2. Antenna Utility

The **antenna** utility allows you to manually control and monitor the radar and antenna. The radar host computer communicates with the Radar and Antenna system over a serial line connected to the radar/antenna control processor (RCP). The **antenna** utility allows you to communicate easily with the RCP to test the features of the RCP and its interface to the radar system, including:

- Setting both the Azimuth and Elevation positions or velocities.
- Turning the servo and the transmitter radiate and cabinet powers on and off.
- Checking the Computer/Local switch position.
- Checking the status of the cooling airflow, waveguide pressure, transmit Radiate/OFF/Warning status, magnetron current, and time stamp.
- Tracking the movement of the sun.

Note: Not all of the readouts and controls, described in this chapter, are available on all systems.

At a new installation, or after extensive maintenance, you should run the **antenna** utility before running IRIS to test the interface between the IRIS host computer and the RCP.

In this chapter:

2.1 Invoking Antenna

Antenna is an operator privileged program and is designed for experienced maintenance personnel only. IRIS observers and others are not permitted to run this utility.

Important: Use caution before running the antenna. Make sure the area surrounding the radar antenna is clear of personnel, who may be injured by the antenna motion or exposed to radiation.

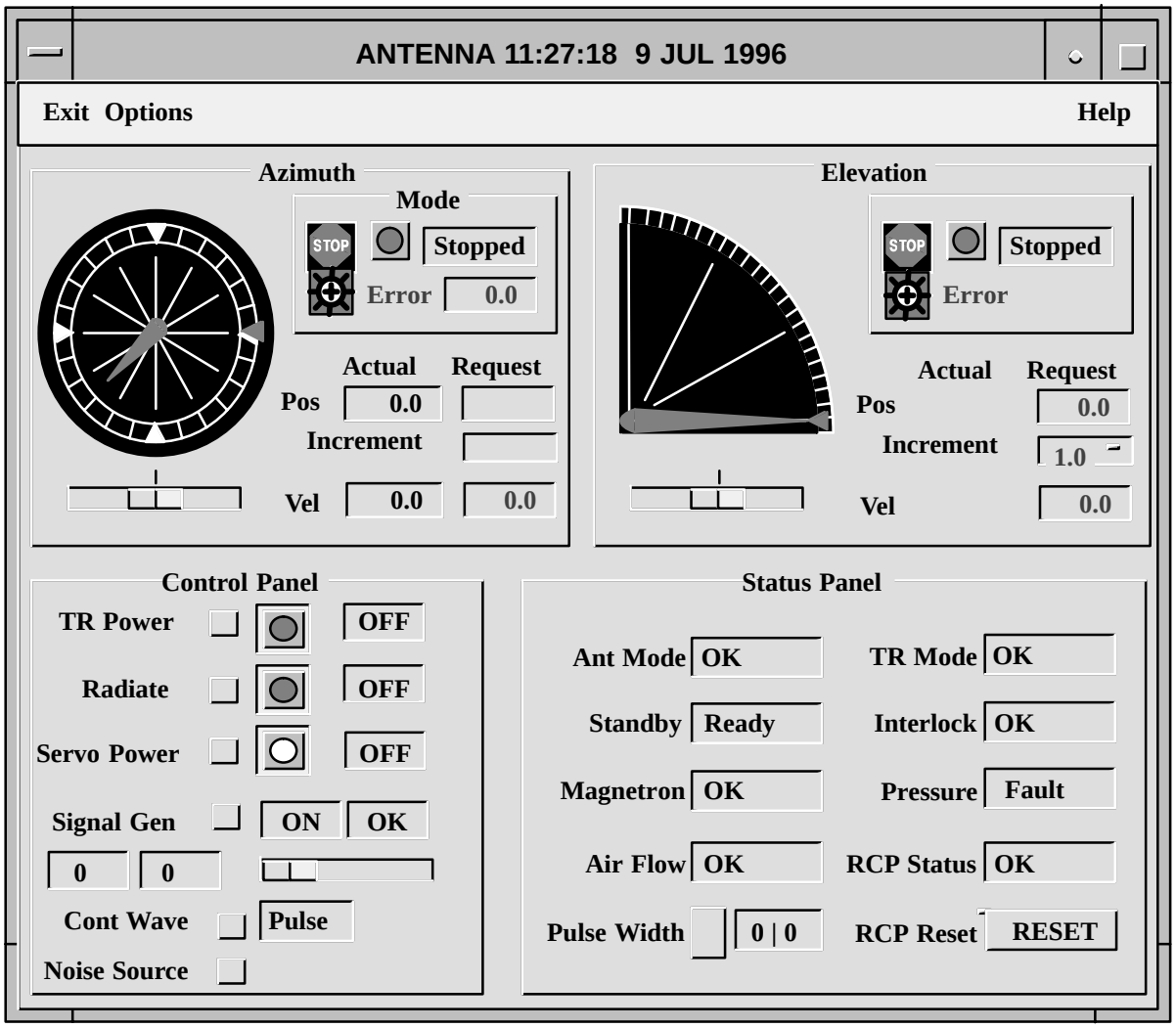
Important: Make sure to use setup to configure the antenna limits and Digital Signal processor (DSP) pulse widths before using the antenna or damage to your antenna system may occur.

