

**SignalVu™**  
**Vector Signal Analysis Software**  
**Printable Online Help**



077-0225-03

**Tektronix**



**SignalVu™**  
**Vector Signal Analysis Software**  
**Printable Online Help**

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# Table of Contents

## Welcome

Welcome .....	1
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## About Tektronix Spectrum Analyzers

Product Description .....	2
Product Software .....	2
Options	
Options .....	3
Documentation and Support	
Documentation .....	4

## Orientation

Connecting Signals and Selecting the Analysis Channel .....	5
Touch-Screen Actions .....	5
Elements of the Display .....	8

## Operating Your Instrument

Restoring Default Settings .....	11
Application Presets .....	11
Setting Options .....	14

## Using the Measurement Displays

Selecting Displays .....	16
--------------------------	----

## Taking Measurements

Measurements	
Available Measurements .....	17

## General Signal Viewing

Overview .....	22
Time Overview	
Time Overview Display .....	23
Time Overview Settings .....	25
Spectrum	
Spectrum Display .....	29
Spectrum Settings .....	31
Spectrogram	
Spectrogram Display .....	33

Spectrogram Settings .....	35
Amplitude vs Time	
Amplitude vs Time Display .....	40
Amplitude vs Time Settings .....	41
Frequency vs Time	
Frequency vs Time Display .....	43
Frequency vs Time Settings .....	44
Phase vs Time	
Phase vs Time Display .....	45
Phase vs Time Settings .....	46
RF I & Q vs Time	
RF I & Q vs Time Display .....	47
RF I & Q vs Time Settings .....	48
Common Controls for General Signal Viewing Displays	
General Signal Viewing Shared Measurement Settings .....	49

## Analog Modulation

Overview .....	58
AM	
AM Display .....	59
AM Settings .....	60
FM	
FM Display .....	66
FM Settings .....	68
PM	
PM Display .....	74
PM Settings .....	76

## RF Measurements

Overview .....	82
Channel Power and ACPR	
Channel Power and ACPR (Adjacent Channel Power Ratio) Display .....	83
Channel Power and ACPR Settings .....	86
MCPR	
MCPR (Multiple Carrier Power Ratio) Display .....	89
MCPR Settings .....	92
Occupied BW & x dB BW	
Occupied BW & x dB BW Display .....	98
Occupied BW & x dB BW Settings .....	100
Spurious	
Spurious Display .....	102
Spurious Display Settings .....	106

CCDF	
CCDF Display.....	115
CCDF Settings .....	116
Common Controls for RF Measurements Displays	
RF Measurements Shared Measurement Settings.....	118
<b>Pulsed RF</b>	
Overview .....	124
Pulse Table Display	
Pulse Table Display.....	125
Pulse Table Settings .....	126
Pulse Trace Display	
Pulse Trace Display.....	127
Pulse Trace Settings .....	128
Pulse Statistics	
Pulse Statistics Display.....	129
Pulse Statistics Settings .....	131
Common Controls for Pulsed RF Displays	
Pulsed RF Shared Measurement Settings .....	132
<b>GP Digital Modulation</b>	
Overview .....	142
Constellation	
Constellation Display.....	144
Constellation Settings .....	145
Demod I & Q vs Time	
Demod I & Q vs Time Display.....	146
Demod I & Q vs Time Settings .....	148
EVM vs Time	
EVM vs Time Display.....	149
EVM vs Time Settings .....	150
Eye Diagram	
Eye Diagram Display.....	151
Eye Diagram Settings .....	153
Frequency Deviation vs Time	
Frequency Deviation vs Time Display .....	154
Frequency Deviation vs Time Settings .....	156
Magnitude Error vs Time	
Magnitude Error vs Time Display .....	157
Magnitude Error vs Time Settings .....	159
Phase Error vs Time	
Phase Error vs Time Display .....	160

Phase Error vs. Time Settings .....	162
Signal Quality	
Signal Quality Display .....	163
Signal Quality Settings .....	168
Symbol Table	
Symbol Table Display .....	169
Symbol Table Settings .....	170
Trellis Diagram	
Trellis Diagram Display .....	171
Trellis Diagram Settings .....	173
Common Controls for GP Digital Modulation Displays	
GP Digital Modulation Shared Measurement Settings .....	174
Standard Settings Button .....	175
Symbol Maps	
Symbol Maps .....	189
User Filters	
Overview: User Defined Measurement and Reference Filters .....	195
User Filter File Format .....	195

## Marker Measurements

Using Markers	
Using Markers .....	199
Controlling Markers with the Touchscreen Actions Menu .....	199
Measuring Frequency and Power in the Spectrum Display .....	202
Common Marker Actions	
Marker Action Controls .....	203
Peak .....	203
Next Peak .....	203
Marker to Center Frequency .....	203
Sync Scope C1/C2 to Active Marker .....	203
Define Markers Control Panel	
Enabling Markers and Setting Marker Properties .....	204
Markers Toolbar	
Using the Markers Toolbar .....	206
Noise Markers in the Spectrum Display	
Using Noise Markers in the Spectrum Display .....	207

## Search (Limits Testing)

The Search Tool (Limits Testing) .....	209
Search (Limits Testing) Settings .....	209
Define Tab (Search) .....	209
Actions Tab .....	213



## Analyzing Data

Analysis Settings	
Analysis Settings.....	214
Analysis Time Tab.....	214
Spectrum Time Tab.....	216
Frequency Tab.....	216
Units Tab.....	219
Analyzing Data Using Replay	
Replay Overview.....	220
Replay Menu.....	221
Play All Selected Records.....	221
Play Current.....	221
Play from Selected.....	222
Pause.....	222
Stop.....	222
Select All.....	222
Select Records from History.....	222
Replay Toolbar.....	222

## Amplitude Corrections

Amplitude Settings.....	224
External Gain/Loss Correction Tab.....	224
External Gain Value.....	224
Apply Table Corrections To.....	225
External Loss Tables.....	225

## Controlling the Acquisition of Data

Acquisition Controls in the Run Menu	
Continuous versus Single Sequence.....	227
Run.....	227
Resume.....	227
Abort.....	227
Acquisition Controls in the Acquire Control Panel	
Acquire.....	228
Vertical.....	228
IQ Sampling Parameters.....	230
Scope Settings.....	231
Scope Data Tab.....	232

## Managing Data, Settings, and Pictures

Saving and Recalling Data, Settings, and Pictures.....	233
Data, Settings, and Picture File Formats.....	235

Printing Screen Shots ..... 238

## Reference

Online Help ..... 239

About the Vector Signal Analysis Software ..... 239

Menus

- Menu Overview ..... 241
- File Menu
  - File Menu ..... 242
  - Application Presets... ..... 246
- View Menu
  - View Menu ..... 247
- Run Menu
  - Run Menu ..... 249
- Replay
  - Replay Menu ..... 251
- Markers Menu
  - Markers Menu ..... 252
- Setup Menu
  - Setup Menu ..... 253
- Tools Menu
  - Tools Menu ..... 254
- Window Menu
  - Arranging Displays ..... 255
- Help Menu
  - Help Menu ..... 256

Troubleshooting

- Error and Information Messages ..... 257
- Displaying the Windows Event Viewer ..... 263

Upgrading the Instrument Software

- How to Find Out If Instrument Software Upgrades Are Available..... 266

Changing Settings

- Settings..... 267

## Glossary

## Index

## Welcome

This help provides in-depth information on how to use the SignalVu™ Vector Signal Analysis Software. This online help is also available in a PDF format for printing.

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**NOTE.** *Most of the screen illustrations in this document are taken from the vector signal analysis software version that runs on the RSA6100A Real-time Spectrum Analyzers. These instruments support additional hardware-based functionality and buttons, such as Trig, that are not present in the SignalVu™ application.*

---

## Product Description

SignalVu™ vector signal analysis software helps you easily validate wideband designs and characterize wideband spectral events. By combining the signal analysis engine of the RSA6100A real-time spectrum analyzer with that of the industry's widest bandwidth digital oscilloscopes, designers can now evaluate complex signals up to 20 GHz without the need of an external down converter. You get the functionality of a vector signal analyzer, a spectrum analyzer and the powerful trigger capabilities of a digital oscilloscope, all in a single package. Whether your design validation needs include wideband radar, high data rate satellite links or frequency hopping communications, SignalVu vector signal analysis software can speed your time-to-insight by showing you time variant behavior of these wideband signals.

### Key Features

Tightly integrated software and hardware control allows you to easily switch between SignalVu and oscilloscope user interfaces to optimize triggers and other acquisition parameters. Key features of SignalVu include:

- Direct observation of microwave signals to 20 GHz without an external down converter
- All signals up to the analog bandwidth of oscilloscope are captured in memory
- Customizable oscilloscope acquisition parameters for effective use of capture memory
- Four channel acquisitions help you correlate independent RF events
- Apply custom math and filtering to acquisition channels
- Extensive time-correlated, multi-domain displays connect problems in time, frequency, phase and amplitude for quicker understanding of cause and effect when troubleshooting
- Power measurements and signal statistics help you characterize components and systems: ACLR, Multi-Carrier ACLR, Power vs. Time, CCDF, OBW/EBW, and Spur Search
- Advanced Signal Analysis Suite (Opt. SVP) provides automated pulse measurements including rise time, pulse width and pulse-to-pulse phase provide deep insight into pulse train behavior
- General Purpose Digital Modulation Analysis (Opt. SVM) provides vector signal analyzer functionality
- Tektronix OpenChoice® enables easy transfer to a variety of analysis programs such as Excel and Matlab

## Product Software

Occasionally new versions of software for your instrument may become available at our Web site. Visit [www.tektronix.com/software](http://www.tektronix.com/software) for information.

## Options

To view a listing of the software options installed in your software, select **Help > About Your Tektronix Vector Signal Analysis Software**.

Options can be added to your instrument. For the latest information on available option upgrades, see the [Tektronix Web site](#).

## Documentation

In addition to the online help, the following documents are available:

- **SignalVu Reference** (Tektronix part number 077-0224-XX). This document provides a brief overview of the SignalVu software. It identifies elements of the SignalVu screen, elements of different displays and includes a menu tree. The Reference Manual is provided as a printable PDF file.
- **SignalVu Programmer Manual** (077-0223-XX). This document provides supplementary information about the remote commands for the SignalVu software. The Programmer Manual is provided as a printable PDF file. For detailed descriptions of the remote commands, see the *RSA6100A Series Real-Time Spectrum Analyzers Programmer Manual* (077-0249-XX) and the *DPO7000, DPO70000 and DSA70000 Series Digital Oscilloscopes Programmer Manual* (077-0010-XX).
- **SignalVu Printable Help Document (PDF)** (077-0225-XX). A PDF file version of the online help that can easily be printed.

The SignalVu documentation PDFs are located on the *Optional Applications Software for Windows-Based Oscilloscopes* DVD.

The most recent versions of the product documentation, in PDF format, can be downloaded from [www.tektronix.com/manuals](http://www.tektronix.com/manuals). You can find the manuals by searching on the product name.

## Connecting Signals and Selecting the Analysis Channel

SignalVu analyzes signals acquired by the oscilloscope. For information on the oscilloscope input signal capabilities and how to trigger on a signal, see the oscilloscope online help. Note that SignalVu does not control triggering on the oscilloscope; you will need to use the oscilloscope triggering functions to achieve a stable, triggered signal on the oscilloscope.

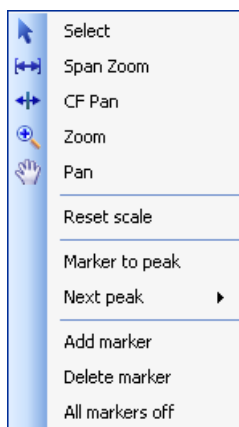
The SignalVu software analyzes one channel at a time, so you need to specify which oscilloscope input channel will be analyzed.

To specify which oscilloscope channel is analyzed:






1. Select **Settings** > **Acquire** to display the Acquire control panel.
2. Select the channel you want to analyze using the **Channel** drop-down list.
3. Use the oscilloscope functions to achieve a stable, triggered signal.

## Touch-Screen Actions

You can use the touch screen to change marker settings and how waveforms are displayed by using the Touch-screen Actions menu.



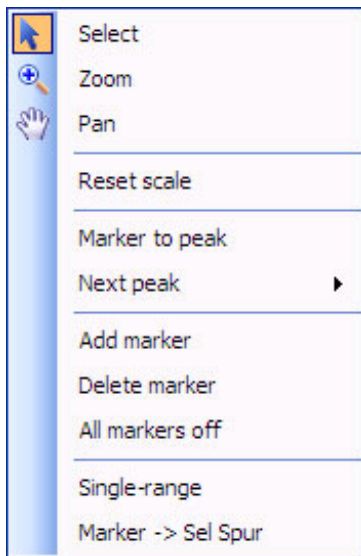
To use the Touch-screen Actions menu, touch the display in a graph area and hold for one second, then remove your finger. You can also use a mouse to display the Touch-screen Action menu by clicking the right mouse button.

Icon	Menu	Description
	Select	Selects markers and adjusts their position.
	Span Zoom	Zooms the graph area about the selected point. Touch the graph display at a point of interest and drag to increase or decrease the span about the point of interest. Span Zoom adjusts the span control and can affect the acquisition bandwidth.
	CF Pan	Adjusts the Center Frequency according to horizontal movement.
	Zoom	Adjusts horizontal and vertical scale of the graph. The first direction with enough movement becomes the primary scale of adjustment. Adjustment in the secondary direction does not occur until a threshold of 30 pixels of movement is crossed.  Dragging to the left or down zooms out and displays a smaller waveform (increases the scale value). Dragging to the right or up zooms in and displays a larger waveform (decreases the scale value).
	Pan	Adjusts horizontal and vertical position of the waveform. The first direction with enough movement becomes the primary direction of movement. Movement in the secondary direction does not occur until a threshold of 30 pixels of movement is crossed.
-	Reset Scale	Returns the horizontal and vertical scale and position settings to their default values.
-	Marker to peak	Moves the selected marker to the highest peak. If no marker is turned on, this control automatically adds a marker.
-	Next Peak	Moves the selected marker to the next peak. Choices are Next left, Next right, Next lower (absolute), and Next higher (absolute).
-	Add marker	Defines a new marker located at the horizontal center of the graph.
-	Delete marker	Removes the last added marker.
-	All markers off	Removes all markers.

### Touch-Screen Menu for Spurious Display

The Touch-screen actions menu in the Spurious display has some minor changes compared to the standard version used in other displays.

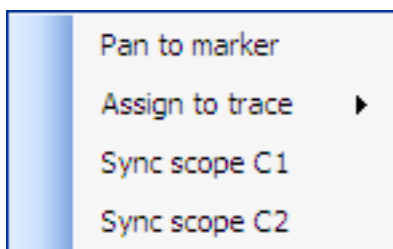




Icon	Menu	Description
-	Single-range	Changes the current multi-range display to a single range display. The displayed range is the range in which you display the touchscreen-actions menu. Selecting Single-range from the menu is equivalent to selecting Single on the Settings > Parameters tab.
-	Multi-range	Changes the current single-range display to a multi-range display. Selecting Multi-range from the menu is equivalent to selecting Multi on the Settings > Parameters tab.
-	Marker -> Sel Spur	Moves the selected marker to the selected spur.

### SignalVu Markers Menu

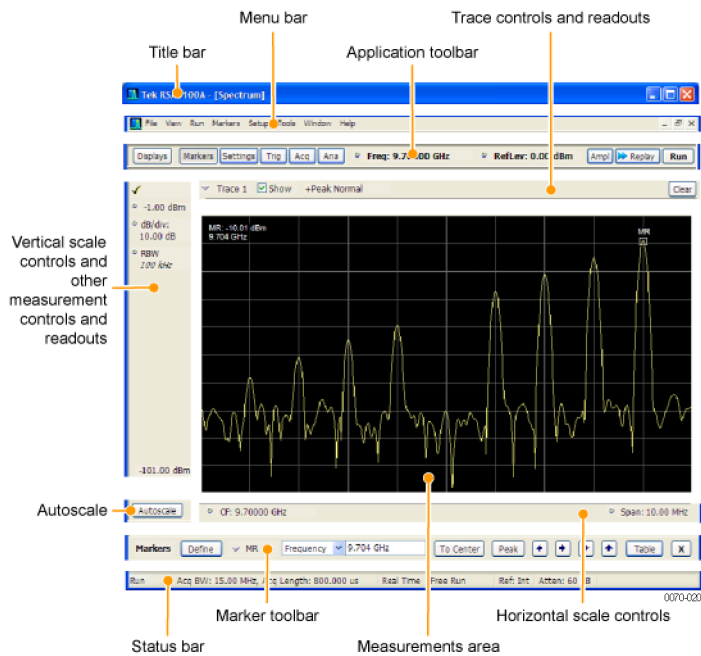
The SignalVu Markers menu appears when you right-click (or touch and hold) on a marker. The SignalVu Markers menu enables you to assign a marker to a different trace, synchronize markers with oscilloscope, cursors and pan the trace to place the marker at the measurement frequency.



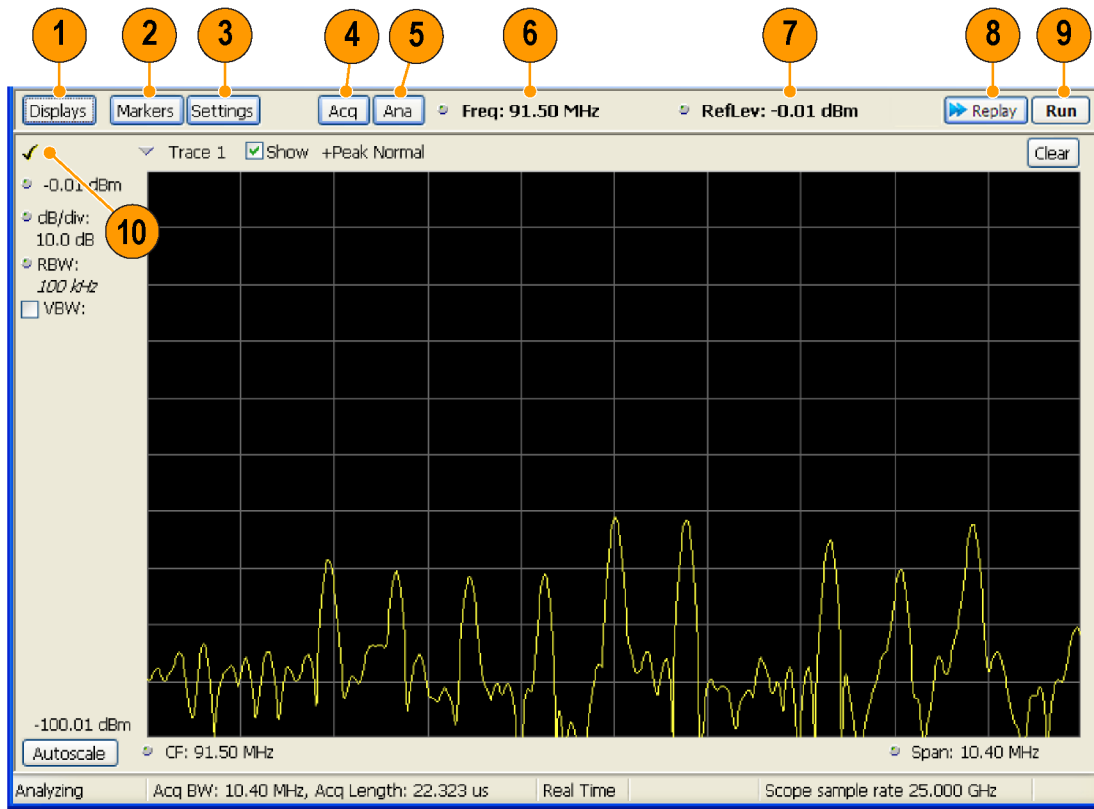
Icon	Menu	Description
-	Pan to marker	Adjusts horizontal position of the waveform to locate the selected marker at the measurement frequency.
-	Assign to trace	Assigns the selected marker to Trace 1, Trace 2, Trace 3 or the Math trace. A trace must be enabled to assign a marker to it.
-	Sync scope C1	Synchronizes the position of Cursor 1 with the location of the selected marker. Turns on cursors if necessary.
-	Sync scope C2	Synchronizes the position of Cursor 2 with the location of the selected marker. Turns on cursors if necessary.

