3. Ascope Utility

The **ascope** utility is a diagnostic and test utility used for aligning and testing the radar and signal processor. In addition, **ascope** provides a stand-alone radar display and control capability. Displays of the signal processor output data are generated vs. range in a graphical format. **Ascope** also generates displays of a single Doppler spectrum, time series, or raw A/D samples vs. range or at a selected range bin. During **ascope** operation, the antenna is usually controlled by hand wheels or the **antenna** utility to select interesting targets.

The supported signal processors are SIGMET Models RVP6, RVP7 and RVP8.

In this chapter:

3.1 Invoking Ascope

⚠ **Caution: Before running ascope, the setup utility must be run to install the proper wavelength and pulse width configurations. The latter is especially important for duty cycle limit protection.**

Command

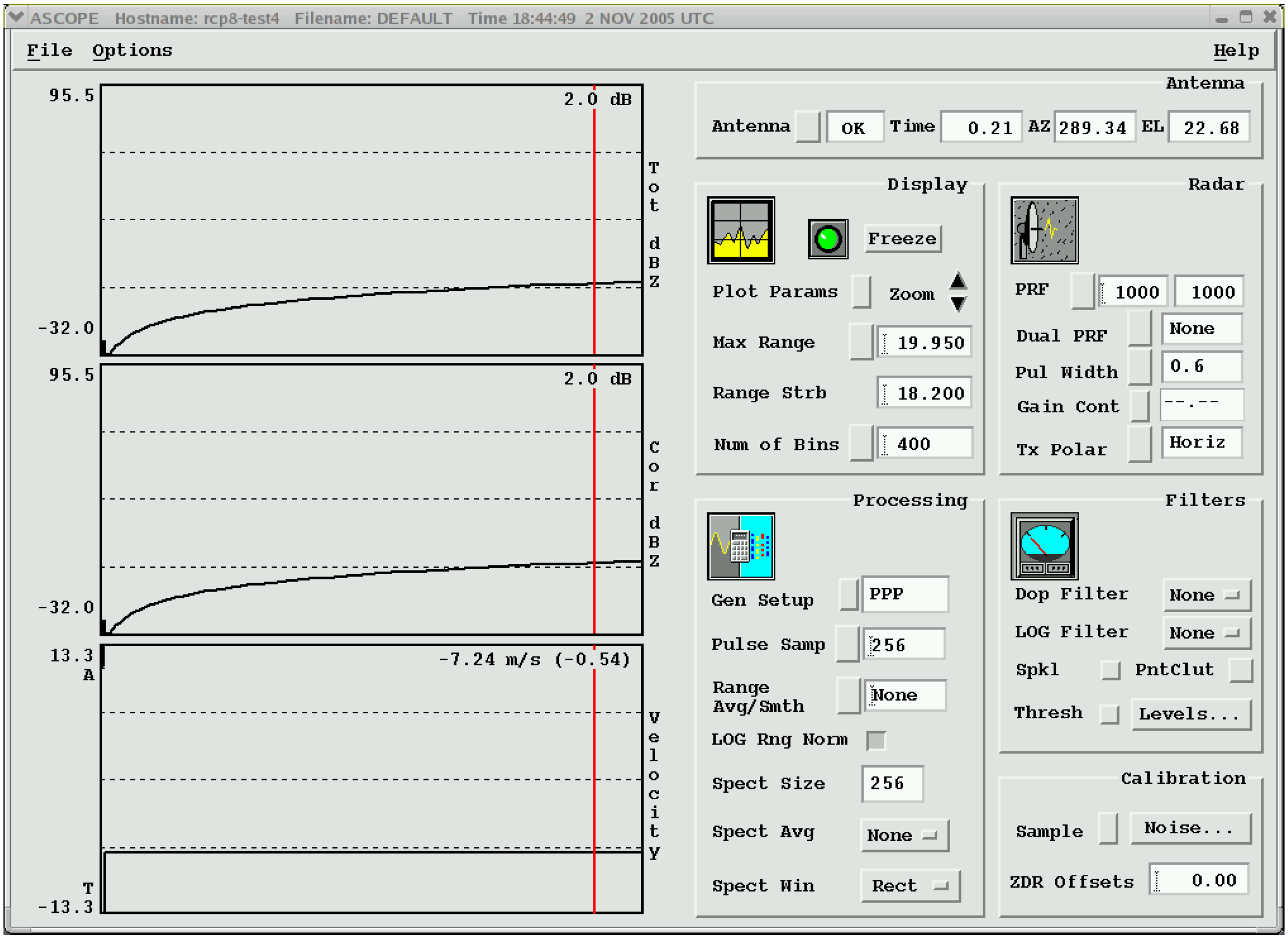
`ascope`

Options

`–demo`	Runs **ascope** without the signal processor, for testing and demonstration purposes.
`–step`	Runs with a special “single step” button enabled.
`–display NODE`	Create the display on NODE, rather than on the default display device.
`<name>`	Starts up with the named configuration, otherwise uses the saved DEFAULT configuration. If neither of these exist then factory default options are used.

If **ascope** cannot talk to the signal processor (for example, if the signal processor is not turned on), an error message is displayed. After repairing the problem, simply restart **ascope**.

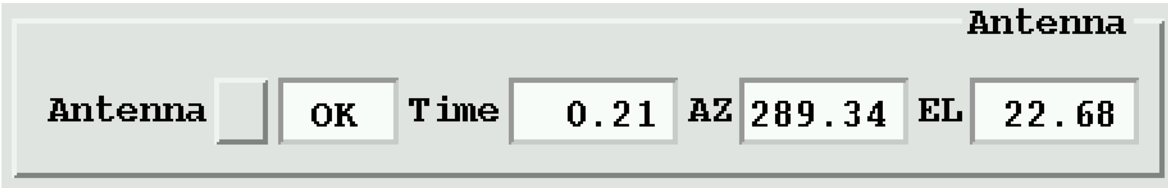
3.2 Ascope Menu



Antenna Status **Section 3.2.1**	Contains information about the current status of the antenna.
Display Status **Section 3.2.2**	Lets you freeze and resume the display and set display parameters, such as choosing the data to be plotted.
Radar Status **Section 3.2.3**	Displays information about the status of the radar, such as the PRF and pulse width settings.
Processing Status **Section 3.2.4**	Displays information about the processing mode and other processing options.
Filters **Section 3.2.5**	Lets you set the Doppler, LOG, Speckle, and Threshold filters.
Calibration **Section 3.2.6**	Displays information about DSP calibration. Buttons can take noise samples or set A/D converter offsets and gains

The **ascope** title bar contains the current date and time to log the time in printouts of the menu. See Section 3.3 for information on the plots that **ascope** can display.

3.2.1 Antenna Status



Antenna

Displays the antenna status as one of the following values:

OK	The antenna is functioning properly.
Dead	No data has been received from the RCP for at least five seconds.

Pressing the Antenna button invokes the **antenna** utility. (See Chapter 2).

Time

Shows the time between successive frames of the display.

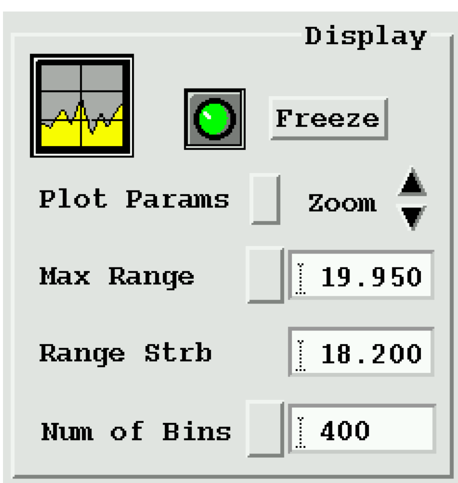
Azimuth

Shows the current azimuth of the antenna. Tag lines must be wired for this.

Elevation

Shows the current elevation of the antenna.

3.2.2 Display Status

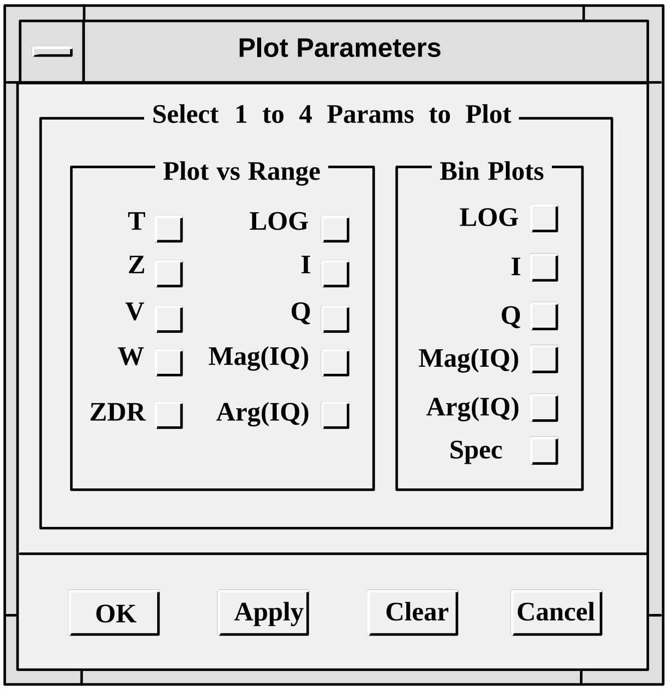


Freeze/Resume

Freezes or unfreezes the display, and stops or starts the signal processor. The green light indicates that the display is not frozen and the signal processor is running; the red light indicates that the display is frozen and the signal processor is not running.

Plot Parameters

Shows the currently selected plot parameters. Clicking on the button pops up the Plot Parameters menu, where you can select from one to four plots displayed in the order you choose. Note that up to sixteen parameters can be selected at once (See Data Recording Section 3.5), but that only the first four will be plotted on the display.



Choose the plot parameters you want to display.

If fewer than four are specified, only the specified plots are displayed.

If more than four are specified, only the first four are displayed.

If no parameters are selected (by clicking on the Clear button), **ascope** displays only one plot — the reflectivity vs. range plot.

