents the drive from providing torque to the motor. *If the motor is used to hold a hanging weight that could fall, the circuits activating the STO inputs must also activate a break that can hold the load safely.*

The Model 2350 supports two inputs on azimuth and elevation that feed the motor drive's STO input pins. One input on each drive is fed by the cabinet and customer E-Stop daisy-chain. The second input on each drive is intended for use with a manual hand-crank input.

### 3.2.2.2 Non-STO Interlocks

The 2350 supports inputs for stow pin interlocks. When engaged, the drive may maintain torque to the motors for some period of time, depending on the antenna design. After any applicable time has elapsed, the controller will prevent power to the motors until the stow pin is disengaged.

### 3.2.3 Travel Limits

The 2350 supports two sets of travel limits for azimuth and elevation:

- **Pre-Limits:** activation of the pre-limit switch causes the motors to run at a reduced velocity.

- **Final Limits:** there are two final limit functions: *hard final* and *soft final*. The soft final limit is a travel limit — programmed into the motor drive during the Setup Wizard's limit-discovery process — that is set to activate before encountering the hard final limit. When the soft final limit is activated, motion out of the limit is allowed while motion into the limit is disabled. The hard final limit is the physical limit switch at the end of mechanical travel. When the hard final limit is activated, motion in all directions is disabled and the antenna position must be corrected manually.

### 3.2.4 Motion Warning

The Model 2350 supports powering a motion-warning light and/or horn (24V 2A). The motion-warning circuit is activated when there is potential for movement of the axis; specifically, it is active whenever the control is not in Standby mode. Outputs for *normally closed* and *normally open* are available.

| Function | CIB# | Description |
|---|---|---|
| **IFL** | 220 | Ethernet to ACU |
| | | |
| **AZ Position feedback** | 210-7 | Shield |
| | 210-6 | Rotor |
| | 210-5 | Rotor Not |
| | 210-4 | Sine |
| | 210-3 | Sine Not |
| | 210-2 | Cosine |
| | 210-1 | Cosine Not |
| | | |

| | | |
|---|---|---|
| **EL Position feedback** | 200-7 | Shield |
| | 200-6 | Rotor |
| | 200-5 | Rotor Not |
| | 200-4 | Sine |
| | 200-3 | Sine Not |
| | 200-2 | Cosine |
| | 200-1 | Cosine Not |
| **Crank** | 181 | Summary Crank Source |
| | 180 | Summary Crank Return |
| **Stow** | 173 | EL Stow Source |
| | 172 | EL Stow Return |
| | 171 | AZ Stow Source |
| | 170 | AZ Stow Return |
| **E-STOP** | 163 | SW1 Source |
| | 162 | SW1 Return |
| | 161 | SW2 Source |
| | 160 | SW2 Return |
| **MOTION (1A Max)** | 152 | Motion Warning Normally Open |
| | 151 | Motion Warning Return |
| | 150 | Motion Warning Normally Closed |
| **EL Limit** | 145 | Elevation Up Pre-Limit |
| | 144 | Elevation Pre-Limit Common Source |
| | 143 | Elevation Down Pre-Limit |
| | 142 | Elevation Up Final Limit |
| | 141 | Elevation Max Limit Common Source |
| | 140 | Elevation Down Final Limit |

| | | |
|---|---|---|
| **AZ Motor** | 69-7 | AZ Resolver Cable Shield |
| | 69-6 | AZ Resolver R2 REF - |
| | 69-5 | AZ Resolver R1 REF + |
| | 69-4 | AZ Resolver S4 COS - |
| | 69-3 | AZ Resolver S3 SIN - |
| | 69-2 | AZ Resolver S2 COS + |
| | 69-1 | AZ Resolver S1 SIN + |
| | 68 | Motor Thermal Sensor - |
| | 67 | Motor Thermal Sensor + |
| | 66 | AZ Brake Return |
| | 65 | AZ Brake |
| | 64 | PE |
| | 63 | Shield |
| | 62 | U |
| | 61 | V |
| | 60 | W |
| **EL Motor** | 59-7 | EL Resolver Cable Shield |
| | 59-6 | EL Resolver R2 REF - |
| | 59-5 | EL Resolver R1 REF + |
| | 59-4 | EL Resolver S4 COS - |
| | 59-3 | EL Resolver S3 SIN - |
| | 59-2 | EL Resolver S2 COS + |
| | 59-1 | EL Resolver S1 SIN + |
| | 58 | Motor Thermal Sensor - |
| | 57 | Motor Thermal Sensor + |
| | 56 | EL Brake Return |
| | 55 | EL Brake |
| | 54 | PE |
| | 53 | Shield |
| | 52 | U |
| | 51 | V |
| | 50 | W |

| | | |
|---|---|---|
| **Main Power** | 5 | L1 |
| | 4 | L2 |
| | 3 | L3 |
| | 2 | Neutral |
| | 1 | Ground |

SECTION 4

# 4 Model 2048 Smart Motor Controller (RL2048SMC)

*Relevant to Model 2200 ACUs only.*

The Model 2048 Smart Motor Controller is specifically designed to allow the ACU to control Moog Animatics SmartMotors on the M² AE2000 antenna. It is mounted in the antenna's drive cabinet, which provides the power and jog controller.

**Figure 4-1** The Model 2048 Smart Motor Controller (RL2048SMC)

**Interfaces:**
For connection details, see appendix A-4.3, "Interfaces."

## 4.1 Remote/Local Control

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

### 4.1.1 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.

### 4.1.2 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.

## 4.2 Jog Controller

The RL2048SMC interfaces with the handheld jog controller provided with the M² ACU-X2PFM-C230. 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.


**Figure 4-2** Jog controller provided with the M² ACU-X2PFM-C230. (Not the same as the handheld PMCU made by Radeus Labs.)

### 4.2.1 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."

### 4.2.2 Zeroing with the Jog Controller

*Care must be taken to ensure the antenna is safe for fast motion before initiating the zeroing function.* It 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.

### 4.2.3 Limits

The zeroing function discovers the positions of the hard limit switches. When their locations are found, the system sets a *soft limit* 1° from each limit switch in order to protect the mechanical system from damage. This soft limit cannot be changed by the user.

SECTION 5

# 5 System-Fault Conditions

See the safety information in "Important Precautions" before proceeding.

**WARNING**

⚠ Disconnect power in case of any emergency.

The 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.

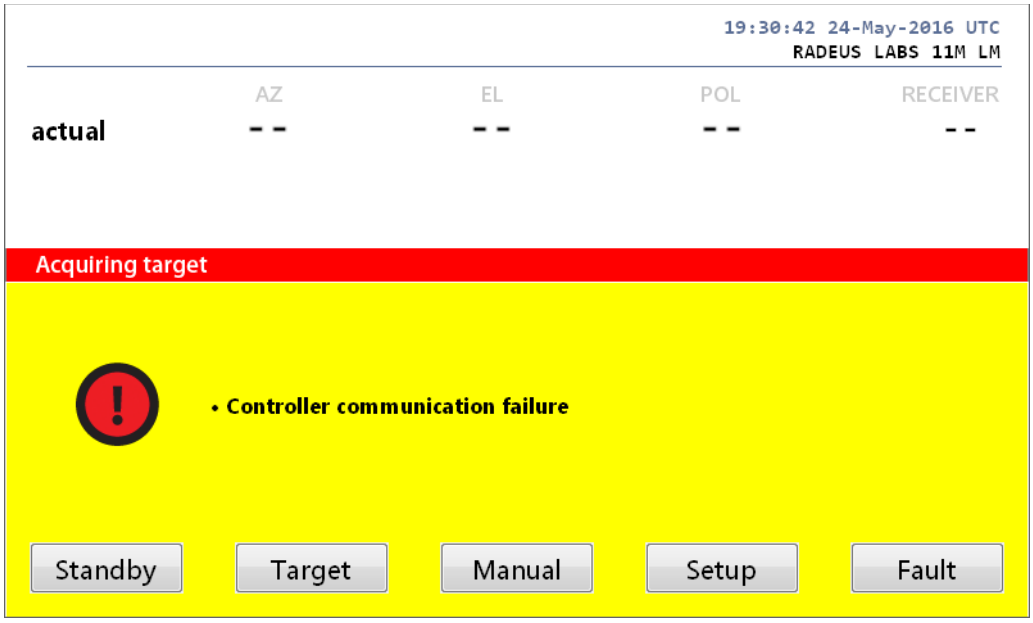



**Figure 5-1** A warning and fault description(s) are displayed, and a warning tone can be issued, if the ACU detects a fault condition.

## 5.1 Faults and System Standby

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

Drive disabled at control panel (pg. 77)

Maintenance override at drive cabinet (pg. 77)

…motor communication failure (pg. 75)
…not zeroed (pg. 76)
…motor program downloading (pg. 76 )

Polarization travel limit switch tripped (pg. 77)
Elevation travel limit switch tripped (pg. 76)
Azimuth travel limit switch tripped (pg. 75)

Azimuth motor controller fault (pg. 75)
Elevation motor controller fault (pg. 76)

## 5.2 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 5.3.

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.

## 5.3 Fault Messages & Causes

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

### 5.3.1 "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.

### 5.3.2 "Azimuth CW soft travel limit"

See preceding.