## Elements of the Display

The main areas of the application window are shown in the following figure.



Specific elements of the display are shown in the following figure.



Ref number	Setting	Description
1	Displays	Opens the Select Displays dialog box so that you can select measurement displays.
2	Markers	Opens or closes the Marker toolbar at the bottom of the window.
3	Settings	Opens the Settings control panel for the selected display. Each display has its own control panel.
4	Acquire	Opens the Acquire control panel so that you can define the acquisition settings.
5	Analysis	Opens the Analysis control panel so that you can define the analysis settings such as frequency, analysis time, and units.
6	Center Frequency	Displays the Center Frequency. To change the value, click the text and enter the frequency with a keyboard. For fine adjustments, you can use the mouse wheel.
7	Reference Level	Displays the reference level. To change the value, click the text and enter a number using a keyboard, or use a mouse scroll wheel.
8	Replay	Runs a new measurement cycle on the existing acquisition data record using any new settings.
9	Run	Starts and stops data acquisitions. When the instrument is acquiring data, the button label has green lettering. When stopped, the label has black lettering. You can specify the run conditions in the Run menu. For example, if you select Single Sequence in the Run menu, when you click the Run button, the instrument will run a single measurement cycle and stop. If you select Continuous, the instrument will run continuously until you stop the acquisitions.
10	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display indicates the display for which the acquisition hardware is optimized.

## Restoring Default Settings

To restore the instrument to its factory default settings:

- Select **File > Preset** to return the analyzer to its default settings.

Preset resets all settings and clears all acquisition data. Settings and acquisition data that have not been saved will be lost.

## Application Presets

### Menu Bar: File > Application Presets

SignalVu includes a set of configuration files that are tailored to specific applications. These configuration files, referred to as Application Presets, open selected displays and load settings that are optimized to address specific application requirements. You can add to the default application presets by creating your own application presets. See [Creating Application Presets \(see page 14\)](#). You access the application presets through the Application Presets menu item.

To load an application preset:

1. Select **File > Application Presets**. This opens the **Applications Presets** dialog window.
2. Select the application preset that suits your needs.
3. Click **OK** to recall the application preset.

Application Preset	Description
Modulation Analysis	The Modulation Analysis setup application preset provides you with the most common displays used during modulation analysis.
Pulse Analysis	The Pulse Analysis application preset provides you with the most common displays used during pulse analysis, and makes changes to the default parameters to settings better optimized for pulsed signal analysis. Option SVP is required to use the pulse measurements applications preset.
Time-Frequency Analysis	The Time-Frequency preset configures the instrument with settings suited to analyzing signal behavior over time.

### Modulation Analysis

The Modulation Analysis application preset opens the following displays:

- **Signal Quality:** Shows a summary of modulation quality measurements (EVM, rho, Magnitude Error, Phase Error, and others).
- **Constellation:** Shows the I and Q information of the signal analyzed in an I vs. Q format.
- **Symbol Table:** Shows the demodulated symbols of the signal.

To use the Modulation Analysis preset:

1. Select **File > Application Presets > Modulation Analysis**. Click **OK**.
2. Set the measurement frequency.
3. Set the reference level so that the peak of your signal is about 10 dB below the top of the spectrum display.
4. Set the modulation parameters for your signal. This includes the Modulation Type, Symbol Rate, Measurement Filter, Reference Filter and Filter Parameter. All of these settings are accessed by pressing the Settings button.

For most modulated signals, the Modulation Analysis application preset should present a stable display of modulation quality. Additional displays can be added by using the Displays button, and other settings can be modified to better align with your signal requirements.

## Pulse Analysis

The Pulse Analysis application preset opens the following displays:

- Time Overview: Shows amplitude vs. time over the analysis period.
- Pulse Trace: Shows the trace of the selected pulse and a readout of the selected measurement from the pulse table.
- Pulse Measurement Table: This shows a full report for the user-selected pulse measurements.

You can make a selected pulse and measurement appear in the Pulse Trace display by highlighting it in the Pulse Measurement Table. Key pulse-related parameters that are set by the Pulse Analysis application preset are:

- Measurement Filter: No Filter.
- Measurement Bandwidth: This is set to the maximum real-time bandwidth of the instrument. Note: The label on the “Measurement Bandwidth” setting is just “Bandwidth”. Like the main instrument Preset command and the other application presets, the Pulse Analysis application preset also sets most other instrument controls to default values.
- Analysis Period: This is set to 2 ms to ensure a good probability of catching several pulses for typical signals.

To use the Pulse Analysis preset:

1. Select **File > Application Presets > Pulse Analysis**. Click **OK**.
2. Set the Center Frequency control to the carrier frequency of your pulsed signal.
3. Set the Reference Level to place the peak of the pulse signal approximately 0-10 dB down from the top of the Time Overview display.

You may need to trigger on the signal to get a more stable display. This is set up with the oscilloscope's controls. A rising-edge trigger works well for many pulsed signals.

4. Set the Analysis Period to cover the number of pulses in your signal that you want to analyze. To do this, click in the data entry field of the Time Overview window and set the analysis length as needed.

## Time-Frequency Analysis

The Time-Frequency Analysis application preset opens the following displays:

- Time Overview: Shows a time-domain view of the analysis time 'window'.
- Spectrogram: Shows a three-dimensional view of the signal where the X-axis represents frequency, the Y-axis represents time, and color represents amplitude.
- Frequency vs. Time: This display's graph plots changes in frequency over time and allows you to make marker measurements of settling times, frequency hops, and other frequency transients.
- Spectrum: Shows a spectrum view of the signal. The only trace showing in the Spectrum graph after selecting the Time-Frequency Analysis preset is the Spectrogram trace. This is the trace from the Spectrogram display that is selected by the active marker. Stop acquisitions with the Run button because it's easier to work with stable results. In the Spectrogram display, move a marker up or down to see the spectrum trace at various points in time.

The analysis period is set to 5 ms.

To use the Time-Frequency application preset:

1. Select **File > Application Presets > Time-Frequency Analysis**. Click **OK**.
2. When the preset's displays and settings have all been recalled and acquisitions are running, adjust the center frequency and span to capture the signal of interest.
3. Set the Reference Level to place the peak of the signal approximately 0-10 dB down from the top of the Spectrum graph.
4. If the signal is transient in nature, you might need to set a trigger to capture it. You will need to use the oscilloscope triggering functions to capture the signal.

When the signal has been captured, the spectrogram shows an overview of frequency and amplitude changes over time. To see frequency transients in greater detail, use the Frequency vs. Time display.

The Time-Frequency Analysis preset sets the analysis period to 5 ms. The Spectrum Span is 40 MHz. The RBW automatically selected for this Span is 300 kHz. For a 300 kHz RBW, the amount of data needed for a single spectrum transform is 7.46  $\mu$ s. A 5 ms Analysis Length yields 671 individual spectrum transforms, each one forming one trace for the Spectrogram to display as horizontal colored lines. This preset scales the Spectrogram time axis (vertical axis) to -2, which means that the Spectrogram has done two levels of time compression, resulting in one visible line for each four transforms. This results in 167 lines in the Spectrogram for each acquisition, each covering 29.84  $\mu$ s.

## Creating Application Presets

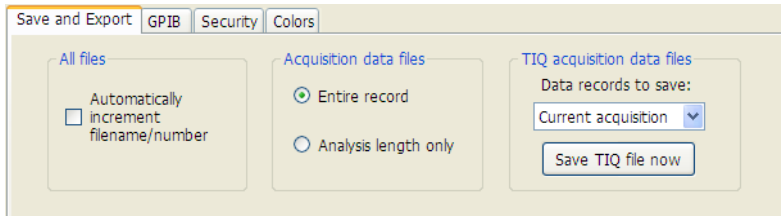
You can add your own application presets to the list that appears in the Application Presets dialog box. Create a Setup file and save a copy of it to **C:\SignalVu Files\Application Presets**. The name you give the file will be shown in the Application Presets list along with the sets provided by Tektronix. For instructions on how to save a Setup file, see [Saving Data \(see page 233\)](#).

If the Tektronix application presets files are accidentally deleted, you can restore them by reinstalling the SignalVu software. The software installation process will not remove user files you have placed in the Application Presets directory.

## Setting Options

### Menu Bar: Tools > Options

There are several settings you can change that are not related to measurement functions. The Option settings control panel is used to change these settings.



Settings tab	Description
Save and Export	Use this tab to specify whether or not save files are named automatically and what information is saved in acquisition data files.
GPIB	Do not use this tab to set the GPIB address for the instrument. Use the <b>Utilities &gt; GPIB Configuration</b> control window in the TekScope application to set the instrument GPIB address.
Security	Selecting the <b>Hide Sensitive readouts</b> check box causes the instrument to replace measurement readouts with a string of asterisks.
Colors	Use this tab to select different color schemes for the measurement graphs.



## Save and Export

The Save and Export tab allows you to specify whether or not files are saved with an automatically generated name, and how much data is saved in an acquisition data file.

- All Files — The Automatically increment filename/number function can automatically name saved files by appending a number to a base file name. Use this tab to enable/disable automatic naming of files. For example, if **Automatically Increment Filename Number** is disabled, when you select Save from the File menu, you will have to enter a name for the file.
- Acquisition data files — This setting specifies whether saved data files include the entire acquisition record or only the data for the analysis length (a subset of the acquisition record).
- TIQ acquisition data files — Specifies which data records to save. You can choose from the following:
  - Current acquisition: Saves the current acquisition.
  - Current frame: If Fast Frame is enabled, saves only the current frame. The current frame is the one most recently analyzed.
  - Selected frames: If Fast Frame is enabled, saves the specified frames.
  - All in history: Saves all acquisition records in the history.

## Colors

The Color scheme setting provides three color schemes for the measurement graphs. The color scheme setting does not change the overall instrument application or Windows color scheme.

- Thunderstorm — This scheme displays graphs in shades of blue. This provides a less vibrant color scheme than the default setting.
- Blizzard — This scheme displays graphs with a white background to save ink when printing.
- Classic — The default setting. This scheme displays the graph area with a black background.

## Selecting Displays

**Menu Bar:** Setup > Displays

**Application Toolbar:** Displays

Use the **Select Displays** dialog to choose the displays that appear on the screen.

To select displays:

1. Press the **Displays** button or select **Setup > Displays**.
2. Select one of the choices under **Folders**. The folder chosen determines the choices available in **Available displays**.
3. Double-click the desired display in the **Available displays** box or select the desired display and click **Add**.
4. Click **OK**.

### Interactions Between Displays

Different displays can require different settings, for example acquisition bandwidth, analysis length, or resolution bandwidth, to achieve optimum results. The instrument automatically adjusts some settings to optimize them for the selected display. The check mark indicator in the upper, left-hand corner of the display indicates the display for which the acquisition hardware is optimized. Depending on instrument settings, some displays might stop displaying results if they are not the selected display.

## Available Measurements

The automatic measurements available include RF power measurements, analog modulation measurements, digital modulation measurements, and pulse measurements.

### Power Measurements

Measurement	Description
Channel Power	The total RF power in the selected channel (located in the ACPR display).
Adjacent Channel Power Ratio	Measure of the signal power leaking from the main channel into adjacent channels.
Multi-Carrier Power Ratio	The ratio of the signal power in the reference channel or group of channels to the power in adjacent channels.
Peak/Avg Ratio	Ratio of the peak power in the transmitted signal to the average power in the transmitted signal (located in the CCDF display).
CCDF	The <i>Complementary Cumulative Distribution Function</i> (CCDF). CCDF shows how much time a signal spends at or above a given power level relative to the average power of a measured signal.

## Modulation Measurements

### Measurements for all modulation types except nFSK, C4FM, OQPSK and SOQPSK

Measurement	Description
EVM	The normalized RMS value of the error vector between the measured signal and the ideal reference signal over the analysis length. The EVM is generally measured on symbol or chip instants and is reported in units of percent and dB. EVM is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed. These estimates are made over the analysis length. Displays RMS and Peak values with location of Peak value.
Phase Error	The RMS phase difference between the measured signal and the ideal reference signal. Displays RMS and Peak values with location of Peak value.
Mag Error	The RMS magnitude difference between the measured signal and the reference signal magnitude. Displays RMS and Peak values with location of Peak value.
MER (RMS)	The MER is defined as the ratio of I/Q signal power to I/Q noise power; the result is indicated in dB.
IQ Origin Offset	The magnitude of the DC offset of the signal measured at the symbol times. It indicates the magnitude of the carrier feed-through signal.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Gain Imbalance	The gain difference between the I and Q channels in the signal generation path. Constellations with gain imbalance show a pattern with a width that is different from height.
Quadrature Error	The orthogonal error between the I and Q channels. The error shows the phase difference between I and Q channels away from the ideal 90 degrees expected from the perfect I/Q modulation. Not valid for BPSK modulation type.
Rho	The normalized correlated power of the measured signal and the ideal reference signal. Like EVM, Rho is a measure of modulation quality. The value of Rho is less than 1 in all practical cases and is equal to 1 for a perfect signal measured in a perfect receiver.

**Measurements for QPSK and SOQPSK modulation types**

<b>Measurement</b>	<b>Description</b>
EVM	The normalized RMS value of the error vector between the measured signal and the ideal reference signal over the analysis length. The EVM is generally measured on symbol or chip instants and is reported in units of percent and dB. EVM is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed. These estimates are made over the analysis length. Displays RMS and Peak values with location of Peak value.
Offset EVM	Offset EVM is like EVM except for a difference in the time alignment of the I and Q samples. For EVM, I and Q samples are collected at the same time, for every symbol decision point (twice the symbol rate for offset modulations). For Offset EVM, the I and Q symbol decision points are time-aligned before collecting the I and Q samples. In this case, one I and one Q sample is collected for each symbol (half as many samples as the same number of symbols for (non-offset) EVM).
Phase Error	The RMS phase difference between the measured signal and the ideal reference signal. Displays RMS and Peak values with location of Peak value.
Mag Error	The RMS magnitude difference between the measured signal and the reference signal magnitude. Displays RMS and Peak values with location of Peak value.
MER (RMS)	The MER is defined as the ratio of I/Q signal power to I/Q noise power; the result is indicated in dB.
IQ Origin Offset	The magnitude of the DC offset of the signal measured at the symbol times. It indicates the magnitude of the carrier feed-through signal.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Gain Imbalance	The gain difference between the I and Q channels in the signal generation path. Constellations with gain imbalance show a pattern with a width that is different from height.
Quadrature Error	The orthogonal error between the I and Q channels. The error shows the phase difference between I and Q channels away from the ideal 90 degrees expected from the perfect I/Q modulation. Not valid for BPSK modulation type.
Rho	The normalized correlated power of the measured signal and the ideal reference signal. Like EVM, Rho is a measure of modulation quality. The value of Rho is less than 1 in all practical cases and is equal to 1 for a perfect signal measured in a perfect receiver.

**Measurements for nFSK modulation types**

<b>Measurement</b>	<b>Description</b>
Peak FSK err	Peak value of the frequency deviation error at the symbol point.
RMS FSK Err	RMS value of the frequency deviation error at the symbol point.
Peak Mag Err	The Peak magnitude difference between the measured signal and the reference signal magnitude.
RMS Mag Err	The RMS magnitude difference between the measured signal and the reference signal magnitude.
Freq Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Freq Deviation	Frequency distance from the center frequency at the symbol point.
Symbol Rate Error	This compares the user-entered symbol rate to the instrument calculated symbol rate of the analyzed signal.
Symbol Rate	When in Auto-symbol rate, the instrument calculates the symbol rate of the signal and the instrument calculates the error between the user entered value and the instrument calculated value.

**Measurements for C4FM modulation type**

<b>Measurement</b>	<b>Description</b>
RMS Error Magnitude	RMS value of the frequency deviation error at the symbol point.
Carrier Frequency Error	Frequency difference between averaged signal frequency and the center frequency.
Deviation	Frequency distance from the center frequency at the symbol point.
Length	Number of symbols in the analysis area.

**Pulse Measurements**

<b>Measurement</b>	<b>Description</b>
Average ON Power	The average power transmitted during pulse on.
Peak Power	Maximum power during pulse on.
Average Transmitted Power	The average power transmitted, including both the time the pulse is on and the time it is off, and all transition times.
Pulse Width	The time from the rising edge to the falling edge at the $-3$ dB / $-6$ dB level (50%) of the user selected 100% level. Level is user selectable for Volts or Watts.
Rise Time	The time required for a signal to rise from 10% to 90% (or 20% to 80%) of the user selected 100% level.
Fall Time	The time required for a signal to fall from 90% to 10% (or 80% to 20%) of the user selected 100% level.
Repetition Interval	The time from a pulse rising edge to the next pulse rising edge.
Repetition Rate	The inverse of repetition interval.
Duty Factor (%)	The ratio of the width to the pulse period, expressed as a percentage.
Duty Factor (Ratio)	The ratio of the pulse width to the pulse period.

Measurement	Description
Ripple	<p>Ripple is the peak-to-peak ripple on the pulse top. It does not include any preshoot, overshoot, or undershoot. By default, the first 25% and the last 25% of the pulse top is excluded from this measurement to eliminate distortions caused by these portions of the pulse.</p> <p>If the Amplitude units selected in the Amplitude panel (affects all amplitude measurements for the analyzer) are linear, the Ripple results will be in %Volts. For log units, the Ripple results will be in %Watts. The default for the general Units control is dBm, so the Ripple results default is %Watts.</p> <p>See also <a href="#">Ripple (see page 280)</a>.</p>
Ripple dB	The Ripple measurement expressed in dB.
Droop	Droop is the power difference between the beginning and the end of the pulse On time. A straight-line best fit is used to represent the top of the pulse. The result is a percentage referenced to the Average ON Power.
Droop dB	The Droop measurement expressed in dB.
Overshoot	The amount by which the signal exceeds the 100% level on the pulse rising edge. Units are %Watts or %Volts.
Overshoot dB	The Overshoot measurement expressed in dB.
Pulse-Pulse Phase Difference	The phase difference between the selected pulse and the first pulse in the analysis window. The instantaneous phase is measured at a user-adjustable time following the rising edge of each pulse.
Pulse-Pulse Freq Difference	The difference between the frequency of the current pulse and frequency of the previous pulse. The instantaneous frequency is measured at a user-adjustable time following the rising edge of each pulse.
RMS Freq Error	The RMS Frequency Error measurement is the RMS average of the Freq Error vs. Time trace, computed over the Measurement Time.
Max Freq Error	The maximum frequency error is the difference between the measured carrier frequency of the signal and the user-selected center frequency of the analyzer.
RMS Phase Error	The RMS Phase Error measurement is the RMS average of the Phase vs Time trace, computed over the Measurement Time.
Max Phase Error	The phase is measured at each point during the pulse's ON time. The phase error for each point is the difference between the measured phase value and the calculated ideal phase value. After the phase error is calculated for all points in the acquisition record, the largest error in the positive direction and the largest in the negative direction are determined. Whichever of these two values has the greater absolute value is designated the Max Phase Error.
Freq Deviation	The Frequency Deviation measurement is the difference between the maximum and minimum measured values of the signal frequency during the Measurement Time.
Phase Deviation	The Phase Deviation is the difference between the maximum and minimum Phase values measured during the ON time of a pulse.
Impulse Response Amplitude	The difference in dB between the levels of the main lobe and highest side lobe.
Impulse Response Time	The difference in time between the main lobe and highest side lobe.
Time	This is the time in seconds relative to the time reference point in the first acquisition record in the data set.

## Overview

The displays in the General Signal Viewing folder (Displays > Folders > General Signal Viewing) are:

- Amplitude vs Time
- Frequency vs Time
- Phase vs Time
- RF I & Q vs Time
- Spectrogram
- Spectrum
- Time Overview

These displays provide extensive time-correlated multi-domain views that connect problems in time, frequency, phase and amplitude for enabling you to more quickly understand cause and effect when troubleshooting.



