DSS-13 EAC
User's Guide

Rev. C

March 1, 2001

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Change Log

Revision	Description	Author	Date
A	Original Release	JGL	11-20-00
B	Added “Clear subreflector offset” button to fig. 68. Subreflector offset values added to fig. 69. Scan width changed to off source beamwidths and rate changed to degrees/sec in fig. 77. Scan script directive revised.	JGL	01-10-01
C	Fig. 69 replaced. Subreflector axes (Y&Z) added to POFFSET script command. XSCAN default width changed. Width and rate interaction noted.	JGL	03-01-01

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I. General

The EAC (Equipment Activity Controller) is composed of a set of applications that may run on one workstation or may be spread across several networked workstations. The EAC provides the following:

1. A local and/or remote control point for manual station operation
2. Calibration and observation data collection
3. An interface for control from an external computer
4. SOE script driven operation
5. Autonomous operation from a schedule (in development)

The station computer is UNIX based, and will boot itself on power up. It should not be necessary to routinely reboot the system, but if shutdown or reboot is required, ***do not*** shut off the power without halting the computer first. To halt the computer, enter <sudo halt>. To reboot the computer, enter <sudo reboot>. To boot the computer after a halt, enter <boot>. After the computer boots, a login window will appear. Log in, and use the root window menu to start the EAC applications.

System data flow is shown below.

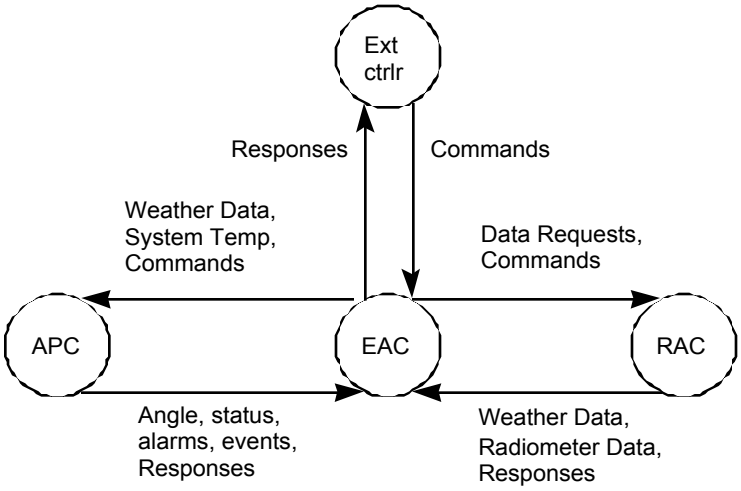

Figure 1. Data Flow

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II. Clients & Servers

The EAC and the host system contain a number of servers and clients of those servers. Connection between applications is made using sockets. For a client to successfully connect to a server, the server has to be running, have an available socket, and accept the client connection request. Because some clients connect only on startup, the start sequence is important. The available socket requirement sometimes prevents more than one type of client from connecting to the server. Because some clients have a menu item that allows connection requests to be made after startup, those clients may be started before the server.

The station client-server hierarchy is as follows:

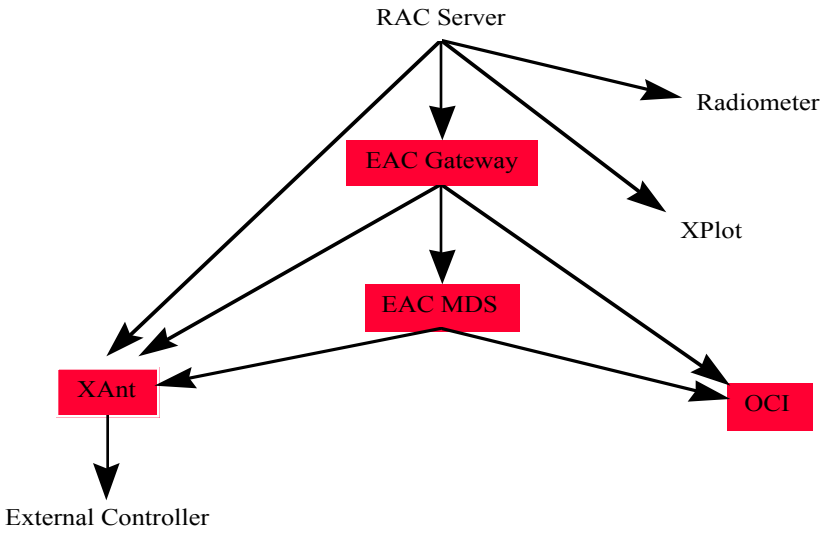

Figure 2. Client-Server Relationship

The applications in red must be started in top to bottom order.

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III. Functions

A. Local Control

The following can be done from the EAC graphical user interfaces (GUIs).

1. Link assignment of 890-131 protocol devices
2. Input of Radio Astronomy Controller (RAC) commands including beam waveguide antenna ellipsoid control and minicals
3. Antenna controller configuration
4. Generation and distribution of pointing predictions
5. Antenna startup, operation, and shutdown including emergency stop
6. Subreflector offsets
7. Offset of antenna position and rates
8. Boresights
9. Input and edit of source position data
10. Manual commanding of other subsystems

B. Display

EAC GUIs provide the following information.

1. Universal Coordinated Time
2. Source position and trajectory for both cable wrap directions
3. Antenna position graphically and in three coordinate systems
4. Antenna rates
5. Antenna limits and cable wrap (graphically)
6. Rule based antenna status determination
7. Antenna offsets both manual and boresight (graphically and numerically)
8. Antenna position error
9. Source identification
10. On/off source indication
11. Primary channel center frequency
12. UT correction
13. Systematic error model name
14. Primary and secondary channel system temperature
15. Antenna correction status
16. Weather (pressure, temperature, humidity, wind speed, and wind direction)
17. Log of alarms, events, manual commands, and responses
18. Manual command history
19. Strip chart of system temperatures (four channels)

C. Remote Control

The EAC accepts connection from external control clients. This capability allows users to develop their own interface, and it allows other computers to perform automated system operation.

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IV. Displays

A. Gateway

Functions: The gateway display provides a user interface to control assignment/unassignment of 890-131 protocol devices to a “link”. The gateway also provides control and indication of radio astronomy controller (RAC) connection status, indication of antenna pointing controller (APC) data flow status, and display of the APC data flow parameters.

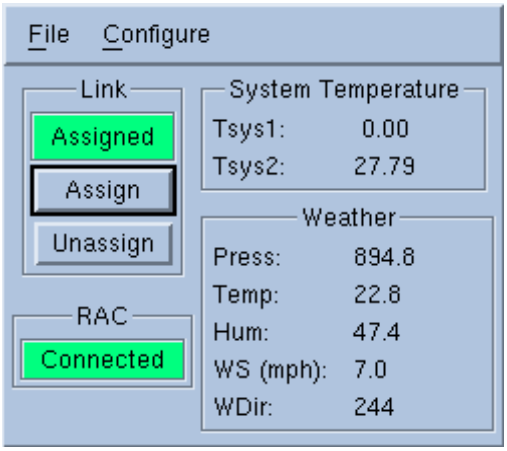


Figure 3. Gateway Main Window

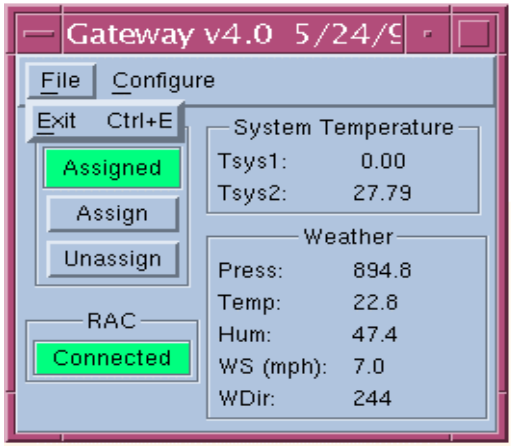


Figure 4. Gateway File Pulldown

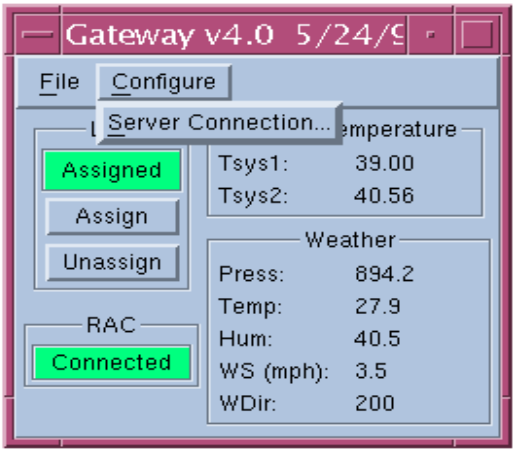


Figure 5. Gateway Configuration Pulldown

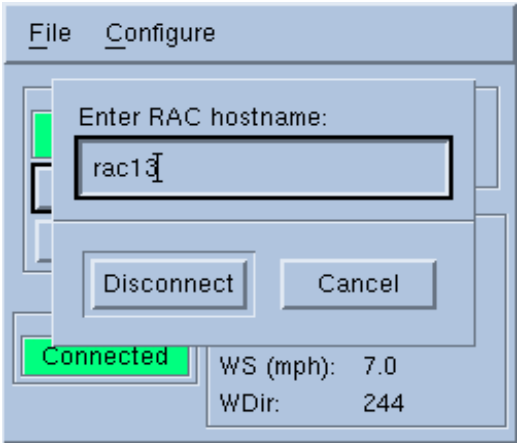


Figure 6. RAC Server Connection Popup when Connected

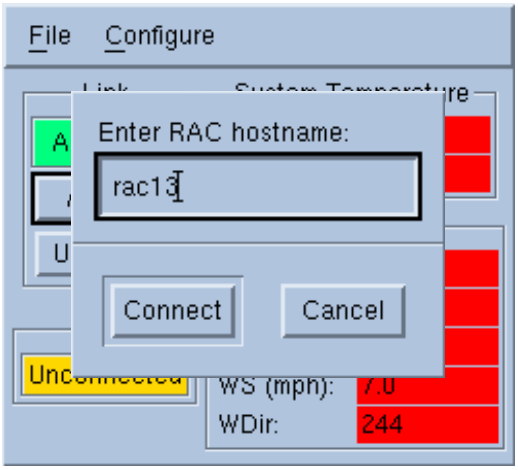


Figure 7. RAC Server Connection Popup when Disconnected

B. XAnt

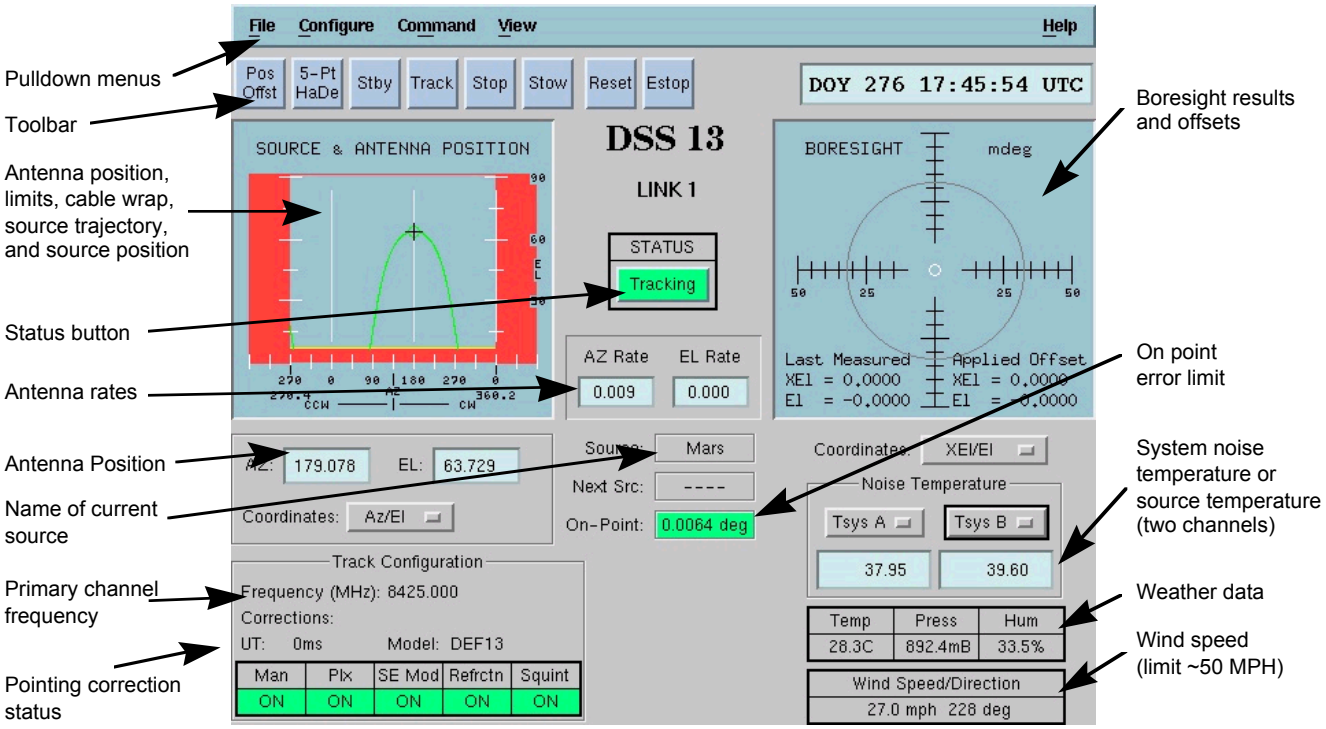
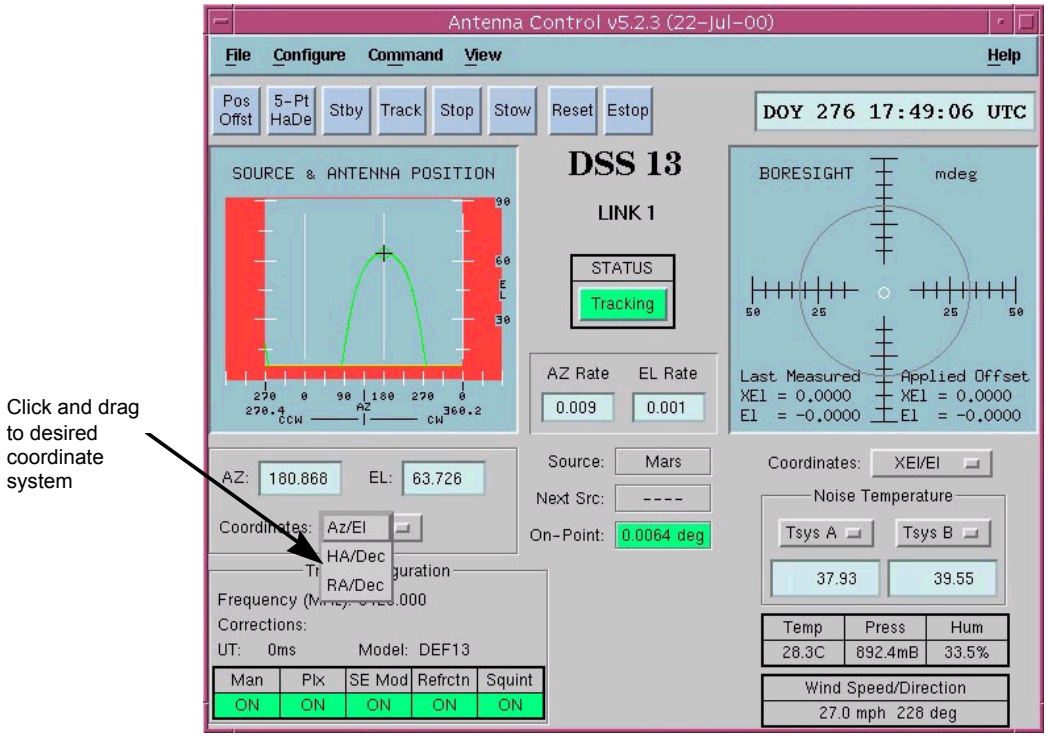
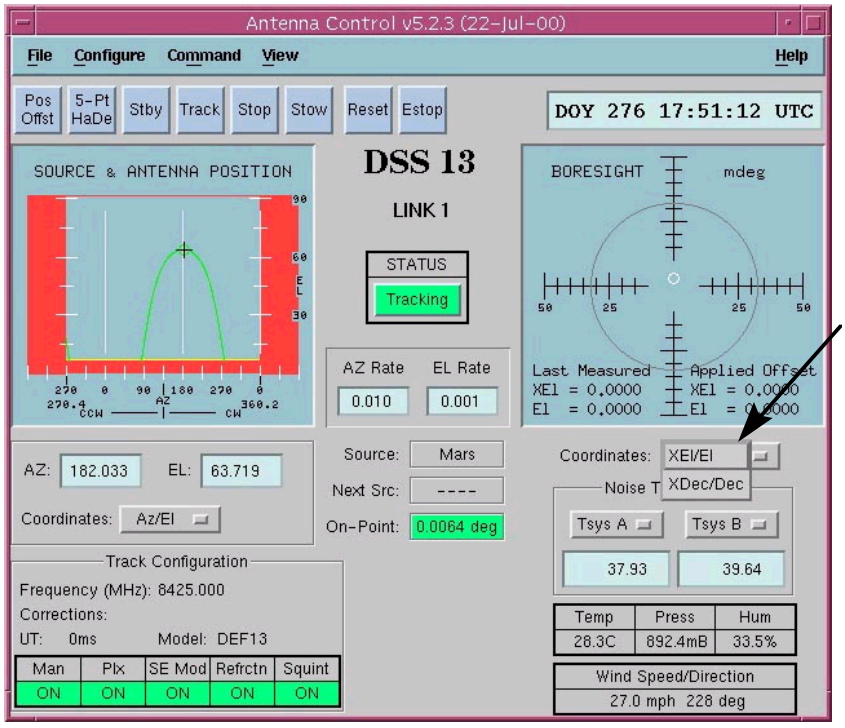


Figure 8. Antenna Control (XAnt)



Click and drag to desired coordinate system

Figure 9. XAnt Antenna Position Readout Options



Click and drag to select boresight display coordiante option

Figure 10. XAnt Boresight Offset Coordinate Options

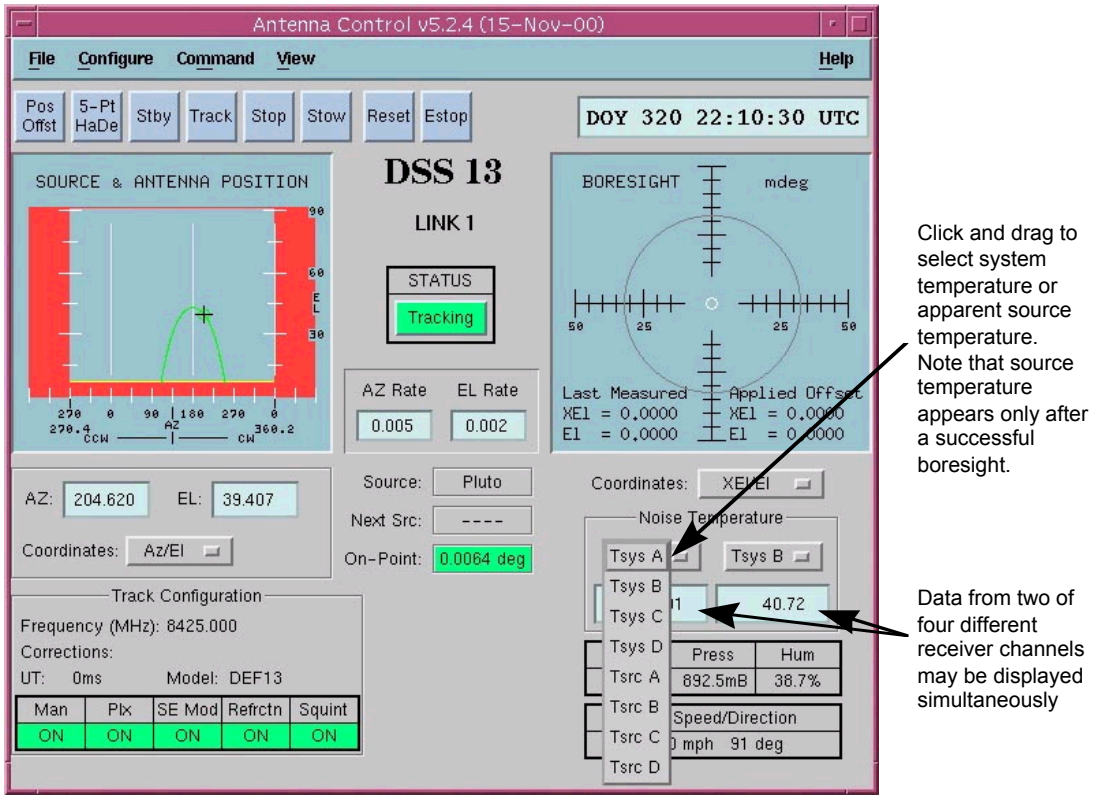


Figure 11. XAnt System Temperature Readout Options

After as boresight, source temperature can be displayed.

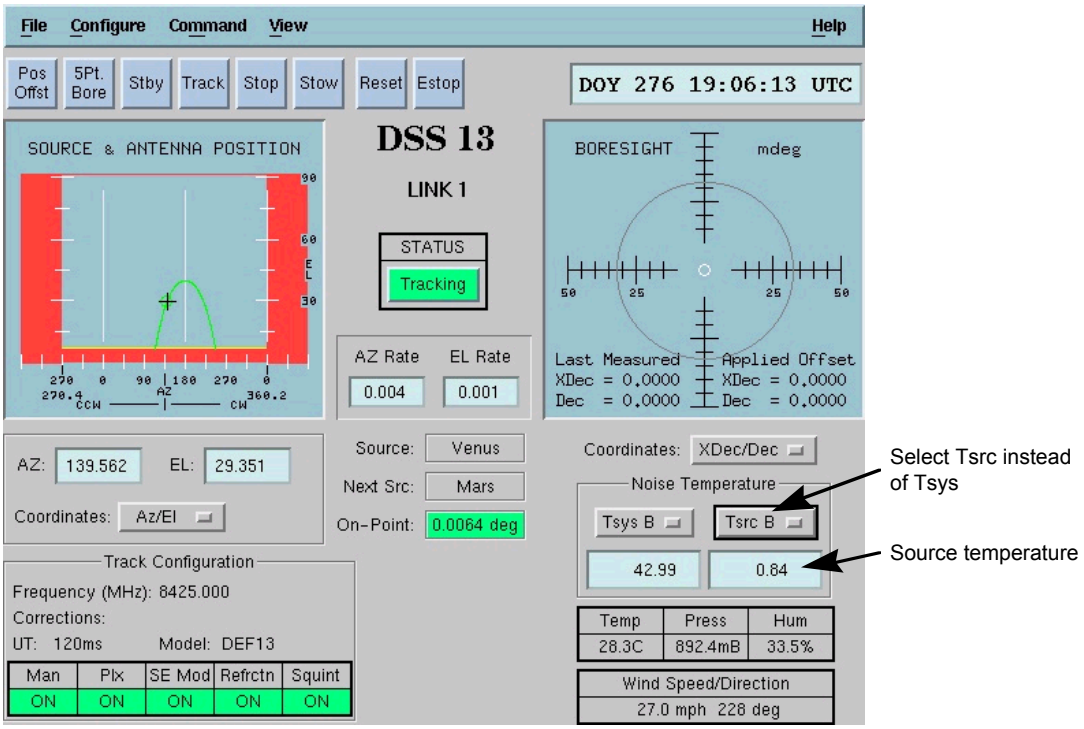


Figure 12. XAnt Source Temperature Display

C. *XPlot*

XPlot displays the product of power and gain data. System gain can be established from minical data if received or by entering the system temperature in the ***Calibrate*** pulldown menu. XPlot displays gain, load temperature, and linearity also. Received power data can be logged to a file.

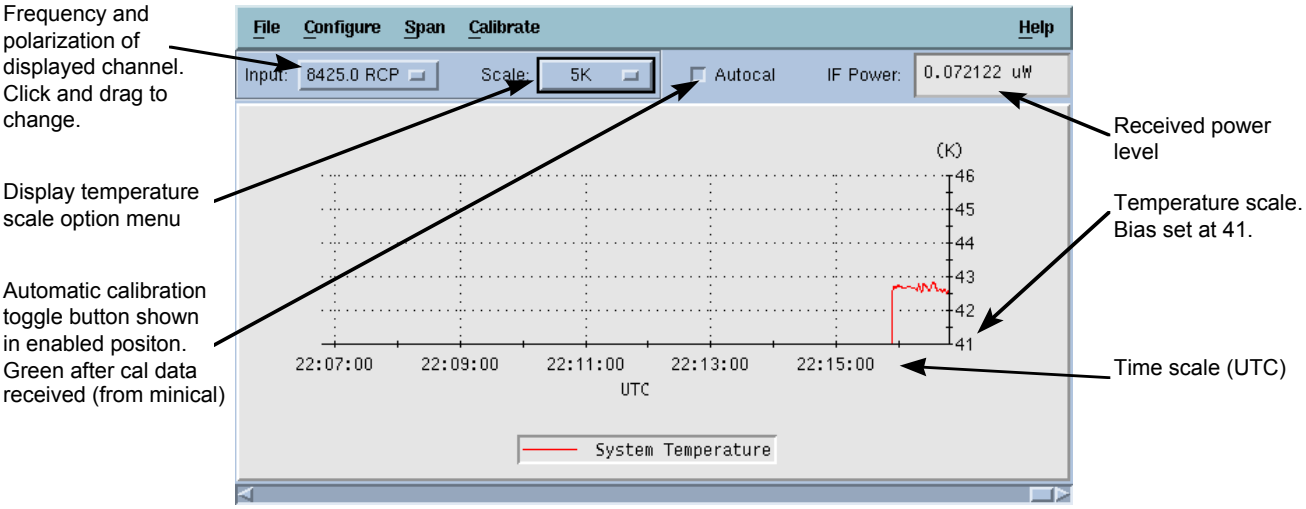


Figure 13. XPlot

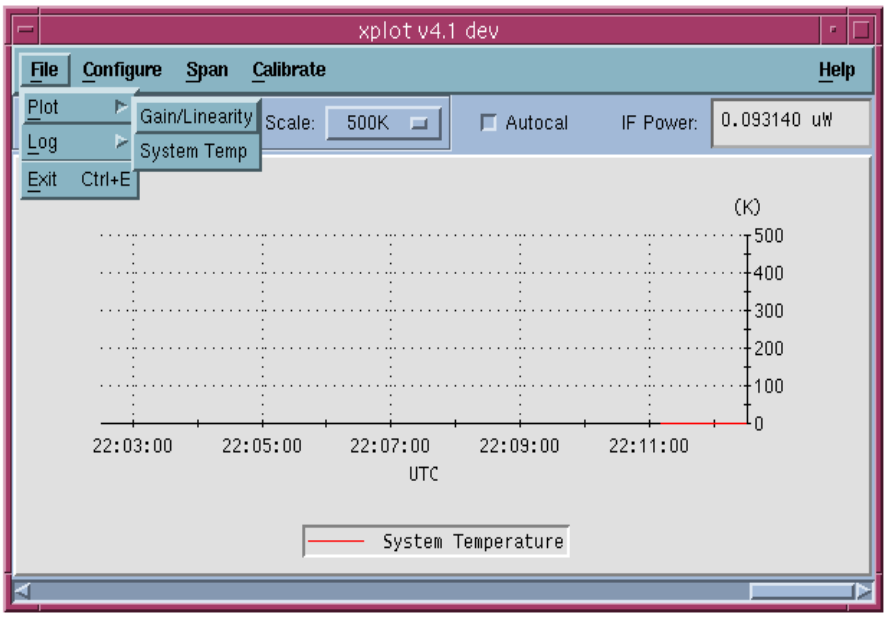


Figure 14. XPlot File Menu Pulldown

The ***Configure*** menu is used for disconnecting/reconnecting to the RAC server.