### 5.3.3 "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.

### 5.3.4 "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.

### 5.3.5 "Azimuth motor communication failure"

May put system in standby.

### 5.3.6 "Azimuth not zeroed"

See section 1.4, “Zeroing.” May put system in standby.

### 5.3.7 "Azimuth motor program downloading"

May put system in standby.

### 5.3.8 "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.

### 5.3.9 "Elevation upper soft travel limit"

See preceding.

### 5.3.10 "Elevation motor controller fault"

See section 5.3.3, "Azimuth motor controller fault". May put system in standby.

### 5.3.11 "Elevation travel limit switch tripped"

See section 5.3.4, "Azimuth travel limit switch tripped". May put system in standby.

### 5.3.12 "Elevation motor communication failure"

See section 5.3.5, "Azimuth motor communication failure". May put system in standby.

### 5.3.13 "Elevation not zeroed"

See section 1.4, “Zeroing.” May put system in standby.

### 5.3.14 "Elevation motor program downloading"

See section 5.3.7, "Azimuth motor program downloading" May put system in standby.

### 5.3.15 "Polarization CCW soft travel limit"

See section 5.3.1, "Azimuth CCW soft travel limit".

### 5.3.16 "Polarization CW soft travel limit"

See section 5.3.2, "Azimuth CW soft travel limit".

### 5.3.17 "Polarization travel limit switch tripped”

See section 5.3.4, "Azimuth travel limit switch tripped". May put system in standby.

### 5.3.18 "Polarization motor communication failure"

See section 5.3.5, "Azimuth motor communication failure" May put system in standby.

### 5.3.19 "Polarization not zeroed"

See section 1.4, “Zeroing.” May put system in standby.

### 5.3.20 "Polarization motor program downloading"

See section 5.3.7, "Azimuth motor program downloading" May put system in standby.

### 5.3.21 "Drive disabled at control panel"

Drive was disabled via the drive-enable switch on the ACU front panel. Use that switch to re-enable the drive. May put system in standby.

### 5.3.22 "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.

### 5.3.23 "Drive cabinet door open"

*Applies only to the Model 2200 ACU.*

This fault is simply informative, it does not affect normal operation. It indicates that the door on the M² ACU-X2PFM-C230 cabinet is open.

## Touch-panel computer (TPC) faults

### 5.3.24 "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.

### 5.3.25 "Unstable tracking signal level"

The tracking signal is varying too rapidly to steptrack.

### 5.3.26 "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.

### 5.3.27 "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.

### 5.3.28 "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 Home > Fault to simply clear the fault *alert* — if the issue isn't addressed, the system may report the fault again.

### 5.3.29 "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.

### 5.3.30 "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.

### 5.3.31 "Receiver not locked"

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

### 5.3.32 "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).

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

### 5.3.33 "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:*

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

### 5.3.34 "Orbital tracking limit"

The ACU is attempting to track the target along the path bound by the orbital tracking limit option. The ACU may partially or completely lose the target signal during this condition.

*Troubleshooting:*

1. Increase the orbital tracking limit.
2. Verify the tracking beamwidth.
3. Increase the tracking deadband (see section 1.4.6, "Positioner").
4. To disable orbital track, set Setup > Limits > Orbital to 0.

### 5.3.35 "Sun outage"

The ACU detects a sun outage that will occur or is currently occurring. It prevents further steptrack cycles until the sun outage has passed.

### 5.3.36 "PMCU firmware update failed"

*Troubleshooting:*

1. Clear the fault and verify system is operating normally.
2. If not, cycle power at the drive cabinet.
3. If issues persist, contact support.

SECTION

A

# APPENDICES

# Appendix 1: Model 2200 & 2300 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

| | |
|---|---|
| Remote: | Ethernet, SNMP |
| Serial: | USB, RS-232 (x2 each) |
| Receiver: | Analog 0–10 VDC interface |
| | Serial DTR interface |
| | Optional internal L-band receiver |
| ADU: | Ethernet interface |
| Alarm: | Summary output |
| | Audible tone for fault conditions |

## 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

| | |
|---|---|
| Power: | 100–240 VAC |
| | 47–63 Hz |
| | 100 W typical |
| | |
| Motor: | Moog Animatics SmartMotor Series |

## Mechanical

Height: 7” (four-rack units)

Width: 19”

Depth: 19”

Weight: 20 lbs.

# Appendix 2: ACU Rear Panel Connections

**Also see:** Appendix 3: "ACU, RS-232 Interface"

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

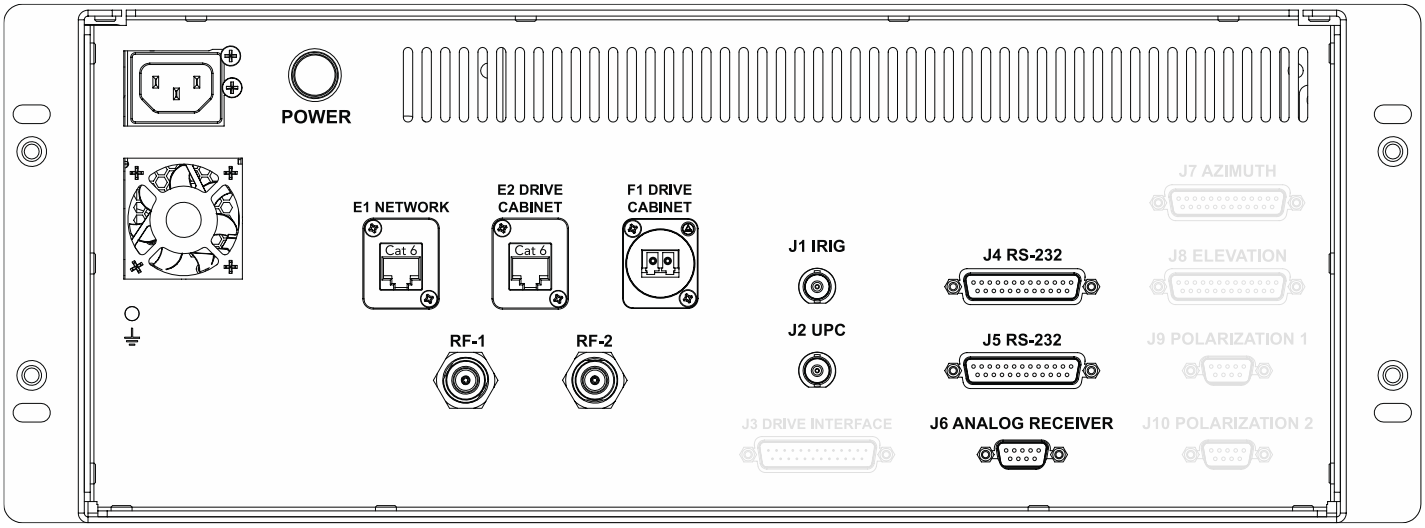



**Figure 5-2** Actual rear panels vary depending on the configuration.

**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: ACU, RS-232 Interface.)

**J5 — RS-232**

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

**J6 — ANALOG RECEIVER**

DB9M connector for internal receiver analog output.

# A-2.1 Pinouts

**RF-1**
**RF-2**
**J1 — IRIG**
**J2 — UPC**

| PIN | FUNCTION |
|---|---|
| center | positive (+, signal) |
| shield | negative (–) |

**J4**
**J5 — RS-232**
***Also see:*** **Appendix 3: "ACU, RS-232 Interface"**

| PIN | FUNCTION |
|---|---|
| 1 | DCD |
| 2 | RXD |
| 3 | TXD |
| 4 | DTR |
| 5 | SGND |
| 6 | DSR |
| 7 | RTS |
| 8 | CTS. |
| 9 | RI. |
| 10 | N.C. |

| | |
|---|---|
| 11 | N.C. |
| 12 | N.C. |
| 13 | N.C. |
| 14 | N.C. |
| 15 | N.C. |
| 16 | N.C. |
| 17 | N.C. |
| 18 | N.C. |
| 19 | N.C. |
| 20 | N.C. |
| 21 | N.C. |
| 22 | N.C. |
| 23 | N.C. |
| 24 | N.C. |
| 25 | N.C. |

## J6 — ANALOG RECEIVER

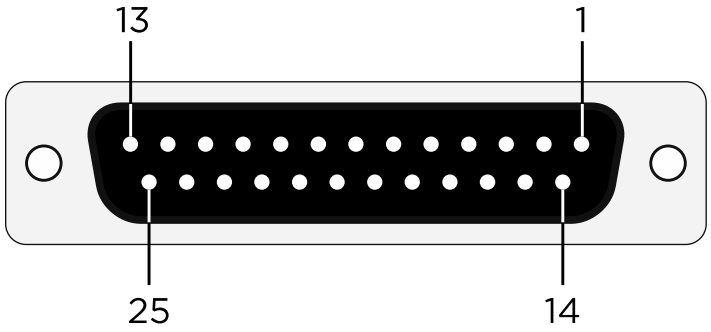
| PIN | SIGNAL | FAN PIN |
|---|---|---|
| 1 | NC | NC |
| 2 | AD1+ | J14-1 |
| 3 | AD1 GND | NC |
| 4 | AD2- | J15-2 |
| 5 | NC | NC |
| 6 | NC | NC |
| 7 | AD1- | J14-2 |
| 8 | AD2+ | J15-1 |
| 9 | AD2 GND | NC |

# Appendix 3: ACU, RS-232 Interface

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

The 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 Appendix A-2.1, "Pinouts" and Appendix 2: "ACU Rear Panel Connections"



# Appendix 4: RL2048SMC Controller

With the exception of mechanical drawings, this appendix duplicates the content of Radeus Labs' "RL2048 Hardware Interface Control Document (ICD)," *rev.: 9/6/2018*.

