RADEUS LABS, INC.

Satellite Earth Station Antenna Control System

Series 8000™ ACS

Operation & Maintenance

Model 8200™ Antenna Control Unit

Model 8250™ Drive Cabinet

April 2025

Antenna Control Systems for

Satellite Earth Stations

Series 8000™ ACS

Operation & Maintenance

Model 8200™ Antenna Control Unit

Model 8250™ Drive Cabinet

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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 applying common industry standards, best practices, and due diligence.

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

Documentation for the Model 8200 antenna control unit (ACU) and Model 8250 drive cabinet from Radeus Labs, Inc.

Service and Support

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

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SECTION

1

1 Series 8000™ Setup — Overview

For detailed instructions, refer to the following sections.

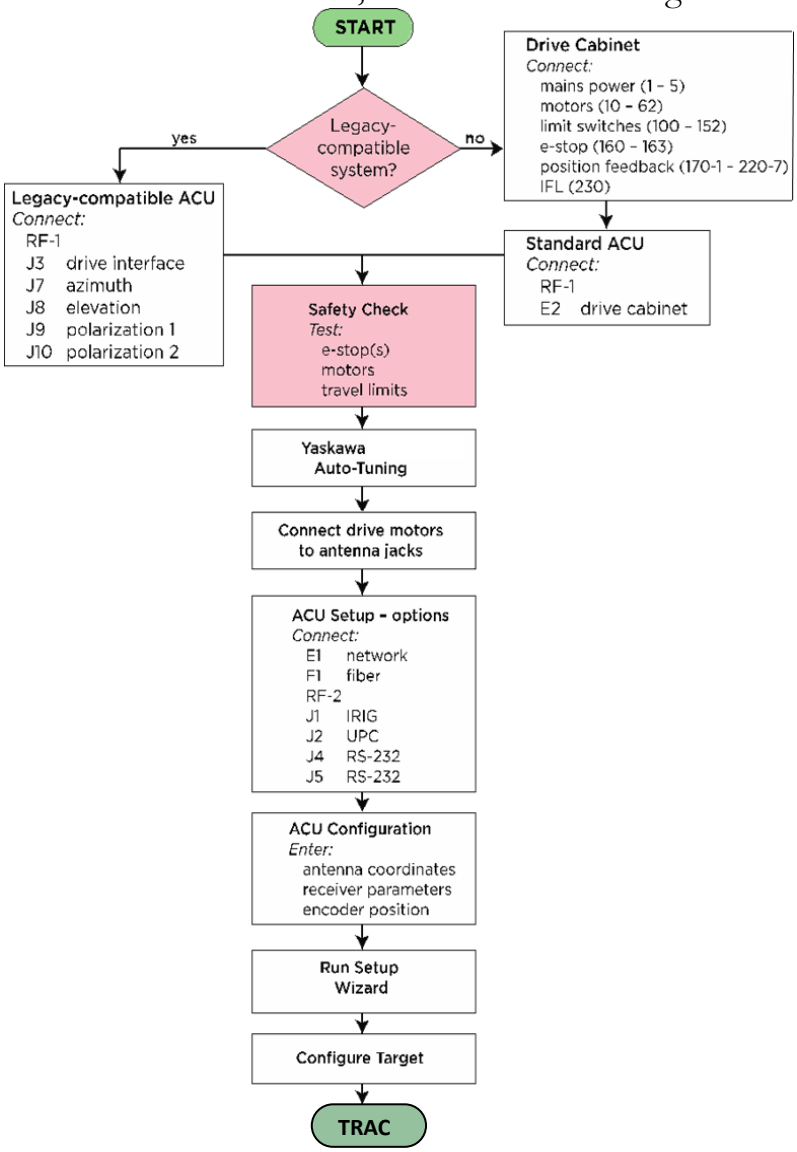


Figure 1-1 Navigation Chart

SECTION

2

2 Model 8250 Drive Cabinet

Also see Appendix 4: "Model 8250 Drive Cabinet."

This drive cabinet from Radeus Labs offers compelling advantages, but the Model 8200 ACU can be ordered with support for previous-generation GD (Vertex) 7150 cabinets.

Figure 2-1 The Model 8250 drive cabinet from Radeus Labs.

2.1 Jog Controls at the Cabinet

The Model 8250 has a *jog panel* with antenna jog controls similar to those on the front of the Model 8200 ACU.

Figure 2-2 Model 8250's jog panel with the display option.

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 8250's operator to move the antenna without the ACU:

- Local:

The operator can control the antenna from the drive cabinet's jog panel and this LED will be illuminated green.

- Slew

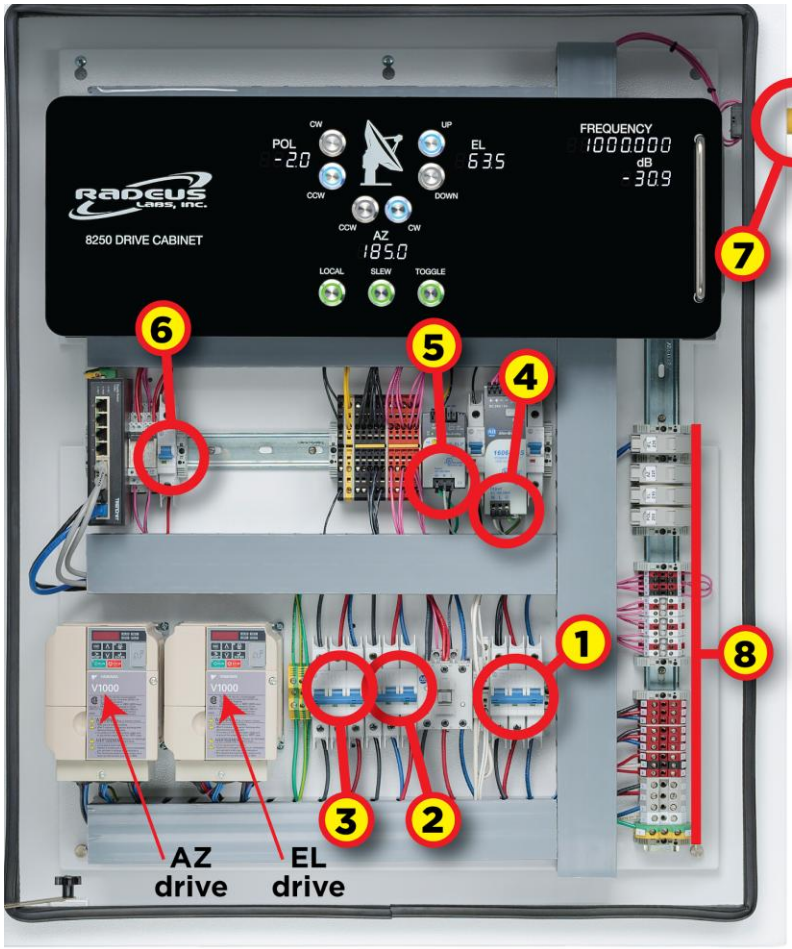
If *slew* is selected, the cabinet's jog controls will move the antenna at its slew speed and this LED will be illuminated green.

- 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.

2.2 Power, Breakers, E-Stop

In addition to the jog panel, above, more controls are shown in **Figure 2-3**. The E-Stop switch works by de-asserting the drive-enable line.



1. Mains
2. EL drive breaker
3. AZ drive breaker
4. 24V power supply breaker
5. 12V power supply breaker
6. POL circuit breaker
7. E-Stop switch
8. Customer Interface Block (CIB)

All circuit breakers:

Down = OFF
green: finger-safe

Up position = ON
red: hot, not safe

Figure 2-3 Model 8250 power mains, breakers, and emergency stop

2.2.1 Emergency Stop

Figure 2-4 Emergency Stop Button

- To stop all antenna motion as quickly as possible, push the red e-stop switch.
- To release the e-stop, twist the knob clockwise.
- During an emergency, disconnect all power sources.
- The e-stop stops the motor and engages brakes (if available).

⚠
- *Activating the e-stop does not remove electrical power from the drive cabine*

SECTION

3

3 Antenna Control Unit (ACU) Setup

Figure 3-1 Antenna Control Unit (ACU) from Radeus Labs, Inc.

3.1 Retrofitting an existing system?

Radeus Labs recommends replacing older position-feedback devices, e.g., resolvers or SSI optical encoders, with EnDAT optical encoders.

3.2 Before installing the system

Before proceeding with setup:

- Review the safety information in "Important Precautions."
- Ensure all items listed in Appendix A-12.1, "Pre-installation checklist" are true.

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, other persons, and property.

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

3.3 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 3-2 ACU Rear Panel Connections

3.4 Setup and Configuration

The Model 8200™ includes a Setup Wizard. It can finish configuring the system after you supply the essential data described in this section.

The home screen offers access to all system settings and controls:

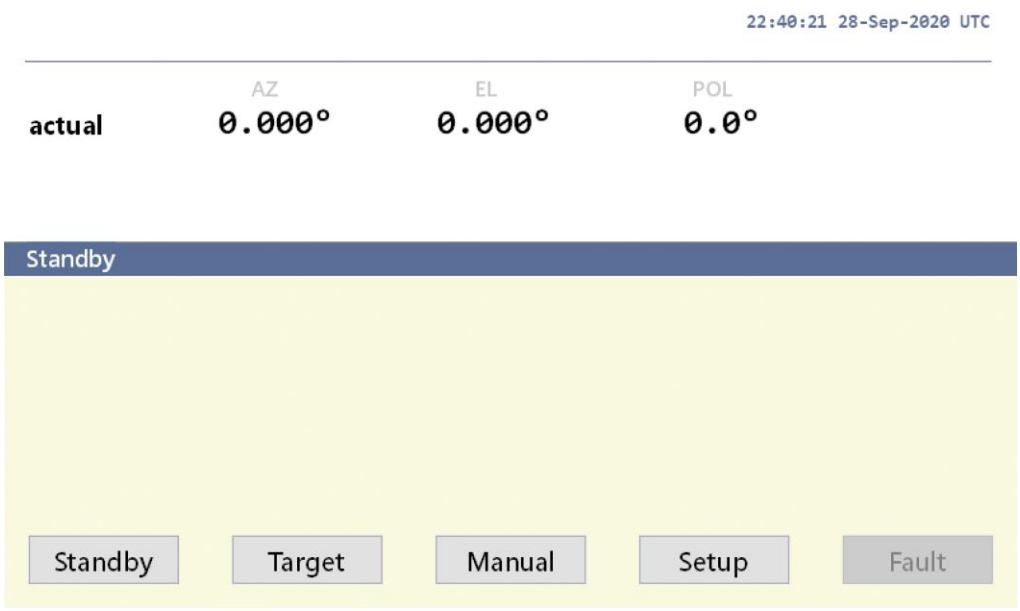


Figure 3-3 The home screen of the ACU's display.

To configure or edit system settings, tap the Setup button.

3.4.1 Specify the antenna & location

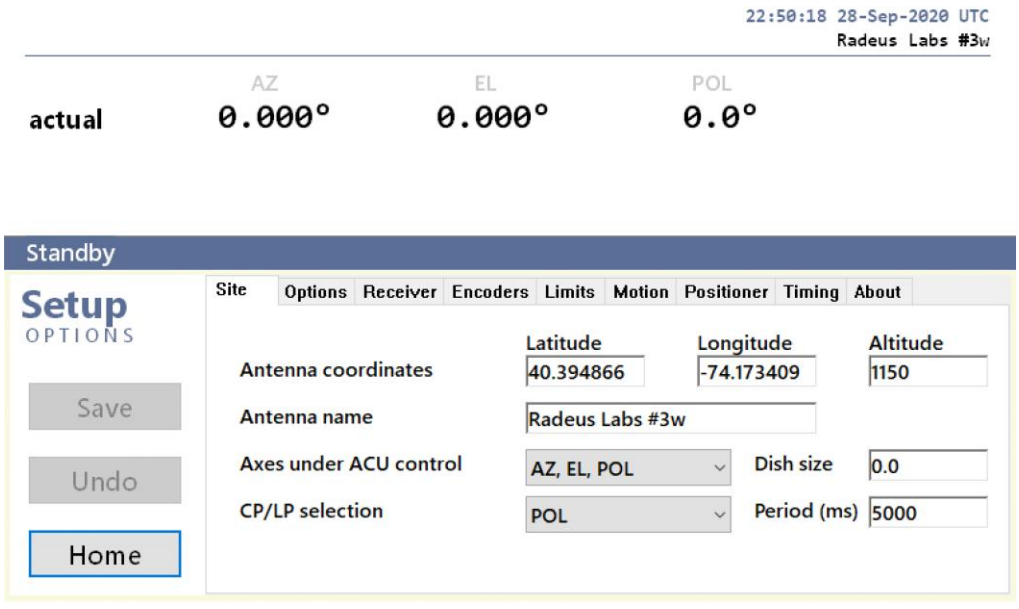


Figure 3-4 Options on the Setup>Site tab

To set up your antenna, follow these steps:

1. From the home screen, go to the Setup>Site tab.

2. Enter the latitude (in degrees north) and longitude (in degrees east) of your antenna. You can use up to six decimal places for greater accuracy.

3. Enter the altitude of your antenna in meters.

4. Name your antenna to distinguish it from other systems easily. This name will be displayed on the touchscreen.

5. Enter the size of your dish in meters, rounded to the tenth place.

6. Once complete, configure your antenna's POL settings, which will be discussed next.

Note: the location of the I/O controller (IOC) depends on whether the 8200 will be integrated with a Radeus Labs Model 8250 Drive Cabinet or other equipment — see "Model 8250 Drive Cabinet."

3.4.2 Antenna Polarization Settings

Some Series 8000™ systems, such as the Model 2200, support various polarization capabilities. Some systems have no POL fields and some have two POL axes and will display POL1 and POL2 fields.

The axes setting in Setup > Site determines which POL fields appear in the data display and in target-configuration screens.

NOTE: the distinction between the two following settings:

- Specify which antenna axes are under ACU control.

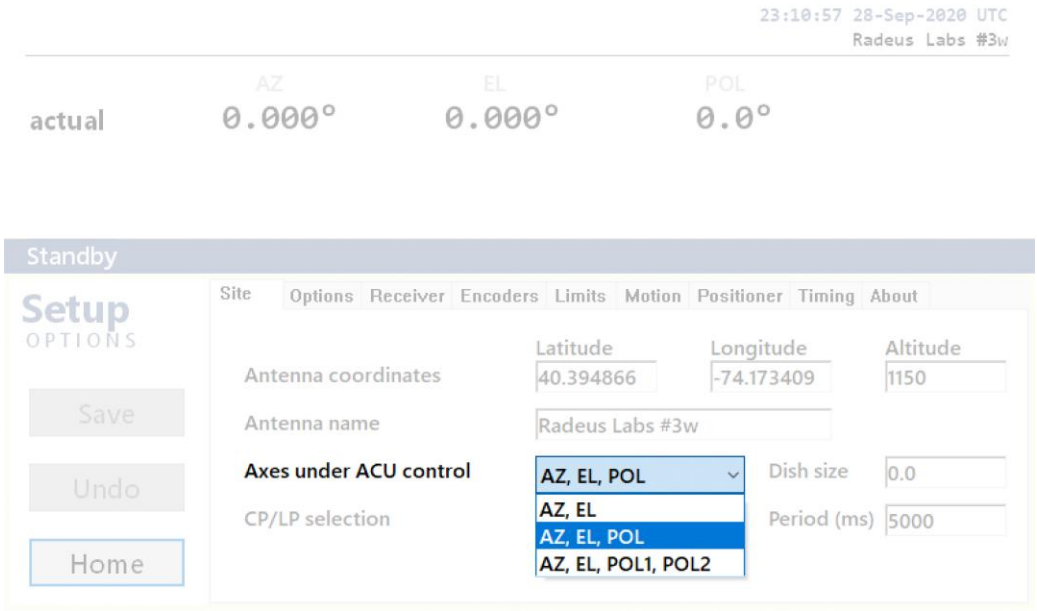


Figure 3-5 Setup>Site tab: Axes under ACU control

- Use "CP/LP selection" to specify the axes, if any, for which ACU operators are permitted to switch between lnear and circular POL.
- Set the period: determines the maximum timeout for CP/LP switching (in milliseconds).

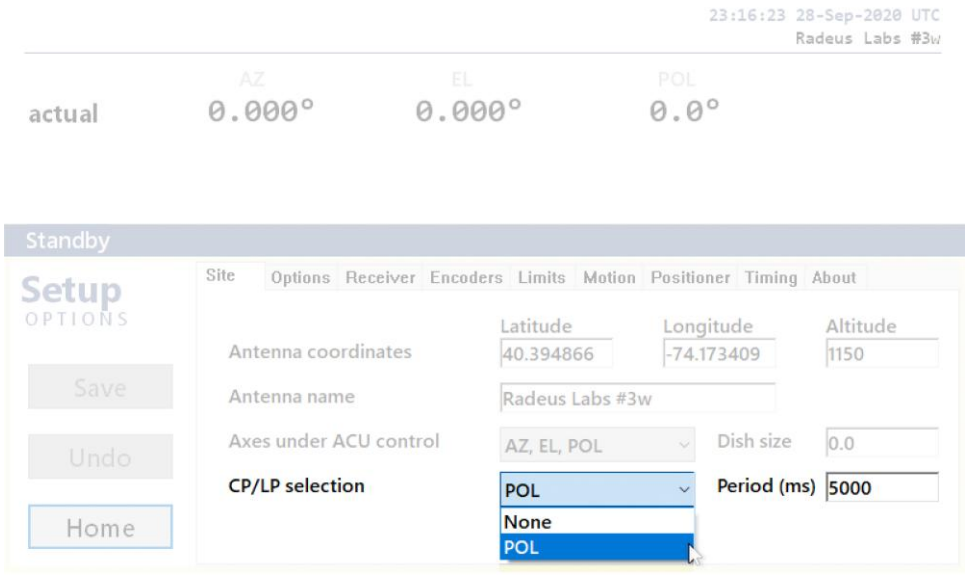


Figure 3-6 CP/LP selection on Setup>Site tab

To continue the setup, tap the Options tab.

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	Prevents steptrack operation if the beam width is pointing within 0.25° of the sun.
Remote M&C	Choose whether the ACU will allow Remote M&C connections
Orbital Tracking Limit	The antenna control maneuvers must align with the satellite's analemma trajectory to track a satellite. However, if the satellite's trajectory brings it close to other satellites, it is essential to prevent unintentional tracking of those nearby satellites. This is achieved by using orbital tracking limits.

3.4.3 Potentiometer Interface

Some systems include a potentiometer for measuring polarization feedback. To configure the Potentiometer Interface, follow these steps:

3.4.3.1 Accessing the Potentiometer Interface:

- Open the ACU application.
- Click the **Setup** button on the home page, then navigate to the **Site** tab.
- Under the **Axes under ACU control** dropdown, select **Az, El, Pol** as shown in the image below, and click **Save**.

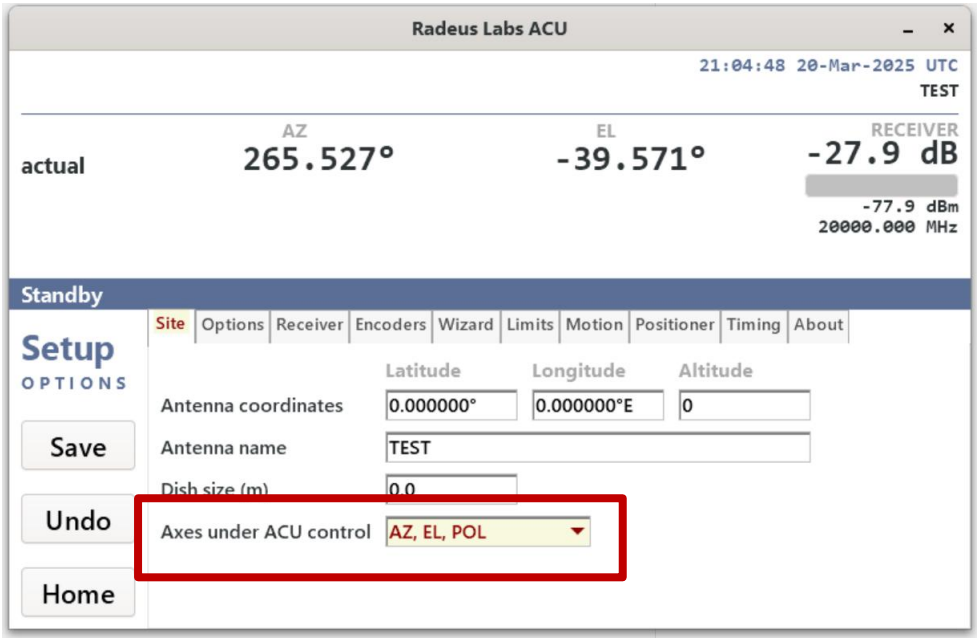


Figure 3-7 Adding Pol to the Axes under ACU control section in the ACU Application

3.4.3.2 Configuring the Encoder for Polarity:

- Navigate to the Encoders tab

- In the **POL** column, under the dropdown for **Type**, choose the **Pot (Potentiometer)** option, and click **Save**.

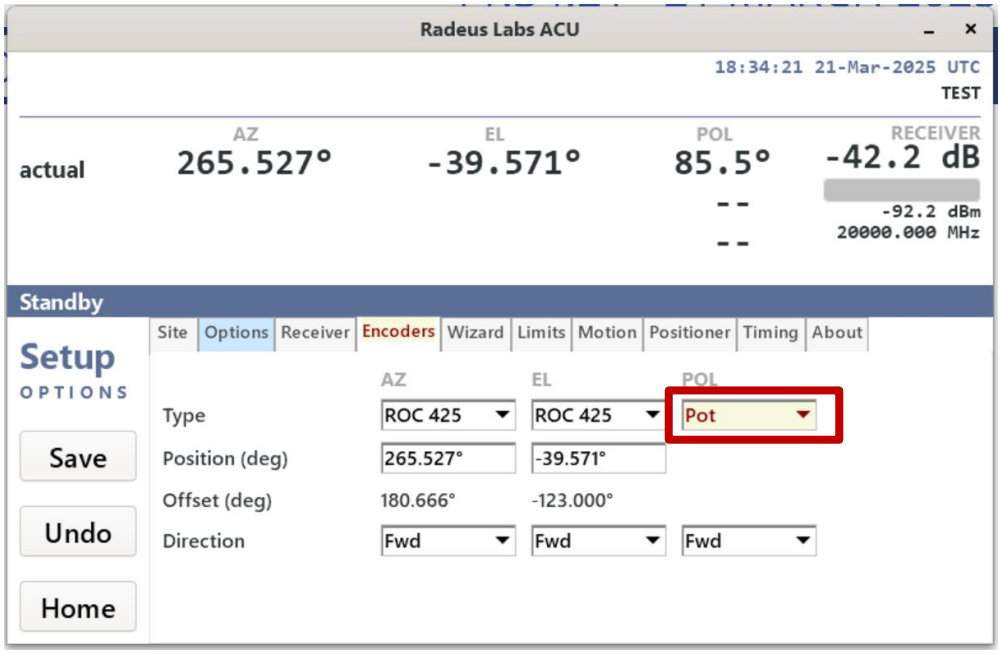


Figure 3-8 Potentiometer setting selected in Encoders page for Polarity reading

3.4.3.3 Setting the Potentiometer Limits:

- Go to the **Limits** tab.
- To establish the absolute position of your potentiometer, use an inclinometer on your system to determine angles when in the CW and CCW limits.
- If an inclinometer is unavailable, use these default values and click **Save**:
  - **CW/upper soft limit:** 90°
  - **CCW/lower soft limit:** -90°
  - **CW/upper hard limit:** 180°
  - **CCW/lower hard limit:** -180°

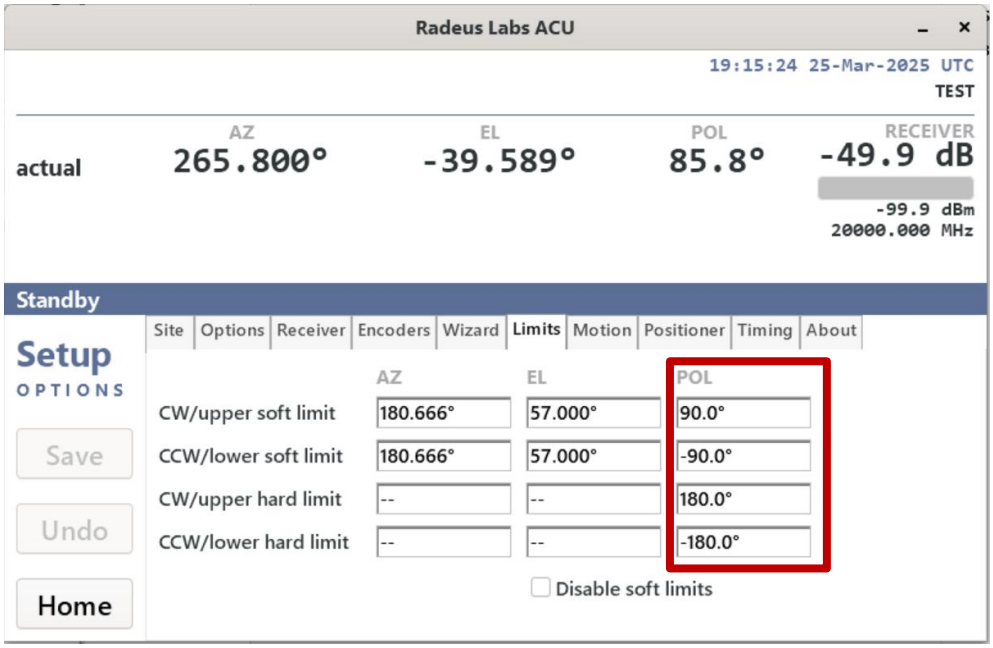


Figure 3-9 Default values for Pol soft and hard limits

These steps will configure your system to correctly read and apply polarity feedback using the potentiometer interface.

3.4.4 Options

For HA-DEC antennas, see note below.

The orbital tracking limit is the maximum allowable offset from the target trajectory. It is determined by factors of the antenna's 3dB receive beamwidth (n*BW). For Example:

Orbital Training Limit = 2
Receive Beamwidth = .27
(2 x .27° = .54°)

The orbital limit would constrain tracking maneuvers to a maximum offset of .54° from the target trajectory.

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

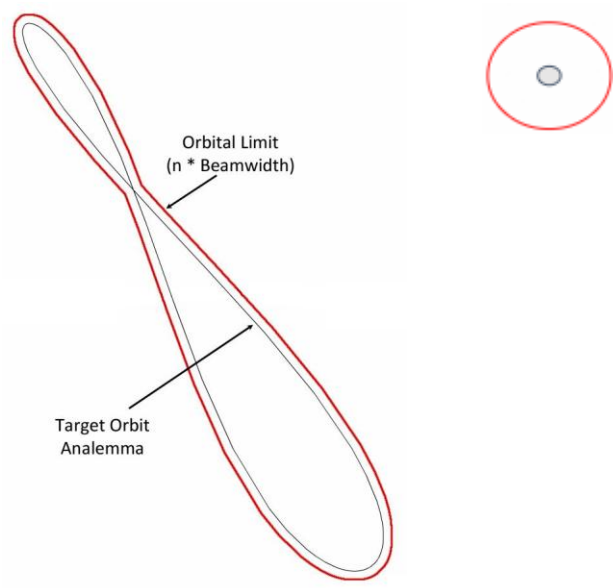


Figure 3-10 Orbital tracking limits constrain antenna maneuvers to the analemma trajectory of the GEO target satellite.

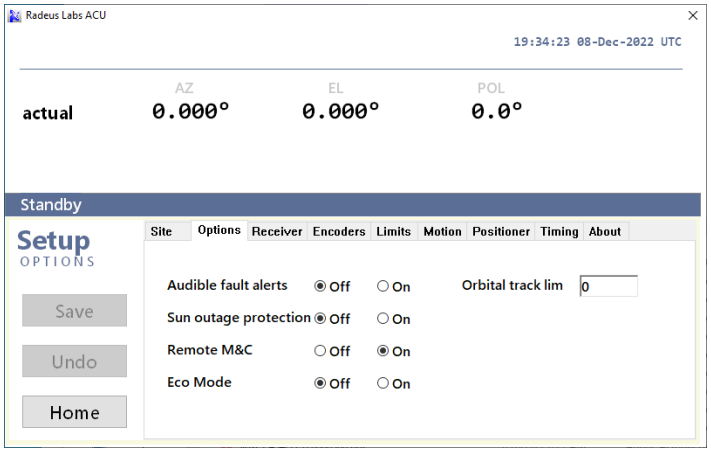


Figure 3-11 Options on the Setup>Options tab

- *Brake control*
  To enable this feature, edit the **BRAKE** key in the acu.ini file. (See Appendix 10: "Advanced Configuration — acu.ini.")

  The options on the brake control drop-down menu indicate when the brakes are engaged:

  - "None" — no brakes are controlled by the ACU (default).

- "Drive disabled" — brakes are engaged only when the drives are disabled.
- "Standby" — brakes are engaged only when the drives are disabled or the ACU is in Standby.
- "Motion complete" — brakes are engaged while movement is not commanded.

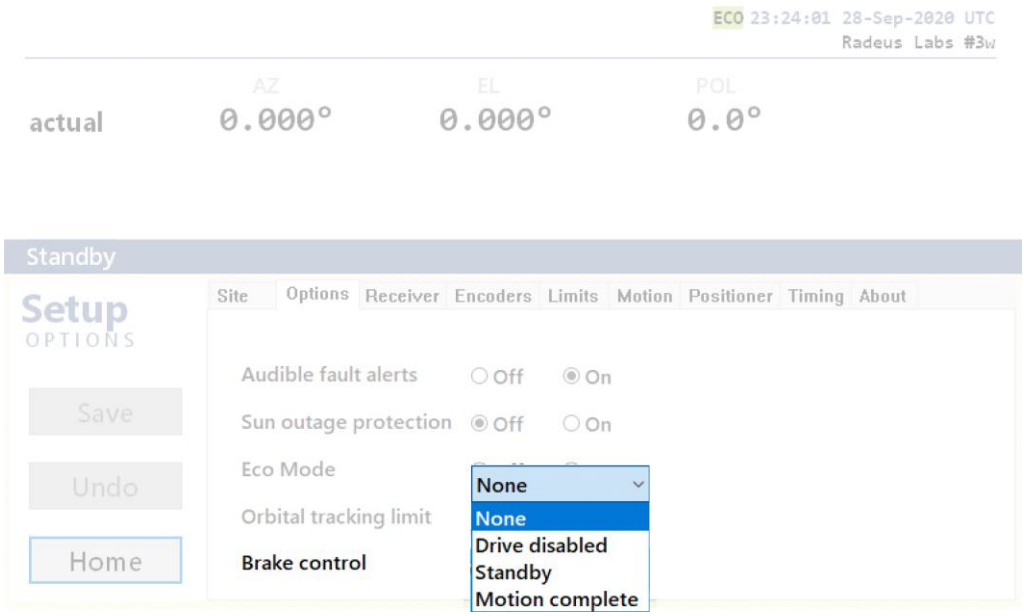


Figure 3-12 Brake control on the Setup > Options tab

- *Display units*
  Provided for antennas that use hour angle and declination. This setting determines whether the ACU's real-time data is shown in HA-DEC or AZ-EL units. (See Appendix 15: "Units: Hour Angle and Declination.")