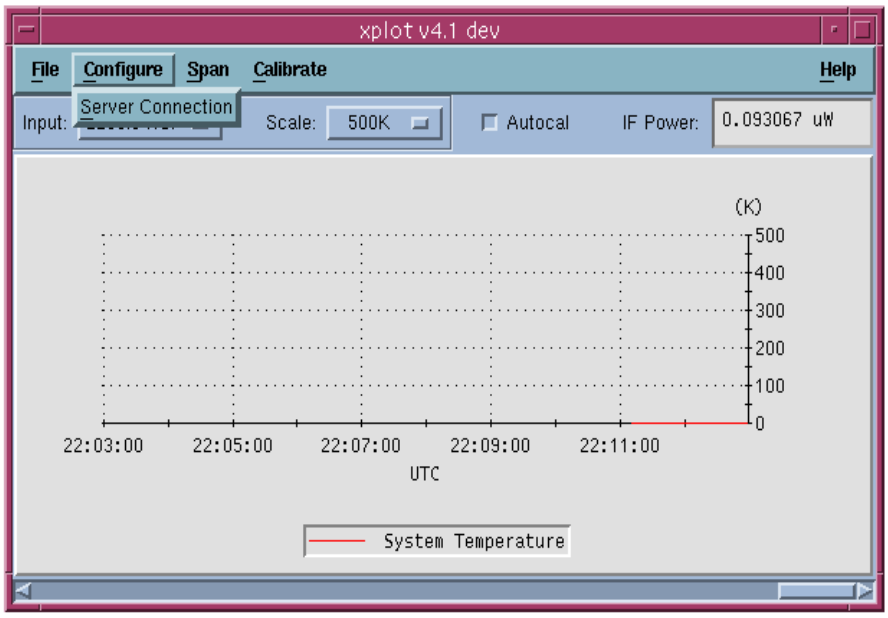


Figure 15. XPlot RAC Server Reconnection Pulldown

The ***Span*** menu controls the horizontal range (time span).

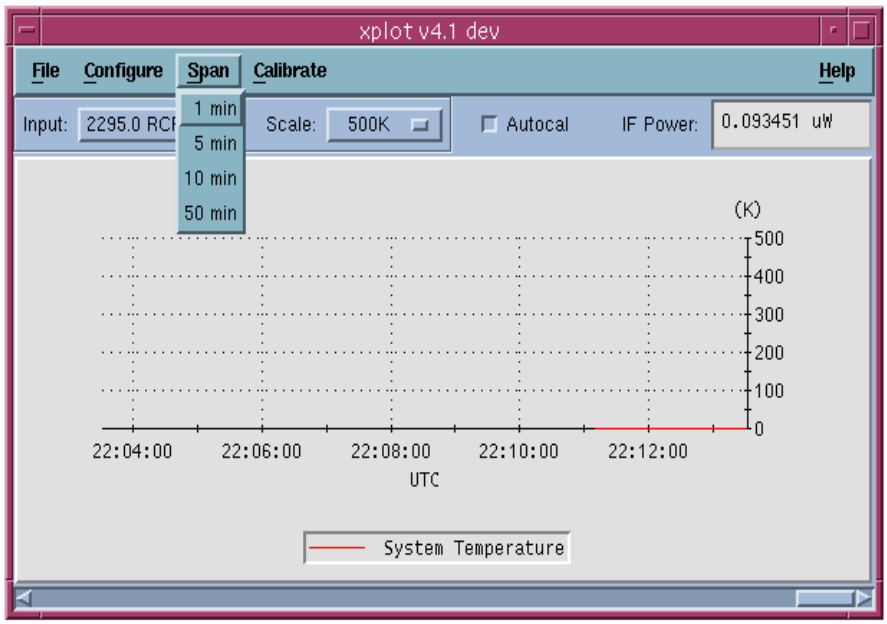


Figure 16. XPlot Span Menu

The vertical axis (system temperature) can be manually calibrated and biased using the ***Calibrate*** menu. Automatic calibration (from minicals) can be disabled/enabled using the ***Autocal*** toggle button.

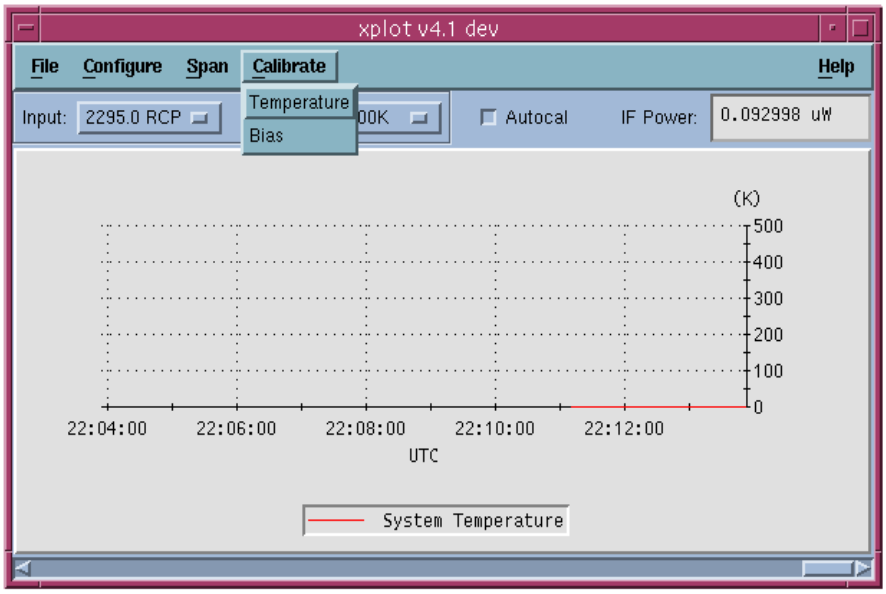


Figure 17. XPlot Calibration Pulldown

The calibration popup will be either for system temperature or temperature scale bias.

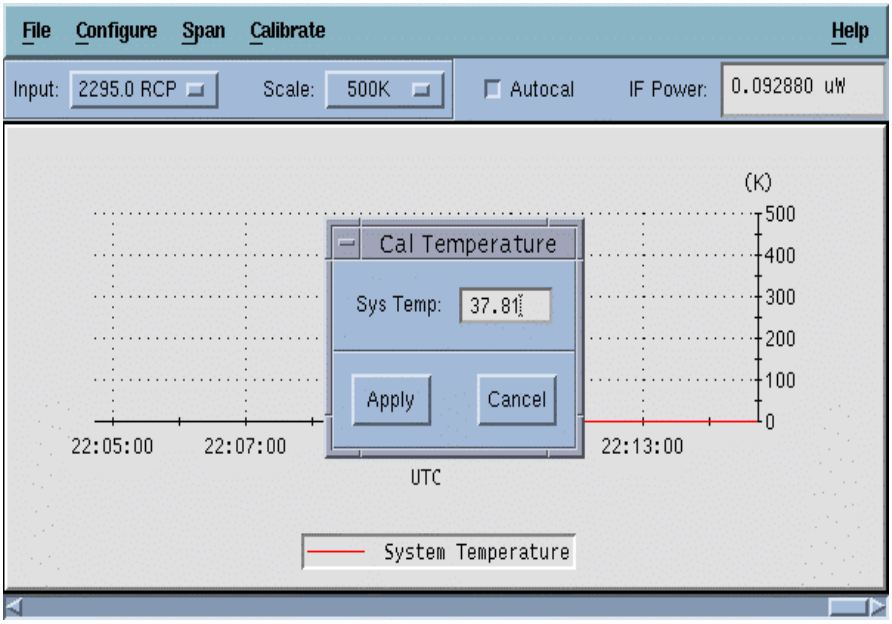


Figure 18. XPlot Temperature Calibration Popup

D. OCI

OCI is used to manually enter commands. It is provided for those cases where other GUIs do not provide the desired function. Commands that XAnt needs to know about will not be forwarded. XAnt should be used in those cases, and OCI will tell you.

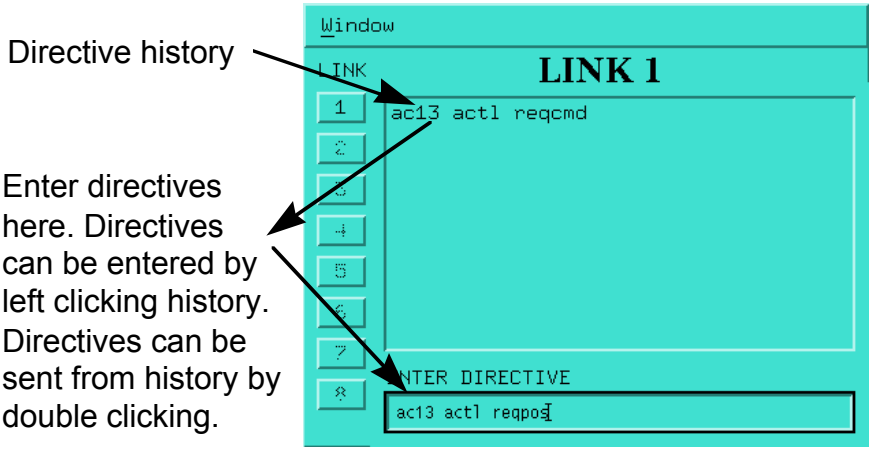


Figure 19. OCI

E. Miscellaneous

An XAnt sidereal time display is accessed from the ***View*** menu. Antenna status detail is accessd by clicking on the ***Status*** button.

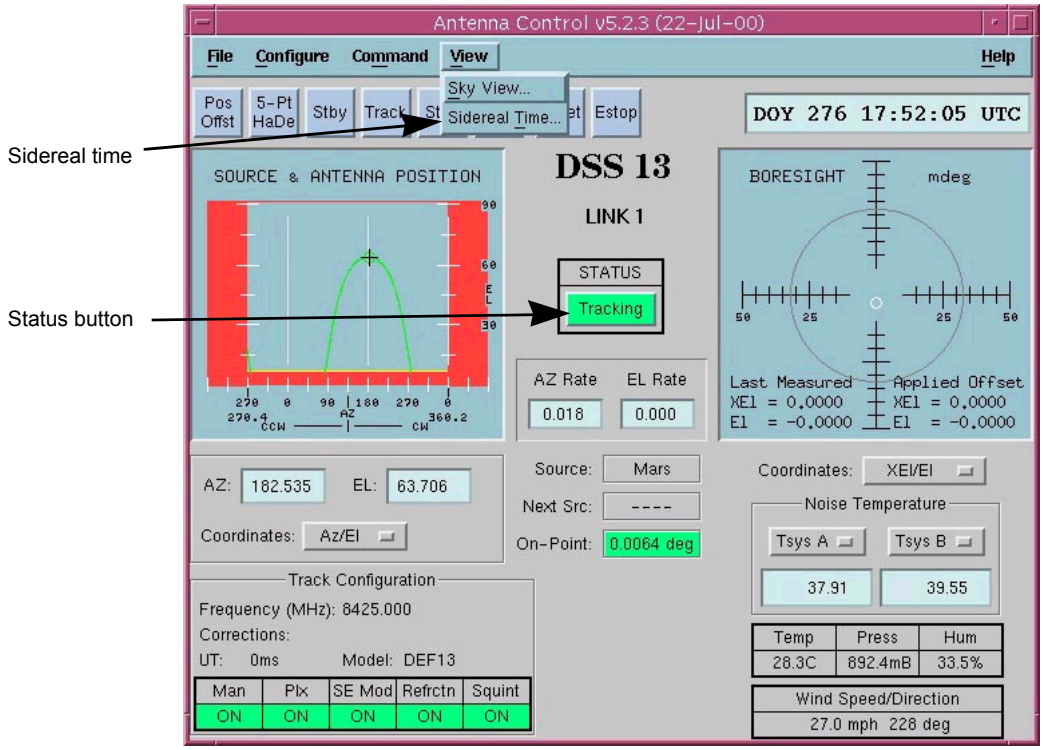


Figure 20. XAnt View Menu Pulldown

Selecting the ***Sidereal Time*** button pops up the time display.

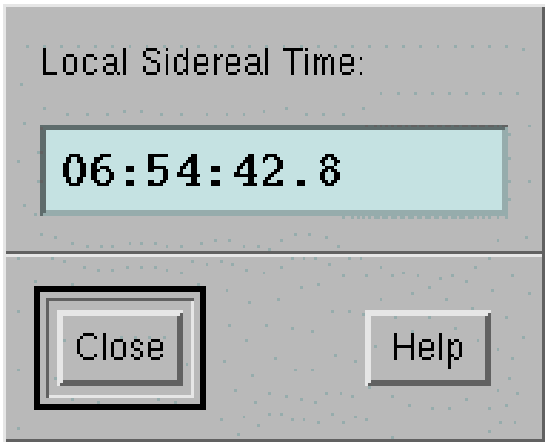


Figure 21. XAnt Sidereal Time Popup

Click on the XAnt expert ***Status*** button to see the antenna status popup

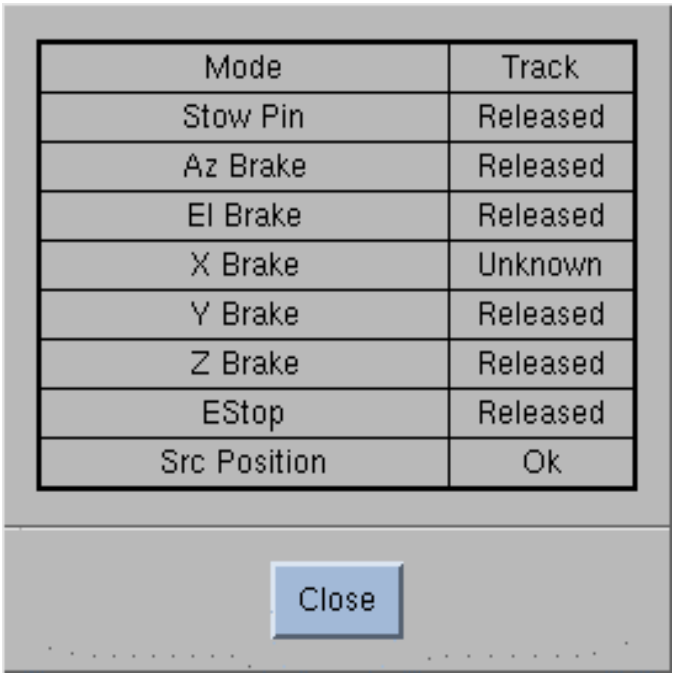


Figure 22. XAnt Ant Status Popup

V. Operation

A. Operating sequence

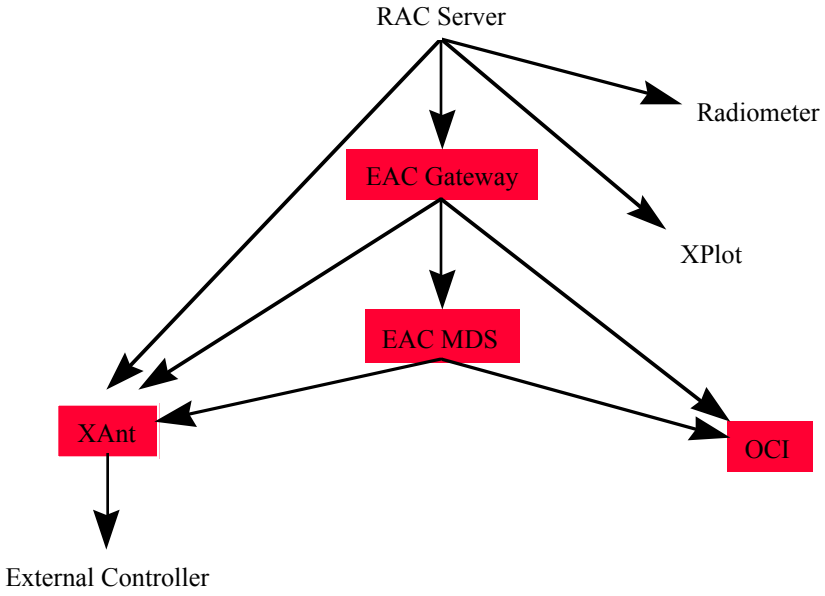
The following sequence is a suggestion, but not the only way to operate the system. The sequence is:

1. Startup and connection
2. Configure XAnt
3. Select source
4. Startup antenna
5. Calibrate
6. Acquire data
7. Stow

Unless they need to be killed to avoid interference with other station activities, all of the EAC applications may be left running after the antenna is stowed. Remote operation will kill everything except XPlot. Because the EAC is limited to four simultaneous XPlots, no more than two should be left running so that remote users can bring up at least two of their own.

B. System Startup

It is necessary to follow a startup sequence to ensure that some of the servers are running before their clients start. Four clients, the gateway, XAnt, XPlot, and the external PCFS can be connected after they are started and do not require their server to be running when they are started. The full top to bottom sequence is as follows:



The applications in red must be started in top to bottom order.

Upon startup, the console display appears as follows. There are no error messages after “5 tasks out of 5”.

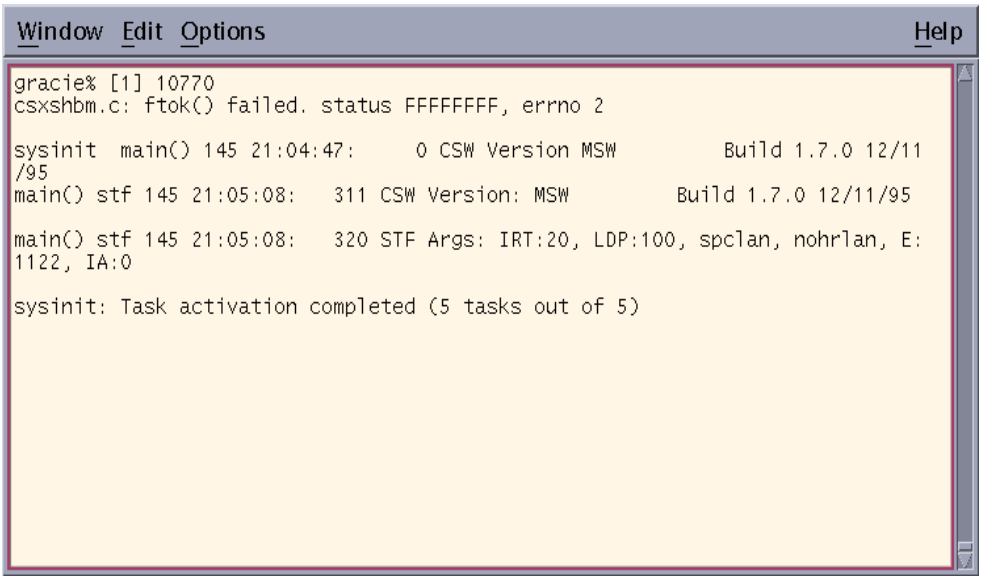


Figure 23. Gateway Startup Console Messages

MDS is task 3. XAnt may be task 4 through 11. OCI is task 12.

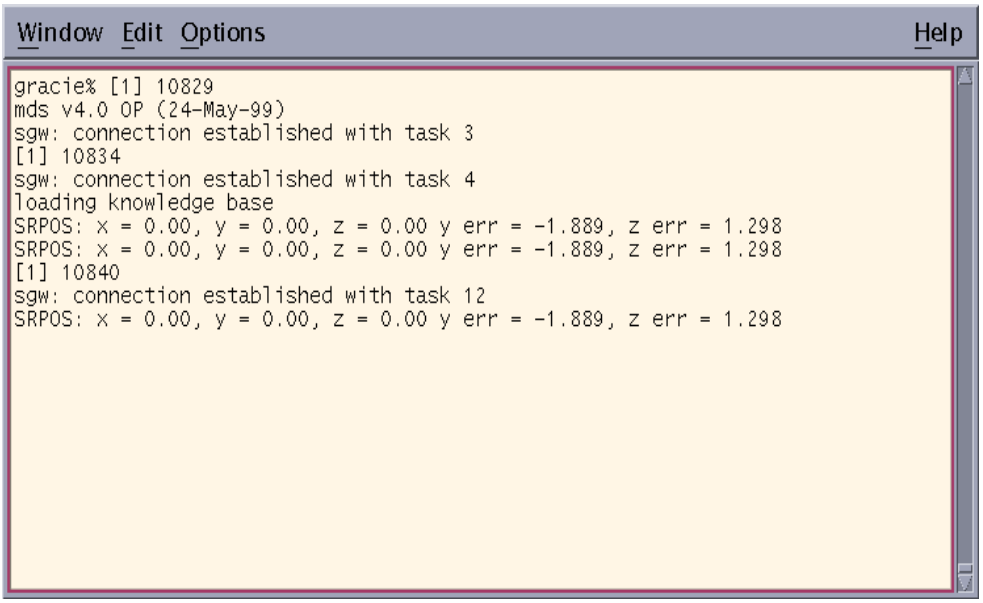


Figure 24. Normal Startup, MDS, XAnt, OCI

The gateway provides an 890-131 protocol interface to the APC. The 890-131 protocol requires transmission of link assignment blocks to devices, which must communicate with each other. Clicking on the ***Assign*** button causes unassign then assign blocks to be sent to the gateway, APC, and EAC. Since the MDS maintains assignment data, the EAC is ready for assignment after MDS is started. The gateway initializes to unassigned and connected to the RAC server (if the RAC server is running).

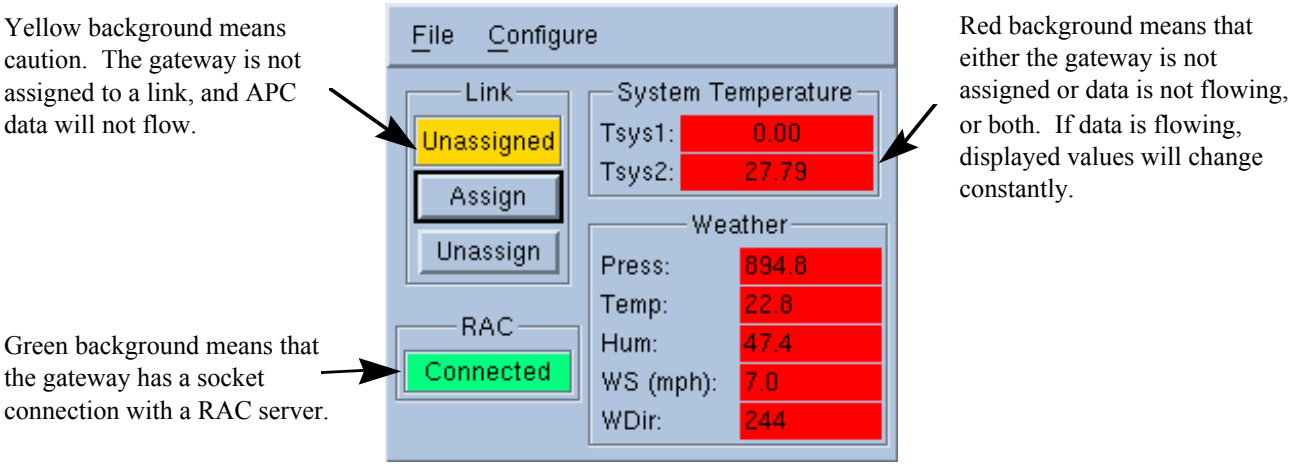


Figure 25. Normal Gateway Startup

To connect or disconnect from the RAC server, do the following.

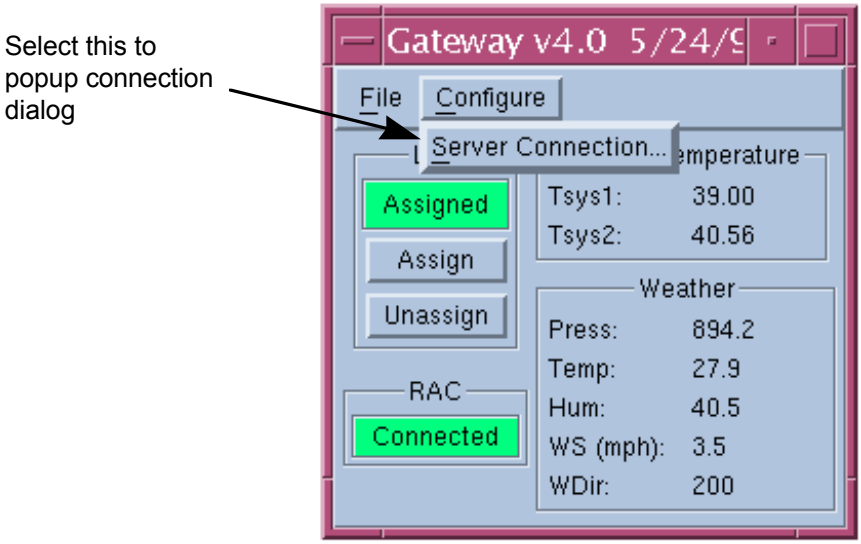


Figure 26. RAC Server Connect Pulldown

If the RAC server is connected, the following pops up.