## A-4.1 Operating Environment, Power

| | |
|---|---|
| Temperature: | -10 to 50°C |
| Humidity: | 100% condensing |
| Electrical: | 5VDC 0.25A |

## A-4.2 Mechanical

Height: 2.5"

Width: 8.2"

Depth: 3.5"

## A-4.3 Interfaces

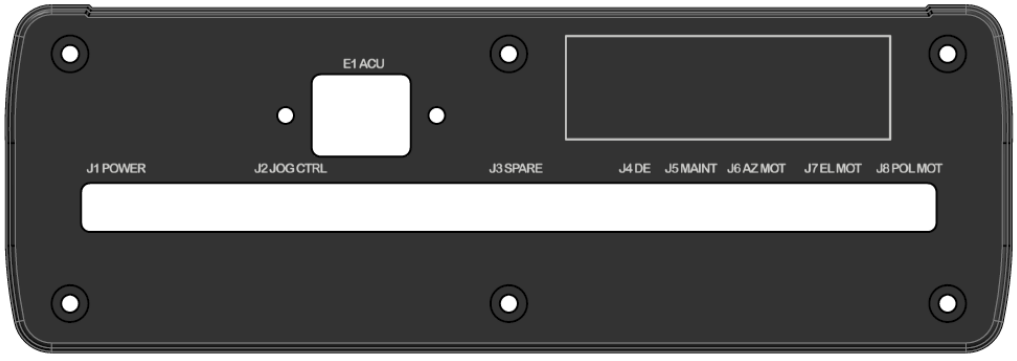
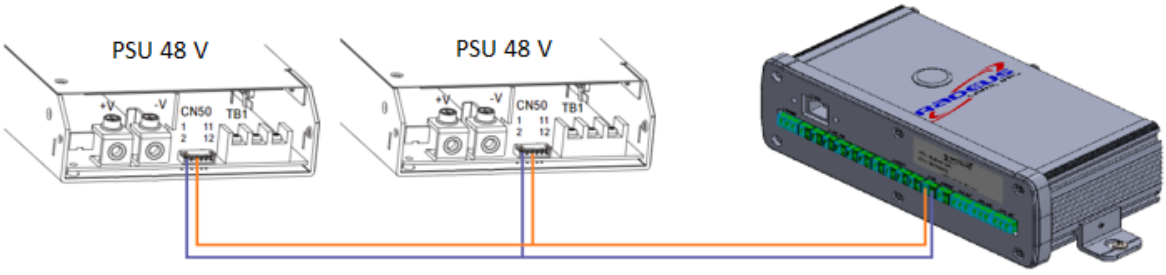


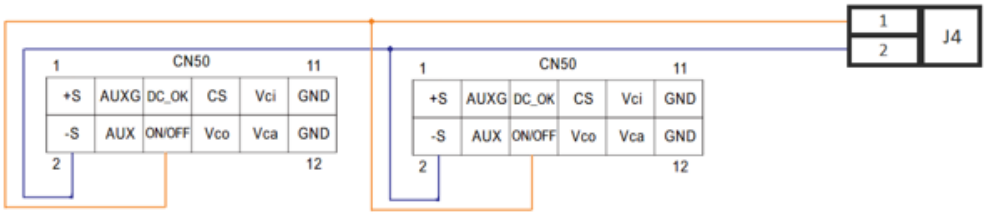

**Figure 5-3** Connections to the Model 2048 are documented below.

| CONNECTOR (MATING PN) | PIN | DESCRIPTION | Notes |
|---|---|---|---|
| *Pins listed top to bottom, here, are located left to right in the above image.* | | | |
| **J1 – POWER** (20020004 – D031B01LF) | 1 | +5V DC POWER | Requires +/- 5% Power Input; 0.25A max |
| | 2 | +5V SENSE | Optional 5V return for power supply sense input |
| | 3 | GROUND | Return for Unit Power |
| **J2 – JOG CONTROLLER** (20020004-D121B01LF) | 1 | NOT CONNECT | NA |
| | 2 | POL LED COMMAND | TBD |
| | 3 | POL CCW COMMAND | BLACK |
| | 4 | POL CW COMMAND | BLUE |
| | 5 | AZ LED COMMAND | RED |
| | 6 | EL LED COMMAND | PINK |
| | 7 | GROUND | DARK GREEN |
| | 8 | AZ CCW COMMAND | ORANGE |
| | 9 | AZ CW COMMAND | YELLOW |
| | 10 | EL DOWN COMMAND | WHITE |
| | 11 | EL UP COMMAND | GRAY |

| CONNECTOR (MATING PN) | PIN | DESCRIPTION | Notes |
|---|---|---|---|
| | 12 | HOME COMMAND | BROWN |
| **J3 – SPARE INPUTS AND OUTPUTS** (20020004 – D081B01LF) | 1 | SPARE OUT 1 N.O. | OPTIONAL RELAY NORMALLY OPEN |
| | 2 | SPARE OUT 1 COM | OPTIONAL RELAY COMMON |
| | 3 | SPARE OUT 2 N.O. | OPTIONAL RELAY NORMALLY OPEN |
| | 4 | SPARE OUT 2 COM | OPTIONAL RELAY COMMON |
| | 5 | SPARE IN 1 SIGNAL | OPTIONAL OPTO-ISOLATED 0V TO 24V |
| | 6 | SPARE IN 1 RETURN | OPTIONAL |
| | 7 | SPARE IN 2 SIGNAL | OPTIONAL OPTO-ISOLATED 0V TO 24V |
| | 8 | SPARE IN 2 RETURN | OPTIONAL |
| **J4 – DRIVE ENABLE** (20020004 – D021B01LF) | 1 | ENABLE N.O. | SOLID STATE OPTO-ISOLATED RELAY NORMALLY OPEN<br>SEE CONNECTION DIAGRAM |
| | 2 | ENABLE COM | SOLID STATE OPTO-ISOLATED RELAY COMMON<br>SEE CONNECTION DIAGRAM |
| **J5 – MAINTENANCE** (20020004 – D021B01LF) | 1 | DOOR OPEN SWITCH | GROUND |
| | 2 | DOOR OPEN SWITCH | +5V PULL-UP |

| CONNECTOR (MATING PN) | PIN | DESCRIPTION | Notes |
|---|---|---|---|
| **J6 – AZ MOTOR CONTROL** (20020004 – D031B01LF) | 1 | RS-232 RX | DTE INPUT |
| | 2 | RS-232 TX | DTE OUTPUT |
| | 3 | GROUND | |
| **J7 – EL MOTOR CONTROL** (20020004 – D031B01LF) | 1 | RS-232 RX | DTE INPUT |
| | 2 | RS-232 TX | DTE OUTPUT |
| | 3 | GROUND | |
| **J8 – POL MOTOR CONTROL** (20020004 – D031B01LF) | 1 | RS-232 RX | DTE INPUT |
| | 2 | RS-232 TX | DTE OUTPUT |
| | 3 | GROUND | |
| **E1 - ACU** | NA | RJ-45 | STANDARD RJ-45 ETHERNET FOR ACU CONNECTION |



# Appendix 5: Setup: GD Model 253 Tracking Receiver

1. Power -off the Model 253 and set its internal switch S1 to position 1.
2. Power-on the 253.
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 6: 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 7: Setup: IRIG

**Important**
Connect the IRIG source *before* powering-up the ACU.

The BNC connector for this is labeled "IRIG" on the rear panel.

See Appendix 2: "ACU Rear Panel Connections"

If the ACU is configured for IRIG-B,[6] it supports IRIG-B sources that output *one of the following:*