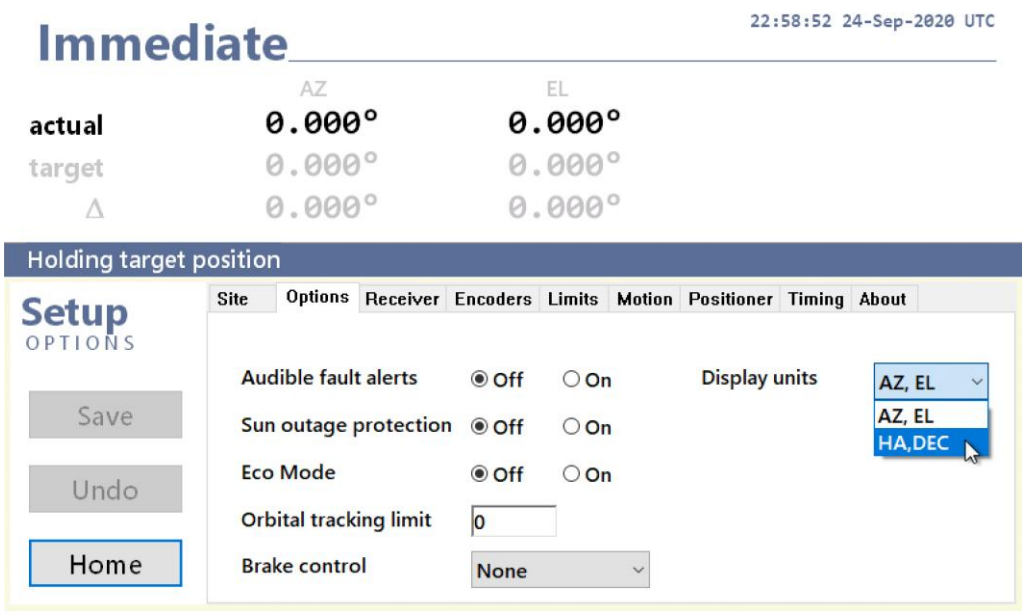


Figure 3-13 Display units setting on the Setup > Options tab

3.4.5 Receiver Characteristics

From the Home screen, go to Setup > Receiver tab and refer to the following for the type of receiver being used:

NOTE: When Internal and Internal KU is selected the *RF Input tab* is available

Internal	If the receiver type is *Internal,* the band on the *RF Inputs tab* must be specified. If the receiver type is "Internal," the BDC LO ("local oscillator") on the *RF Inputs tab* can be set separately for each input.

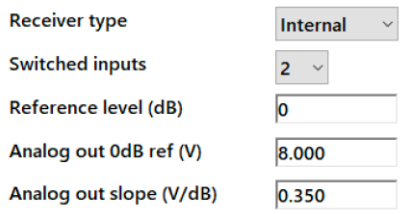
Switch Inputs	If the receiver type is "Internal," the BDC LO ("local oscillator") can be set separately for each input.
Reference Level	The dynamic range of the internal receiver is 60 dB, with a reference level from -40 to 0 dB.
Analog Output Voltage	The analog output voltage for relative power level 0 dB.
Analog Output Slope	The analog output's slope (V/dB).

<table>
<tr><td>Internal KU</td><td>If the receiver type is Internal Ku, the default band on the RF Inputs tab is Ku
<table>
<tr><td>Switch Inputs</td><td>If the receiver type is “Internal,” the BDC LO (“local oscillator”) can be set separately for each input.</td></tr>
<tr><td>Reference Level</td><td>The dynamic range of the internal receiver is 60 dB, with a reference level from -40 to 0 dB.</td></tr>
<tr><td>Analog Output Voltage</td><td>The analog output voltage for relative power level 0 dB.</td></tr>
<tr><td>Analog Output Slope</td><td>The analog output’s slope (V/dB).</td></tr>
</table></td></tr>
</table>

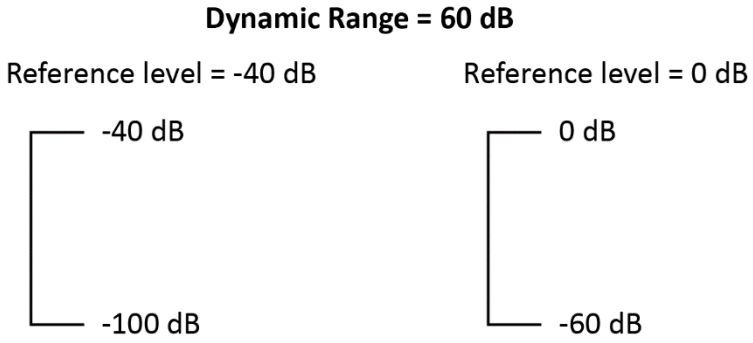
3.4.5.1 “Internal” vs. “Internal Ku” receivers

- **Internal**: The internal receiver used is the AVCOM of Virginia SBS2-2150E
  a. Input frequency range: 950 to 2150MHz
  b. Acquisition bandwidth: 125 kHz
  c. Tracking bandwidth: 60 kHz
  d. Acquisition CN0: 30.0
  e. Tracking CN0: 30.0

The same fields are shown. If the internal receiver is Ku band, the “Internal Ku” receiver type must be selected so that the Ku band BDC is properly utilized.



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.



<table>
<tr><td>DTR</td><td>Appendix 6: “Setup: DTR.”</td></tr>
<tr><td>253</td><td>Appendix 5: “Setup: GD Model 253.”</td></tr>
<tr><td>Analog receivers</td><td>When Analog is selected, two additional fields must be completed:<table><tr><td>Reference (V)</td><td>The voltage for the given reference level</td></tr><tr><td>Reference level dBm</td><td>The dBm for the given Reference Voltage</td></tr><tr><td>Slope (V/dB)</td><td>The analog input’s slope (V/dBm).</td></tr></table></td></tr>
<tr><td>3430 Serial</td><td>Appendix 7: “Setup: Radeus SSC Model 3430.”</td></tr>
<tr><td>3430 Ethernet</td><td>Appendix 7: “Setup: Radeus SSC Model 3430.”</td></tr>
<tr><td>3500 Serial</td><td>Appendix 7: “Setup: Radeus SSC Model 3430.”</td></tr>
<tr><td>3500 Ethernet</td><td>Appendix 7: “Setup: Radeus SSC Model 3430.”</td></tr>
<tr><td>520/550 Ethernet</td><td>Enter the IP address of the unit</td></tr>
</table>

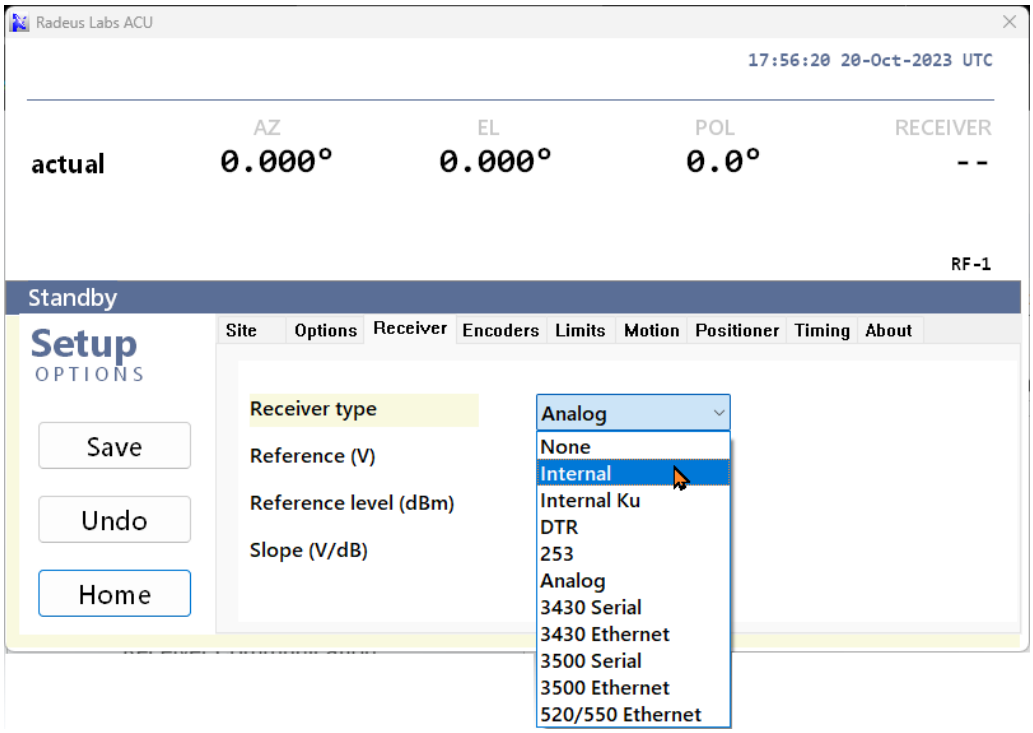


Figure 3-14 Options for the Receiver type on the Setup > Receiver tab

3.4.6 Receiver Communication Failure

The ACU application continuously monitors the frequency and signal level of the receiver and updates the information on the screen every 100 milliseconds. It calculates an average of these signals to display accurate information. If the ACU fails to receive a response or receives a "bad response" within 1000 milliseconds, an error message appears on the screen indicating a "Receiver communication failure."

3.4.7 RF Inputs

Note: This screen is available only if Receiver Type, on the preceding tab, is set to Internal or Internal Ku.

Use RF Inputs to specify which polarization is used for each input. This determines how they are displayed on the touchscreen.

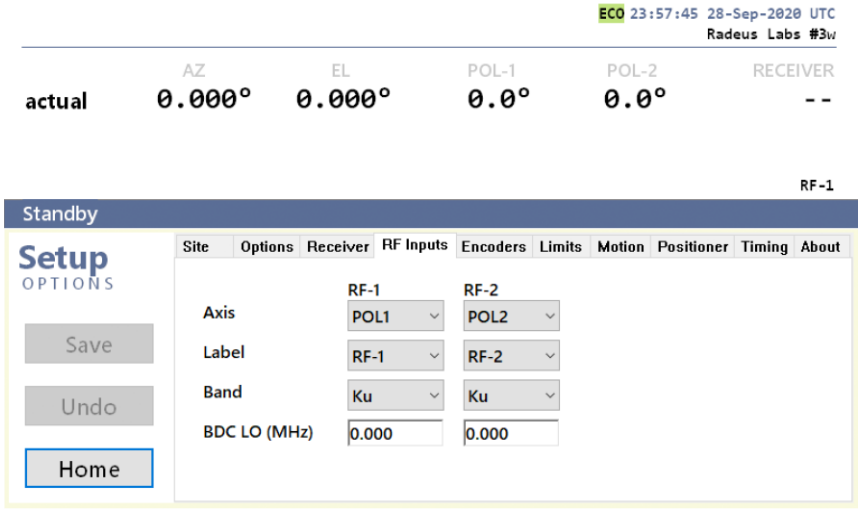


Figure 3-15 Options on the Setup>RF Inputs tab

1. Assign an axis to each RF input and choose a label to display on *the touchscreen.*

Note: If the receiver type is Internal Ku, the default band is Ku. If the receiver type is Internal, the band must be specified.

2. Specify the BDC LO ("local oscillator") frequency for each input.

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

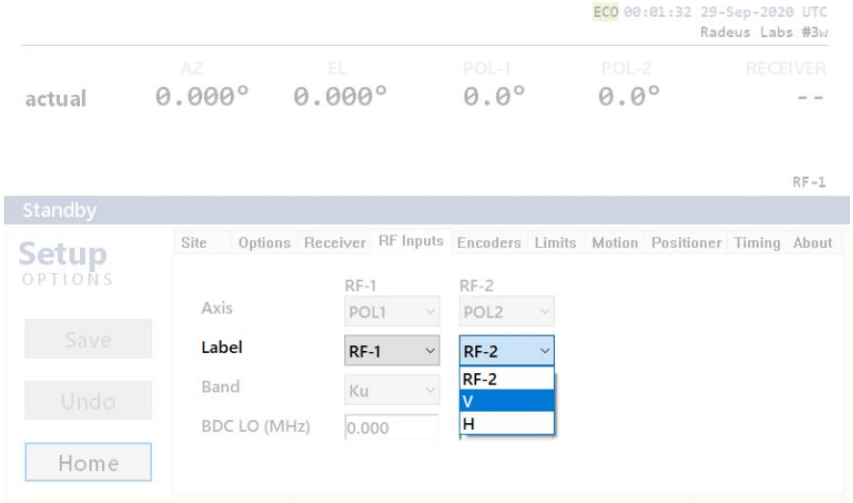


Figure 3-16 Label drop-down options on the Setup>RF Inputs tab

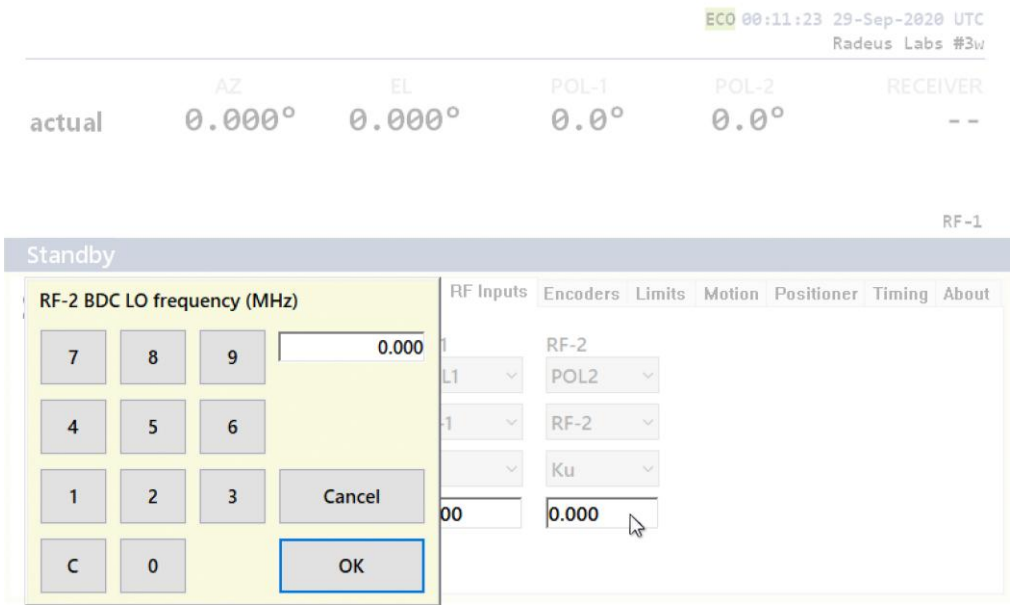


Figure 3-17 Entering BDC LO frequency (Mhz) Setup>RF Inputs tab

3.4.8 Specify encoder types and positions

Required:
A position and direction must be entered for each encoder or resolver.

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

For each axis, the *encoder angle* plus its *offset* equals the actual *look angle* (Encoder Angle + Offset = Look Angle)

Position (deg)	The direction the antenna needs to face to track a satellite or something else.
Outset	This is automatically populated once the position is entered.
Direction	The direction the axis position feedback device moves when the axis is moving in the positive direction
Type	The type of feedback device
Ratio	Gear ratio from the encoder to the axis movement

1. Use the jog controls to point the antenna to a *known or referenced* look angle (e.g., a known satellite's or star's position, true north, or the horizon).
2. If the angles are unknown and there's no reference, measure them with an inclinometer, tilt sensor, level (EL), or compass (AZ).
3. Enter the angles into the Encoders > Position (deg) fields. The ACU will populate the offset fields (**Figure 3-15**).

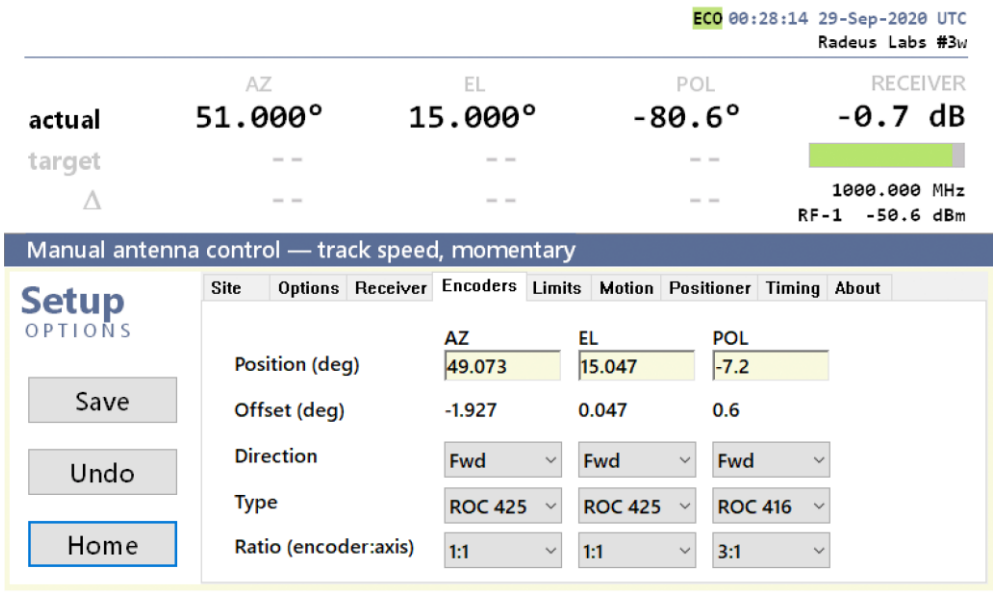


Figure 3-18 Options on the Setup>Encoders tab

4. "Ratio (encoder:axis)" — to enable this, edit the RATIOS key as in Appendix 10: "Advanced Configuration — acu.ini."

   RATIOS=1 *(the default is 0, for "off" — not enabled)*

   Then you can choose from the drop-down menus the number of encoder/resolver-shaft revolutions for antenna movement along each axis:

   - Default ratio is 1:1
   - Maximum ratio is 8:1

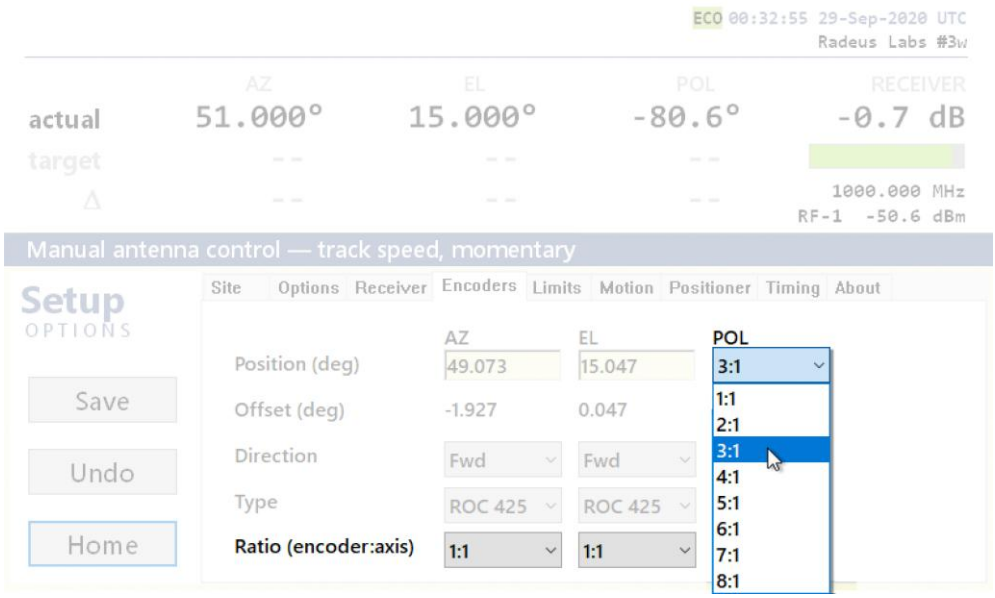


Figure 3-19 POL options on the Setup > Encoders tab

3.4.9 Celestial Body mode

The ACU allows pointing and following a few predefined celestial targets as well as the option to point and follow a custom celestial body based on ephemeris data.

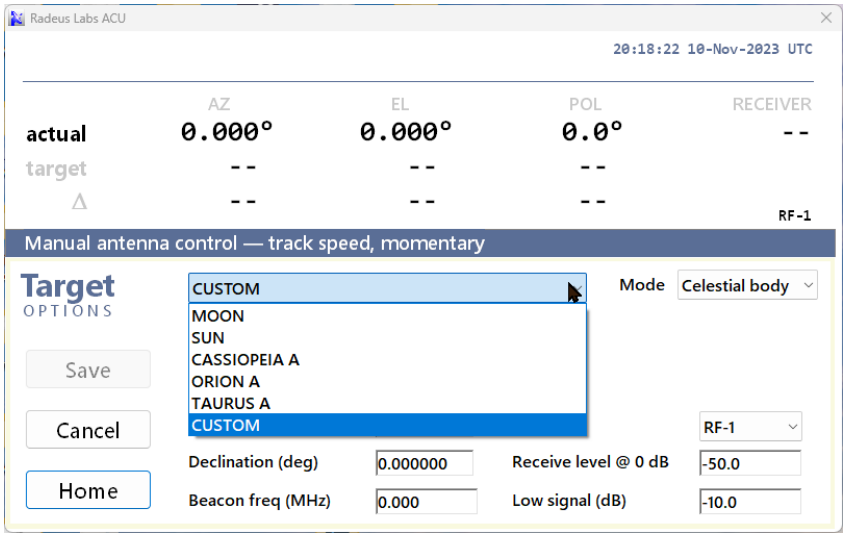


Figure 3-20 Predefined celestial targets

The custom option allows the user to define a custom target based on J2000.0 epoch right ascension and declination (RA/Dec). The target must be a deep-space object with a distance sufficiently far enough to not be a consideration (distance will be assumed to be infinite).

As with all targets, bias angles can be defined for the custom target. The target can disable the RF input or allow for the selected RF Input signal to be monitored during pointing/following.

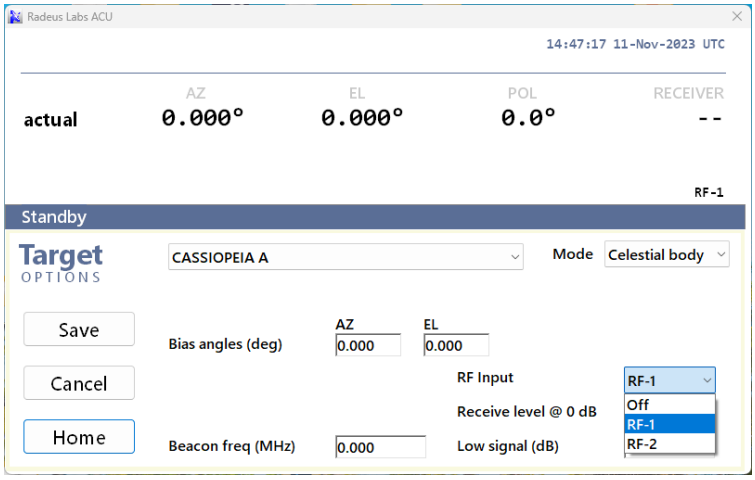


Figure 3-21 RF Input

3.5 Setup Wizard

⚠ ***Warning:***
Do not run the Setup Wizard 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.

The Setup Wizard (see warning notes) is used to discover the position of limit switches (soft limits and final hard limits) and to measure antenna backlash. All settings can still be edited.

The Setup Wizard may be useful…

- after installing and connecting the ACU
- after significant changes to antenna or drive hardware
- to verify the integrity of a system experiencing issues

⚠ **Caution:**
While the wizard runs, the ACU drives the antenna to determine optimal operating parameters along each axis. The antenna will be in motion a number of times during this operation. Even if it pauses, motions may resume until the Setup Wizard concludes.

3.5.1 Requirements, before the Setup Wizard

1. The Model 8200 must be installed and connected properly.

NOTE: ENSURE ALL LIMIT SWITCHES ARE TESTED AND WORKING CORRECTLY ON EVERY AXIS.

2. Auto-tune the Yaskawa drives (see Appendix 9: Setup: V1000 Motor Drives).

3. The antenna must not be tripping any limit switches.

4. Any limit jumpers need to be removed.

Figure 3-22 Remove limit jumpers to be removed (*left* installed) (*right* removed)

5. Encoder offsets must be established for each axis (see section 3.4.5 about Setup > Encoders).

3.5.2 How the wizard works

Setup details:
To view or edit settings determined by the Setup Wizard, browse the 8200's Home > Setup

⚠ **Required:**
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 axis — until it has hit all the hardware limit switches.

When the system detects a limit switch, it backs away from it by two degrees. That new position is 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 back to center to determine the angles and periods of the motion faults, and the threshold and deadband for the positioner parameters. It also will calibrate the bump and coast times.

3.5.3 Run the wizard

How long will it take?
Precise times are site-specific. 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.

First, complete the Setup screens for Site, Receiver (if present), RF Inputs, and Encoders, *and verify the wizard requirements,* above. Then:

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

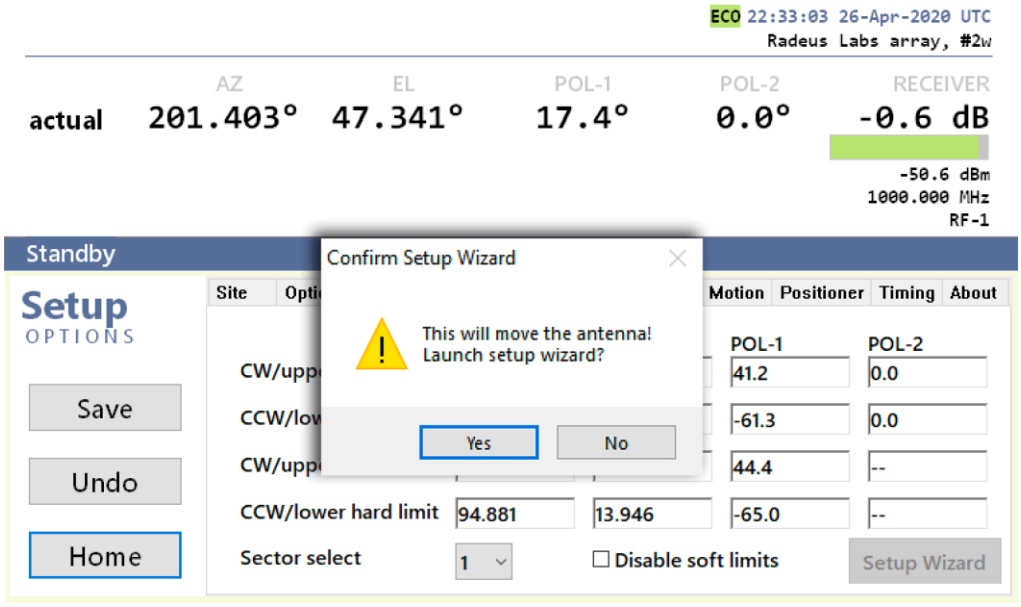


Figure 3-23 Conferming the setup wizard

The wizard will exercise the antenna's full range of motion along each axis, and more tasks, to detect vital characteristics. 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. *The wizard might overwrite settings that have been applied manually.*

3.5.4 Antenna Travel Limits

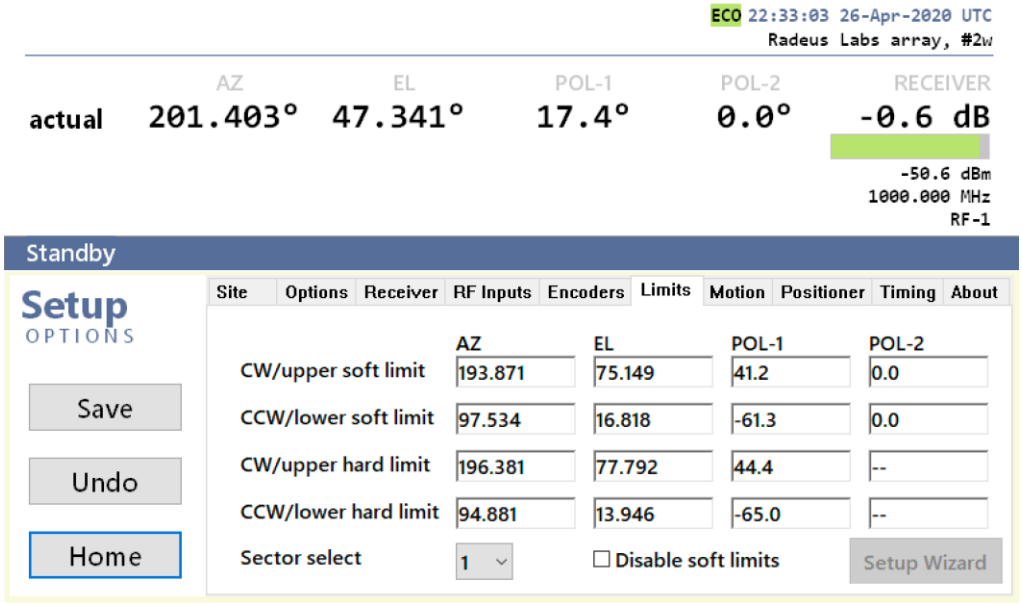


Figure 3-24 Option on the Setup > Limits tab

- 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 the values can be edited.
- *About "Disable soft limits":* also see the related system fault discussed in section 5.3.28, "Soft travel limit disabled".

> ⚠ **CAUTION:** Hard-limit values are determined by the placement of the hardware limit switches. *Run the Setup Wizard after any change to the limit switches to update the limit settings.*

3.5.5 Antenna Sectors

The Model 8200 supports antennas with multiple azimuth *sectors*, parts of the antenna's range of motion that are used frequently. Configuring sector parameters in the ACU allows it to operate with correct travel limits without needing to rediscover limit-switch positions.

Changing the sector *is the same as* using Setup > Limits to enter new numbers for AZ soft and hard limits.

Changing sectors *doesn't change the physical limit inputs* monitored by the IOC.

<table>
<tr>
<td>Sector Select</td>
<td>

"Sectors" — to enable this feature, edit AZ_SECTORS in acu.ini. (See Appendix 10: "Advanced Configuration — acu.ini.")
AZ_SECTORS=n
…where n is the maximum number of sectors that can be selected. (The default value is 0, which disables this feature.)

Setting the number of sectors to 1 has no effect.
Typical use sets this value to 2.
The maximum number of sectors is 8.

Using sectors during normal operation:

Turn off the drive cabinet.
Physically move the antenna to new sector.
Turn on drive cabinet.
Select new sector in ACU.
If configuring a new sector for the first time, enter the new limits manually or run the Setup Wizard.