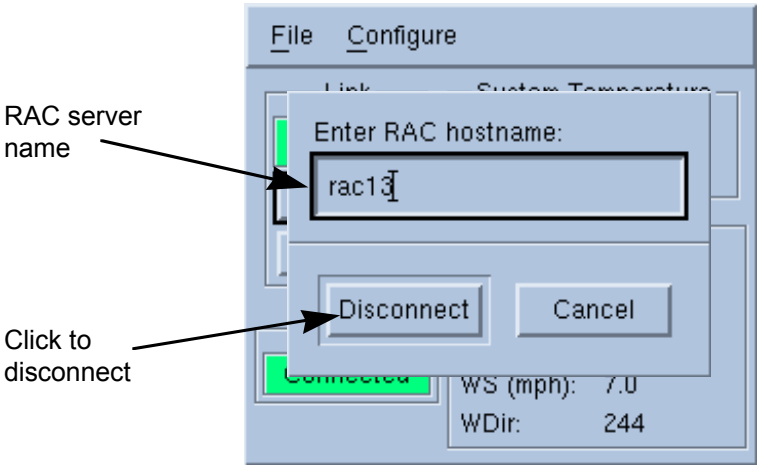


Figure 27. RAC Server Disconnect Pulldown

If the RAC server is not connected, the popup looks like this.

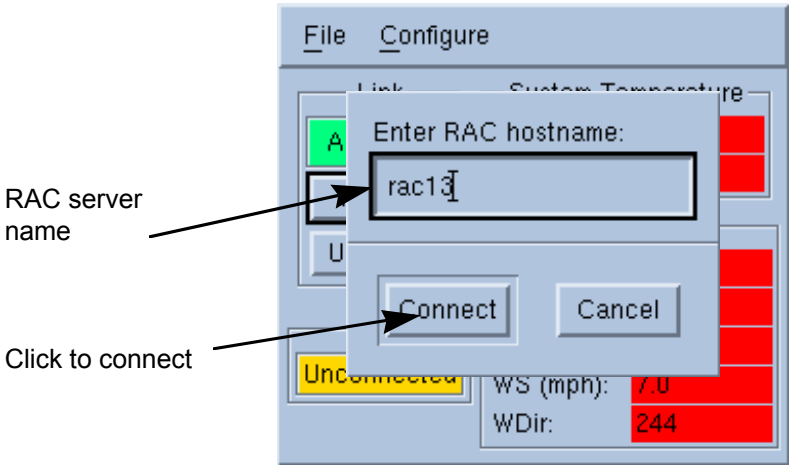


Figure 28. RAC Server Connect Popup

If XAnt is started before Link Assignment, it will appear as follows. Since XAnt may not assign properly when started before assignment (see Gateway windows), the best strategy is to start the Gateway and MDS, assign the link, then start XAnt.

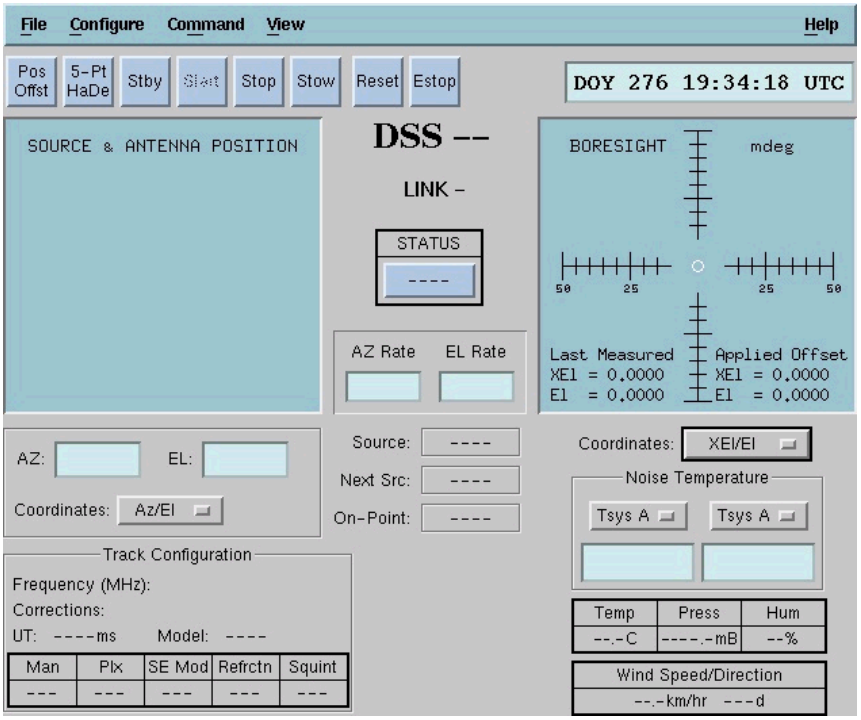


Figure 29. XAnt Before Link Assignment

OCI may be started before or after link assignment.

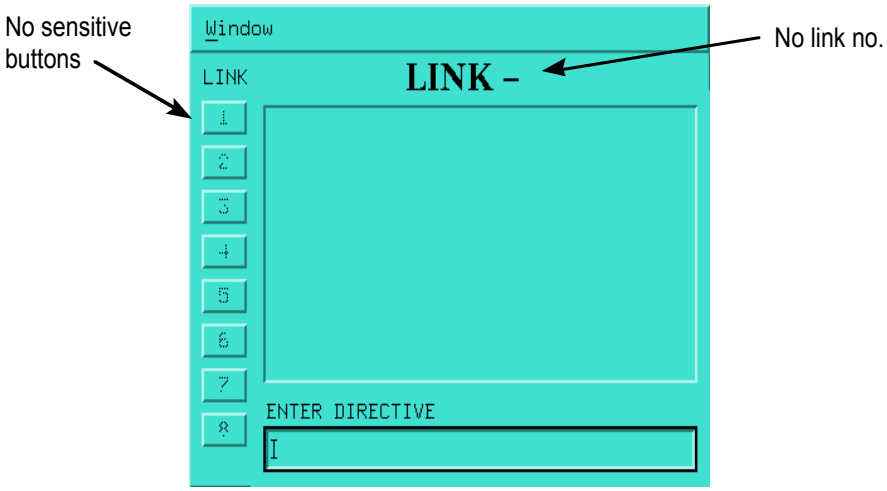


Figure 30. OCI Unassigned

XPlot is not link assignable, and may be started any time. Data may or may not be flowing.

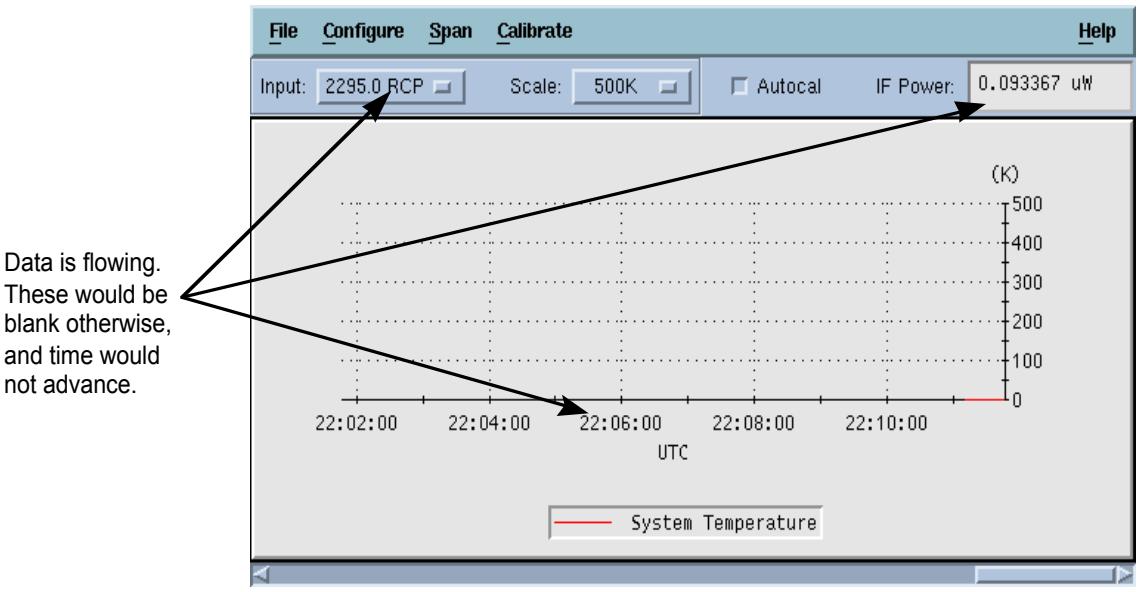


Figure 31. XPlot Normal Startup

Once MDS is running, the link may be assigned. MDS maintains the EAC assignment data. If the gateway is assigned before MDS is started, the link may be reassigned after MDS is started by clicking on the gateway ***Assign*** button.

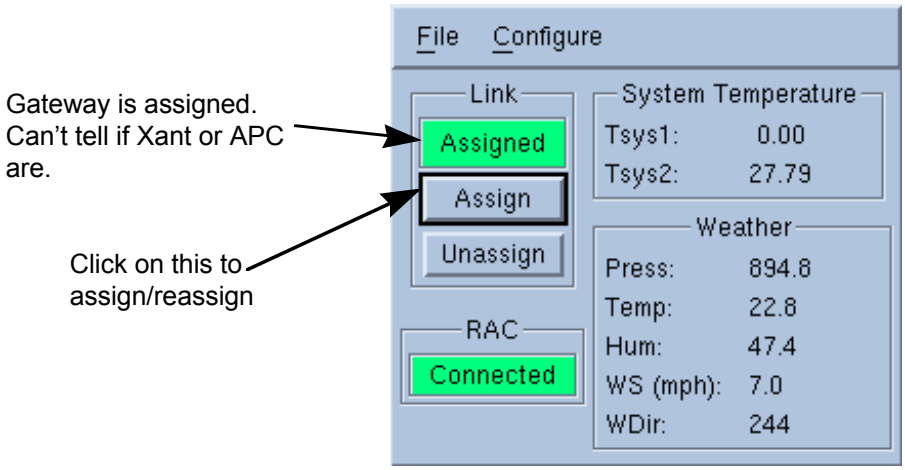


Figure 32. Link Assignment/Reassignment

Once the link is assigned, XAnt may be started. XAnt should appear in the assigned state. If XAnt was started before assignment by the gateway, it should change to the assigned state. If it doesn't change to the assigned state when the gateway assignment is issued, exit the unassigned XAnt and start another one.

Pressing the ***Reset*** button will pop up a reset dialog. The ***Start*** button is not sensitive until the e-stop is reset. After e-stop reset, ***Start*** can be pressed. If a source has not been selected before ***Start*** is pressed, the antenna will halt during startup and wait for a source to be selected.

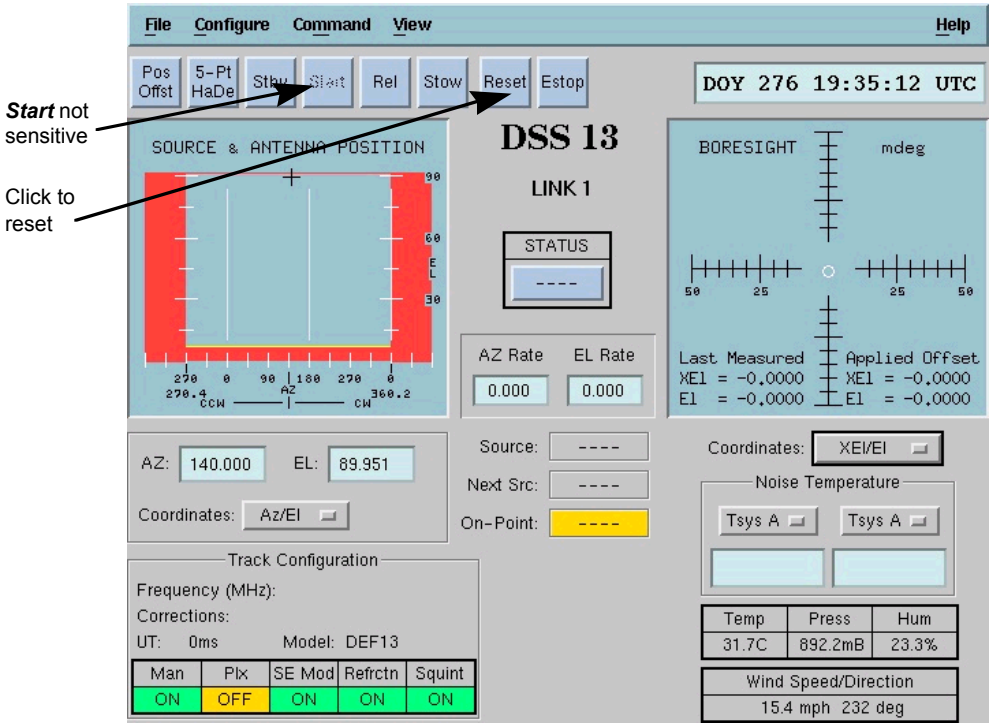


Figure 33. XAnt Assigned, not Configured

Figure 34. XAnt Reset Command Popup

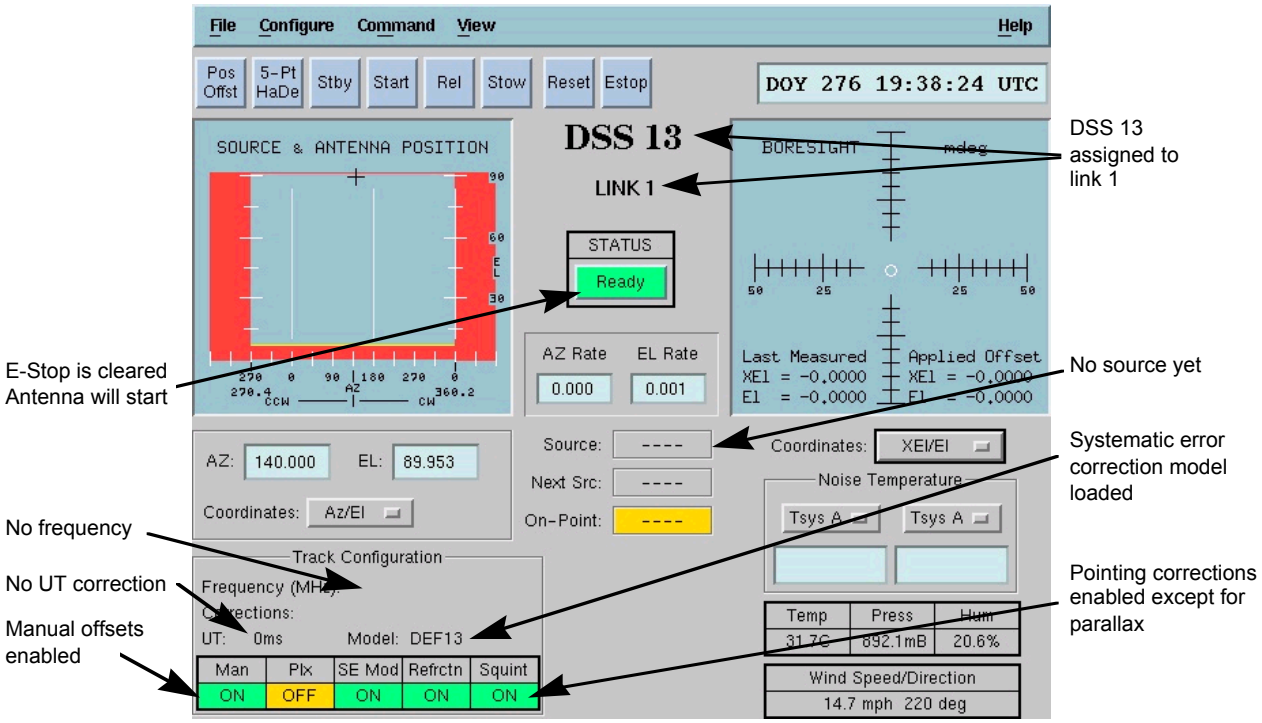


Figure 35. XAnt Assigned and E-Stop Reset

The OCI target link must be selected after the link is assigned. Buttons with the available link numbers will become sensitive.

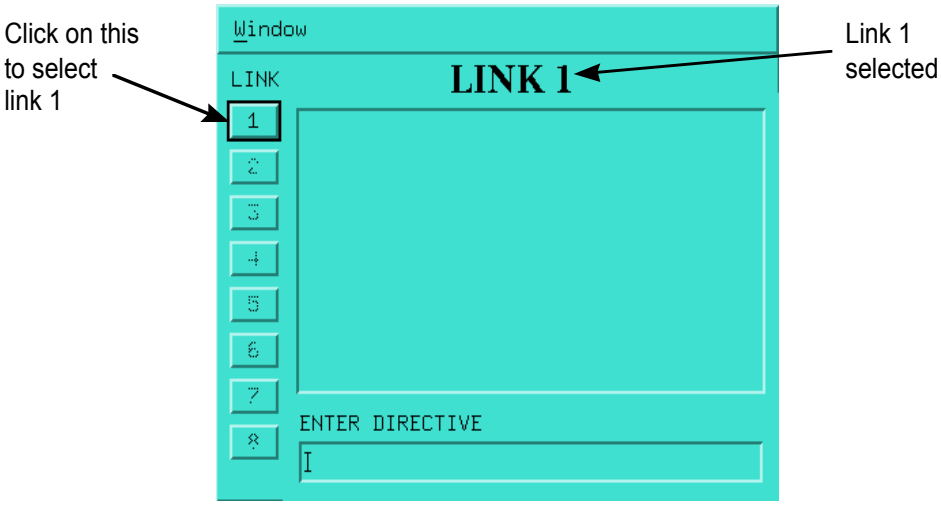


Figure 36. OCI Assigned & Link 1 Selected

Startup error popups are shown below. Be sure to watch the terminal window for problems when starting the applications.

If the RAC server is not running or connection is attempted to a machine that is not running the RAC Applications, the connection will be “refused”.

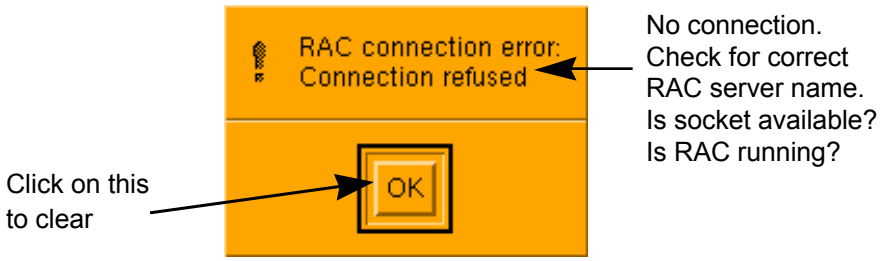


Figure 37. Gateway and XAnt Connection Refused

If a unknown name or address is specified for the RAC, error 0 will occur.

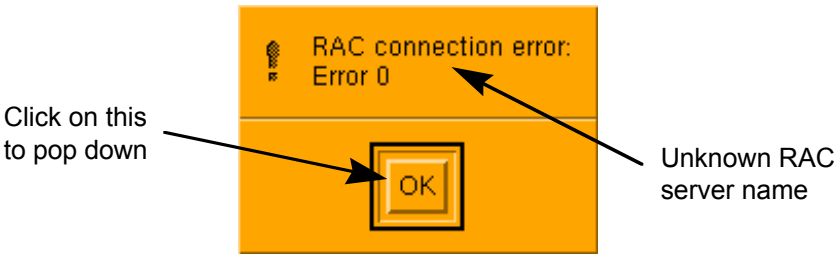


Figure 38. Unknown RAC Server

C. Configuration

XAnt needs to know about frequencies, polarizations, amplifiers, antenna corrections ellipsoid position, and UT1-UTC time offset. The Radio Astronomy Controller (RAC) provides access to switches, noise diodes, ambient load temperature, and calibrations.

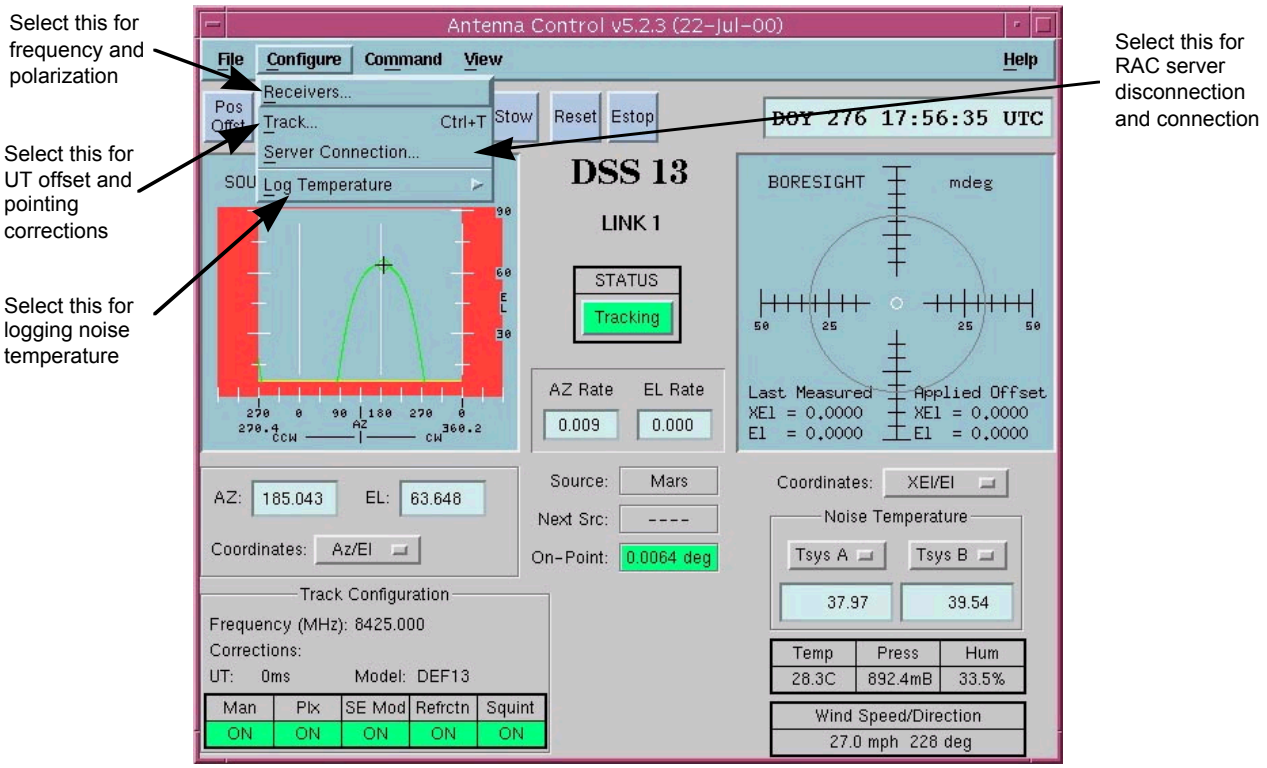


Figure 39. XAnt Configuration Pulldown

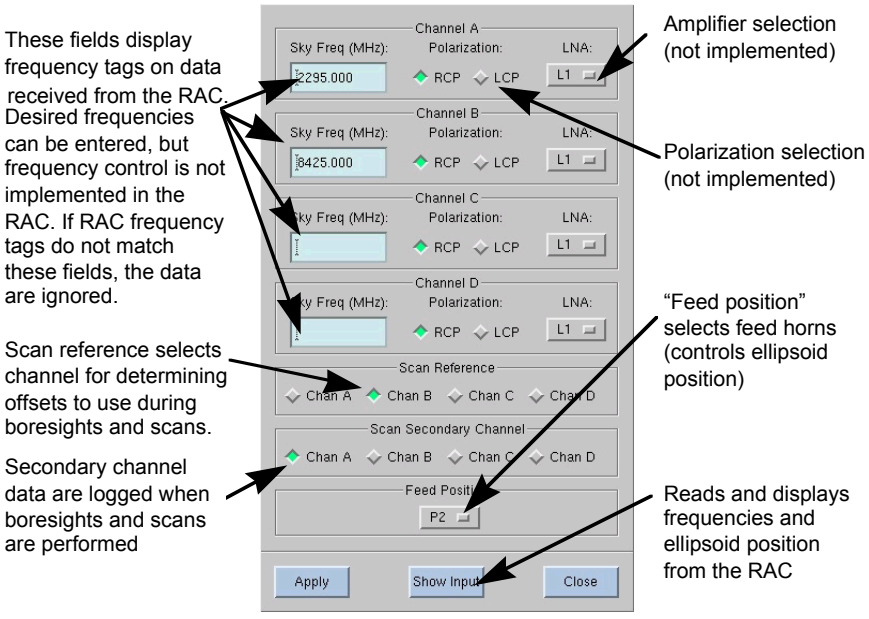


Figure 40. XAnt Receiver Configuration Popup

Toggle button changes in the track configuration popup must be saved to arm the changes. The changes will become effective the next time the ***Start*** button is pressed. Note that the ***Start*** button changes to ***Track*** after antenna startup.

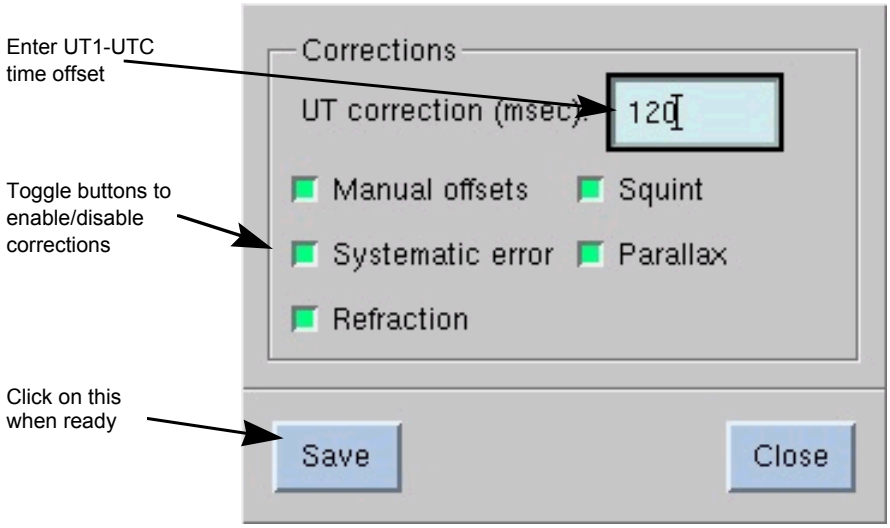


Figure 41. XAnt Track Configuration Popup

The gateway and XAnt server connection popups look the same.