Command

`antenna`

The **antenna** utility should not be running while IRIS is running because of the possibility of interference with IRIS commands to the RCP. During IRIS operation, nearly all of the monitoring information available in the **antenna** utility is displayed in the IRIS Radar Status menu.

2.2 Antenna Menu



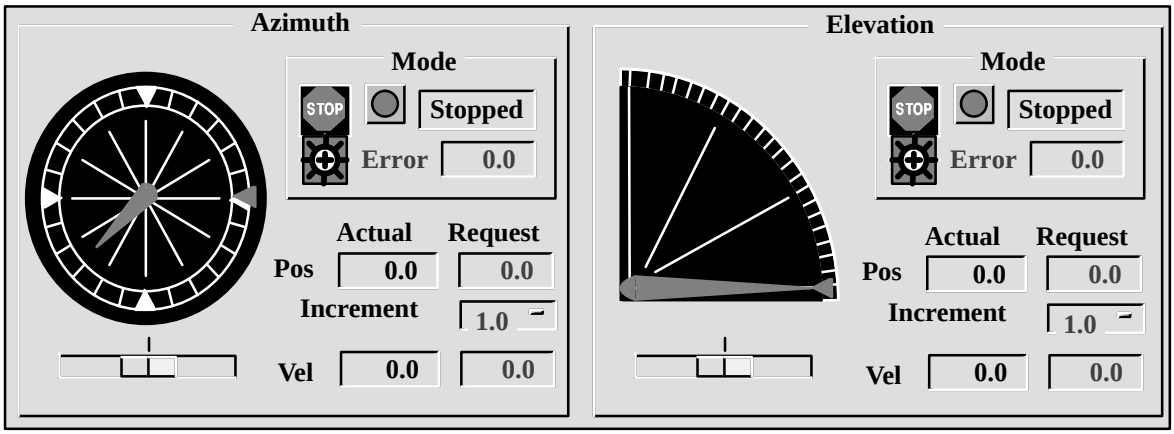
Azimuth and Elevation Panels Section 2.2.1 — Controls both the Azimuth and Elevation positions and velocities for the antenna.

Control Panel Section 2.2.2 — Turns the transmitter, radiate, servo, signal generator, and continuous wave powers on and off.

Status Panel Section 2.2.3 — Displays the status of the radar and RCP.

The title bar contains the current date and time so that this information can be saved on menu printouts.

2.2.1 Azimuth and Elevation Section



Azimuth Position Indicator

To set the Azimuth position, move the arrow along the edge of the position indicator. The pointer will display the movement of the antenna to the new position.

Elevation Position Indicator

To set the Elevation position, move the arrow along the edge of the position indicator. The pointer will display the movement of the antenna to the new position.

Mode

The **antenna** utility can operate in the following three modes:

Position	Enables setting the azimuth or elevation position.
Velocity	Enables setting the azimuth or elevation velocity.
SunTracking	Invokes a sun tracking procedure, which computes the direction to the sun from the radar location, and positions the antenna there. See Section 2.5 for more information on using the Antenna utility in Sun Tracking mode.

The following buttons, icons, and fields control the antenna mode:

- The Stop button stops the movement of the antenna, regardless of the current mode. The antenna does not stop abruptly when you click on the Stop button, but slows to a stop as indicated by the pointer within the position indicator.
- The Stop light changes from green to red when the antenna is stopped, or from red to green when the antenna is restarted.

- The Status field indicates the current antenna mode —"Position," "Velocity," "Sun Track," or "Stopped."
- The blue and yellow Sun Tracking button puts the antenna into the Sun Tracking mode. Click on this button again to exit from the Sun Tracking mode.
- While in the Sun Tracking mode, the Error field allows you to enter an offset to be added to the sun's position before moving the antenna. This field is disabled when the antenna is not in the Sun Tracking mode.

Sliding Scale

The sliding scales set the requested velocity for either the Azimuth or Elevation position. The scale has a "tick" at velocity 0. For the Azimuth velocity, positive speeds are for clockwise scanning while negative speeds are for counterclockwise scanning. For the Elevation velocity, positive speeds are for upwards scanning (toward the zenith), while negative speeds are for downward scanning (away from the zenith).

Position—Actual and Requested

Both the Actual and Requested position of the antenna are displayed, as they may differ.

When the antenna is in the Position mode, you may enter a position (in degrees) in the Request field. Both the Azimuth and Elevation positions can be observed to change and ultimately end up at or near the requested positions. The Azimuth positions range from 0 to 360°; elevation angles beneath the horizon are displayed as negative numbers.