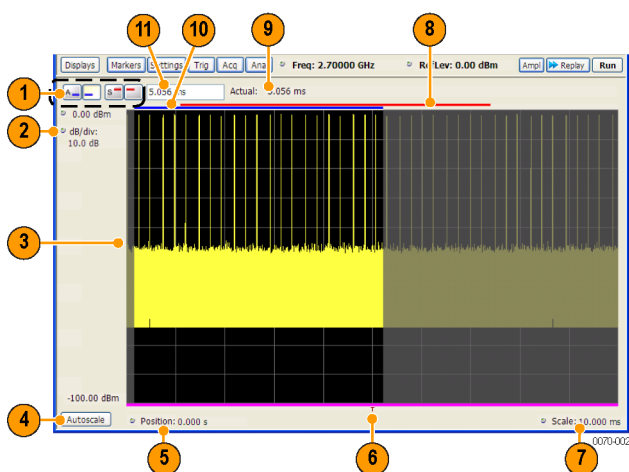
## Time Overview Display

The Time Overview display shows the entire acquisition record and shows you how the spectrum time and analysis time fit within the acquisition record. This enables you to see how you can adjust the spectrum time and analysis time to measure portions of the data.

You can specify the maximum number of trace points in the Time Overview display. You can set the maximum number of trace points to 1K, 10K, 100K, 1M points or to Never decimate. If the Acquisition Length includes more than 10,000 sample points (and Max trace points is not set to Never decimate), the trace is decimated (using the +Peak method, similar to +Peak detection in a Spectrum display) to 10,000 points. This decimated trace is what is used for marker measurements.

The Time Overview window displays the Spectrum Length and Analysis Length. The Spectrum Length is the period of time within the acquisition record over which the spectrum is calculated. The Analysis Length is the period of time within the acquisition record over which all other measurements (such as Amplitude vs. Time) are made. The Spectrum Length and Analysis Length can be locked together so that the data used to produce the Spectrum display is also used for measurement displays; however, they do not have to be tied together. They are by default specified separately and used to analyze different parts of the acquisition record.

### Elements of the Display



Item	Element	Description
1	Analysis Time Control	Click a button to select the value to be adjusted. In order, the buttons represent Analysis Offset, Analysis Length, Spectrum Offset, and Spectrum Length.
2	Position and Scale	Adjusts the vertical scale and position.
3	Amplitude vs. Time graph	The trace represents the entire acquisition record (at full horizontal scale). The graph indicates the Analysis Length or Spectrum Length on the graph with a darker background.
4	Autoscale button	Resets the horizontal scale to display the entire acquisition record and the vertical scale to show all trace points.
5	Horizontal Offset	Adjusts the horizontal offset.
6	Results Timeline	This fuchsia line indicates the portion of the record actually used for calculating the selected result. For example: if a pulse measurement is selected, it shows the period of the specific pulse. For a constellation display, it shows the points included in the demodulation.
7	Horizontal Scale	Adjusts the span of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the acquisition record by adjusting the offset.
8	Spectrum Length and Offset Indicator	This red line indicates the Spectrum Length and Offset. The longer the time, the longer the bar. Adjusting the offset shifts the bar left or right.
9	Actual length display	Displays the actual time for the selected value. If the user-adjusted length extends past the end of the acquisition record, the realizable analysis length is less than requested.
10	Analysis Length and Offset Indicator	This blue line indicates the Analysis Length and Offset. The longer the time, the longer the bar. Adjusting the offset shifts the bar left or right.
11	Setting Adjustment box	Click in this box to adjust the value selected by the Analysis Time Control buttons.

**NOTE.** *The area with black background (not gray) in the Amplitude vs. Time Graph highlights the control selected in the Analysis Time Control drop-down list.*

[Changing the Time Overview Display Settings \(see page 25\)](#)

## Time Overview Settings

**Menu Bar:** Setup > Settings

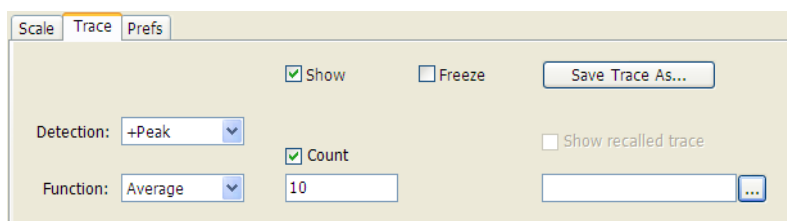
**Application Toolbar:** Settings

The Setup settings for Time Overview are shown in the following table.

Settings tab	Description
<a href="#">Scale (see page 56)</a>	Adjusts the vertical and horizontal scale and offset of the display.
<a href="#">Trace (see page 25)</a>	Allows you to select the types of trace to display and its function.
<a href="#">Prefs (see page 57)</a>	Specifies whether or not certain display elements are shown.

## Trace Tab

The Trace Tab allows you to set the display characteristics of displayed traces.



Setting	Description
Show	Shows / hides the selected trace.
Detection	Sets the Detection method used for the trace. Not available for saved traces. Available detection methods are +Peak, -Peak, +/-Peak, Avg (VRMS), and Sample. Not all detection methods are available in all displays.
Function	Selects the trace processing method. Available settings are: Normal, Average, Max Hold, and Min Hold.
(Number of Traces)	Sets the number of traces averaged to generate the displayed trace. (Present only when Function is set to Average.)
Freeze	Halts updates to the selected trace.
Save Trace As	Saves the selected trace to a file for later recall and analysis.
Show Recalled trace	Displays a saved trace instead of a live trace.

## Detection

Trace Detection occurs when the trace is being decimated by the measurement. For example, if the maximum number of trace points is 100,000, and the selected analysis region is 200,000 samples, the measurement must decimate the 200,000 resulting trace points by 2 to prevent exceeding the 100,000 trace point limit. Since only one value can be selected for each trace point, an algorithm must be used to select (detect) the appropriate value to use.

The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the +Peak, -Peak, Avg (VRMS) and Sample values are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods (depending on the display) are:

- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **+/-Peak** – Selects the highest and lowest values of all the samples contained in two consecutive acquisition intervals.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.
- **Sample** – The result is calculated based on the first sample available in the set of IQ samples for each trace point.

## Trace Processing

Traces can be processed to display in different ways. The Function setting controls trace processing.

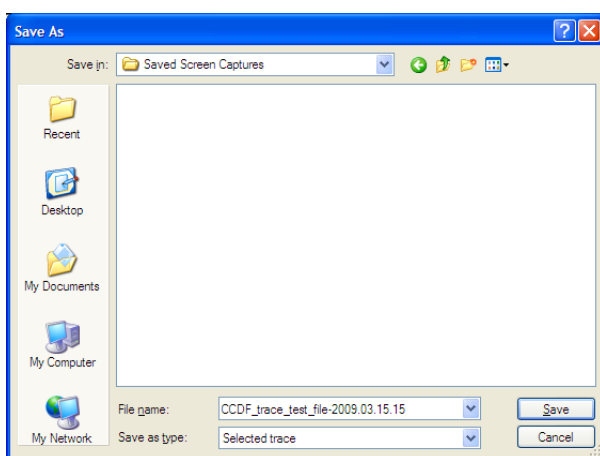
- **Normal** - Each new trace is displayed and then replaced by the next trace. Each data point contains a single vertical value.
- **Average** - Multiple traces are averaged together to generate the displayed trace. There is one vertical value for each underlying frequency data point. Once the specified number of traces have been acquired and averaged to generate the displayed trace, each new trace takes the place of the oldest trace in the calculation. The **Number of Traces** setting specifies how many traces averaged.

- **Max Hold** - Displays the maximum value in the trace record for each display point. Each new trace display point is compared to the previous maximum value and the greater value is retained for display and subsequent comparisons.
- **Min Hold** - Displays the minimum value in the trace record for each display point. Each new trace display point is compared to the previous minimum value and the lesser value is retained for display and subsequent comparisons.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



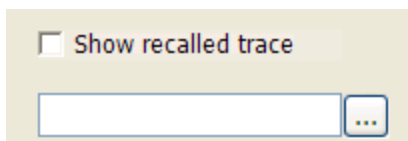
2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

## Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

1. Select the trace into which the recalled trace will be loaded, from the Trace drop-down list.
2. Check the **Show** check box.
3. Click the ... button to display the Open dialog box.



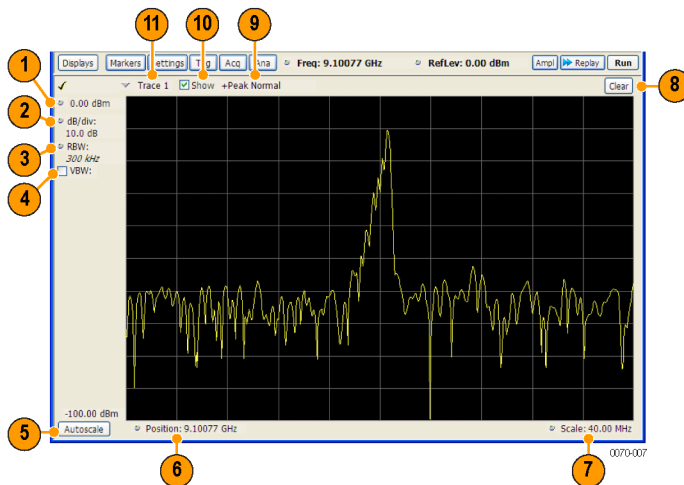
4. Navigate to the desired file and click **Open**.
5. Check the **Show Recalled Trace** check box.
6. Verify that the trace's **Show** check box is selected (either on this tab or next to the drop-down list located at the top-left corner of the graph).

## Spectrum Display

To display a spectrum:

1. Click the **Displays** button or select **Setup > Displays**.
2. From the Folders box, select **General Signal Viewing**.
3. Double-click the **Spectrum** icon in the **Available displays** box. This adds the Spectrum icon to the **Selected displays** box (and removes it from the Available displays box). Alternatively, you can click the Spectrum icon and then click the Add button to select Spectrum for display.
4. Click the **OK** button.

### Elements of the Spectrum Display



Item	Display element	Description
1	Vert Offset	Sets the top of graph value. This is only a visual control for panning the graph. The Reference Level is adjusted in the Toolbar. By default, Vert Offset = Ref Level.
2	dB/div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
3	RBW	Sets the resolution bandwidth. Note that when the RBW is set to Auto, its value is italicized.
4	VBW	Enables the VBW (Video Bandwidth) filter. See Setup > Settings > <a href="#">BW Tab (see page 54)</a> .
5	Autoscale	Adjusts the Vertical and Horizontal scaling to display the entire trace on screen.
6	Position	Default function is CF - center frequency (equivalent to the Freq setting). If Horizontal scaling has been manually adjusted in Settings > Scale, then Offset will replace CF as the setting at the bottom-left corner of the screen.
7	Span / Scale	Default function is Span - frequency difference between the left edge of the display and the right edge. If Horizontal scaling has been manually adjusted in Settings > Scale, then Scale will replace Span as the setting at the bottom-right corner of the screen.
8	Clear	Restarts multi-trace functions (Avg, Hold).
9	Function	Readout of the Detection and Function selections for the selected trace.
10	Show	Controls whether the selected Trace is visible or not. When trace is Off, the box is not checked.
11	Trace	Selects a trace. Touching here pops up a context menu listing the available traces, whether they are enabled or not. If user selects a trace that is not currently enabled, it will be made enabled.

### Touchscreen Actions on Markers in the Graph Area

Action	Description
Mouse click within 1/2 div. of a marker	Selects the marker and updates the marker display to show the selected marker's values.
Touch marker to select and then use knob, or arrow keys	Adjust the setting associated with the Marker.
Touch and drag a marker	Changes marker position to the "drop point".

### [Changing the Spectrum Display Settings \(see page 31\)](#)



## Spectrum Settings

**Menu Bar: Setup > Settings**

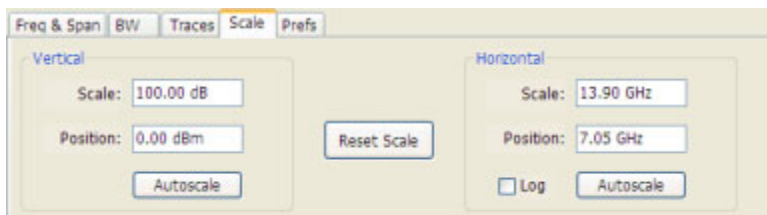
**Application Toolbar: Settings**

The Setup settings for the Spectrum display are visible when Spectrum is the selected display.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets frequency and span parameters for the Spectrum Analysis display.
<a href="#">BW (see page 54)</a>	Sets Resolution Bandwidth and windowing parameters.
<a href="#">Traces (see page 50)</a>	Sets Trace display parameters.
<a href="#">Traces (Math) (see page 54)</a>	Sets the traces used to create the Math trace.
<a href="#">Scale (see page 32)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs Tab (see page 57)</a>	Specifies whether or not certain display elements are shown.

## Scale Tab

The Scale tab allows you to change the vertical scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
Vertical	
Scale	Changes the vertical scale.
Position	Vertical Offset adjusts the reference level away from top of the graph.
Autoscale	Resets the Offset so that the trace appears below the top of the graph.
Horizontal	
Scale	Allows you to change the range of frequencies shown in the graph without changing the span or measurement frequency.
Position	Allows you pan the graph.
Autoscale	Resets Scale to the Span setting.
Reset Scale	Resets all settings to their default values.
Log scale	Resets the display to show the frequency axis in a logarithmic scale.

## Spectrogram Display

The Spectrogram is a display with the vertical axis (time) composed of successive spectral displays, each having the amplitude represented by color or intensity. The horizontal axis represents frequency. The most recently acquired spectrum results are added to the bottom of the spectrogram. The addition of a new spectrum can occur at the fastest rate that new spectra can be plotted, or, if you choose, new spectra can be added at a timed rate. The spectrogram view is well-suited to displaying long-term trends of spectral data. The maximum number of lines that can be displayed in a spectrogram is 125,000.

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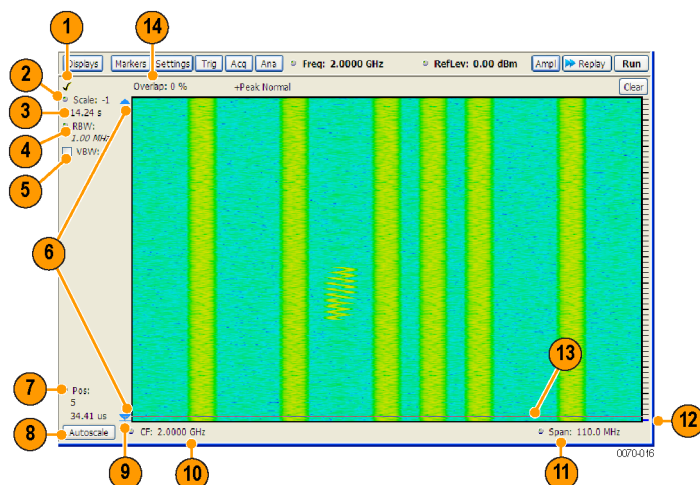
**NOTE.** *Spectrogram data is shared with the Spectrum display.*

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To display a Spectrogram:

1. Select the **Displays** button or select **Setup > Displays**. This displays the **Select Displays** dialog box.
2. From the **Folders** box, select **General Signal Viewing**.
3. Double-click the **Spectrogram** icon in the **Available Displays** box. This adds the Spectrogram icon to the Selected displays box.
4. Click the **OK** button. This displays the spectrogram view.

### Elements of the Spectrogram Display



Item	Display element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Spectrogram display is the optimized display.
2	Scale	Sets the vertical scale factor, increasing or decreasing the amount of time in each line.
3	Total time	This value represents the total time displayed in the Spectrogram.
4	RBW	Sets the resolution bandwidth. Note that when the RBW is set to Auto, its value is italicized.
5	VBW	Enables the VBW (Video Bandwidth) filter. See Setup > Settings > <a href="#">BW Tab (see page 54)</a> .
6	Selected records indicators	These indicators show positions of the start and stop records selected on the Select data records tab. Drag the indicators to select which records will be played by Replay All.
7	Pos	Position indicates the bottom line visible in graph.
8	Autoscale	Resets Vertical and Horizontal scale and Pos to default values.
9	T	Trigger indicator. This icon indicates the trigger point within the current acquisition.
10	CF	Sets the Center Frequency.
11	Span	Sets the span of the spectrogram display.
12	Current data record indicator	This blue line indicates the current data record. When the analysis length is short, the blue line appears as a thin line much like the selected indicator line. When the analysis length is relatively long, the blue line is much taller than shown in the illustration.
13	Selected indicator	This line indicates the line that will appear in the Spectrum display (if the Spectrogram trace is enabled in the Spectrum display). This line is attached to the selected marker.
14	Overlap	Shows what portions of its time period a given line shares with previous or later lines.

The Spectrogram can show results from one or multiple acquisitions and it can show one or multiple lines for each acquisition.

[Changing the Spectrogram Display Settings \(see page 35\)](#)

## Spectrogram Settings

**Menu Bar: Setup > Settings**

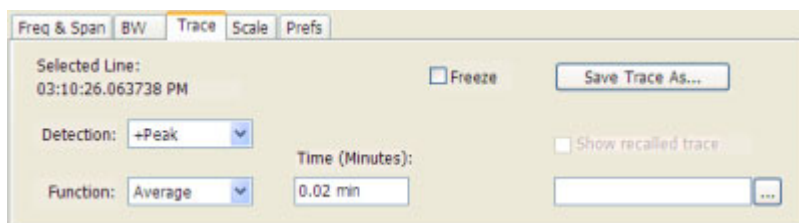
**Application Toolbar: Settings**

The Setup settings for the Spectrogram display are visible when Spectrogram is the selected display.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets frequency and span parameters for the Spectrogram display.
<a href="#">BW (see page 54)</a>	Sets Resolution Bandwidth and windowing parameters.
<a href="#">Trace (see page 35)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 39)</a>	Sets vertical scale parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether or not certain display elements are shown.

## Trace Tab

The Traces Tab allows you to set the display characteristics of displayed traces.



Setting	Description
Selected Line	Displays the time at the Selected Line. If Markers are enabled, the selected line is positioned by the selected marker. If no markers are enabled, the selected line is the first line in the current analysis period.
Detection	Sets the Detector method used for the trace. Not available for saved traces. Available detection methods are +Peak, -Peak, +/-Peak, Avg (VRMS), Sample, and CISPR Pk. Not all detection methods are available in all displays.
Function	Selects the trace processing method. Available settings are: Normal, Average, Max Hold, and Min Hold.
Time (Minutes)	Sets the period of time the spectrum trace is averaged to generate each line of the displayed spectrogram.
Freeze	Halts updates to the selected trace.
Save Trace As	Saves the selected trace to a file for later recall and analysis.
Show Recalled trace	Displays a saved trace instead of a live trace.

## Detection

Trace Detection occurs when the trace is being decimated by the measurement. For example, if the maximum number of trace points is 100,000, and the selected analysis region is 200,000 samples, the measurement must decimate the 200,000 resulting trace points by 2 to prevent exceeding the 100,000 trace point limit. Since only one value can be selected for each trace point, an algorithm must be used to select (detect) the appropriate value to use.

The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the +Peak, -Peak, Avg (VRMS) and Sample values are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods are:

- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.
- **CISPR Pk** [CISPR Peak] – The trace value is calculated by the methods described for peak detectors in the CISPR documents.

## Trace Processing

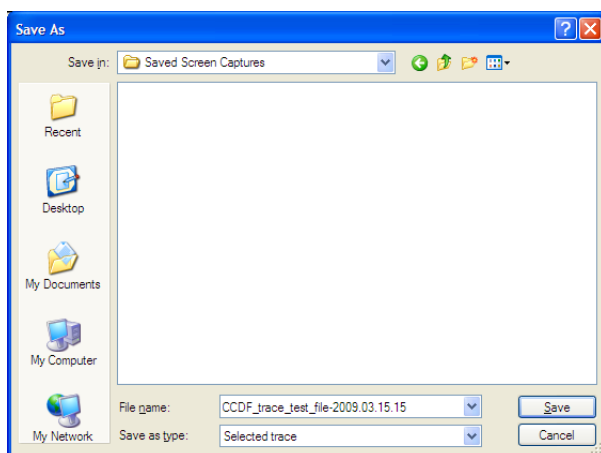
Traces can be processed to display in different ways. The Function setting controls trace processing.

- **Normal** - Each new trace is displayed and then replaced by the next trace. Each data point contains a single vertical value.
- **Average** - Multiple traces are averaged together to generate the displayed trace. There is one vertical value for each underlying frequency data point. Once the specified number of traces have been acquired and averaged to generate the displayed trace, each new trace takes the place of the oldest trace in the calculation. The **Number of Traces** setting specifies how many traces averaged.
- **Max Hold** - Displays the maximum value in the trace record for each display point. Each new trace display point is compared to the previous maximum value and the greater value is retained for display and subsequent comparisons.
- **Min Hold** - Displays the minimum value in the trace record for each display point. Each new trace display point is compared to the previous minimum value and the lesser value is retained for display and subsequent comparisons.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



2. Type a name for the saved trace and click **Save**.

## Recalling Trace

You can recall a previously saved trace for analysis. First, specify a trace for recall and second, enable Show Recalled Trace.