Changing sectors usually involves physically moving antenna jacks and limit hardware to change the antenna's range of motion.
<hr>
NOTE: This should be done prior to selecting the active sector on the ACU.
<hr>
For example, as shown in Figure 3-20, below, sector A occupies the range 270° to 20°. Selecting sector B would change the ACU's soft limits to the range 340° to 90°.

</td>
</tr>
</table>

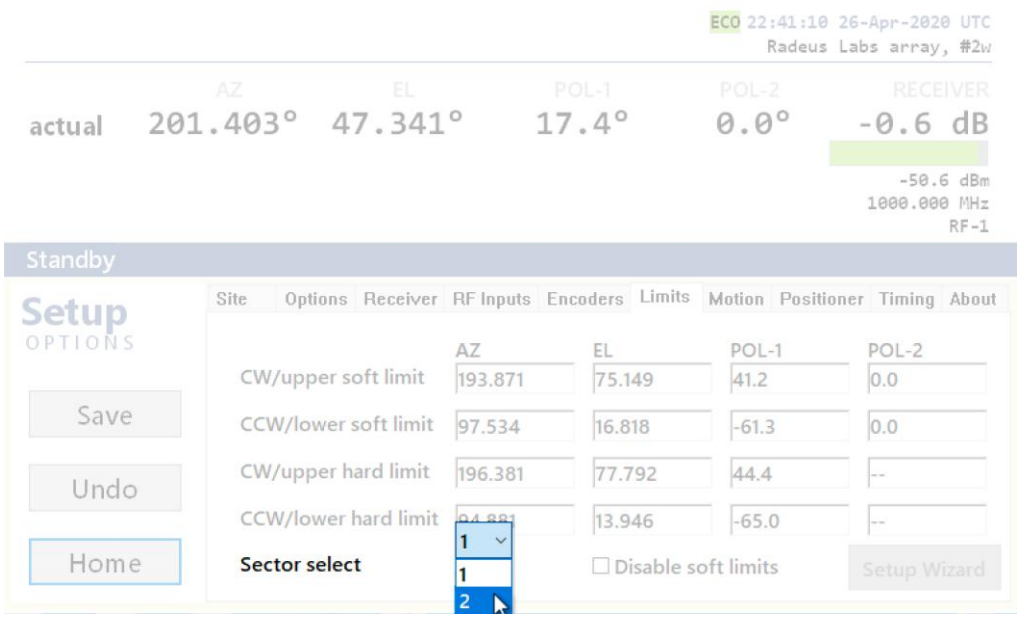


Figure 3-25 Sector select settings on the Setup>Limits tab

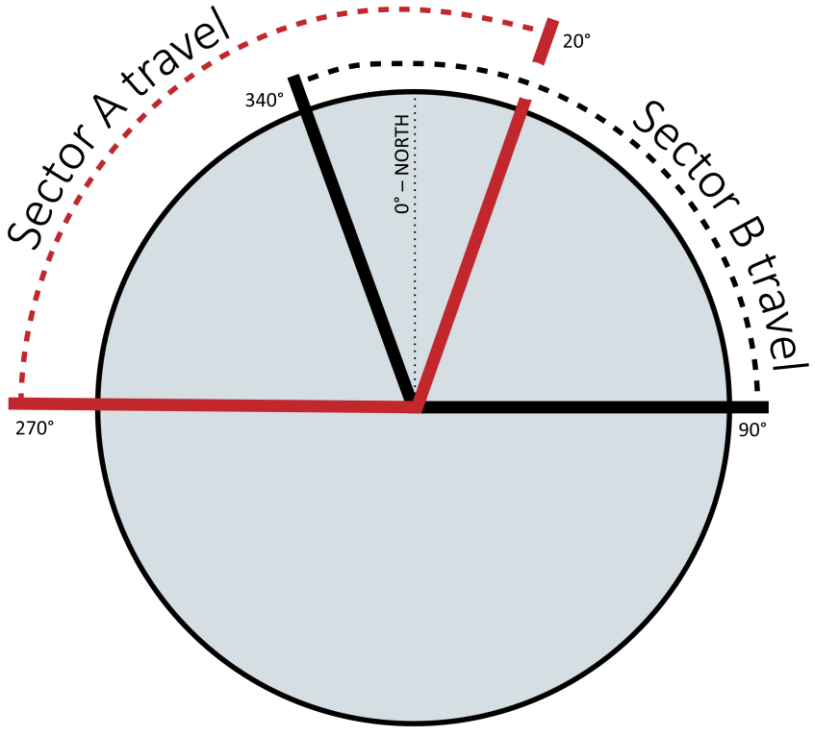


Figure 3-26 Sector travel limits

3.5.6 Motion Faults

Settings on the Motion tab determine when certain key fault conditions are asserted by the ACU.

Period (ms)	How often, in milliseconds, measurements are checked for the two motion faults, which are:
Tolerance (deg)	If a motion is commanded and the measured angle does not change by at least the number of degrees entered here, the *axis-immobile* fault is asserted. If motion is detected reverse to the commanded direction, by this amount, the *reversed* fault is asserted.
Runway (deg)	If no motion is being commanded but the measured angle changes by this amount or greater, the *runaway* fault is asserted and the ACU cuts off the drive enable. (For details, see the runaway faults' descriptions at, for example, "Azimuth runaway".)

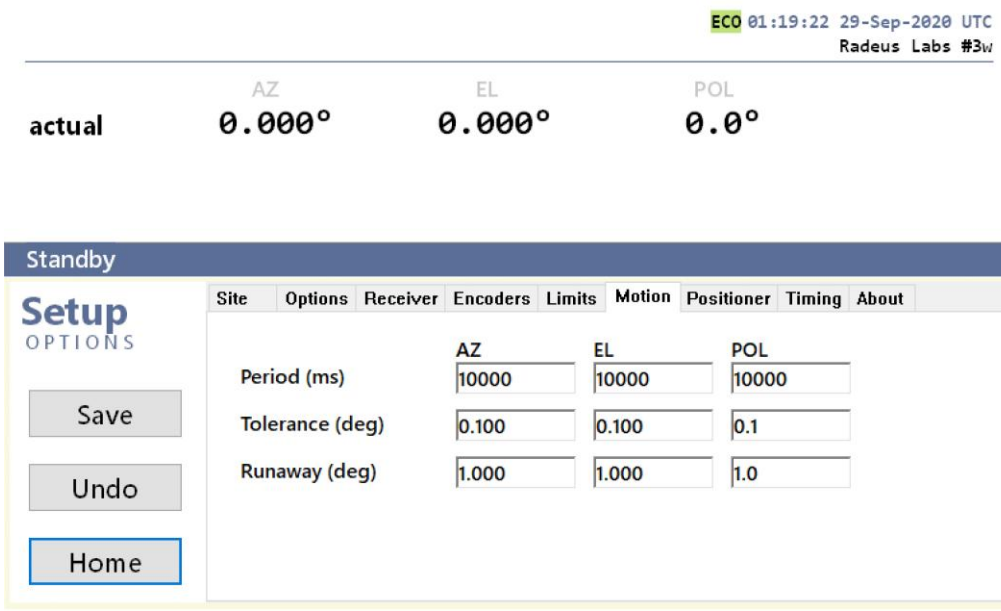


Figure 3-27 Options on the Setup > Motion Faults tab

3.5.7 Positioner

Deadband (deg)	The angle within which the controller will hold the axis. When the actual angle is within the deadband of a

	commanded position, the only antenna motions are momentary, “bump” adjustments.
Eco mode offset (deg)	To reduce such momentary adjustments and, hence, the wear on mechanical equipment, *Eco mode* minimizes corrective motions when the system is actively holding a position. Eco mode does not apply while moving to a new target. It has minimal effect on tracking behavior. To activate Eco mode: Use the Home > Setup > Options tab to set Eco Mode to On. On the Home > Setup > Positioner tab, enter the desired offsets within which Eco mode will minimize small antenna adjustments.
Slew Threshold (deg)	If no motion is being commanded but the measured angle changes by this amount or greater, the *runaway* fault is asserted and the ACU cuts off the drive enable. (For details, see the runaway faults’ descriptions at, for example, "Azimuth runaway".)
Rate (deg/sec)	the track speed of the axis calculated by the Setup Wizard. If the Setup Wizard has not been run, these fields’ values will be zero.
Motor Time (hr)	the number of operating hours each motor has logged. If a motor has been operated before the current setup, the ACU operator can enter the amount of pre-existing in-use time. The ACU will increase as the system is used. (Motor time is recorded in milliseconds but is displayed as hours).

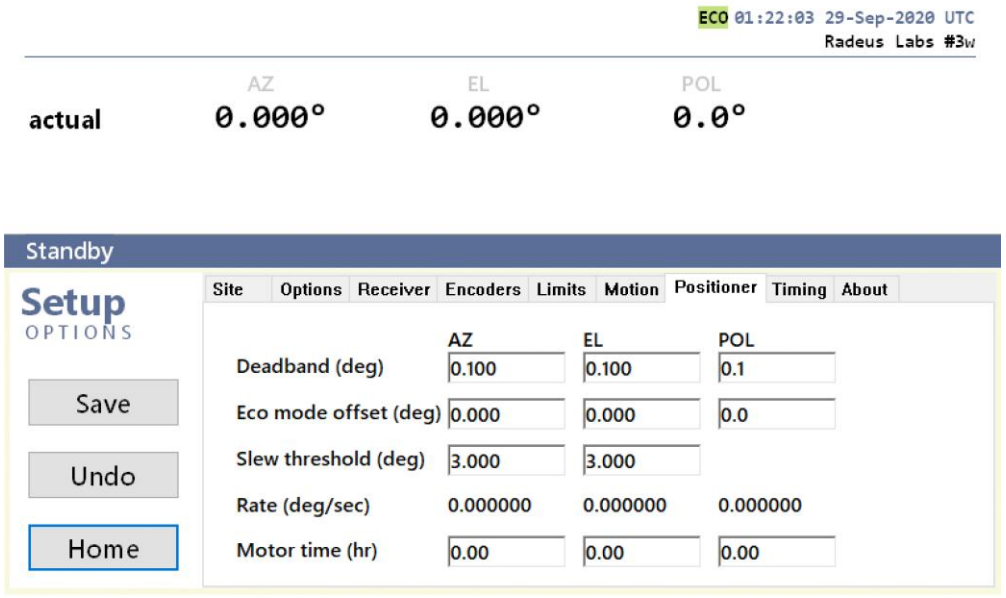


Figure 3-28 Options on the Setup > Positioner tab

3.5.8 Timing

Bump Duration (ms)	the amount of time to take a very small, measurable step in position. The amount depends on the resolution of the position transducer (encoder or resolver).
Bump coast (ms)	the wait period to allow the antenna to “coast” to a stop, after a bump, before initiating another motion.
Track coast (ms)	the period to wait after running at track speed before moving again.
Slew coast (ms)	the time to wait after ending a slew motion before beginning another motion.
Brake release (ms)	the amount of time, in milliseconds, the brakes require to physically disengage before movement can be commanded

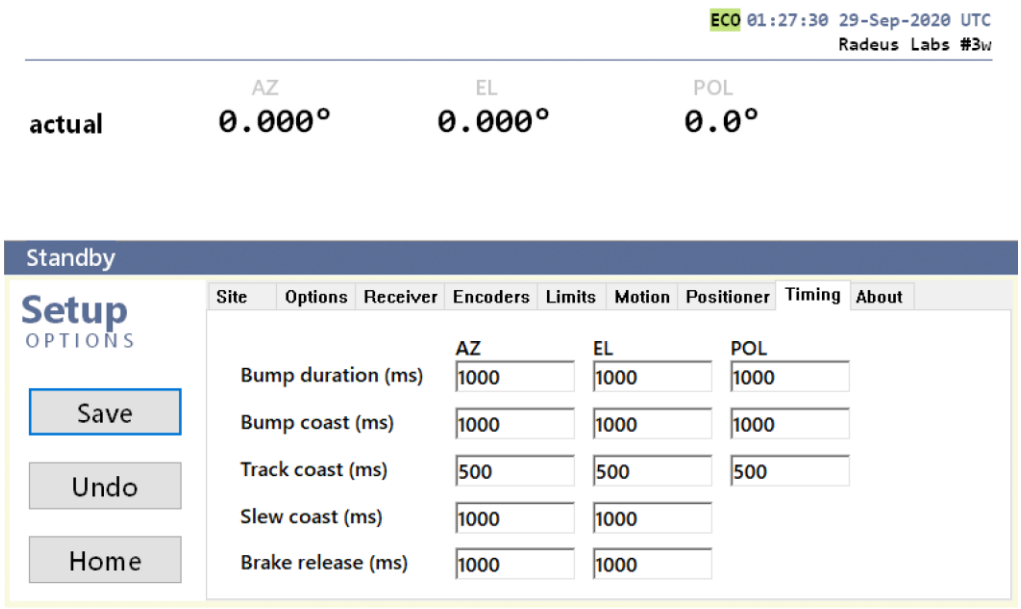


Figure 3-29 Option on the Setup > Timing tab

4 Typical Operations

System configuration and all normal operations are carried out via the ACU's touchscreen and hardware jog buttons. (Equivalent jog controls are provided in the Model 8250 drive cabinet.)

4.1 Touchscreen Display

The upper part of the touchscreen is for *real-time data*. It identifies the antenna, target object, and position and signal information.

Real-Time Data (AZ, EL, POL-1, POL-2)	Display shows… …during tracking or pointing: the antenna's position, commanded position, and the difference of those values.

	…if the ACU is not in an active tracking or pointing mode: the antenna's position and the mechanical position[1] ("mech") of the limit switches. 
Receiver	Shows the relative signal strength, target beacon frequency, and signal level coming from the receiver. 
Status Bar	Shows system-status messages. 

The area below is dedicated to controls and settings.

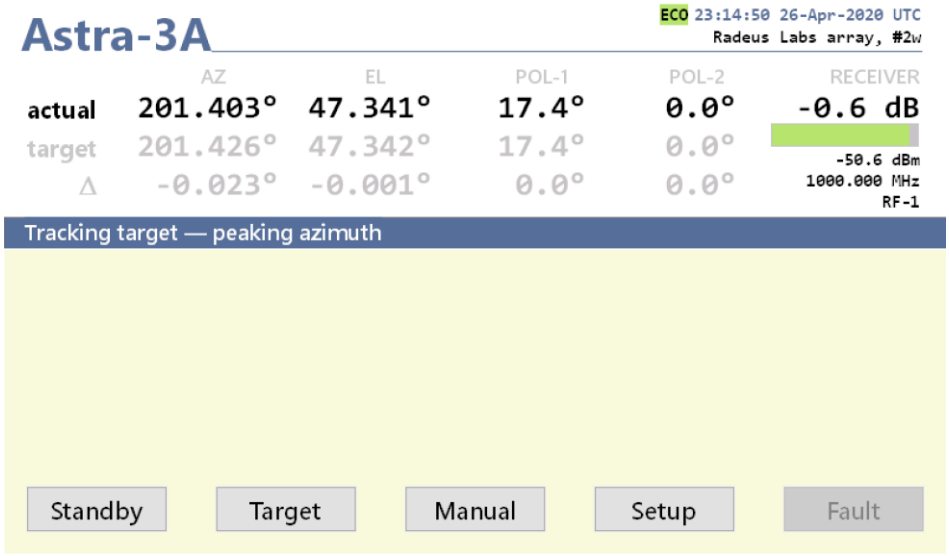


Figure 4-1 The Home screen offers access to controls and system settings without obscuring any real-time data.

- The blue *status bar* shows system-status messages.

[1] 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).

The system responds to fault conditions with messages (listed in section 5, “System-Fault Conditions”), and optional audible alert tones.

For example:

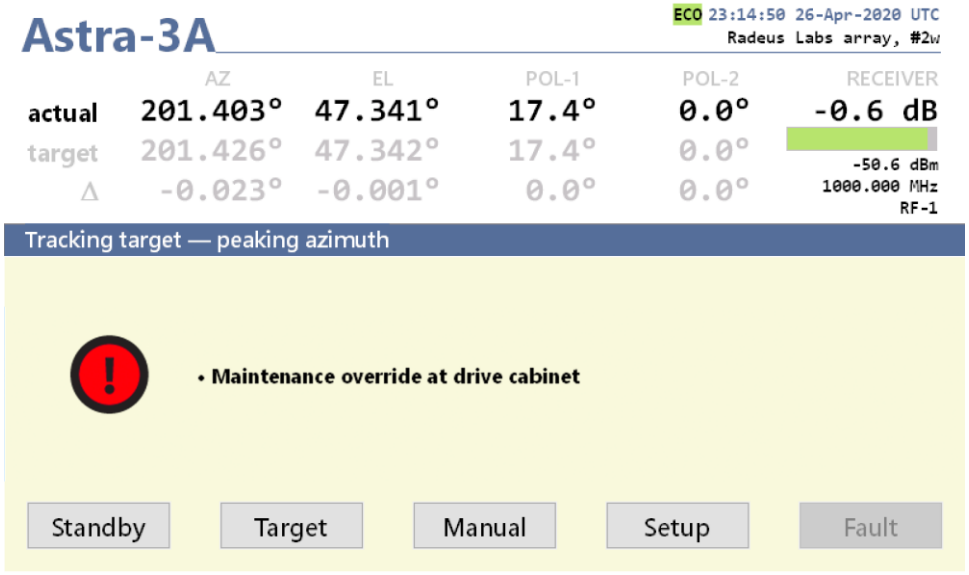


Figure 4-2 The Home screen displaying fault messages, which are listed in section 5.3. To enable or disable *audiable* fault alerts see Figure 3.7

4.2 Start Up, Quit, Shut Down

4.2.1 Start the ACU application

The ACU software starts when the unit powers on.

If the power is on but the ACU software is *not* running:

- Launch the ACU application via the desktop shortcut, or…
- …re-launch Windows, which will restart the ACU application.

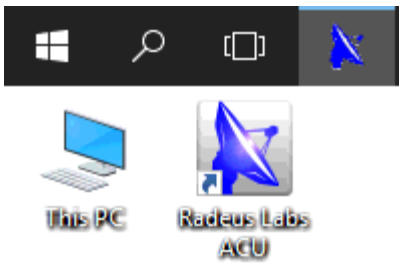


Figure 4-3 Radeus labs ACU desktop icon

4.2.2 Quit the ACU application

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

To minimize the ACU window without quitting the application, tap "Desktop." You'll see the host OS with the ACU in the task bar.

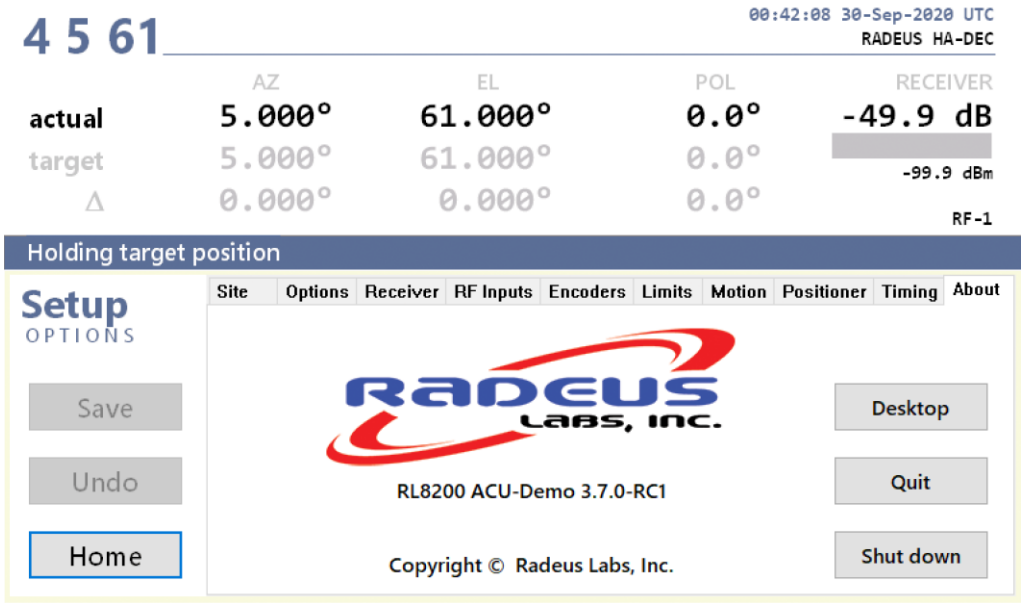


Figure 4-4 Quit the ACU software, or Shut Down *both* the ACU and the OS.

Power down the ACU and Operating System

NOTE: To quit both the ACU application and the operating system, do so in an orderly manner:

1. Go to the Home > Setup > About screen (**Figure 4-3**).
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.

4.3 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.

4.4 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:

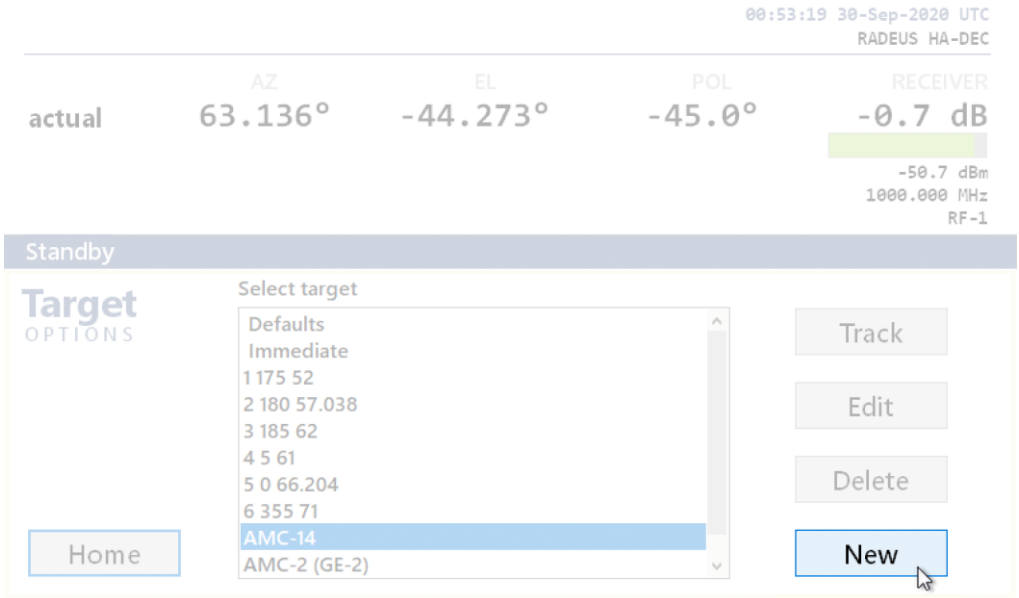


Figure 4-5 Adding a new Target Home>Target

A screen will appear for entering a new satellite's characteristics.

Which fields will be shown, and whether they occupy one or more screens, depends on the Mode selected for this target.

3. In the Mode drop-down, select a mode to use for this target. The available modes are described in sections 4.6 and 4.7:

* The marked modes require the system to have a receiver that is enabled.

- Look angles
- Longitude
- Predictive*
- Steptrack*
- TLE (SGP4)
- IESS-412
- TLE/Steptrack*
- IESS/Steptrack*

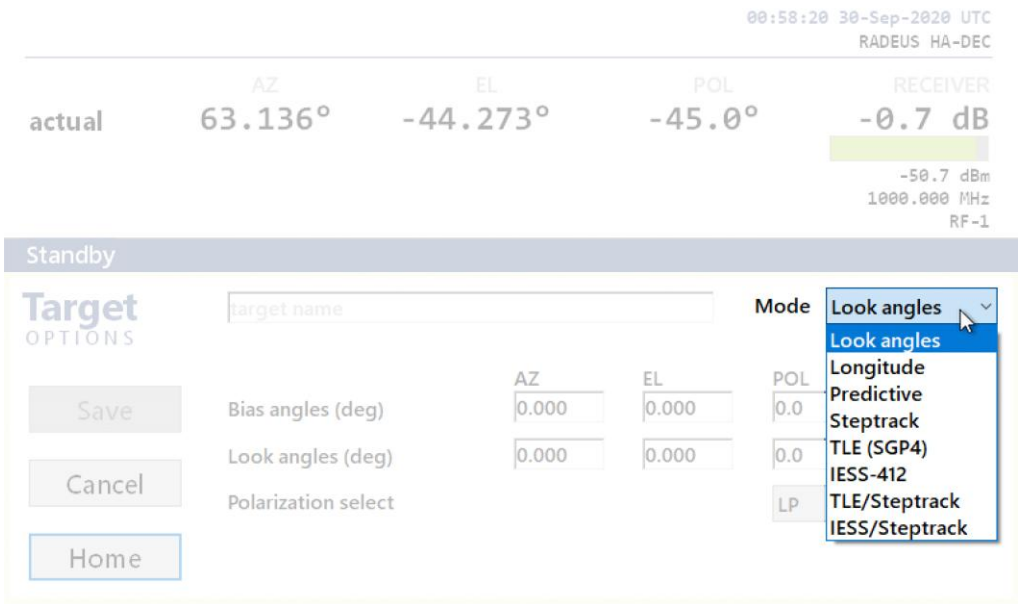


Figure 4-6 Option the for the mode of a new target

4. *Unless you're using TLE or IESS data* (section 4, "When peaked, tap Apply to save the new bias angles for that target, for use when it is acquired again later.

5. TLE/Steptrack and IESS/Steptrack"), tap the "Target name" field to assign a unique name to the satellite, then tap OK. (The name can be edited any time.)

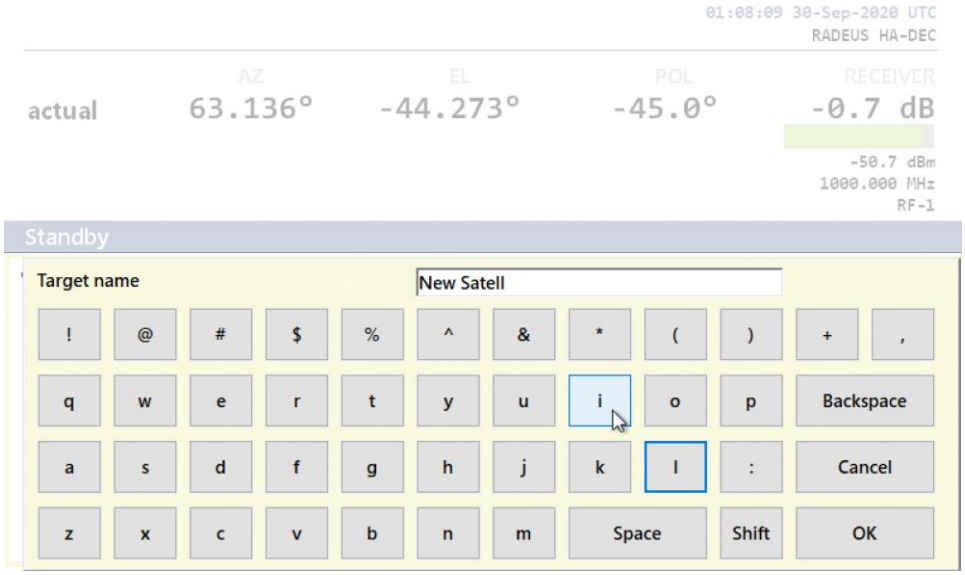


Figure 4-7 A satellite's name can be any unambiguous label useful at the earth station (except TLE and IESS target names, which are pre-defined).

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

6. After selecting the Mode (discussed in sections 4.6 and 4.7), the other fields requiring operator input change accordingly. Enter any parameters required by the new target's mode, then tap the Save button.

The list at Home > Target includes any operator-defined targets:

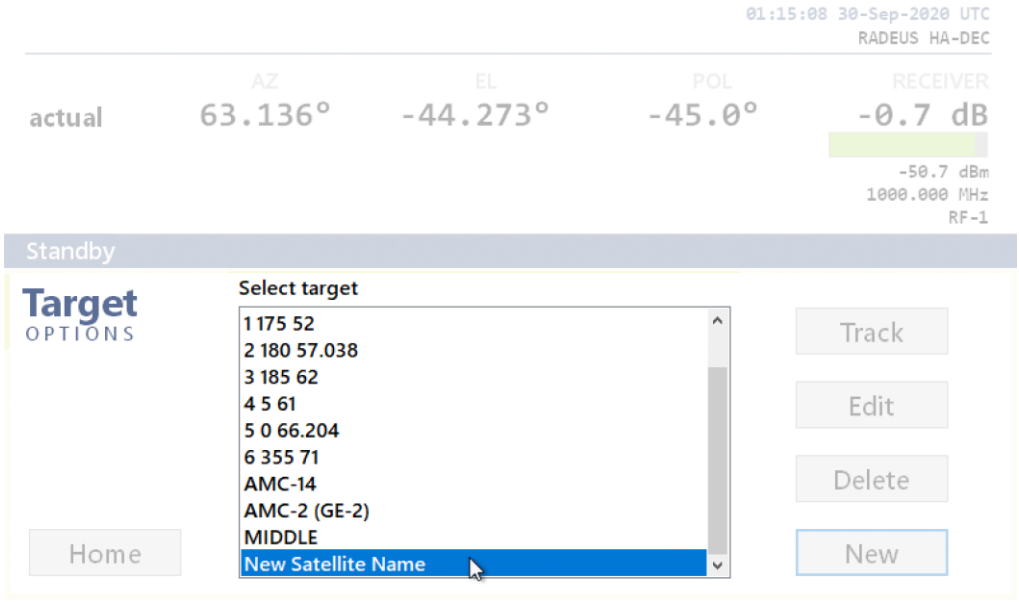


Figure 4-8 Operator-defined targets are in the list at Home > Target.

4.4.1 "Default" and "Immediate" targets

Two special-purpose items begin the list of targets displayed in the list of targets (for example, see **Figure 4-4**):

- **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, described in section 4.5.

Immediate
Select this, then tap Track to begin tracking at the antenna's current position (discussed in section 4.7.6, "Track Immediate, Manual Peaking, and Bias Angles").

Note: Immediate cannot be used with TLE or IESS pointing modes, because those associate the satellite name with the target profile name. But Immediate and Default profile names cannot be modified, so separate, new target profiles must be created instead.