Note: The RCP has its own "soft" elevation limits. If the antenna elevation does not move all the way up or down, to fulfill a position request, the request may be outside the limits imposed by the RCP. Consult with your manufacturer if you are unsure.

Some RCPs cannot move both axes of the antenna, in a velocity servo, at the same time. On these systems, the following message may be displayed at your request:

"**WARNING**: Bad Combination of Servo Types."

Velocity—Actual and Requested

Both the actual and requested velocities of the antenna are displayed, as they may also differ.

When the antenna is in the Velocity mode, you may enter a velocity in the Request field. Enter the speed as a signed number (in degrees) per second—six degrees per each second is equivalent to 1 RPM. For the Azimuth velocity, positive speeds are for clockwise scanning while negative speeds are for counterclockwise scanning. For the Elevation velocity, positive speeds are for upwards scanning (toward the zenith), while negative speeds are for downward scanning (away from the zenith).

If a velocity request exceeds the maximum velocity allowed by the configuration, set in the Setup utility, then the maximum velocity is substituted.

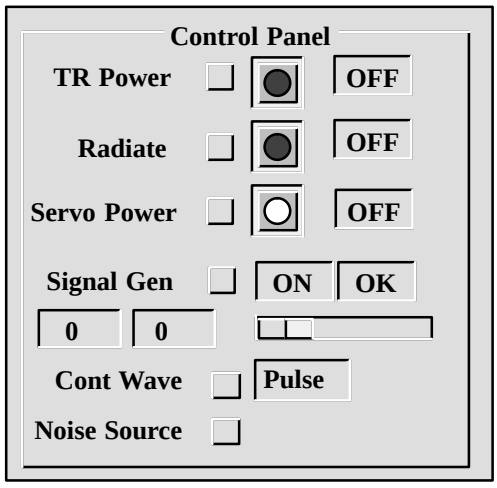
Example: If the upper limit in the Maximum Elevation field of RCP Section (See 8.3.3) is 80 degrees and you enter an elevation position of 90 degrees, the Request field will display 80 degrees and the antenna will increase to that elevation. At installation, this feature should be tested to verify that the protection is functioning properly, as described in Section 2.4.

Velocity and Increment Fields

To set the Velocity field with the sliding scale, click inside the scale and the slider will move. If fine adjustments are desired, set the Increment field to 0.1 and click until the correct value appears in the Request field.

To move the Platform parameters, many other values are displayed, such as the pitch, the roll, and the heading angles and velocities. Train-order and elevation-order angles are also displayed including the platform-relative pointing angles of the antenna pedestal. The platform position is also displayed as latitude, longitude, and altitude. There are also two velocities displayed. The first is the speed of the inertial navigation unit, or the center of the ship, and the second is the speed of the radar antenna. To the right of the longitude velocities, under the Xmit field, the velocity correction called Vcor is displayed. This represents the velocity correction in meters per second that needs to be applied to the Doppler date. The Vcor computed by a dot product of the antenna velocity with a unit vector pointing in the direction of the antenna.

2.2.2 Control Panel



The Control Panel controls the transmitter receiver and radiate, the servo, and the signal generator powers. The Indicator lights changes from red to green, indicating if the power is off or on.

TR Power

The TR Power field requests the RCP to turn the main power on or off to the transmitter/receiver cabinet. When the power is off, many of the sensed status fields are reported as faults.

Radiate

Important: Make sure that personnel will not be inadvertently exposed to microwave radiation before turning Radiate on.

The Radiate button requests the RCP to turn the transmitter radiate on or off. If there is a problem with a subsystem, such as the waveguide pressure or cooling airflow, the RCP may not grant a radiate request.

Servo Power

The Servo power button requests the RCP to turn the antenna servo amplifier on or off. When the servo power is turned off, the antenna position cannot be controlled.

Signal Generator

The Signal Generator button toggles the calibration signal generator on or off while the sliding scale sets the power level. Status fields display the current state of the Signal Generator, such as “ON” and “OK.” Other status fields indicate the power-level setting.

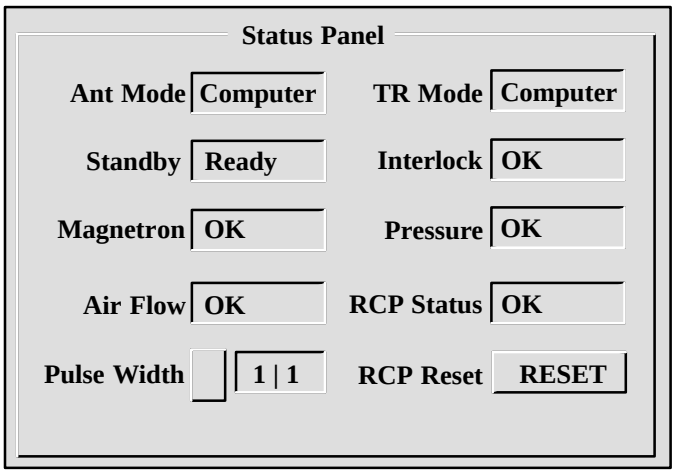
Continuous Wave

The Continuous Wave field toggles between continuous and pulse mode.