To recall a previously saved trace:

1. Click the ... button to display the Open dialog box.

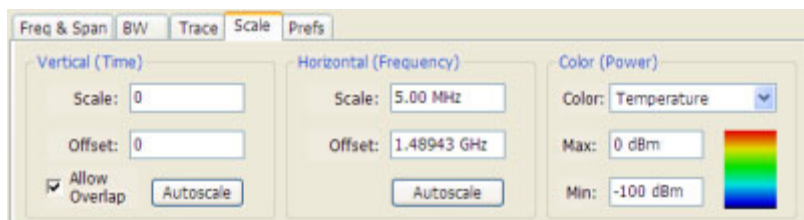


2. Navigate to the location of the saved spectrogram trace.
3. Select the desired trace and click **Open**.
4. Check the **Show Recalled Trace** check box.



## Scale Tab

The Scale tab allows you to change the vertical and horizontal scale settings and set the color scheme used for the spectrogram trace.



Setting	Description
<b>Vertical (Time)</b>	
Scale	Changes the vertical scale or the length of time shown in the graph. The most recent acquisition appears at the bottom of the graph.
Offset	Offset adjusts which of the lines is placed at the bottom position in the graph.
Autoscale	Resets the scale of the vertical axis to contain the complete trace for one acquisition.
Allow Overlap	Allows the use of overlapped frequency transforms.
<b>Horizontal (Frequency)</b>	
Scale	Allows you to change the range of frequencies shown in the graph without changing the span or measurement frequency.
Offset	Allows you pan the graph.
Autoscale	Resets Scale to the Span setting.
<b>Color (Power)</b>	
Color	Displays a drop-down list that allows you to set the color scheme used for the spectrogram trace.
Max	Sets the maximum power level represented by the top of the color scale.
Min	Sets the minimum power level represented by the bottom of the color scale.

### Vertical Scale

The Spectrogram display allows you to zoom in and out in the time scale. Positive values zoom in (expand the scale) and negative values zoom out (compress the scale). If the Scale control does not allow positive values, either the Analysis Length (Setup > Analysis > Analysis Time) provides only enough time for a single spectrogram line (manually increase the Analysis Length as needed) or Allow Overlap is disabled.

## Amplitude vs Time Display

The Amplitude vs. Time display plots the signal amplitude against time. The amplitude appears on the vertical axis while time is plotted along the horizontal axis.

Note that the trace(s) in the Amplitude vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export. You can set the Max trace points on the **Settings > Prefs** tab.

To show Amplitude vs. Time display:

1. Press the **Displays** button or select **Setup > Displays**.
2. In the **Select Displays** dialog, select **General Signal Viewing** in the **Folders** box.
3. In the **Available displays** box, double-click the **Amplitude vs. Time** icon or select the icon and click **Add**. The Amplitude vs. Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK**.

### Elements of the Display



Item	Display element	Description
1	Vert Offset	Adjusts the vertical display offset.
2	Vertical scale adjustment	Adjusts the vertical scaling.
3	Span	Adjust the bandwidth of the data to be analyzed. (Not the period of time shown in the display.)
4	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
5	Offset	Adjust the horizontal offset.
6	Max and Min readouts	Displays the maximum and minimum amplitudes, as well as when those values occur.
7	Scale	Sets the time spanned by the graph.
8	Clear button	Restarts multi-trace functions (Avg, Hold).
9	Trace function	Displays the current trace function setting (Settings > Trace tab > Function).

Reference. [Changing Amplitude vs Time Display Settings \(see page 41\)](#)

## Amplitude vs Time Settings

**Menu Bar:** Setup > Settings

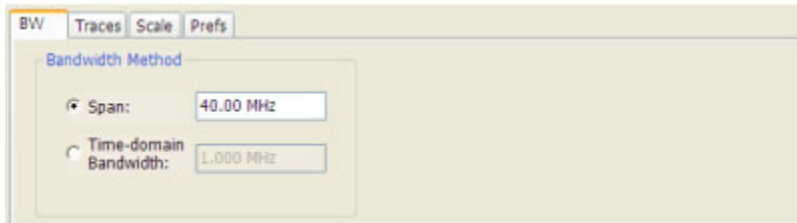
**Application Toolbar:** Settings

The settings for the Amplitude vs. Time display are shown in the following table.

Settings tab	Description
<a href="#">BW (see page 42)</a>	Sets the Bandwidth Method used for setting the measurement bandwidth.
<a href="#">Traces (see page 50)</a>	Allows you to select the type of trace to display and their functions.
<a href="#">Traces (Math) (see page 54)</a>	Sets the traces used to create the Math trace.
<a href="#">Scale (see page 56)</a>	Sets the vertical and horizontal scale parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether certain display elements are visible.

## BW Tab

The BW (Bandwidth) tab allows you to specify the Bandwidth Method used for setting measurement bandwidth. This determines what Acq BW the measurement will request.



Settings	Description
Span	The frequency span used for analysis in the Amplitude vs. Time display. If the spectrum display is open, the span is automatically set to the analyzer bandwidth.
Time-domain Bandwidth	Time-domain Bandwidth is a filter used to process the input signal before the acquisition system analyzes the signal.

## Frequency vs Time Display

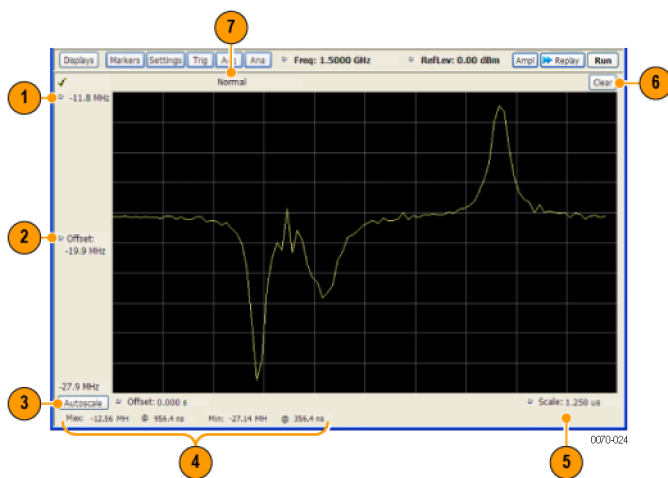
The Frequency vs. Time Display shows how the signal frequency varies with time.

Note that the trace(s) in the Frequency vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export. You can set the Max trace points on the **Settings > Prefs** tab.

To display the Frequency vs. Time Display:

1. Select the **Displays** button or **Setup > Displays**.
2. In the **Select Displays** dialog, select **General Signal Viewing** in the **Folders** box.
3. In the **Available displays** box, double-click the **Frequency vs. Time** icon or select the icon and click **Add**. The Frequency vs. Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK** to display the Freq vs. Time display.

### Elements of the Display



Item	Display element	Description
1	Top of graph adjustment	Use the knob to adjust the frequency range displayed on the vertical axis.
2	Offset adjustment	Adjusts the frequency shown at the center of the display.
3	Autoscale button	Adjusts the offset and range for both vertical and horizontal to provide the best display.
4	Maximum and Minimum frequency readouts	Displays the maximum and minimum values, as well as when those values occur.
5	Horizontal Scale	Sets the time spanned by the graph.
6	Clear button	Restarts Average trace.
7	Trace function	Displays the current trace function setting (Settings > Trace > Function).

[Changing Frequency vs Time Display Settings \(see page 44\)](#)

## Frequency vs Time Settings

**Menu Bar: Setup > Settings**

**Application Toolbar: Settings**

The Setup settings for Frequency vs. Time are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets the frequency and span parameters.
<a href="#">Trace (see page 50)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 56)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether certain display elements are visible.

## Phase vs Time Display

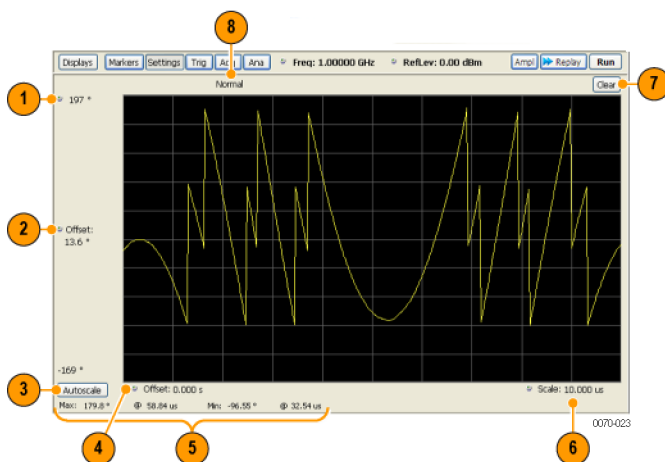
The Phase vs. Time display plots the signal phase against time. The phase appears on the vertical axis while time is plotted along the horizontal axis.

Note that the trace(s) in the Phase vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export. You can set the Max trace points on the **Settings > Prefs** tab.

To display Phase vs. Time:

1. Press the **Displays** button or select **Setup > Displays**.
2. In the **Select Displays** dialog, select **General Signal Viewing** in the **Folders** box.
3. In the **Available displays** box, double-click the **Phase vs. Time** icon or select the icon and click **Add**. The Phase vs. Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK** to show the Phase vs. Time display.

### Elements of the Display



Item	Display element	Description
1	Top of graph adjustment	Adjusts the vertical scale. Use the knob to adjust the value of the top of the graph.
2	Vertical offset adjustment	Adjusts the phase error shown at the vertical center of the display.
3	Autoscale button	Adjusts the vertical and horizontal settings so that the entire trace fits in the view.
4	Horizontal Offset	Adjusts the horizontal position of the trace.
5	Max and Min readouts	Displays the maximum and minimum value of the phase error within the analysis times and the times at which they occurred.
6	Horizontal Scale	Sets the time spanned by the graph.
7	Clear button	Restarts multi-trace functions (Avg, Hold).
8	Trace function	Shows the trace function as set on the Settings > Trace tab.

[Changing the Phase vs Time Display Settings \(see page 46\)](#)

## Phase vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The settings for the Phase vs. Time display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets the frequency and span parameters.
<a href="#">Trace (see page 50)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 56)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether certain display elements are visible.



## RF I & Q vs Time Display

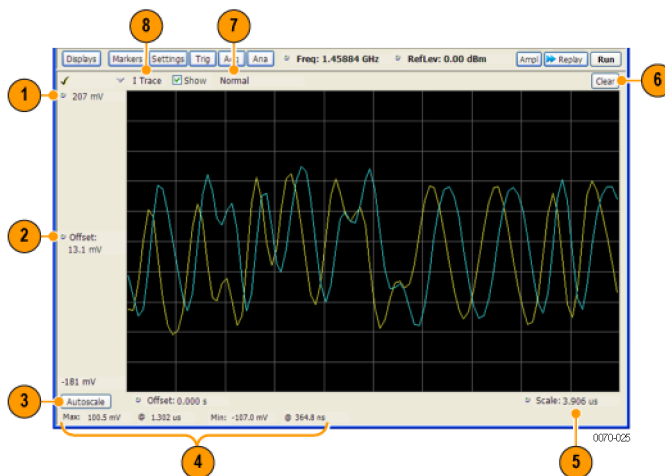
This is a plot of the baseband In-Phase (I) and Quadrature (Q) components of a modulated carrier. The plot is in the time domain, with I and/or Q values the Y-axis.

Note that the trace(s) in the RF I & Q vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export. You can set the Max trace points on the **Settings > Prefs** tab.

To display an RF I & Q vs. Time display:

1. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **General Signal Viewing**.
3. Double-click the **RF I&Q vs. Time** icon in the **Available Displays** box. This adds the RF I & Q vs. Time icon to the **Selected displays** box.
4. Click the **OK** button.

### Elements of the Display



Item	Display element	Description
1	Top of Graph adjustment	Use the knob to adjust the vertical scaling.
2	Vertical offset adjustment	Adjusts the level shown at the center of the display.
3	Autoscale button	Adjusts the offset and scale for both vertical and horizontal to provide the best display.
4	Maximum and Minimum level readouts	Displays the maximum and minimum values, within the Analysis Time, as well as the times at which they occurred.
5	Scale	Sets the time spanned by the graph.
6	Clear button	Restarts multi-trace functions (Avg, Hold).
7	Trace function	Displays the current trace function setting (Settings > Trace > Function). If the traces are averaged, the number of averages is displayed.
8	Trace Control	Selects which trace is displayed (using the drop-down list) and which trace is active (click on the trace name to display a menu).

[Changing the RF I & Q vs Time Display Settings \(see page 48\)](#)

## RF I & Q vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup settings for RF I&Q vs. Time are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets the frequency and span parameters.
<a href="#">Trace (see page 50)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 56)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether certain display elements are visible.

## General Signal Viewing Shared Measurement Settings

The control panel tabs in this section are identical or very similar for each of the displays in the General Signal Viewing folder (Setup > Displays). Some tabs are shared by all the displays, some tabs are shared by only a couple of displays.

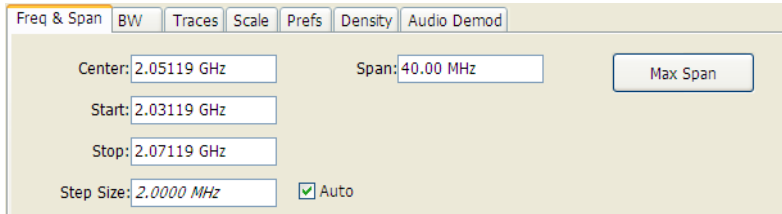
For some tabs, the control values are shared across all the General Signal Viewing displays. For other control values, each display has unique values for the controls. Details are provided for the specific tabs.

### Common controls for general signal viewing displays

Settings tab	Description
<a href="#">Freq &amp; Span (see page 50)</a>	Sets the frequency and span parameters.
<a href="#">Trace (see page 50)</a>	Sets the trace display parameters.
<a href="#">Traces – Math (see page 54)</a>	Sets the traces used to create the Math trace.
<a href="#">BW (see page 54)</a>	Sets the Bandwidth Method used for setting the measurement bandwidth.
<a href="#">Scale (see page 56)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 57)</a>	Specifies whether certain display elements are visible.

## Freq & Span Tab

The Freq & Span tab provides access to settings that control frequency settings for the trace display. The control values set in this tab are shared by all the General Signal Viewing displays.



Setting	Description
Center	The frequency at the center of the selected Span.
Start	The lowest frequency in the span.
Stop	The highest frequency in the span.
Step Size	Sets the increment/decrement size for Center, Start and Stop values.
Span	The difference between the start and stop frequencies. This is the measurement bandwidth for the general signal viewing displays.
Max Span	Sets the Span to the maximum value.

### Center, Start, Stop, and Span Frequencies Are Correlated

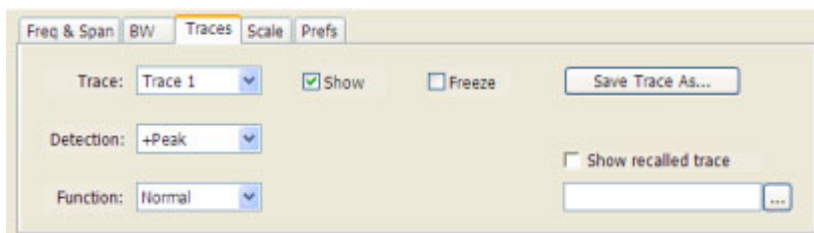
Changing the values for Center frequency, Start frequency, Stop frequency or Span will change the values for the other settings, depending on which setting you change. For example, if you change the Center frequency, the Start and Stop frequencies will be adjusted automatically to maintain the same Span.

Note however that if the Start and Stop frequencies are changed so that they are closer than the minimum span setting, the Start and Stop frequencies will be adjusted to maintain the minimum Span setting.

Setting Changed Manually	Settings Changed Automatically As a Result	Setting Not Automatically Changed
Start	Center, Span	Stop
Stop	Center, Span	Start
Center	Start, Stop	Span
Span	Start, Stop	Center

## Traces Tab

The Traces Tab allows you to set the display characteristics of displayed traces.



Setting	Description
Trace	Selects a trace. (This setting is not present for every display.)
Show	Shows / hides the selected trace.
Detection	Sets the Detection method used for the trace. Not available for saved traces. Available detection methods are +Peak, -Peak, +/-Peak, Avg (VRMS), Sample, and CISPR Peak. Not all detection methods are available in all displays.
Function	Selects the trace processing method. Available settings are: Normal, Average, Max Hold, and Min Hold.
Count	Sets the number of traces averaged to generate the displayed trace. (Present only when Function is set to Average, Min Hold, or Max Hold.)
Freeze	Halts updates to the selected trace.
Save Trace As	Saves the selected trace to a file for later recall and analysis.
Show Recalled trace	Displays a saved trace instead of a live trace.

## Trace

Available traces for Spectrum are: Trace 1, Trace 2, Trace 3, Math, and Spectrogram. Other displays support fewer traces. Traces 1-3 are based on the input signal and enable you to display the input signal using different processing. For example, you could display Trace 1 with Function set to Normal, Trace 2 with Function set to Max Hold and Trace 3 with Function set to Min Hold.

The Math trace is the result of subtracting one trace from another.

The Spectrogram trace applies only to the Spectrum display and is available only if the Spectrogram display is shown. The Spectrogram trace shows the trace selected in the Spectrogram as a spectrum trace.

## Detection

Trace Detection occurs when the trace is being decimated by the measurement. For example, if the maximum number of trace points is 100,000, and the selected analysis region is 200,000 samples, the measurement must decimate the 200,000 resulting trace points by 2 to prevent exceeding the 100,000 trace point limit. Since only one value can be selected for each trace point, an algorithm must be used to select (detect) the appropriate value to use.

The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the

+Peak, -Peak, Avg (VRMS) and Sample values are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods (depending on the display) are:

- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **+/-Peak** – Selects the highest and lowest values of all the samples contained in two consecutive acquisition intervals.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.
- **Sample** – The result is calculated based on the first sample available in the set of IQ samples for each trace point.
- **CISPR Peak** – The trace value is calculated by the methods described for peak detectors in the CISPR documents.

## Trace Processing

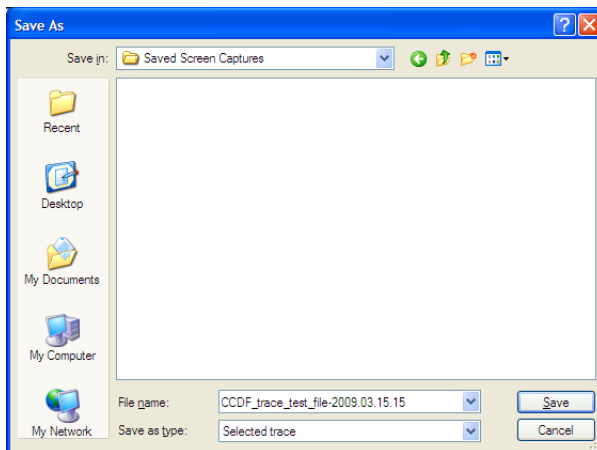
Traces can be processed to display in different ways. The Function setting controls trace processing.

- **Normal** - Each new trace is displayed and then replaced by the next trace. Each data point contains a single vertical value.
- **Average** - Multiple traces are averaged together to generate the displayed trace. There is one vertical value for each underlying frequency data point. Once the specified number of traces have been acquired and averaged to generate the displayed trace, each new trace takes the place of the oldest trace in the calculation. The **Number of Traces** setting specifies how many traces averaged.
- **Max Hold** - Displays the maximum value in the trace record for each display point. Each new trace display point is compared to the previous maximum value and the greater value is retained for display and subsequent comparisons.
- **Min Hold** - Displays the minimum value in the trace record for each display point. Each new trace display point is compared to the previous minimum value and the lesser value is retained for display and subsequent comparisons.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save TraceAs** button. This displays the Save As dialog box.