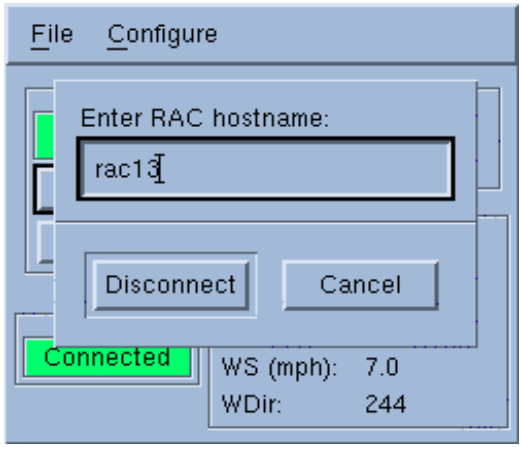


Figure 42. Server Connection Popup

The **On-Point** indicator will be green when the antenna is tracking with no errors and the standard deviation of the pointing error is less than the on-point limit. To provide hysterisis, initially, the standard deviation must be less than one-half of the on-point limit. If the on-point limit has never been specified, the default of one tenth of the reference channel (set by REFCHAN) half power beamwidth will apply. Data will not be taken when **On-Point** is not green.

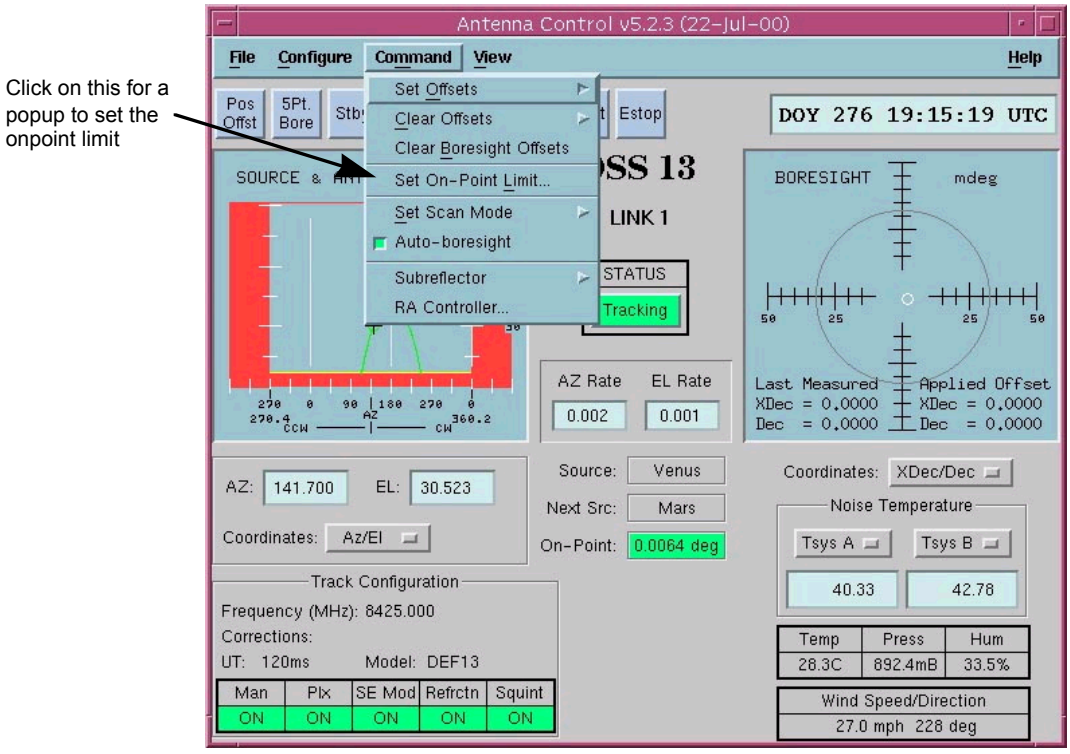


Figure 43. XAnt On-point Limit Selection

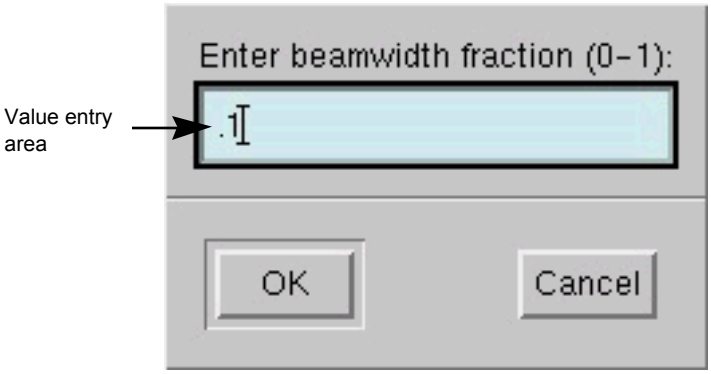


Figure 44. XAnt On-point Limit Popup

XAnt displays primary frequency, delta UT, and receiver power level when configured. System temperature replaces power level after a calibration (minical) is run.

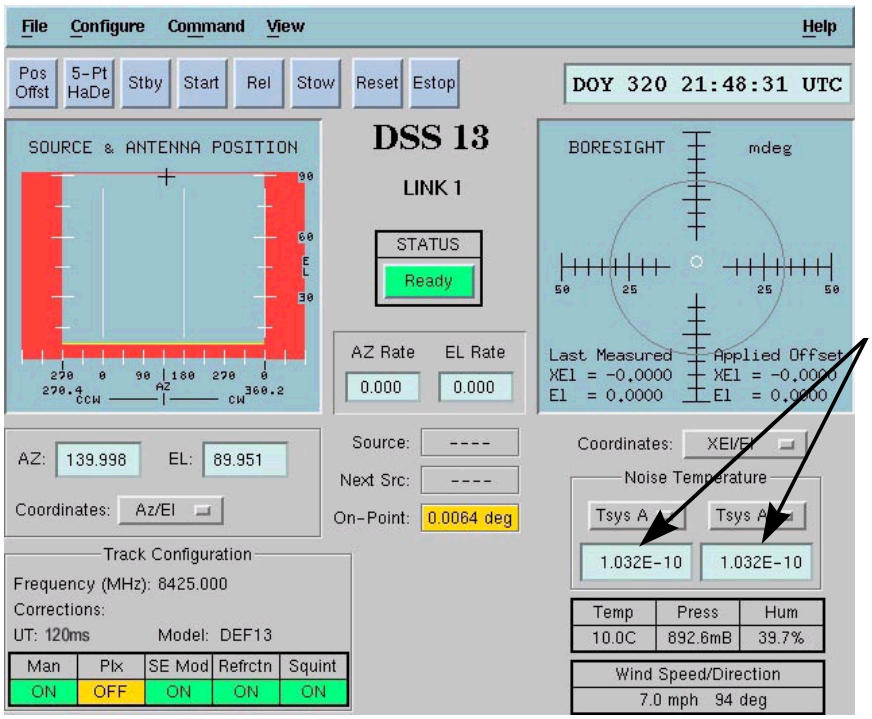


Figure 45. XAnt Configured, Not Calibrated

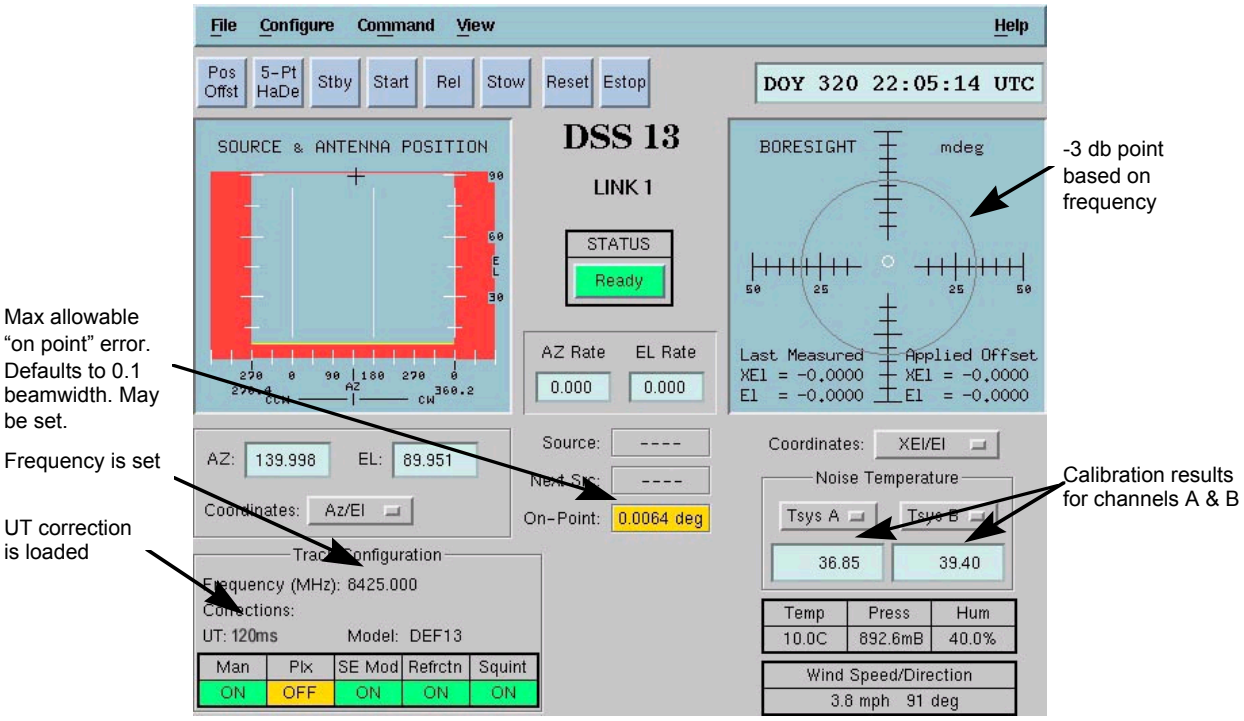


Figure 46. XAnt Configured and Calibrated

D. Source Selection

Source apparent position predictions are generated on demand from file data. They ***cannot*** be entered via the OCI window. To edit or enter new sources (see the section on predict maintenance). To generate source predictions, use the ***File*** menu.

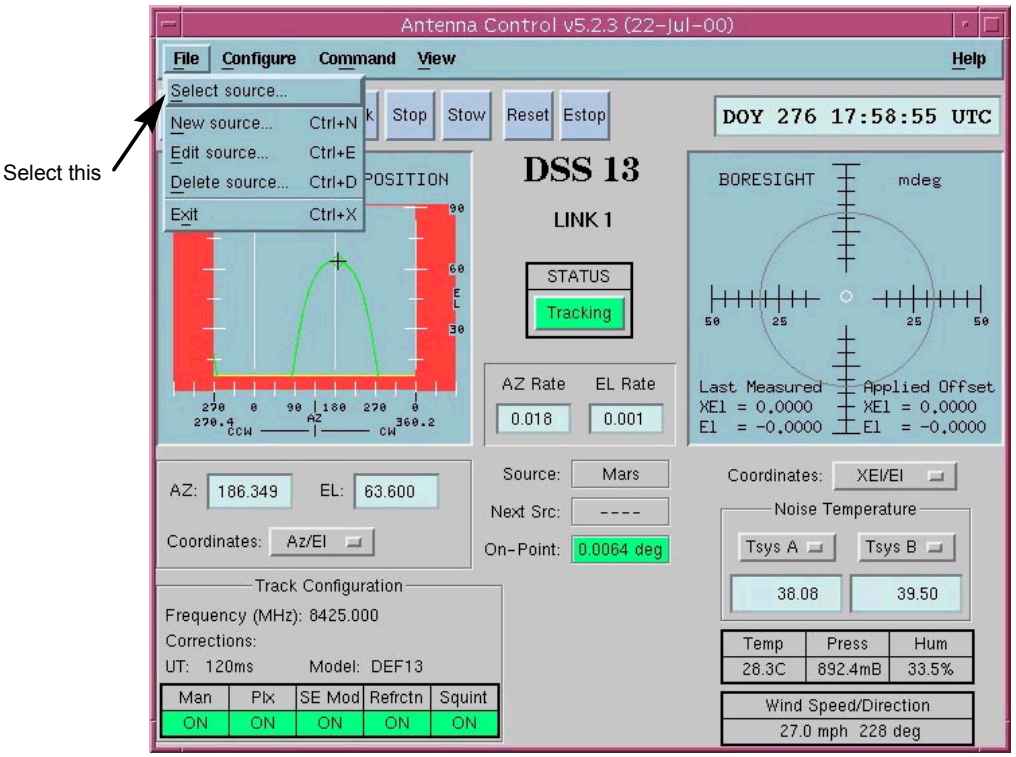


Figure 47. XAnt Source Selection Pulldown

To select a source, select a directory, click on ***Filter***, select the source, and click ***OK***.

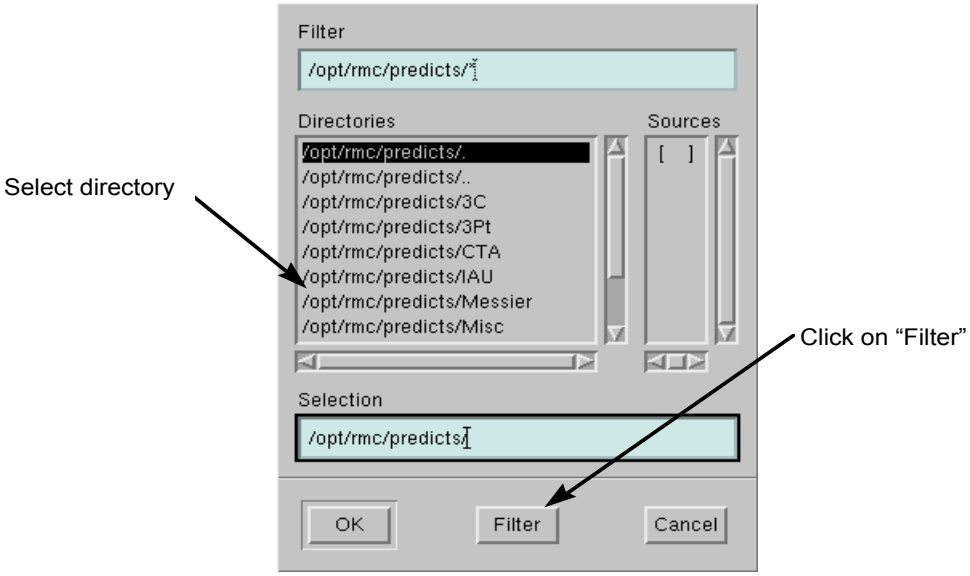


Figure 48. XAnt Source Selection Popup

Source selection can be done without interrupting the track in progress. Clicking on ***OK*** for a new source loads the source name into the XAnt ***Next Src*** window. The change to the next source will be initiated when the XAnt ***Track*** button is clicked. If there is no ***Next Src*** selected, clicking on ***Track*** will cause the current ***Source*** to be reloaded.

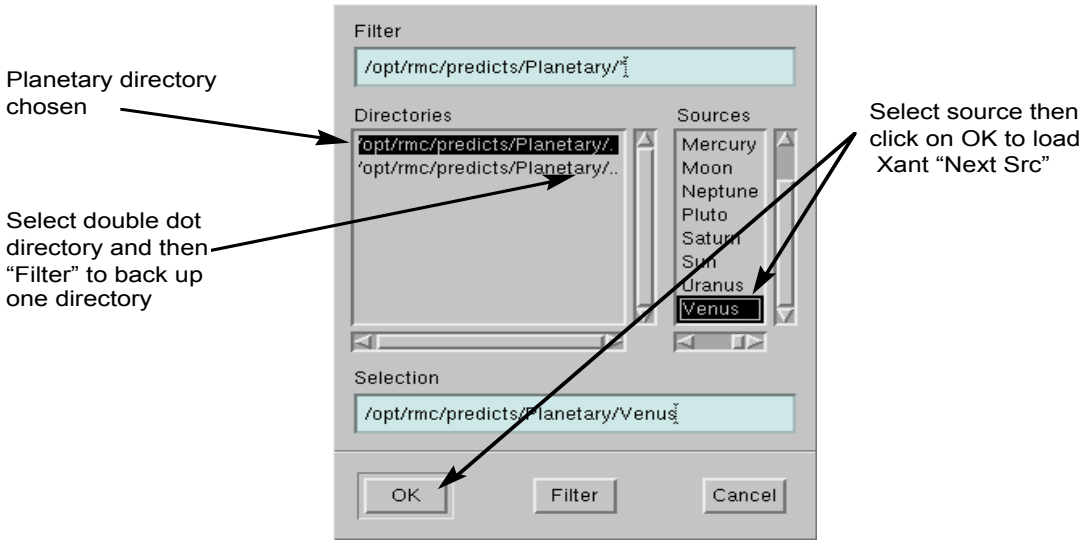


Figure 49. XAnt Source Selected

If there is a ***Next Src*** selected, a ***Source*** is loaded already, and ***Next Src*** is different from ***Source,*** clicking on ***Track*** will cause the following confirmation popup to appear showing the ***Next Src*** name.

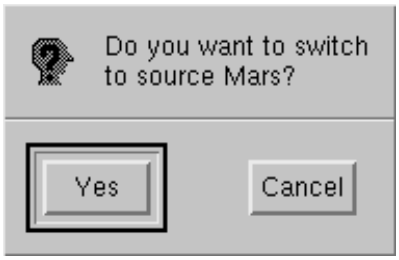


Figure 50. XAnt Source Change Confirmation Popup

E. Antenna Safety

The antenna does have a number of automatic safety features for the protection of the equipment.

1. In the event of significant seismic activity, the antenna will be e-stopped by a seismic sensor, and is not to be moved until inspected.
2. When under software control, soft limits will keep the antenna from driving into the hardware limits.
3. In the event of antenna control processor failure, a set of hardware limits will stop the antenna. Manual intervention at the antenna is required to back out of the hard limits. Remote operators should be aware that this exposes the antenna to potential damage while waiting for maintenance personnel if the winds are high, so running close to the limits in high winds is not advisable.
4. To assist with prevention of activation of hard limits, the EAC has a watchdog on antenna communications. In most antenna runaway situations, the antenna control computer stops communicating with the EAC. The EAC will apply an e-stop in less than 10 seconds after communication loss.
5. Loss of communication between the station and remote XAnt windows for a period of 90 seconds will cause a stow command to be sent to the antenna. Stowing the antenna leaves it shutdown in the preferred position.
6. Winds above the limit set in the antenna control computer will cause the antenna to stow automatically. If the system is working (EAC and APC are communicating normally and wind data are being presented on the XAnt), the APC will be receiving the necessary data. Remote operation requires that the EAC is receiving wind data.
7. The EAC will send a stop command if the antenna rates exceed 0.8 deg/sec.
8. A ***stop*** and an ***e-stop*** button are provided in the EAC's XAnt graphical user interface.
9. There are three surveillance video cameras attached to a web server. Before antenna start, there must be no vehicles on the antenna pad, no people around the antenna who do not know of the imminent movement, and nothing obstructing the azimuth runner. Both exterior view cameras have presets 2 and 3 set to provide views of the runners.

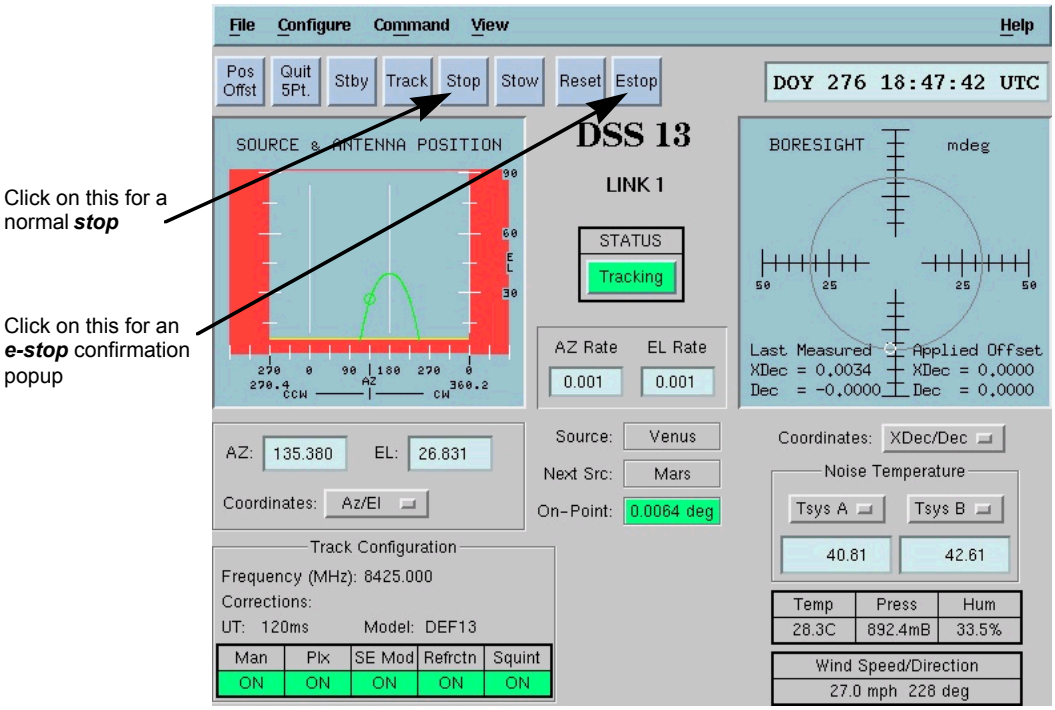


Figure 51. XAnt Stop and E-Stop Buttons

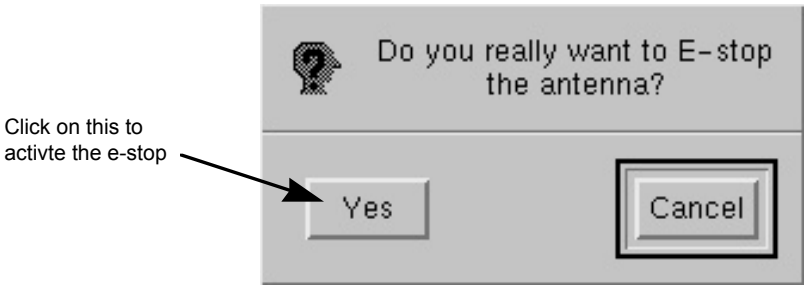


Figure 52. XAnt E-Stop Confirmation Popup

F. Antenna Startup

The antenna automatic startup sequence is initiated by pressing the ***Start*** button.

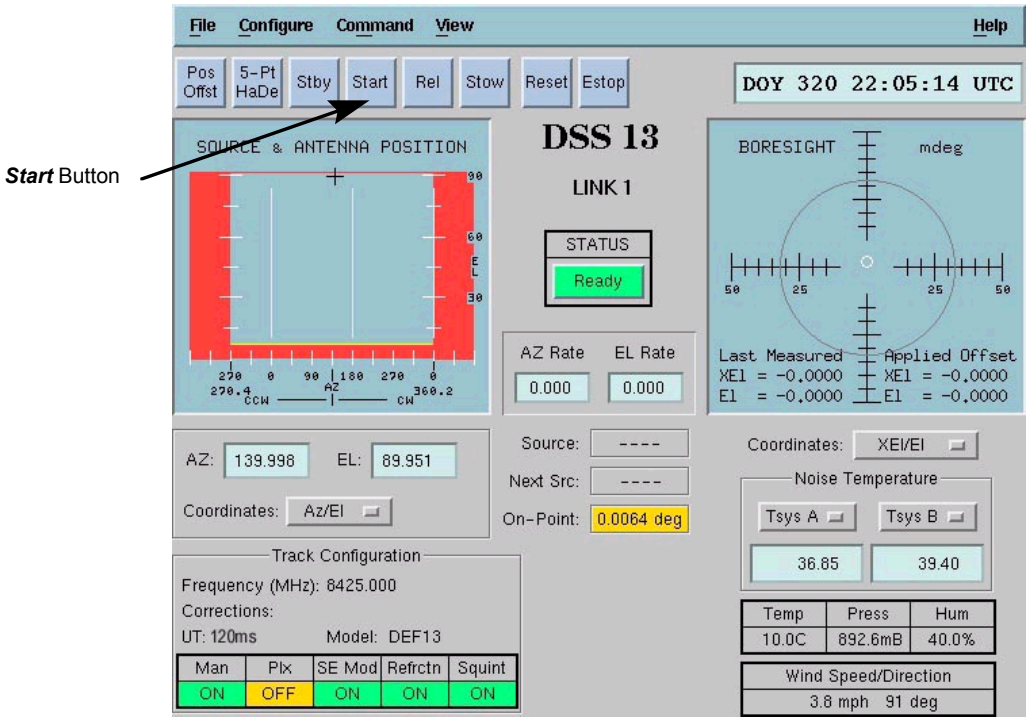


Figure 53. XAnt Antenna Startup

When starting, the APC will pause prior to antenna movement to allow an audio safety page. A popup will appear at this time. Acknowledge the popup and click on the ***Resm*** button when ready to proceed.