Noise Source

The Noise Source button turns the noise source on and off within the radar receiver. This procedure is usually done for testing purposes only.

2.2.3 Status Panel



Ant Mode, TR Mode

The following Mode fields display the position of the control switch on the radar console and indicate when IRIS is collecting radar data:

Computer The computer controls the antenna and RCP. The mode should be set to "Computer" for normal IRIS operation.

Local Antenna control requests from the computer are ignored, and the antenna is controlled manually using handwheels or a terminal connected to the RCP. This mode is used for testing though, on some systems, you may record manual scans and run Ascope in local mode.

IRIS This status is displayed when IRIS is controlling the antenna to record data. The control switch is set to Computer.

Other Status Indicators

Other status indicators report "OK," "Ready," or "Fault." Not all systems have the same status indicators, but the following are typical on most systems supplied by Enterprise Electronics Corporation:

- Air Flow refers to the flow of cooling air in the transmitter/receiver cabinets. This is usually sensed by a vane switch.
- Waveguide pressure is usually sensed by a pressure transducer.
- Interlock refers to the interlock on a door that protects a high-voltage or radiation hazard.
- Magnetron displays whether or not the magnetron current is within normal limits.

During installation, the Antenna utility is the best way to check if the various sensors are properly installed and reporting to IRIS.

Pulse Width Request and Status and Pulse Width Control Button

There are two numbers displayed:

- The first number is the pulse width that is currently being requested by the host computer.
- The second number is the pulse width status reported back from the RCP to the host computer.

The pulse widths here are referred to by index rather than microseconds. IRIS supports up to 4 pulse widths and the indices are labeled 0, 1, 2, 3. Most systems only use 2 pulse widths (i.e., 0 and 1).

In most systems the RCP controls the pulse width. In this case you can use the control button next to the pulse width status field to change the pulse width. The selection menu displays both the index and the value in microseconds.

For systems where the signal processor controls the pulse width, this button cannot be used to change the pulse width. The proper request and status will be reported however. Note that in this case the Ascope utility can be used to change the pulse width.

RCP Status

The SIGMET RCI field indicates whether the RCP has shut down by displaying either “OK” or “Shutdown.”

RCP Reset

The RCP button resets the antenna controller. The button will take the antenna controller out of the shutdown state for the SIGMET RCI.

2.3 Antenna Commands

The Antenna utility provides the following commands:

Exit

Print creates an X-window dump of the menu you are running, as follows:

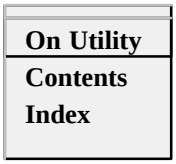
- **Print–>to Printer** sends the output to the Postscript or color printer specified in the Printer Setup menu.
- **Print–>to File s**ends the output to a file in your default home directory.
- **Print–>Setup** Allows you to configure the printer on your system. See the *SIGMET Installation Manual* for information on configuring a printer.

Exit exits from the Antenna utility.

Options

I/O Summary presents a summary of antenna I/O operations.
Time Set sets the system clock.
Stable Platform Params adds a center portion to the display which shows information such as heading, pitch, roll related to shipboard or airborne applications. This is described in Section 2.6.

Help

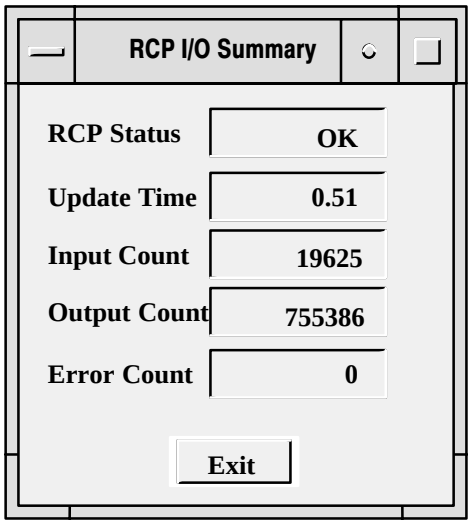


On Utility displays information on the **antenna** utility.
Contents displays the table of contents for the *IRIS Utilities Manual.*
Index displays the index to the *IRIS Utilities Manual.*

See Section 1.4 for more information on getting online help.

2.3.1 I/O Summary Menu

When you choose **Options–>I/O Summary**, the Antenna utility displays a summary of the information gathered by the antenna process. Whenever the IRIS or **antenna** first runs after boot-up, an internal antenna process is started in the IRIS host computer. This process, which monitors all I/O to the RCP, runs until it is stopped by a **`qant`** command or until the computer shuts down.