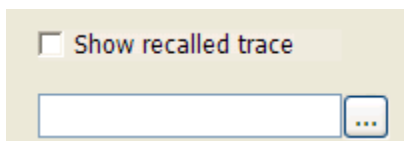
2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

### Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

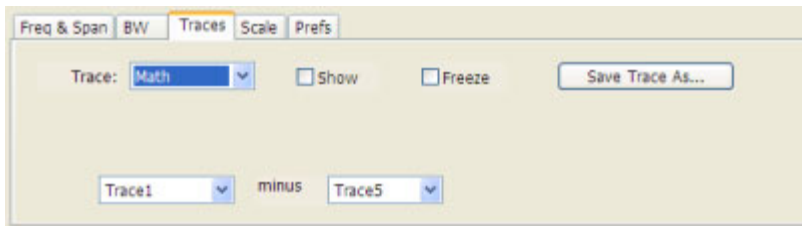
1. Select the trace into which the recalled trace will be loaded, from the Trace drop-down list.
2. Check the **Show** check box.
3. Click the ... button to display the Open dialog box.



4. Navigate to the desired file and click **Open**.
5. Check the **Show Recalled Trace** check box.
6. Verify that the trace's **Show** check box is selected (either on this tab or next to the drop-down list located at the top-left corner of the graph).

## Traces Tab – Math Trace

This tab is not a distinct tab, it is just how the Traces tab appears when Math is selected in the Traces drop-down list.

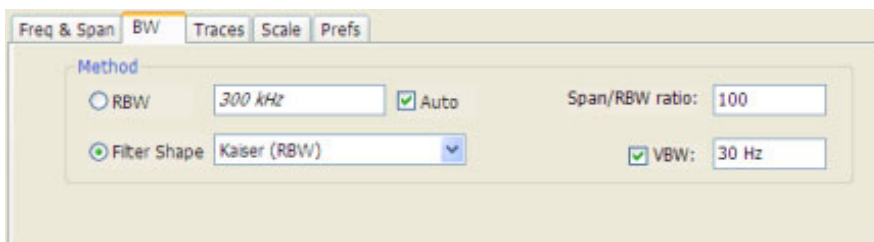


Trace 4 is a mathematically-derived trace defined as Trace A minus Trace B. You can select Trace 1, 2, or 3 to serve as either Trace A or Trace B.

Setting	Description
Trace	When set to Trace 4 (Math), this tab is displayed.
Show	Shows / hides the selected trace.
Freeze	Halts updates to the selected trace.
Save Trace As...	Saves the selected trace to a file for later recall and analysis.
Trace minus Trace	Selects which traces serve as Trace A and Trace B.

## BW Tab

The BW (bandwidth) tab allows you to change Resolution Bandwidth and Video Bandwidth settings, set the windowing method used by the transform process by selecting a filter shape, and specify how gain and bandwidth are optimized.





Setting	Description
RBW	Sets the Resolution Bandwidth value to be used in the spectrum analysis view. The value is italicized when Auto is selected.
Auto	When Auto is checked, the RBW is calculated as a percentage of the Span. Kaiser is selected as the windowing method. When Auto is unchecked, the RBW is set by the user. Selecting any Window other than Kaiser changes the RBW setting to manual.
Span/RBW ratio	If Auto is checked, this value is used to calculate the RBW. If Auto is unchecked, this setting is not selectable.
Filter Shape	Specifies the windowing method used for the transform (when Auto is unchecked). (Spectrum and Spectrogram displays only.)
VBW	Adjusts the VBW (Video Bandwidth) value. (Spectrum and Spectrogram displays only.)

### Filter Shape Settings

In the analyzer, computationally efficient discrete Fourier transform algorithms such as FFT (Fast Fourier Transform) or CZT (Chirp-Z Transform) are generally employed to transform time-domain signals into frequency-domain spectra. There is an assumption inherent in the mathematics of Discrete Fourier Transforms that the data to be processed is a single period of a periodically repeating signal. The discontinuities between successive frames will generally occur when the periodic extension is made to the signal. These artificial discontinuities generate spurious responses not present in the original signal, which can make it impossible to detect small signals in the presence of nearby large ones. This phenomenon is called spectral leakage.

Applying a filter, such as Kaiser, to the signal to be transformed is an effective method to combat the spectral leakage problem. Generally the filter has a bell shape. Multiplying the transform frame by the filter function eliminates or reduces the discontinuities at the ends of the frame, however, at the expense of increased RBW.

### Filter Shape Characteristics

The choice of filter shape depends on its frequency response characteristics such as side-lobe level, equivalent noise bandwidth and maximum amplitude error. Use the following guidelines to select the best filter shape.

Filter Shape	Characteristics
Kaiser (RBW)	Best side-lobe level, shape factor closest to the traditional Gaussian RBW.
-6dB RBW (MIL)	These filters are specified for bandwidth at their -6 dB point, as required by military EMI regulations.
CISPR	These filters comply with the requirements specified in the P-CISPR 16 -1-1 document for EMI measurements.
Blackman-Harris 4B	Good side-lobe level.
Uniform (None)	Best frequency resolution, poor side-lobe level and amplitude accuracy.
FlatTop	Best amplitude accuracy, best representation of brief events captured near the beginning or end of the time-domain data frame, poor frequency resolution.
Hanning	Good frequency resolution, high side-lobe roll-off rate.

## VBW

The VBW setting enables/disables the Video Bandwidth filter. VBW is used in traditional swept analyzers to reduce the effect of noise on the displayed signal. The VBW algorithm in the analyzer emulates the VBW filters of traditional swept analyzers.

The maximum VBW value is the current RBW setting. The minimum VBW value is 1/10,000 of the RBW setting. VBW is disabled when the Filter shape is set to CISPR.

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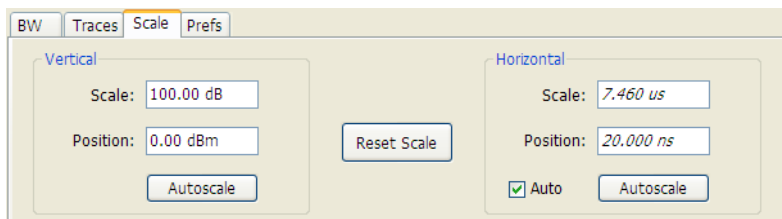
**NOTE.** *If you are following a procedure that says to "set VBW to three times the RBW value or greater", it means that the test should be conducted with no VBW effects. In the SignalVu software, this condition is met by disabling the VBW function.*

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## Scale Tab

The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.

The Scale tab values are unique to each display. Also, note that each display uses horizontal and vertical units that are appropriate for the display. For example, for the Spectrum display uses power (dBm) units and frequency (Hz) units; the Amplitude vs. Time display uses power (dBm) and time (seconds) units; and the Phase vs. Time display uses phase (degrees) and time (seconds) units.

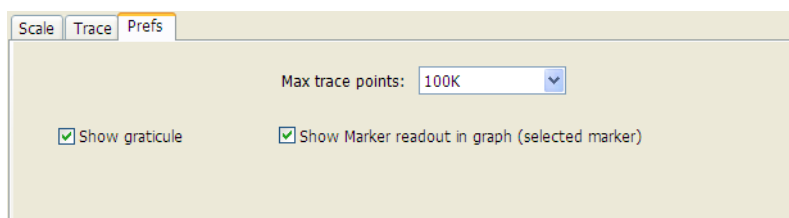


Setting	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale.
Offset	Vertical Offset adjusts the reference level away from top of the graph.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Horizontal	Controls the span of the trace display and position of the trace.
Scale	Sets the period of time shown in the graph.
Offset	Allows you to pan a zoomed trace.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Reset Scale	Resets all settings to their default values.

## Prefs Tab

The Prefs tab enables you to change parameters of the measurement display. The parameters available on the Prefs tab vary depending on the selected display, but include such items as enabling/disabling Marker Readout, switching the Graticule display on/off, and Marker Noise mode.

Each of the General Signal Viewing displays maintains its own separate values for the controls that appear on the Prefs tab. Some parameters appear with most displays while others appear with only one display. For example, the Show Marker readout in graph check box appears in the Prefs tab for every display. However, the Show Power Trigger level check box only appears on the Amplitude vs Time Prefs tab.



The following table explains the controls that can appear on the Prefs tab.

Setting	Description
Show:	Selects the horizontal settings that appear below the graph area. You can choose Start, Stop or Center, Span.
Max trace points	Sets the number of trace points used for marker measurements and for results export.
Show trace legend	Enables display of a legend in the measurements area that shows the Detection method and Function setting for displayed traces. The color of the legend text matches the color of the associated trace.
Show graticule	Select to display or hide the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Show Power Trigger Level	Displays or hides a green line in the graph that indicates the level at which the power trigger is set. The line is not displayed if Trigger is set to Free Run.
Marker Noise mode	Select to enable or disable the Marker Noise mode. Use this mode to measure noise on the trace. See <a href="#">Using Noise Markers in the Spectrum Display (see page 207)</a> .

## Overview

The displays in the Analog Modulation folder (Displays > Folders > Analog Modulation) are:

- AM
- FM
- PM

The Analog Modulation displays provide measurements and time-domain trace displays.

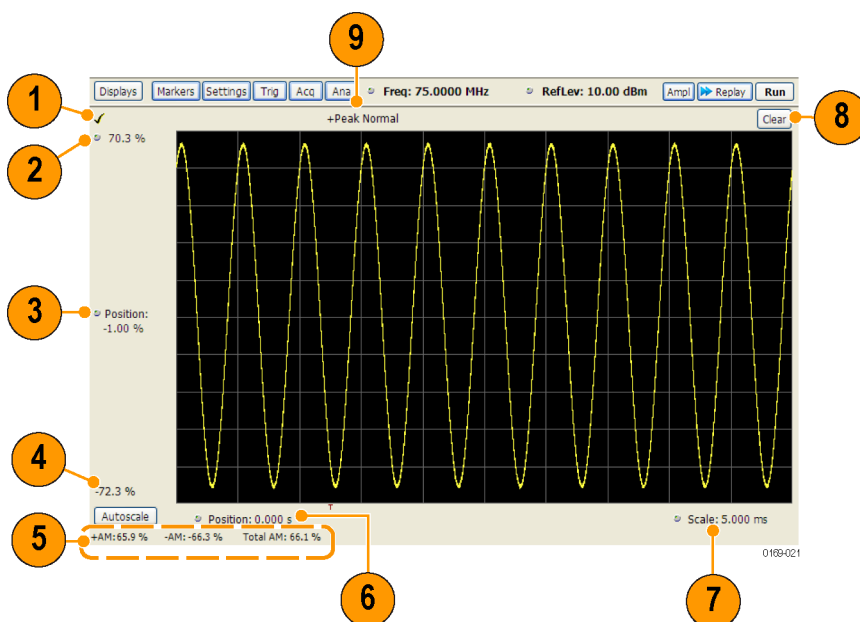
## AM Display

The Amplitude Modulation Display is a graph of Modulation Factor vs Time. The AM display includes three numeric readouts.

To show the AM display:

1. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **Analog Modulation**.
3. Double-click the **AM** icon in the **Available Displays** box. This adds the AM icon to the **Selected displays** box.
4. Click the **OK** button. This shows the AM display.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the AM display is the optimized display.
2	Top of Graph	Sets the %AM indicated at the top of the graph by increasing or decreasing the vertical scale. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable).
3	Position	Specifies the %AM shown at the center of the graph display.
4	Bottom Readout	Displays the value of the modulation factor shown at the bottom of graph.
5	Measurement readouts	Displays numeric values for the +AM (positive modulation factor), -AM (negative modulation factor), and Total AM.
6	Position	Specifies the horizontal position of the trace on the graph display.
7	Scale	Adjusts the horizontal range of the graph. By decreasing the scale (time across the entire graph), the graph essentially becomes a window that you can move over the trace by adjusting the position.
8	Clear	Erases the trace from the graph.
9	Trace Detection readout	Displays the Settings > Trace > Detection setting.

[Changing the AM Settings \(see page 60\)](#)

## AM Settings

**Menu Bar: Setup > Settings**

**Application Toolbar: Settings**

The AM Settings control panel provides access to settings that control parameters of the AM Display.



Setting	Description
<a href="#">Parameters (see page 61)</a>	Sets the Carrier Amplitude Detection method. You can choose either Average or Median.
<a href="#">Trace (see page 62)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 64)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 65)</a>	Specifies whether or not certain display elements are shown. Specifies the maximum number of points shown in the display graph.

## Parameters Tab

The Parameters tab enables you to specify two parameters that control the carrier amplitude detection.



Setting	Description
Average	Selects the Average method for computing the average baseline for measurements.
Median	Selects the Median method for computing the average baseline for measurements.
Measurement BW	Specifies the bandwidth about the center frequency at which measurements are made.

### AM Modulation

An amplitude modulated carrier can be described mathematically by:

$$X(t) = [A + a(t)] \cos \omega_0 t$$

A, in the above equation, represents the carrier amplitude, a(t) represents the time-varying modulation and  $\omega_0$  represents the carrier frequency.

The signal modulation envelope is given by:

$$E_M(t) = A + a(t)$$

There are several ways to express the AM modulation depth, expressed as a percentage.

*Peak method*

$$AMModulationDepth = \frac{Max[A + a(t)]}{A}$$

*Trough Method*

$$AMModulationDepth = \frac{Min[A + a(t)]}{A}$$

*Max-Min Method*

$$AMModulationDepth = \frac{Max[A + a(t)] - Min[A + a(t)]}{2A}$$

In each case, the value of the carrier amplitude, A, needs to be estimated from the input signal.

The instrument represents signals in a sampled form. The sampled envelope can be expressed as a function of sample index K and sampling period T as:

$$E_M[KT] = A + a[KT]$$

The instrument allows the choice of two methods for estimating the carrier amplitude:

*Average Method*

$$A = \text{Average} \{E_M [KT]\}$$

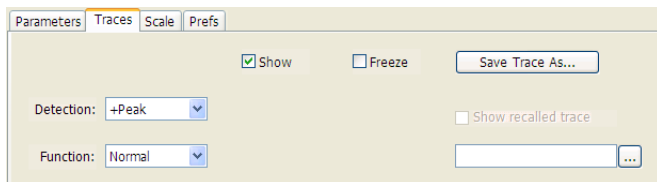
*Median Method*

$$A = \text{Median} \{E_M [KT]\}$$

In both cases, the instrument computes the average and the median over the analysis period. It should be noted that the two methods give the same result for sinusoidal modulation where the sampling frequency is much higher than the modulation frequency.

## Trace Tab

The Trace Tab allows you to set the display characteristics of a trace.



Setting	Description
Show	Shows/hides the trace. If the instrument continues to run, the measurement results below the graph display continue to update even if the trace is hidden.
Detection	Sets the Detection method used for the trace. Available detection methods are +Peak, -Peak, and Avg (VRMS). Not available for saved traces.
Function	Selects the trace processing method. The only available setting is Normal.
Freeze	Halts updates to the trace.
Save Trace As	Saves the trace to a file for later recall and analysis.
Show recalled trace	Displays a saved trace instead of a live trace.

### Detection

Detection refers to the method of processing the data acquisition points when creating a trace. The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the +Peak, -Peak, and Avg (VRMS) are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods are:



- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.

## Trace Processing

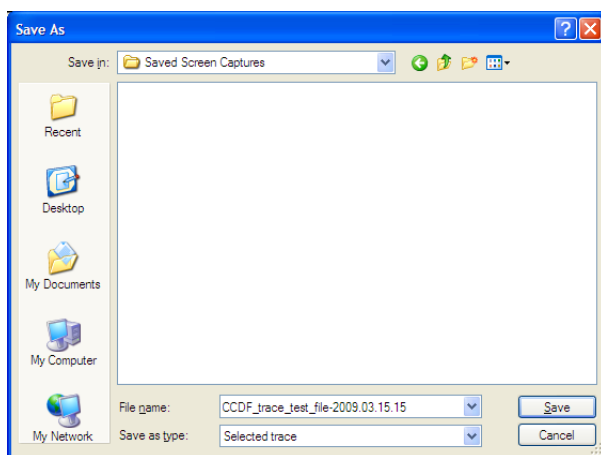
Traces can be processed to display in different ways. The Detection setting controls trace decimation, when needed. When the trace points each cover more than one sample data point, the vertical results values for multiple data points are combined into each trace point. Each trace point ends up with a single vertical value.

- **Average** - Each trace point is computed by averaging together the multiple results points it represents.
- **+Peak** - Each trace point represents the highest vertical value among the results it includes.
- **-Peak** - Each trace point represents the lowest vertical value among the results it includes.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

## Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

1. Click the ... button to display the Open dialog box.
2. Navigate to the desired file and click **Open**.
3. Check the **Show Recalled Trace** check box.
4. Verify that the **Show** check box is selected.

## Scale Tab

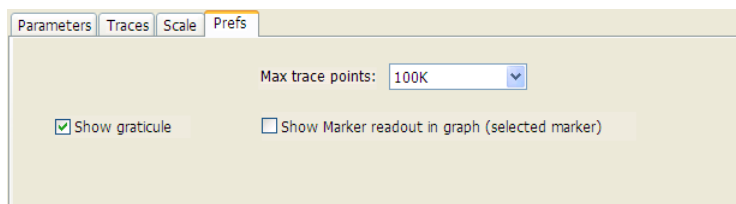
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
Vertical	
Scale	Changes the range shown between the top and bottom of the graph.
Position	Adjusts the level shown at the center of the graph.
Autoscale	Resets the Position so that the entire trace is in the graph.
Horizontal	
Scale	Changes the range shown between the left and right sides of the graph.
Position	Adjusts the position of the acquisition record shown at the left edge of the graph.
Autoscale	Resets the Scale and Position settings to provide the optimum display.

## Prefs Tab

The Prefs tab enables you to change appearance characteristics of the AM display.



Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Max trace points	The trace in the AM display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 500,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export.

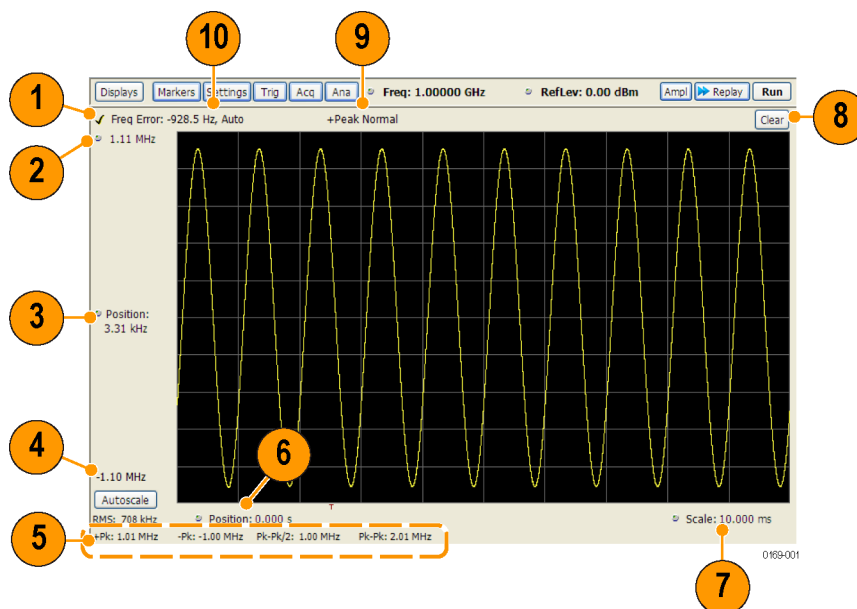
## FM Display

The Frequency Modulation Display shows Frequency Deviation vs. Time. The vertical axis units are Hertz and the horizontal axis units are seconds. When taking measurements, only the first burst in the Analysis period is analyzed. No trace points are shown for data outside the first detected burst, nor are measurements made on data outside the first detected burst.