Max Range

Shows the maximum range plotted for the selected plot parameters. You can also specify a new maximum range by entering any number or choosing from a menu. If the specified Max Range exceeds the unambiguous range, then the unambiguous range is substituted. The maximum range is constrained to be an integer multiple of the signal processor resolution multiplied by the number of range bins.

Menu choices are: 20, 40, 60, 120, 240.

Range Strobe

Shows the value of the selected range for the spectrum and time series plots, as well as the range for the numerical values displayed in the parameter vs. range plots. This range is also used for noise samples.

The Range Strobe is displayed in the plots as a vertical red line. You can change the value of the Range Strobe field and the position of this line in a number of ways:

- Enter a value directly in the field, and the line is moved to the new position. If the range you enter exceeds the Max Range, then the value for the Max Range field is substituted, and the vertical line is displayed at the far edge of the plot.

- Click the left mouse button within the plot. The vertical line moves to that location and the value of the Range Strobe field is updated to the new value.
- Use the right or left arrow keys to move the line to the right or the left. The value of the Range Strobe field is updated to the new value.

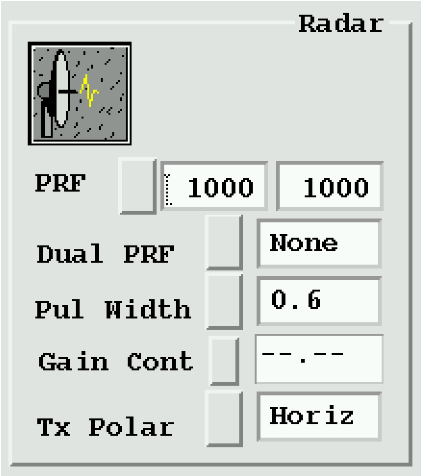
In any case, the Range Strobe is rounded to exactly hit the nearest processed range bin.

Number of Bins

Shows the number of range bins being plotted. Click on the button to select the number of acquired bins. The maximum value that this field can have depends on the signal processor.

The number of bins determines the number of points plotted on the parameter vs. range plots, including the Z, T, V, W, AI, AQ and ALOG plot parameters. Reducing this value can increase the update rate because less data needs to be transferred. This is useful when more rapid updates are required, especially for serial line graphics displays.

3.2.3 Radar Status



PRF

Shows the current PRF selection in pulses per second. Two values are displayed. The left box shows your requested PRF, while the right box shows the measured PRF. In configurations using an external trigger these numbers may differ. You can set this field to any number between the minimum and the duty cycle limit, or choose a value from a pop-up menu. The value shown is the higher PRF if dual PRF is selected. Note that **ascope** automatically limits the PRF to be within the duty cycle limit of the transmitter as configured in the **setup** utility. For this reason, it is important to run the **setup** utility before running **ascope**. The PRF should be set to 300 or greater when alternating polarization is used.

Menu choices are: 250, 300, 500, 600, 1000, 1200.

Dual PRF

For automatic velocity unfolding. This field shows either “None,” “3:2,” “4:3,” or “5:4.”

When you change this value, the velocity limits on the data plot are changed appropriately. Note that the PRF displayed as part of the status is the higher PRF rate. If any plots require time series, Dual PRF is set to “None” (no unfolding). In other words, there is no unfolding when I, Q, L, AI, AQ, ALOG, or Spec displays are plotted.

Menu choices: None, 3:2, 4:3, 5:4.

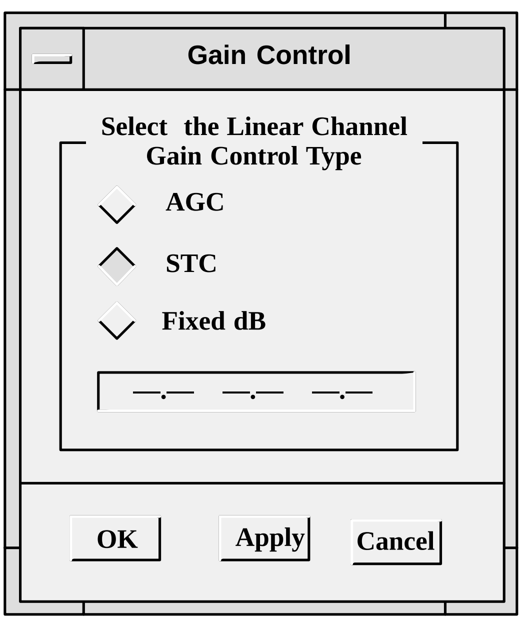
Pulse Width

Shows the current pulse width in microseconds. The pulse width can be changed by choosing from the pop-up menu. Note that this uses the pulse width signal lines of the signal processor and/or the antenna controller to set the pulse width. When switching longer pulse widths, **ascope** automatically lowers the PRF as required to stay within the duty cycle limits established in Setup.

Menu choices: 0.5, 1.0, 2.0, 6.0.

Gain Control

Shows what kind of gain control is being used. Click on this field to change the gain control scheme, using the Gain Control menu.



On the Gain Control menu, choose between the following:

- AGC — Automatic gain control
- STC — Sensitivity time control
- Fixed dB — Gain at a fixed level of attenuation. When you choose Fixed dB and you’re running in IAGC mode, you can enter from 1 to 3 dB levels. **Ascope** cycles between these settings.

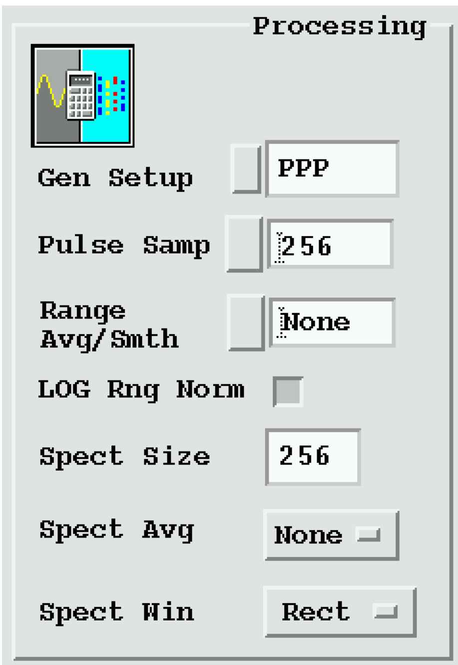
Click on the OK button to close the menu.

Tx Polarization *(available with ZDR option)*

Displays the transmitted polarization and lets you set the polarization and switching scheme. Box is desensitized on single polarization systems.

Menu choices: Horizontal, Vertical, H+V, or Alternating.

3.2.4 Processing Status



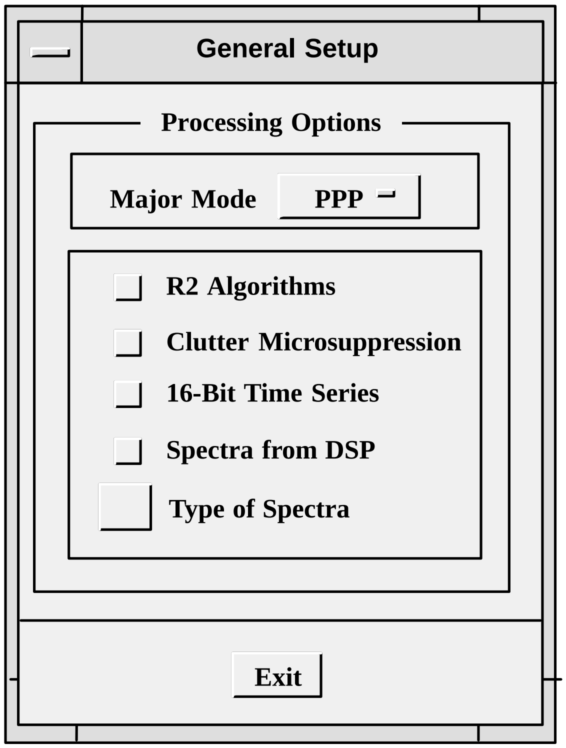
General Setup

Pops up a menu displaying the current processing mode and options. You can use this menu to switch between major modes of the RVP (such as PPP and FFT), and to select other processing options.

- The R2 Algorithms button selects whether the computation for spectral width uses three correlation lags (R0, R1, and R2), or only two (R0, and R1).
- The Clutter Microsuppression button enables the algorithm for removing suspected clutter bins from a run of range averaged samples.
- The 16-Bit Time Series button instructs **ascope** to read extended precision samples during the time series modes. It should generally be pressed ON; the OFF position causes 8-bit fixed point data to be read.
- The Spectra from DSP button causes **ascope's** spectrum plot to be drawn from spectral components that are read directly from the DSP, rather than internally computing those components from the raw time series. The DSP spectra are often

interesting to view during major modes that employ spectral filtering (such as the "FFT" and "Random Phase" modes).

- The Type of Spectra button is sensitized only in Random Phase major mode and only if spectra are being read directly from the DSP. This button pops up a menu of eight power spectra and lets you view the data as they progress through the RVP6 and RVP7 processing stages.



All of the buttons in this menu are "live"; they take effect immediately upon being selected. You may keep the menu up on the screen to compare the results with different settings. Click on Exit to remove the menu when you are finished. The Major Mode will remain visible in the button on the main screen.

Pulse Samples

Shows the current number of pulses for averaging of the spectrum moments or for time series. You can also select the number of samples (pulses) to be averaged into each of the V, W, Z or T plots; or the number of I, Q or L time series points to be plotted. The valid range is from 4 to 256. This field also sets the Spectrum Size field.

Menu choices: 8, 16, 32, 64, 128, 256.

Range Average or Smoothing

Sets the number of consecutive range bins to average within the DSP before displays. Choose "None" for no range averaging. Smoothing performs an average in range, but does not reduce the number of recorded range bins. An entry such as "1/4" means no range averaging, but do range smoothing over 4 bins.

Menu choices: None, 2, 4, 8, 1/2, 1/4. Other values available by type in.

LOG Range Normalization

Toggles range normalization of the LOG channel on and off. In some cases, you may want to disable the LOG channel range normalization algorithm in the signal processor. In this case, the reflectivity vs. range plot displays dBm above threshold rather than radar reflectivity factor.