IRIG–B122/B123

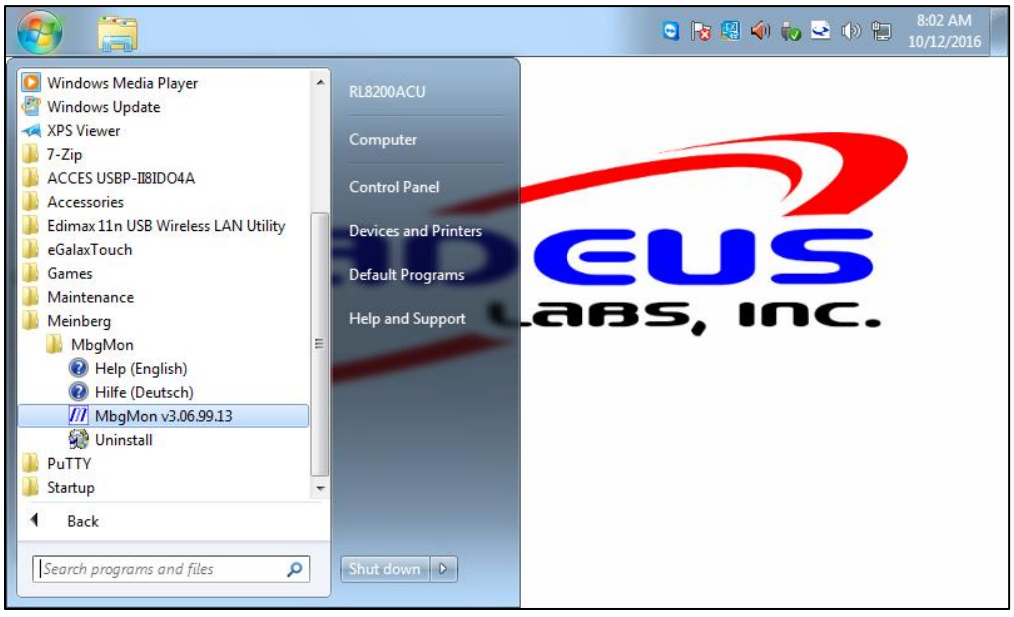
B002/B003

B126/B127

B006/B007

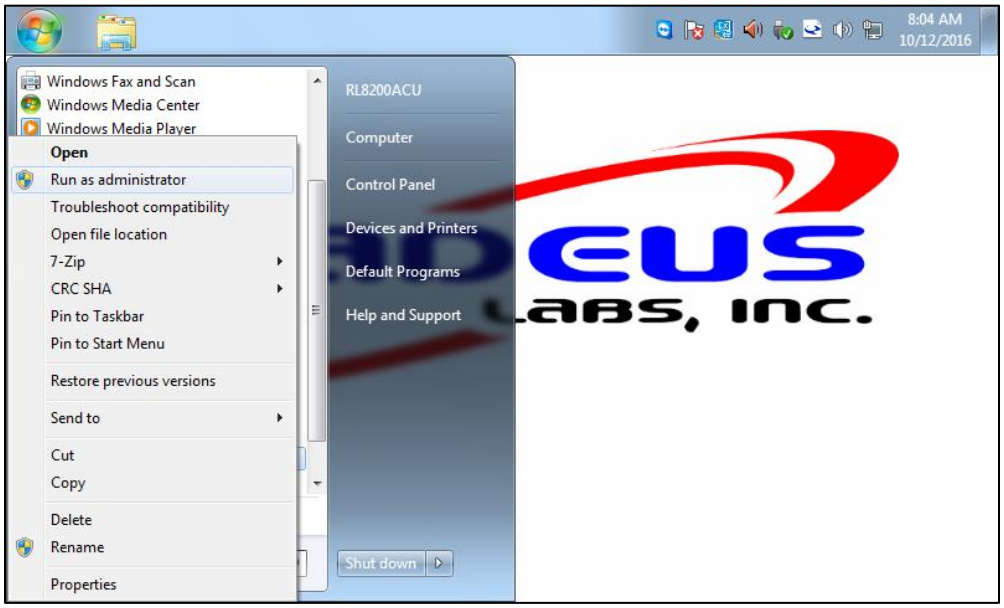
If local time is needed, set it through the Windows time manager. (Quit the ACU application, or minimize it, to access OS functions.) If the time does not update within the first five minutes of using the ACU, follow the instructions below.

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




[6] 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":

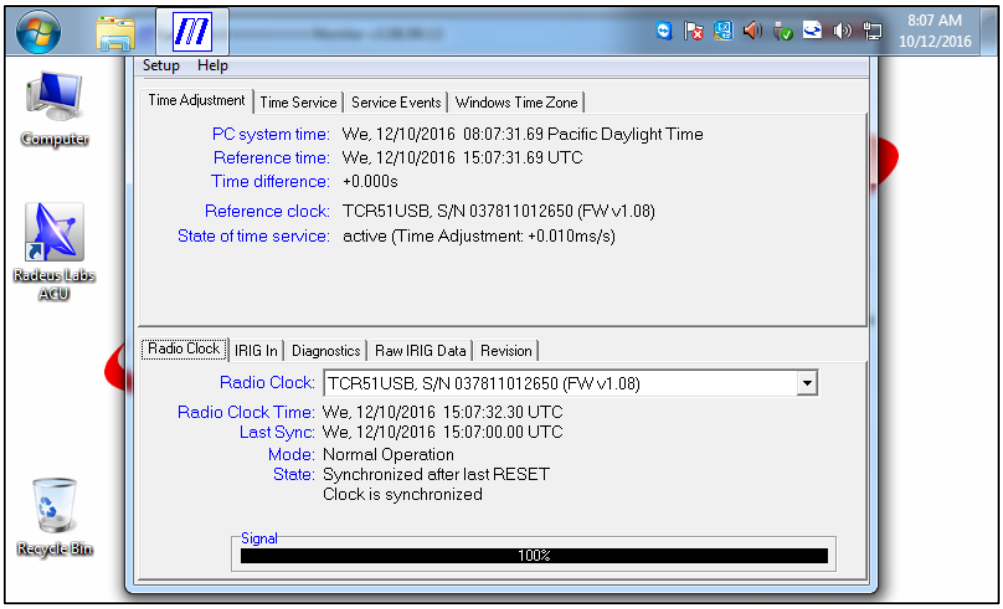



3. When the program opens:

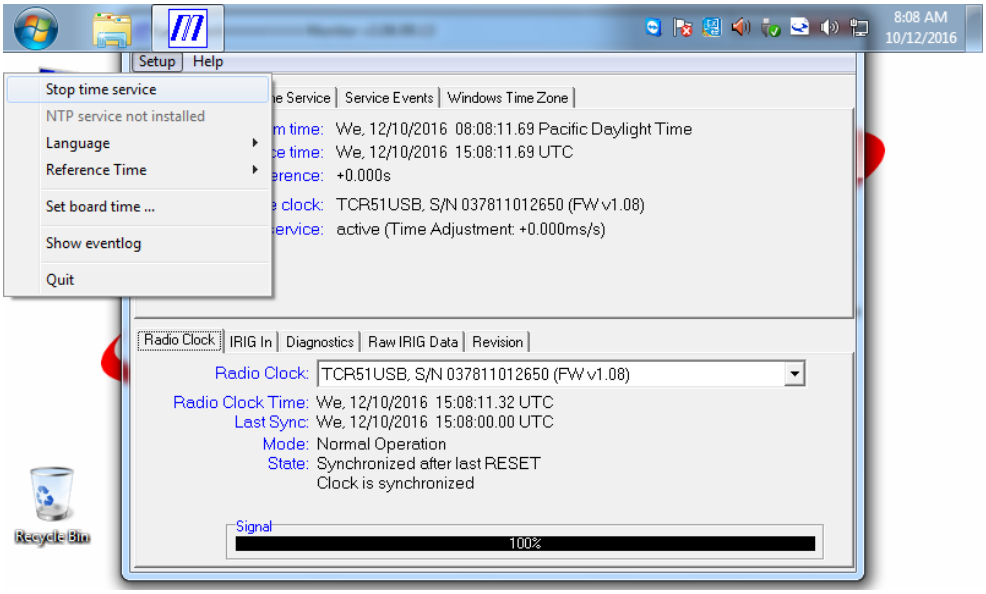
   a) Make sure the signal is 100%.

   b) Check that the clock is synchronized.

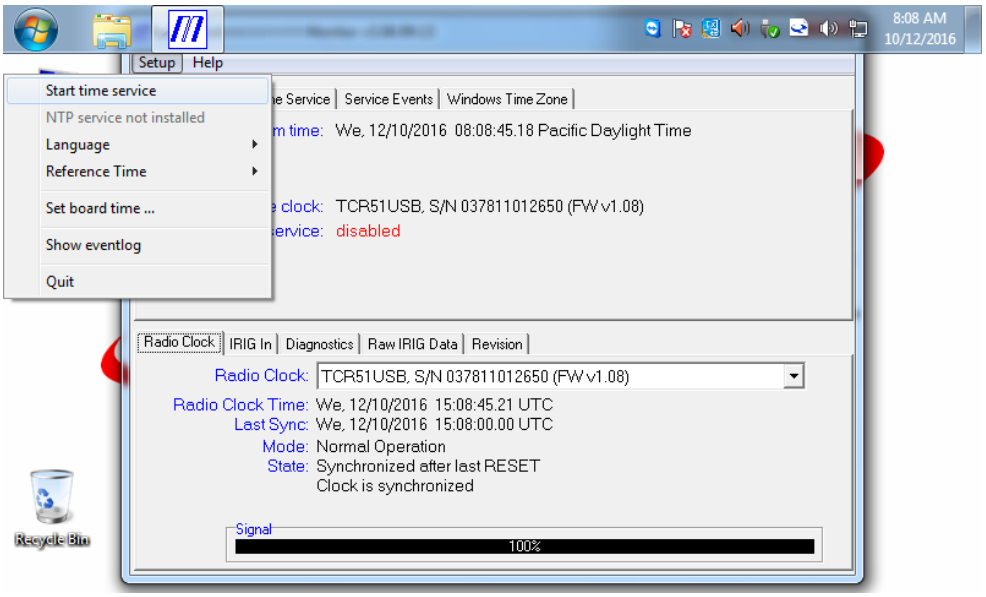
   c) Check that the Reference time is correct.