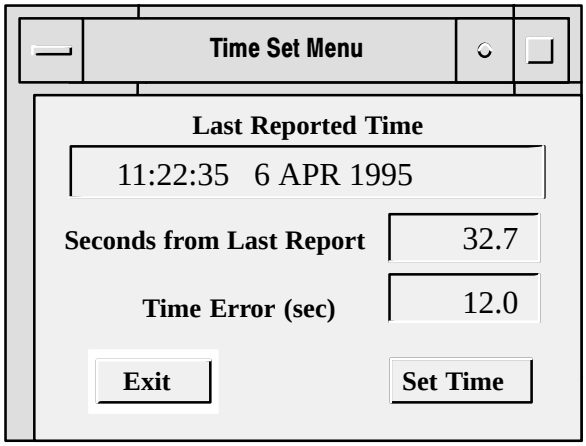
- **RCP Status** — The status of the RCP, either "OK" or "Shutdown."
- **Update Time** — The time in seconds since the last update was received from the RCP by the antenna process.
- **Input Count** — The total number of bytes read by the antenna process since it was started.
- **Output Count** — The total number of bytes written.
- **Error Count** — The total number of bytes received that were discarded because of an error.

The RCP serial line can receive time reports. This section of the menu allows operators to view the time sent from the RCP and the time error between the host system time and the RCP time. The operator can also reset the system time to match the time reported from the RCP.

Automatic updates can also be done by IRIS. This is configured in the **setup** utility in the General button (Section 8.5), for the question "Operating system's time".

Note: All automatic updates by IRIS are made only if the time error is between two and five seconds. This compensates for the slow drifts that are typical of computer clocks. However, when automatic time setting is first invoked, there will usually be an error greater than five seconds. In this case, the **Time Set** menu is a convenient way to force synchronization, after which the automatic time resetting will properly track the time.

When you choose **Options–>Time Set**. the following submenu will appear.



- **Last Reported Time** — The last time report that was received from the RCP.
- **Seconds from Last Report** — The number of seconds elapsed since the last time report.
- **Time Error** — Defined as the system clock minus the RCP time, e.g., for positive numbers the system time is fast.

If the fields are blank, then you are not receiving the time from the RCP. Check with your system manager to see if your RCP has this feature.

If the time is being received from the RCP, then pushing the **Set Time** button causes the system time to be reset to match the RCP time.

2.4 Testing Antenna Safeguards

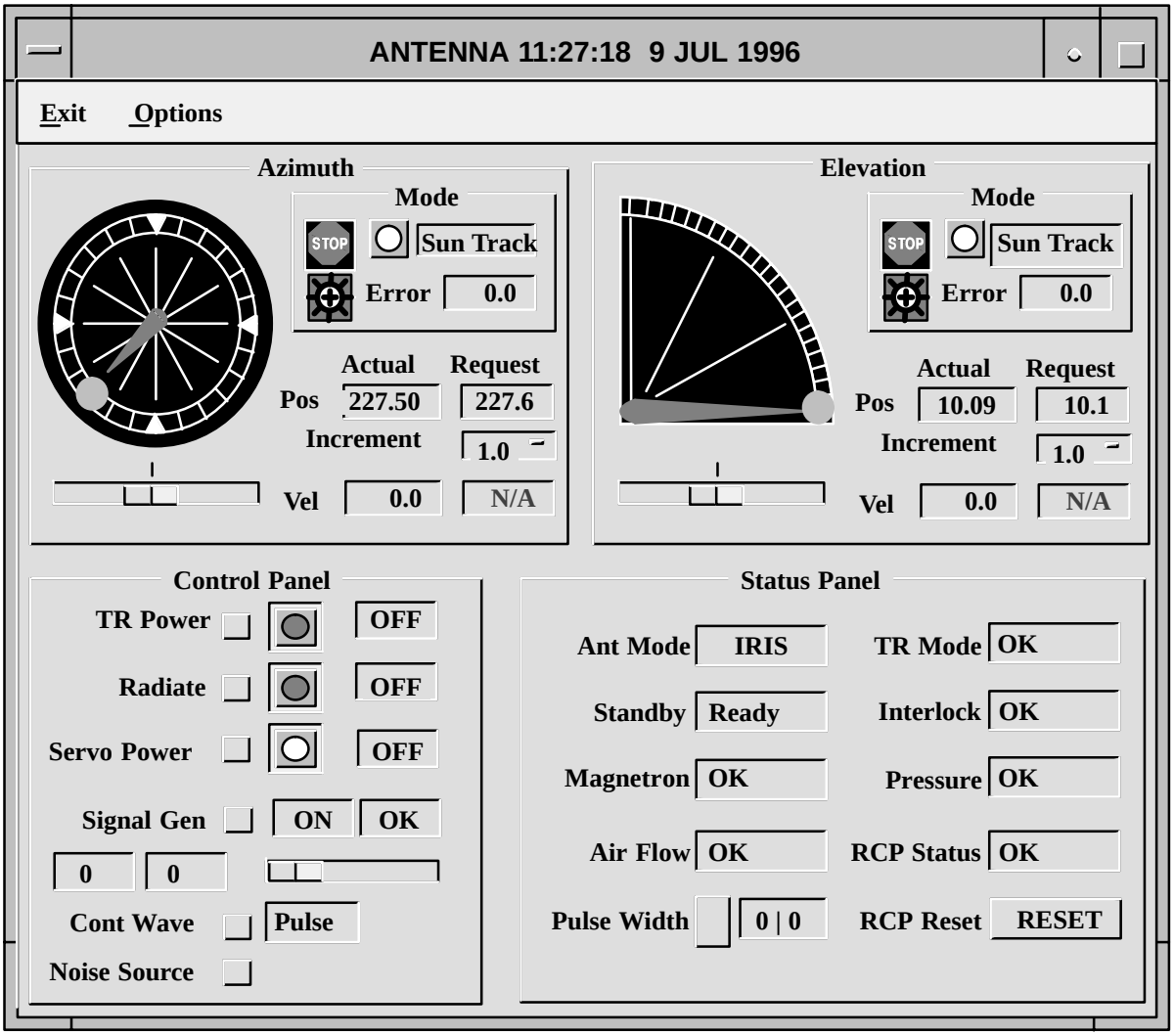
The host computer provides no elevation limit protection in the velocity servo mode. This protection is provided by the RCP. Therefore, it is important to verify with the Antenna utility that the RCP is providing proper limit protection.