Spectrum Size

Shows the number of samples used for a Doppler spectrum. This is always the greatest power of two less than or equal to the Pulse Samples field. That is, the Spectrum Size is the value of Pulse Samples field rounded down to the nearest of 4, 8, 16, 32, 64, 128 or 256.

For alternating polarization, this number is the sample size at each polarization, and the maximum value is 128.

Spectrum Average

Shows the averaging constant for spectrum averaging. The time constant for spectrum averaging affects only the spectrum display (the Spec plot parameter). The argument “None” corresponds to no averaging. The number 8 corresponds to maximum averaging. This number is the time constant of an exponential average in CPIs. Thus, a value of 1 means that after spectrum is computed, the previous data has weight 1/e. You should allow ample time for the spectrum to settle after changing the averaging. Changing the spectrum size zeroes the averaging. The annotation numbers displayed in the spectrum plot are also averaged.

Menu choices: None, 1, 2, 3, 4, 6, 8.

Spectrum Window

Lets you select the window to be applied to the time series before the spectrum is computed. The three choices are Black (Blackman), Hamm (Hamming), and Rect (Rectangular). The window dramatically affects the spectrum and can affect the computed SQI shown on the plot.

3.2.5 Filters

Doppler Filter, LOG Filter

These fields show the current filter selection.

You can select the clutter filter by number. The RVP6 and RVP7 have filters numbered 0 to 7. In all cases, filter 0 is equivalent to no clutter filter. Refer to the *Signal Processor User's Manual* for a description of the filter characteristics.

The RVP6 supports a LOG receiver base filter called the statistic clutter filter. To turn this filter on, specify two numbers — the first is the Doppler filter, and the second is the LOG filter. The data filtered by the LOG filter is determined by the RVP6 setup.

Menu choices: 0 to 7.

Speckle Filter

The speckle remover thresholds a data bin for which the bin before and after are already thresholded. Use this toggle button to clean random data from the display.

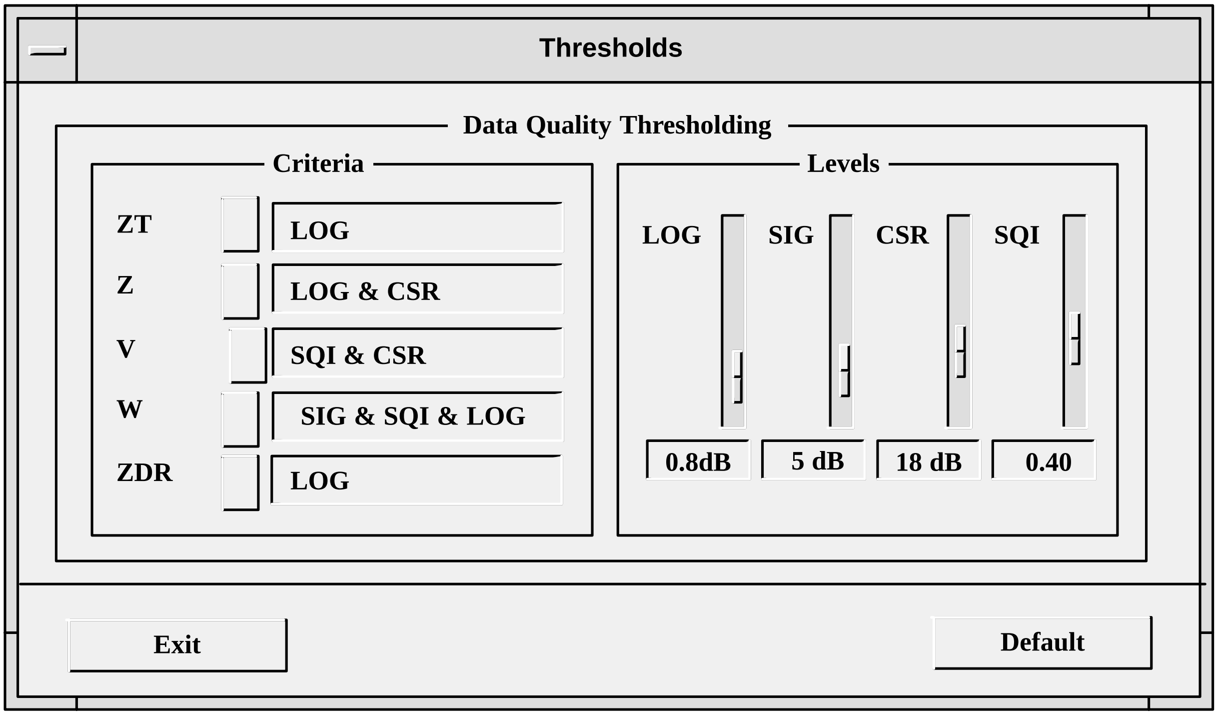
Point Clutter

Turns on/off the point clutter remover. This is a NEXRAD algorithm which runs on the I/Q stream before the data moments are computed. If it sees a sudden spike in power, it will replace with the average values from before and after in range.

Thresholds

Thresholding is the means by which the signal processor removes range bins that have weak signal power or unreliable estimates of the Doppler parameters. The Thresholds toggle button turns thresholding on and off. The Levels button pops up the Thresholds menu for setting the threshold criteria and levels.

For a general discussion of thresholding, see Chapter 2 of the *IRIS User's Manual*. See also the *Signal Processor User's Manual* for more details.



Criteria for thresholding are set for each of the data parameters — ZT, Z, V, and W. You can choose to discard the data when one or more of the following threshold parameters are weak:

- LOG — LOG receiver signal-to-noise ratio.
- SQI — Doppler channel signal quality index.
- CSR — Doppler channel clutter-to-signal ratio.
- SIG — A measure of the power from weather targets, excluding noise.

You can set the criteria from pop-up menus (click on the button beside the criteria you want to set), or enter any Boolean equation using the variables SQI, LOG, CSR, and SIG, separated by “and” and “or”. Choose or enter “all pass” to accept any value, in effect turning off thresholding.

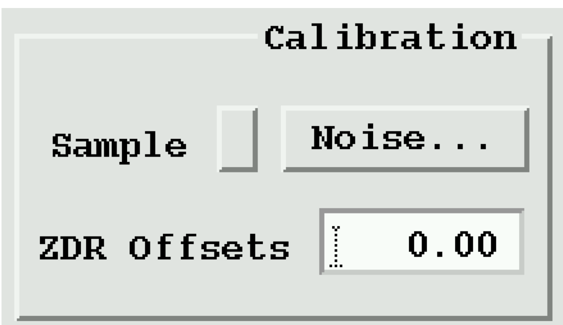
Levels are set by entering a value directly or by moving the sliding scale until the value you want appears in the field.

- LOG — Sets the LOG receiver threshold in dB above noise. If thresholding is turned on and the LOG video signal is below this threshold level, reflectivity is thresholded on the reflectivity plots. You can enter a value between 0 and 5 dB.
- SIG — Sets signal power threshold level in dB above noise. Often this is used to threshold widths. If the LOG video signal power is below this threshold after removal of clutter power, the widths are thresholded. You can enter a value between 0 and 20 dB.

- CSR — Sets the clutter-to-signal ratio threshold. If the ratio exceeds this threshold, and thresholds are enabled, the Doppler data are thresholded. Enter a value between 0 and 50 dB.
- SQI — Sets the Doppler threshold level. Similar to the LOG threshold level except that it is for the Doppler channel signal quality index. If the processor computes an SQI less than the threshold defined here, the velocity and width data for that range bin are not plotted. You can enter a value between 0 and 1. A value of 0 causes nearly all data to be plotted; 1 causes nearly nothing to be plotted. A value of 0.3 generally eliminates the weak signals and passes signals that have good mean velocities. Note that the “noise points” that get by the threshold correspond to speckles on the color display. This is useful for reducing the amount of data that is transferred to serial line graphics displays.

After you have entered your thresholding criteria and levels, click on OK to apply your settings and exit from the menu. If you want to reset the values to their defaults, click on the Default button.

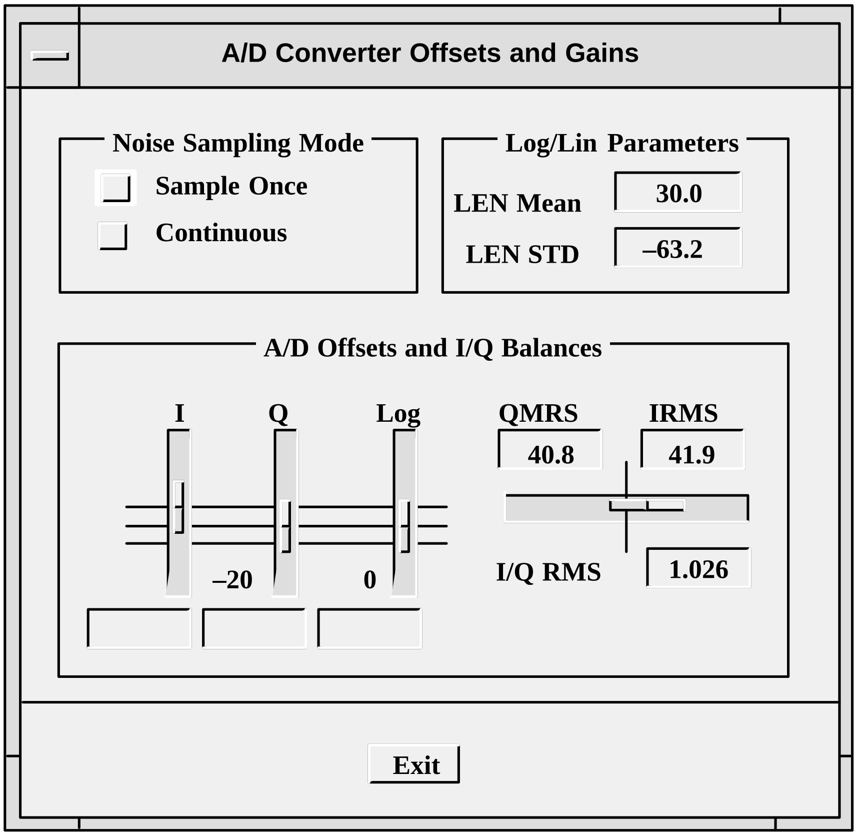
3.2.6 Calibration



Sample Noise

The Samples Noise button takes a new signal processor noise sample at the range specified by the Range Strobe field. Refer to the *Signal Processor User’s Manual* for details.