To show the FM display:

1. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **Analog Modulation**.
3. Double-click the **FM** icon in the **Available Displays** box. This adds the FM icon to the **Selected displays** box.
4. Click the **OK** button. This shows the FM display.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the FM display is the optimized display.
2	Top of Graph	Sets the frequency indicated at the top of the graph. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable).
3	Position	Specifies the frequency shown at the center of the graph display. Changing this value adjusts the top of graph setting and the bottom readout display.
4	Bottom Readout	Displays the frequency value indicated by the bottom of the graph.
5	Measurement readouts	Displays numeric values for the +Pk (positive frequency deviation), -Pk (negative frequency deviation), RMS (RMS value of the deviation), Pk-Pk (peak-to-peak frequency deviation), and Pk-Pk/2 (peak-to-peak frequency deviation divided by two).
6	Position	Specifies the horizontal position of the trace on the graph display.
7	Scale	Adjusts the range of the graph. By decreasing the scale (time per division), the graph essentially becomes a window that you can move over the acquisition record by adjusting the position.
8	Clear	Clears the trace and numeric measurement results.
9	Trace Detection readout	Displays the Settings > Trace > Detection setting.
10	Freq Error	This readout can show Freq Error or Freq Offset. When it displays Freq Error, it shows the difference between the instrument Frequency setting and the measured value of the signal's carrier frequency. When it displays Freq Offset, it shows the frequency offset specified on the Settings > Parameters tab. If Freq Error is displayed, it also indicates that the Carrier frequency detection setting is Auto. If Freq Offset is displayed, it indicates that the Carrier frequency detection setting is manual.

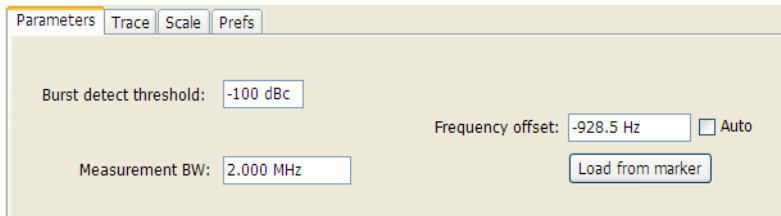
[Changing the FM Settings \(see page 68\)](#)

## FM Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

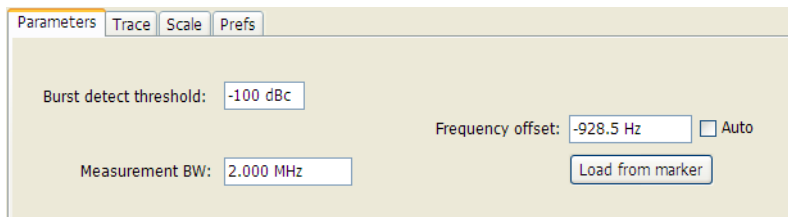
The FM Settings control panel provides access to settings that control parameters of the FM Display.



Setting	Description
<a href="#">Parameters (see page 69)</a>	Sets the burst detection threshold, measurement bandwidth, and carrier frequency detection method.
<a href="#">Trace (see page 70)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 72)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 73)</a>	Specifies whether or not certain display elements are shown. Specifies the maximum number of points shown in the display graph.

## Parameters Tab

The Parameters tab enables you to specify parameters for carrier detection.



Setting	Description
Burst detect threshold	This parameter specifies the power level used to determine whether a burst is present. A valid burst is required to take measurements. The burst detected first is used for the analysis. The units for burst detect threshold are dBc, relative to the maximum acquisition sample data points level.
Measurement BW	Specifies the bandwidth about the center frequency at which measurements are made.
Frequency offset	Displays the offset from the center frequency at which measurements are made. Auto is used to select the method for determining the carrier frequency. When Auto is selected, the instrument determines the carrier frequency by analyzing the signal. When Auto is deselected, you can set the carrier frequency using Frequency Offset.
Load from Marker	Pressing this button sets the frequency offset to the frequency offset of the selected marker. (Pressing this button automatically deselects Auto.)

### Frequency Offset

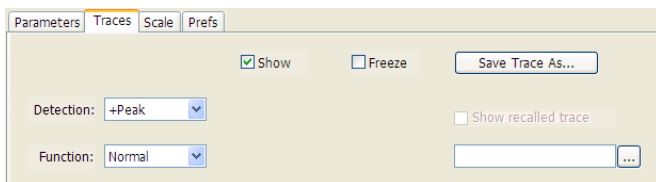
In Auto (Auto is selected), the instrument scans the measurement bandwidth about the measurement frequency and looks for the highest-powered signal. This is defined as the carrier frequency. In Manual (Auto is deselected), the carrier frequency is specified by adding/subtracting the specified Frequency offset from the measurement frequency. Range:  $-(\text{Measurement BW} * 1.1) / 2$  to  $+(\text{Measurement BW} * 1.1) / 2$ . If the **Load  $\Delta$  from marker** button is pressed, the frequency offset is determined from the phase difference between the two markers on screen compared to the time between the two markers. This function is useful for removing frequency slope from the phase modulated signal.

### Load from Marker

When the Auto check box is selected, the instrument scans the measurement bandwidth about the center frequency and looks for the highest-powered signal. This is defined as the carrier frequency. When the Auto check box is deselected, the carrier frequency is specified by adding/subtracting the specified Frequency offset from the center frequency. Pressing the Load from marker button loads the marker frequency into the Frequency offset box.

## Trace Tab

The Trace Tab allows you to set the display characteristics of displayed trace.



Setting	Description
Show	Shows / hides the trace. If the instrument continues to run, the measurement results below the graph display continue to update even if the trace is hidden.
Detection	Sets the Detection method used for the trace. Available detection methods are +Peak, -Peak, and Avg (VRMS). Not available for saved traces.
Function	Selects the trace processing method. The only available setting is Normal.
Freeze	Halts updates to the trace.
Save Trace As	Saves the trace to a file for later recall and analysis.
Show Recalled trace	Displays a saved trace instead of a live trace.

### Detection

Detection refers to the method of processing the data acquisition points when creating a trace. The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the +Peak, -Peak, and Avg (VRMS) are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods are:

- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.



## Trace Processing

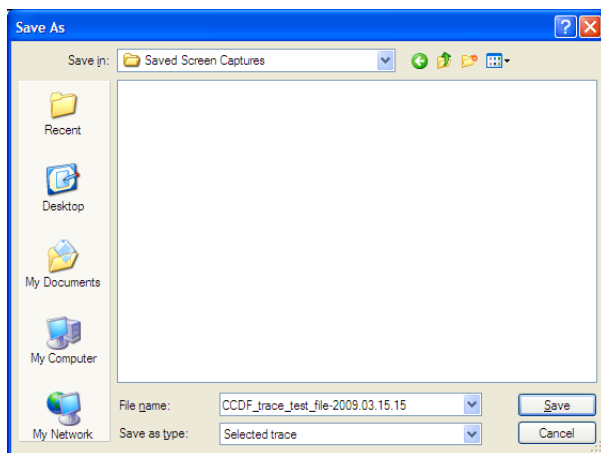
Traces can be processed to display in different ways. The Function setting controls trace processing.

- **Normal** - Each new trace is displayed and then replaced by the next trace. Each data point contains a single vertical value.
- **Average** - Each trace point is computed by averaging together the multiple results points it represents.
- **+Peak** - Each trace point represents the highest vertical value among the results it includes.
- **-Peak** - Each trace point represents the lowest vertical value among the results it includes.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

## Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

1. Click the ... button to display the Open dialog box.
2. Navigate to the desired file and click **Open**.
3. Check the **Show Recalled Trace** check box.
4. Verify that the **Show** check box is selected.

## Scale Tab

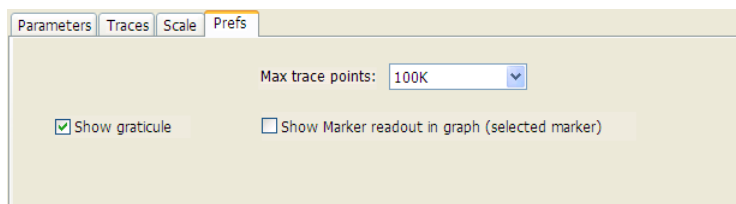
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
Vertical	
Scale	Changes the range shown between the top and bottom of the graph.
Position	Adjusts the frequency shown at the center of the graph.
Autoscale	Resets the Position so that the entire trace fits within the graph.
Horizontal	
Scale	Changes the range shown between the left and right sides of the graph.
Position	Adjusts the position of the acquisition record shown at the left edge of the graph.
Autoscale	Resets the Scale and Position settings to provide the optimum display.

## Prefs Tab

The Prefs tab enables you to change appearance characteristics of the FM display.

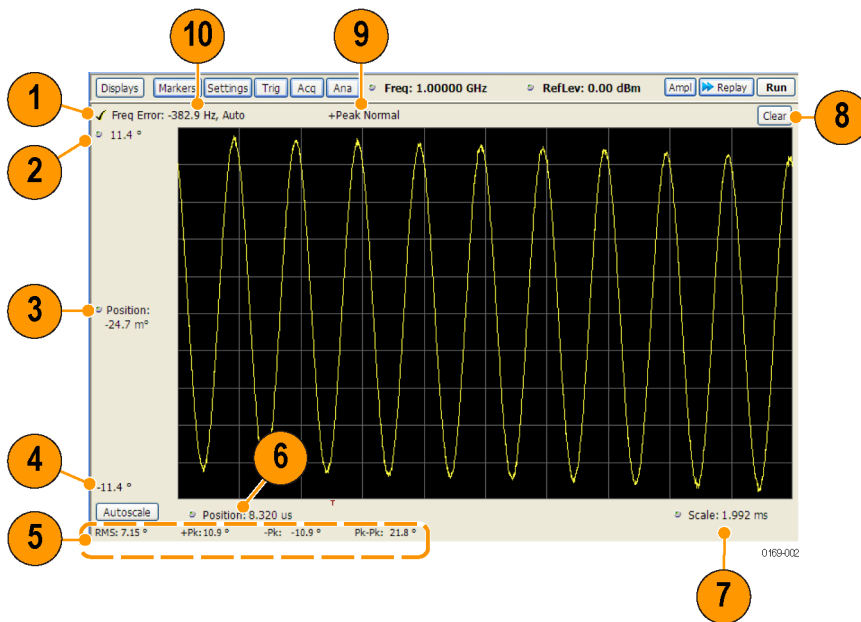


Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Max trace points	The trace in the FM display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 500,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export.

## PM Display

The Phase Modulation Display shows Phase vs. Time. The vertical axis units are degrees and the horizontal axis units are seconds. When taking measurements, only the first burst in the Analysis period is analyzed. No trace points are shown for data outside the first detected burst, nor are measurements made on data outside the first detected burst.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the PM display is the optimized display.
2	Top of Graph	Sets the phase value indicated at the top of the graph. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable).
3	Position	Specifies the phase shown at the center of the graph display. Changing this value adjusts the top of graph setting and the bottom readout display.
4	Bottom Readout	Displays the phase value indicated by the bottom of the graph.
5	Measurement readouts	Displays numeric values for the +Pk (positive phase deviation), -Pk (negative phase deviation), Pk-Pk (peak-to-peak phase deviation), and RMS (RMS value of the phase deviation).
6	Position	Specifies the horizontal position of the trace on the graph display.
7	Scale	Adjusts the span of the graph. By decreasing the scale (time per division), the graph essentially becomes a window that you can move over the acquisition record by adjusting the offset.
8	Clear	Clears the measurement results.
9	Trace Detection readout	Displays the Trace Detection setting (see Settings > Trace > Detection).
10	Freq Error	This readout can show Freq Error or Freq Offset. When it displays Freq Error, it shows the difference between the instrument Frequency setting and the measured value of the signal's carrier frequency. When it displays Freq Offset, it shows the frequency offset specified on the Settings > Parameters tab. If Freq Error is displayed, it also indicates that the Carrier frequency detection setting is Auto. If Freq Offset is displayed, it indicates that the Carrier frequency detection setting is manual.

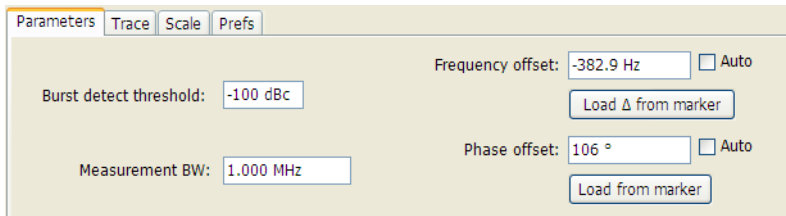
[Changing the PM Settings \(see page 76\)](#)

## PM Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

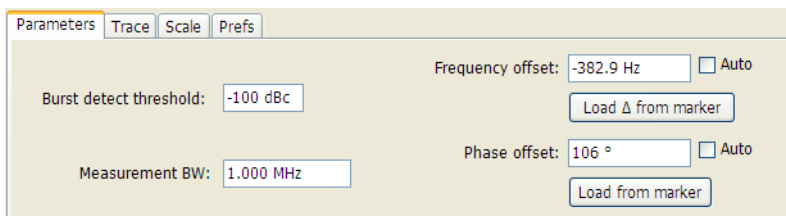
The PM Settings control panel provides access to settings that control parameters of the PM Display.



Setting	Description
<a href="#">Parameters (see page 76)</a>	Sets the Carrier Frequency Detection method. You can choose either Automatic or Manual. Sets burst threshold and phase detection method.
<a href="#">Trace (see page 77)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 80)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 81)</a>	Specifies whether or not certain display elements are shown. Specifies the maximum number of points shown in the display graph.

## Parameters Tab

The Parameters tab enables you to specify parameters that control the carrier frequency and phase detection.



Setting	Description
Burst detect threshold	Specifies the power level used to determine whether a burst is present. A valid burst is required to take measurements. The burst detected first is used for the analysis. The units for burst detect threshold are dBc, relative to the maximum acquisition sample data points level.
Measurement BW	Specifies the bandwidth about the center frequency at which measurements are made.
Frequency offset	Displays the offset from the center frequency at which measurements are made. Auto is used to select the method for determining the carrier frequency. When Auto is selected, the instrument determines the carrier frequency by analyzing the signal. When Auto is deselected, you can set the carrier frequency using Frequency Offset.
Load $\Delta$ from Marker	Pressing this button disables the Auto Frequency Offset function and sets the Frequency offset to the frequency of the two selected markers.
Phase offset	Displays the phase offset. When Auto is selected, the instrument determines the phase offset. When Auto is deselected, the instrument sets the phase offset using phase offset setting.
Load from marker	Pressing this button sets the phase offset to the phase offset of the selected marker. (Pressing this button automatically deselects Auto.)

### Frequency Offset

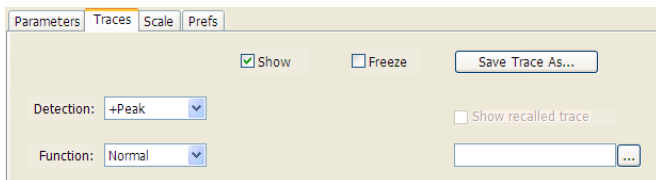
In Auto (Auto is selected), the instrument scans the measurement bandwidth about the center frequency and looks for the highest-powered signal. This is defined as the carrier frequency. In Manual (Auto is deselected), the carrier frequency is specified by adding/subtracting the specified Frequency offset from the center frequency. Range:  $-(\text{Measurement BW} * 1.1) / 2$  to  $+(\text{Measurement BW} * 1.1) / 2$ . If the **Load  $\Delta$  from marker** button is pressed, the frequency offset is determined from the phase difference between the two markers on screen compared to the time between the two markers. This function is useful for removing frequency slope from the phase modulated signal.

### Phase Offset

In Auto (Auto is selected), the instrument sets the phase offset to fit the waveform to the screen centering  $0^\circ$  phase on the vertical axis. The actual phase offset is indicated on the Phase Offset readout. In Manual (Auto is deselected), the instrument sets the phase offset using the value specified in Phase offset. For example, when Phase offset is set to  $10^\circ$ , the waveform shifts upward by  $10^\circ$  on screen. Selecting **Load from marker** sets the phase offset to the value of the selected markers. Range:  $-180$  to  $+180^\circ$ .

## Trace Tab

The Traces Tab allows you to set the display characteristics of displayed trace.



Setting	Description
Show	Shows / hides the trace. If the instrument continues to run, the measurement results below the graph display continue to update even if the trace is hidden.
Detection	Sets the Detection method used for the trace. Available detection methods are +Peak, -Peak, and Avg (VRMS). Not available for saved traces.
Function	Selects the trace processing method. The only available setting is Normal.
Freeze	Halts updates to the trace.
Save Trace As	Saves the trace to a file for later recall and analysis.
Show Recalled trace	Displays a saved trace instead of a live trace.

### Detection

Detection refers to the method of processing the data acquisition points when creating a trace. The IQ samples in a data acquisition can be detected in a variety of ways. The number of IQ samples available to each trace point varies with both analysis length and trace length. For example, with Spectrum Length set to 'Auto' in the Analysis menu, the instrument analyzes just enough samples to produce one IQ sample pair per trace point. In this case, the detection method chosen has very little effect, as the +Peak, -Peak, and Avg (VRMS) are all equal. Changing the Spectrum Length causes the available detection methods to differ in value because they have a larger set of samples for the various detection methods to process.

The available detection methods are:

- **+Peak** – Each point on the trace is the result of detecting the positive peak value present in the set of IQ samples available to that trace point.
- **-Peak** – Each point on the trace is the result of detecting the negative peak value present in the set of IQ samples available to that trace point.
- **Avg (VRMS)** [Average  $V_{RMS}$ ] – Each point on the trace is the result of determining the RMS Voltage value for all of the IQ samples available to the trace point. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results. When the averaging function is applied to a trace, the averaging is performed on the linear (Voltage) values, resulting in the correct average for RMS values.

### Trace Processing

Traces can be processed to display in different ways. The Function setting controls trace processing.

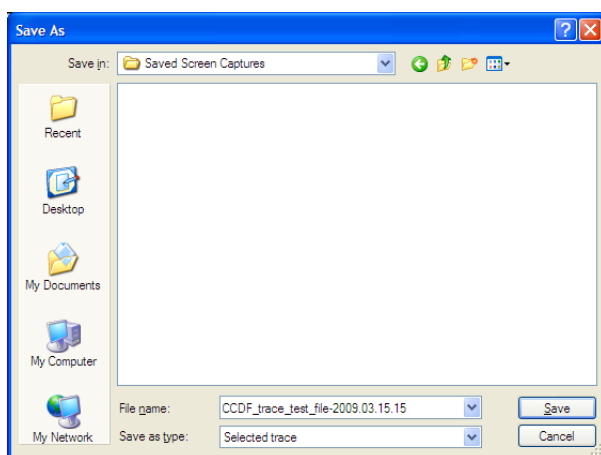


- **Normal** - Each new trace is displayed and then replaced by the next trace. Each data point contains a single vertical value.
- **Average** - Each trace point is computed by averaging together the multiple results points it represents.
- **+Peak** - Each trace point is represents the highest vertical value among the results it includes.
- **-Peak** - Each trace point is represents the lowest vertical value among the results it includes.

## Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

## Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

1. Click the ... button to display the Open dialog box.
2. Navigate to the desired file and click **Open**.
3. Check the **Show Recalled Trace** check box.
4. Verify that the **Show** check box is selected.

## Scale Tab

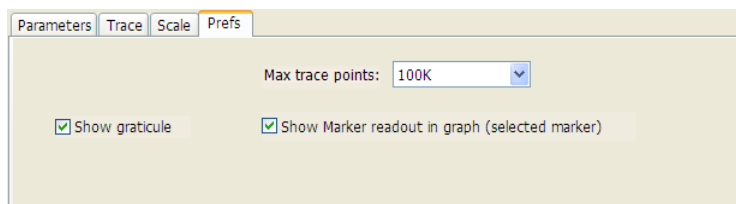
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
<b>Vertical</b>	
Scale	Changes the range shown between the top and bottom of the graph.
Position	Adjusts the phase shown at the center of the graph.
Autoscale	Resets the Position so that the entire trace in the graph.
<b>Horizontal</b>	
Scale	Changes the range shown between the left and right sides of the graph.
Position	Adjusts the phase shown at the left edge of the graph.
Autoscale	Resets the Scale and Position settings to show the entire trace within the graph.

## Prefs Tab

The Prefs tab enables you to change appearance characteristics of the PM display.



Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Max trace points	The trace in the PM display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 500,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the trace is decimated (using the method specified with the Detection control) to be equal to or less than the Max trace points setting (except when Max trace points is set to Never Decimate). This decimated (or undecimated) trace is what is used for marker measurements and for results export.