All antenna systems are equipped with safeguards against damaging the antenna during elevation scanning. However, at installation these safeguards may not be in place. For this reason, it is important to test the safeguards using **antenna**.

To test antenna safeguards:

1. The first time elevation velocity scanning is used, position an observer safely near the antenna to watch and listen for signs that the antenna drive is trying to push against the stops.
2. Start the **antenna** utility by typing **`antenna`** at the operating system prompt, then set the antenna controls as follows:
    - Set the Elevation Position to 75. This positions the antenna elevation close to the upper limit.
    - Set the Elevation Velocity field to .5 degrees per second (first + then –) to move the antenna slowly up, then down.
    - For the safety of the observer, be ready to stop the antenna if there is a problem.
3. Start the antenna and be prepared to stop.
4. The observer should hear the antenna drive stop when the RCP soft limit is encountered. The soft limit should be encountered before the limit switch is encountered. If the antenna tries to power up past the soft limit, then the observer should signal the operator to stop the antenna.

2.5 Running Antenna in Sun Tracking Mode



When you enter the Sun Tracking mode, the **antenna** utility computes the direction to the sun from the radar location and positions the antenna there. The Request field displays the azimuth and elevation settings of the antenna. The utility updates the position every ten seconds, which usually produces a change of about 0.01 degrees on both axes.

When **antenna** is in the Sun Tracking mode, the arrows within the position indicators are replaced by yellow circles displaying the sun's current azimuth and elevation positions. The Errors field is also enabled, allowing you to specify an offset to add to the sun's position before moving the antenna. This lets you correct for errors.

The purpose of the sun tracking mode is test your radar pedestal's alignment. Because the sun is a black body radiator, it transmits microwaves which you can pick up with your radar, even though the clouds. Briefly, the test consists of moving the antenna until you get the maximum return from the sun, then comparing the pedestal angles with the know position of the sun. Below are some steps to help do this:

1. Do you antenna stabilization and tuning first. You need the antenna to accurately go to a requested position, to within less than 0.2 degrees.

2. Set your system time accurately. SIGMET recommends that you set the time to within a second of the correct time, though a 10 second error will only give you a 0.05 degree error. If you are using time synching, such as ntp, set the time on the server system or turn synching off.

3. Verify that your latitude and longitude are set correctly. For a shipboard radar run **antenna**, then select Options/Stable platform params. For a system with no INU, check **setup**/rcp in the "Radar Site and Antenna Placement" section.

4. Perform the test when the sun is low in the sky. At high elevations, the sun is so wide in azimuth that you cannot measure the azimuth offset accurately.

5. Configure and save a special sun–track mode for **ascope**. We recommend turning off range normalization, displaying T only, sample size of 256.

6. Now press the "Sun" button on antenna. Set the az and el steps to 0.5 degrees. Search around, changing the az and el offsets until you find the sun. The power displayed on **ascope** should be several dB above the noise.