The Offsets button pops up a the A/D Converter Offsets and Gains menu for setting the A/D converter offsets and gains.



In this menu, you can set the Noise Sampling Mode to one of the following:

- Sample Once — Takes a single noise sample.
- Continuous — Takes continuous noise samples. This slows the display speed.

Be careful not to take a noise sample when a test signal is present, or the test signal level is interpreted as the noise level. This leads to erroneous displays of reflectivity.

Log/Lin Parameters are:

- LEN Mean — The linear averaged mean of the LOG samples, expressed in A/D converter units.
- LEN STD — The linear averaged standard deviation of the LOG samples, expressed in A/D converter units.

Set the A/D Offsets and I/Q Balances as follows:

- I, Q, and Log — Show the DC offsets of the A/D channels. I and Q are between –127 and 127; Log is between 0 and 256. You can enter values in the fields or move the sliding scale until the value you want appears in the field.
- IRMS, QRMS — The standard deviation of the I and Q noise samples. These should be nearly the same, or the signal processor must be adjusted (I and Q gain). Enter a value directly into these fields.

- IQRMS — The ratio of the I RMS to Q RMS values. This should be within ±0.03 of 1.00.

When you are satisfied with these settings, click on the Exit button.

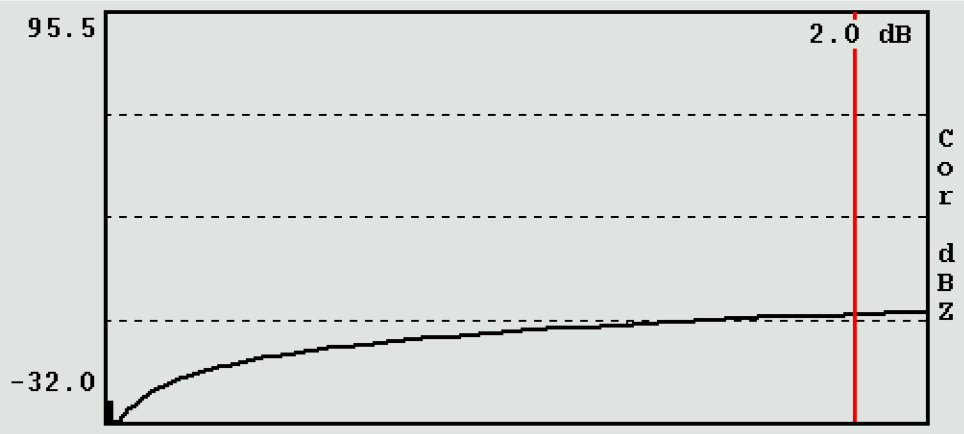
ZDR Offset *(available with ZDR option)*

Shows the ZDR calibration offset, or “N/A” for systems without ZDR. You can also use this field to set the ZDR offset. The number you enter is added to the differential reflectivity to correct for differences in the receiver chain.

3.3 Ascope Plots

Ascope can plot from one to four parameters at a time. The plots are scaled so that when only one plot is requested, it is zoomed to fill the left side of the menu.

3.3.1 Reflectivity vs. Range Plot (T and Z)

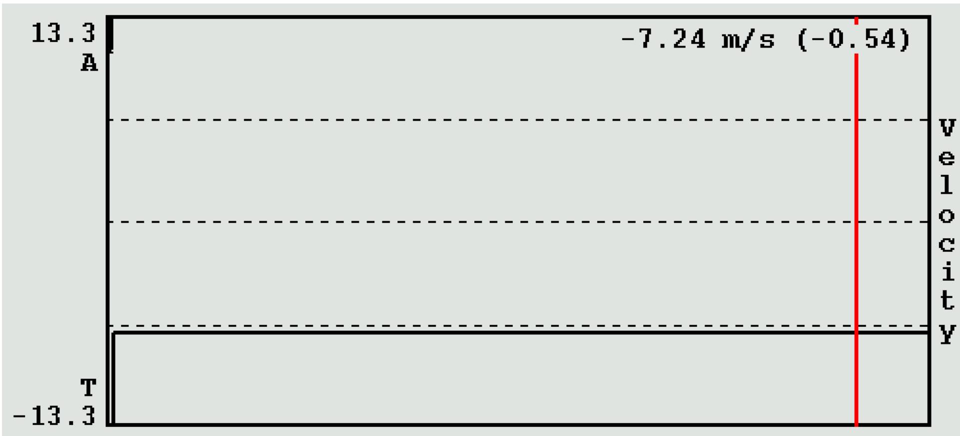


This plot is generated when you choose the T and Z plot parameters. T is the total reflectivity without clutter correction; Z is the reflectivity with clutter correction. These are the equivalent radar reflectivity factors and are fully calibrated estimates. Of course, you need to calibrate your radar system before the values are correct (see the **zauto** utility and the *Signal Processor User's Manual*). The **ascope** utility lets you temporarily change the slope and offset of the calibration without modifying the calibration file used for the IRIS system.

The data are plotted in decibel values between –32 and 96 dBZ between 0 and the selected Max Range. The numerical value in the upper right portion of the display shows the reflectivity at the selected range, indicated by the vertical red line.

See also the Pulse Samples, LOG Filter, Thresholds, Number of Bins, LOG Range Norm, Calibration ZCAL, and Calibration Slope fields.

3.3.2 Doppler Mean Velocity vs. Range Plot (V)

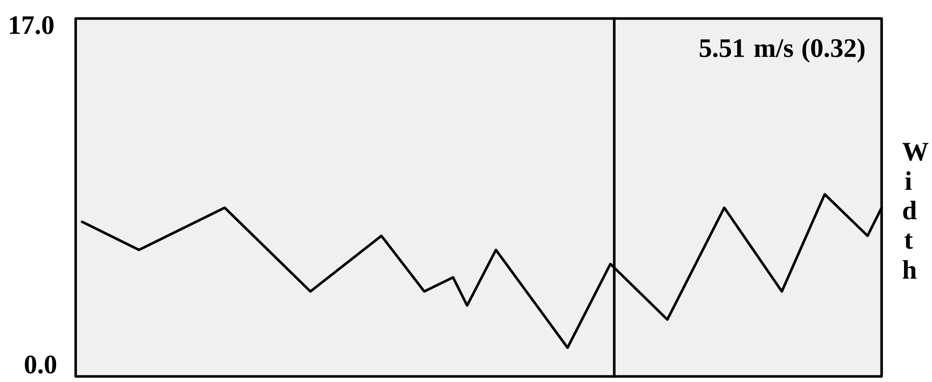


This plot is generated when you choose the V plot parameter. The mean velocity corresponds closely to the peak velocity in the Doppler spectrum display. Velocity is displayed in m/s on the unambiguous velocity interval. “T” indicates toward, and “A” indicates away. This plot should be checked on a known wind to make sure the velocity sign is correct. Otherwise, it is necessary to swap the I and Q inputs of the processor.

Similar to the reflectivity plots, the value of the mean velocity in m/s (and normalized to the interval [–1, +1]) at the selected range is displayed in the upper right corner of the plot.

See also the Pulse Samples, Threshold Levels, Doppler and LOG Filter, Thresholds, and Number of Bins fields.

3.3.3 Spectrum Width vs. Range Plot (W)



This plot is generated when you choose the W plot parameter. The spectrum width is the standard deviation of the Doppler spectrum. (The Doppler spectrum display itself always appears broader than the indicated width, because the spectrum is on a log scale). Width is displayed in m/s up to the unambiguous velocity value. Broader widths are difficult to measure.

Similar to the mean velocity, the numerical value of the width is displayed in m/s and for the normalized velocity interval [–1, +1] for the selected range (as indicated by vertical yellow line).

See also the Pulse Samples, Threshold Levels, Doppler and LOG Filter, Thresholds, and Number of Bins fields.

3.3.4 ZDR vs. Range Plot (ZDR) *(available with ZDR option)*

This plot is generated when you choose the ZDR plot parameter. The differential reflectivity is the ratio of the reflectivity at vertical polarization to the reflectivity at horizontal polarization. The range displayed is roughly –8 to +8 db.

Similar to the spectrum width, the numerical value of the ZDR in dB is displayed for the selected range (as indicated by vertical yellow line).

See also the Polarization, Plot Samples, ZDR Offsets, and Number of Bins fields.

3.3.5 Linear Channel A/D vs. Range Plot (I and Q or Mag and Arg)

This plot is generated when you choose the I and Q plot parameters vs range. This display is important for alignment of the analog to digital converters. The A/D values are between –128 and 127. The range is between 0 and the Max Range. The number of points plotted is determined by the Number of Bins field.

The I and Q DC offsets (if any) and average amplitudes are displayed in the status display. These are important for the signal processor A to D converter alignment. Note that the I and Q A/D values should never be allowed to saturate — hit the top of the box. If this is observed, the gain of the converters needs to be adjusted as described in Sections 3.7.1 and 3.7.2 of this manual and the *Signal Processor User's Manual*.

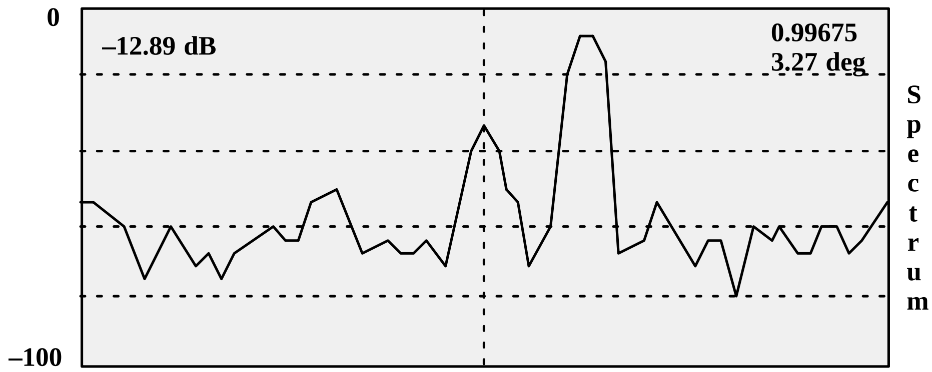
The Mag and Arg choices represent I and Q in polar form as a phaser. The magnitude is the SQRT ($I^2 + Q^2$) while the phase is ATAN (Q / I). These plots are sometimes more intuitive than the I and Q plots.