4.5 Edit a Target's Properties

To change the settings for any target in the Home > Target list:

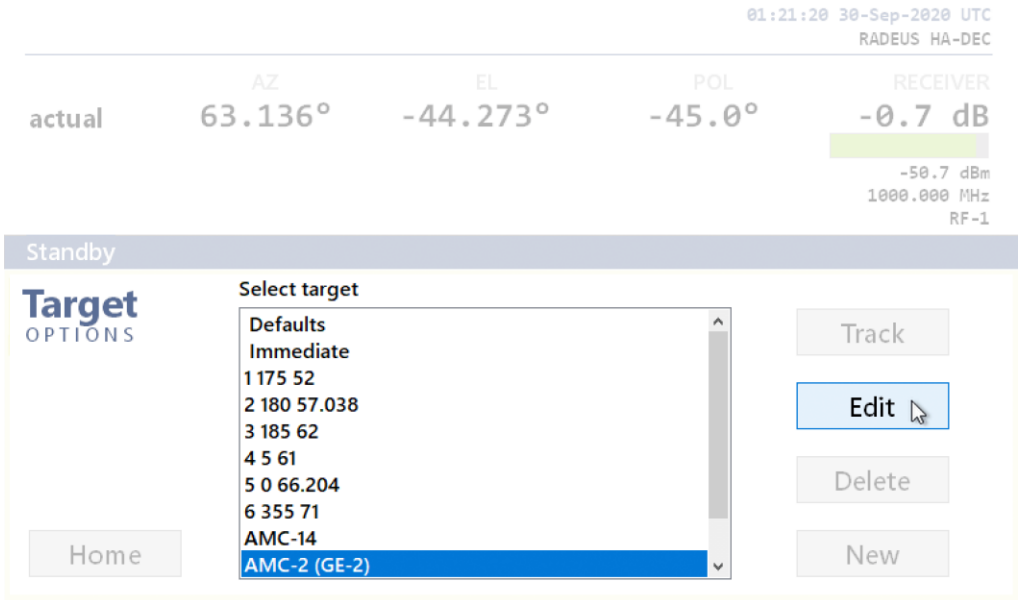


Figure 4-9 The characteristics of targets can be edited.

1. Highlight the target you want to modify.
2. Tap the Edit button to display that target's characteristics.
3. *The specific settings shown depend on the tracking or pointing mode in use for that target.*

Also see section 4.7.6, "Track Immediate, Manual Peaking, and Bias Angles."

4.6 Pointing Modes

The mode is set on a per-target basis (see section 4.4). A *pointing mode* directs the antenna to a fixed location and actively holds that position.

Also see section 4.7, "Tracking Modes."

To position a target, we apply any saved *bias angles* to its *look angles*. You can find more information on this in section 4.6.4.2 under "Using Bias Angles for TLE and IESS-412", as well as in section 4.7.6 under

"Track Immediate, Manual Peaking, and Bias Angles."Any saved *bias angles* are applied to a target's *look angles* to produce the *commanded position*. See section 4.6.4.2, "Using Bias Angles for TLE and IESS–412" and 4.7.6, "Track Immediate, Manual Peaking, and Bias Angles."

Look angles mode

4.6.1 Look angles mode

Move the antenna to the *look angles* entered for the target, then actively hold. See **Figure 4-9**.

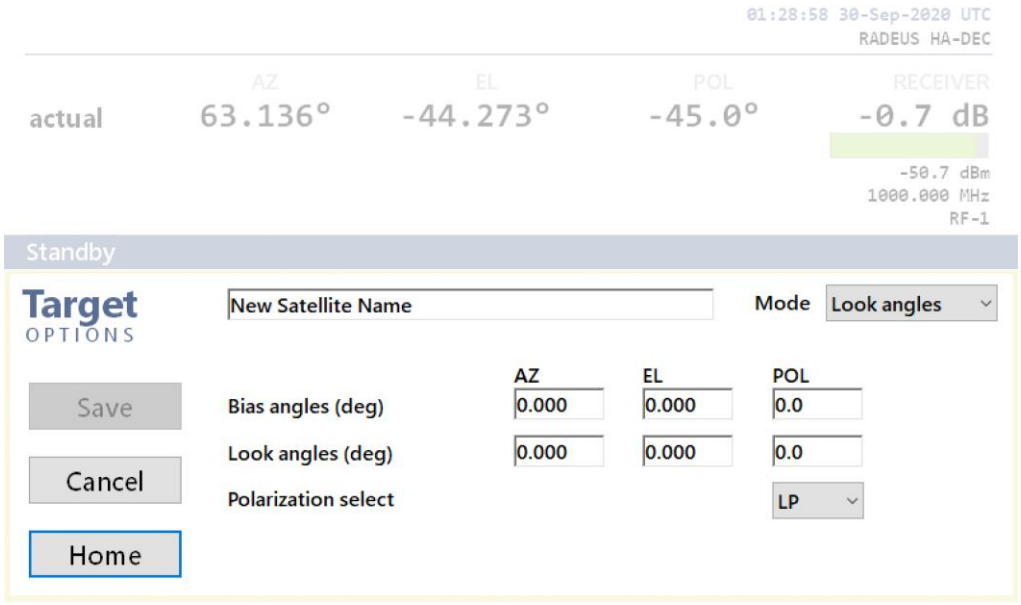


Figure 4-10 Settings for pointing by *look angles*. See section 4.6.4.2, "Using Bias Angles for TLE and IESS–412."

4.6.2 Longitude mode

Much like look angles, except the initial angles are computed from antenna data and the satellite's box center longitude. See **Figure 4-10**.

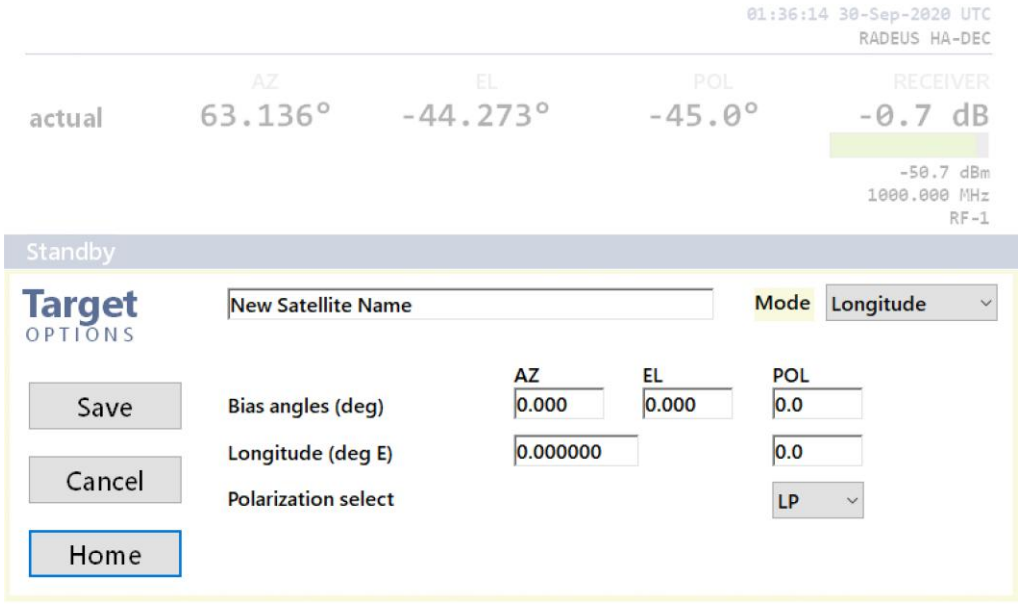


Figure 4-11 Settings for pointing by longitude.

4.6.3 TLE — NORAD two-line element

The Model 8200 ACU supports the TLE data format for locating a target by using the SPG4 simplified perturbation model. (See section 4.6.4.1, "Requirements for TLE and IESS–412," and 4.6.4.2, "Using Bias Angles for TLE and IESS–412.")

To point at a TLE object:

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

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

[2] The names of TLE targets are from their data sources and cannot be edited.

The names of TLE targets are determined by the TLE data source and cannot be edited.

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 soft limits.

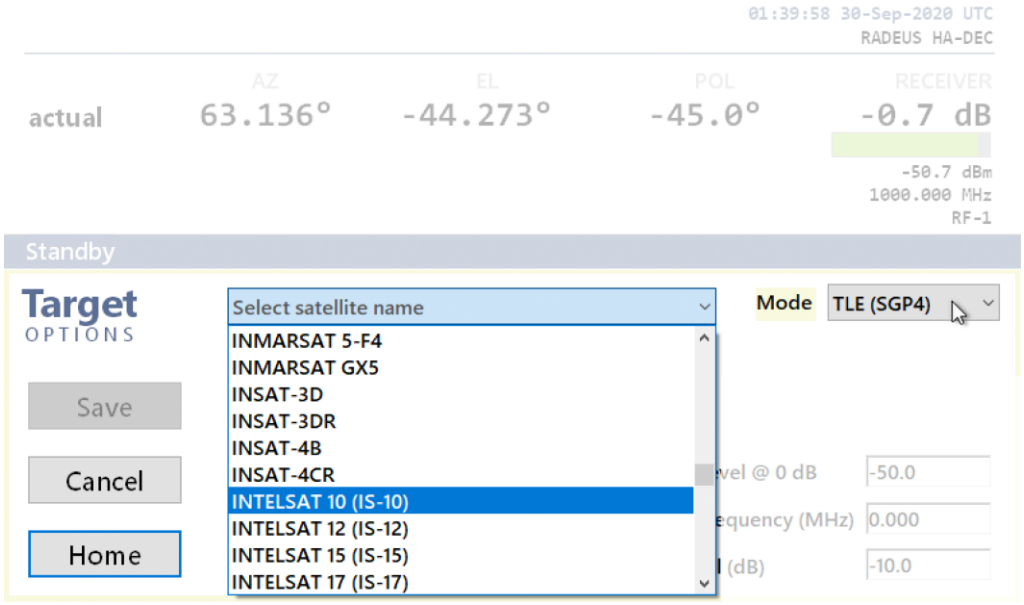


Figure 4-12 After choosing a TLE mode, a drop-down list shows all TLE targets that are within the antenna's range.

3. For cycle time, enter the interval (HH:MM:SS) desired between calculations of the antenna's next position.

4. For Bias angles, enter any known adjustments for TLE tracking due to site calibration; otherwise, use defaults of 0°. See **Figure 4-15** and section 4.6.4.2, "Using Bias Angles for TLE and IESS–412."

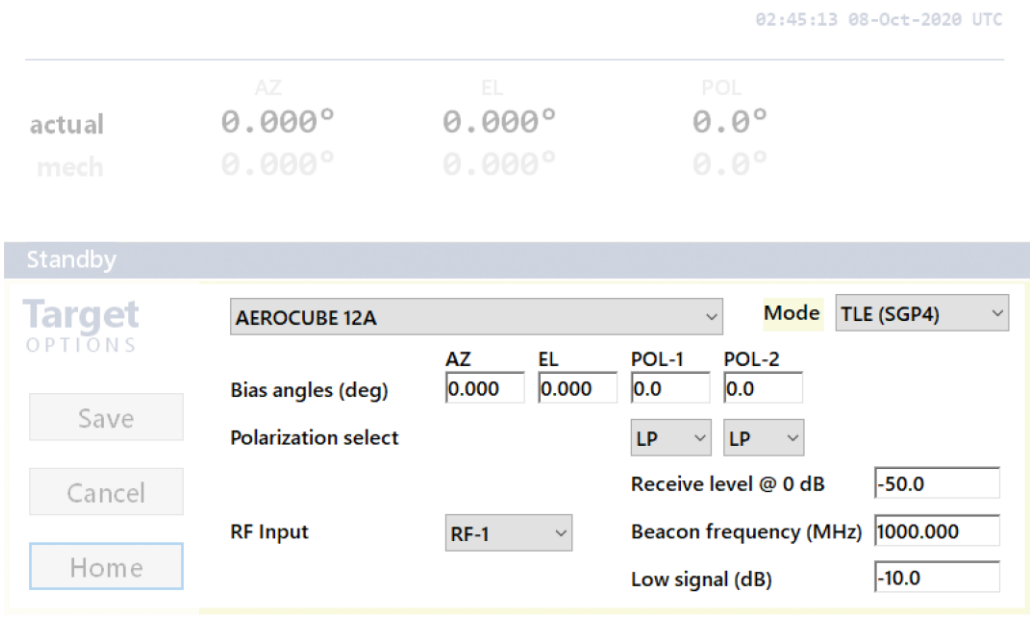


Figure 4-13 Edit a TLE target's settings to make any site-specific adjustments.

5. After saving the target's settings, you may track it normally:

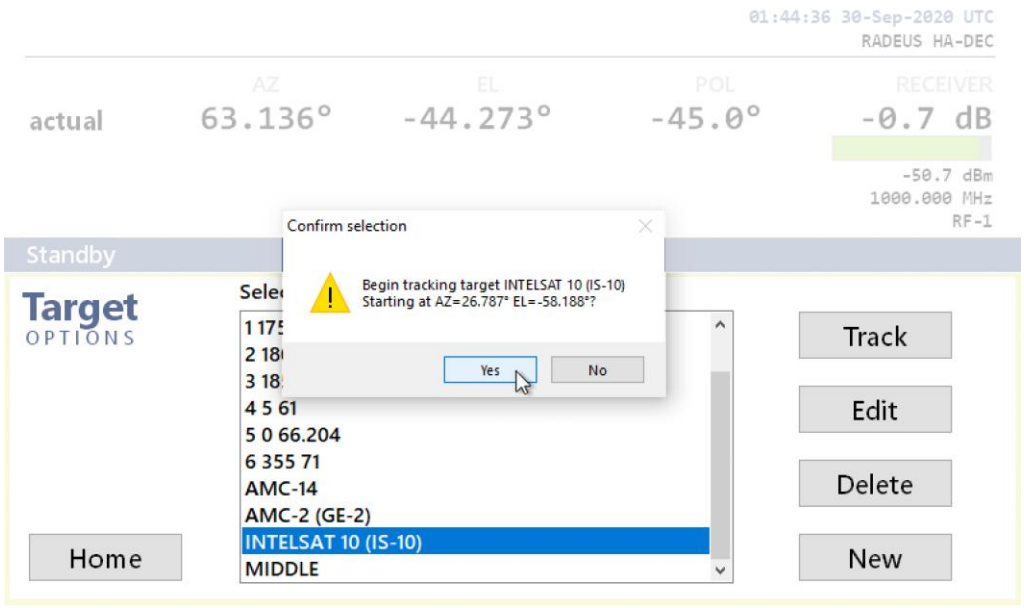


Figure 4-14 An operator must confirm before the antenna will change to a different target.

4.6.4 IESS–412 — Intelsat Earth Station Standards

The Model 8200 ACU supports IESS-412 data for targeting Intelsat spacecraft. (See section 4.6.4.1, "Requirements for TLE and IESS–412" and 4.6.4.2, "Using Bias Angles for TLE and IESS–412.")

To track an object by IESS-412:

1. Choose Target > New (or edit an existing target) and, instead of typing a name, use Mode to select IESS-412.

2. In place of the name-,input text field,[3] a drop-down list will present all Intelsat objects whose orbits will place them *within range of the antenna's soft limits* any time in the next sidereal day — select one of them.

Target missing?
If a desired target is not shown in the drop-down list, check the values in Setup > Site > Antenna coordinates and in Setup > Site > Travel Limits to confirm the target is within the antenna's soft limits.

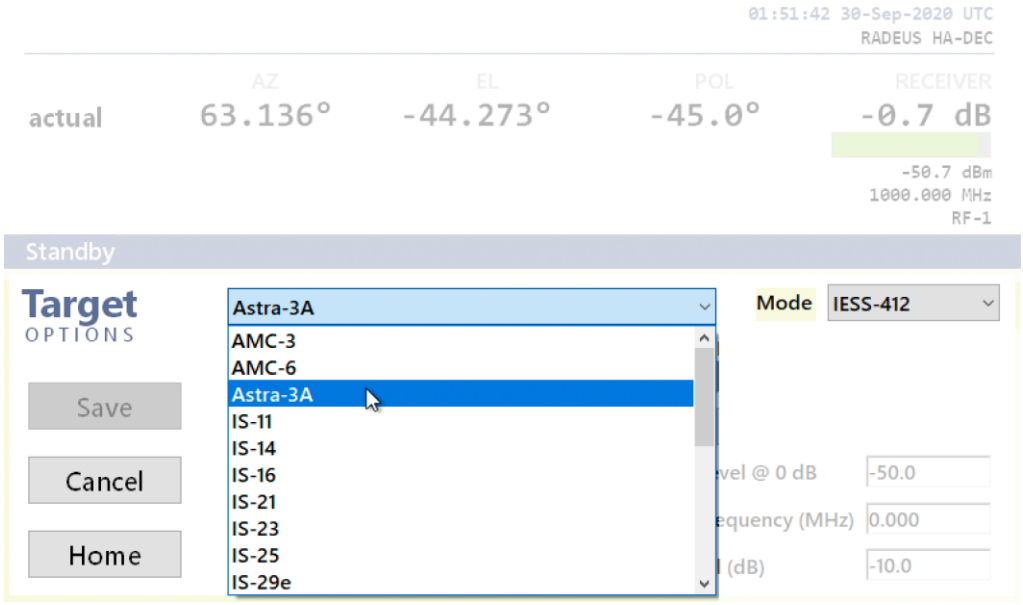


Figure 4-15 Setting the mode to IESS-412 lists the Intelsat spacecraft that are within range of the antenna's limit switches and settings.

3. For cycle time, enter the interval (HH:MM:SS) desired between calculations of the antenna's next position.

[3] The names of TLE and IESS targets are from their data sources and cannot be edited.

4. In the Bias angles fields of the pointing modes, enter any known adjustments for IESS targeting due to site-specific calibration issues. Otherwise, use the default 0° for all bias values (see **Figure 4-15** and section 4.6.4.2, "Using Bias Angles for TLE and IESS–412").

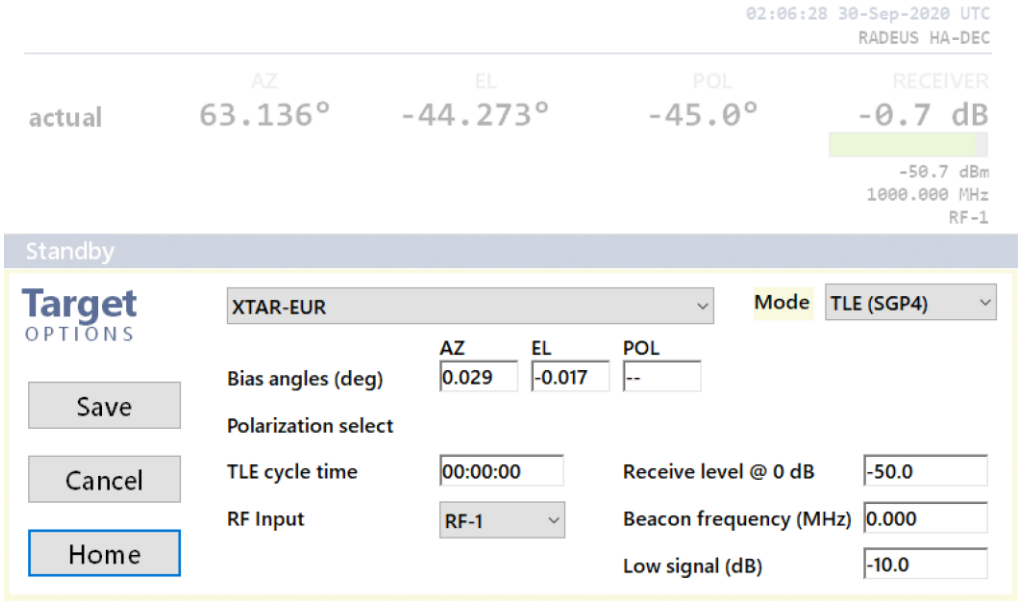


Figure 4-16 Settings for TLE (SGP4) or IESS-412 mode. Bias angles can be saved to more easily re-peak any target for which a pointing mode (i.e., not tracking) is used (see section 4.6.4.2). Default, if unknown: 0°

5. Save any changes, then you may Home > Track normally.

4.6.4.1 TLE and IESS-412

System Time Basis

Ephemeris based pointing is one of the most fundamental modes of operation for most antenna control systems. Pointing angles are generated based on known formulas solved at a specific point in time. Thus, the system timing accuracy is critical to making accurate pointing angle calculations.

The 8200 ACU is a windows based system and without an external time reference, the system clock may drift over the life of the equipment due to inaccuracies in the clock reference frequency source.

While this will not prevent pointing angle calculations, it may cause inaccuracies in the calculated look angles relative to the current target position. If the target is relatively stationary, this may not be an issue. However, if the target has movement relative to the earth station position, then system clock accuracies may begin to impact the received signal levels as the calculated look angles begin to deviate from the actual target position due to the drifting or inaccurate system clock.

For faster moving targets, better time accuracy may be required depending on received signal level requirements. Two common solutions to improve the system clock accuracy are an NTP server (milliseconds level accuracy) or an IRIG B time code server (microseconds level accuracy). The most common solution is to use an NTP server on the network which allows the 8200 ACS to continually update the system clock for high accuracy pointing angle calculations.

For the 8200 ACS, the NTP service is built in and requires only that the unit be pointed to an NTP server on the network. This level of accuracy is sufficient for most applications, particularly for limited motion systems. Whereas the NTP service is a standard feature of the 8200 ACS, an IRIG-B time code receiver is also an available option when high accuracy timing is required. For the 8200 ACS the IRIG-B time code receiver must be ordered as a system option.

In summary, there are 3 options available listed in increasing order of accuracy. The stand alone 8200 ACS computer clock, 8200 ACS clock referenced to an NTP server on the network, or an IRIG-B time code receiver ordered as a system option.

Ephemeris Pointing Mode Behaviors

When the 8200 ACS is commanded to track a target in either the TLE or IESS-412 pointing modes of operation, the system will calculate approximately 24 hours of pointing data spaced at 1 second intervals. The TLE CYCLE TIME setting determines how often the system will move the antenna to a new set of predetermined look angles. Meaning if my cycle time is set to '0' then the smallest increment of time available is 1 second, thus each second the system will move the antenna to a new location on the calculated path. If the target is slower

and less motor activation is desired, the cycle time may be increased to reduce the amount of wear and tear on the antenna drive train. If for example, the cycle time is set to 10 seconds, the system will only move the antenna every 10 seconds to a new position.

The 8200 ACS will set software limits for the range of motion in each axis when the SETUP WIZARD is run at system commissioning. The soft limits determine the antennas viewable or accessible window of operation relative to satellite visibility. When the 8200 ACS is commanded to track a TLE or IESS-412 target, the system will make a calculation to determine if the target is within the viewing window of the antenna based on the soft limit settings. If the target is not in the viewing window the 8200 ACS will move the antenna to the pointing angles where the target will come into the field of view and wait for the target to move into view. The initial viewable target position is called the acquisition of signal (AOS) position and the final viewable position in the field of view is called the loss of signal (LOS) position.

When tracking a TLE or IESS-412 target, the system will follow the target to the LOS position, then it will reset the tracking loop causing the system to calculate the pointing angles for the next pass and reposition the antenna to the AOS position then wait for the target. It will continue to point to the target each time it comes into the field of view until the 8200 ACS is commanded to STANDBY or to track a different target.

Movement Types

The 8200 ACS has three types of movements that are utilized in all tracking modes. Those movements are called Bump, Track and Slew. A Bump movement is a momentary burst causing the smallest perceivable movement possible for the antenna and is used if the desired angular distance movement is less than or equal to two times the position deadband parameter setting. A Track (speed) movement is used when the angular distance is greater than two times the deadband, but less than the slew threshold setting. A Slew (speed) movement is used if the angular distance is greater than the slew threshold.

Movement Type	Used When
Bump	Distance <= 2X Position Deadband
Track Speed	Distance > 2X Position Deadband & Distance < Slew Threshold
Slew Speed	Distance >= Slew Threshold

By manipulating the Position Deadband and Slew Threshold parameter values the antenna movement behaviors may be changed. The 8200 ACS is a position-based system, closing the loop on the angular position difference between the actual and desired positions. The 8200 ACS is primarily used with limited motion, jack driven antennas tracking geosynchronous satellites. This contrasts with a velocity-based system that closes the loop on the difference between the actual angular velocity and the desired angular velocity. Position based systems are typical for geosynchronous satellite tracking where movements are relatively small and predominantly governed by the satellites eccentricity and inclination. Velocity based systems such as the Radeus Labs 2200, 2300 or 9000 are typically used for faster moving, non-geosynchronous targets in low earth orbit (LEO) and medium earth orbit (MEO) missions where a smooth velocity movement of the antenna is required.

4.6.4.2 Requirements for TLE and IESS–412

The ACU auto-updates its TLE and IESS–412 data daily, if it has web access.

- Internet connection to the network connector (located on the ACU's back panel; see section 3.3).

  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 geo.txt (for TLE) or satlist.csv (for IESS-412) 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 on the ACU's front panel. Use the ACU's Windows interface (Setup > About > Desktop) to copy the data into C:\Radeus Labs.

- *IESS-412 and TLE (SGP4) modes are not available for Default or Immediate targets.* To use either of those modes, first choose Target > New or edit an existing target.
- Encoder offsets must be non-zero values.
- The antenna's coordinates must be set.

It is recommended to have the system synced to a timing source so the ephemeris calculated movements performed by the antenna are synced to the movements of the target satellite. This can be done through the built-in Windows NTP service or IRIG if that option was purchased.

⚠ Caution:
When providing custom TLE or IESS data, the ACU should be configured to disable automatic TLE download. Otherwise, any custom TLE data will be overwritten. See Appendix A-10.4.1, "Disable automatic TLE download" for details.

The ACU checks the C:\Radeus Labs directory every second for sources of TLE or IESS data. To force the ACU to use new data, delete geo-local.txt and supply new TLE data using the above methods.

Whenever any limit changes, the lists of available TLE and IESS-412 targets will update to include only potential targets within the antenna's range.

4.6.5 Using Bias Angles for TLE and IESS–412

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

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

Bias angles can only be updated in this way while both…

- …using a pointing mode — e.g., look angles, longitude, TLE (SGP4), or IESS-412 — *and*…
- …the antenna is actively pointing at the target, not in Standby.

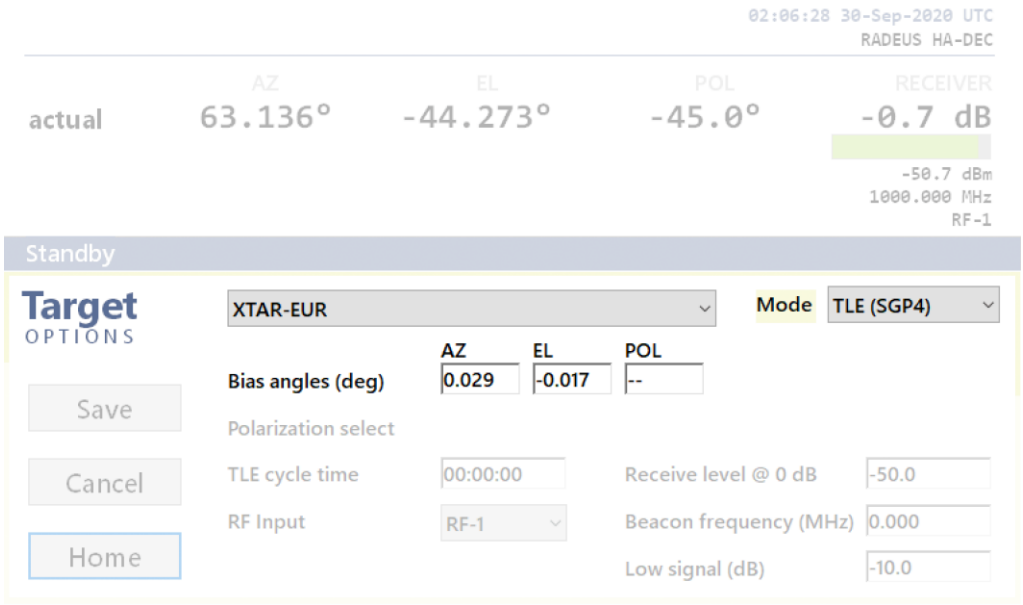


Figure 4-17 In pointing modes, you may save peak adjustments as bias angles that will reload when the same target is tracked again in the future.

The general procedure is:

1. Acquire a target using a *pointing mode* (section 4.6).
2. *Do not adjust bias angles while the controller is acquiring the targeted position.* In the blue status bar, verify that the ACU reports:

   Holding Target Position – next calculation in [hh:mm:ss]

3. Select Home > Manual and peak to an optimal signal. Such adjustments will appear in this target's "Bias angles" fields.
4. When peaked, tap Apply to save the new bias angles for that target, for use when it is acquired again later.

4.6.6 TLE/Steptrack and IESS/Steptrack

These work like TLE (section 4.6.3) and IESS–412 (section 4.6.4), with the added advantage of steptracking[4] periodically to…

- peak the signal, and
- adjust bias angles.

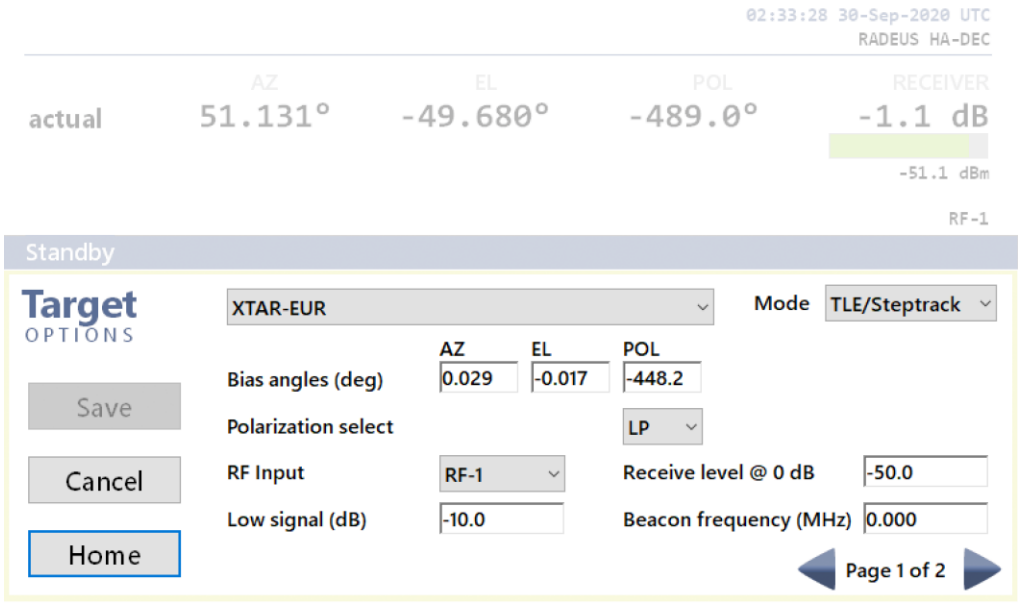


Figure 4-18 Settings for TLE/Steptrack and IESS/Steptrack mode (1 of 2). ACU updates and saves the bias angles during steptrack peaking.

As always, "Polarization select" is only available if enabled in the Home > Setup > Options. (See section 3.4.3, "Options.")