Figure 54. XAnt Pause Warning Popup

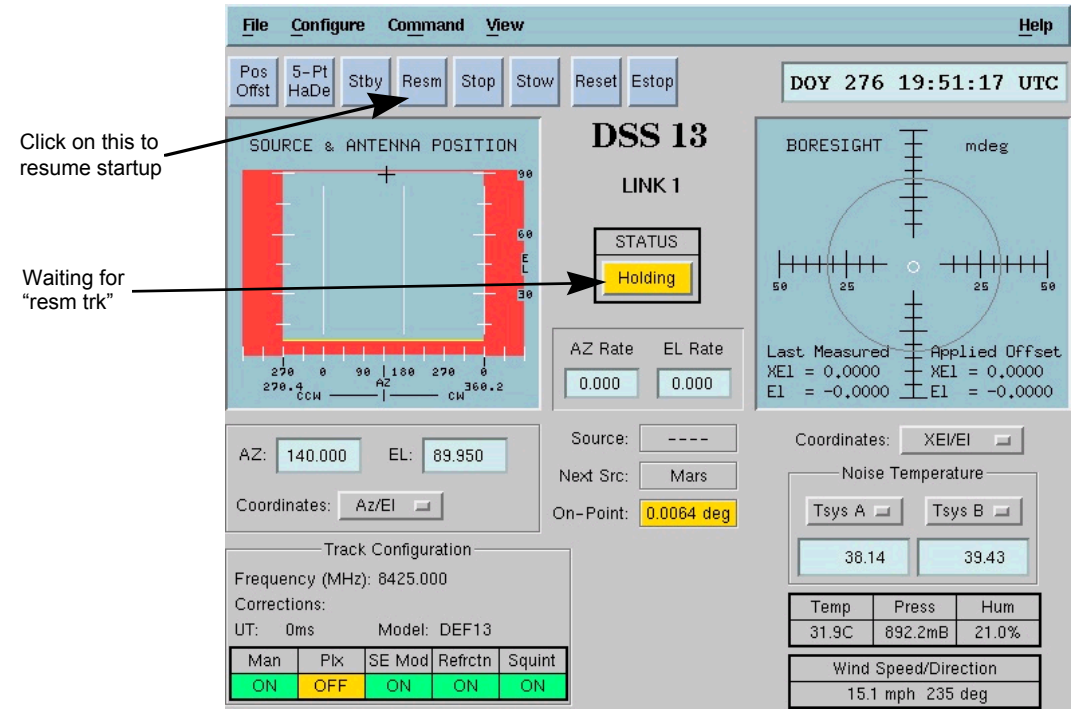


Figure 55. XAnt Holding for Resm

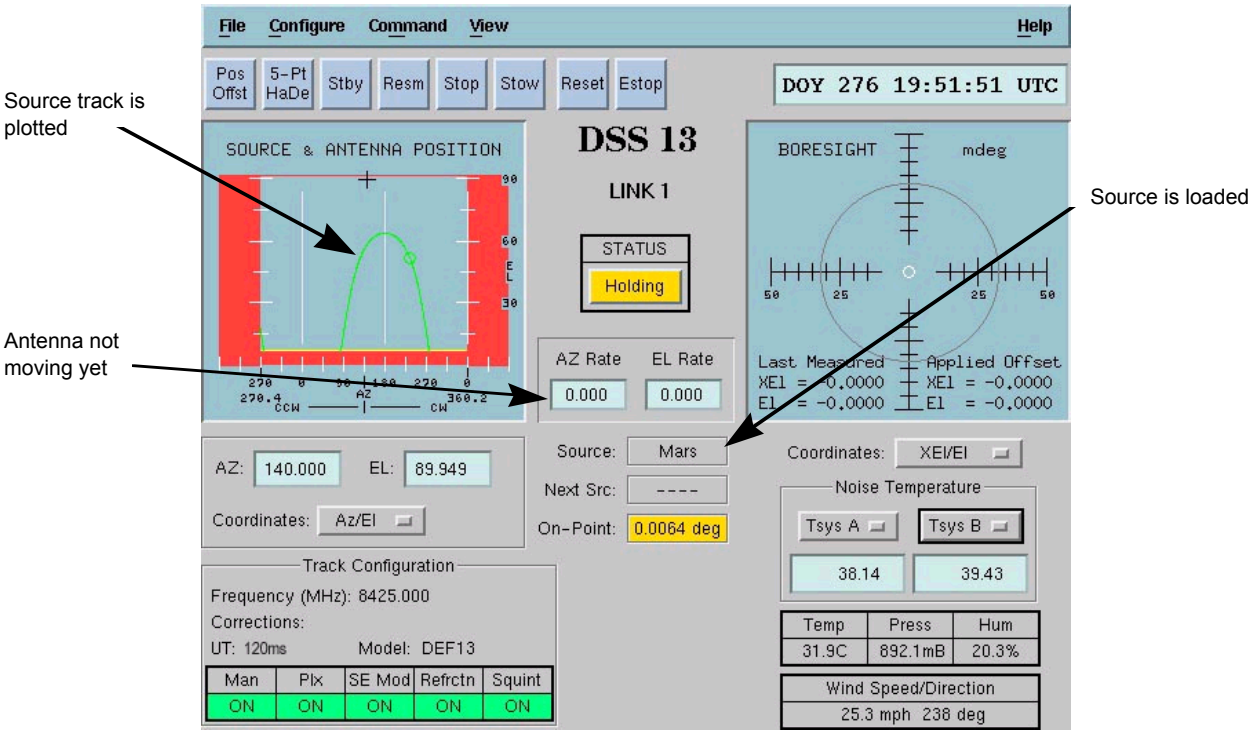


Figure 56. XAnt Startup Sequence Resumed

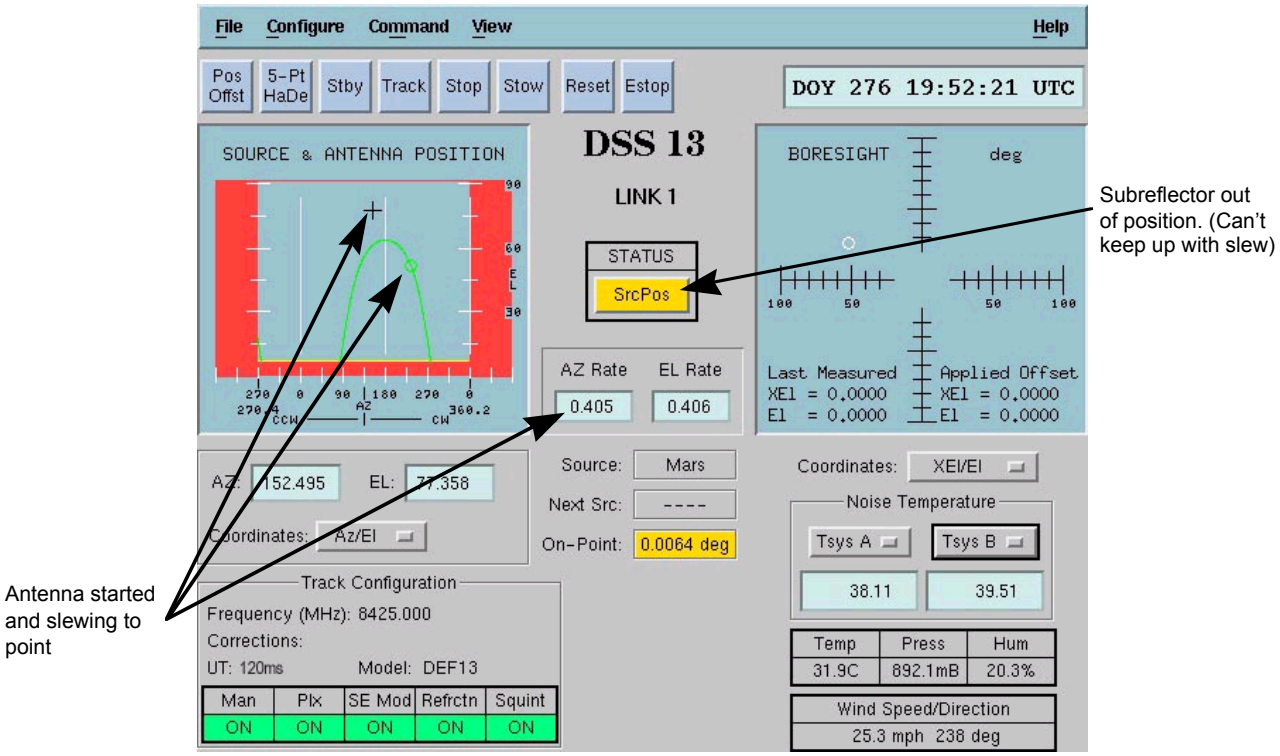


Figure 57.XAnt Slewing. Subreflector Out of Position

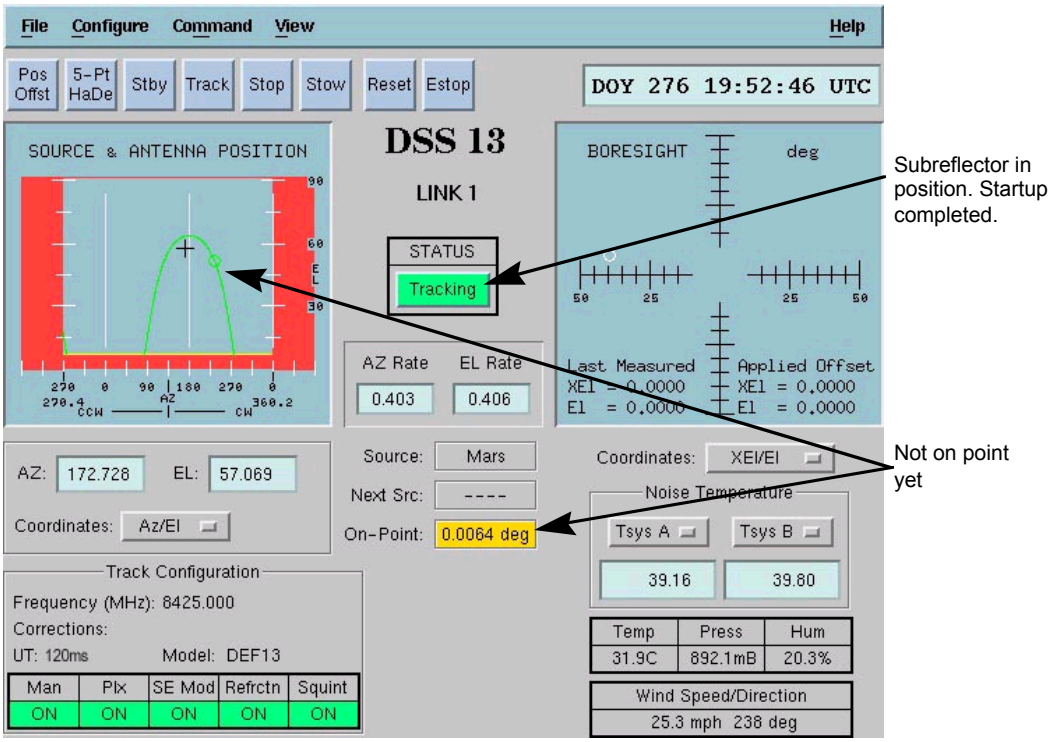


Figure 58. XAnt Started and Subreflector in Position

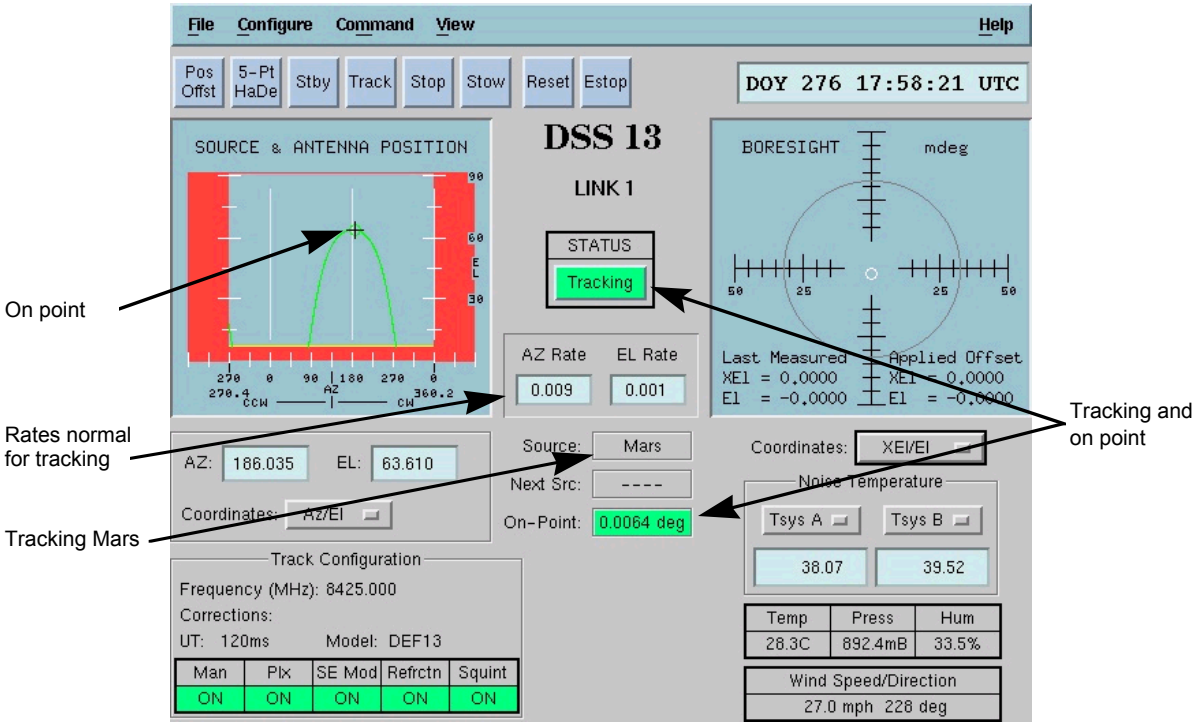


Figure 59. XAnt Tracking

A new source can be selected (see source selection section) while tracking. The source change will not be effective until the ***Track*** button is activated again.

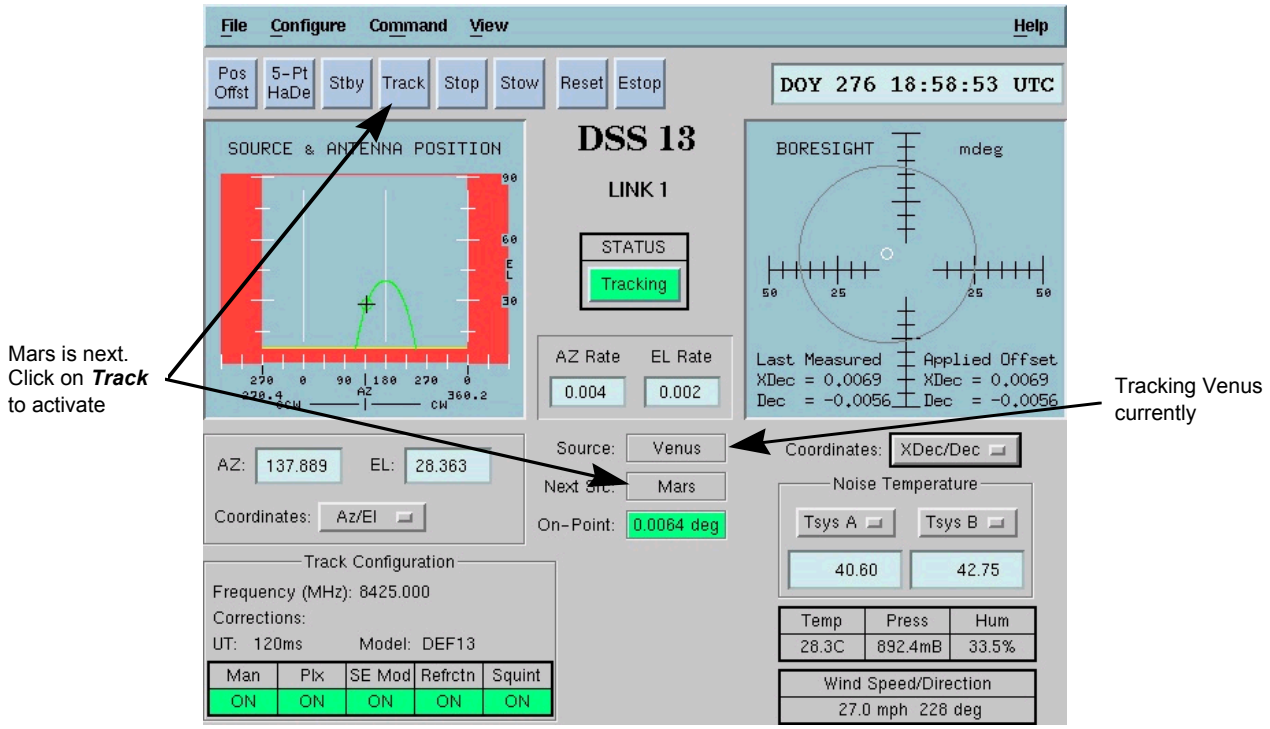


Figure 60. XAnt Next Source Selected

G. Calibration

To perform minicals, click and drag to ***RA Controller***. The RAC popup will appear. Enter the minical or any other RAC command in the command entry area. The RAC will send minical results back for display and calibration of system temperature.

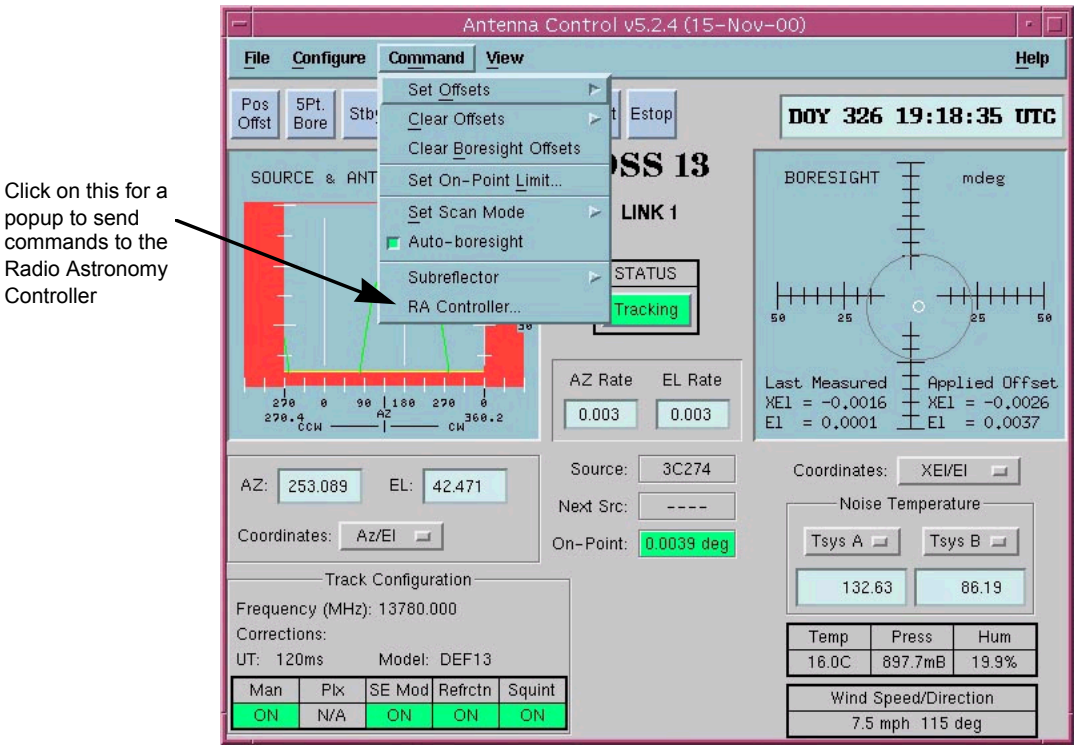


Figure 61. XAnt Command Menu Pulldown

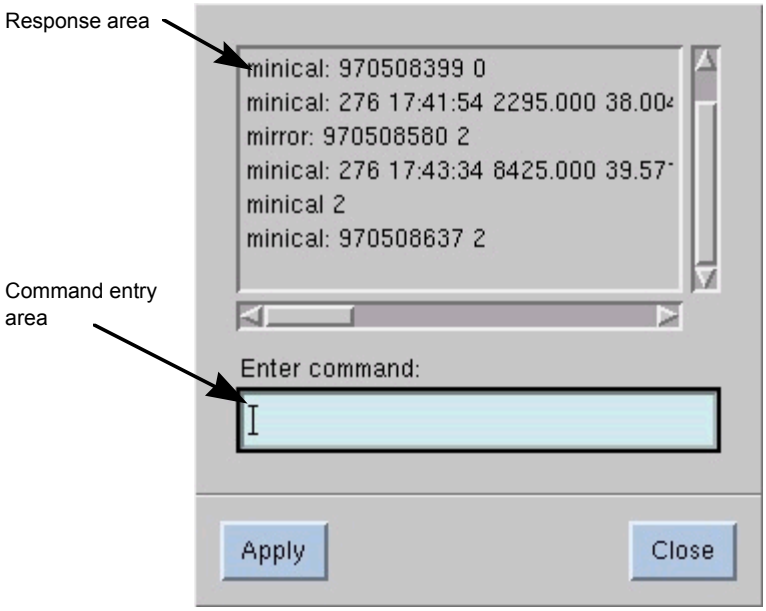


Figure 62. XAnt RAC Command Popup

H. Offsets

The antenna may be offset from the position generated from predicts by entering a position or rate offset. Position offsets are entered in **degrees** and simply drive the antenna off point by the amount entered. Rate offsets are entered in **milli-degrees** and drive the antenna off point by accumulating an offset at the specified rate. To obtain a popup for offset entry, click on the **Pos Offset** toolbar button or pull down the **Command** menu and select **Set Offsets**.

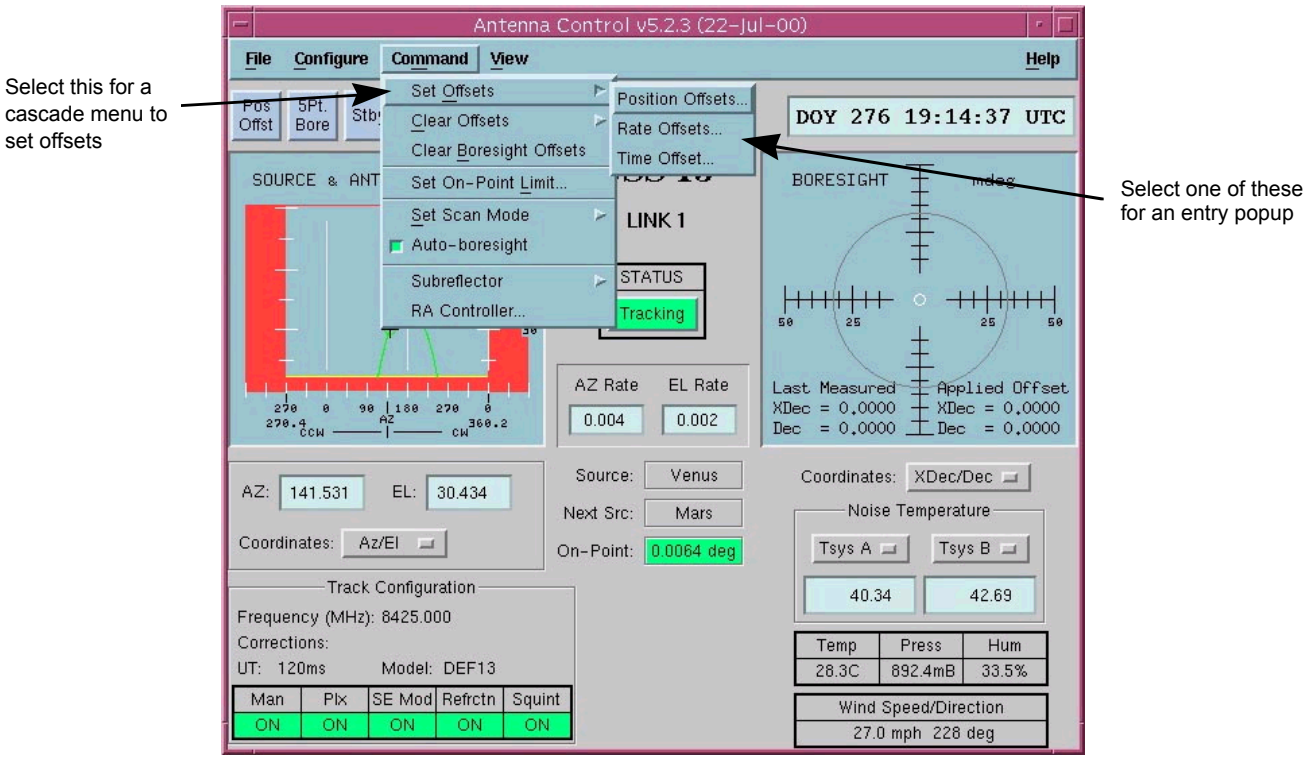


Figure 63. XAnt Command Menu Set Offsets

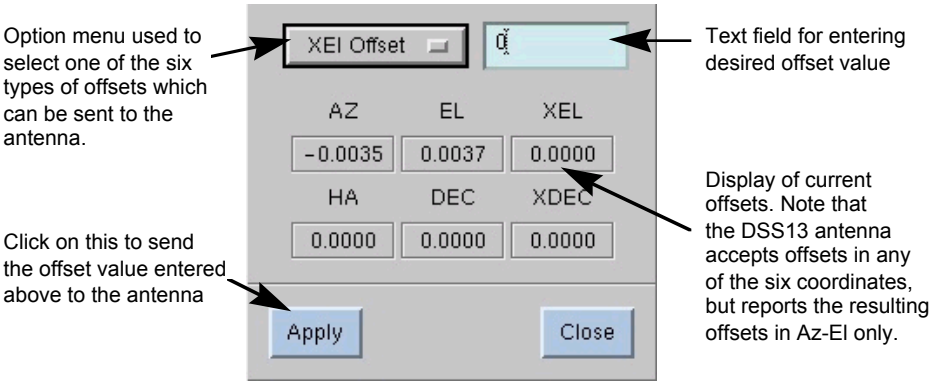


Figure 64. XAnt Offset Entry Popup

XAnt and the offset popup appear as follows after an Xel offset of 0.020 degrees has been applied.

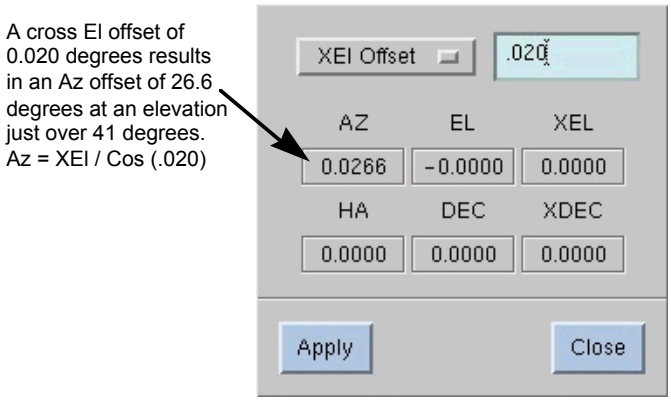


Figure 65. XAnt .020 Degree Offset Entry

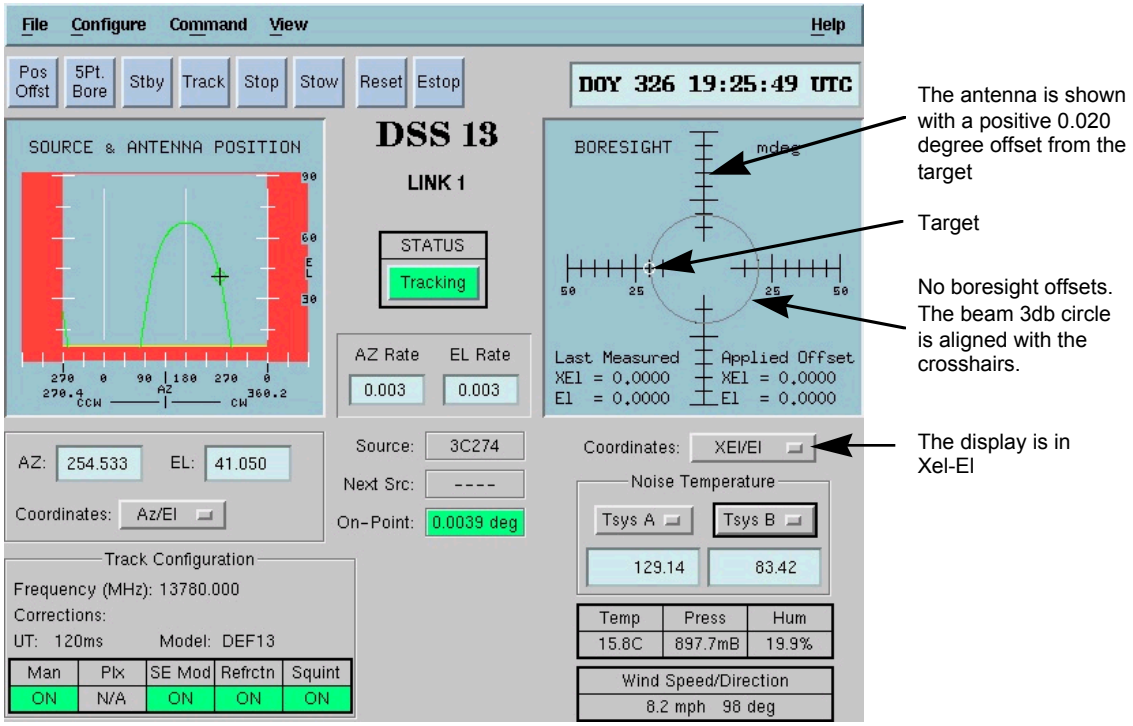


Figure 66. XAnt With .020 Degree Offset

To clear offsets, pull down the ***Command*** menu and select ***Clear Offsets***.