3.3.6 LOG Channel A/D vs. Range Plots (ALOG)

This plot is generated when you choose the ALOG plot paramter. This plot is similar to the linear channel AI and AQ plots, but the values correspond to the LOG channel analog to digital converter. The values are between 0 and 255.

The Z offset is displayed in the status section. This is the average value of the LOG A/D samples and should be between approximately 10 and 30 A/D units. If it is not, refer to Sections 3.7.1 and 3.7.2 of this manual and the *Signal Processor User's Manual* to align the A/D converter.

3.3.7 Doppler Spectrum Plot (Spec)



This plot is generated when you choose the Spec plot parameter. This is the single most useful plot for monitoring the alignment and performance of the Doppler channel. The Doppler spectrum is computed from the I and Q time series (see Section 3.3.8) for the selected range. The FFT mode spectrum can be displayed directly. The scale is in dB marked with 20 dB divisions. Zero velocity is indicated by a vertical line. This is the velocity of ground clutter targets. The Doppler spectrum plot is always given twice as much vertical height on the screen as the other plots.

The numerical values in the display are as follows:

- Top left — Linear channel power in dB. This is uncalibrated on an absolute scale. However it is very accurate on a relative scale as long as the linear receiver is not saturated.
- Top right — Signal quality index or SQI (|R1|/R0). This is a value between 0 (white noise) and 1 (pure tone). This is useful in determining how coherent the radar system is (see Section 3.7).
- Top right (beneath SQI) — RMS phase noise in degrees. This includes noise contributions caused by both amplitude and phase errors, and is computed directly from the SQI as follows:

$$PhaseNoise = \frac{180}{\pi} \times \sqrt{-\ln(SQI)}\ .$$

- Time series from the are clutter filtered, so the filter fields can be used to see the effect of various filters on the Doppler spectrum.

The typical Doppler spectrum contains white noise at all velocities, a ground clutter spike at zero velocity, and a weather spectrum. Some points to note:

- With the clutter filter set to “None” (no filter), you can observe a strong clutter target to determine the linear dynamic range of the system. Observe the dB difference between the peak of the clutter and the white noise.
- Coherent artifacts are caused by leakage of other signals, such as 50 or 60 cycle line power into the transmitter/receiver system. These appear as peaks located

symmetrically about zero velocity. To obtain the best Doppler measurements, coherent artifacts should be minimized by reducing the leakage of stray signals.

- Image spectra occur when a weather spectrum has a mirror image on the other side of zero velocity. Usually the image is smaller than the primary weather peak. Image spectra are typically caused by the following:

  — Saturation of the A/D converters
  — Gain imbalance of the I and Q channels

To correct these problems, see the *Signal Processor User's Manual* and the procedures described in Sections 3.7.1 and 3.7.2 of this manual.

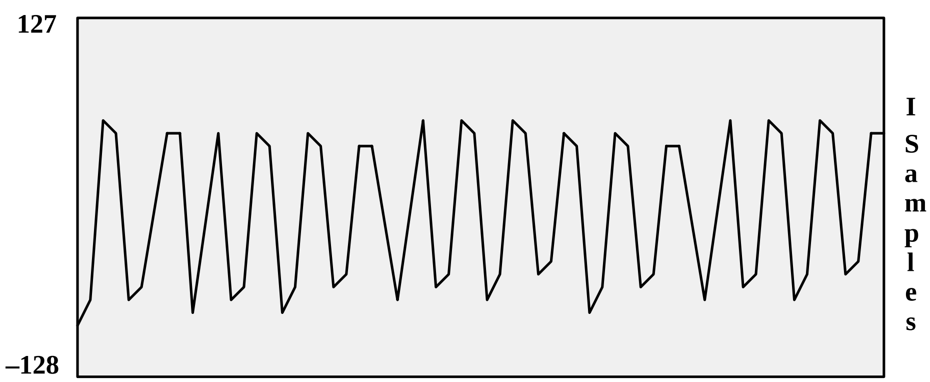
The number of points that are plotted are 4, 8, 16, 32, 64, 128 or 256 as indicated by the Spectrum Size field. The number of points can be changed with the Pulse Samples field. If a number other than a power of 2 is entered, the next lowest allowable value is accepted (for example, a Pulse Sample of 126 sets the Spectrum Size field to 64 points).

When selecting the range for the spectrum, it is useful to display a velocity vs. range (V) or reflectivity vs. range (Z) plot. These plots can show you where there are targets of interest.

Because spectra can be very noisy, **ascope** has a spectrum averaging feature for detecting weak signals. Averaging causes the update rate to slow down. A value of "None" corresponds to no averaging. A value of 8 is the maximum value.

See also the Pulse Samples, Spectrum Average, Spectrum Window, Doppler and LOG Filter and Range Strobe fields.

3.3.8 Time Series at a Selected Range (I, Q, and LOG)



These plots are generated when you select the I, Q and LOG plot parameters. I and Q correspond to the linear channel in-phase and quadrature signals, and LOG corresponds to the LOG channel video signal. These plots are similar to the AI, AQ and ALOG plots except that the samples at a single range are plotted versus time — each point represents a different pulse.

The Pulse Samples field sets the number of points that are plotted. As with the spectrum display, the velocity or reflectivity vs. range plots can help you select a range where there are interesting targets.

An alternative way to show I and Q is to use the Mag and Arg displays (the phaser form of I and Q). The numerical value displayed in the upper right is the RMS value of the fluctuations. When viewing a clutter target, these values can be used to assess both the phase and amplitude stability of the transmitter/receiver.

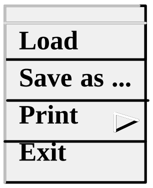
Note that the RVP6 and RVP7 time series are clutter filtered. When using the time series plots remember that the clutter filter removes low velocity signals. This can be perplexing when a test signal is inserted and no signal time series is observed. It may be that the clutter filter is effectively removing the signal.

See also the Pulse Samples, Range Strobe, and Doppler and LOG Filter fields.

3.4 Ascope Commands

The **ascope** utility provides the following commands:

File



Load pops up a list of configuration files. Choose the one you want to load..

Save As... lets you save your configuration under the same name or under a new name that you specify.

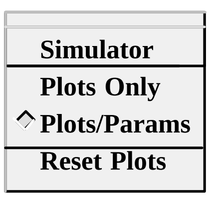
Print creates an X-window dump of the menu you are running, as follows:

- **Print–>to Printer** sends the output to the Postscript or color printer specified in the Printer Setup menu.
- **Print–>to File** sends the output to a file in your default home directory.
- **Print–>Setup** lets you configure the printer on your system. See Section NO TAG for information on configuring a printer.

Exit exits from the **ascope** utility.

The named **ascope** configurations are stored in the files **`*.ASCOPE`** in the **`config`** directory. The default startup configuration is named **`DEFAULT.ASCOPE`**

Options



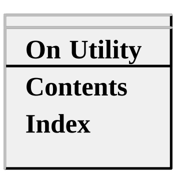
Simulator pops up a menu for defining a digital signal. See Section 3.6 for information on this menu.

Plots Only removes the plot parameters from the **ascope** menu, so that the plots can take up the entire window.

Plots/Params divides the menu in half, with the plots displayed on the left and the parameters displayed on the right.

Reset Plots

Help



On Utility displays information on the **ascope** 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.

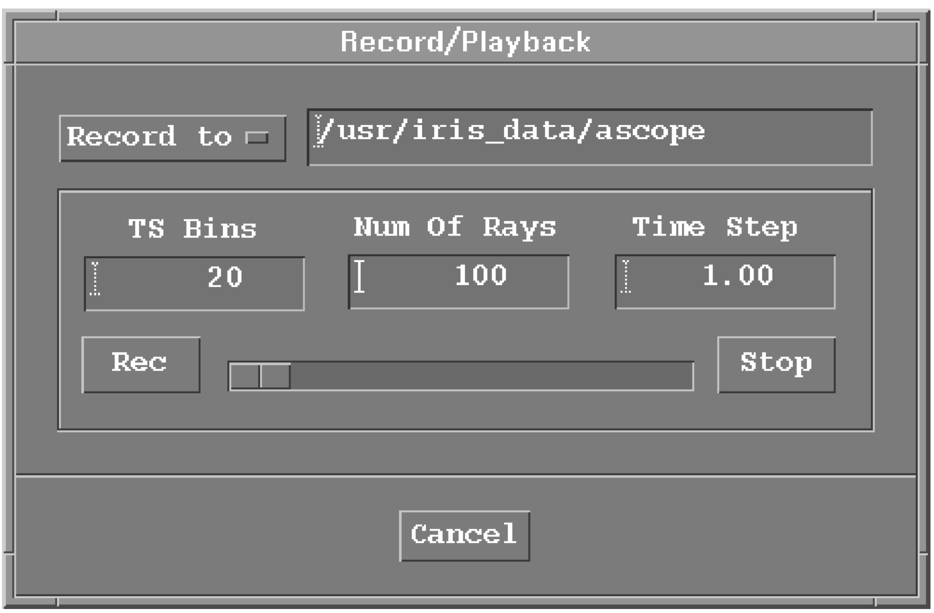
3.5 Data Recording and Playback

The **ascope** utility has the ability to record live DSP data directly to a disk file so that users may develop their own off-line application programs for custom data analysis. The recording procedure is interactive and may be invoked any time that interesting data are observed on the display. The files may also be played back by **ascope**, both to review their contents and to check the integrity of the values.

Note: After you have recorded files to disk, you can archive them to tape using UNIX tar, or SIGMET's easy-to-use sigbru backup/restore utility that is based on gnutar. sigbru allows you to selectively backup/restore ascope data files and provides useful tape and disk inventory information. Refer to the *IRIS Installation Manual* for information on sigbru.