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

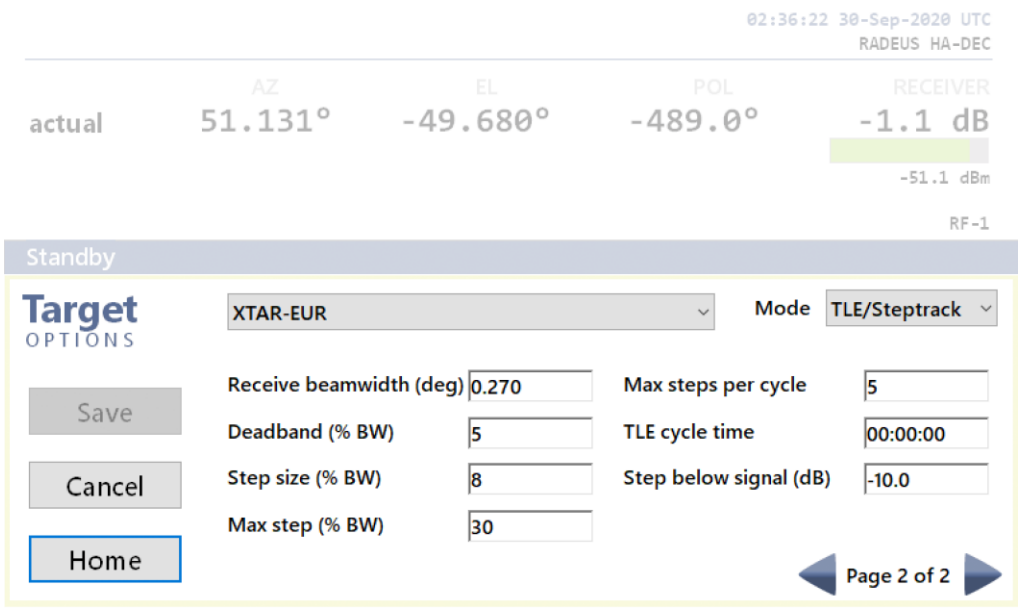


Figure 4-19 Settings for TLE/Steptrack and IESS/Steptrack mode (2 of 2)

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.

4.7 Tracking Modes

If the system has a receiver enabled, the Model 8200 supports several ways to acquire and track a target's signal. *Tracking modes* are specified when defining or editing a target.

Also see section 4.6, "Pointing Modes."

4.7.1 Predictive track

Predictive tracking is preferred 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 peak position.

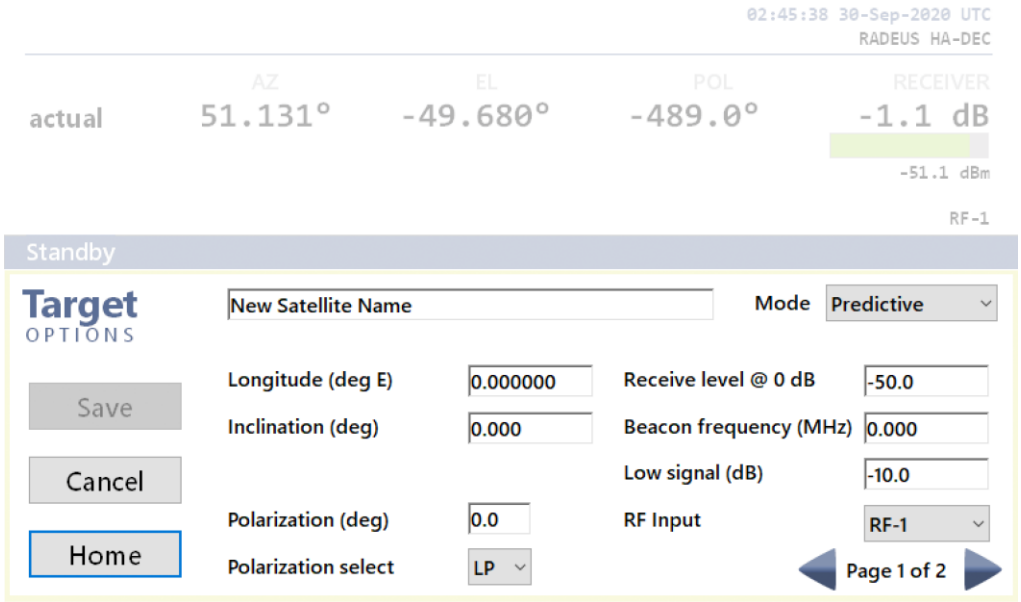


Figure 4-20 Settings for predictive tracking (1 of 2)

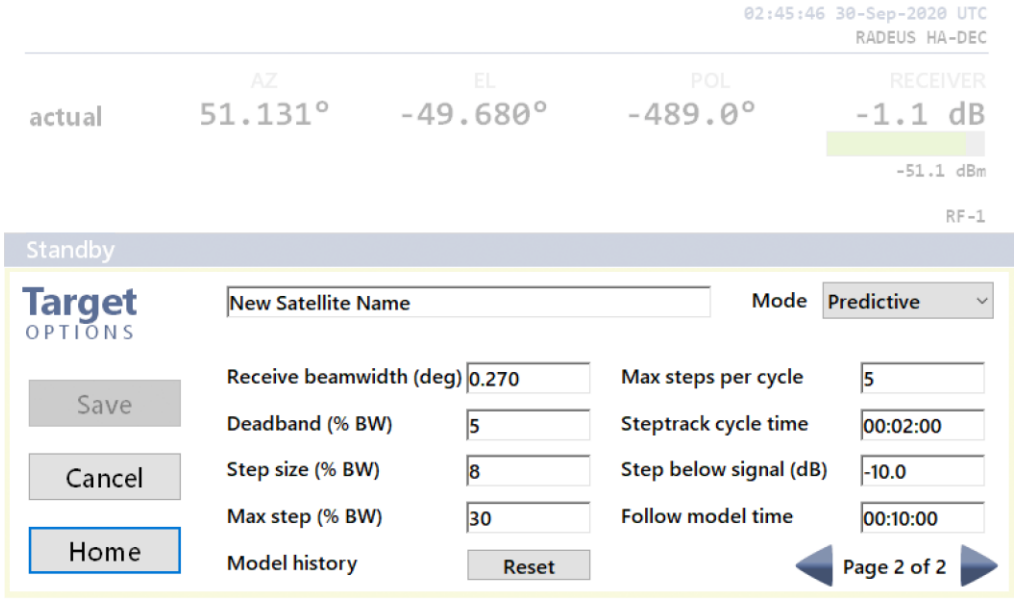


Figure 4-21 Settings for predictive tracking (2 of 2)

4.7.2 Steptrack

⚠ * **Caution**
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. See section 4.7.2.

The steptrack algorithm provides robust performance and a flexible parameter set. Steptrack cycles may be initiated periodically, as defined by the Steptrack Cycle Time parameter, which has a range of 00:00:00 up to 23:59:59. When set to zero, a steptrack cycle will be initiated immediately following the previous cycle, effectively causing a continuous steptrack or peaking of the signal level.

Steptrack cycles may also be initiated by a signal-level threshold — when the signal drops by a predefined amount, a steptrack cycle is initiated. Both modes may be used simultaneously to achieve longer cycle times backing up a threshold-triggered cycle. Steptrack determines in which axis and direction to take an initial step, based on the major axis of motion and the direction of motion for the target satellite.

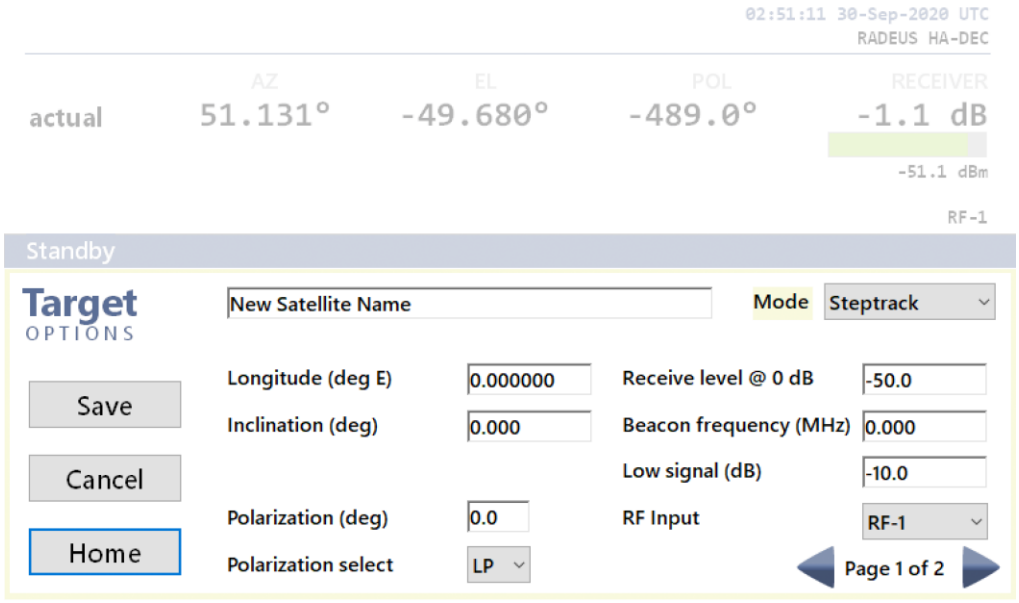


Figure 4-22 Settings for steptracking* (1 of 2)

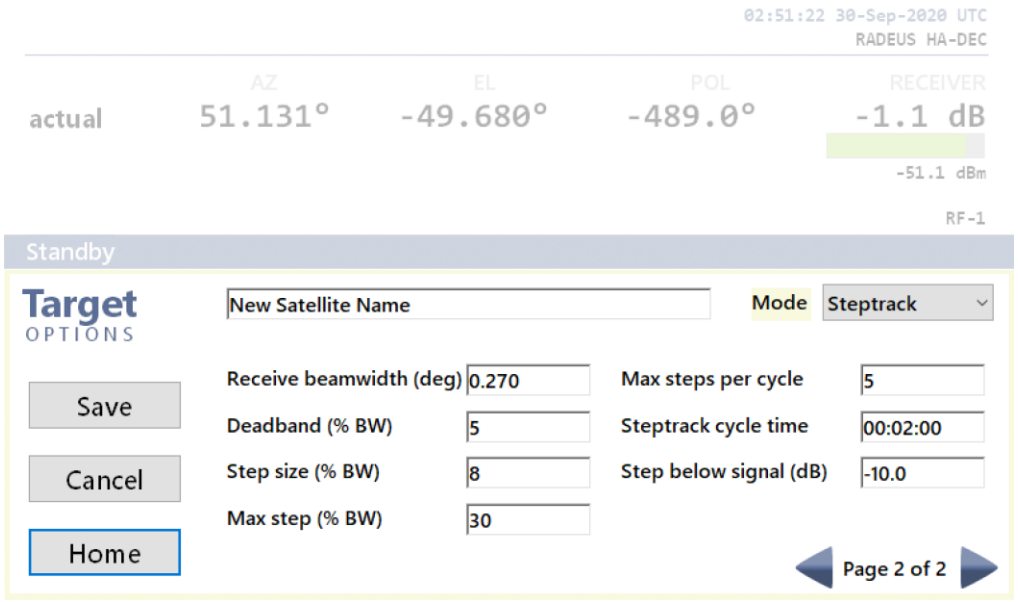


Figure 4-23 Settings for steptracking* (2 of 2)

Also see predictive tracking, above.

4.7.3 TLE/Steptrack

Steptracking TLE targets is discussed in section 4.7.3, "TLE/Steptrack." General TLE considerations are found in section 4.6.3, "TLE — NORAD two-line element."

4.7.4 IESS/Steptrack

Steptracking IESS targets is discussed in section 4.7.4, "IESS/Steptrack." General IESS considerations are in section 4.7.4, "IESS/Steptrack."

4.7.5 Manual jog

⚠ Caution
Only move the antenna while you are sure it is safe to do so.

Note
Hardware jog buttons are disabled unless the ACU user selects Home > Manual.

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

Figure 4-24 The ACU's hardware jog buttons have LEDs that show what the controller is doing. See Figure 4-24 and section 4.7.6, "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 peak the antenna and, optionally, to save that adjustment as *bias angles*. This is referred to as *manual biasing*.

Soft limits when jogging: The ACU will not allow the antenna to move past its software-defined ("soft") travel limits (see section 3.5.4, "Antenna 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.*

4.7.6 Track Immediate, Manual Peaking, and Bias Angles

Also see:
Section 4.6.4.2, "Using Bias Angles for TLE and IESS–412."

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

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

After manual peaking, tracking can be (re)initiated:

1. *Select a tracking mode* with Home > Target > Immediate > Edit.

   The selected mode (see sections 4.6 and 4.7) determines the antenna's behavior while using Immediate tracking — e.g., holding a static position or peaking.

2. *Position the antenna:* tap the Home > Manual button, adjust those settings as needed via the touchscreen, then use the 8200's hardware jog buttons (**Figure 4-23**).

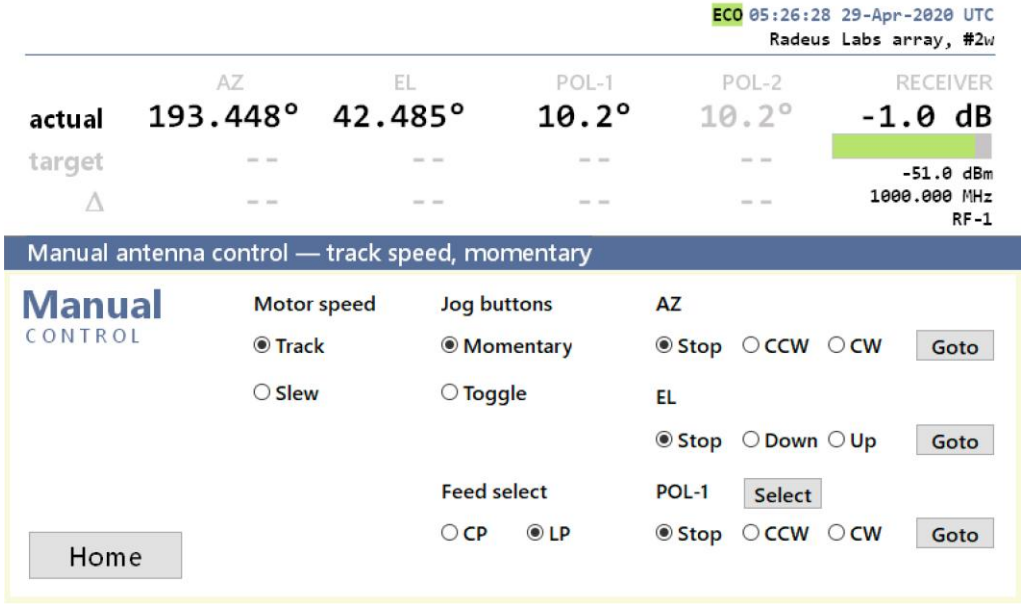


Figure 4-25 Home > Manual Touchscreen settings adjust how the hardware jog controls work.

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.

Note:
Never leave the antenna unattended when it's moving in Toggle mode.

The Momentary/Toggle choice determines how the hardware buttons move the antenna.

- *Momentary:* the antenna will move only while the operator is actively depressing a button.
- *Toggle:* pressing a button once starts the antenna moving along that axis until the same button is pressed again.

4.7.6.1 Resume tracking after manual peaking

After peaking, tracking can be (re)initiated:

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

   The selected tracking mode (see sections 2.6 and 2.7) will determine 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 4-23**).

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

4.8 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:*
   RL8200-base-setup-X.X.X.exe

[5] Subject to standard licensing.

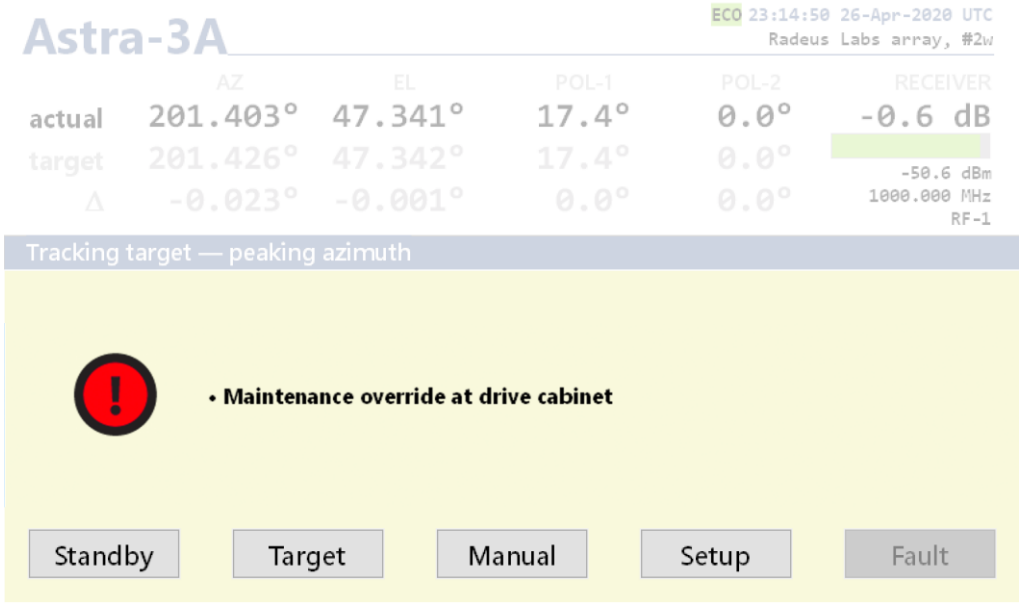
* To update earlier versions to version 2.2.0 or greater, *first manually back up acu.dbf* to an alternate location — the installer will not create a backup of it. Then you may run the installer normal

5 Faults and Conditions

See safety information in “Important Precautions” before proceeding.

WARNING
⚠ Disconnect power in case of any emergency.

The Model 8200™ 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.



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

Azimuth CCW soft travel limit pg, 72
Azimuth CW soft travel limit pg, 72

USB I/O interface ID 2 not found pg, 81

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 runaway"

The ACU has detected that the axis is moving but the ACU is not commanding it to move. The ACU responds by de-asserting the drive-enable line to the drive cabinet. May put system in standby.

Common causes:

- Stuck drive command relay
- Malfunctioning position transducer

5.3.2 "Azimuth immobile"

The axis is being commanded to move, but it is not moving. May put system in standby.

Common causes:

- Motor and/or motor controller is not producing enough torque to move the axis.
- Position transducer has become decoupled from the structure.

5.3.3 "Azimuth reversed"

The axis is reporting movement in the opposite direction to which it is being commanded to move. May put system in standby.

Possible causes:

- On the Setup > Encoders screen, the direction value needs to be reversed.
- Motor is wired incorrectly.

5.3.4 "Azimuth encoder fault"

The encoder is reporting invalid values. May put system in standby.

Possible causes:

- Electrical noise corrupting the encoder signals
- Encoder hardware malfunction

Verify that the encoder is connected and that the pinouts are correct (see Appendix A-4.5).

5.3.5 "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.

5.3.6 "Azimuth CW soft travel limit"

See preceding.

5.3.7 "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.

5.3.8 "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.

5.3.9 "Elevation runaway"

See section 5.3.1, "Azimuth runaway". May put system in standby.

5.3.10 "Elevation immobile"

See section 5.3.2, "Azimuth immobile". May put system in standby.

5.3.11 "Elevation reversed"

See section 5.3.3, "Azimuth reversed". May put system in standby.

5.3.12 "Elevation encoder fault"

See section 5.3.4, "Azimuth encoder fault". May put system in standby.

Verify that the encoder is connected and that the pinouts are correct (see Appendix A-4.5).

5.3.13 "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.

5.3.14 "Elevation upper soft travel limit"

See preceding.

5.3.15 "Elevation motor controller fault"

See section 5.3.7, "Azimuth motor controller fault". May put system in standby.

5.3.16 "Elevation travel limit switch tripped"

See section 5.3.8, "Azimuth travel limit switch tripped". May put system in standby.

5.3.17 "Polarization runaway"

See section 5.3.1, "Azimuth runaway". May put system in standby.

5.3.18 "Polarization immobile"

See section 5.3.2, "Azimuth immobile". May put system in standby.

5.3.19 "Polarization reversed"

See section 5.3.3, "Azimuth reversed". May put system in standby.

5.3.20 "Polarization encoder fault"

See section 5.3.4, "Azimuth encoder fault".

Verify that the encoder is connected and that the pinouts are correct (see Appendix A-4.5).

5.3.21 "Polarization select in wrong position"

If the system detects the CP/LP (circular POL/linear POL) setting is incorrect — based on POL-3 and POL-4 limits[6] CIB 110–112 and CIB 100–102 — it will attempt *up to five times* to move the feed to the correct position, after which this fault will be asserted and no further movement will be attempted until an operator clears the fault.

To restore proper operation, the CP/LP feed must be repositioned:

1. Manually position the feed at the antenna to CP or LP.
2. At the ACU, select Home > Manual and choose the position (CP or LP) that corresponds to the feed.
3. Back at the Home screen, double-tap the Fault button.
4. Verify that the fault clears.

5.3.22 "Polarization CCW soft travel limit"

See section 5.3.5, "Azimuth CCW soft travel limit".

5.3.23 "Polarization CW soft travel limit"

See section 5.3.6, "Azimuth CW soft travel limit".

5.3.24 "Polarization travel limit switch tripped”

See section 5.3.8, "Azimuth travel limit switch tripped". May put system in standby.

5.3.25 "Emergency stop pressed”

The emergency stop has been engaged. May put system in standby.

[6] POL3 and POL4 are labeled on the IOC board in the drive cabinet.

5.3.26 "Drive disabled at control panel"

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

5.3.27 "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.

5.3.28 "Soft travel limit disabled"

The system's soft travel limits are disabled, which is normal only during testing and setup. This fault will persist until the soft limits are re-enabled on the Setup > Travel Limits" screen (**Figure 3-18**).

5.3.29 "Travel limit switch tripped"

In systems with a single summary travel-limit switch status line, this indicates that one or more axes engaged a travel-limit switch. The ACU has no way of knowing which limit was exceeded and it does not inhibit motion. May put system in standby.

5.3.30 "No power at drive cabinet"

This fault condition is inferred when all drive cabinet faults occur simultaneously. May put system in standby.

5.3.31 "Halted at PMCU"

The system was halted via a Portable Maintenance Control Unit.

5.4 Touch-panel computer (TPC) faults

5.4.1 "Low tracking signal level"

The tracking-signal level is too low to perform steptrack operations.

Common causes:

- Not beginning tracking on the target signal main lobe.
- Incorrect tracking receiver frequency.
- Incorrect tracking receiver source selected.

5.4.2 "Unstable tracking signal level"

The amplitude tracking signal is varying too rapidly to steptrack.

5.4.3 "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.

5.4.4 "IOC2 communication failure"

See preceding, but applied to the secondary I/O controller board.

5.4.5 "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.

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.

5.4.6 "IOC2 firmware update failed"

See preceding, but applied to the secondary I/O controller board.

5.4.7 "ENC communication failure" "ENC2 communication failure"

The ACU cannot communicate with the encoder board.

Troubleshooting:

1. Verify the drive cabinet is turned on.
2. Verify power supplies in drive cabinet are turned on, check the Ethernet connection(s).
3. Verify IFL from the drive cabinet is connected to the ACU
4. Verify the appropriate position feedback is selected in Setup > Encoders > Type

5.4.8 "ENC firmware update failed"

The automatic installation of new firmware on the encoder did not complete successfully.

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.

5.4.9 "RDC communication failure" "RDC2 communication failure"

The ACU cannot communicate with the resolver board.

Troubleshooting:

1. Verify the drive cabinet is turned on.
2. Verify power supplies in drive cabinet are turned on, check the Ethernet connection(s).
3. Verify IFL from drive cabinet is connected to the ACU.
4. Verify the appropriate position feedback is selected in Setup > Encoders > Type.

5.4.10 "RDC firmware update failed"

Automatic installation of new firmware on the resolver-to-digital converter did not complete.

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.

5.4.11 "JPB communication failure"

The ACU cannot communicate with the jog panel.

Troubleshooting:

1. Verify the drive cabinet is turned on.
2. Verify power supplies in drive cabinet are turned on, check the Ethernet connection(s).
3. Verify IFL from drive cabinet is connected to the ACU.
4. Verify the appropriate position feedback is selected in Setup > Encoders > Type.

5.4.12 "JPB firmware update failed"

The automatic installation of new firmware on the jog panel did not complete successfully.

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.

5.4.13 "Ephemeris data file needs update" "TLE ephemeris data file needs update" "IESS ephemeris data file needs update"

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

- Restore the network connection, which will cause the ACU to update the data. *Or…*
- Double-tap the Home > Fault button to clear the *alert* — if the issue isn't addressed, the system may report the fault again.

5.4.14 "Fault condition forced standby"

Standby mode was asserted by the system in response to a detected fault. Clear the fault condition and resume operation. If the fault condition still exists, the fault will be re-asserted.

5.4.15 "Can't access settings file"

Another instance of acu.exe has the settings file open. Quit the ACU application (Home > Setup > About > Quit). Use Windows Task Manager to kill any other instances of acu.exe, then restart the ACU.

5.4.16 "Can't access tracking history file"

Another instance of acu.exe has the tracking-history file open. Exit your ACU application, then use Windows Task Manager to kill any other instances of acu.exe.

5.4.17 "Receiver communication failure"

The ACU application cannot communicate with the tracking receiver.

Possible remedies:

- Check all connections and cables related to the receiver.

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

5.4.18 "Receiver not running"

The beacon receiver has not entered run state after being commanded to do so.

Possible remedy:

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

5.4.19 "Receiver not locked"

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

5.4.20 "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).

5.4.21 "USB I/O interface ID 1 not found" "USB I/O interface ID 2 not found"

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

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

Possible remedies:

- It may be necessary to replace the USB I/O interface.*
- Contact support.

5.4.22 "Drive cabinet network interface misconfigured"

The IP address of the ACU, on the NIC that connects to the drive cabinet network, is wrong. 192.168.244.1 is the correct address.

5.4.23 "Motor controller reset in progress"

The ACU has detected a motor controller fault and is attempting to correct the issue by cycling power to them for three attempts. If the attempts are not successful, the fault will persist and the drive cabinet will remain in the error state.

If the fault still remains, check the following:

1. Manually cycle power at the drive cabinet using the mains breaker.
2. On the Yaskawa Inverter display, check the error code. Refer to the V1000 Manual, section 5.2, "Fault Detection."
3. Verify Auto Tune has been performed, refer to Appendix 9: Setup: V1000 Motor Drives.
4. Verify the Setup Wizard has been performed (section 3.5).
5. Inspect motor wiring
6. Inspect motor

5.4.24 "Orbital tracking limit"

The ACU is attempting to track the target along a path bound by the orbital tracking limit option.

The ACU may partially or completely lose the target's signal during this fault condition.

Troubleshooting:

1. Increase the orbital tracking limit.

2. Verify the tracking beamwidth.
3. Increase the Setup > Positioner > Deadband value (see section 3.5.6, “Positioner”).
4. Disable orbital track by setting the Setup > Options > Orbital tracking limit to 0.

5.4.25 "Sun outage"

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

5.4.26 "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.

Appendices

APPENDIX 1: MODEL 8200 ACU SPECIFICATIONS..... 97
APPENDIX 2: ACU REAR PANEL CONNECTIONS..... 99
APPENDIX 3: RS-232 INTERFACE 108
APPENDIX 4: MODEL 8250 DRIVE CABINET 109
APPENDIX 5: SETUP: GD MODEL 253.....117
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SECTION

A

Appendix 1: Model 8200 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 3-2 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
	Ethernet or fiber 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
	50 W typical
Motor size:	1–5 HP standard. Larger sizes available.

Mechanical
Height: 7” (four-rack units)
Width: 19”
Depth: 19”
Weight: 20 lbs.

Appendix 2: ACU Rear Panel Connections

Also see Appendix 3: "RS-232 Interface" and the documentation that shipped with the unit you are using.

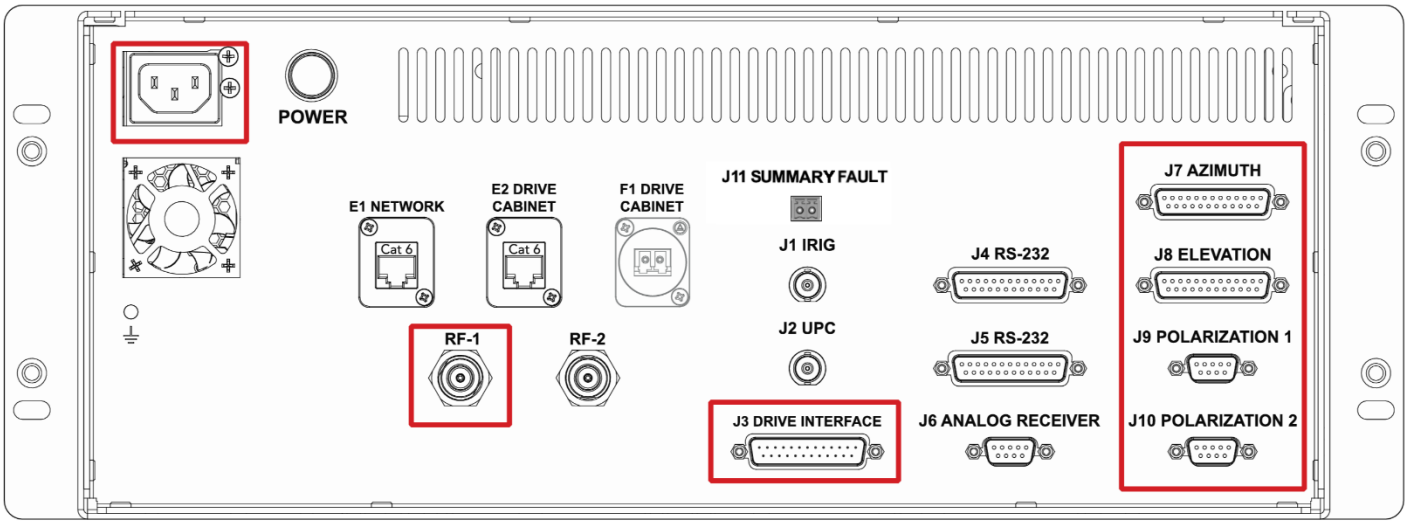


Figure A-1 Rear panels may vary. Above shows the legacy-compatible version of the 8200, designed for drop-in replacement of GD's older (Vertex) Model 7200. Required connections are shown in red.