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 8: 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-8.1 Requirements

Radeus Labs ACU application version 2.2.0 or greater

## A-8.2 File location

In the ACU's host OS, the file is located at:

C:\Radeus Labs\acu.ini

## A-8.3 Default acu.ini — Model 2200

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

```
; ****EDIT THIS FILE WITH EXTREME CAUTION***
; Lines beginning with ';' are comments and have no effect.
; Uncomment lines as needed to enable features."
[OPTIONS]
LOOKANGLES=1
LONGITUDE=1
PREDICTIVE=1
STEPTRACK=1
TLE=1
IESS=1
TLE_GROUP=1
[EPHEMERIS]
;TLEPATH=
;IESSPATH=

[SNMP]
;READ_COMMUNITY=
;WRITE_COMMUNITY=
```

## A-8.4 Example acu.ini

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

[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-8.5 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:* TLE_STEPTRACK=0

TLE_STEPTRACK =1

TLE_GROUP

*Type:* Boolean

*Range:* 0, 1

*Examples:* TLE_GROUP=0

TLE_GROUP =1

## A-8.6 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.[7]

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:*[8]

TLEPATH=http://the.domain.com/file%20repository/… [more path] …/geo.txt

### A-8.6.1 Disable automatic TLE download

When providing custom TLE files by means such as LAN or USB (see section 2.6.3.1), the ACU can be instructed to disable downloading TLE so the custom TLE files are not overwritten. The following entry should be used for this purpose:

TLEPATH=0

[7] https://www.celestrak.com/NORAD/documentation/tle-fmt.asp

[8] Any space characters must be %-encoded, as shown.

[SNMP]

READ_COMMUNITY

Specify a read community string for SNMP (v1 & v2c) GET requests. If this is not specified, the ACU will accept any community string for GET requests. For example:

READ_COMMUNITY=public

WRITE_COMMUNITY

Specify a write community string for SNMP (v1 & v2c) SET requests. If this is not specified, the ACU will accept any community string for SET requests. For example:

WRITE_COMMUNITY=private

# Appendix 9: Advanced 2300 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 — Model 2300

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

```
; ****EDIT THIS FILE WITH EXTREME CAUTION***
; Lines beginning with ';' are comments and have no effect.
Uncomment lines as needed to enable features."
[OPTIONS]
LOOKANGLES=1
LONGITUDE=1
PREDICTIVE=1
STEPTRACK=1
TLE=1
IESS=1
```

[EPHEMERIS]

;TLEPATH=

;IESSPATH=

[SNMP]

;READ_COMMUNITY=

;WRITE_COMMUNITY=

## A-9.4 Example acu.ini

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

[OPTIONS]

LOOKANGLES=1

LONGITUDE=1

PREDICTIVE=0

STEPTRACK=1

TLE=1

IESS=1

[EPHEMERIS]

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

IESSPATH= http:// … *[path to]* … /satlist.csv*

*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

### IESS

*Type:* Boolean

*Range:* 0, 1

*Examples:* IESS=0

IESS=1

### TLE/STEPTRACK

*Type:* Boolean

*Range:* 0, 1

*Examples:* TLE_STEPTRACK=0

TLE_STEPTRACK =1

IESS/STEPTRACK

*Type:* Boolean

*Range:* 0, 1

*Examples:* IESS_STEPTRACK=0

IESS_STEPTRACK =1

## 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.[9]

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

[9] https://www.celestrak.com/NORAD/documentation/tle-fmt.asp

## A-9.5.1 Disable automatic TLE download

When providing custom TLE files by other means, such as internal LAN or USB (as described in Section 2.6.3.1), the ACU can be instructed to disable downloading TLE so the custom TLE files are not overwritten. The following entry should be used in this scenario:

TLEPATH=0

### IESSPATH

Used to specify an alternate web location for the ACU to request IESS-412 ephemeris data. An Ethernet cable must be connected to the rear-panel port labeled:

E1 NETWORK

- The web server must not be password protected and must be accessible by the ACU over HTTP (not HTTPS).
- The file must conform to spec; see Appendix 10: "IESS-412 file format."
- 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 satlist.csv.

*Type:* string, unquoted

*Example IESS path…* any space characters must be encoded as %20 as shown here:

IESSPATH=http://the.domain.com/file%20repository/ … [more path] … /geo.txt

## A-9.5.2 Disable automatic IESS download

When providing custom IESS files by other means such as internal LAN or USB (as described in Section X.X.X.X) the ACU can be instructed to disable downloading IESS so that the custom IESS files are not overwritten. The following entry should be used in this scenario:

IESSPATH=0

[SNMP]

READ_COMMUNITY

Specify a read community string for SNMP (v1 & v2c) GET requests. If this is not specified, the ACU will accept any community string for GET requests. For example:

READ_COMMUNITY=public

WRITE_COMMUNITY

Specify a write community string for SNMP (v1 & v2c) SET requests. If this is not specified, the ACU will accept any community string for SET requests. For example:

WRITE_COMMUNITY=private

# Appendix 10: IESS-412 file format

An IESS-412 data file consists of comma-separated values (CSV) for 11 ephemeris parameters and additional parameters supported by Intelsat Earth Station Standards.[10] For example records, see below.

| | |
|---|---|
| sat_name | Satellite name<br>*Type:* string, unquoted |
| nom_cob | Nominal Center-of-Box position, nominal orbital location<br>*Type:* decimal number<br>*Range:* 0.00 – 360.00 |
| Epoch | Epoch expressed as a Julian day number<br>*Type:* decimal number<br>*Range:* 0 – 1.7E308 |
| lm0 | Mean longitude (deg. east of Greenwich)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lm1 | Drift rate (deg/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |

[10] https://www.celestrak.com/NORAD/elements/supplemental/IESS_412_Rev_2.pdf

| | |
|---|---|
| lm2 | Drift Acceleration (deg/day/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lonc | Longitude Oscillation-amplitude (deg)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lonc1 | lonc rate of change, cosine term (deg/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lons | Longitude Oscillation-amplitude (deg)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lons1 | lons rate of change, sine term (deg/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| latc | Latitude Oscillation-amplitude (deg)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| latc1 | latc rate of change, cosine term (deg/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |

| | |
|---|---|
| lats | Latitude Oscillation-amplitude (deg)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| lats1 | lats rate of change, sine term (deg/day)<br>*Type:* decimal number<br>*Range:* -1.7E308 – 1.7E308 |
| verify_lon | Predicated satellite longitude at 170 hours after epoch<br>*Type:* decimal number<br>*Range:* 0.00000 – 360.000 |
| verify_lat | Predicated satellite latitude at 170 hours after epoch<br>*Type:* decimal number<br>*Range:* -90.000 – 90.000 |
| norad_num | NORAD catalog number, NORAD ID, satellite catalog number<br>*Type:* integer<br>*Range:* 0 – 99999 |

## A-10.1 Example IESS-412 data

Authorized users of related Radeus Labs equipment have access to our comprehensive IESS-412 data file, which is updated regularly.

Two example records from such a file:

```
sat_name  nom_cob  epoch             lm0        lm1      lm2       lonc      lonc1 …
IS-21     302.00   2458451.50000000  302.0018   0.0034  -0.000586  0.0218  -0.0007…
IS-34     304.50   2458451.50000000  304.4936  -0.0025  -0.000586  0.0118  -0.0007…

        …lons    lons1   latc    latc1  lats   lats1   verify_lon verify_lat norad_num
        …-0.0120 0.0005  0.0265 -0.0018 0.0094 0.0010 302.0048    0.0209     38749
        …0.0299  0.0005 -0.0283 -0.0018 0.0157 0.0011 304.4721   -0.0187     40874
```

**Figure 5-4** Sample data records in IESS-412 format (split onto two lines here).

# Appendix 11: Pre-installation checklist

- ☐ Ensure that the antenna was balanced/focused recently, that all maintenance has been performed on it, and it is in good working order according to the manufacturer's instructions.
- ☐ 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.)

## A-11.1 Model 2300™

- ☐ Ensure that all recommended maintenance has been performed on the antenna and it is in working order according to the manufacturer's instructions. Ensure that jacks and/or gears have been recently greased.
- ☐ For older systems, all wiring has been checked for rodent damage or other signs of deterioration.
    - Motor wiring
    - Limit switches, emergency stop wiring
    - Position feedback (encoders/resolvers) 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.)

- ☐ All the position feedback devices are installed on axis and are well aligned.
- ☐ There is no water ingress (present or past) in the protective housing of any position-feedback devices or mechanically based limit switches.
- ☐ Limit switches and emergency stops have been wired in a fail-safe manner. (They are wired as normally closed.)
- ☐ The satellite dish has been balanced/focused recently.
- ☐ Ensure that the main breaker in the drive cabinet is in the off position. It is located in the lower right-hand corner of the cabinet.

# Appendix 12: Model 2200 On-Site Test Procedure

*These instructions assume the installation was completed properly, including all items in the pre-installation checklist(s).* See Appendix 11: "Pre-installation checklist."

*Radeus 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-12.1 Motor Checks

### A-12.1.1 Jog Controller Test

☐ Jog the Azimuth CW and verify that the antenna moves *clockwise*.

☐ Jog the Azimuth CCW and verify the antenna moves *counterclockwise*.

☐ 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-12.2 Limit Switch Checks

**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.

☐ *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.