3.5.1 The "Record" Menu

From the top level menu choose "File–>Rec/Play..." to get the following popup. The menu initially appears in the "Record" mode; to switch to the "Playback" mode (described in the next section) use the menu's selection widget.



Information Displayed on the "Record" Menu

The "Record" menu shows the following information:

- Directory in which data files will be recorded. This defaults to `/usr/iris_data/ascope`, but it may be changed to any directory that is writable by the user.

- Number of bins at which time series and/or power spectra will be recorded. The chosen bins will be centered on the range strobe that is selected in **ascope's** main menu. The number of TS Bins must be between 0 and 128.
- The number of rays of data to record. Each "ray" represents the data from one complete iteration of the basic **ascope** loop, i.e., one acquisition of the set of all data types that are selected in the "Plot Parameters" menu. The maximum number of rays that can be recorded is 10000.
- The desired time step between rays. This is the time in seconds between successive recorded rays, and may range from 0 to 600 seconds (ten minutes). Setting this value to zero will give continuous data recording; but larger values may be used to record over a longer time interval without creating too large a data file. For example, a time step of ten seconds would record six rays per minute to disk, even though the DSP and display still update continuously.
- "Rec" and "Stop" push buttons, used to begin recording or to stop before reaching the full number of rays.
- Progress slide bar that gives a visual indication of the progress of the current recording session.
- "Cancel" button to dismiss the menu and return to normal **ascope** operation.

Making a Data Recording

To operate the "Record" menu, begin by configuring **ascope** in the normal manner so that the weather phenomenon is visible on the screen. Select a maximum range and bin spacing that will capture the entire event at an adequate resolution. Setup the PRF, clutter filters, range averaging, spectral averaging, etc. so that the weather target's characteristics are nicely captured.

Ascope operates the DSP in the usual continuous manner when the "Record" menu is first popped up on the screen. You may proceed with modifying **ascope's** main menu and all submenus, including the "Record" menu itself. This makes it easy to create the exact configuration that you would like to record. However, once the "Rec" button is pressed and actual recording begins, all **ascope** menus become desensitized so that no changes can be made during the recording session. The menus and plots remain live and visible, but the only button that can be pressed is "Stop".

During the recording session the menu's slidebar will move from left to right to indicate the progress. Recording will stop automatically when the the full number of rays are recorded and the slidebar has reached 100%; or it may be stopped earlier with the "Stop" button. At that point the entire **ascope** environment becomes resensitized and returns to normal operation.

A valid recording directory should be selected prior to pressing "Rec", but the actual file names are created automatically by **ascope**. The file names are of the form "WWWYYMMDDHHMMSS.ASC" where "WWW" represents the 3-character local site code, and the remaining characters are the 2-digit year, month, day, hour, minute, and second at the start of recording. The ".ASC" suffix is always appended so that these files can easily be spotted in a directory.

Choosing the Parameters to Record

Up to sixteen different parameters may be recorded to disk at once. These are chosen from the "Plot Parameters" menu in the usual way, except that more than just four items can be selected at once. Only the first four parameters will actually be plotted on the screen, but all of the selected items will be archived. This feature makes the process of recording and live monitoring very flexible.

For example, suppose that the six buttons: "Z", "T", "V", "W", "I", and "Q" are selected in that order. **Ascope** will then display the first four parameters versus range, but will record all six as soon as the "Rec" button is pressed. If the time step and number of rays were setup for a long interval of recording, you could monitor the plotted parameters by eye and discontinue recording if the weather event changed or became less interesting.

Ascope can record power spectra, either in place of or in addition to the "I" and "Q" data from which the spectra are derived. If spectra are recorded on their own, then the size of the data files will be reduced by approximately a factor of two. This may be significant when many bins of data are being recorded. But another advantage that spectra offer is that they can be averaged prior to being recorded, and thus could supplement the "I" and "Q" data in a useful way. For example, if "I", "Q", and "Spec" rays were recorded every ten seconds, and if the spectral averaging were set to approximately ten seconds, then the archived data would contain highly averaged spectra plus occasional instantaneous time series.

Each individual data parameter ("T", "V", "Zdr", etc.) is recorded over the full range interval specified by the maximum range and bin count in **ascope's** main menu. Likewise, the single-pulse "AI', "AQ", and "AL" data samples are also recorded over the full range interval. However, time series and spectra are recorded only at the limited number of bins specified in the "TS Bins" field, and centered at the distance of the range strobe. Whenever the "Record" menu is visible, this secondary range interval will be seen as a pair of dotted vertical lines drawn on either side of the range strobe. Thus, to record time series and/or spectra, you must choose a nonzero value for "TS Bins", and must select "I", "Q", and/or "Spec" from the "Plot Parameters" menu.

Note that the MAG and ARG parameters are not available for recording to disk. This is because these parameters are merely computed at display time and are completely redundant with "I" and "Q". They would not add any averaging or data reduction possibilities if recorded. If you press the "Rec" button while a MAG or ARG plot is selected a warning message will appear to remind you that you may not be recording exactly what you think. However, the data file will still properly contain all of the other selected parameters.

3.5.2 The “Playback” Menu

This menu is used primarily to review the contents of the recorded data files, and to serve as a confidence check on the entire recording process. Any file may be selected for viewing, and the rays may be displayed either individually or as a continuous “movie loop”. A sample “Playback” menu is shown below.

Information Displayed on the “Playback” Menu

The “Playback” menu shows the following information:

- Directory from which data files will be played. This defaults to the same directory that was used for recording, but it may be changed to any directory that is readable by the user and which contains **ascope** data files.
- Scrolled list of file names, dates, and times. This list is refreshed each time the “Playback” menu pops up or reappears. The files are displayed in reverse chronological order so that the most recently recorded data are always at the top. The entire menu may be stretched vertically to enlarge the file viewing area. Files are selected (highlighted) by a single-click of the mouse, and they may be deselected in the same manner.

- Slide pot for selecting the ray number to be displayed. The left and right limits correspond to the first and last ray within the selected file. The ray number (starting from zero) is displayed on top of the slider. You may move this control freely to browse the recorded rays. Left-clicking on either side of the slider will increment or decrement the ray number by one.
- “Play” and “Stop” buttons for activating the movie loop playback mode. When the “Play” button is pressed, **ascope** will loop continuously through all of the rays in the data file. This is handy for watching a phenomenon evolve over time.
- “Pause” and “Speed” slide pots for adjusting the end-of-loop pause and frame rate when the “Play” button is pressed. The pause at the end of each loop can be up to ten seconds, and the delay between successive rays can be up to two seconds.
- “Cancel” button to dismiss the menu and return to normal **ascope** operation.

Procedure for Playback of Data

The “Playback” menu may be invoked whenever **ascope** is in its normal mode of operation, i.e., acquiring live data from the DSP. It may also be used off-line (in a system with no DSP) by initially starting the utility with the “`–demo`” option. Each time the menu is activated the playback directory is rescanned for files that match the **ascope** naming convention. This collection of files is then displayed in the scrolling list. The file names and times reflect the start time of each data file.

Initially, none of the file names will be selected and **ascope** will continue to run normally even though the “Playback” menu is exposed. However, the following actions will take place as soon as a file is selected:

- The entire **ascope** configuration is reloaded from the header of the data file. This causes all menus and displays to return to the appearance that they had at the time the recording was made. The name displayed in the top title bar of the main menu will change to the name of the selected file.
- All **ascope** menus become desensitized, except for the “Play” button and slide pots of the “Playback” menu itself. **Ascope** is now bound by the original selections of the highlighted data file; hence, the main menu functions are all disabled.
- The data from the first ray are loaded from the file and plotted on the screen. The ray selection slide bar is initialized to its left edge (ray #0), and the time shown in the top title bar changes to the time of this first ray.
- **Ascope** waits in this state indefinitely, until either the file is deselected or the “Playback” menu is exited. But in the meantime, the recorded dataset may be browsed interactively using the ray slide bar, or continuously via the “Play” function.

Each time a new ray is requested from disk, not only are the data values displayed in the plotting area, but all other numeric fields are updated as well. **Ascope** is able to do this because each recorded ray is tagged with additional header information consisting of the time, TAG bits, and GPARM information. Thus, the azimuth and elevation angles will be displayed, along with the current PRF, error bits, etc., that were originally measured with each ray.

3.5.3 Format of the Recorded Data

The data files are organized as a 1280-byte **asc_stats** configuration structure, followed by the individual ray data in their original order of arrival. Furthermore, each ray is prefaced with a 200-byte **asc_ray_header** structure that holds additional information from the exact moment that each ray was acquired. Both structures are detailed in the public header file **ascope.h** (refer to this file for detailed comments).

To process the contents of an **ascope** data file, begin by opening the file and reading the first 1280-bytes into an **asc_stats** structure. Use the actual ray count **irec_rays_actual,** and ray data length in bytes **irec_ray_size,** to divide the remainder of the file into fixed length blocks. Each block consists of an **asc_ray_header** structure followed by the ray data itself.

The ray data are defined by the **iplottypes[]** array, which lists up to sixteen different data parameters that were recorded. Each parameter is stored in its native format as read from the DSP. These data formats are described in the *Signal Processor User's Manual*, section on the "PROC" command, also in the *IRIS Programmer's Manual*. The length of each data parameter array is rounded up to the next multiple of four bytes to insure that successive elements within the file will be aligned on 4-byte boundaries if they need to be.

There is no difference between "I" and "AI", "Q", and "AQ", etc. in terms of data format. The only difference is that the "A" terms span the full range, and the non–A terms span the full pulse count.

The 4 "derived parameters" MAG_AIQ(10), ARG_AIQ (11), MAG_IQ (15) and ARG_IQ (16) are not actually recorded on disk, since doing so would not add any more information than was contained in the original (I,Q) data. ASCOPE can plot these four parameters (because that is often handy), but they will not be included in the archived disk file. Please include the raw (I,Q) parameters themselves if that's what you want to archive.