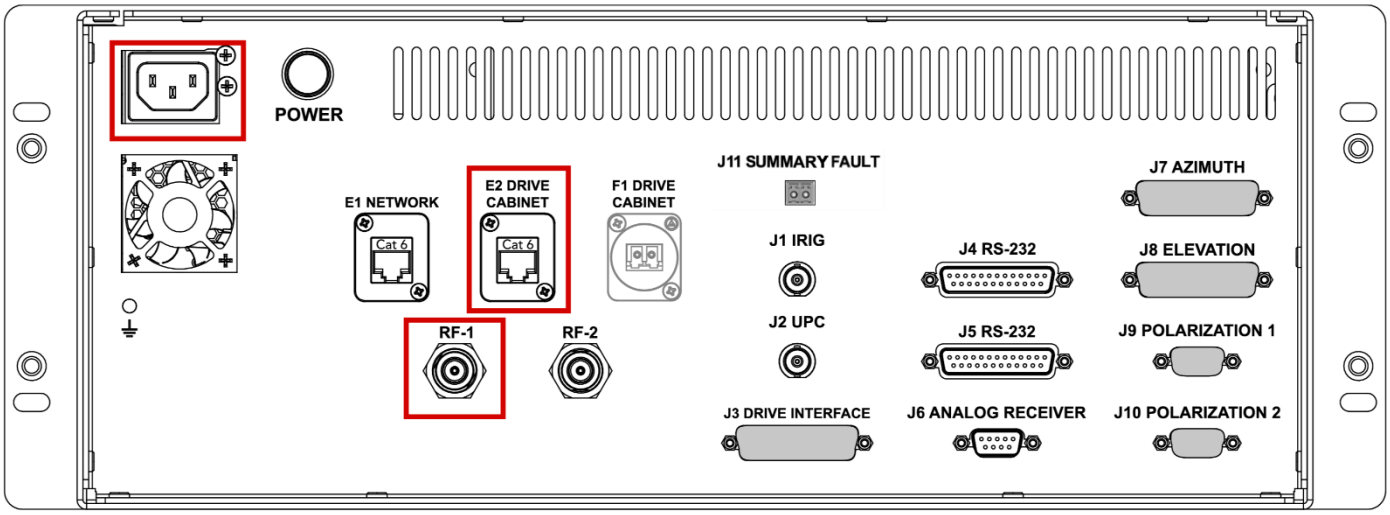


Figure A-2 Rear panels may vary. Above shows the legacy-compatible version of the 8200, designed for drop-in replacement of GD's older (Vertex) Model 7200. Required connections are shown in red.

E1 — NETWORK

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

E2 — DRIVE CABINET

RJ45 Ethernet connection for interfacing with the RL8250DC Drive Cabinet (G1 configuration only)

F1 — DRIVE CABINET

LC/LC fiber-optic connector for interfacing with the RL8250DC Drive Cabinet. (G1 configuration only, 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.

***Note:**
J3, J7, J8, J9, and J10 are present only on 7200-compatible systems.

J3* — DRIVE INTERFACE

DB25M connector for interfacing with legacy drive cabinets (LGCY configuration only)

J4 — RS-232

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

J5 — RS-232

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

J6 — ANALOG RECEIVER

DB9M connector for optional internal receiver's analog output.

J7* — AZIMUTH

DB25F connector for encoder or resolver position feedback on AZ axis.

J3 — DRIVE INTERFACE

Present only on 7200-compatible systems

PIN	FUNCTION	COLOR
DI-25	MAINT STAT RTN	gray
DI-24	MAINT STAT	gray
DI-23	DRIVE ENABLE	gray
DI-22	EL SPEED	gray
DI-21	AZ SPEED	gray
DI-19	E-STOP	gray
DI-18	EL FAULT COM	gray
DI-17	AZ FAULT COM	gray
DI-16	E-STOP RTN	gray
DI-15	EL FAULT	gray
DI-14	AZ FAULT	gray
DI-13	POL2 CCW	gray
DI-12	POL2 DE	gray
DI-11	POL2 CW	gray
DI-10	SUM LIM	gray
DI-09	POL1 CCW	gray
DI-08	POL1 DE	gray
DI-07	POL1 CW	gray
DI-06	EL DN	gray

DI-05	EL COM	gray
DI-04	EL UP	gray
DI-03	AZ CCW	gray
DI-02	AZ COM	gray
DI-01	AZ CW	gray

J8* — ELEVATION

DB25F connector for encoder or resolver position feedback on EL axis.

J9* — POLARIZATION 1

DB25F connector for resolver position feedback on POL 1 axis.

J10* — POLARIZATION 2

DB25F connector for resolver position feedback on POL 2 axis.

J11* — Summary Fault

The Summary Fault is a normally open relay, that is in connection with the ACU. The ACU keeps the relay closed as long as no faults are detected. If a fault exists, the relay will open until the fault is acknowledged, in which case it closes again.

The maximum voltage is 60VDC, and the maximum current is 1 amp.

A-2.1 Pinouts

Also see: Appendix 3: "RS-232 Interface"

RF-1
RF-2
J1 — IRIG
J2 — UPC

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

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

PIN	FUNCTION
1	N.C.
2	RXD
3	TXD
4	CTS
5	RTS
6	DTR
7	GND
8	RI
9	N.C.
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	DCD
21	N.C.
22	RI
23	N.C.
24	N.C.
25	N.C.

J6 — ANALOG RECEIVER

PIN	SIGNAL	FAN PIN
1	N.C.	N.C.
2	AD1+	J14-1
3	AD1 GND	N.C.
4	AD2-	J15-2
5	N.C.	N.C.
6	N.C.	N.C.
7	AD1-	J14-2
8	AD2+	J15-1
9	AD2 GND	N.C.

J7 — AZIMUTH *and* J8 — ELEVATION

Present only on 7200-compatible systems

PIN	FUNCTION
1	N.C.
2	R (R1)
3	$\underline{S}$ (S4)
4	$\underline{C}$ (S3)
5	S (S2)
6	N.C.
7	N.C.
8	$\underline{R}$ (R2)
9	C (S1)
10	N.C.
11	N.C.
12	N.C.
13	N.C.
14	N.C.
15	CLK

16	$\underline{CLK}$
17	N.C.
18	N.C.
19	N.C.
20	N.C.
21	DAT
22	$\underline{DAT}$
23	N.C.
24	+12V
25	GND

J9 — POLARIZATION 1

Present only on 7200-compatible systems

PIN	FUNCTION
1	N.C.
2	R (R1)
3	$\underline{S}$ (S4)
4	$\underline{C}$ (S3)
5	S (S2)
6	N.C.
7	N.C.
8	$\underline{R}$ (R2)
9	C (S1)

J10 — POLARIZATION 2

PIN	FUNCTION
1	N.C.
2	R (R1)
3	$\underline{S}$ (S4)
4	$\underline{C}$ (S3)
5	S (S2)
6	N.C.
7	N.C.
8	$\underline{R}$ (R2)
9	C (S1)

Appendix 3: 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.

J4 is used for connection to an External Receivers only

J5 is used for connection to a serial M&C system only

8200 Serial Communication default settings for J5

echo = no	Baud = 9600
newline = CR	Parity = none
handshake = no	Data Bits =8
checksum = disabled	Stop Bits = 1

8200 INI settings to change configurations settings for J5

Pinout details:
See Appendix A-2.1 and Appendix 2: "ACU Rear Panel Connections"

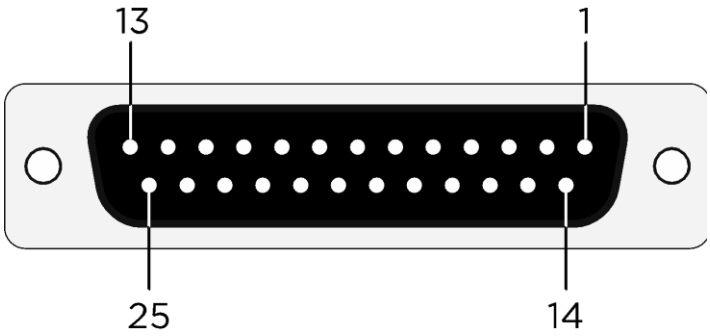


Figure A-3 RS-232 pin numbering

Appendix 4: Model 8250 Drive Cabinet

Also see section 2, "Model 8250 Drive Cabinet."

A-4.1 Operating Environment, Power

Temperature:	-40 to 50°C Low-temp package necessary below -10°C.
Humidity:	100% condensing
Electrical:	200 and 400 Volt Class, 50–60 Hz, 5-wire WYE Electrical-current requirements determined by motor horsepower.

A-4.2 Mechanical

Height: 36" (legs 18"H)
Width: 30"
Depth: 10"
Weight: 100 lbs.
Motor size: 1–5 HP standard. Larger sizes available.

A-4.3 I/O Controller Location

- *Using the Model 8200 with a Radeus Labs Model 8250 drive cabinet:*

  The I/O controller (IOC) is mounted in the drive cabinet. The only connections to the ACU are an Ethernet cable

- *Using the Model 8200 with a legacy GD/Vertex 7150 drive cabinet:*

  The I/O controller is mounted inside the ACU chassis. All control lines must run from the legacy cabinet to the ACU.

A-4.4 Inter-Facility Link (IFL)

The drive cabinet and ACU communicate by IFL.

"IFL" is standard, grounded Ethernet using RJ45 connectors.

"IFL-F" is dual-fiber using LC connectors, in *multi mode* by default and *single mode* as an option.

Fiber cable shorter than 600 meters:

- 2-strand
- Male/Male
- LC/LC
- OM2 50/125UM

Fiber cable longer than 600 meters:

- Contact Radeus Labs with questions about fiber connection.

A-4.4.1 Encoder & Resolver Connections

Each axis-position feedback is set up as either Resolver or Encoder, based on what was ordered by the customer.

Encoder connections

	NUM	FUNCTION	WIRE COLOR
AZ ENCODER POSITION FEEDBACK	**220-7**	CBL SHLD	*cable braid*
	220-6	GND	*white/green*
	220-5	VCC	*brown/green*
	220-4	DATN	*pink*
	220-3	DAT	*gray*
	220-2	CLKN	*yellow*
	220-1	CLK	*violet*

Resolver connections

	NUM	FUNCTION	WIRE COLOR
AZ RESOLVER POSITION FEEDBACK	**220-7**	CBL SHLD	*cable braid*
	220-6	R	*red/white*
	220-5	RN	*yellow/white or black/white*
	220-4	S1 or C	*red*
	220-3	S3 or CN	*black*
	220-2	S2 or S	*yellow*
	220-1	S4 or SN	*blue*

Potentiometer connections

	NUM	FUNCTION	WIRE COLOR
POL POTENTIOMETER **POSITION FEEDBACK**	**200-7**	CBL SHLD	*cable braid*
	200-6	N/A	*N/A*
	200-5	DATN	*white/green*
	200-4	N/A	*N/A*
	200-3	DAT	*green*
	200-2	N/A	*N/A*
	200-1	VCC	*brown*

This organization and the wire colors are the same for all other encoders and resolvers, which are assigned to these positions:

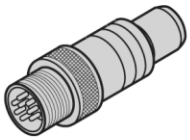
EL 2101 through 210-7

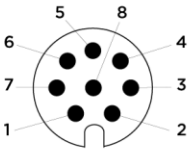
POL1 200-1 through 200-7

POL2 190-1 through 190-7

A-4.4.2 Encoder side — ships terminated

8-pin coupling, M12





	power supply				position values			
	8	2	5	1	3	4	7	6
	Up	Sensor Up	0 V	Sensor 0 V	DATA	$\overline{\text{DATA}}$	CLOCK	$\overline{\text{CLOCK}}$
	brown/green	blue	white/green	white	gray	pink	violet	yellow

A-4.5 Customer Interface Block (CIB) Connections

See below for the proprietary connections in the Customer Interface Block.

SECTION	NUM*	FUNCTION
E-STOP	163	SW1 LEAD
	162	SW1 RETURN
	161	SW2 LEAD
	160	SW2 RETURN
AZ LIMIT	152	CW LIM
	151	COM
	150	CCW LIM

EL LIMIT	142	UP LIM[1]
	141	COM
	140	DN LIM[1]
POL1 LIMIT	132	CW LIM
	131	COM
	130	CCW LIM
POL2 LIMIT	122	CW LIM
	121	COM
	120	CCW LIM
CP/LP 1 INDICATOR	112	CP IND
	111	Source
	110	LP IND
CP/LP 2 INDICATOR	102	CP IND
	101	Source
	100	LP IND
AZ MOTOR	63	GND[2]
	62	L1
	61	L2

	60	L3
	53	GND[2]
EL MOTOR	52	L1
	51	L2
	50	L3
POL1 MOTOR	42	CW or L1
	41	RETURN or L2
	40	CCW or L3
POL2 MOTOR	32	CW or L1
	31	RETURN or L2
	30	CCW or L3
CP/LP MOTOR/SWITCH	22	CP
	21	RETURN
	20	LP
CP/LP MOTOR/SWITCH	12	CP
	11	RETURN
	10	LP
	5	L1
	4	L2

MAINS	3	L3
	2	Neutral
	1	GND

Three-phase power color codes follow North American common practice.

Radeus Labs recommends adding an extra 1 – 2 feet of length in a service loop outside the drive cabinet, in case of future changes.

* *The CIB is shown as item #8 in the preceding illustration of the drive cabinet's interior (in section 2.2, "*Power, Breakers, E-Stop*."*

[1] When controlling an Hour Angle/Declination system in the southern hemisphere **only** the EL/DEC up limit should be connected to the positive pointing angle side of travel and the EL/DEC down limit should be connected to the negative or smaller pointing angle side of travel

[2] CE option only

Appendix 5: Setup: GD Model 253

Instructions for the General Dynamics 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 8200'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 8200, use a straight-through serial cable (i.e., no null modem required).
8. On the 8200 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 8200's data display.

Appendix 6: Setup: DTR

Set the DTR to its remote mode using SHIFT+HELP

Set DTR settings for PORT 1 as follows:

a) BPS: 57600
b) NEWLINE: DISABLED
c) ECHO: DISABLED
d) SHELL: M&C SHELL

Select RESET PORT on DTR

Connect the DTR's PORT 1 RS-232 to the 8200's port J4 RS-232

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

If installing a new 8200, use a straight-through serial cable (no null modem).

On the 8200 ACU, ensure that DTR is selected as the Setup > Receiver > Receiver type.

Verify that the frequency set at the DTR is shown on the 8200's data display.

Appendix 7: Setup: Radeus SSC Model 3430

For use with the Model 3430 beacon-tracking receiver.

See the Model 3430 manual for details and important safety notes.

Figure A-4 The Radeus SSC Model 3430 beacon tracking receiver (BTR)

A-7.1 Serial Port Connection

1. Connect the BTR's J2 M&C port to the 8200's port J4 RS-232.
2. Use the L/R button to enter *local mode*.
3. Press the > (right-arrow) button.
4. Press the + button to select RS-232.
5. Press the + button to select 19200 baud.
6. Press the CUR button to exit the menu.
7. Use the L/R button to enter *remote mode*.

A-7.2 Ethernet Connection

Connect the BTR's ethernet port to the 8200's ethernet port.

Use the L/R button to enter local mode.

Press the > (right-arrow) button.

Press the > (right-arrow) button to select the Network.

Press the + button to select ethernet.

Press the + button to select 19200 baud.

Press the CUR button to exit the menu.

Use the L/R button to enter remote mode.

Appendix 8: Setup: IRIG

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

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

See Appendix 2:
"ACU Rear Panel Connections"

If the Model 8200 ACU is configured for IRIG-B,[7] 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.

1. To do so, first quit the ACU application, or minimize it, to access OS functions — use Setup > About > Quit or Desktop.

   Note: If the time does not update within the first five minutes of using the ACU, follow the instructions below.

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

[7] IRIG-A is an option but must be configured before shipment. Inquire with Radeus Labs.

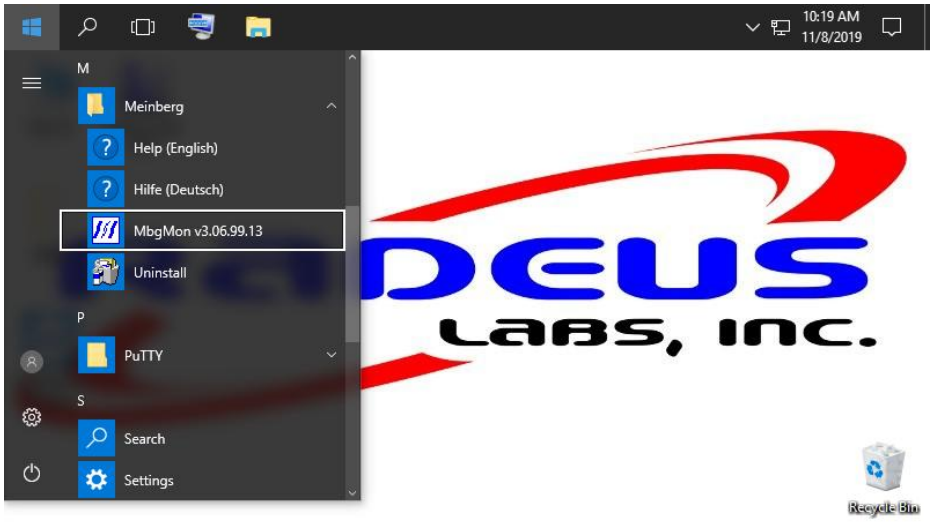


Figure A-5 This and the following figures demonstrate changing local time if the Windows time manager is not successful.

3. Right-click on the program and choose to "Run as administrator":

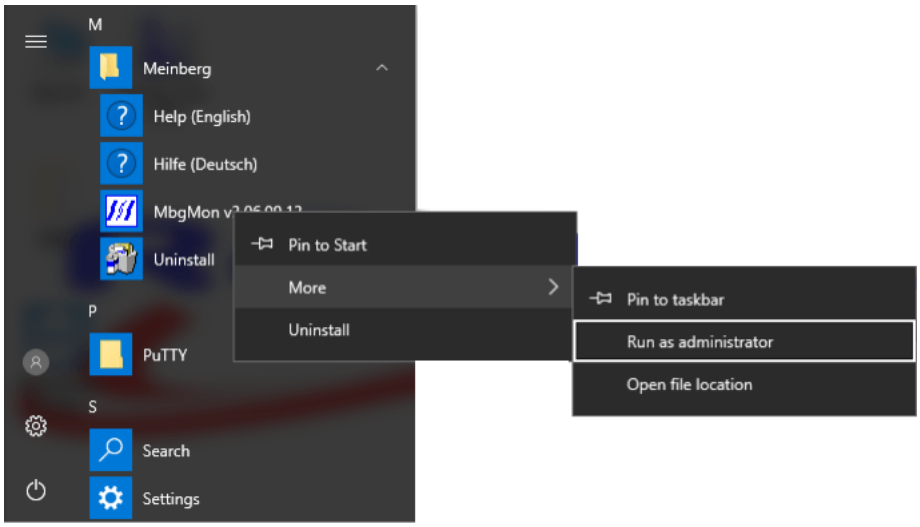


Figure A-6 Running the IRIG program as administrator

4. When the program opens:
   - Make sure the signal is 100%.
   - Check that the clock is synchronized.

- Verify that the Reference time is correct.

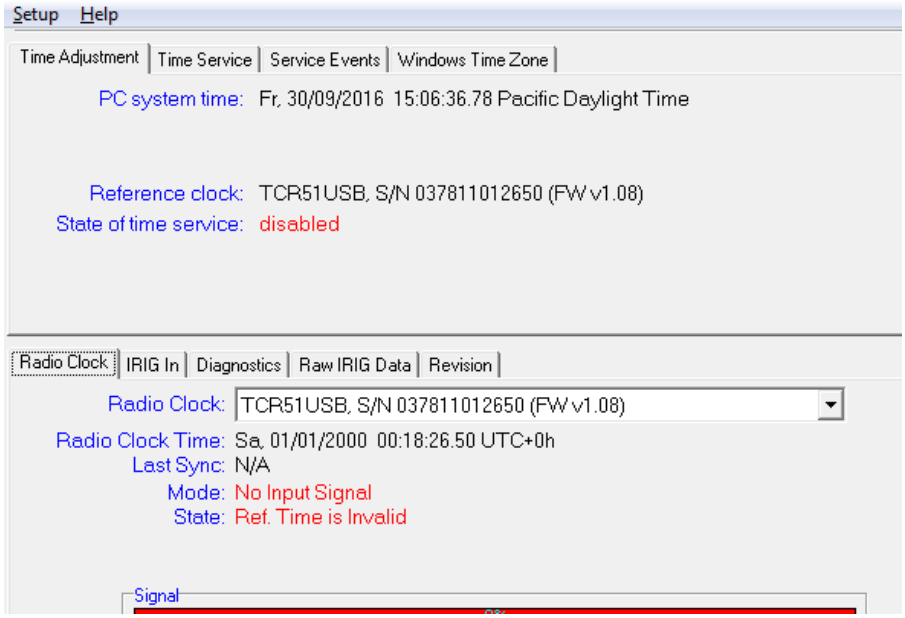


Figure A-7 IRIG program if the time is not synced with the computer

5. If those three are correct, choose Setup > Stop time service.

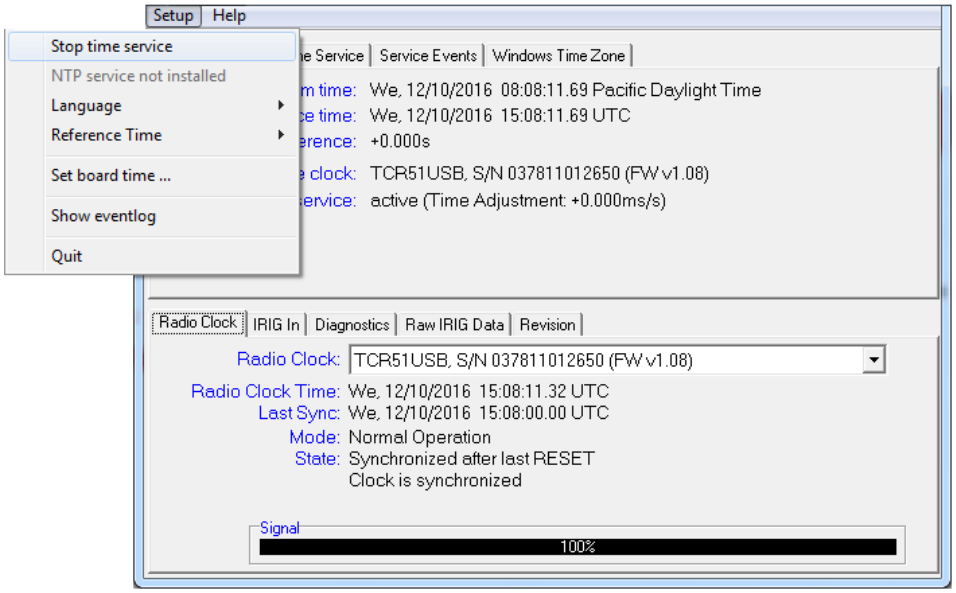


Figure A-8 Stop time service in IRIG Program

6. Then choose Setup > Start time service and the system time should update:

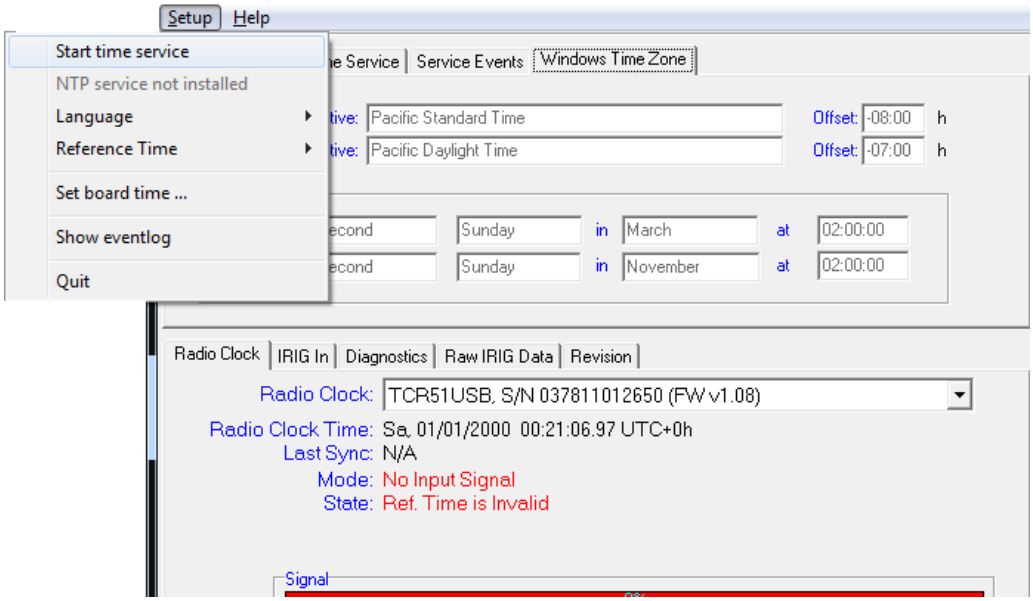


Figure A-9 Starting time service in IRIG Program

Appendix 9: Setup: Yeskawa V1000/GA500 Motor Drives

Reference
The parameter list starts on page 176 of the *V1000 Quick Start Guide*, included with the Radeus Labs model 8250 Drive Cabinet. The full document is downloadable.

This process is used to…

- Reset the Yaskawa V1000/GA500 motor drives
- set up and auto-tune the motors for the electro-mechanical characteristics of the motors and load
- set parameters for proper operation in a Model 8200™ ACU

- **Caution:** This procedure assumes the motors are not yet installed on jacks. *It requires them to be able to turn freely.*

A-9.1 Reset the V1000/GA500

1. Set A1-03 to 2220, then press Enter to reset the drive.
2. Set A1-02 to 2 to set the inverter to Open Loop Vector control.

A-9.2 Run the Motor Tuning

Note
Experienced, knowledgeable installers may choose to deviate from recommended settings.

1. Go to ATUN and set the following. (*Note:* example values, shown in gray, probably will not match your specific motors.)

T1-01: 00	Set inverters for rotational auto-tuning.
T1-02: .19	Motor Rated Power: use the rated power from motor nameplate, in KW.

T1-03: 230	Motor Rated Voltage: use the rated voltage from motor nameplate, in Volts.
T1-04: 1.1	Motor Rated Current: use the rated current from motor nameplate, in Amperes.
T1-05: 60	Motor Rate Frequency: use the rated frequency from motor nameplate, in Hertz.
T1-06: 4	Number of Poles: use the number of poles from the motor nameplate.
T1-07: 1750	Motor Base Speed: use the rated speed from the motor nameplate, in RPM.

2. Next, press the up ↑ key. After "RUN10" is displayed, press the green RUN button to begin the auto-tune procedure.

   The motor will make high-pitched sounds, spin, then the inverter will indicate "END."

   Continue setting parameters, next:

A-9.3 Set the Remaining Parameters

Continuing from preceding section:

B1-01: 0	Frequency reference selection: use 0 = digital operator, using D1-01 and D1-02 to determine track and slew frequencies/speeds.
B1-02: 01	Run command selection 1: use 1 = digital input terminals S1 – S7. This is how the IOC board (located in the drive cabinet) commands the inverters to run at track and slew speeds.
C1-01: 0.1	Acceleration time 1: 0.1 is the default. Can be made larger for slower ramp times.

C1-02: 0.1	Deceleration time 1: 0.1 is the default. Can be made larger for slower ramp times.
C6-02: 7	Carrier frequency selection: use 7: swing PWM 1
D1-01: 6	Frequency reference 1: 6 Hz is the default for track speed. Usually 10–15% of slew speed.
D1-02: 60	Frequency reference 1: 60 Hz is default for slew speed. Usually 10–15% of slew speed.

3. Setup of that drive is complete. Press ESC (repeatedly, if needed) to return to the top-level menu.

Perform the above procedures for every V1000/GA500 in the drive cabinet.

After all motor drives are configured properly, connect the motors to the gearbox and proceed to section 3.5, "Setup Wizard."

A-9.4 Wire sizes for motors

	HP	kW	Model	Phase	Volt class	Max Amp	Motor AWG	Mains Powers AWG
MOTORS	0.54	0.4	BA0002FAA	single	200	1.9	14	12
	2.95	2.2	4A0005FAA	three	400	5.4	14	10
	4.96	3.7	4A0009FAA	three	400	8.8	14	10
	2.95	2.2	2A0010FAA	three	200	9.6	14	10
	7.38	5.5	4A0011FAA	three	400	11.1	14	8
	7.38	5.5	2A0020FAA	three	200	19.6	10	6

Figure A- 10 Wires sizes for motors

Appendix 10: Advanced Configuration — acu.ini

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

The text file acu.ini[8] consists of key-value pairs. It is used to configure ACU options not exposed by the system's GUI.