## A-12.3 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:

***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.

| | |
|---|---|
| Longitude (deg E) | |
| Inclination (deg) | |
| RF Input | |
| POL (deg) | |
| Receive level @ 0dB<br>(see 6.3 note above) | |
| Beacon frequency (MHz) | |
| Low signal (dB) | |
| Receive beamwidth (deg) | |
| Deadband (% BW) | |
| Step size (% BW) | |
| Max step (% BW) | |
| Max steps per cycle | |
| Steptrack cycle time | |
| Follow model time | |

☐ 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:

| Direction | Steptrack Level | Manual Level | Delta |
|---|---|---|---|
| Azimuth CW | | | |
| Azimuth CCW | | | |
| Elevation UP | | | |
| Elevation DOWN | | | |

Calculate the RMS tracking accuracy

$$TrackingError_{RMS} = ( |(AZ\_CW)^2 + (AZ\_CCW)^2 + (EL\_UP)^2 + (EL\_DOWN)^2|^{1/2} ) / 2$$

☐ Record $TrackingError_{RMS}$: _____

# Appendix 13: Model 2300 On-Site Test Procedure

*Radeus 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-13.1 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. Ensure that jacks and/or gears have been recently greased.
- ☐ For older systems, all wiring has been checked for rodent damage or other signs of deterioration.
  - Motor wiring
  - Limit switches, emergency stop wiring
  - Position feedback (encoders/resolvers) 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.)
- ☐ All the position feedback devices are installed on axis and are well aligned.
- ☐ There is no water ingress (present or past) in the protective housing of any position-feedback devices or mechanically based limit switches.
- ☐ Limit switches and emergency stops have been wired in a fail-safe manner. (They are wired as normally closed.)
- ☐ The satellite dish has been balanced/focused recently.
- ☐ Ensure that the main breaker in the drive cabinet is in the off position. It is located in the lower right-hand corner of the cabinet.

# A-13.2 Drive Cabinet Power Checks

☐ Measure — and record below — the voltages on the line side (bottom) of the main cabinet breaker.

**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.
**Three-phase System** (4 lines, 1 neutral, ground)

*Note:* early systems may not utilize the neutral — if that is the case, record “n/a”.

| | |
|---|---|
| L1 Phase to L2 Phase | VAC |
| L2 Phase to L3 Phase | VAC |
| L3 Phase to L1 Phase | VAC |
| L1 Phase to Neutral | VAC |
| L2 Phase to Neutral | VAC |
| L3 Phase to Neutral | VAC |

Switch the main breaker to the *on* position (up).

☐ Verify that the emergency stop button is in the *out* position, not depressed. (It is located outside of the drive cabinet, on the right-hand side.)

☐ Switch all circuit breakers to the *on* position (up).

☐ Verify that the motor inverters for both azimuth and elevation power on.*

***WARNING**

If any motors begin turning, hit the emergency stop button — on the right, outside of the cabinet — to stop them.

☐ Verify that all power supplies show green on the DC "ok power" LED.*

***WARNING**

If any power supply shows red on the OVL LED, switch its breaker off (toward the right) and troubleshoot.

☐ Use the LOCAL button on the drive cabinet jog panel and ensure the cabinet is in REMOTE mode — the button *is not lit*.

# A-13.3 Motor Checks

## A-13.3.1 Drive Cabinet Jog Panel Test

1. ☐ Ensure that the SLEW button is in Track mode — the button is not lit.
2. ☐ Ensure that the TOGGLE button is in Momentary mode — the button is not lit.
3. ☐ Jog the Azimuth momentarily CW and verify that the antenna moves clockwise.
4. ☐ Jog the Azimuth momentarily CCW and verify that the antenna moves counterclockwise.
5. ☐ Jog the Elevation momentarily Up and verify that the antenna moves up.
6. ☐ Jog the Elevation momentarily Down and verify that antenna moves down.
7. ☐ Jog the Polarization momentarily CW and verify that the polarization moves clockwise when observed from the rear of the antenna.
8. ☐ Jog the Polarization momentarily CCW and verify that the polarization moves counterclockwise when observed from the rear of the antenna.
9. ☐ Set the SLEW button to Slew — the button is lit.
10. ☐ Jog the Azimuth momentarily CW and verify that the antenna moves clockwi*se* at its quicker, *slew speed.*
11. ☐ Jog the Azimuth momentarily CCW and verify that the antenna moves counterclockwise at quicker, slew speed.

12. ☐ Jog the Elevation momentarily Up and verify that the antenna moves up at quicker, slew speed.

13. ☐ Jog the Elevation momentarily DOWN and verify that the antenna moves down at the quicker, slew speed.

14. ☐ Jog the Polarization momentarily CW and verify that the polarization moves clockwise, when observed from the rear of the antenna, at the quicker, slew speed.

15. ☐ Jog the Polarization momentarily CCW and verify that the polarization moves counterclockwise, when observed from the rear of the antenna, at the quicker, slew speed.

16. ☐ If the system has a second POL axis, repeat steps 14 and 15 for that axis.

17. ☐ Press the LOCAL button on the drive cabinet jog panel so the cabinet is in Local mode — the button is lit.

## A-13.4 Limit Switch Checks

1. ☐ At the ACU, go to Home > Setup and choose Travel Limits. Ensure that "Disable soft limits" is checked, then tap Save.

2. ☐ An audible alarm may be sounding. If so, tap the Home screen's Fault button once to mute the alarm.

3. ☐ Go to Home > Setup and choose Positioner. Ensure that the "Slew threshold (deg)" fields are non-zero. If they are, enter 0.01 in each, then Save.

4. ☐ Go to Home > Manual to enter manual mode.

5. ☐ Ensure that motor speed is set to Track and that the jog buttons are set to Toggle.*

**WARNING**

**The 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 drive until the jog button is pressed again*.

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

6. ☐ Jog the Azimuth CW to trip the CW limit switch while the motor is moving. Verify that the motor stops. Release the limit switch. (An alarm may sound, indicating a hard limit was hit.)

7. ☐ Jog the Azimuth CW and trip the CCW limit switch while the motor is moving. Verify that the motor continues to move. Release the limit switch.

8. ☐ Jog the Azimuth CCW and trip the CCW limit switch while the motor is moving. Verify that the motor stops. Release the limit switch. (An alarm may sound indicating a hard limit was hit.)

9. ☐ Jog the Azimuth CCW and trip the CW limit switch while the motor is moving. Verify that the motor continues to move. Release the limit switch.

10. ☐ Repeat the preceding steps 6 through 9 for every axis in the antenna system.

11. ☐ Exit manual mode via the Home > Standby button.

# A-13.5 ACU Setup and Parameter Record

☐ Refer to *Model 8200 ACU Operation and Maintenance,* perform the steps in section Error! Reference source not found..

☐ After the Setup Wizard has completed successfully, record its ACU settings in the following tables. For systems with one POL axis, use the POL1 fields:

| **Antenna Parameters** | | | |
|---|---|---|---|
| Geographical Coordinates | Latitude: | Longitude: | Altitude: |
| Antenna Name | | | |
| Polarization Type | | | |

| **Receiver** | | |
|---|---|---|
| BDC LO Frequencies | Low: | High: |
| Analog output 0dB ref | | |
| Analog output slope | | |

| **Encoders** | | | | |
|---|---|---|---|---|
| Position (deg) | AZ: | EL: | POL1: | POL2: |
| Offset (deg) | AZ: | EL: | POL1: | POL2: |

| | | | | |
|---|---|---|---|---|
| Direction | AZ: | EL: | POL1: | POL2: |
| Type | AZ: | EL: | POL1: | POL2: |

| **Travel Limits** | | | | |
|---|---|---|---|---|
| CW/upper (deg) | AZ: | EL: | POL1: | POL2: |
| CCW/lower (deg) | AZ: | EL: | POL1: | POL2: |
| Soft limits | enabled disabled (circle one) | | | |

| **Motion Faults** | | | | |
|---|---|---|---|---|
| Period (ms) | AZ: | EL: | POL1: | POL2: |
| Tolerance (deg) | AZ: | EL: | POL1: | POL2: |
| Runaway (deg) | AZ: | EL: | POL1: | POL2: |

| **Positioner** | | | | |
|---|---|---|---|---|
| Deadband (deg) | AZ: | EL: | POL1: | POL2: |
| Slew Threshold (deg) | AZ: | EL: | | |

| **Timing** | | | | |
|---|---|---|---|---|
| Bump duration (ms) | AZ: | EL: | POL1: | POL2: |
| Bump coast (ms) | AZ: | EL: | POL1: | POL2: |
| Track coast (ms) | AZ: | EL: | POL1: | POL2: |
| Slew coast (ms) | AZ: | EL: | | |

Software version: _____
Date:_____

## A-13.6 Steptrack Test

1. ☐ 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.

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

***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.

| | |
|---|---|
| Longitude (deg E) | |
| Inclination (deg) | |
| RF Input | |
| POL (deg) | |
| Receive level @ 0dB<br>(see 6.3 note above) | |
| Beacon frequency (MHz) | |
| Low signal (dB) | |
| Receive beamwidth (deg) | |
| Deadband (% BW) | |
| Step size (% BW) | |
| Max step (% BW) | |
| Max steps per cycle | |
| Steptrack cycle time | |
| Follow model time | |

3. ☐ 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.