As an example, suppose that a recording is made with the following settings:

- 30 bins and 10 pulses are selected in main menu.
- "T" reflectivity and "L" time series are selected in the "Plot Parameters" menu.
- 5 TS-Bins and 7 Rays are selected in the "Record" menu.
- 16-bit time series is selected in the "General Setup" menu.

Then the data file will be 3604 bytes long and will consist of:

- A 1280-byte **asc_stats** header

- Seven ray blocks, each 332-bytes long, comprised of a 200-byte **asc_ray_header** structure, followed by 32 bytes of “T” data, and 100-bytes of 16-bit “L” samples. Note that the length of the “T” data was rounded up to the next multiple of four, and that the “L” sample length is based on:

$$\left(10 \ \frac{pulses}{ray}\right) (5 \ bins) \left(2 \ \frac{bytes}{bin \times pulse}\right) \ = \ \left(100 \ \frac{bytes}{ray}\right) .$$

ASCOPE data file headers can also be examined using the following command:

```
dd < RVP8040722170814.ASC bs=1280 count=1 | structmap asc_stats –recursive –data
```

3.6 The Digital Signal Simulator

To test the signal processor and evaluate the performance in response to weather targets, **ascope** provides a digital signal simulator (DSS), which allows you to:

- Simulate weather and clutter targets in the host workstation using **ascope**.
- Automatically download the simulated LOG, I and Q signals to the signal processor where they are processed as usual.
- See the processed results displayed in **ascope**.

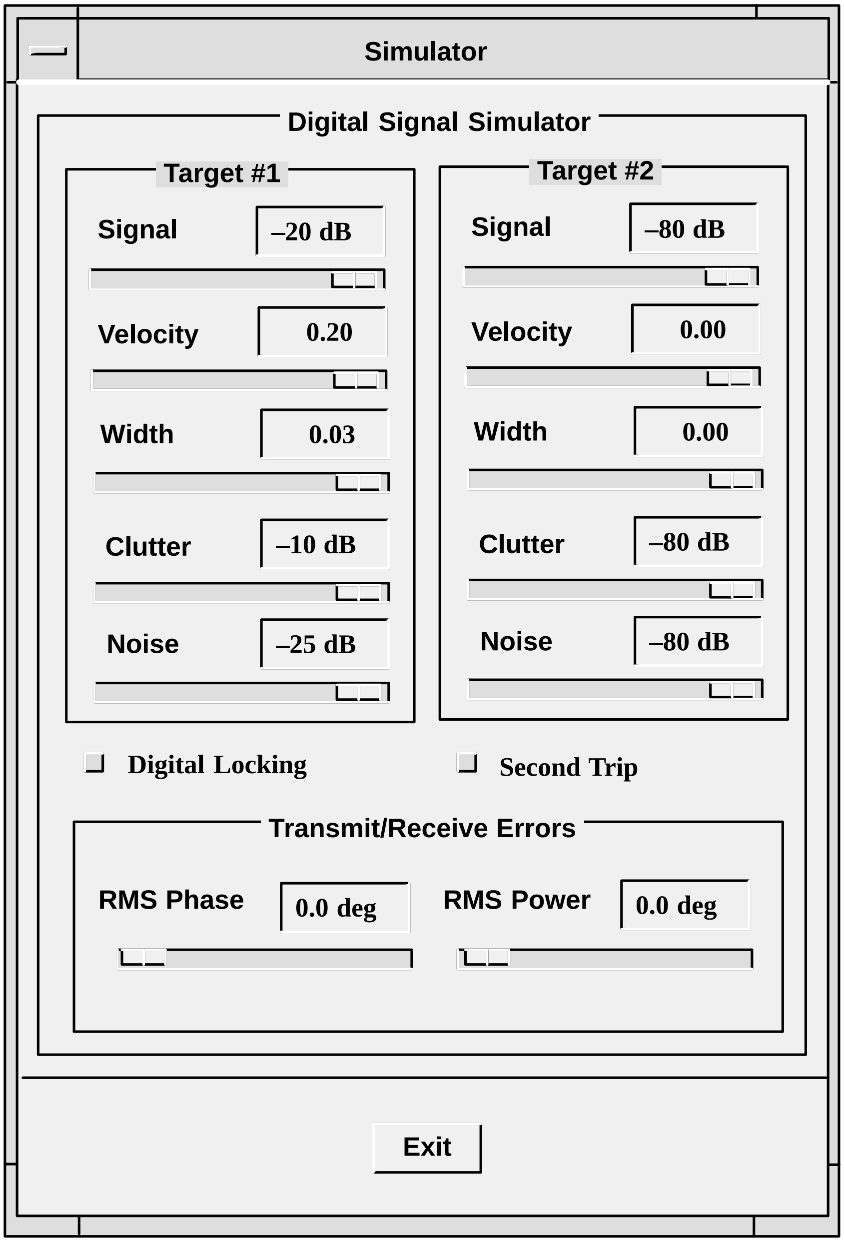
Only one range bin is simulated and the resulting I, Q and LOG time series are then loaded into every range bin that is processed.

The technique is based on Sirmans and Bumgarner's (1975: *Jour. Appl. Meteor.*, **14**, 991–1003) signal simulation approach. A Doppler spectrum is constructed with magnitudes that have Poisson statistics and random phases. This is then inverted to provide digital I and Q values. The simulation approach used in **ascope** is extended to include ground clutter, transmitter/receiver instabilities and second trip echoes.

Starting the Simulator and Viewing the Results

Choose **Options–>Simulator** to turn on the simulator and display the control panel. For the discussion that follows, we recommend that you display a Doppler spectrum with 128 samples so that you can see the results of any changes that you make. Once you are satisfied with the Doppler spectrum that you have constructed, you can switch to other types of displays.

The DSS can simulate either one or two targets which can occur both in the first trip or the first and the second trip. This tests the random phase range unfolding feature of the RVP6 and RVP7, discussed later. When you first experiment with the DSS, disable Target #2 by setting all of the Target #2 slide pots to the far left. This will make it easier to interpret your results.



Signal

This field sets the signal power of the meteorological target in arbitrary dB. As you raise this value, the Doppler spectrum of weather increases in power.

Velocity

This field sets the mean radial velocity of the weather target normalized between [–1, +1] to correspond to the Nyquist interval (fold point). As you change this value, the Doppler spectrum moves horizontally.

Width

This field sets the standard deviation of the weather target for the normalized velocity interval of [–1, +1]. As you change this value, the spectrum become broader.

Clutter

This field sets the amount of clutter power. As you increase this value, the clutter peak at zero velocity increases. The power is calibrated in the same way as the signal power. For example, if both the Clutter and Signal powers are the same, the clutter-to-signal ratio is 0 dB.

Noise

This field sets the power of the noise. Raising this value causes the noise floor to increase.

Digital Locking

The RVP6 and RVP7 signal processors can do digital phase locking by measuring the phase of the transmitted pulse. This is used for systems that implement 2nd trip echo filtering and recovery. Even if your radar does not implement this feature, you can test it with the simulator.

Note: You must enable digital phase locking in the signal processor. This is set in the non-volatile setups which can be accessed via the dspx utility (chat mode). See Section 6.3 for a description of the dspx chat mode.

If digital phase locking is enabled in the processor, pushing this button has no effect on the Doppler spectrum. If digital phase locking is not enabled in the processor, pushing this button causes the spectrum to become incoherent (white noise).

Second Trip and Target #2

Once you have configured Target #1, you can try adding a second target. The **Second Trip** button places target #2 in the second trip. When you first configure Target #2, leave the **Second Trip** button out (disabled) so that Target #2 is in the first trip. Then try pushing the **Second Trip** button. You will see the power from Target #2 put into the white noise of the first trip spectrum.

RMS Phase

Radars are not perfect. This feature simulates phase noise. Typically, a magnetron radar has between 1 and 3 degrees of phase noise. A Klystron system can have as little as 0.1 degrees of phase noise. Increasing the phase noise increases the white noise level in the Doppler spectrum.

RMS Power

This simulates pulse-to-pulse variation in transmitted power. The effect is similar to phase noise.

3.6.1 Testing with the Digital Signal Simulator

The DSS is designed so that you can develop better operational processing strategies. The operational configuration can be configured in **ascope**, then tested using signals from the DSS. A secondary benefit is for training, so that operators can get a feel for what the various signal processing options do.

Velocity, Width and Intensity Display Features for Testing

The DSS lets you input signals of known properties, then view the results in the **ascope** displays. Effects of clutter filters, time averaging and PRF can be determined. The spectrum display is useful for this. However, the following special features of the moment displays are designed to make testing easy:

- The velocity vs. range plot shows the numerical value (in parentheses) of the mean velocity normalized to the interval [–1, 1]. This can be compared directly to the value set in the DSS.
- The width vs. range plot also shows the normalized value of the width for direct comparison with the DSS.
- With no clutter power in the DSS and LOG Range Normalization turned off, the Z or T readouts are 80 dB greater than the DSS setting for signal power (for signal powers > 10 dB).
- With no clutter power in the DSS the MAG(IQ) plot are 3 dB less than the DSS setting for signal power.

When making comparisons, remember that the natural fluctuations of weather echoes are also simulated. This means that you will see fluctuations in the values, particularly if the spectrum width and/or the noise power are large.

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Note: After you set the DSS, the same time series is loaded into the signal processor every time. To get a new “realization” click on any of the slide pots that you are using. A fresh time series is created.

Random Phase 2nd Trip Echo Testing

The DSS can also be used for testing random phase for 2nd trip echo recovery. This requires that the random phase features of the RVP6 or RVP7 are licensed on your system. Random phase processing filters and recovers second trip echoes which can be a serious problem when operating at high PRF. Refer to the *Signal Processor User’s Manual* for a description of random phase processing.

Test random phase as follows:

1. Verify that the RVP6 non-volatile setup (under Mc) has digital phase locking enabled. This question is in the Mb section for the RVP7. See Section 6.3 on the **dspx** utility chat mode.