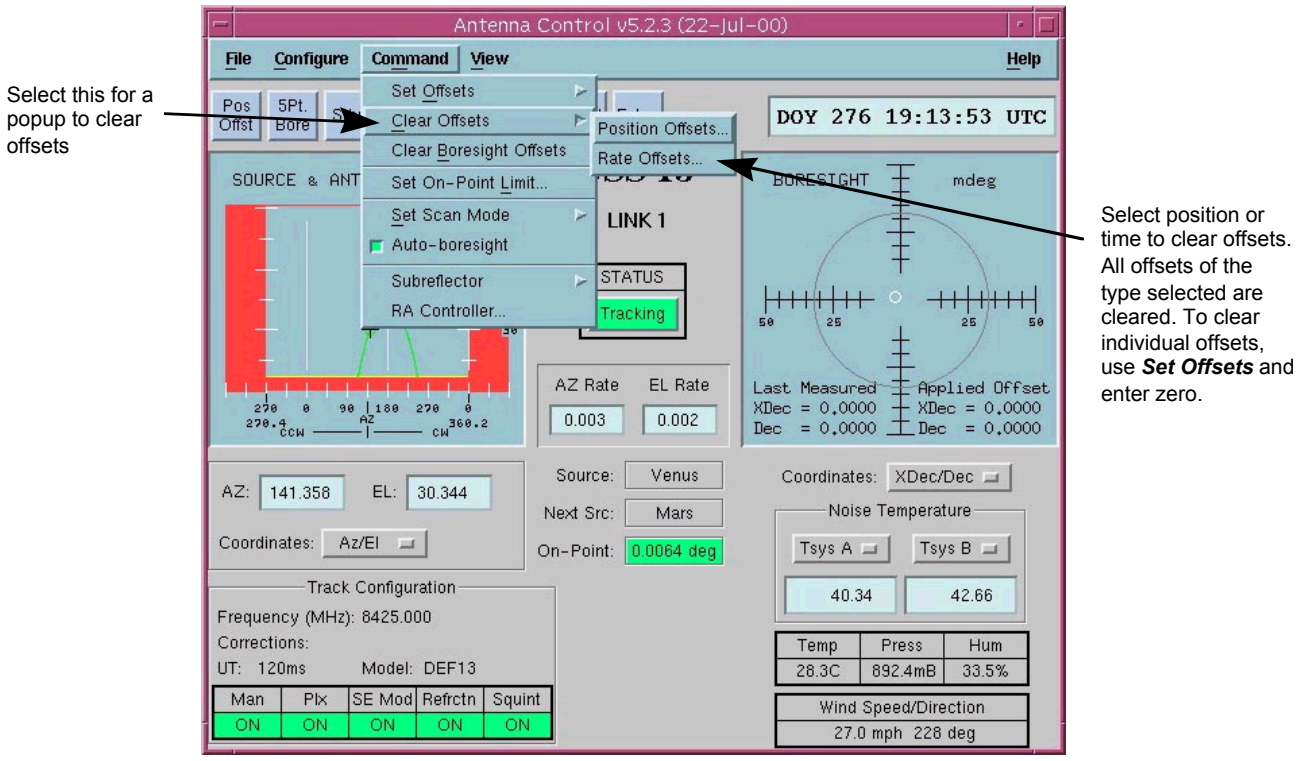


Figure 67. XAnt Command Menu Clear Offsets

DC offsets can be applied to the subreflector position. Offsets are specified in inches.

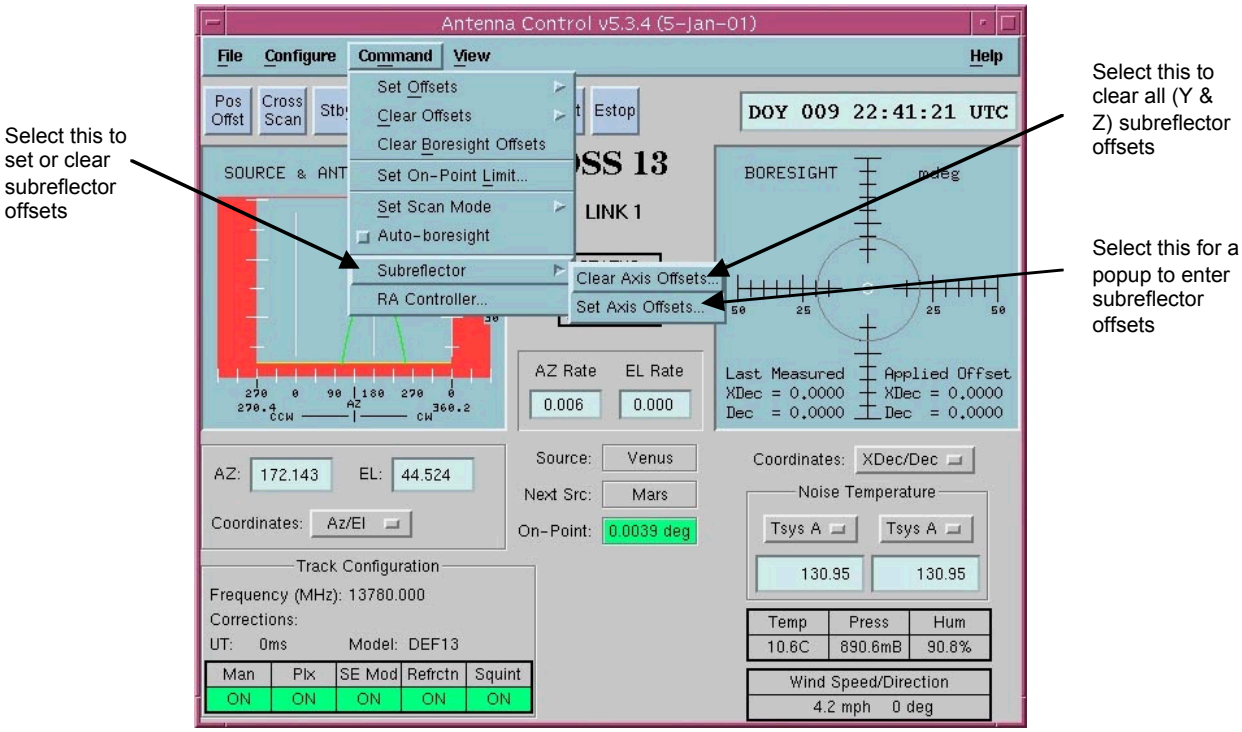


Figure 68. XAnt Command Menu Subreflector Position

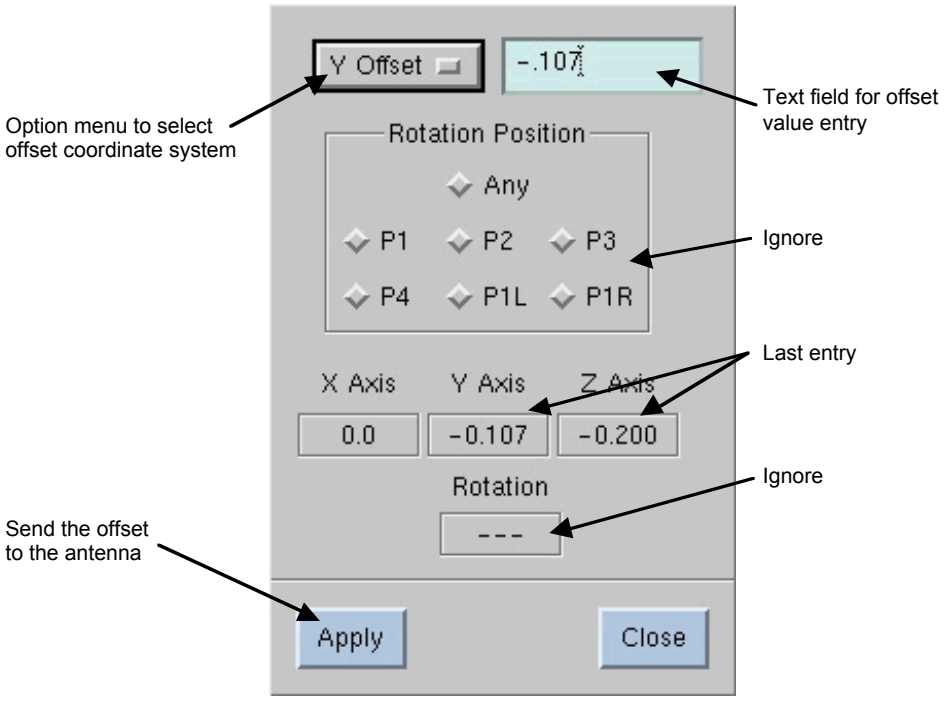


Figure 69. XAnt Subreflector Offset Popup

I. Boresights

Boresights may be initiated once the antenna is on source. Select the boresight type from the ***Command*** pulldown ***Set Scan Mode***. Click on the toolbar button to start boresight setup. The toolbar button will be labeled with the selected boresight type. By default, pointing corrections determined by boresighting are applied to the antenna as pointing offsets. If corrections are to be calculated without applying them to the antenna, switch off ***Auto-boresight*** in the ***Command*** pulldown.

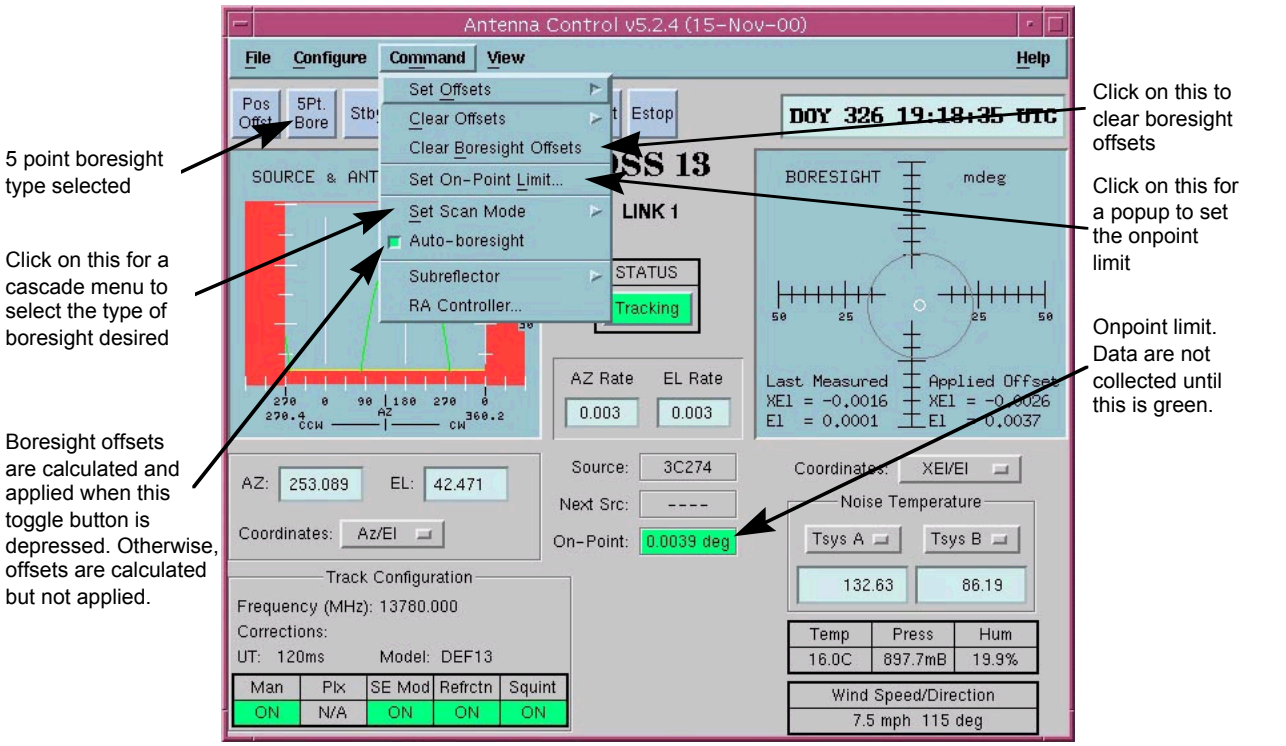


Figure 70. XAnt Boresight Functions

Boresights can be executed in either 5point or cross scan modes.

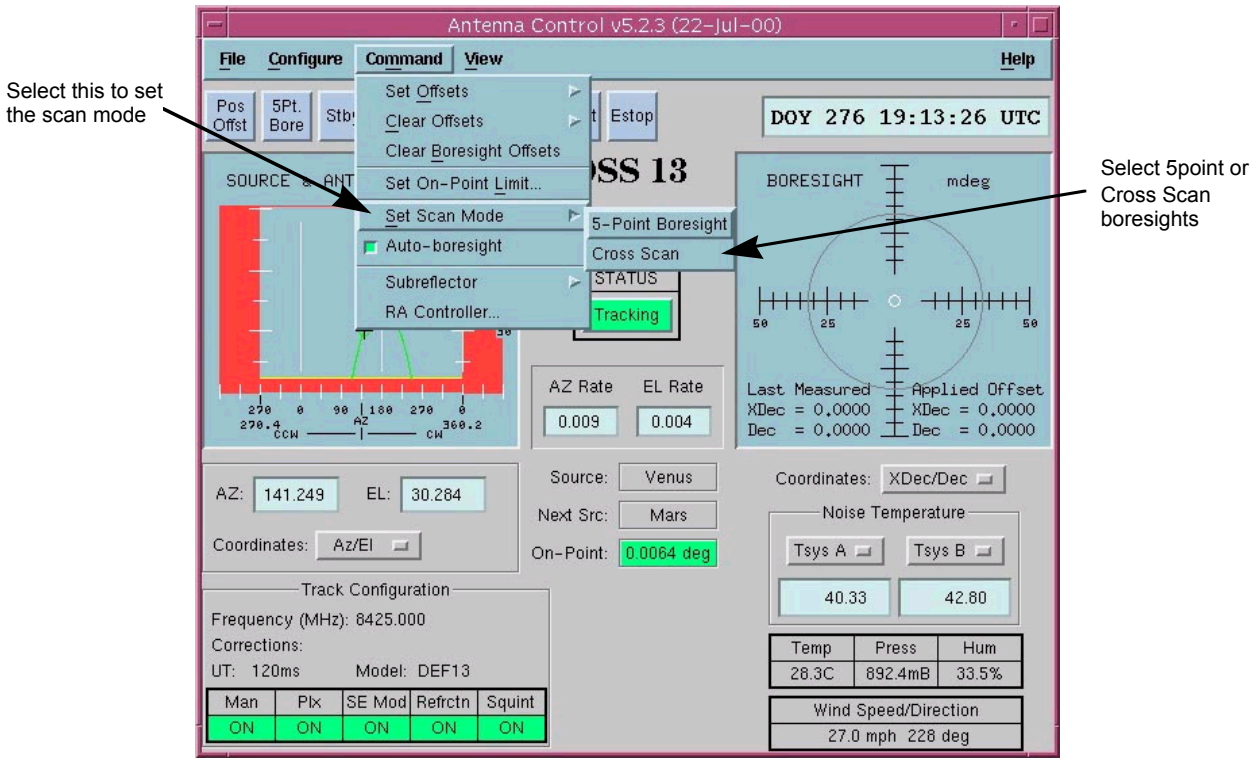


Figure 71. XAnt Boresight Mode Selection

To start the boresight, click on the boresight button.

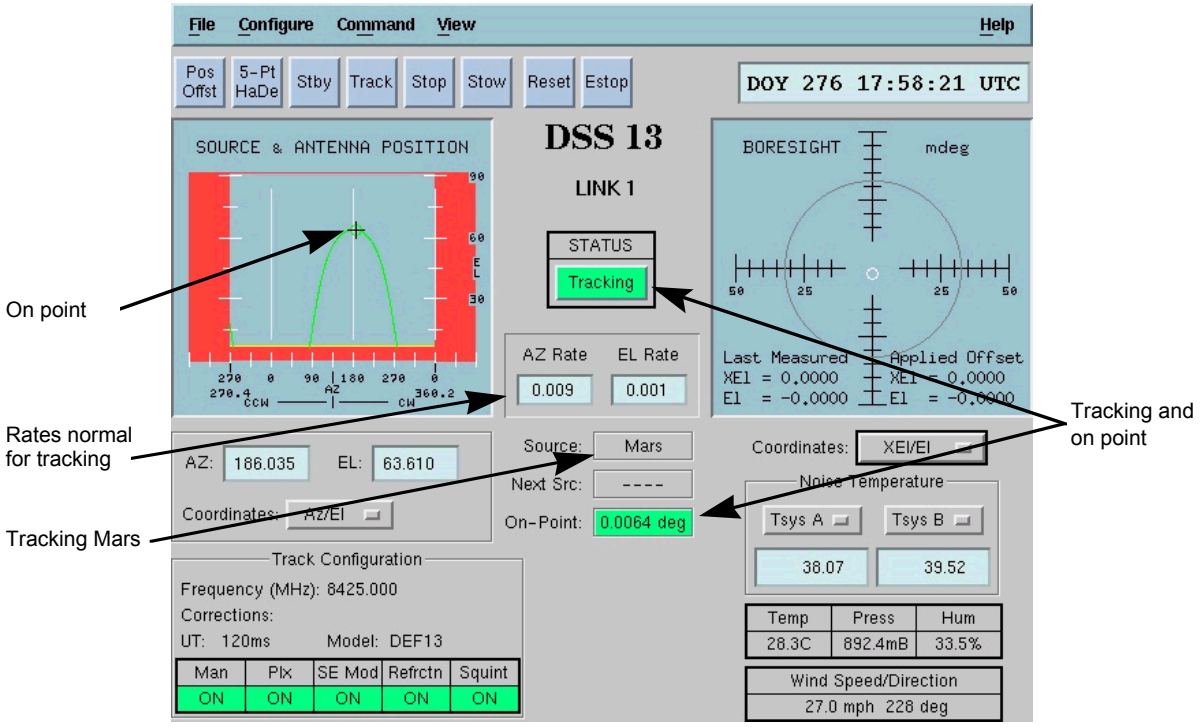


Figure 72. XAnt 5Point Scan Mode

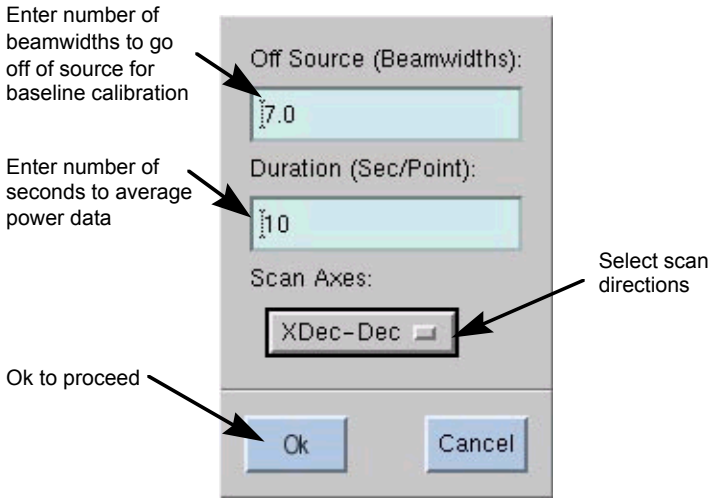


Figure 73. XAnt Five Point Boresight Setup Popup

Boresights may be stopped while in progress. Offsets applied during the boresight will be backed out. Offsets applied before the boresight will remain.

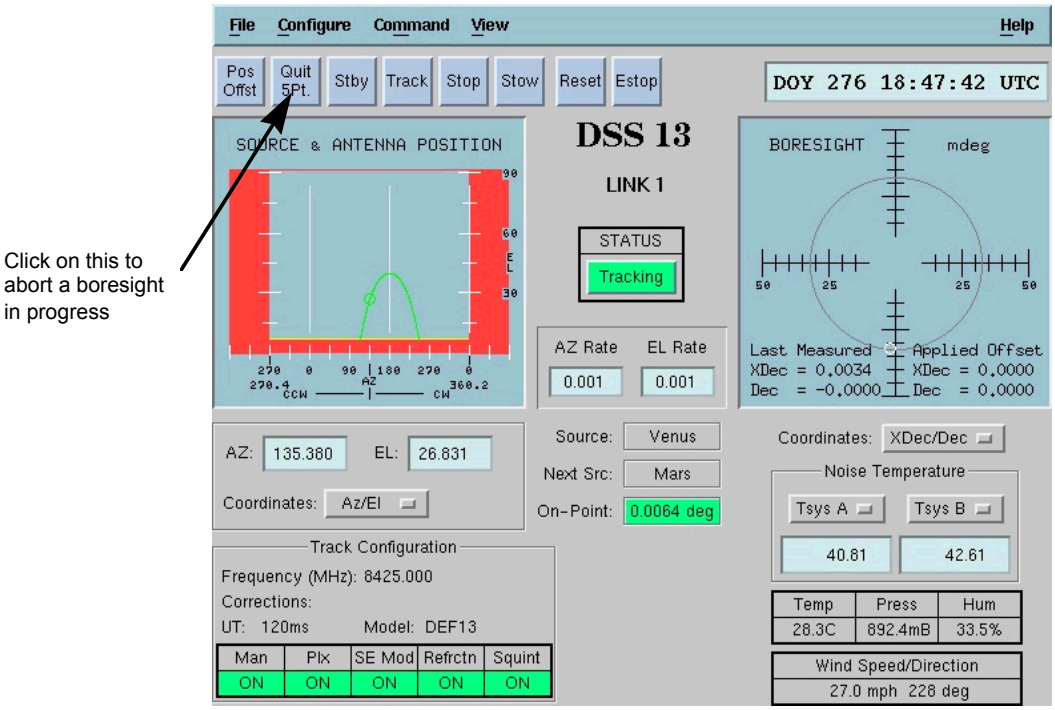


Figure 74. XAnt Quit Five Point Boresight

To remove boresight offsets, pull down the **Command** menu and select **Clear Boresight Offsets**. A confirmation popup will appear.

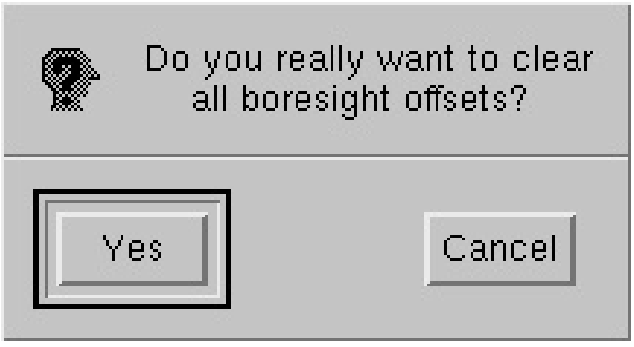


Figure 75. XAnt Clear Boresight Offset Confirmation Popup

If ***Cross Scan*** is selected from the ***Command*** menu, the boresight button label changes to agree.

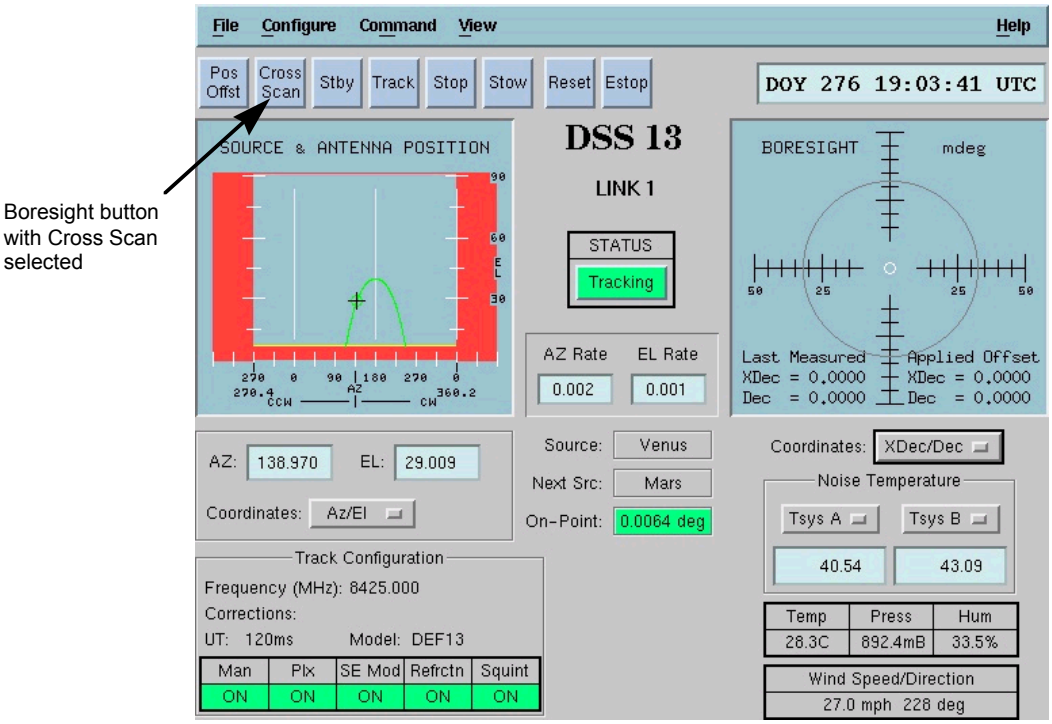


Figure 76. XAnt Cross Scan Selected

A different setup is required if Cross Scan boresights are selected.