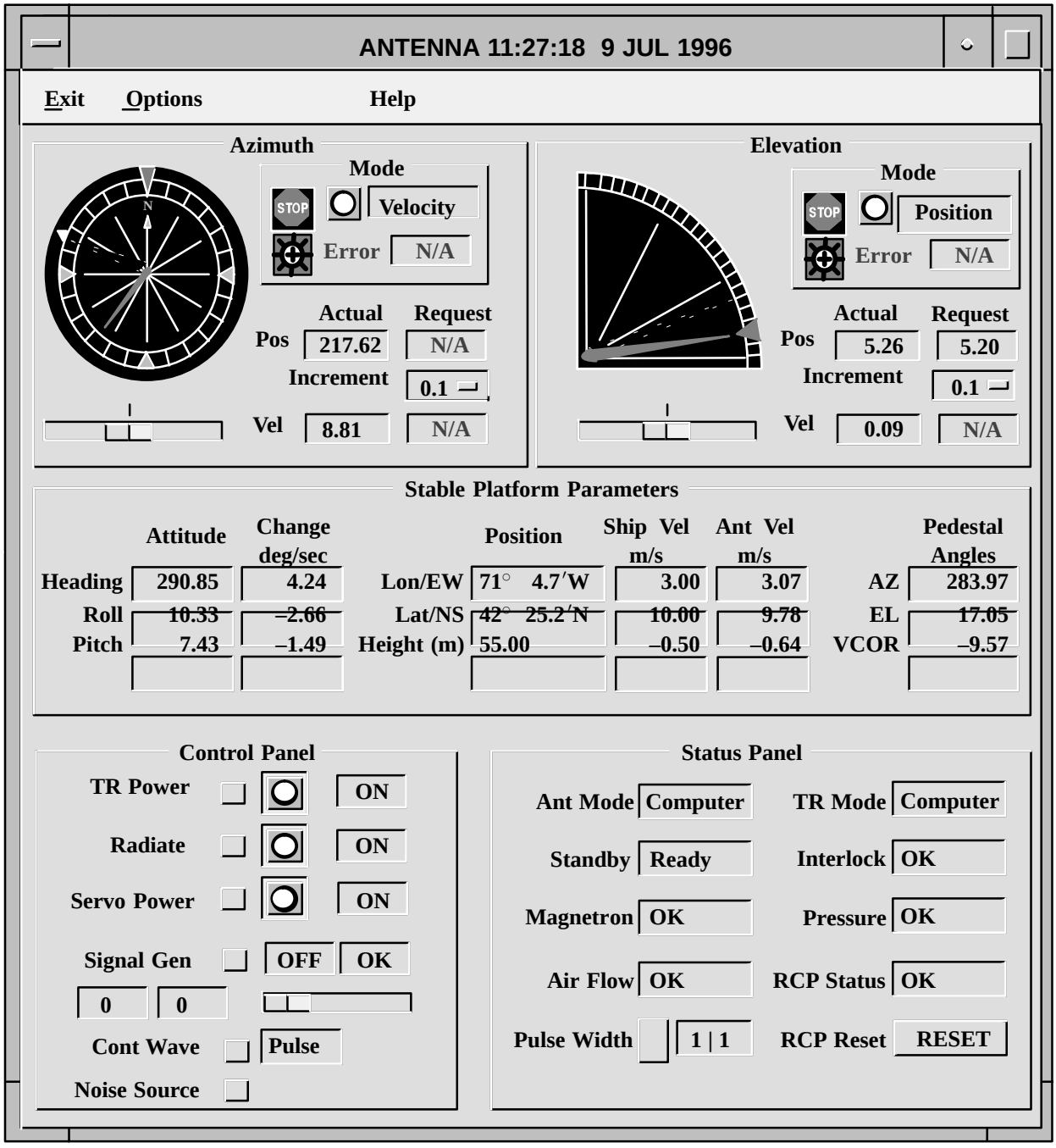
7. After finding the sun, set the step to 0.2 degrees. Then make a pass through each axis. Make a table of the power vs. angle error. It should be possible to figure out the error at the peak.

8. Repeat the same test with the sun in a different azimuth direction (morning vs. afternoon). This will allow you to differentiate a tip in the pedestal from a fixed offset.

9. Enter the measured errors in your antenna controller. For the SIGMET RCP02, enter TTY setups, enter the "axis azimuth" command and set the "Input offset from true orientation". Type in the measured error value. Do the same thing for the "axis elevation". If there was a non–zero offset before, be sure to add the new error to it.

If you are unable to find the sun manually with small offsets, it may be because of a large unknown offset. If the weather is clear, you may be able to spot the sun on the antenna to indicate the correct direction. Alternatively, configure an IRIS sector scan centered on the sun and see if you can spot it on the real-time display.

2.6 Stable Platform Display



2.6.1 Overview of Stable Platform Concepts

This feature is for shipboard or airborne applications where the antenna is stabilized by a SIGMET, Inc. RCI or RCP02 radar control processor that is connected to an inertial navigation unit (INU). The inertial navigation unit provides high-speed

accurate information on the attitude (heading, roll and pitch) and position (East-West, North-South and height) of the ship. The RCP uses this information to correct the antenna scanning for the ship motion, i.e., the RCP moves the antenna in 'earth-relative coordinates' just as if the antenna were not on a moving platform. The concept of 'pedestal-relative coordinates' refers to how the antenna is moving relative to the pedestal, or since the pedestal is mounted on the ship, relative to the ship.