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

5. ☐ Repeat these steps 4 – 6 for each axis-direction listed in the following table:

| Direction | Steptrack Level | Manual Level | Delta |
|---|---|---|---|
| Azimuth CW | | | |
| Azimuth CCW | | | |
| Elevation UP | | | |
| Elevation DOWN | | | |

Calculate the RMS tracking accuracy

$TrackingError_{RMS} = ( |(AZ\_CW)^2 + (AZ\_CCW)^2 + (EL\_UP)^2 + (EL\_DOWN)^2|^{1/2} ) / 2$

☐ Record $TrackingError_{RMS}$: _____

# Appendix 14: ACU Remote Control Methods

The following remote-control methods are supported:

## A-14.1 TeamViewer

TeamViewer software enables remote access to the ACU. It supports both Internet and private network connection.

This remote-control method provides access to the functions available on the ACU touch panel. Additionally, files can be transferred between the ACU and the device running TeamViewer.

This software is loaded on all Radeus Labs ACUs.

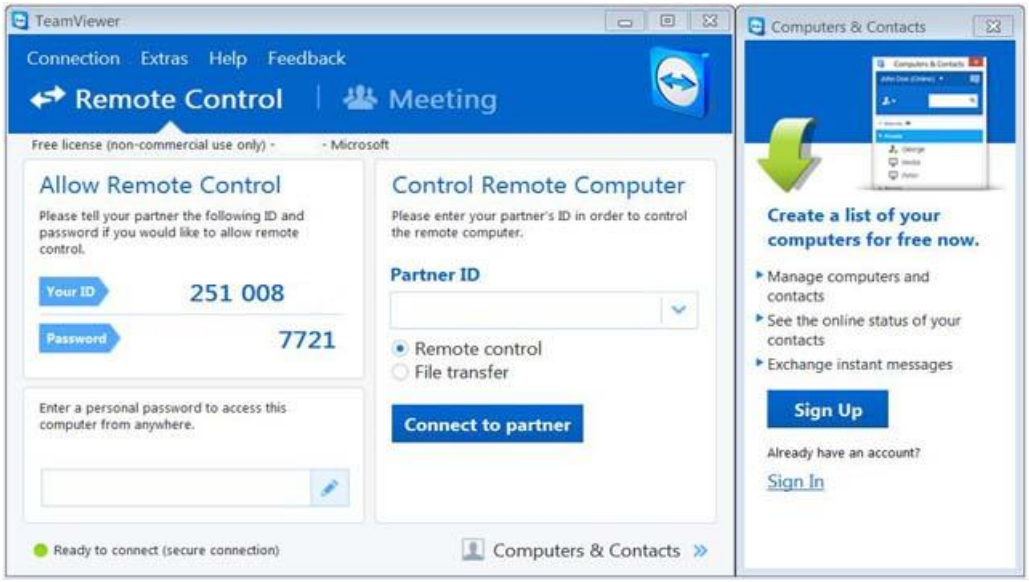



**Figure 5-5** TeamViewer software provides remote-control access to Radeus Labs ACUs.

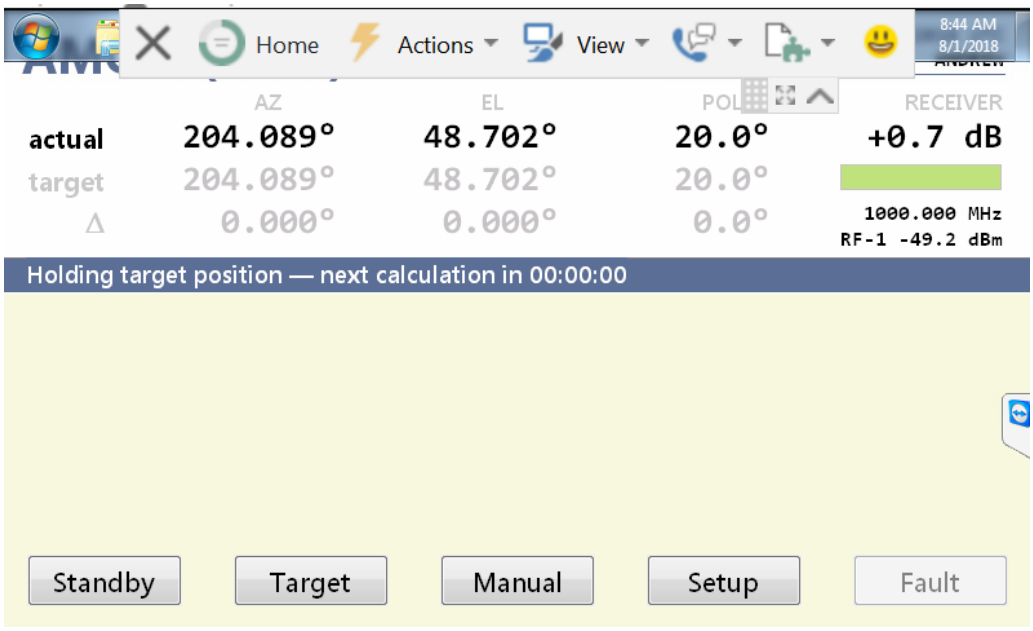



**Figure 5-6** TeamViewer provides a remote view of the ACU's display.

If permission is granted, Radeus Labs Support can connect to an ACU using TeamViewer in order to update software and provide troubleshooting. By downloading logs and system parameters, Radeus Labs Support can deliver tracking performance and diagnostics.

For instructions on how to connect to an ACU using TeamViewer, refer to TeamViewer - Spontaneous Support instructions.

### A-14.1.1 TeamViewer Requirements

An Ethernet network connection to the ACU rear panel port "E1 NETWORK" is required for TeamViewer access.

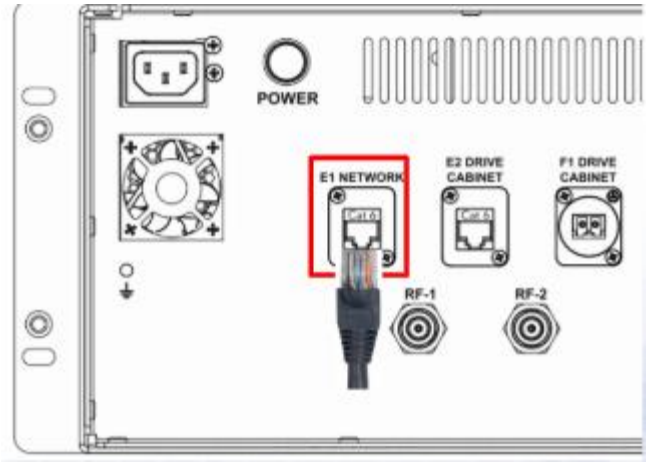



**Figure 5-7** TeamViewer requires the E1 Network port on the ACU's rear panel.

*Use of TeamViewer for commercial purposes requires a TeamViewer license. Please refer to TeamViewer.com for more information.*

## A-14.2 SNMP

The Simple Network Management Protocol (SNMP) allows extensive ACU control and diagnostics via network connection. It consists of GET and SET commands to retrieve and configure parameters and to command actions. Radeus Labs ACUs support SNMP v1 and v2c.

SNMP typically is used for integrating the ACU into Monitor-and-Control (M&C) systems that provide real-time system information, fault detection, target scheduling, etc.

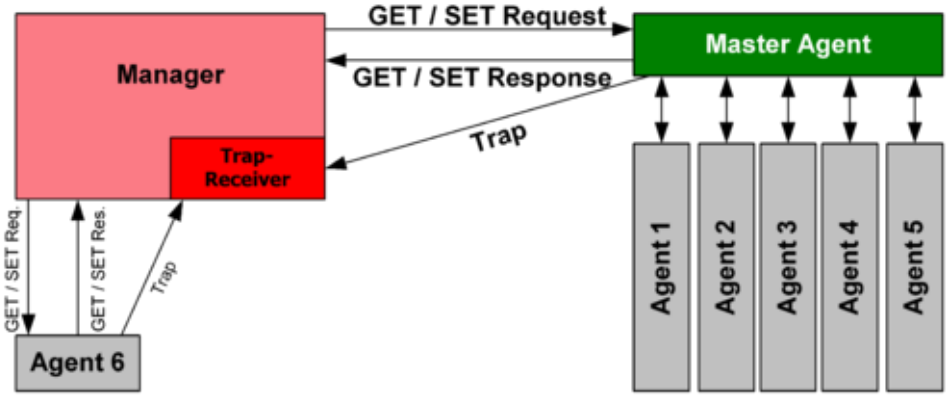



**Figure 5-8** The SNMP option for remote control uses GET/SET commands.

Management Information Base (MIB) files define the SNMP calls that can be issued to the ACU for remote control. A copy of these files is located on the ACU Windows Desktop (C:\Users\Public\Desktop\MIBS).

Updated MIB files are also available for download from:
https://www.radeuslabs.com/
Please contact support@radeuslabs.com for access.


**Figure 5-9** The desktop of a typical ACU, here showing the MIBS directory.

Also see Section A-14.5, "SNMP Tools"

### A-14.2.1 SNMP Requirements

An Ethernet network connection to the ACU rear panel port "E1 NETWORK" is required for SNMP communication.