## Overview

The displays in the RF Measurements folder (Displays > Folders > RF Measurements) are:

- CCDF
- Channel Power and ACPR
- MCPR
- Occupied Bandwidth
- Spurious

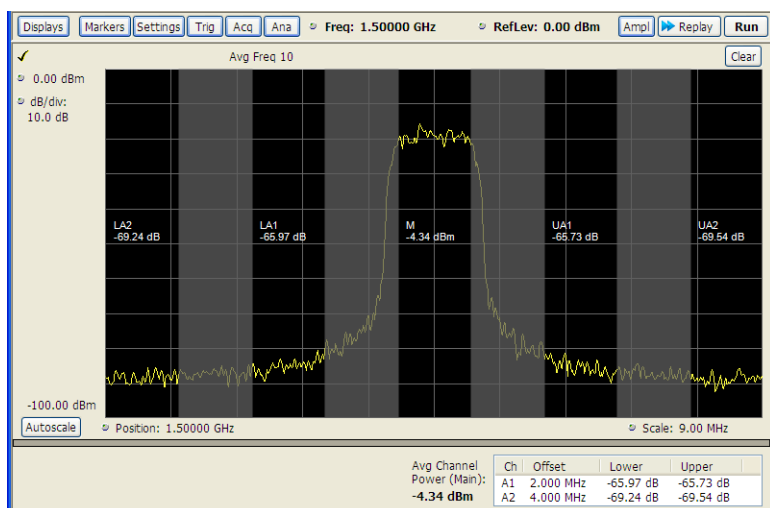
The RF Measurements power measurements and signal statistics help you characterize components and systems.

### Power Measurements

Measurement	Description
Channel Power	The total RF power in the selected channel (located in the ACPR display).
Adjacent Channel Power Ratio	Measure of the signal power leaking from the main channel into adjacent channels.
Multi-Carrier Power Ratio	The ratio of the signal power in the reference channel or group of channels to the power in adjacent channels.
Peak/Avg Ratio	Ratio of the peak power in the transmitted signal to the average power in the transmitted signal (located in the CCDF display).
CCDF	The <i>Complementary Cumulative Distribution Function</i> (CCDF). CCDF shows how much time a signal spends at or above a given power level relative to the average power of a measured signal.

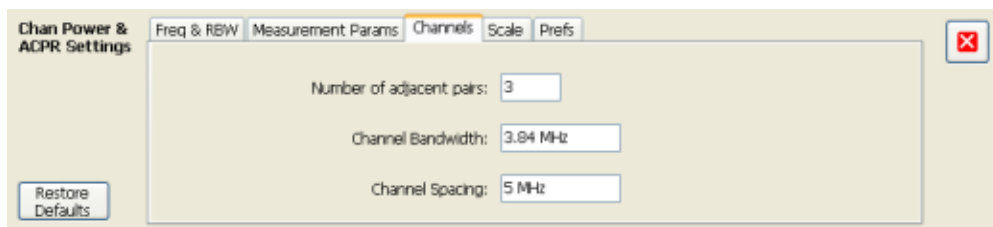
## Channel Power and ACPR (Adjacent Channel Power Ratio) Display

Use the **Channel Power and ACPR** measurement to measure channel power by itself, or adjacent channel leakage ratio with one main channel.



### Measuring Adjacent Channel Power Ratio

1. Select the **Displays** button.
2. Select **RF Measurements** from the **Folders** box.
3. Double-click **Chan Power and ACPR** in the Available displays box. Click **OK** to complete your selection.
4. Press the front-panel **Freq** button and use the front panel keypad or knob to adjust the frequency to that of your main channel.
5. Press the **Settings** button. This displays the control panel for Chan Power and ACPR (the tab displayed will be the tab displayed the last time the Settings panel was opened).




- To set the number of adjacent channels, select the **Channels** tab. Enter the number of channels in the **Number of adjacent pairs** value box. If zero is entered for the number of adjacent pairs, the resultant measurement will be channel power only.

---

**NOTE.** *As you add adjacent channels, the span of the display is adjusted so that all the channels can be seen. Use the horizontal scale and offset to zoom the display in on any portion of the trace.*

---

- To set the spacing between channel centers, enter the required value in the **Channel Spacing** value box.
- To set the channel bandwidth, enter the required value in the **Channel Bandwidth** value box.
- After you have configured the channel settings, click the close button (  ) in the Settings panel or press the **Settings** button again to remove the settings panel.
- Press the **Run** button to take the measurements.

### Viewing Results

Measurement results are displayed in a table below the graph and within the graph itself (which can be enabled/disabled in the Settings > Prefs tab). To see all measurements, you might need to scroll the table. The size of the results table can be changed by dragging the horizontal divider bar between the graph and table areas.

Avg Channel Power (Main): <b>-10.66 dBm</b>	Ch	Offset	Lower	Upper
	A1	5 MHz	-58.76 dB	-59.33 dB
	A2	10 MHz	-58.39 dB	-58.40 dB
	A3	15 MHz	-58.58 dB	-57.74 dB

Heading	Description
Channel	Identifies the displayed channels. A1 means the first adjacent channel. A2 means second adjacent channel. Adjacent channels are numbered according to their offset from the Main channel. The closest channel is numbered 1. The next closest channel is numbered 2; and so forth.
Lower	The power measured for the lower adjacent channel. Adjacent channel power measurements are displayed in dB relative to the Main channel.
Upper	The power measured for the upper adjacent channel. Adjacent channels power measurements are displayed in dB relative to the Main channel.
Avg Channel Power (Main)	The power measured for the Main channel. The detection type used for measuring channel power and adjacent channel powers is Average. This means that the average of the linear (pre-log) samples is used to determine the power. The Main channel power is displayed in dBm.

[Setting Channel Power and ACPR Settings Parameters \(see page 86\)](#)

## RF Channel Power Measurement

The RF channel power gives an indication of the total average (and other measures ) RF power in a given channel.

For some communications systems, there is an “out-of-service” total power measurement defined in the specifications that calls for a specified constant modulation. In this case, the output power should be relatively constant. For many measurements, this may not be the case, and the Power Measurement results will vary as the signal varies.

Average power is the square root of the sum of the squares of the voltage samples over the measurement time.

The defined “channel” width for the Power Measurement defines the bandwidth and shape of the filter used to remove any RF power on frequencies outside of the channel bandwidth.

## Channel Power

The total RF power in the selected frequency band. The detection type used for measuring channel power is Average. This means that the average of the linear (pre-log) samples is used to determine the channel power. To measure channel power, use the ACLR measurement, and set the number of adjacent channels to zero. This results in only the channel power being measured.

## Average Channel Power

The total RF power in the selected channel (located in the ACPR display).

## Adjacent Channel Leakage Power Ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the mean power centered on the assigned channel frequency to the mean power centered on an adjacent channel frequency. In the 3GPP specification, both the main channel and adjacent channels are required to be filtered with RRC (Root Raised Cosine) filters.

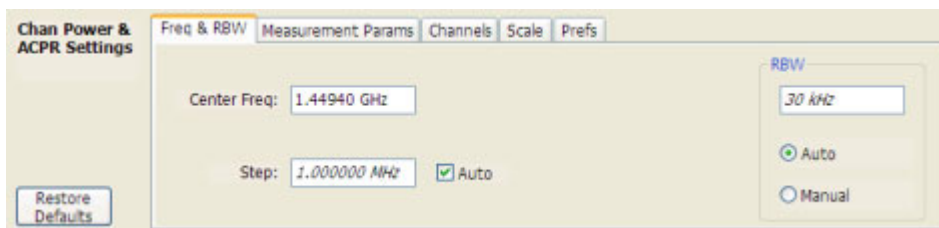
## Adjacent Channel Power

Measure of the signal power leaking into nearby channels.

## Channel Power and ACPR Settings

**Menu Bar:** Setup > Settings

The settings for the Channel Power and ACPR display are shown in the following table.



Settings tab	Description
<a href="#">Freq &amp; RBW (see page 93)</a>	Specify the frequency and resolution bandwidth used for the ACPR measurement.
<a href="#">Measurement Params (see page 94)</a>	Specify several parameters that control the measurement, such as channel filter, chip rate, averaging, and correcting for noise floor.
<a href="#">Channels (ACPR) (see page 86)</a>	This tab specifies the BW and offset parameters of the Channels for the selected ACPR measurement.
<a href="#">Scale (see page 122)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 123)</a>	Specifies whether certain display elements are visible.

**Restore Defaults.** Sets parameters for a 1-channel WCDMA measurement.

## Channels Tab for ACPR

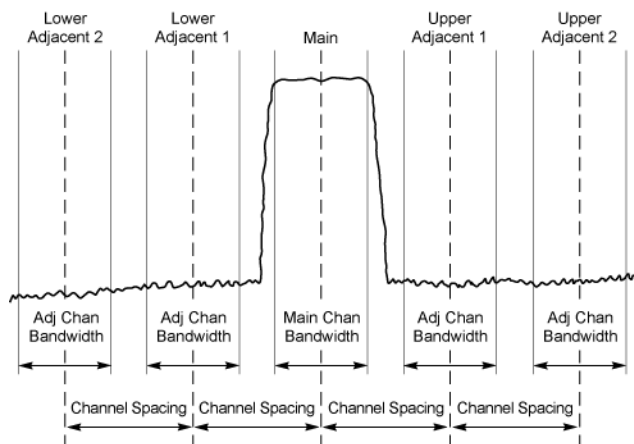
The Channels tab is where you specify parameters for the channels measured in the ACPR display.





Setting	Description
Number of adjacent pairs	Specifies the number of adjacent channel pairs. Range: 1 - 50; Resolution 1.
Channel Bandwidth	Specifies the frequency width of each channel (all channels share the same value).
Channel Spacing	Specifies the difference in frequency between the centers of each channel.

The following figure illustrates the settings controlled from the Channels tab.



### Changing the Number of Adjacent Pairs

1. Select **Number of adjacent pairs** number entry box.
2. Enter a value for the number of adjacent pairs using the knob or the keypad.

---

**NOTE.** As you change the value for the number of adjacent pairs, the analyzer will update the spectrum display to identify the adjacent channels.

---

3. Select the Close box when you have finished making changes.

### Changing the Channel Bandwidth

1. Select the **Channel Bandwidth** number entry box.
2. Enter a value for the number of adjacent pairs using the knob or the keypad.

---

**NOTE.** *As you change the value for the number of adjacent pairs, the analyzer will update the display to indicate the channel bandwidth*

---

3. Select the Close box when you have finished making changes.

### Channel Spacing

1. Select **Channel Spacing** number entry box.
2. Enter a value for the difference in center frequency between channels using the knob or the keypad.

---

**NOTE.** *As you change the value for the number of adjacent pairs, the analyzer will update the display to indicate the channel bandwidth*

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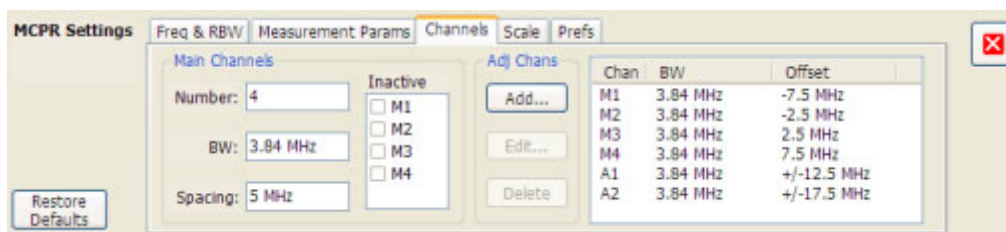
3. Select **Close** when you have finished making changes.

## MCPR (Multiple Carrier Power Ratio) Display

Use the MCPR measurement to measure adjacent channel power ratio for multiple main channels or when adjacent channel pairs have different offsets and/or bandwidths. The MCPR display show the Reference Power and the ratio of each adjacent channel to the Reference Power. You can select whether the Reference Power is the total of all active channels or a single channel.

### Measuring Multiple Carrier Power Ratio

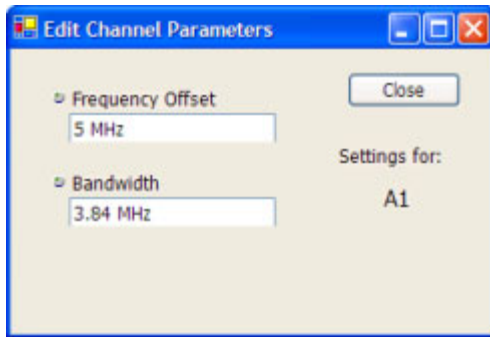
1. Press the front-panel **Displays** button.
2. From the **Select Displays** window, select **RF Measurements** from the Folders box.
3. Double-click the **MCPR** icon in the **Available displays** box. Click **OK** to complete your selection.
4. Press the front-panel **Freq** button and use the front panel keypad or knob to adjust the frequency to that of the main channel. Select **Meas. Freq** to set the measurement frequency. Use the front panel knob to adjust the frequency.
5. Press the **Settings** button. This displays the control panel for MCPR (the tab displayed will be the tab displayed the last time the Settings panel was opened).



6. Click on the **Channels** tab. To set the number of Main channels, enter the number of Main channels in the **Number** text entry box under **Main Channels**.

**NOTE.** As you add channels, the span of the display will be adjusted so that all the channels can be seen.

7. To set the bandwidth of all main channels, enter a value in the **BW** value box.
8. To set the spacing between the main channels, enter a value in the **Spacing** value box.
9. To prevent a main channel power level from being included in the Power Reference (Total) calculation, select the channel to be excluded in the **Inactive** box.
10. To add adjacent channels, click the **Add...** button under **Adj Chans**.





11. To edit Frequency Offset or Bandwidth, click within the value box and use the front-panel knob or your keyboard to set the value. Click **Close** to save your changes.

---

**NOTE.** *Frequency Offset is the difference between the center frequency of the selected channel and the Measurement Frequency. All channels (Main or Adjacent) are specified by their offset from the Measurement Frequency.*

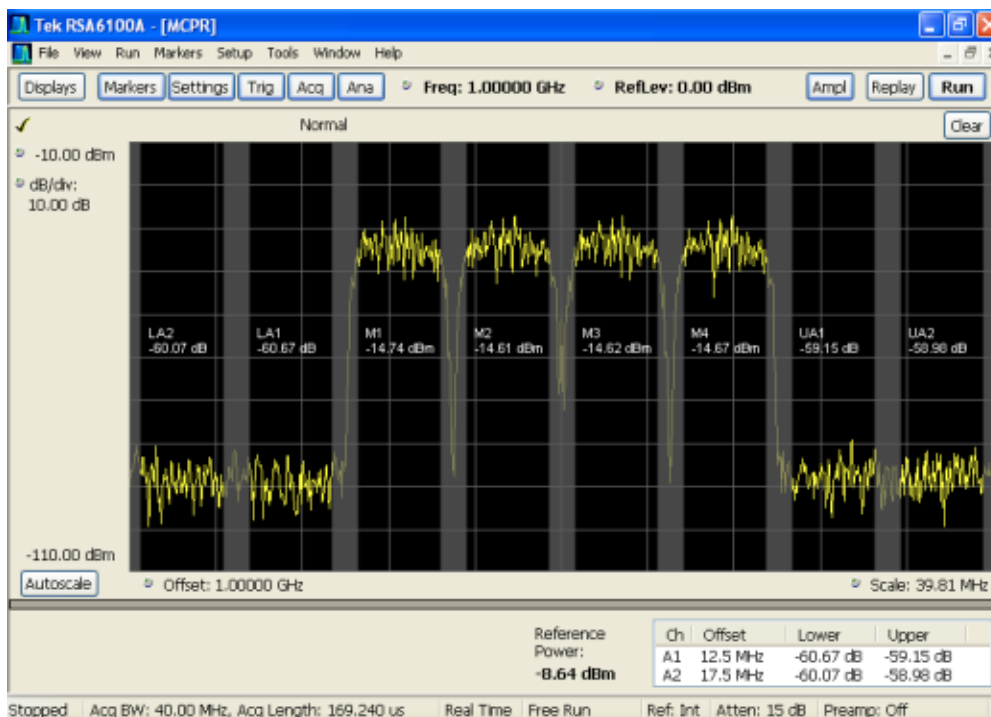
---

12. After you have configured the Main and Adjacent channels, click the close button () in the Settings panel or the **Settings** button to remove the settings panel.

13. Click the Run button () to take the measurements.

## Viewing Results

MCPR measurement results are displayed both in the spectrum graph and in a table below the spectrum display. Individual Main channel power measurements appear in the graph under their channel identifiers. Individual adjacent channel power ratios also appear in the graph under the adjacent channel identifier.



The following table details the entries in the results table.

Heading	Description
Ch	Identifies the adjacent channels. Adjacent channels are numbered according to their offset from the Main channel. The closest channel is numbered 1. The next closest channel is numbered 2; and so forth. The prefix “L” means lower; “U” means upper.
Offset	The offset is the difference in frequency between the Measurement Frequency and the center frequency of the channel.
Lower	Displays the ratio of the lower adjacent channel power to the Power Reference.
Upper	Displays the ratio of the upper adjacent channel power to the Power Reference.
Power Reference	Depending on the selected Power Ref, this readout displays either the power of the selected main channel or the total power in the active main channels.

Depending on the number of adjacent channels, to see all the measurements, you might need to drag the divider bar between the main display and the results table at the bottom of the window to change the height of the results table.

[Setting MCPR Measurement Parameters \(see page 94\)](#)

## Multiple Carrier Power Ratio

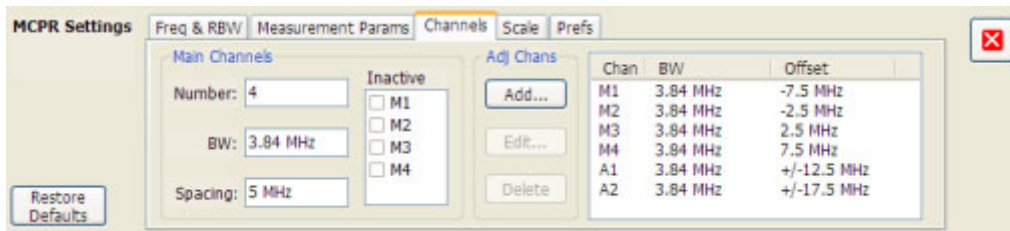
The ratio of the signal power in an adjacent channel to the power in one or more main channels.

## MCPR Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup control panel tabs for MCPR (Multiple Carrier Power Ratio) are:



Settings tab	Description
<a href="#">Freq &amp; RBW (see page 93)</a>	Specify the frequency and resolution bandwidth used for the MCPR measurements.
<a href="#">Measurement Params (see page 94)</a>	Specifies parameters controlling how the MCPR measurement is made.
<a href="#">Channels (see page 95)</a>	Specifies the parameters of the channels to be measured.
<a href="#">Scale (see page 122)</a>	Specifies the vertical and horizontal scale and offset values.
<a href="#">Prefs (see page 123)</a>	Specifies whether or not certain display elements are shown.

**Restore Defaults.** Sets parameters for a 4-carrier WCDMA measurement.

## Freq & RBW Tab for ACPR and MCPR Displays

The Freq & RBW tab specifies frequency parameters for the Channel Power & ACPR measurements and MCPR measurement.



Setting	Description
Center Freq	Specifies the center/measurement frequency.
Step	The Step control sets the increment/decrement size for the adjustment of the center frequency. If Auto is enabled, the analyzer will adjust the Step size as required.
RBW	Select Auto or Manual. Adjusts the RBW for the entire measurement. This setting is independent of the Spectrum view's RBW setting.
VBW	Adjusts the VBW (Video Bandwidth) value. VBW Maximum = current RBW value. VBW Minimum = 1/10,000 RBW setting.

**NOTE.** While the center frequency and step settings on this control tab are shared between ACPR, MCPR and Occupied Bandwidth, the RBW setting is not shared. The RBW setting is unique for each measurement.