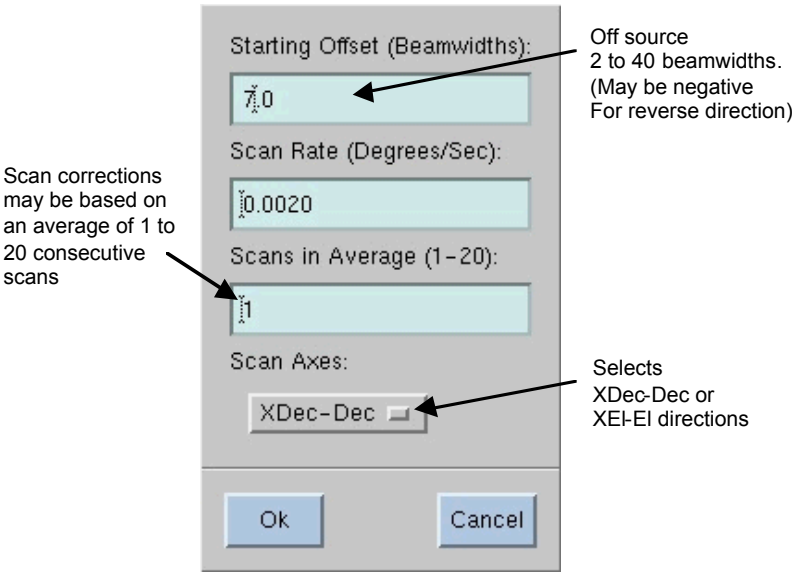


Figure 77. XAnt Cross Scan Setup Popup

Cross scan width and rate interact to ensure an integral number of seconds in the scan. Changing the width affects the rate, and changing the rate affects the width. For example, the width may be set to a nominal value and then an exact rate may be entered. The width will be adjusted slightly if required. If the width is set last, the rate will be adjusted to fit the width.

The following XPlot shows a typical five point boresight sequence. First, the antenna is taken off point in the positive HA direction by the amount specified in the boresight offset popup to get the first baseline measurement. Then half power, peak, and half power measurements are made. Finally, a second baseline measurement is made. A gaussian is fit to the three mid-points to determine the pointing offset. The antenna is then offset in the positive DEC direction, and the process is repeated. If either gaussian cannot be fit, the antenna is offset in the appropriate direction so a search can be carried out.

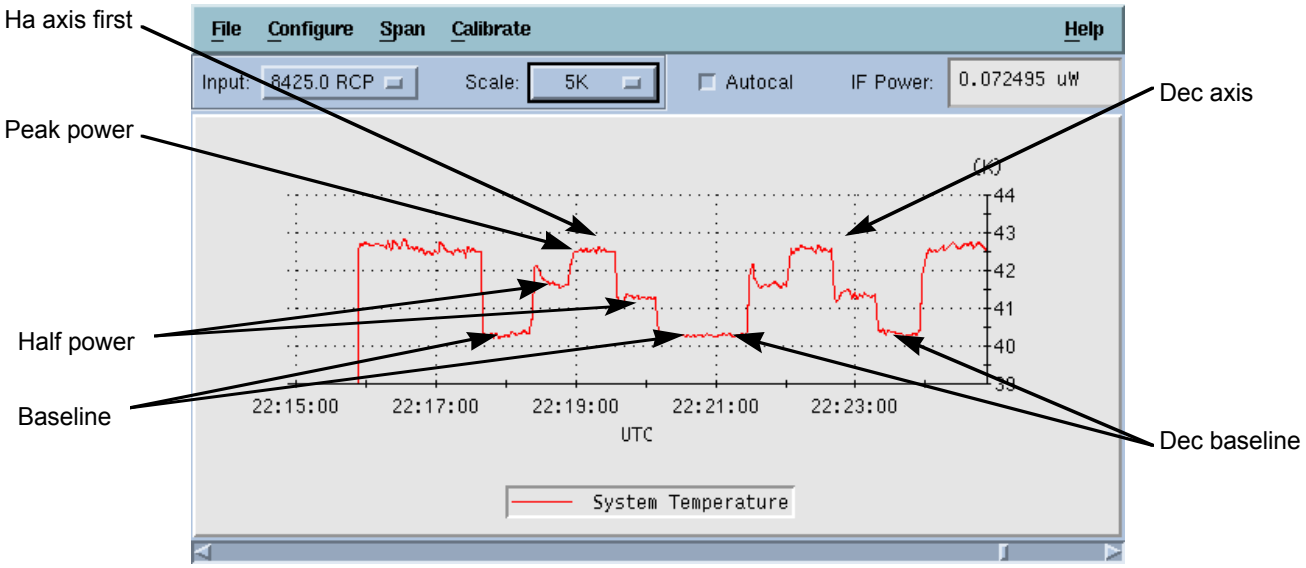


Figure 78. XPlot Five Point Boresight

The following XAnts show what happens after the boresight routines compute the offsets. The boresight display shows boresight offsets and manual offsets applied after the boresight. Offsets applied before the boresight will be absorbed into the boresight offsets. Clear boresight or manual offsets using the ***Command*** menu pulldown. Note that clearing boresight offsets does not clear manual offsets applied after the boresight. Individual manual offsets can be cleared using the ***Pos Offset*** popup to enter zero. Note that clearing manual offsets does not clear boresight offsets.

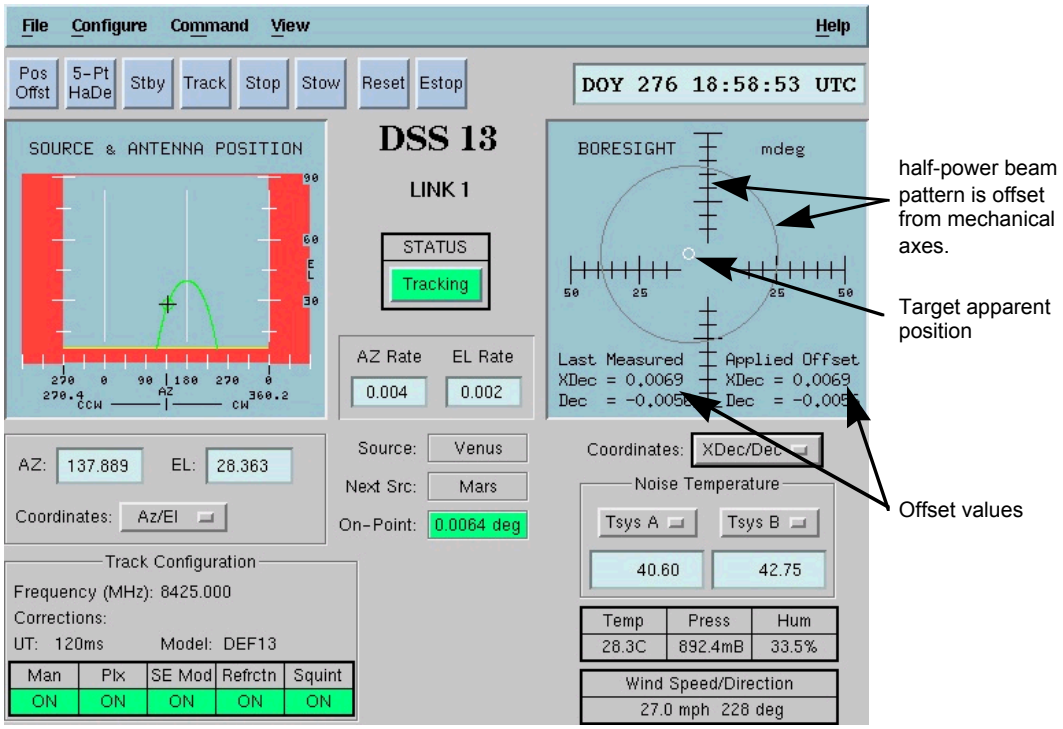
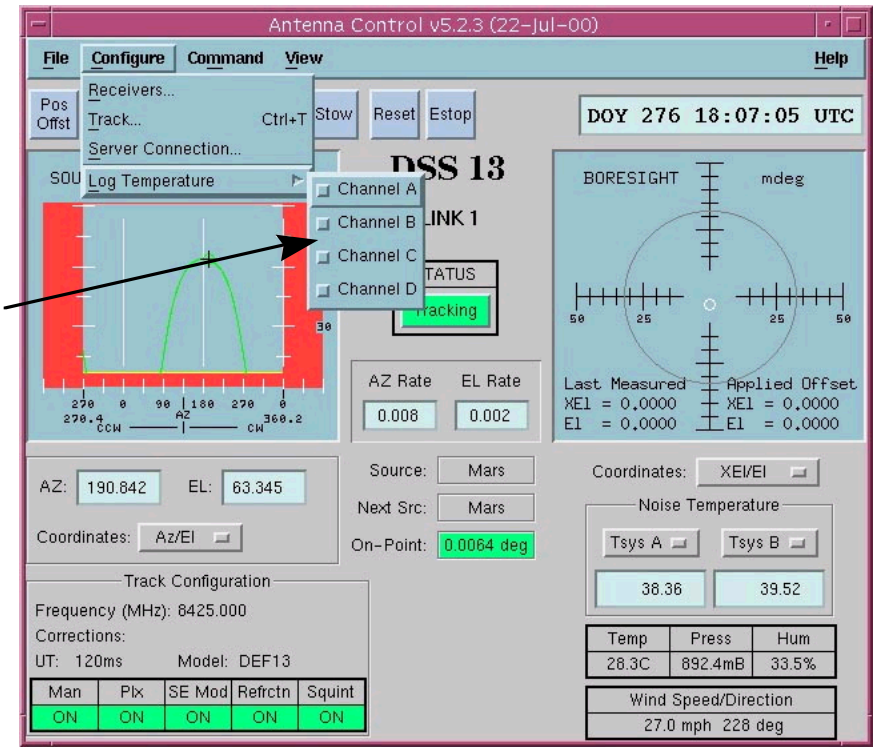


Figure 79. XAnt After Boresight

J. Logs

XAnt automatically generates separate minical, primary, and secondary channel boresight logs. Also, XAnt will generate logs of received temperature data. To turn temperature data logs on and off, pull down the **Configure** menu, select **Log Temperature**, and activate the toggle button for the desired channel. There is a command line option (**-ld** <filepath>) to set the boresight log directory path. The default path is set to /home/ops/logs. An additional log showing time-tagged pointing commands is available by setting the command line option, -pf, to true (**-pf true**).

XAnt temperature logging is started/stopped using the **Log Temperature** cascade under the **Configure** pulldown menu.



Select the desired channel(s). Frequency is set using ***Receivers*** popup

Figure 80. XAnt Temperature Log Cascade Menu

XPlot will generate a system temperature and calibration log when requested. To start a log, pull down the ***File*** menu, then drag to ***Log.*** Click on the desired toggle button and a file path popup will appear. Accept the default or enter a new path.

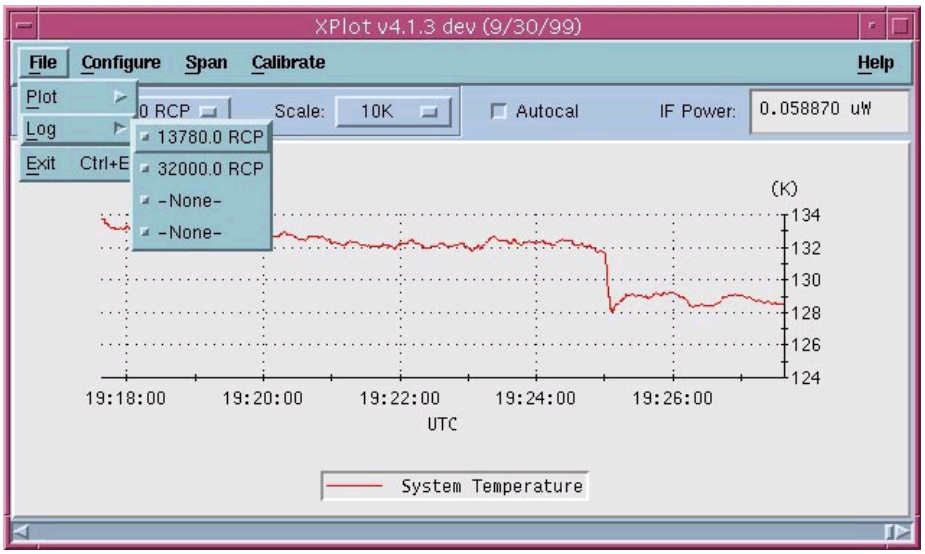


Figure 81. XPlot Log

K. Shutdown

The antenna is always left in the stow position if possible. Stow it when the pass is over. The normal shutdown sequence is the reverse of startup. However, the sequence isn't critical. Most clients will terminate if their server connection is broken. Killing the gateway will kill MDS and thereby XAnt. OCI will not terminate when MDS is killed and should be killed first. Normally, it is not necessary to terminate all of the applications. Proceed as follows:

1. Stow the antenna by clicking on the ***Stow***.
2. After antenna stow is completed, terminate OCI.
3. Terminate XPlot.
4. Terminate XAnt.
5. Terminate the gateway. MDS will be terminated with the gateway.

XAnt appears as follows when antenna stow has been successfully completed.

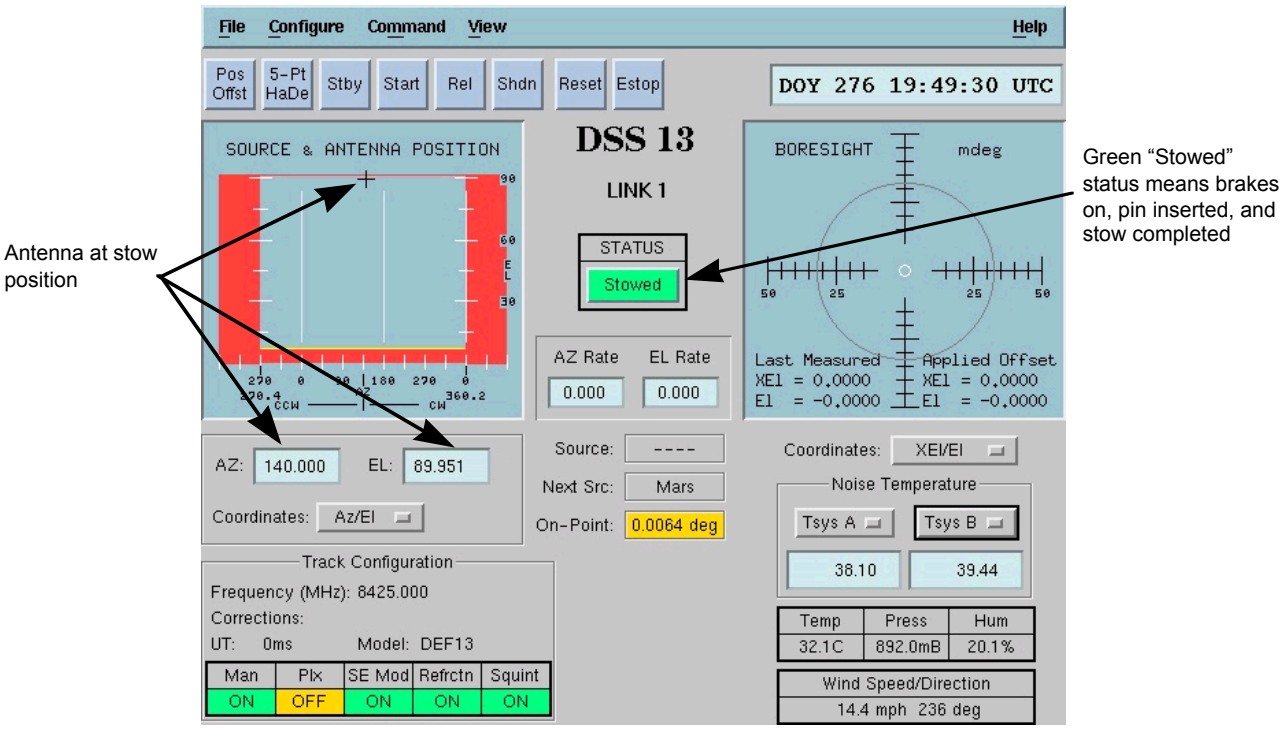


Figure 82. XAnt with Antenna at Stow

If the RAC server is terminated while the Gateway, XAnt, or XPlot is up, a warning popup will appear for early RAC server disconnection.

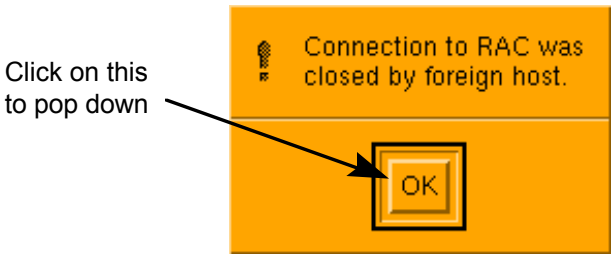


Figure 83. RAC Early Termination

There is a confirmation popup for XAnt termination.

Figure 84. XAnt Terminate Confirmation Popup

Terminate the gateway from the ***File*** pulldown.

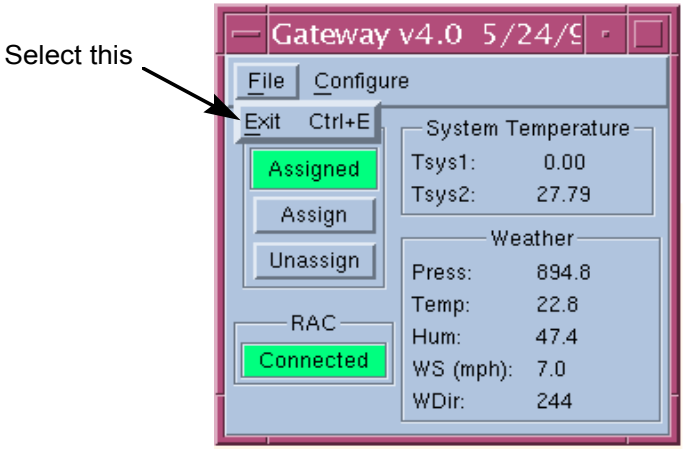


Figure 85. Gateway Exit Pulldown

Selecting ***Exit*** causes a confirmation dialog to pop up.

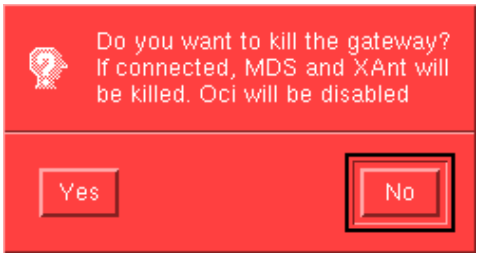


Figure 86. Gateway Exit Confirmation

VI. Script operation

A. Commands

Commands are case sensitive (all uppercase). Arguments are not case sensitive. Arguments in brackets are optional.

NAME

ASSIGN - sets sky frequency, polarization, and channel number

SYNOPSIS

ASSIGN channel frequency polarization

DESCRIPTION

The ASSIGN command sets receive frequency and polarization and associates them with a specified channel. The channel is required as an operand in other commands (e.g. MINICAL, REFCHAN, etc.).

OPERANDS

The following operands are supported:

channel Acceptable values are A through D.

frequency The sky (receiving) frequency in megahertz. Specification to .001 MHz will be accepted.

polarization Receiving antenna polarization. Acceptable values are **rcp** or **lcp**.

NAME

AZEL - Send the antenna to a fixed position

SYNOPSIS

AZEL az el

DESCRIPTION

The **AZEL** command sends the antenna to the azimuth and elevation specified by the arguments.

OPERANDS

The following operands are supported:

az The desired azimuth in decimal degrees (e.g. 180.000)

el The desired elevation in decimal degrees (e.g. 45.000)

NAME

BEEP - sound an audible alert

SYNOPSIS

BEEP

DESCRIPTION

The **BEEP** command generates an audible tone.

OPERANDS

None.

NAME

CLR - clear offsets

SYNOPSIS

CLR type coord

DESCRIPTION

The **CLR** command sets the specified offset type to zero in the specified coordinate.

OPERANDS

The following operands are supported:

type — Acceptable types are **po** (position), **ro** (rate), and **bso** (boresight).

coord — Acceptable coordinates for **po** and **ro** are **all**, **az**, **el**, **xel**, **ha**, **dec**, and **xdec**. Acceptable coordinates for **bso** are **all**, **dec**, **xdec**, **el**, and **xel**.

NAME

DELTA_UT - sets UT1 - UTC offset for antenna pointing calculations

SYNOPSIS

DELTA_UT msec

DESCRIPTION

The **DELTA_UT** command inputs the time offset necessary to allow the antenna pointing controller to corrects its UTC reference for earth orientation.

OPERANDS

The following operands are supported:

msec — The signed magnitude of the offset in milliseconds (e.g. 500). The offset may be obtained at **maia.usno.navy.mil/eo** Follow the link to **IERS Bulletin A**.

NAME

FEEDPOS - selects beam waveguide feed

SYNOPSIS

FEEDPOS number

DESCRIPTION

The **FEEDPOS** command rotates the ellipsoid to the feed position specified by the number argument.

OPERANDS

The following operands are supported:

number — An integer specifying the position of the desired feed. Acceptable values are 1 through 6.

NAME

MINICAL - calibrates system temperature, gain, and linearity of specified channel

SYNOPSIS

MINICAL channel

DESCRIPTION

The **MINICAL** command executes a single sequence of calibration steps for the specified channel (see the ASSIGN command to establish channels). The order of the steps may vary for different radiometers, but the measurements are a power meter zero offset, a sky baseline, the sky with a noise diode, the ambient load, and the ambient load with noise diode.

OPERANDS

The following operands are supported:

channel — The letter representing the particular receiver to be calibrated. See the ASSIGN commands for acceptable channel designations.

NAME

POFFSET, POFFSETS - send position offset(s) to the antenna

SYNOPSIS

POFFSET coord value

POFFSETS coord value value

DESCRIPTION

The **POFFSET** command sends a single position offset to the antenna.

The **POFFSETS** command sends a pair of orthogonal offsets to the antenna.

OPERANDS

The following operands are supported:

coord	The coordinate system to use for antenna offsets. Acceptable coordinates for POFFSET are **az**, **el**, **xel**, **ha**, **dec**, **xdec, y, and z**. Acceptable coordinates for POFFSETS are **azel**, **xelel**, **hadec**, and **xdecdec**.
value	The desired offset in decimal degrees (x.xxxx) for antenna offsets. Offset in decimal inches for y and z. Negative values are acceptable.

NAME

RADLOG - start/stop radiometer recording of Tsys

SYNOPSIS

RADLOG state

DESCRIPTION

The **RADLOG** command is used to start/stop Tsys vs time recording in the radiometer. All active radiometer channels are turned on or off by this command.

OPERANDS

The following operands are supported:

state	Acceptable values are **on** or **off**.

NAME

REFCHAN - sets channel used for scan (boresight) measurements

SYNOPSIS

REFCHAN ref [sec]

DESCRIPTION

The **REFCHAN** command is used to specify the reference channel for boresight offset calculations and power measurements. An optional argument may be supplied to specify a second, simultaneous, channel for the boresight log.

OPERANDS

The following operands are supported:

ref The channel used for calculations. Acceptable values are **A**, **B**, **C**, or **D**.

sec The channel logged like a boresight, but not used in calculations.

NAME

ROFFSET - send a rate offset to the antenna controller

SYNOPSIS

ROFFSET coord value

DESCRIPTION

The **ROFFSET** command sends a rate offset of **value** in the axis specified by **coord** to the antenna .

OPERANDS

The following operands are supported:

coord The coordinate system to use for antenna offsets. Acceptable coordinates are **az**, **el**, **xel**, **ha**, **dec**, and **xdec**.

value The desired rate in decimal milidegrees per second (x.xxxx).

NAME

SCAN, PSCAN, XSCAN - execute antenna movement and coordinate data acquisition

SYNOPSIS

SCAN type coord samples [offset]
PSCAN coord samples [offset]
XSCAN coord average [offset] rate

DESCRIPTION

These commands execute antenna movement and coordinate data acquisition for Tsource, and pointing offsets, or source brightness maps. **PSCAN** executes a five point boresight, and **XSCAN** executes a cross scan. **SCAN** has been replaced by **PSCAN,** but is retained for backward compatibility.

OPERANDS

The following operands are supported:

type — The name of the scan type to be invoked. The only acceptable type is **5point**.

coord — The coordinate system to use for antenna offsets. For **PSCAN**, only **xdecdec** is acceptable. For **XSCAN**, acceptable coordinates are **xdecdec** or **xelel**.

samples — Number of 1 second samples in each data point (e.g. there are five data points in a 5point scan). The acceptable range is 1 through 1000.

offset — Offset from source to use when measuring baseline power. Specify this offset in terms of half-power antenna beamwidths. If not specified, the default offset is 4.0 beamwidths at the reference channel frequency.

average — Number of consecutive cross scan pairs used in offset calculation. Acceptable range 1 through 20.

rate — Rate beam scans through source in degrees/second. Acceptable range 0.0001 to antenna slew rate. Please note that the **offset** may change slightly to fit an integer number of intervals into the scan at the chosen rate.

NAME

SET_RAD_INT - set the radiometer integration value

SYNOPSIS

SET_RAD_INT value

DESCRIPTION

The **SET_RAD_INT** command sends the value argument to the radiometer to determine how many seconds to integrate each point.

OPERANDS

The following operands are supported:

value Acceptable values are 0 through 9.

NAME

SOURCE - causes the antenna to track a new source

SYNOPSIS

SOURCE name [ra dec [epoch]]

DESCRIPTION

The **SOURCE** command sends position data to the antenna controller under control of the operands and, if started (see the **STARTUP** command), sends the antenna to the new source. If name only is specified, the apparent position is computed from internal catalogs for sidereal sources and from ephemeredes for solar system objects. If ra and dec are specified without an epoch, they are considered to be precessed sidereal source positions and are sent unchanged. If epoch is also specified, ra and dec are precessed to the current epoch before being sent.

OPERANDS

The following operands are supported:

name The source name to use in a catalog search and in the operations log.

ra Right ascension in decimal degrees or hhmmss.s.

dec Declination in decimal degrees or hhmmss.

epoch Reference time for ra and dec positions.

NAME

STARTUP - prepares the antenna for a SOURCE or TRACK command

SYNOPSIS

STARTUP

DESCRIPTION

If the antenna is shutdown, stowed, or in standby, the **STARTUP** command initiates a startup sequence that ends in a safety hold waiting for a **SOURCE** or **TRACK** command. If the antenna is already tracking, this command is equivalent to **TRACK**.

OPERANDS

None.

NAME

STOP - stops antenna movement

SYNOPSIS

STOP

DESCRIPTION

The **STOP** command stops the antenna where it is. Use the **TRACK** command to resume movement.