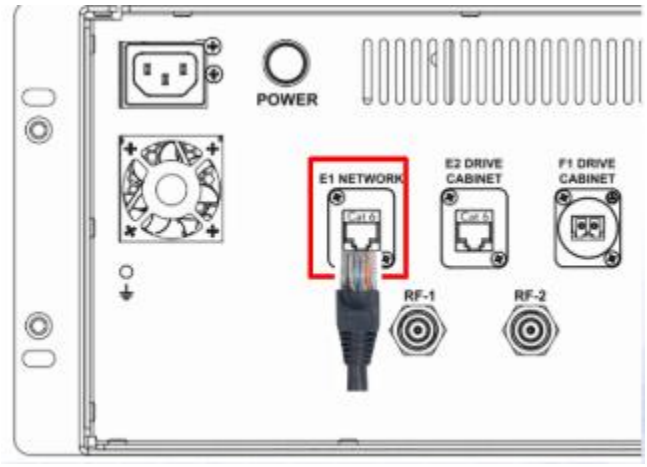



**Figure 5-10** Like TeamViewer, SNMP control requires the E1 Network port on the rear panel of the ACU.

## A-14.3 Commercial M&C software with Radeus Labs ACU support

The following commercial M&C (Monitor and Control) software offer M&C solutions for Radeus Labs ACUs:

- Dataminer
- Kratos Compass
- SED Mon-A-Co

## A-14.4 Open source M&C software

The following software is freely available for M&C use:

- Cacti
- Zabbix

## A-14.5 SNMP Tools

The following can help test SNMP communication with an ACU:

- net-snmp — Unix-based command-line utility for walking the tree, setting and getting values via SNMP.
- SnmpB — GUI-based utility for SNMP communication

## A-14.6 Serial M&C (7200 Request / Command M&C Protocol)

As a drop-in replacement for the GD 7200 ACU, the Radeus Labs ACU supports serial remote control. The simple protocol provides limited ACU control useful in supporting legacy systems or transitioning from 7200 to Radeus Labs 8000 or 2000 series ACUs.

For more information refer to CG-6042 (Rev. L, Nov. 2005).

### A-14.6.1 Requirements for serial M&C

- A straight-through serial cable must be connected to the ACU rear panel port J5 RS-232 (DB25F). If using existing 7200 serial cables, a null modem is required (one ships with Radeus Labs 8200 ACU Legacy configurations).
- For pinout information, please see Appendix A-2.1, "Pinouts."

# Appendix 15: Portable Maintenance Control Unit (PMCU)

The handheld Portable Maintenance Control Unit (PMCU) provides a means for moving an antenna manually by a user who is around or near the antenna or its drive cabinet. It can be used with the Model 2300 ACU to maintain the antenna and associated systems.

PMCU functions are similar to functions available at the Radeus Labs Model 2350™ drive cabinet's jog panel.

# A-15.1 PMCU in the Series 8000 ACS

## Power

The PMCU device operates at 48VDC~52VDC delivered over its Ethernet connection to the drive cabinet.

## Dependency

An ACU is required in order to display signal strength. If no ACU is detected, the signal display shows: -ACU

PMCU buttons except Halt or Local will be ignored if the ACS is in standby, manual, or tracking mode, or if there is no ACU and the drive cabinet is in remote mode.

## Drive Cabinet (DC) and PMCU cooperate

DC and PMCU are always in the same Local or Remote mode.

When under Local control, the DC and connected PMCU are both active and can move the antenna. The last button pressed on either takes precedence.

The PMCU and DC display the same motion.

*Except:*

The PMCU's toggle and slew buttons do not affect the DC's jog panel. An LED indicates when each mode is active on the PMCU.

## Unplugging

If the PMCU is *unplugged after it was in local mode,* the DC goes into remote mode and the ACU is in standby.

### Testing

*Test mode 1:* Press and hold Toggle and AZ CCW (the two upper-left buttons) while powering up. It sequences through all the LEDs – press any of those buttons and the LED by it will remain illuminated while you depress the button. The 7-segment display steps through all the displays continuously and lights up all the segment.

*Test mode 2:* Press the two upper-right buttons (SLEW and AZ CW) Lights up all the LEDs to show all LEDs and segments function.

*To exit a test mode,* the PMCU must be powered off and back on (unplugged, then plugged in).

## A-15.2 PMCU Controls

### LOCAL

The PMCU must be in Local mode in order to function.[11] When Local mode is active, the word LOCAL at the top of the device is illuminated in green.

- Entering Local mode also changes the drive cabinet to Local mode.

### HALT — while in HALT mode…

…the drive cabinet's Local LED blinks and no axis movement can happen (power is removed from the motors).

…the ACU displays a PMCU fault and a maintenance override fault.

Halt mode can be canceled by pressing the PMCU's Halt button again or by pressing drive cabinet's Local button twice. (Pressing the drive cabinet's Local button puts the system into Remote mode; one more push puts it back into Local mode.)

[11] The exception is the Halt button, which works whenever the PMCU is connected to the drive cabinet.

## TOG ("toggle")

The movement buttons normally cause the antenna to move only while they are depressed. Toggle mode changes that, so pressing a direction button starts *motion that will continue until the button is pressed again.*

## GO TO ANGLE


*Warning:* soft limits will not be respected in this mode.

Press and hold the Toggle ("TOG") button for one second to activate *go-to-angle mode*. The blue LED under it will light and all valid directional LEDs will blink.

Press the jog buttons to change the commanded display angles — no motion will take place until…

…pressing the toggle button starts the commanded movement.

*Change your mind?* When in go-to mode, press and hold toggle for one second, then release, to cancel and start over. If no change has been made to the angles and you tap toggle, it exits go-to mode. Returning to remote mode (pressing Local) or entering halt mode (pressing Halt) cancels go-to mode and discards any changes to the angles.

This uses the slew threshold and deadband settings specified in Setup > Positioner.

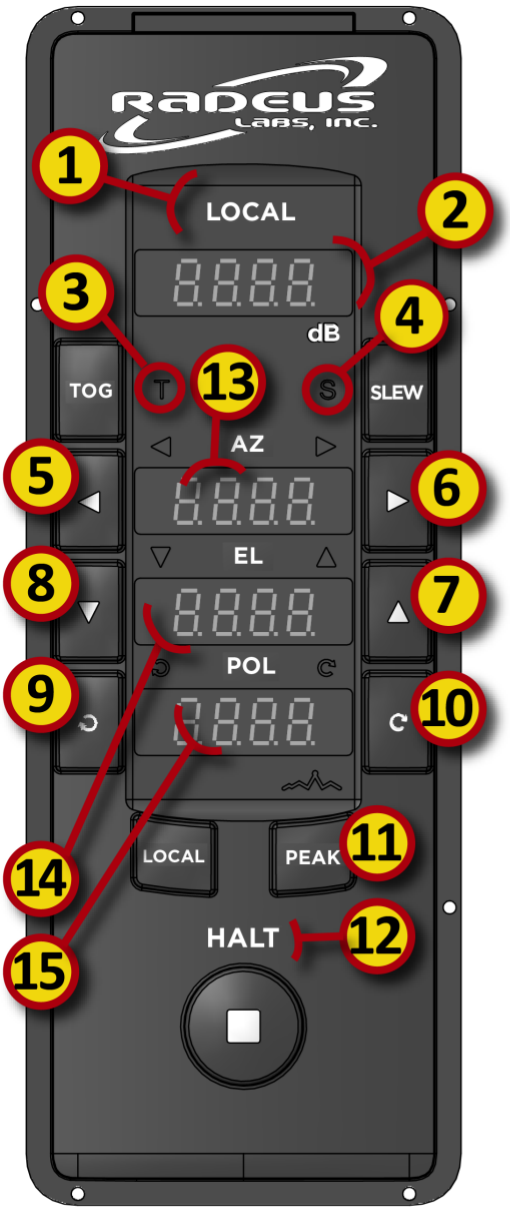
- The Slew button doesn't respond in this mode.

## PEAK

Reserved for future use.

Will require an ACU signal level.

# A-15.3 Indicators & Displays




**1.** Local LED — on when drive cabinet (DC) is in local mode

**2.** Signal Level — when connected to ACU, display relative signal level

**3.** Toggle LED — off: system is in momentary (DC or PMCU)
green on: system is in toggle mode (DC or PMCU)
blue blinking: waiting for user to choose move-to angles
blue on: moving to look angle
red blinking: movement interrupted by fault

**4.** Slew LED — on: system is in slew mode (DC or PMCU)
off: system is in track mode (DC or PMCU)

**5.** AZ CCW — on: AZ motor is moving CCW
**6.** AZ CW — on: AZ motor is moving CW

**7.** EL UP — on: EL motor is moving UP
**8.** EL Down — on: EL motor is moving Down

**9.** POL CCW — on: POL motor is moving CCW
**10.** POL CW — on: POL motor is moving CW

**11.** Peak — blue LED on: performing peaking function
blue LED blinking: waiting for user to choose direction/axis to peak
red LED on: peak pressed in unsupported function
red LED blinking: movement interrupted by a fault

**12.** HALT — on: system is in Halt mode

**13.** AZ
**14.** EL
**15.** POL
] if ACU is present, show offset angles

# Appendix 16: List of Figures

# Appendix 17: 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.