Since the motion of the ship effects the Doppler velocity, the **antenna** utility also calculates the velocity correction that is required to remove the effect of ship motion.

2.6.2 Invoking the Stable Platform Display Section

Since most systems do not use this feature, it is normally not displayed in the **antenna** utility. You can invoke the display if your system is configured for shipboard operation with an INU, i.e., the RCP data format RCV03 with shipboard information is selected in the Setup utility. Note that the SIGMET RCP02 can run an INU simulator for test purposes if an INU is not actually connected.

To start the display select

Options–>Stable Platform Params

The **antenna** utility display will change to show:

- Graphical representation of selected information on the azimuth and elevation displays.
- A center section with numeric read-outs of the INU information and Doppler velocity correction.

Note that there are no new control features introduced when Stable Platform Parameters are selected. All of the shipboard features are display-only.

2.6.3 AZ/EL Graphical Display Features

The azimuth and elevation display features provide additional information as follows:

- The solid red arrows show the earth relative antenna positions. This is the same as if the antenna were not on a moving platform. All antenna scan velocity and position requests are made in earth-relative coordinates. This means that the **antenna** utility for a moving platform behaves in a manner identical to the fixed platform case — the RCP makes all of the necessary corrections to the scanning.
- The yellow outline arrows show the pedestal relative antenna positions. In the example, the ship is heading 290.85 degrees and the earth relative position is 217.62. The pedestal (ship) antenna position is 283.97 degrees.
- For the Azimuth display, a small yellow triangle on the outside of the compass ring is used to denote the ships heading. In the example, the triangle is at 290 degrees.

2.6.4 Stable Platform Parameters Display

The center section of the **antenna** utility shows the parameters associated with the platform motion. These are described below.

Platform Attitude and Change

The platform attitude is described by the heading, pitch and roll as follows:

	Attitude	Change deg/sec
Heading	290.85	4.24
Roll	10.33	–2.66
Pitch	7.43	–1.49

- **Heading** — the angle in which the bow of the ship points measured positive toward true north. Positive angles are clockwise.
- **Pitch** — the up/down angle of the bow of the ship relative to the horizon. Positive angles are bow down.
- **Roll** — the up/down angle of the side of the ship (normal to the long axis of the ship) relative to the horizon. Positive angles are port (left looking forward) side down.

Associated with each of these are rates of change in degrees/second.

Ship and Antenna Position and Velocity

The motion of the inertial navigation unit is described in the middle section of the display as shown below.

	Position	Ship Vel m/s	Ant Vel m/s
Lon/EW	71° 4.7′W	3.00	3.07
Lat/NS	42° 25.2′N	10.00	9.78
Height (m)	55.00	–0.50	–0.64

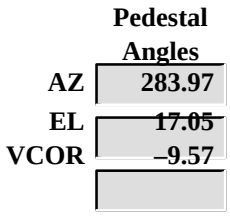
- **Longitude and Latitude** — Standard conventions are used for North/South and East/West.
- **Height** — is in meters above sea level. This is the height of the INU rather than the antenna.
- **Ship Velocity** — is actually the INU vector (3D) velocity in meters per second. The first entry is positive east, the second entry is positive north and the third entry is positive up.
- **Antenna Velocity** — This is the 3D vector velocity of the antenna feed in meters per second which is generally different from the INU velocity.

The difference between the ship velocity and the antenna velocity is because the INU and the antenna feed are usually not co-located, i.e., there is a moment arm between them. When the ship pitches, rolls and yaws, this moment arm induces a velocity.

Note: The INU is not assumed to be at the center of rotation of the ship. One example is to imagine yourself on a tall mast of a ship where antennae are typically mounted. The rocking of the ship is amplified by the mast. Thus if the INU is located on the deck and the antenna is aloft, this difference is important.

Pedestal Angles and Velocity Correction

Even though the RCP is correcting the antenna scanning for the motion of the ship, sometimes it is important to see the antenna position relative to the pedestal. In some cases when the ship motion is severe, the antenna may not be able to achieve an earth relative elevation because the antenna encounters an elevation limit of the pedestal.



- **AZ** — The azimuth angle of the antenna relative to the bow of the ship. Positive values are clockwise from the bow.
- **EL** — The elevation angle of the antenna relative to the "deck" of the ship.
- **VCOR** — is the Doppler velocity correction that is required to compensate measured Doppler velocities for the ship motion.

2.6.5 Sun Tracking Check of Stable Platform Corrections

In sun tracking mode, the antenna should track the sun regardless of the ship motion. The **ascope** utility, digital power meter or oscilloscope and be used to monitor the received power. This is an excellent final check on the stabilization of an antenna system on a moving platform.