2. Under **Plot Params,** select spectrum display.
3. Under **General Setup**, select **Major Mode–>Random Phase.**
4. Under **General Setup**, select **Type of Spectra–>Raw #1**.
5. On the DSS panel, turn **Digital Locking** on (button in).
6. On the DSS panel, set **Second Trip** off (button out).
7. Use the DSS to configure Target #1 and Target #2.
8. Set **Second Trip** on (button in) to put Target #2 in the 2nd trip.
9. Under **General Setup**, select **Type of Spectra–>Raw #1, #2, etc.** to verify the various stages of the algorithm.
10. Set up moment plots (Z, V, etc. vs. range) to verify the moments.

You can trace the various filtering steps of the random phase algorithm and experiment with different set-ups for the so-called whitening filters.

3.7 Ascope Checkup Procedures

3.7.1 Coarse Adjustment of the Gain and Offset Pots

Note: In the *Signal Processor User's Manual*, refer to the section on A/D alignment for information on the location and use of the adjustment pots.

This procedure should be done only after all signal line drivers have been adjusted and the I, Q and LOG video signals have been checked with a scope to assure that they are within the proper limits of the signal processor A/D converters. Otherwise at best, the procedure will have to be repeated, and at worst the signal processor could be damaged if an inappropriate voltage is applied.

The analog-to-digital converter section of each DSP contains two potentiometers for each digitized video signal. Nominally, I and Q signals should be between ±1V and the LOG channel between 0 and 2V. The potentiometers allow the A/D converter span and offsets to be adjusted around these nominal values so that the full span of A/D values is available to the signal processor. These pots are on the outside edge of the RVP6. When signal processors are used for reflectivity-only processing, then only the LOG video channel needs to be adjusted.

To adjust the LOG, I, and Q gain and offset pots:

There are two procedures to set these controls. One procedure is documented in the *Signal Processor User's Manual* and does not require **ascope**. The recommended procedure, described here, uses the AI, AQ and ALOG plots to view the raw time series vs. range.

1. Run Zauto and check the value of the calibration slope. Typical values are from 0.3 to 0.5; the default is 0.5. If the calibration slope is 0, set it to the proper value.
2. Disconnect the gain control output from the processor. This assures that the linear receiver is operating at full gain. If the processor gain is not used on your system, check with your manufacturer to see how the receiver can be set to full gain at close range.
3. Type **ascope** at the operating system prompt, then set up **ascope** as follows:

PRF:	250
Max Range:	100
Number of Bins:	100
Plot Parameters:	AI AQ ALOG

4. While running **ascope**, turn on the transmitter and point the antenna in a direction so that the main bang of ground return can be observed. Sometimes it helps to scan the antenna very slowly to get a representative sample of targets.

5. Make sure all test signals are off, then adjust the LOG offset pot so that the far range noise is approximately 10% off the bottom of the plot (as compared to the full range of A/D values). Click the Sample Noise button to invoke a new noise sample and verify that the Z offset in the status section is between 15 and 30 units.

6. Adjust the LOG gain pot so that the saturated main bang at close range is below the high limit. If there is difficulty observing the saturated main bang close to range zero, reduce the Max Range field to 10 km. Readjust the offset as required, because changing the gain can affect the offset.

   Another technique is to use an RF test signal generator to adjust the A/D range to correspond to the dynamic range of the receiver (typically 80 dB). To do this, use **ascope** to observe the LOG channel A/D vs. range plot (ALOG). Do not click on the Sample Noise button or leave the Sample Offset Noise Sampling Mode set to "Continuous." Use the signal generator in CW mode. The transmitter is usually turned off to avoid damage to the signal generator while it is connected. Now starting from the minimum value of the signal generator output, increase the signal level until the LOG A/D values just start to increase. This is the approximate noise level. The gain should be adjusted so that, for example, the LOG A/D values are at approximately 250 when the signal generator level is increased to 80 dB above the noise level.

7. Adjust the I and Q pots until the signal is approximately centered in the display. Click the Sample Noise button to verify that they are within ±5 units of zero. If not, adjust accordingly.

8. Make sure the gain control is disconnected or otherwise disabled so that the receiver is operating at full gain for this test. Adjust the I and Q gain pots so that the strongest clutter targets at close range are just below saturation. The amplitude of the I and Q signals should be adjusted with the gain pot so that they are equal. Slight saturation on the very strongest clutter targets is tolerable because no useful weather information can be obtained in the vicinity of these anyway. Recheck and readjust the offsets as required.

This completes the coarse adjustment of the I, Q and LOG A/D channels. Now continue with the fine adjustment as detailed in the next section.

3.7.2 Fine Adjustment of the Gain and Offset Pots

Important: Disconnect or otherwise disable the gain control so that the linear receiver is at full gain during this procedure.

In the previous section, the gain and offset of the I and Q video signals were set to roughly the correct values. In order to get high quality velocities and widths, it is necessary that the I and Q signals have the same amplitude. This is quite easy to do using the **ascope** utility, following the procedure for your processor.

RVP6 Procedure

Any normal weather or noise signal can be observed. Click on the Sample Noise Offsets button and set the Noise Sample mode to “Continuous” to provide continuous updates of the noise information. Adjust the I or Q gain pot until the I/Q STD value is close to 1.00 (within ± 0.03). When they are balanced, adjust the offsets so that the mean is at 0.

3.7.3 Phase and Amplitude Stability Checks

This test establishes how much dynamic range is available in the linear channel for clutter cancellation. This is useful for determining the maximum clutter correction that can be achieved.

Important: Disconnect or otherwise disable the gain control so that the linear receiver is at full gain during these tests.

1. Set **ascope** to run as follows:

Pulse Width:	0.5
PRF:	Highest value
Plot Parameters:	T Spec
Doppler Filter:	None
LOG Filter:	None
Thresholds:	Off
Max Range:	20
Pulse Samples:	128
Spectrum Window:	Rect

This creates a Doppler spectrum with a fairly rapid update for searching.

2. Use the Reflectivity vs. Range plot (Total dBZ) to select a range where there are strong clutter targets and observe the peak-to-noise level for the strongest clutter targets. You may want to scan the antenna very slowly, stopping at strong clutter targets. Estimate the peak-to-noise level ratio by eye (20 dB per division) for several of the strongest targets by estimating the average noise level. Spectrum averaging helps to reduce the fluctuations. For a 128-point spectrum (Pulse Samples: 128) the clutter to total noise power in dB is the observed peak-to-noise ratio minus 10 log(128), that is:

   dB(Clutter-to-noise) = dB(Peak-to-noise) – 21 dB

   This is a measure of the available dynamic range of the system. If the value is 20 dB, (typical for a magnetron system), then the maximum clutter correction that can be achieved is approximately 20 to 30 dB depending on the number of samples averaged together.

Another way to assess the coherency of the system is to use the SQI and phase noise values displayed in the upper right corner of the spectrum display. The SQI is a number between 1 (perfectly coherent) and 0 (perfectly incoherent) which is related to the pulse-to-pulse phase noise, the peak-to-noise and the clutter-to-noise. Table 3–1 summarizes these relationships. Note that the calculations in the table assume you are looking at a pure clutter target with no weather or coherent artifacts such as 50 or 60 Hz or image spectra. For example, an SQI of .9800 corresponds to a phase noise of 8.1 degrees, a clutter-to-signal ratio of 16.9 dB and a 128-point peak-to-noise (observable in the spectrum plot) of 37.9 dB.

Table 3–1: Coherency Relationships

SQI	Phase Noise (Degrees)	Clutter-to-Noise (dB)	128-Point Peak-to-Noise (dB)	256-Point Peak-to-Noise (dB)
.99998	0.26	47.0	68.0	71.0
.99996	0.36	44.0	65.0	68.0
.99994	0.44	42.2	63.2	66.2
.99992	0.51	41.0	62.0	65.0
.99990	0.57	40.0	61.0	64.0
.99988	0.63	39.2	60.2	63.2
.99986	0.68	38.5	59.5	62.5
.99984	0.72	38.0	59.0	62.0
.99982	0.77	37.4	58.4	61.4
.99980	0.81	37.0	58.0	61.0
.99970	0.99	35.2	56.2	69.2
.99960	1.15	34.0	55.0	58.0
.99950	1.28	33.0	54.0	57.0
.99940	1.40	32.2	53.2	56.2
.99930	1.52	31.5	52.5	55.5
.99920	1.62	31.0	52.0	55.0

Table 3–1: Coherency Relationships

SQI	Phase Noise (Degrees)	Clutter-to-Noise (dB)	128-Point Peak-to-Noise (dB)	256-Point Peak-to-Noise (dB)
.99910	1.72	30.5	51.5	54.5
.99900	1.81	30.0	51.0	54.0
.99800	2.56	27.0	48.0	51.0
.99700	3.14	25.2	46.2	49.2
.99600	3.63	24.0	45.0	48.0
.99500	4.06	23.0	44.0	47.0
.99400	4.44	22.2	43.2	46.2
.99300	4.80	21.5	42.5	45.5
.99200	5.13	20.9	41.9	44.9
.99100	5.45	20.4	41.4	44.4
.99000	5.74	20.0	41.0	44.0
.98000	8.14	16.9	37.9	40.9
.97000	10.00	15.1	36.1	39.1
.96000	11.58	13.8	34.8	37.8
.95000	12.98	12.8	33.8	36.8
.94000	14.25	11.9	32.9	35.9
.93000	15.43	11.2	32.2	35.2
.92000	16.54	10.6	31.6	34.6
.90000	18.60	9.5	30.5	33.5

3.7.4 Doppler Velocity Sign Check

This test determines whether the mean Doppler velocity has the proper sign. Because of different conventions and the possibility of a cabling error, there is only a 50/50 chance that the velocity has the proper sign (towards or away) when a radar system is first installed. Switching the sign of the velocity is done by simply swapping the I and Q input cables to the signal processor or other location, as determined by your system manager.

To determine if the sign is correct:

1. Make sure your antenna pointing has been properly calibrated.
2. Select a day when there is low level precipitation — ideally, raining at the radar site. Good clear air echoes also work if they are detectable at low levels.
3. Run **ascope**, set the Plot Parameters to V Z W to display the velocity, and manually scan the antenna to observe velocities at low elevation (for example, 0.5 degrees) and close range (<10 km). Select an azimuth where the mean velocity is largest (either toward or away).
4. Go outside and verify that the wind direction is correct.