OPERANDS

None.

NAME

STOW - sends the antenna to a safe position

SYNOPSIS

STOW

DESCRIPTION

The **STOW** command sends the antenna to a safe position (zenith) and shuts down the electronics. The antenna is normally stowed at the end of a pass.

OPERANDS

None.

NAME

TLOG - start or stop system temperature logging

SYNOPSIS

TLOG channel state

DESCRIPTION

The **TLOG** command controls time tagged logging of system temperature for the specified channel.

OPERANDS

The following operands are supported:

channel — Acceptable channels are **A**, **B**, **C**, and **D**. All four, or any combination of the four may be on at any one time. Refer to the **ASSIGN** command for channel assignment.

State — Acceptable states are **on** or **off**.

NAME

TRACK - starts the antenna moving to point

SYNOPSIS

TRACK

DESCRIPTION

The **TRACK** command loads position coordinates and starts the antenna moving to point after **STARTUP** or **STOP**. If XAnt “Next Src” has been loaded, “Next Src” will replace the current source. Otherwise, **TRACK** commands reload the current coordinates. Note that the **SOURCE** command contains an implicit **TRACK** command and is normally used following a **STARTUP** command.

OPERANDS

None.

NAME

UNTIL_DO - provides a loop construct based on time

SYNOPSIS

```
UNTIL_DO  year  doy  utc {
        Command 1
        Command n
}
```

DESCRIPTION

The **UNTIL_DO** command tests time first and executes the bracketed command sequence if the specified time has not been reached. After sequence execution, time is tested again. The loop exits if the specified time has been reached or exceeded.

OPERANDS

The following operands are supported:

year	The four digit year.
doy	The day of year up to three digits (using UTC).
utc	Universal Coordinated Time (hh:mm:ss).

NAME

WAIT - halts macro execution for the specified interval

SYNOPSIS

```
WAIT  interval
```

DESCRIPTION

The **WAIT** command halts macro execution for the specified interval. After the wait expires, macro execution resumes.

OPERANDS

The following operands are supported:

interval	The time to wait in whole seconds.

NAME

WAIT_FOR_FEED - halts macro execution until ellipsoid has reached commanded position

SYNOPSIS

WAIT_FOR_FEED

DESCRIPTION

The **WAIT_FOR_FEED** command halts macro execution until the ellipsoid position is reported and is within 0.010 degrees of specified position.

OPERANDS

None

NAME

WAIT_FOR_ON_POINT - halts macro execution until antenna has settled on point within specified error limits

SYNOPSIS

WAIT_FOR_ON_POINT [limit]

DESCRIPTION

The **WAIT_FOR_ON_POINT** command halts macro execution until the standard deviation of the pointing error is less than limit. To provide hysterisis, initially, the standard deviation must be less than one-half of limit. When limit is not specified, the previously specified limit will apply. If limit has never been specified, the default of one tenth of the reference channel (set by REFCHAN) half power beamwidth will apply.

OPERANDS

The following operands are supported:

limit — The maximum acceptable value of the standard deviation for an on point indication as a decimal fraction of the reference channel beamwidth. The acceptable range is 0.001 to 1.0.

B. Script submission

EAC development plans call for a graphical user interface to select, test, start, stop, modify on the fly, and resume scripts. Until then, users must manage scripts in a terminal window.

Scripts are plain text files and may be generated and edited with any text editor. There is no script test software, so the user must review the completed script for typos, time

tag errors, syntax, and so forth. Some errors may result in a skipped instruction, but most will result in script termination. To avoid loss of large periods of time, a periodic check of progress is recommended.

The processing software looks in the current directory for a script called “proc_macro.tcl”. This script is loaded into /home/ops/scripts and /home/scops/scripts. To start processing a user script, open a terminal window, change directory to /home/ops/scripts or /home/scops/scripts and enter the following command line.

pm <station no.> <filename> for example, pm 13 testfile

To stop a script, enter ctrl-C in the window where the pm command was invoked. Remember that scripts always start at the beginning, so partially executed scripts may need to be edited before restarting. When a script completes, a foreign host disconnect message appears on XAnt.

The EAC provides for network transparent control via a socket connection. This means that any machine that can generate EAC commands can control operation. Local script operation uses the same socket connection as remote operation. Therefore, only one remote control connection at a time is allowed. When that connection is terminated (e.g. when a local script completes), a control termination warning popup appears.

Figure 87. XAnt Control Disconnect Popup

VII. Predict File Maintenance

The EAC uses the Multi-mission Analysis Software Library (MASL) to generate predictions on demand. The files are stored in the EAC and must be updated at various frequencies depending on the object.

A. External Files

Files to be maintained are:

1. Spacecraft SPK files
2. Solar system SPK (currently de403.bsp)
3. Earth motion (stoicfile)

B. Internal Files

The EAC maintains RA-Dec files for radio sources, SPK files for planets and spacecraft, and three point RA-Dec files for manually entered planetary predicts. The EAC provides new, edit, and delete capabilities for these files. To add or edit a file, pull down the ***File*** menu then select ***New Source*** or ***Edit Source*** and enter a new name or select an existing file using the file selection dialog which appears.

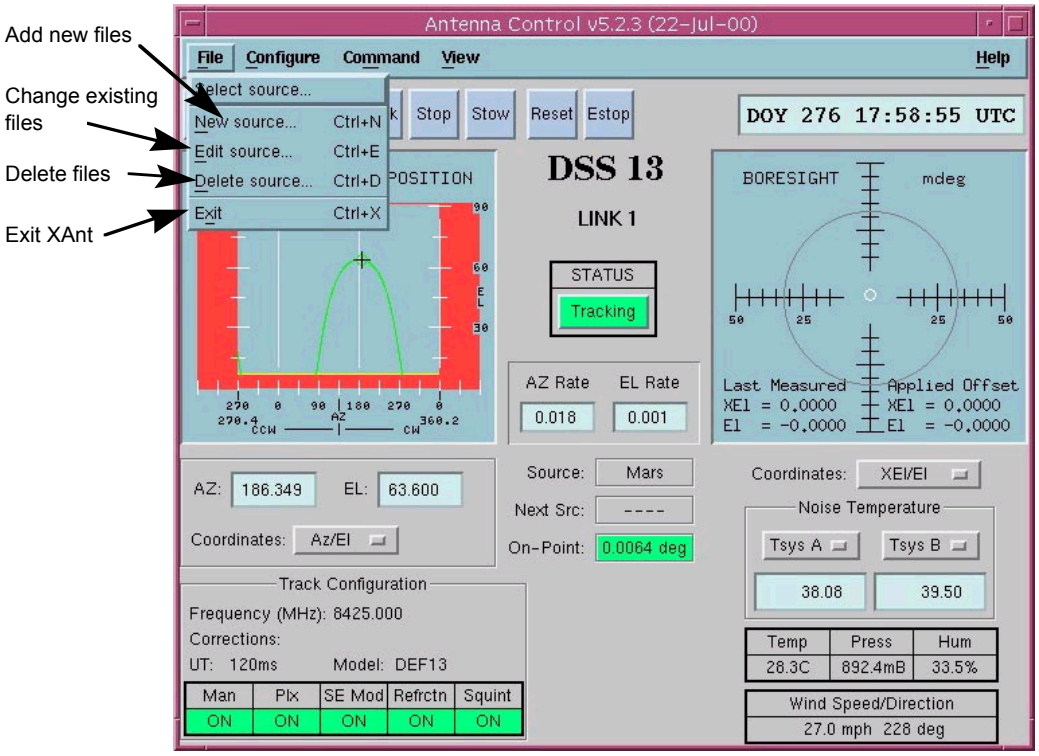


Figure 88. XAnt File Menu Pulldown

A file selection dialog appears when editing. Select the desired directory.

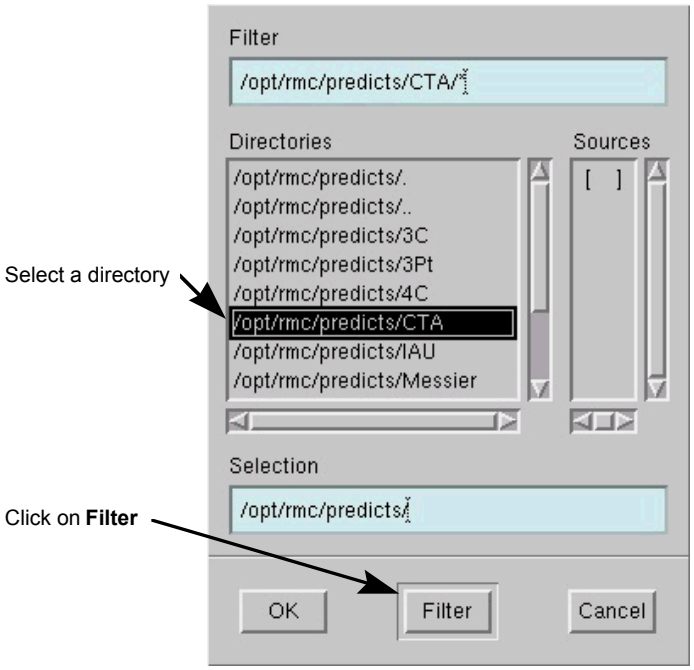


Figure 89. XAnt File Selection Dialog

Enter a filename or select an existing file to edit.

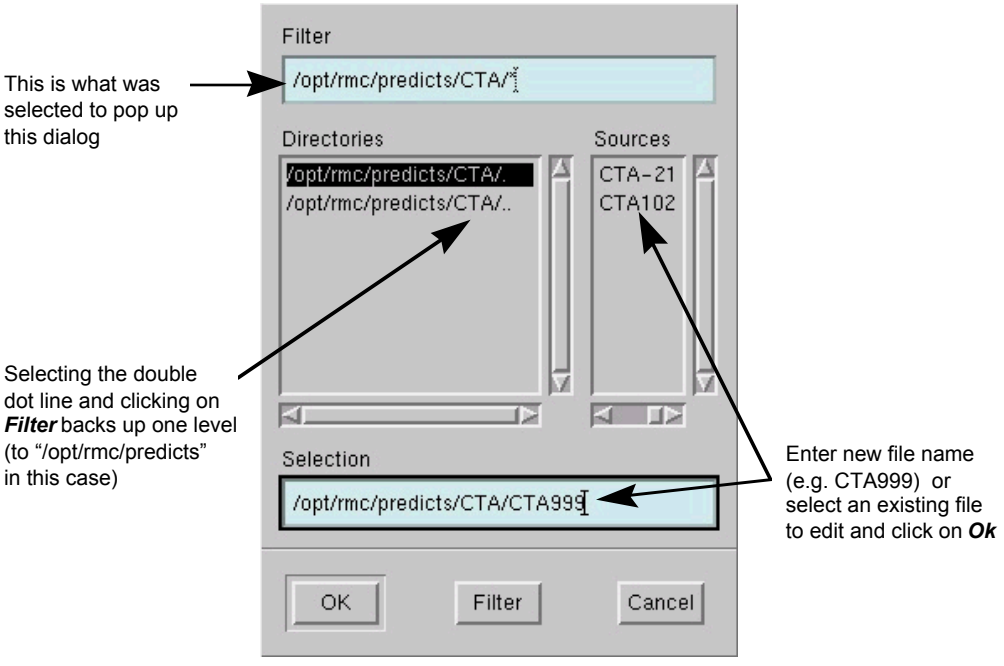


Figure 90. XAnt File Name Entry/Selection

After filename entry, a data entry popup appears. Different popups appear for different file types. Right ascension and declination may be entered in shhmmss.sss, sddmmss.ss or decimal degrees. Conversion to decimal degrees will occur automatically.

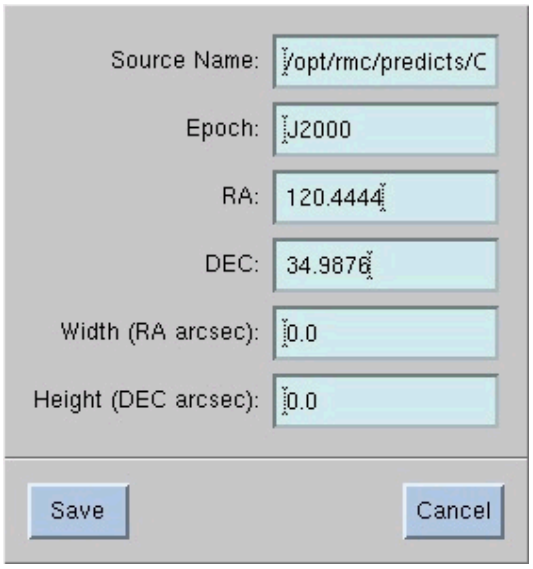


Figure 91. XAnt Sidereal Source Data Entry Popup

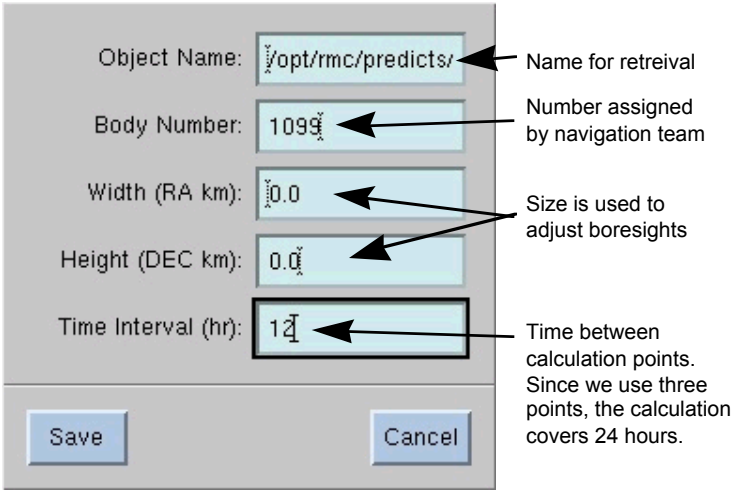


Figure 92. XAnt Planetary Object Entry Popup

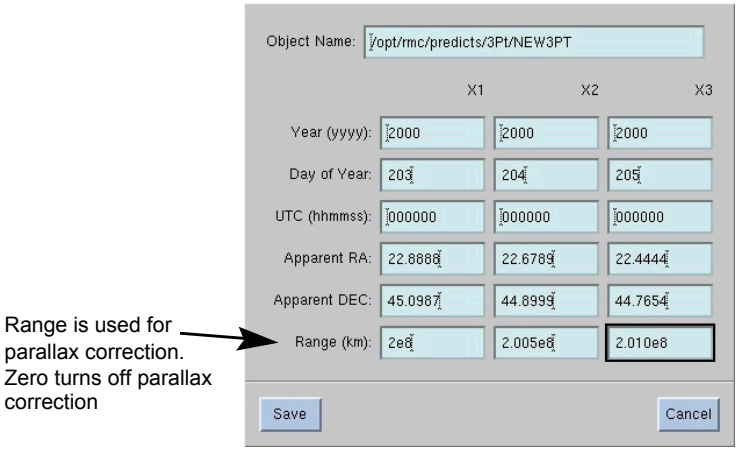


Figure 93. XAnt Three Point Fit Data Entry Popup

Selecting ***Delete*** will cause a file selection dialog to be popped up just like the one used for source selection. Simply select the file to be deleted and click OK. A confirmation popup will appear.

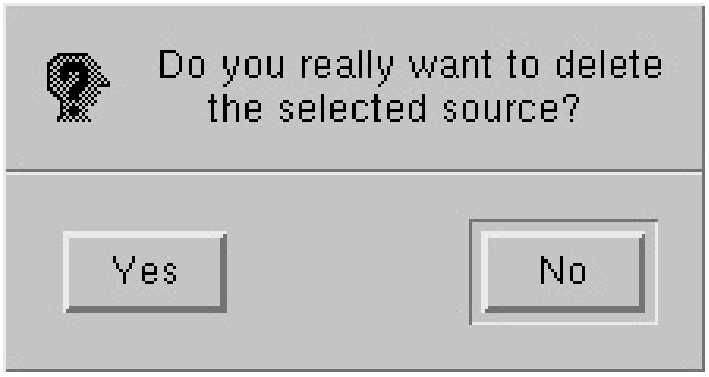


Figure 94. XAnt File Deletion Confirmation Popup

Appendix A

Radio Astronomy Controller Commands

The following commands may be sent to the Radio Astronomy Controller (RAC) using the COMMAND pulldown in the EACS XAnt. The information here is as provided by the RAC development team. Not all functions work and the descriptions may be unclear. To resolve ambiguity or functionality issues, please contact the RAC team.

NAME

calon - turns noise diode on

SYNOPSIS

calon [channel]

DESCRIPTION

The **calon** command turns the noise diode on. If a channel is not specified, this command turns on the noise diode for the current feed position.

OPERANDS

The following operands are supported:

channel Acceptable values are 1 through 4.

NAME

caloff - turns noise diode off

SYNOPSIS

caloff [channel]

DESCRIPTION

The **caloff** command turns the noise diode off. If a channel is not specified, this command turns off the noise diode for the current feed position.

OPERANDS

The following operands are supported:

channel Acceptable values are 1 through 4.

NAME

Ellipsoid_Pos - returns present ellipsoid position

SYNOPSIS

Ellipsoid_Pos

DESCRIPTION

The **Ellipsoid_Pos** command returns the present ellipsoid position.

OPERANDS

None.

NAME

Ellipsoid_Ang - returns present ellipsoid angle

SYNOPSIS

Ellipsoid_Ang

DESCRIPTION

The **Ellipsoid_Ang** command returns the present ellipsoid angle.

OPERANDS

None.

NAME

estop - sets antenna emergency stop

SYNOPSIS

estop

DESCRIPTION

The **estop** command stops the antenna.

OPERANDS

None.

NAME

full_cal - perform full-calibration of IF

SYNOPSIS

full_cal [IF]

DESCRIPTION

The **full_cal** command performs a full-calibration of the IF.

OPERANDS

The following operands are supported:

IF Acceptable values are 0=dual, 1=IF1, 2=IF2

NAME

if_pwr - returns last power meter reading

SYNOPSIS

if_pwr [channel]

DESCRIPTION

The **if_pwr** command returns the last power meter reading. If a channel is not specified, this command returns the last power meter readings from all channels.

OPERANDS

The following operands are supported:

channel Acceptable values are 1 through 4.

NAME

KUBand_LCP - JMOC KU-Band to LCP

SYNOPSIS

KUBand_LCP

DESCRIPTION

The **KUBand_LCP** command switches the polarization of the KU-Band receiver to LCP.

OPERANDS

None.

NAME

KUBand_RCP - JMOC KU-Band to RCP

SYNOPSIS

KUBand_RCP

DESCRIPTION

The **KUBand_RCP** command switches the polarization of the KU-Band receiver to RCP.

OPERANDS

None.

NAME

KUBand_LNA1 - JMOC KU-Band to LNA1 (Ambient)

SYNOPSIS

KUBand_LNA1

DESCRIPTION

The **KUBand_LNA1** command switches the KU-Band system to the ambient temperature HEMT.

OPERANDS

None.

NAME

KUBand_LNA2 - JMOC KU-Band to LNA2 (Cryo)

SYNOPSIS

KUBand_LNA2

DESCRIPTION

The **KUBand_LNA2** command switches the KU-Band system to the cryo temperature HEMT.

OPERANDS

None.

NAME

KUBand_Terminate - JMOC terminate power meter 50 ohm

SYNOPSIS

KUBand_Terminate

DESCRIPTION

The **KUBand_Terminate** command switches the power meter into a 50 ohm load for zero calibration.

OPERANDS

None.

NAME

KUBand_Normal - JMOC power meter to RF signal

SYNOPSIS

KUBand_Normal

DESCRIPTION

The **KUBand_Normal** command switches the power meter to the amplifier chain.

OPERANDS

None.

NAME

load - puts LNA into the load

SYNOPSIS

load [channel]

DESCRIPTION

The **load** command switches the LNA input into an ambient load. If a channel is not specified, this command switches the LNA input for all channels.

OPERANDS

The following operands are supported:

channel Acceptable values are 1 through 4.

NAME

minical - minical IF

SYNOPSIS

minical [channel]

DESCRIPTION

The **minical** command executes a single sequence of calibration steps for the specified channel.

OPERANDS

The following operands are supported:

channel Acceptable values are 0=dual, 1=IF1, 2=IF2.

NAME

mirror - move ellipsoid to position

SYNOPSIS

mirror [feedpos]

DESCRIPTION

The **mirror** command moves the ellipsoid.

OPERANDS

The following operands are supported:

feedpos Acceptable values are 1 through 6.

NAME

PCal_On - turns phase calibrator on

SYNOPSIS

PCal_On

DESCRIPTION

The **PCal_On** command turns the phase calibrator on.

OPERANDS

None.

NAME

PCal_Off - turns phase calibrator off

SYNOPSIS

PCal_Off

DESCRIPTION

The **PCal_Off** command turns the phase calibrator off.

OPERANDS

None.

NAME

pwr - returns last power meter reading

SYNOPSIS

pwr [channel]

DESCRIPTION

The **pwr** command returns the last power meter reading. If a channel is not specified, this command returns the last power meter readings from all channels.

OPERANDS

The following operands are supported:

channel Acceptable values are 1 through 4.

NAME

qt - returns last quartz thermometer reading

SYNOPSIS

qt [channel]

DESCRIPTION

The **qt** command returns the last reading of the quartz thermometer attached to the ambient load associated with the channel.

OPERANDS

The following operands are supported:

channel Acceptable values are 0=dual, 1=IF1, 2=IF2.

NAME

Rad_Disk_Off - turn off radiometer recording

SYNOPSIS

Rad_Disk_Off

DESCRIPTION

The **Rad_Disk_Off** command turns off power meter recording in all active radiometer channels.

OPERANDS

None

NAME

Rad_Disk_On - turn on radiometer recording

SYNOPSIS

Rad_Disk_On

DESCRIPTION

The **Rad_Disk_On** command turns on power meter recording in all active radiometer channels.

OPERANDS

None

NAME

reset_matrix - resets IF selector to no receivers

SYNOPSIS

reset_matrix

DESCRIPTION

The **reset_matrix** resets the IF selector to no receivers.

OPERANDS

None.

NAME

Set_Attenuator1 - set value of IF1 attenuator

SYNOPSIS

Set_Attenuator1 value

DESCRIPTION

The **Set_Attnenuator1** command sets the power meter level for channel 1.

OPERANDS

The following operands are supported:

value Acceptable values are 1 through 31. The values are in db.

NAME

Set_Attneuator2 - set value of IF2 attenuator

SYNOPSIS

Set_Attneuator2 value

DESCRIPTION

The **Set_Attenuator2** command sets the power meter level for channel 2.

OPERANDS

The following operands are supported:

value Acceptable values are 1 through 31. The values are in db.

NAME

Set_IF1_Filter - select IF1 filter

SYNOPSIS

Set_IF1_Filter number

DESCRIPTION

The **Set_IF1_Filter** command is used to select the filter desired for channel 1.

OPERANDS

The following operands are supported:

number — Acceptable values are 1 through 12. The following table lists filter center frequency and bandwidth for IF1.

Number	Center Frequency (MHz)	Bandwidth (MHz)
1	295	20
2	170	92
3	210	92
4	250	92
5	290	92
6	330	92
7	370	92
8	410	92
9	450	92
10	315	20
11	external	
12	No Filter	

NAME

Set_IF2_Filter - select IF2 filter

SYNOPSIS

Set_IF2_Filter number

DESCRIPTION

The **Set_IF2_Filter** command is used to select the filter desired for channel 2.

OPERANDS

The following operands are supported:

number Acceptable values are 1 through 12. The following table lists filter center frequency and bandwidth for IF2.

Number	Center Frequency (MHz)	Bandwidth (MHz)
1	325	20
2	170	92
3	210	92
4	250	92
5	290	92
6	330	92
7	370	92
8	410	92
9	450	92
10	300	30
11	external	*
12	No Filter	

NAME

SET_RAD_INT - set radiometer integration

SYNOPSIS

SET_RAD_INT value

DESCRIPTION

The **SET_RAD_INT** command is used to set the radiometer integration.

OPERANDS

The following operands are supported:

value Integer representing sampling period.

NAME

set_if1_switch - select receiver for IF1

SYNOPSIS

set_if1_switch receiver

DESCRIPTION

The **set_if1_switch** command is used to select the receiver providing IF1.

OPERANDS

The following operands are supported:

receiver Acceptable receivers are 1 through 15. The following table lists available receivers for all four radiometer channels.

Receiver	Description
1	X/Ka Ka1
2	X/Ka Ka2
3	Ku C/R
4	22 GHz - 1
5	S/X S1 RCP
6	S/X S2 LCP
7	S/X X1 RCP
8	S/X X2 LCP
9	X - ULNA X1
10	X - ULNA X2
11	W - Band
12	K - ULNA
13	
14	Ku Ped
15	22 GHz - 2

NAME

set_if2_switch - select receiver for IF2

SYNOPSIS

set_if2_switch receiver

DESCRIPTION

The **set_if2_switch** command is used to select the receiver providing IF2.

OPERANDS

The following operands are supported:

receiver Acceptable receivers are 1 through 15. Refer to the table for **set_if1_switch** to obtain receiver numbers.

NAME

set_if3_switch - select receiver for IF3

SYNOPSIS

set_if3_switch receiver

DESCRIPTION

The **set_if3_switch** command is used to select the receiver providing IF3.

OPERANDS

The following operands are supported:

receiver Acceptable receivers are 1 through 15. Refer to the table for **set_if1_switch** to obtain receiver numbers.

NAME

set_if4_switch - select receiver for IF4

SYNOPSIS

set_if4_switch receiver

DESCRIPTION

The **set_if4_switch** command is used to select the receiver providing IF4.

OPERANDS

The following operands are supported:

receiver Acceptable receivers are 1 through 15. Refer to the table for **set_if1_switch** to obtain receiver numbers.

NAME

sky

SYNOPSIS

sky [channel]

DESCRIPTION

The **sky** command is used to put the LNA associated with channel into the antenna position. With no argument, **sky** puts all LNAs associated with the current feed position into the antenna.

OPERANDS

The following operands are supported:

channel Acceptable channels are 1 through 4.

NAME

tsys - return Tsys for IF1

SYNOPSIS

tsys

DESCRIPTION

The **tsys** command returns the last Tsys measurement and standard deviation for IF1.

OPERANDS

None

NAME

tsys2 - return Tsys for IF2

SYNOPSIS

tsys2

DESCRIPTION

The **tsys2** command returns the last Tsys measurement and standard deviation for IF2.

OPERANDS

None

NAME

wx

SYNOPSIS

wx

DESCRIPTION

The **wx** command returns the last weather measurement.

OPERANDS

None