File location

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

C:\Radeus Labs\acu.ini

A-10.2 Default acu.ini

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

```
; ****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_STEPTRACK=1
;IESS_STEPTRACK=1
;TLE_GROUP=1
;CELESTIAL_BODY=1
;POWER_TIMEOUT=30
;K_BEAMWIDTH=70
```

[8] Requires Radeus Labs ACU application version 2.2.0 or greater

```
;AZ_SECTORS=1
;BRAKE=0
;RATIOS=0
;START_DRIVE_ENABLE=0
;COORDINATE_TRANSFORM=0
;CENTER_POL1=0
;CENTER_POL2=0
;MODEL_LIMIT=6
;MC_BAUD=9600
;MC_BITS=8
;MC_PARITY=0
;MC_STOP=1
;MC_CRLF=1
;MC_ECHO=0
;MC_CHECKSUM=0
;NOISE_LIMIT=200
;NOISE_FLOOR=200
;NOISE_FACTOR=80
;PEDESTAL=1000
;CONTINUOUS=0

[EPHEMERIS]
;TLEPATH=
;IESSPATH=

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

A-10.3 Primary Keys

Used in acu.ini to show or hide various ACU modes or options. *This is for operator accessibility:* it only controls whether the modes or options are

available. *Targets previously defined with a certain mode will still be available* even if that mode isn't among the current options.

LOOKANGLES

Show or hide the tracking mode "Look angles"

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

LONGITUDE

Show or hide the tracking mode "Longitude"

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

PREDICTIVE

Show or hide the tracking mode "Predictive"

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

STEPTRACK

Show or hide the tracking mode "Steptrack"

Type:	Boolean

Range:	0, 1
Examples:	STEPTRACK=0 STEPTRACK=1

TLE

Show or hide the tracking mode "TLE (SGP4)"

Type:	Boolean
Range:	0, 1
Examples:	TLE=0 TLE=1

IESS

Show or hide the tracking mode "IESS-412"

Type:	Boolean
Range:	0, 1
Examples:	IESS=0 IESS=1

TLE/STEPTRACK

Show or hide the tracking mode "TLE/Steptrack"

Type:	Boolean
Range:	0, 1
Examples:	TLE_STEPTRACK=0 TLE_STEPTRACK =1

IESS/STEPTRACK

Show or hide the tracking mode "IESS/Steptrack"

Type:	Boolean
Range:	0, 1
Examples:	IESS_STEPTRACK=0 IESS_STEPTRACK =1

TLE_GROUP

Show or hide the tracking mode "Tle_group"; This is not used in the 8200 software

Type:	Boolean
Range:	0, 1
Examples:	TLE_GROUP=0 TLE_GROUP=1

CELESTIAL_BODY

Show or hide the tracking mode "Celestial body"

Type:	Boolean
Range:	0, 1
Examples:	CELESTIAL_BODY=0 CELESTIAL_BODY=1

POWER_TIMEOUT

The amount of time (in minutes), after a drive cabinet power loss, during which the ACU will attempt to resume tracking if power is restored. For example, if the drive cabinet loses power while tracking a target and POWER_TIMEOUT is set to 30, the ACU will attempt to resume tracking the same target if power is restored within 30 minutes; if the power loss is longer than 30 minutes, the ACU will remain in standby.

- Type: Integer
- Range -1 – 34560 (1 day)
  - 0 specifies that the ACU *will not resume* tracking after a drive cabinet power loss.
  - -1 specifies that the ACU *will always resume* tracking, no timeout.
  - Other numbers in the valid range indicate the number of minutes.

Examples:

POWER_TIMEOUT=-1
POWER_TIMEOUT=30

K_BEAMWIDTH

Antenna efficiency used for calculating nominal 3 dB beamwidth for tracking.

- Type: Integer
- Range 0 – 100

Examples:

K_BEAMWIDTH=70

AZ_SECTORS

Enable or disable selection of Azimuth sectors. See section 3.5.4.1, "Antenna Sectors."

- Type: Integer
- 0 – 1 disables sector selection; 2 – 8 specifies the maximum number of sectors selectable in the ACU.

Examples:

AZ_SECTORS=0
AZ_SECTORS=8

BRAKE

Enable or disable display of brake control. See section 3.4.3, "Options."

- Type: Boolean
- Range: 0 or 1

Example:

BRAKE=1

RATIOS

Section 3.4.6, "Specify encoder types and positions."

- Type: Boolean
- Range: 0 or 1

Example:

RATIOS=1

START_DRIVE_ENABLE

Always assert drive enable when the ACU starts.

- Type: Integer
- 0 = Disable this automatic drive enable.
  1 = Assert the drive enable whenever the ACU starts or restarts.

Example:

START_DRIVE_ENABLE=1

COORDINATE_TRANSFORM

Allow ACU operators to choose between AZ-EL or HA-DEC units in the ACU display. See Appendix 15: "Units: Hour Angle and Declination."

- Type: Integer
- 0 indicates AZ-EL units will be used, 1 selects hour angle and declination.

Example:

COORDINATE_TRANSFORM=1

CENTER_POL1

Changes where the Center of rotation of the POL1 axis when using ratios; defaults to 0

- Type: Integer
- Range: -180 to 180

Example:

CENTER_POL1 = 10

CENTER_POL2

Changes where the Center of rotation of the POL1 axis when using ratios; defaults to 0 ● Type: Integer ● Range: -180 to 180 *Example:* CENTER_POL2=10
MODEL LIMIT A factor applied to the follow model time to determine how long a span can be between model points (plus or minus "Follow Model Time" * "Model Limit"); defaults to 6 ● Type: Integer ● Range: 0 - 100 *Example:* MODEL_LIMIT=6
MC_BAUD Used to configure the M&C Serial port J5 baud rate ● Type: Integer ● Range: 9600 (Default), 19200, 38400 *Example:* MC_BAUD=9600
MC_BITS Used to configure the M&C Serial port J5 data bits ● Type: Integer ● Range: 7, 8(Default)

Example:

MC_BITS=8

MC_PARITY

Used to configure the M&C Serial port J5 parity bits

- Type: Integer
- Range: 0 (none, Default), 1 (odd), or 2 (even)

Example:

MC_PARITY=0

MC_STOP

Used to configure the M&C Serial port J5 stop bits

- Type: Integer
- Range: 1 (Default), 2

Example:

MC_STOP=1

MC_CRLF

Used to configure the M&C Serial port J5 line feed bits

- Type: Integer
- Range: 0 (CR only, Default), 1 (CRLF as newline output)

Example:

MC_CRLF=1

MC_ECHO

Used to configure the M&C Serial port J5 line echo (note: we don't do full input line editing)

	• Type: Integer • Range: 0 (no echo, Default), 1 (echo) *Example:* MC_ECHO=0
MC_CHECKSUM	Used to configure the M&C Serial port J5 line echo (note: we don't do full input line editing) • Type: Integer • Range: 0 (no checksums, Default), 1 (checksum at the start of each input and output line) *Example:* MC_CHECKSUM=0
NOISE_LIMIT	Empirically determined factor used to calculate receive signal deviation; Default: 200 • Type: Integer • Range: 0 - 1000 *Example:* NOISE_LIMIT=300
NOISE_FLOOR	Empirically determined factor used to calculate receive signal deviation; Default: 200 • Type: Integer • Range: 0 - 1000 *Example:* NOISE_FLOOR=200

NOISE_FACTOR

Empirically determined factor used to calculate receive signal deviation; Default: 80

- Type: Integer
- Range: 0 - 160

Example:

NOISE_FACTOR=80

PEDESTAL

Used only in the 2200 software; Causes the Software to adapt the physical characteristics of the AE1000 or AE2000 pedestal

- Type: Integer
- Range: 0 - 160

Example:

PEDESTAL=1000

CONTINUOUS

Used for testing to remove the waiting for Acquisition of signal

- Type: Boolean
- Range: 0, 1

Example:

CONTINUOUS=0

A-10.4 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 checks 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 %20:
TLEPATH=http://the.domain.com/
file%20repository/ … [more path] … /
geo.txt

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:

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

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 11: 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 character must be encoded as %20 as shown below):

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

A-10.4.1 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
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.

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.

Example:

WRITE_COMMUNITY=private

Appendix 11: 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]

Example records:

sat_name	Satellite name *Type:* string, unquoted
nom_cob	Nominal Center-of-Box position, nominal orbital location *Type:* decimal number *Range:* 0.00 – 360.00
Epoch	Epoch expressed as a Julian day number If needed a excel "calculator" can be requested from support@radeuslabs.com to help in converting this number *Type:* decimal number *Range:* 0 – 1.7E308
lm0	Mean longitude (deg. east of Greenwich) *Type:* decimal number *Range:* -1.7E308 – 1.7E308
lm1	Drift rate (deg/day) *Type:* decimal number *Range:* -1.7E308 – 1.7E308
lm2	Drift Acceleration (deg/day/day)

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

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

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

A-11.1 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 5-8 Sample data records in IESS-412 format (split onto two lines here).

Appendix 12: Series 8000 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-12.1 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-12.2 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 (3 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-12.3 Motor Checks

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 *clockwise* 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-12.4 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-12.5 ACU Setup and Parameter Record

- ☐ Refer to *Model 8000 ACU Operation and Maintenance,* perform the steps in section 3.4.
- ☐ 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-12.6 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 (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 13: Portable Maintenance Control Unit (PMCU)

A-13.1 Introduction

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 to maintain the antenna and associated systems.

PMCU functions are similar to functions available at the Radeus Labs Model 8250™ drive cabinet's jog panel.

Figure A-10 PMCU

A-13.2 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-13.3 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.)

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.*

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

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.

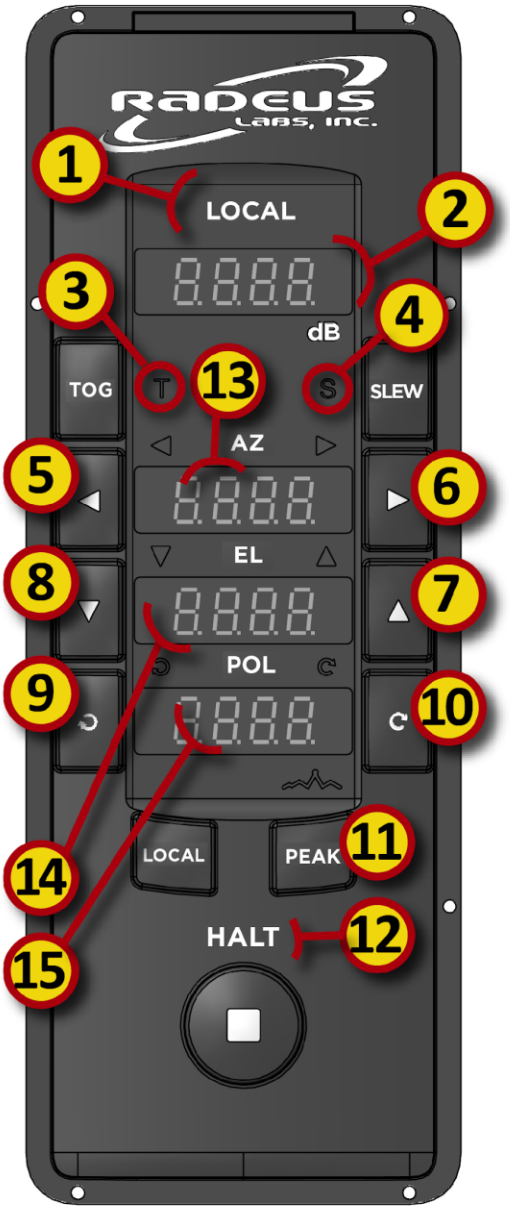
- The Slew button doesn't respond in this mode.

PEAK

Reserved for future use.

Will require an ACU signal level.

A-13.4 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

Figure A-11 PMCU Labels & Displays

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.

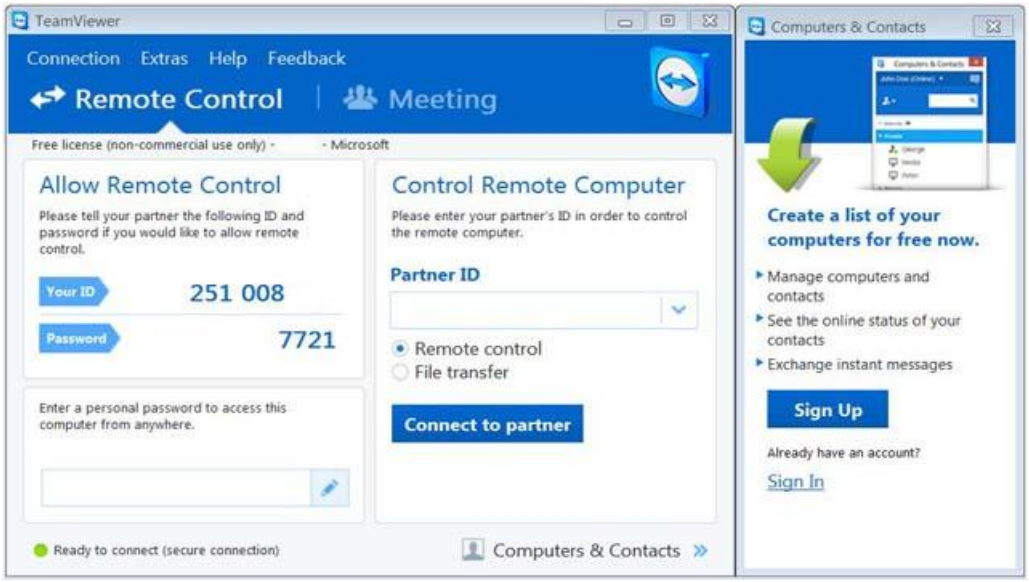


Figure A-12 TeamViewer provides remote access to Radeus Labs ACUs.

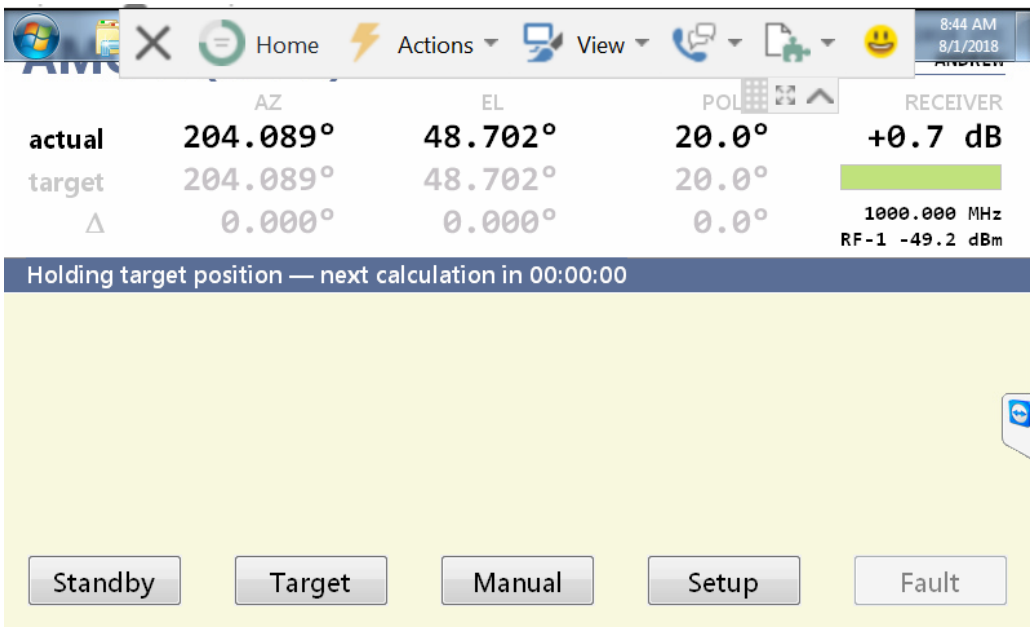


Figure A-13 TeamViewer's remote view of the ACU's display.

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-14.2 TeamViewer Requirements

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

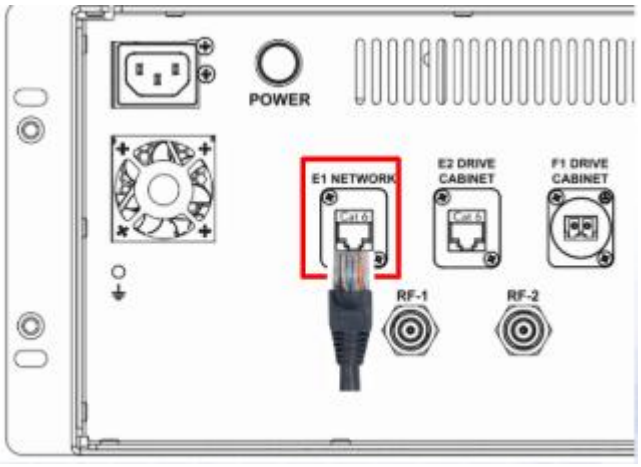


Figure A-14 TeamViewer requires the E1 Network port on the ACU's rear panel.

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

A-14.3 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,v2c, and v3.

The SNMP versions v1, v2c, and v3 refer to system security. V1 and v2c do not provide any security measures, while v3 requires authentication to access the system.

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

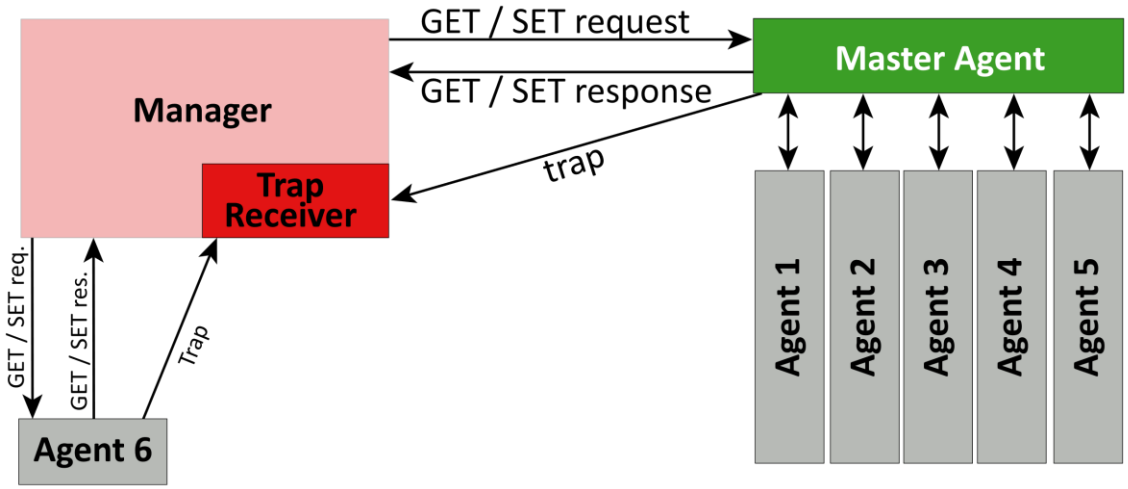


Figure A-15 The SNMP option for remote control uses GET/SET commands.

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 (see **Figure 5-13**):

C:\Users\Public\Desktop\MIBS

Updated MIB files are available for download from:

https://www.radeuslabs.com/

Please contact support@radeuslabs.com for access.

To use SNMPv3, the system needs to have the authentication password and privacy password populated in the INI file. When these fields are populated, the system disables SNMPv1 and v2. When configuring the device to use SNMPv3 in communication with the ACU, use the Security User Name "RadeusLabs," the Authentication Protocol of SHA, and the Privacy Protocol of AES128.

To control the ACU remotely, you can use SNMP calls defined in the Management Information Base (MIB) files. These files are saved on the ACU Windows Desktop:

C:\Users\Public\Desktop\MIBS

Updated MIB files are available for download from:

- https://www.radeuslabs.com/

  Please get in touch with support@radeuslabs.com for access.

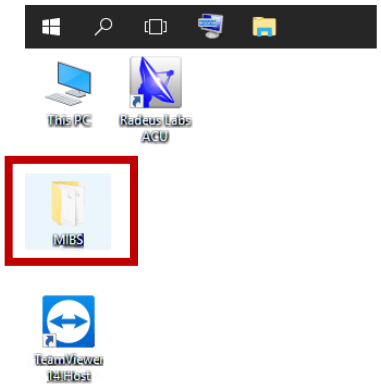


Figure A-16 The desktop of a typical ACU, here showing the MIBS directory. Also see section A-14.7, "SNMP Tools."

When using SNMPv3, it is necessary to provide authentication and privacy passwords in the INI files. Filling out these fields will disable SNMPv1 and v2. To configure a device for communication with the ACU using SNMPv3, use the following steps:

Security User Name: RadeusLabs

Authentication Protocol: SHA

Privacy Protocol: AES128.

A-14.4 SNMP Requirements

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

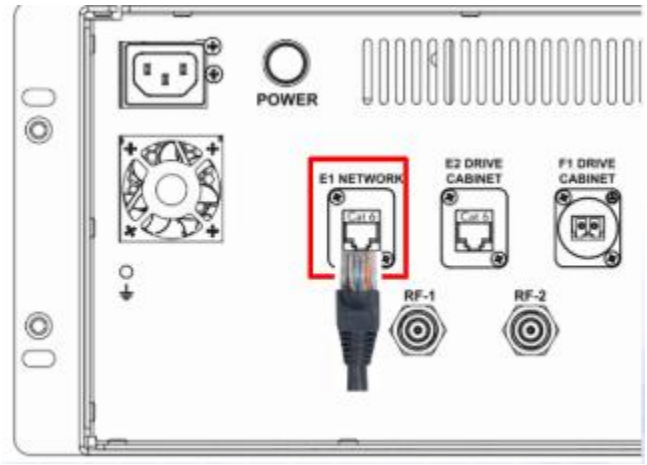


Figure A-17 Like TeamViewer, SNMP control requires the E1 Network port on the rear panel of the ACU.

A-14.5 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:

- Kratos Compass
- SED Mon-A-Co

A-14.6 Open source M&C software

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

- Cacti
- Zabbix

A-14.7 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-14.8 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-14.9 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 legacy 7200 serial cables, a null modem is required (one ships with Radeus Labs 8000 ACU Legacy configurations).

For pinout information, please see Appendix A-2.1.

A-14.10 Web Interface

If the system is connected to a LAN the interface can be connected to using a web browser of a computer on the same network. The ip address to connect will be the ip address assigned to the SCU.

- The system supports a web interface after version 9k-RC152, which allows users to access an ACP-like interface from any computer on the same network. This makes it more convenient to control the unit or operate it remotely in unmanned locations.

Appendix 15: Units: Hour Angle and Declination

The Model 8000 supports antennas that employ *hour angle* and *declination* (HA-DEC) as their *native units*. For all systems:

- An antenna's settings are always expressed in its native units.
- Native units are always shown when in Manual mode.
- Target angles are always expressed as azimuth and elevation.

Configure the ACU to use the desired units:

1. To use HA-DEC in an antenna's settings, edit the acu.ini file to set:

   COORDINATE_TRANSFORM=1

   Appendix 10: "Advanced Configuration — acu.ini"

2. After that, operators can use the ACU's Home > Setup > Options tab (**Figure 5-15**) to set the *display units* used in the real-time data.

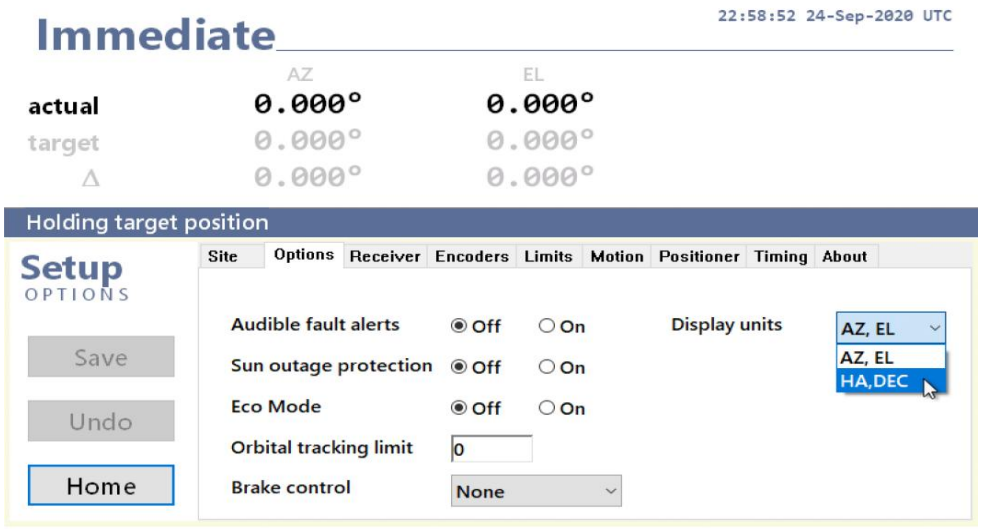


Figure A-18 Change the units used in the ACU's real-time data via the *Display units* drop-down. (Not all options shown here are available on all systems; some options must be enabled, e.g., in acu.ini, see text above.)

Appendix 16: REST API

This document is for developers who want to use the Radeus Labs Antenna Control Unit (ACU) RESTful API. It assumes the reader is familiar with web programming concepts and web data formats.

Before you start

- Obtain the API key for your ACU. This is contained in the file:

  C:\Radeus Labs REST\api-key.txt

  The key is unique to each unit and cannot be reused elsewhere.

- Be familiar with the ACU. The REST API provides a subset of the capabilities offered by both the ACU itself and the SNMP management-and-control interface.

The full OpenAPI specification for the ACU RESTful API is contained in the acu_openapi.yaml file provided by Radeus Labs.

A-16.2 API key

The API key needs to be supplied in the request header for each API call. The key is placed in the api-key field.

A-16.3 Testing API operation

You will need the IP address of your ACU in order to test proper operation.

Options for confirming that the API is properly deployed and working include Postman, curl, and PowerShell's Invoke-RestMethod but other tools and methods may be utilized:

Postman — https://www.postman.com/

Curl — https://curl.haxx.se/

Invoke-RestMethod — https://docs.microsoft.com/en-us/powershell/module/microsoft.powershell.utility/invoke-restmethod

A-16.4 Get API version

The /version command can be used to verify that the REST API has been correctly installed and is accessible in your environment. The following section provides details on how to do this with the most commonly used tools.

Postman

Postman is a full GUI desktop application that can be used for exploring REST APIs. Installation and operation is beyond the scope of this document, but this article…

https://learning.postman.com/docs/getting-started/importing-and-exporting-data/

…describes how you can import the OpenAPI specification into Postman to streamline the process. Alternatively, you can just issue the /version request and go from there.

curl

The following command can be used to test with curl:

```
curl -X GET https://acu.radeuslabs.com/version
```

If the domain name entry has not been created or the CA certificate hasn't been installed, you can use the following command, substituting <ipaddress> with the IP address of your ACU:

```
curl -k -X GET https://<ipaddress>/version
```

Invoke-RestMethod

The following command can be used to test with the Windows Powershell Invoke-RestMethod command:

```
Invoke-RestMethod https://acu.radeuslabs.com/version
```

If the domain name entry has not been created or the CA certificate hasn't been installed, you can use the following command[12], substituting <ipaddress> with the IP address of your unit:

```
Invoke-RestMethod -SkipCertificateCheck
https://<ipaddress>/version
```

All commands, including the script can be run in a non-administrative session.

[12] The -SkipCertificateCheck parameter was added in PowerShell 6.0.0. If you are using an earlier version, you can use the Invoke-RestMethod-SkipCertCheck.ps1 script provided by Radeus Labs.

SSL CA certificate

The API can be used to retrieve the public CA certificate that was used to sign the SSL certificate used by the ACU. This certificate can be installed on your local machine to ensure the identity of the ACU.

It can be requested at the following endpoint:

https://acu.radeuslabs.com/certificate

ACU domain name entry

For the certificate to work, a local DNS entry is needed in either your /etc/hosts file or C:\Windows\System32\drivers\etc\hosts file, depending upon your operating system.

Appendix 17: Steptrack Operation

When using the Radeus Labs ACU it is important to understand the fundamental parameter setup to get the best possible results using steptrack. Further, steptrack is the basis for the predictive track algorithm and is used when using hybrid modes like TLE or IESS with steptrack. The quality of your steptrack setup will affect the performance of all available tracking modes!

The latest version of this document can be found

A-17.1 Introduction

One of the most fundamental means of tracking geostationary satellites is called "steptrack". As the name implies, steptrack is a method of simply stepping away from the signal peak to determine if we are on the peak, or if the pointing needs to be adjusted. Steptrack may be used as a standalone tracking algorithm or it may be used as the basis for more sophisticated algorithms such as an orbital model, or propagator. Thus, it is critical to be able to execute the steptrack process successfully for tracking operations. This article will review the basic parameters used in the 8000 ACS steptrack process and some typical values that under normal circumstances will achieve successful tracking results.

A-17.2 The Steptrack Process

A simplified version of the steptrack algorithm process follows:

- Record my starting location
- Step away from my current location and measure the signal level
- Step in the opposite direction (2x) and measure the signal level
- Calculate a correction step from the starting location to find a new location
- Move to the new location

Of course, there are checks built in so that we do not try to correct too much in any one given step, or if the corrective step will have no meaningful change to the signal level, just stay where you were. Also, what happens if the signal is not where the satellite is supposed to be? Further, how does the control system even know where it is located on the surface of the earth? These are all configuration issues that must be dealt with in the setup of the controller.

A-17.3 Configuring the Site Information

Needless to say, there is some setup and configuration to be done before setting up any targets for tracking in the system. First and foremost is the "SITE" tab in settings. This is where you can tell the system where it is physically located on the surface of the earth. The Site tab can be found by selecting Home>Setup>Site tab and is shown in Figure 5-16.

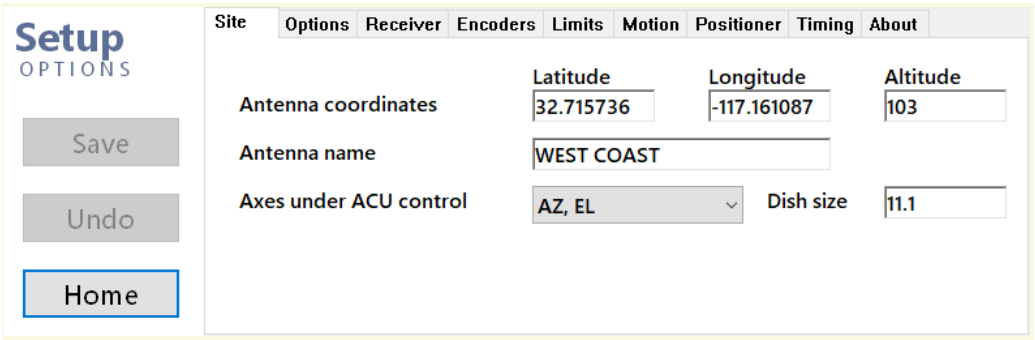


Figure A-19 Site Configuration Tab

This is where the antenna's location information is entered. First plug in the antenna's latitude in degrees north and longitude in degrees east using up to 6 decimal places. The antenna's altitude is entered in meters and of course, you can name the antenna to distinguish it from other nearby systems. The antenna name will appear on the front panel touchscreen display during normal operation. This antenna (for this example) has a circular feed and therefore we will select two axes for control. Finally, enter the dish size in meters to the tenths position. If you do not put in a -3dB beamwidth in a later step, this dish size

will be used to calculate the -3dB beamwidth for the antenna, so an accurate dish size value can reduce the opportunity for errors later in the process! Now SAVE the values you have entered. Unsaved values will be highlighted in yellow as a visual reminder. Now with these values in place, our controller will know where it is located and the size of the antenna it is controlling.

A-17.4 Setting up a Target (Satellite) for Tracking

Now let's take a look at how to set up a target for tracking by selecting the TARGET button from the home screen and then select EDIT to edit one of the existing steptrack targets. The Target options screen 1 is shown in Figure 5-17.

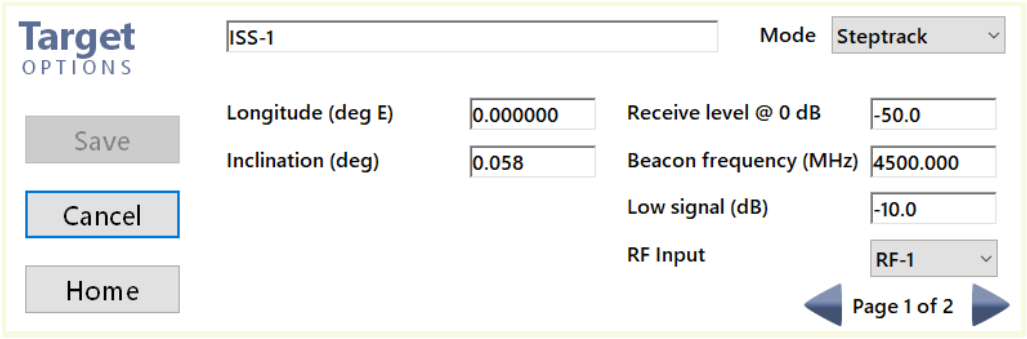


Figure A-20 Screen 1 of Target Options

The Steptrack mode consists of two steps: acquisition and tracking. Acquisition uses the satellite's longitude and inclination to initially point the antenna at the look angles for the satellite. If there is no signal present once the look angles are achieved, then the inclination is used to perform a scan of the expected path of the target.

The receive signal parameters used to initially acquire and then track the target are as follows:

- Receive level @ 0 dB (dB) – an offset value in dB to make the signal level reflect as a 0 dB relative signal level.

- Beacon frequency (MHz) – the RF frequency in MHz of the signal before any down-conversion.
- Low Signal (dB) – a signal threshold level in dB, which if reached, prevents tracking by suppressing the current steptrack cycle. This is relative to the Receive level @ 0 dB setting and has a range of 0 to - 20.
- RF Input – selects the RF input at the back of the ACU for the target (maybe grayed out if not applicable).

Recommendations for these parameters:

1. **Longitude** – Use the actual longitude value of the satellite, typically available from the satellite owner or maintainer.
2. **Inclination** – Use the actual inclination value for the satellite, typically available from the satellite owner or maintainer.
3. **Receive level @ 0 dB** – Set this after peaking up on the target manually, if possible, to reflect a 0 dB relative signal setting.
4. **Beacon Frequency** – Set to the receive satellite beacon frequency (before down conversion) in MHz
5. **Low signal** – Hitting the low signal threshold will cause a pending steptrack cycle to be suppressed. You typically do not want this parameter be too tight such that rain fade or other naturally occurring events with a minor effect on the signal, to suppress a steptrack cycle. -10dB is the default value and it works well for many scenarios.

Once a satellite signal is acquired, the steptrack parameters are then used to track the target. These parameters are located on page 2 of 2 for the target setup and are shown in Figure 5-18.

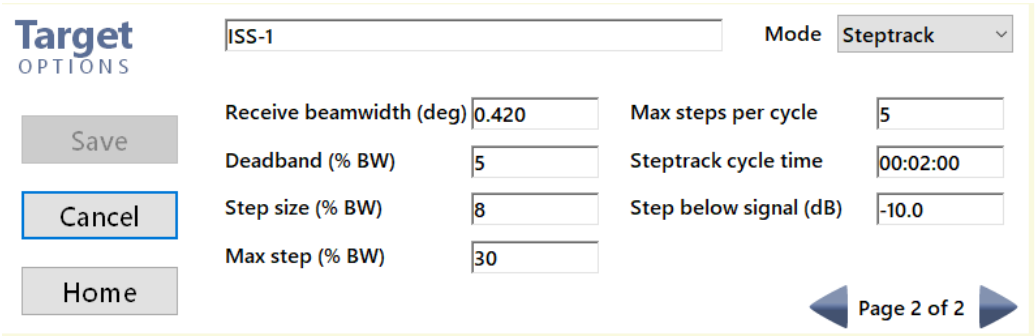


Figure A-21 Screen 2 of Target Options

The following definitions are important to your understanding of the steptrack parameters:

- **Receive beamwidth (deg)** – the calculated full 3dB beamwidth of the signal. This is based on the antenna diameter and the beacon frequency parameters. This can also be manually entered/changed if a measured or more precise beamwidth is known. **A measured value is preferred here since this value is used to calculate a steptrack correction step during a steptrack cycle. If this is smaller than the actual -3dB beamwidth, the correction step will NOT take you back to the peak and the system will appear to lag behind the satellite movement.**

- **Deadband (% BW)** – the threshold for successfully ending a tracking cycle. When the steptrack algorithm determines that the antenna is pointing within the deadband %BW percentage of the peak the steptrack cycle is said to have "converged". The tracking cycle is then ended. A smaller deadband will force the tracking to attempt to be more accurate however it will also require more steptrack cycles to achieve the accuracy. Usually, a larger deadband is preferred since the signal loss due to excessive stepping can degrade the signal level more than having a slightly larger deadband value.

- **Step size (% BW)** – the size of measurement steps (as a percentage of the -3dB beamwidth) the steptrack algorithm uses to measure signal level during tracking. Larger steps will make the tracking results more accurate in the presence of signal noise. The tradeoff for larger steps, however, is that larger step sizes will increase the signal loss due to the tracking motion. The step size should be as large as the system can tolerate for RF loss during measurement steps. Generally speaking, the larger the step size, the more robust the tracking performance.

- **Max step (% BW)** – the maximum limit (as a percentage of the -3dB beamwidth) for the size of correction steps. When the steptrack algorithm determines the antenna needs to be moved to a new position for peaking, the maximum correction step allowed is the Max step. This prevents erroneous calculations (due to noise) from causing very large movements, possibly in the wrong direction.

- **Max steps per cycle** – the limit to how many steptrack cycles will be taken in a given tracking cycle. Setting this low will ensure the antenna is not allowed to "hunt" for the peak for very long in the presence of high signal noise. However, it can also cause the tracking cycle to stop before converging. If the max steps per cycle limit is reached then the tracking cycle aborts and the antenna points back to the original angles.

- **Tracking cycle time** – the time the system will wait between steptrack cycles. When in the tracking cycle time waiting period the antenna is parked at the estimated peak location. Setting this low will cause increased tracking signal loss due to frequent step motions but will also allow the system to follow faster-moving targets with less loss in-between tracking cycles when the antenna is not moving. This should be set to the highest interval that still ensures that the tracking will keep up with the motion of the satellite with a tolerable signal loss.

- **Step below signal (dB)** – the signal threshold that will trigger a steptrack cycle during the waiting period set by the tracking cycle time. Using the step below signal threshold allows the tracking cycle to better match the target need and reduce wear and tear on the drive train equipment. Steptrack cycles will be initiated "on-demand" when the signal level drops below the threshold. The step below threshold is a dynamic threshold meaning that it compares against the highest signal measured since the convergence of the last tracking cycle. If the signal rises due to clearing weather or RF gain adjustments, then the threshold rises with it. However, if the signal drops due to weather or other influences then a lower threshold will be set after a steptrack cycle. The tracking cycle timer (see above) is still in effect and will initiate a steptrack when the timer expires, thus, for the Step below signal threshold to be effective at reducing drive train movement, the steptrack cycle time must be extended.

Recommendations for these parameters:

1. **Receive beamwidth (deg)** – Manually enter the MEASURED value if you have one. This value is used during steptrack cycles to calculate corrective

steps. If the -3dB beamwidth value entered here is smaller than the actual, then the corrective steps will also be smaller and you may never achieve the true peak during tracking. If you do not have the actual -3dB beamwidth, this will be populated with the value calculated based on the antenna diameter parameter and the receive beacon frequency value.

2. **Deadband (% BW)** – This parameter defaults to 5% and that is typically good for most scenarios. A larger value will cause the system to track less accurately, but move the drive train less. A smaller value will typically gain in tracking accuracy, at the cost of drive train wear. A smaller value in the presence of a noisy tracking signal can also cause the steptrack cycles to stop without a solution after the max steps per cycle have been exhausted. For targets inclined more than 1 degree however, a larger value may be required for this parameter.

3. **Step size (% BW)** – A general rule is 10% for good tracking performance. A range of 8 to 12 is ok. Remember that the larger the step size, typically the better performance you will achieve, especially when there is a noisy beacon signal.

4. **Max step (% BW)** – A general rule is 30% of the -3dB beamwidth, however, some have used 20% very successfully. This is a safety net in the presence of a noisy tracking signal.

5. **Max steps per cycle** – Default value of 5 is typically a good value. Too many steps will cause the system to take a lot of time, exercise the drive train extensively, and may not yield any better tracking performance. A smaller value like 2, may complete the cycle faster, but will not perform as well in the presence of noise.

6. **Tracking cycle time –** Generally speaking, this depends on how inclined the satellite is and its eccentricity. Meaning a satellite with more movement requires a shorter cycle time. If the target is highly inclined, you may desire to use a longer cycle time of 10 to 30 minutes or so and use the STEP BELOW SIGNAL parameter in 7 to manage the steptrack cycles so that they are only initiated on signal drops and not on short time-based intervals. IF you are using only the tracking cycle time to manage steptrack initiation, then you can set the Step below signal

parameter to -10dB. If you are using primarily the Step below signal parameter to manage steptrack initiation, then the tracking cycle time should be a longer interval in the 10 to the 30-minute range, and step below signal might be something like (-0.2 dB to -0.3 dB) depending on how much signal loss you can tolerate between steptrack cycles.

7. **Step below signal (dB) –** This parameter works as a complement to the tracking cycle time parameter. If you want to primarily use the cycle time with periodic timing, then the step below parameter should be set to a value like -10dB. That will make the system initiate steptracks based on your desired time interval. For targets that have a lot of movement, the step below signal parameter may be the better choice as it will allow for variable cycle times based on the signal drop rather than a set time interval. In this case, the cycle time would be set to say 10-30 minutes and the step below value in the 0.2 to 0.3 dB range. This will exercise the drive train only when necessary rather than on a timer.

A-17.5 One More Thing…

If you are old enough to remember Detective Colombo, you can appreciate this paragraph. There is a parameter in the ***HOME>SETUP>Positioner*** tab that applies to every movement commanded by the ACS, and for the most part, it is independent of the tracking modes. This tab is shown in Figure 5-19. The parameter of interest is the "Deadband (deg)" parameter. The units are in degrees and there is a setting for each axis of motion. This parameter is used by the position loop to determine when the antenna is pointing "close enough" to the commanded value. It is normally set by the Setup Wizard to a value derived from exercising the motors on each axis. The value will be close to the smallest perceivable movement (by the position feedback sensors) that the system can accurately achieve.

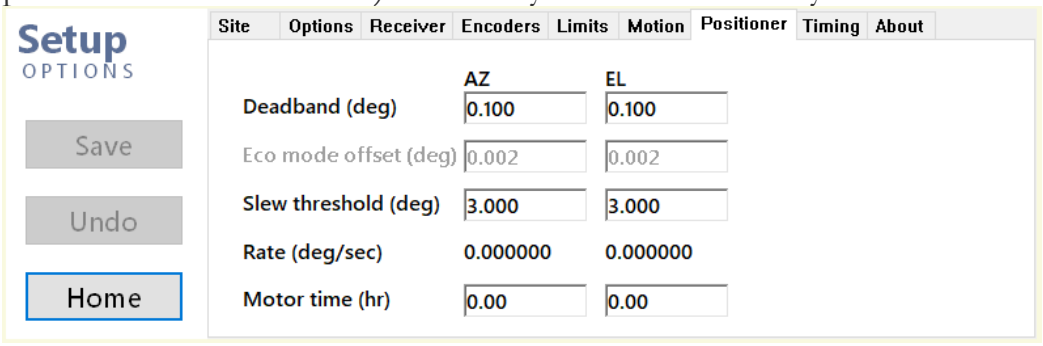


Figure A-22 Positioner Parameter Tab

As stated earlier, this value is used by the position loop to determine when we are close enough to the commanded angle position for each axis. **This is important because if your steptrack size is smaller than the Deadband (deg) parameter for a given axis, the system will never steptrack!** This issue has occurred in the field and should always be checked after you feel the initial system setup is completed. These values may be manually set after the Setup Wizard has been run, but care must be taken not to get this value too small or the system will continuously be exercising the jacks "hunting" a value within the deadband for a commanded movement.

Recommendations for this parameter:

1. **Deadband (deg)** – This parameter is dependent on the type of position feedback transducer implemented for a given axis.
2. The Setup-Wizard will automatically set this value when it is run, but is good practice to review this value following the completion of the setup wizard process.
3. When using 25-bit optical encoders, values of 0.001 to 0.002 are typically achievable providing there is not an excessive amount of backlash in the axis.
4. When using size-11 resolvers, values of 0.01 to 0.02 are typically achievable, with the same backlash disclaimer from 2 above.

A-17.6 Tying it all together

We have discussed the parameters critical to the steptrack process and attempted to give some information or clarity as to how each one impacts the performance of the system. Key parameters were emphasized and recommendations were made regarding these key parameter values to provide you with information that can help you achieve the best possible success with your 8000 ACS. It should also be noted at this point that we discussed the process relative to the "Steptrack" mode of operation, however since the "Predictive Track" mode relies on steptrack solutions to build a model for the target, all of these principles also apply to the Predictive Track mode of operation as well. As a final note on these parameters, it is always a good idea to review the key parameters once your system is configured to ensure that you have not missed something along the way. To that end, the final page of this document is your pre-flight checklist so to speak for running through the key parameters of the system and verifying that you have things in order. Of course, nothing says success like real data, so good tracking performance over 24 to 72 hours can be a good validation of the parameter set. Further, there will always, always be exceptions and we have seen several over the years that require some tweaking of the parameters to fit a niche application. This is beyond the scope of this document, but just a reminder that there is no single set of parameters that will fit every situation. We believe the logic of these guidelines will however provide you with enough information to extract the best possible performance from your Radeus Labs 8000 ACS!

Finally, if you have any questions regarding steptrack or other issues with your system, you can always reach out to us by email at support@radeuslabs.com, this email is monitored by our support team and is the quickest way to get the answers you need!

Steptrack Pre-flight Checklist

- The Site location data is accurate for the site (HOME->SETUP->Site tab)
- The Dish size parameter is accurate for the antenna (HOME->SETUP->Site tab)
- The positioner deadband is less than the steptrack size for each axis. (HOME->SETUP->Positioner)

"Deadband (deg)" << "Step size (% BW)" X "Receive beamwidth (deg)"

IF Deadband (deg) is greater and not less, the system will not steptrack since it appears to already be "close enough" to the new commanded angle. Typical values are given in the body of the document above and are dependent on the type of position transducer used for a given axis.

Target Specific Parameters

- The Receive beamwidth (deg) [-3dB BW of the antenna] parameter is accurate (HOME->TARGET>>Edit a target>>Page 2 of 2)
- The steptrack "Step size (% BW)" is set to a value near 10% (of the receive -3dB beamwidth).
- The "Max step (% BW)" is set to a value near 30, implying the maximum corrective step size allowed is 30% of the receive -3dB beamwidth.
- The Low signal (dB) parameter is correctly set (-10 to -20 dB recommended) so as not to cause the unit to go to standby on a small signal drop.

Appendix 18: Web Link Interface

A-18.1 Download and Install

Visit the Radeus Labs website to access the Web Interface download:

https://www.radeuslabs.com/.

If you encounter any issues with access, contact Support@radeuslabs.com for assistance.

Download the file and make a note of the download location.

Locate the downloaded file and double-click it to initiate the installation process.

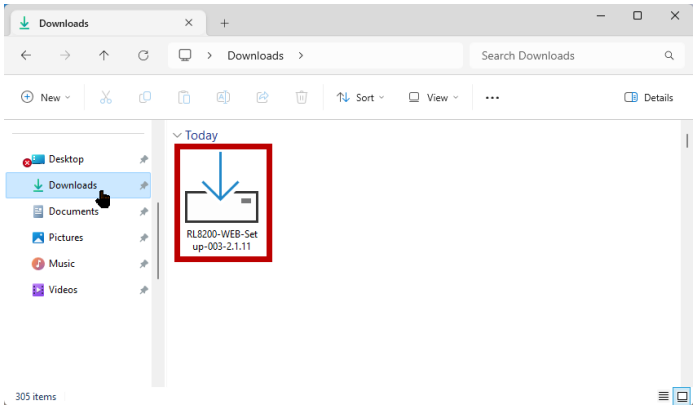


Figure A- 23 Open the Web Interface Download

During the installation, you may encounter prompts asking for your consent to install the interface. Be sure to accept these prompts if you want to proceed.

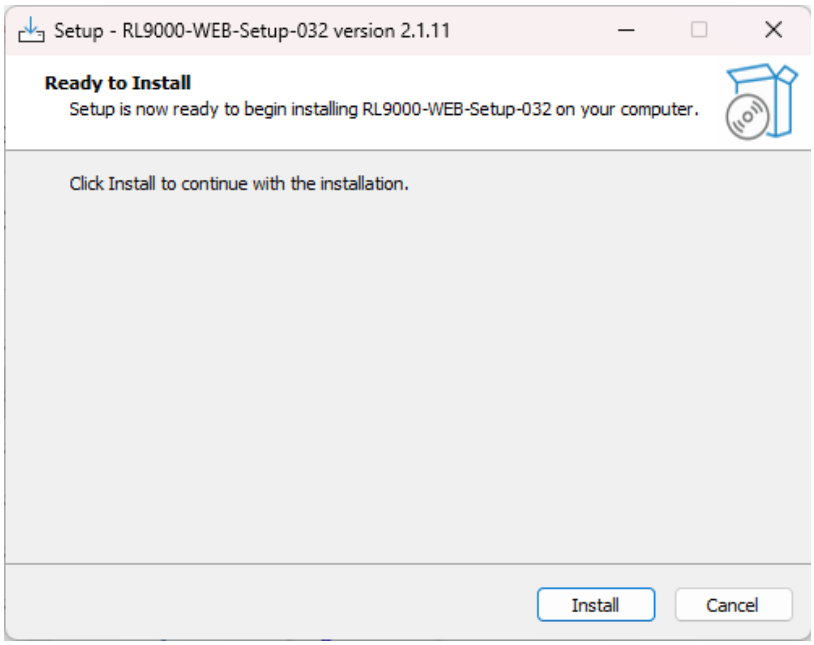


Figure A- 24 Installation Prompt

1. Click the "Install" button, and the necessary files will be installed on your computer.

NOTE: Part of this installation includes a blue dialog box. Once this box closes, you can proceed with your work.

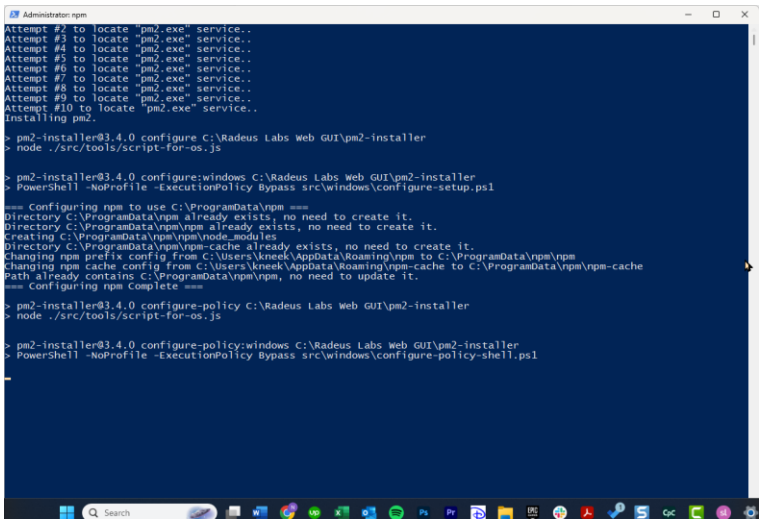


Figure A- 25 Blue dialog box when installing the Web Interface

2. Click Finish to complete the installation.

A-18.2 Opening the Web

NOTE:
Make sure to start the Radeus Labs ACU software on your computer by double-clicking the desktop icon.

Go to the Radeus Labs ACU software and click Setup.

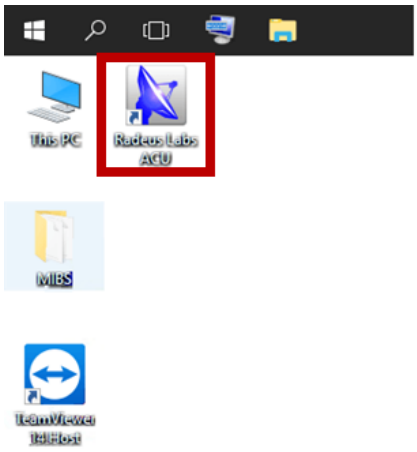


Figure A- 26 Radeus Labs ACU Software Icon on Desktop

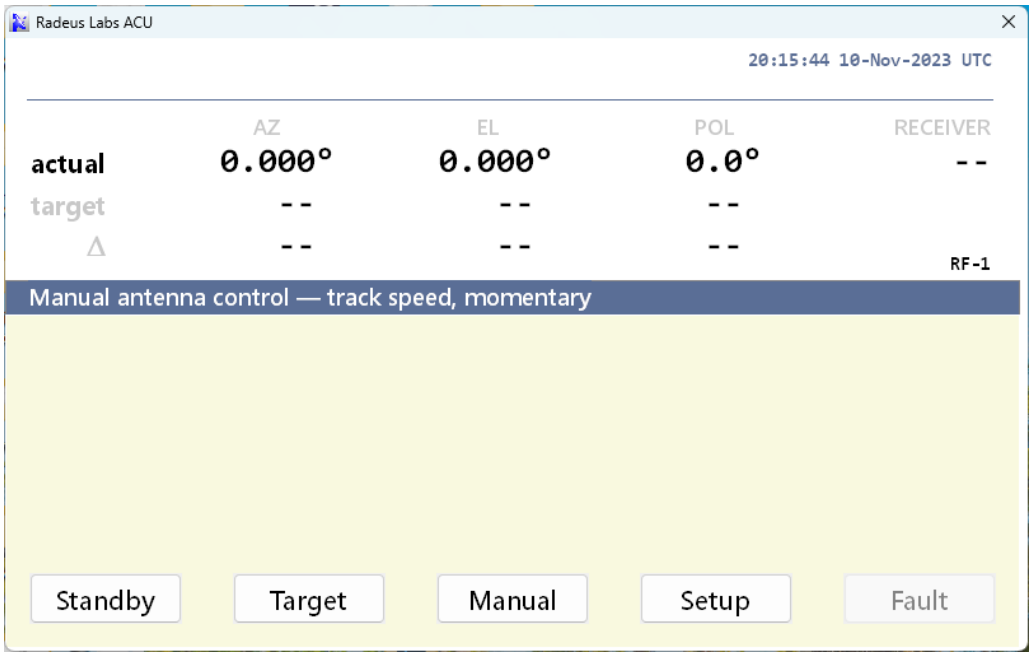


Figure A- 27 Home screen of the Radeus Labs ACU software

3. Open the About tab.
   On there you will see your IP address, write it down, as you will need it to access the Web Link Interface.

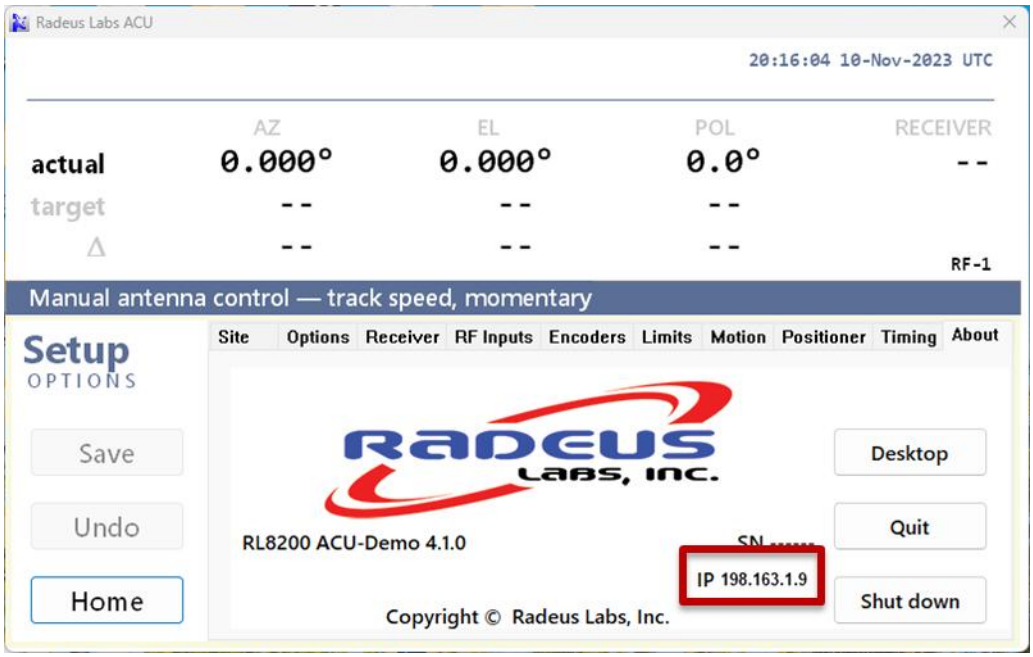


Figure A- 28 Your IP address on the about tab

4. Open your web browser and enter your IP address into the address bar. Then, press "Enter."

Figure A- 29 Typing your IP address in the address bar

5. Before it opens, you may receive a dialog box warning that you are about to open a non-secure website. Follow these steps to proceed:

   - Click "Advanced."
   - Click "Proceed to (IP address) (unsafe)."
     - To avoid having to follow this procedure in the future, you can load an SSL certificate into the site. Contact your IT department for more information

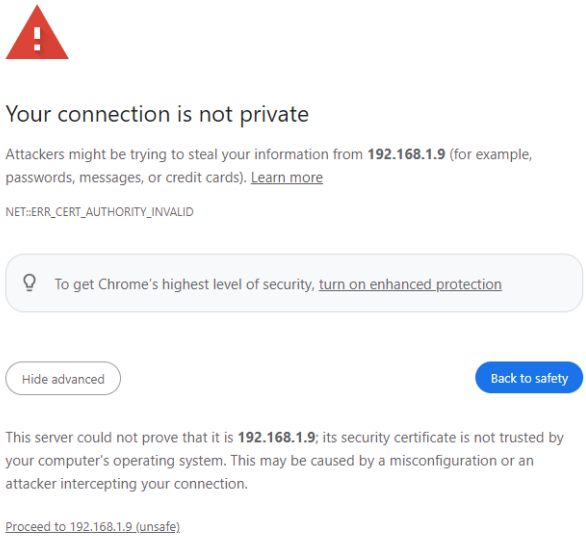


Figure A- 30 Proceed with unsafe Network

6. The Web Interface will open and be ready for use.

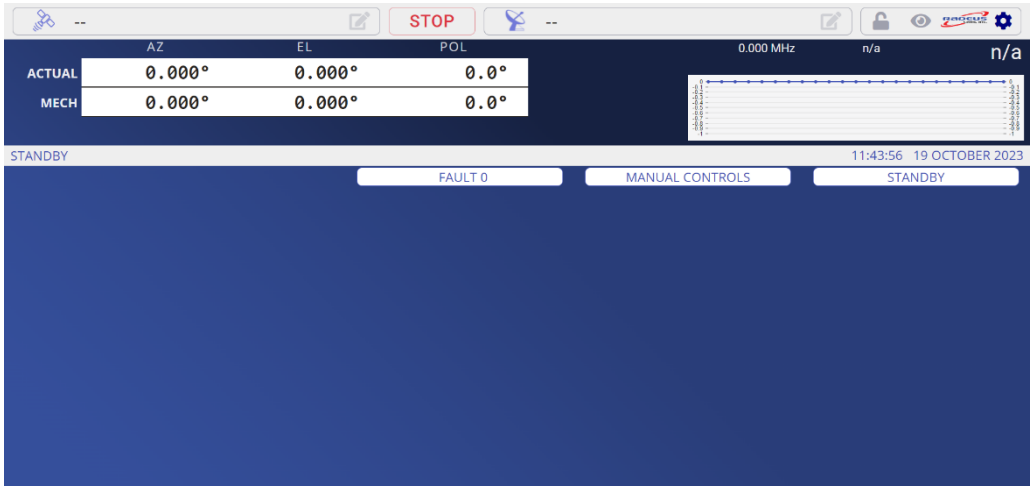


Figure A- 31 Web Interface Home Page

Appendix 19: Admin / Operator Passwords

A-19.1 Changing User Level

To change your user permission level, open the web GUI and go to the **Application Settings** page. In the **Preferences** tab, locate the section for user permissions, as shown in the image below. The default user is set to Monitor.

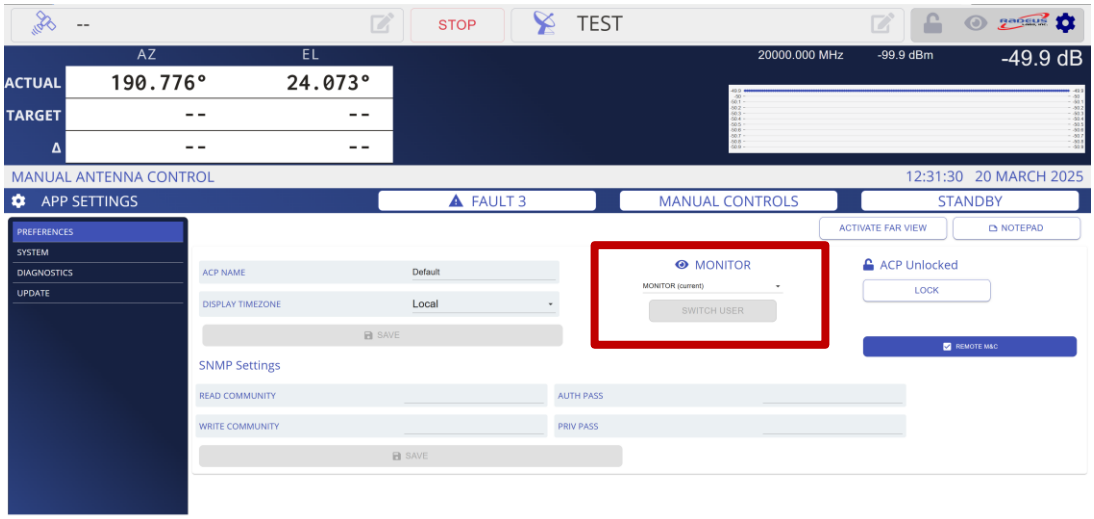


Figure A- 32 User selection setting in the Preferences tab

In some cases, you may encounter a Switch User popup when trying to access pages that require elevated permissions.

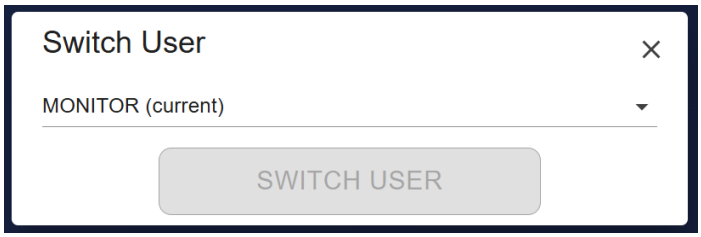


Figure A- 33 Switch User popup in Radeus Labs web GUI

To log in as an Administrator, choose Administrator from the dropdown menu and enter the password **5959**. For Operator access,

select Operator and enter **1212**. Each role—Monitor, Operator, and Administrator—provides a different level of access.

- **Monitor**: Unable to make any changes to settings
- **Operator**: Able to change tracking and target parameters
- **Administrator**: Able to change all settings

Make sure not to share these passwords with unauthorized users. Note that certain settings and setup options require Administrator access.

Appendix 20: Setup: Radeus BTR Model 3500

For use with the Model 3500 enhanced beacon-tracking receiver.

See the Model 3500 manual for details and important safety notes.

Figure A- 34 The Radeus BTR Model 3500 beacon tracking receiver (BTR)

A-20.1 Serial Port Connection

1. Connect the BTR's J2 M&C port to the 8200's port J4 RS-232.
2. Use the **L/R** button to enter *local mode*.
3. Press the **>** (right-arrow) button.
4. Press the **+** button until you get to **Communications**
5. Press the **CUR** button to enter the communications menu
6. Press the **CUR** button to enter the **M&C Port** selection
7. Press the **+** button to select **RS-232**.
8. Press the **CUR** button to confirm selection
9. Press the **+** button to go to **M&C Baud Rate**

10. Press the **CUR** button to enter the **M&C Baud Rate** selection
11. Press the **+** button to select **19200** baud.
12. Press the **CUR** button to confirm selection
13. Press the **RESET** button to exit the menu.
14. Use the **L/R** button to enter *remote mode*.

A-20.2 Ethernet Connection

1. Connect the BTR's ethernet port to a network accessible the 8200's ethernet port.
2. Use the **L/R** button to enter *local mode*.
3. Press the **>** (right-arrow) button.
4. Press the **+** button until you get to **Communications**
5. Press the **CUR** button to enter the communications menu
6. Press the **CUR** button to enter the **M&C Port** selection
7. Press the **+** button to select **Network**.
8. Press the **CUR** button to confirm selection
9. Press the **RESET** button to exit the menu.
10. Use the **L/R** button to enter *remote mode*.

Appendix 21: List of Figures

Appendix 22: 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):

Indicates it is the user's responsibility to dispose of waste 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.