### VBW

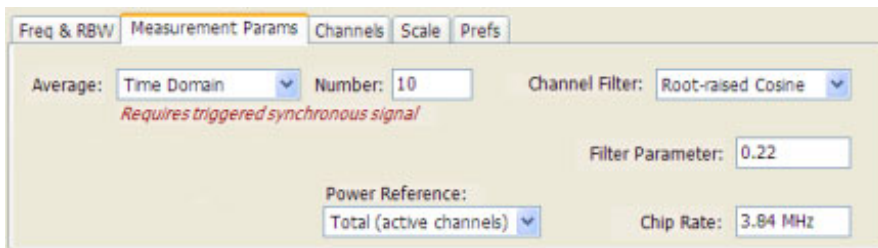
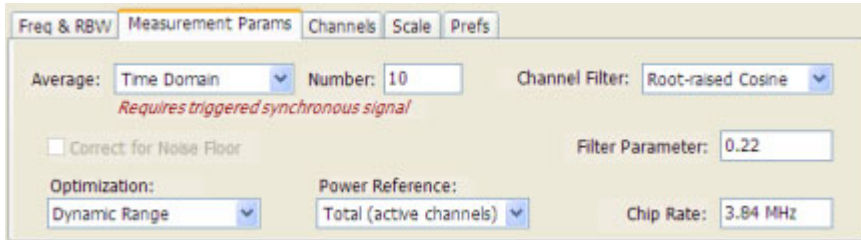
The VBW setting enables/disables the Video Bandwidth filter. VBW is used in traditional swept analyzers to reduce the effect of noise on the displayed signal. The VBW algorithm in the analyzer emulates the VBW filters of traditional swept analyzers.

The maximum VBW value is the current RBW setting. The minimum VBW value is 1/10,000 of the RBW setting.

**NOTE.** If you are following a procedure that says to "set VBW to three times the RBW value or greater", it means that the test should be conducted with no VBW effects. In the SignalVu software, this condition is met by disabling the VBW function.

## Measurement Params for ACPR and MCPR Displays

The Measurement Params tab is where you set parameters that control the ACPR and MCPR measurements.



Measurement	Description
Average	Enables/disables measurement averaging. Averaging can be enabled in either the Frequency Domain or Time Domain.
Number	When Averaging is set to Frequency Domain, this value specifies the number of acquisitions to be averaged. When Averaging is set to Time Domain, this value is the number of successive capture records that are averaged.
Correct for Noise Floor	Enables/disables the Noise Floor Correction function.
Optimization	This parameter is not used by the SignalVu application.
Power Reference	Specifies power against which the results are compared. Choices available are each of the existing main channels and "Total power in main channels". Only present when MCPR is the selected display.
Channel Filter	Specify the channel filter used. Select between None (default) and Root-raised Cosine.
Filter Parameter	Value entry box for the Root-raised Cosine filter Adjacent Channel Filter. Present only when the Channel Filter is set to RRC.
Chip Rate	Value entry box for the RRC chip rate. Present only when the Channel Filter is set to RRC.

### Correct for Noise Floor

When this setting is enabled, the instrument applies a correction to the ACPR or MCPR measurement to reduce the effect of instrument noise on the results. It generates this correction by taking a preliminary acquisition to measure the instrument noise floor. Once this is done, the measurement proceeds, applying



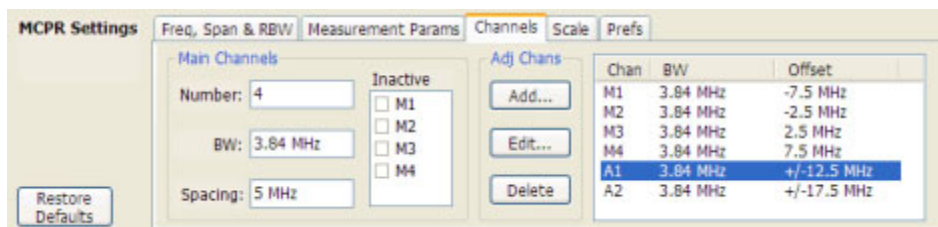
the correction to each result. When any relevant settings (reference level, attenuator, frequency, or span) are changed, the instrument performs a new noise measurement and correction.

## Channels Tab for MCPR

**Path:** Setup > Settings > Channels

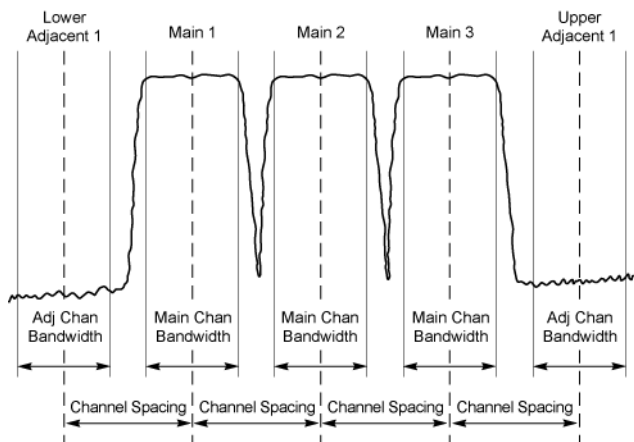
**Application Toolbar / Front Panel: Settings**

The Channels tab is where you specify the parameters for the channels measured in the MCPR display.



Setting	Description
<b>Main Channels</b>	
Number	Sets the number of Main channels.
BW	Sets the bandwidth of the Main channels.
Spacing	Sets the frequency difference between the centers of the Main channels.
Inactive	Selected channels are ignored by the measurement routine.
<b>Adj Chans</b>	
Add...	Opens the Edit Channel Parameters dialog, which you use to specify the parameters of a new pair of adjacent channels. You can add up to 50 adjacent channel pairs.
Edit...	Opens the Edit Channel Parameters dialog box. (You must first select a channel to enable the Edit button.)
Delete	Deletes the selected main channel or adjacent channel pair.
Add Adj.	Add a new pair of adjacent channels at the bottom. Their parameters are copied from the channels just above them.
Channel Definition table	A table of the parameters for every channel. Offset is the frequency difference between the Center Frequency and center of the selected channel. Nothing in the table is editable directly.

The following figure illustrates the settings controlled from the Channels tab.



### Editing Channel Parameters

To edit the offset or bandwidth of a Main channel:

1. Select the value in the **BW** or **Spacing** number entry boxes.
2. Adjust the value as required. All the Main channels share the same BW and Spacing.
3. Select the appropriate check box to make a channel Inactive, as appropriate.
4. Select the Close box when you have finished making changes.

To edit the offset or bandwidth of an Adjacent channel:

1. Select the channel to be edited in the channel definition table.
2. Select **Edit**. This displays the **Edit Channel Parameters** dialog box.
3. Adjust the values for the **Frequency Offset** or **Bandwidth** as required.
4. Select the Close box when you have finished making changes.

### Adding Channels

To add a main channel:

1. Select the **Number** entry box.
2. Use the knob to enter a value for the desired number of Main channels.
3. Select the Close box when you have finished making changes.

To add an adjacent channel pair:

1. Select **Add...** This displays the **Edit Channel Parameters** dialog box.
2. Use the knob to enter values for the **Frequency Offset** and **Bandwidth** as required. The Frequency Offset is measured from the Center frequency of the Main channels.
3. Select the Close box when you have finished making changes.

### Deleting Channels

To delete a main channel:

1. Select the **Number** entry box.
2. Use the knob to reduce the number of channels or enter a new value using the front-panel keypad.
3. Select the Close box when you have finished making changes.

To delete an adjacent channel:

1. Select the channel to be deleted in the channel definition table.
2. Select **Delete**. This removes the selected channel from the channel table.
3. Select the Close box when you have finished making changes.

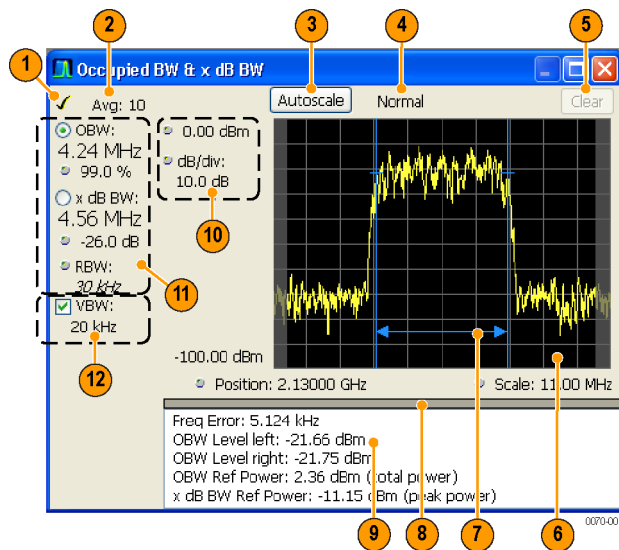
## Occupied BW & x dB BW Display

The Occupied BW display shows the bandwidth within which 99% (a user-defined value, the default is 99%) of the power transmitted within the measurement bandwidth falls.

To show the Occupied BW display:

1. Press the **Displays** button or select **Setup > Displays**.
2. In the **Select Displays** dialog, select **RF Measurements** in the **Folders** box.
3. In the **Available displays** box, double-click the **Occupied Bandwidth** icon or select the icon and click **Add**. The Occupied Bandwidth icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK** to display the Occupied Bandwidth.

### Elements of the Display



Item	Display element	Description
1	Check mark indicator	The check mark indicator denotes the display for which the acquisition hardware is optimized. This indicator appears only when the display is the selected display.
2	Averaging readout	Appears when averaging is enabled (Settings > Parameters tab > Average results). Displays "Avg: n of m" while averaging the results and "Avg: m" once the requested number of results have been averaged.
3	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
4	Trace function readout	Displays either Normal or MaxHold to indicate trace function.
5	Clear	Resets count for Average and MaxHold functions. Enabled only when Averaging or MaxHold is enabled. Pressing Clear will clear the trace and, if acquisition is running, restart the averaging or hold process.
6	Graph	Displays the input signal. Shaded areas indicate the measurement bandwidth (Settings > Parameters tab > Measurement BW).
7	Blue lines	The blue lines indicate where the selected results (selected in the Main results area) are being measured on the trace.
8	Grid divider	Determines the portion of the display allocated to the graph and detailed results area. You can move the grid divider all the way to the top or bottom and any position in between.
9	Detailed results area	Displays additional measurements results.
10	Position and dB/div	Position sets the top of graph value. The dB/div setting is the vertical scale value.
11	Main results area	Displays results for Occupied Bandwidth (OBW) and x dB bandwidth. Use the two radio buttons to select which of the two results are illustrated in the graph with the blue lines and arrows. There are also controls for adjusting OBW % Power, x dB BW, and RBW.
12	VBW	Enables the VBW (Video Bandwidth) filter. Displays current VBW filter setting. See Setup > Settings > <a href="#">Freq &amp; RBW tab (see page 93)</a> .

### Detailed Results Readouts

Measurement	Description
Freq Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the analyzer.
OBW Level left	The signal level at the left edge of the occupied bandwidth.
OBW Level right	The signal level at the right edge of the occupied bandwidth.
OBW Ref Power	The total power measured within the measurement bandwidth.
x dB BW Ref Power	The peak power measured within the measurement bandwidth.

[Changing the Occupied Bandwidth Settings \(see page 100\)](#)

## Occupied Bandwidth

Bandwidth within which some defined percentage of the power transmitted on a single channel lies.

## Occupied BW & x dB BW Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The control panel tabs for the Occupied Bandwidth display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; RBW (see page 119)</a>	Allows you to specify the Center Frequency, Step size and RBW.
<a href="#">Parameters (see page 101)</a>	Allows you to specify the Occupied BW % Power, x dB level, Measurement BW, enable averaging and the Max Hold function.
<a href="#">Scale (see page 122)</a>	Allows you to set the vertical and horizontal scale parameters.
<a href="#">Prefs (see page 123)</a>	The Prefs tab enables you to set characteristics of the measurement display.

## Parameters Tab

The Parameters tab enables you to specify parameters that control the Occupied BW measurement.

The screenshot shows the 'Parameters' tab of the software interface. It contains several input fields and checkboxes:

- Occupied BW % Power: 99.0 %
- x dB level: -26.0 dB
- Measurement BW: 10.00 MHz
- Max Hold spectral data:
- Average results:
- Count: 10

Setting	Description
Occupied BW % Power	Specifies the proportion of power within the occupied bandwidth (referenced against the total power in the measurement bandwidth).
x dB level	x dB level defines the x dB BW level search threshold.
Measurement BW	Specifies the frequency range used by the measurement.
Max Hold spectral data	Enables the Max Hold function.
Average results	Enables/disables results averaging. Note that this is not an averaging of the trace, but an averaging of the results.
Count	Specifies the number of results averaged to calculate the Occupied BW. Range: 2 to 10,000.

### x dB Level

The x dB level determines the x dB BW. The instrument analyzes the spectrum trace to locate the frequencies at which the level is x dB down from the peak level calculated over the measurement bandwidth. The frequency difference between the upper and lower crossing thresholds is the x dB BW.

Range: -80.0 to -1.0 dB; Resolution: 0.1%; Inc/dec small: 0.1%, large: 1%; Default: -26 dB

### Max Hold Spectral Data

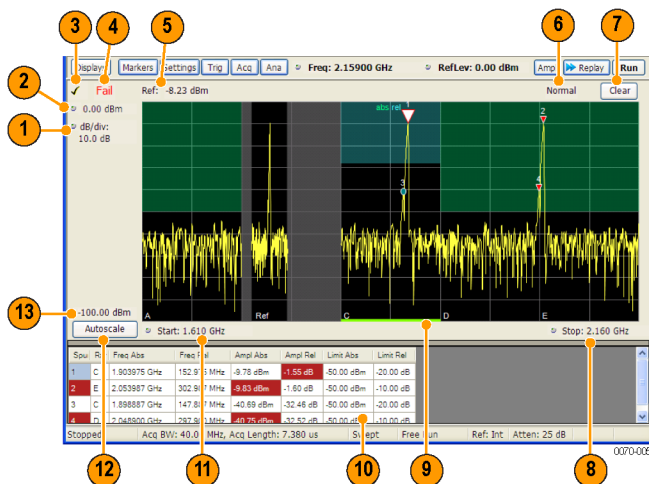
Max Hold displays the maximum value in the acquisition record for each display point. Each new trace display point is compared to the previous maximum value and the greater value is retained for display and subsequent comparisons.

## Spurious Display

To show the Spurious display:

1. Click the **Displays** button or select **Setup > Displays**.
2. From the Folders box, select **RF Measurements**.
3. Double-click the **Spurious** icon in the **Available displays** box. This adds the Spurious icon to the **Selected displays** box (and removes it from the Available displays box). Alternatively, you can click the Spurious icon and then click the Add button to select Spectrum for display.
4. Click the **OK** button.

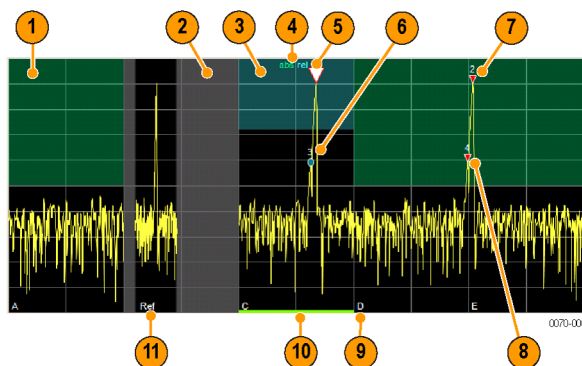
### Elements of the Spurious Display












Item	Display element	Description
1	dB/ div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
2	Vert Position	Sets the top of graph value. This is only a visual control for panning the graph. The Reference Level is adjusted in the Toolbar and the Ampl control panel. By default, Vert Position = Ref Level.
3	Check Mark Indicator	Indicates the display for which the acquisition hardware is optimized.
4	Pass / Fail readout	Indicates whether one or more spurs have exceeded a limit specified on the <b>Settings &gt; Limits</b> tab.
5	Ref:	If enabled, displays the power reference level.
6	Trace function	Indicates the trace processing method. If Average or Max Hold is selected, this readout displays the number of traces being processed (averaged or compared for the Max Hold value).
7	Clear	Restarts multi-trace functions (Average, Max Hold).
8	Stop	Adjusts the graph stop frequency. This setting affects only visual scaling, not measurement parameters.
9	Green bar	Indicates the range that is selected on the Settings > Ranges and Settings > Limits tabs.
10	Spur table	Displays spur measurements. See the following table for details.
11	Start	Adjusts the graph start frequency. This setting affects only visual scaling, not measurement parameters.
12	Autoscale	Adjusts the Vertical and Horizontal scaling to display the entire trace on screen. Selects Multi-range display mode.
13	Bottom-of-graph readout	Indicates the amplitude at the bottom of the graph. This value changes with the dB/div and Vertical Position settings.

### Elements of the Spurious Graph Display



Item	Display element	Description
1		The green line or shading indicates an Abs (absolute) limit. The absolute limit is enabled when the mask is set to Abs, Abs & Rel, or Abs OR Rel. Note that absolute and relative amplitude masks can overlap.
2		The gray-shaded area indicates a portion of the spectrum where no measurements are being taken.
3		The cyan line or shading indicates a Relative limit. The relative limit is enabled when the mask is set to Rel, Abs & Rel, or Abs OR Rel. Note that absolute and relative amplitude masks can overlap.
4	abs rel	Reminder that green-shaded areas highlight absolute limits and cyan-shaded areas highlight relative limits.
5		This indicates the selected spur, when it is in violation of the limits. In Run mode, this is the peak spur violation. The selected marker is highlighted in the Spur table below the graph with a blue background.
6		A spur marker. Indicates a spur that does not exceed the mask settings. See the <a href="#">Settings &gt; Limits tab (see page 112)</a> .
7		A violation marker. Indicates a spur that exceeds the mask settings. See the <a href="#">Settings &gt; Limits tab (see page 112)</a> .
---		Indicates the selected spur when it is not in violation of the limits. The selected marker is highlighted in the Spur table below the graph with a blue background.
8	1, 2, 3...	A Spur number. The number indicates the row in the spur table that corresponds to the spur. The instrument can display up to 999 spurs.
9	A, B, C, D...	Identifies the enabled ranges.
10	Green bar	Indicates the range selected on the <a href="#">Settings &gt; Limits (see page 112)</a> and <a href="#">Settings &gt; Ranges (see page 110)</a> tabs.
11	Ref	Indicates the location of the power reference. See <a href="#">Settings &gt; Reference (see page 107)</a> .

### Elements of the Spur Table

Spur	Range	Freq Abs	Freq Rel	Ampl Abs	Ampl Rel	Limit Abs	Limit Rel
1	E	2.053987 GHz	302.987 MHz	-10.18 dBm	-2.05 dB	-50.00 dBm	-10.00 dB
2	C	1.903975 GHz	152.975 MHz	-10.25 dBm	-2.12 dB	-50.00 dBm	-20.00 dB
3	E	2.052888 GHz	301.887 MHz	-16.96 dBm	-8.83 dB	-50.00 dBm	-10.00 dB
4	C	1.903012 GHz	152.012 MHz	-17.24 dBm	-9.11 dB	-50.00 dBm	-20.00 dB
5	E	2.051925 GHz	300.925 MHz	-22.86 dBm	-14.74 dB	-50.00 dBm	-10.00 dB
6	C	1.901912 GHz	150.912 MHz	-22.98 dBm	-14.85 dB	-50.00 dBm	-20.00 dB
7	E	2.050962 GHz	299.962 MHz	-28.55 dBm	-20.42 dB	-50.00 dBm	-10.00 dB
8	C	1.900950 GHz	149.950 MHz	-28.85 dBm	-20.72 dB	-50.00 dBm	-20.00 dB
9	C	1.899025 GHz	148.025 MHz	-39.65 dBm	-31.52 dB	-50.00 dBm	-20.00 dB
10	D	2.049037 GHz	298.037 MHz	-39.81 dBm	-31.68 dB	-50.00 dBm	-10.00 dB

Column	Description
Spur	A number that identifies a spur in the graph area. The instrument can display a maximum of 999 spurs.
Range	The letter representing the frequency range where the spur is located.
Freq Abs	The absolute frequency at which the spur occurs.
Freq Rel	The relative frequency at which the spur occurs. The relative frequency is the difference between the absolute frequency (absolute) and the carrier frequency.
Ampl Abs	The absolute amplitude of the spur.
Ampl Rel	The relative amplitude at which the spur occurs. The relative amplitude is the difference between the absolute amplitude and the carrier amplitude. See the Settings > Limits tab.
Lim Abs	The value of the absolute amplitude limit at the spur frequency. This value can vary even with small spur frequency changes if the start and stop limit values are different. See the <a href="#">Settings &gt; Limits tab (see page 112)</a> .
Lim Rel	The relative amplitude limit at which the spur occurs. This value can vary even with small spur frequency changes if the start and stop relative amplitude limit values are different. See the <a href="#">Settings &gt; Limits tab (see page 112)</a> .
Blue background	The cell in the Spur column with a blue background identifies the selected spur.
Red background	Cells in the Spur column with a red background identify violations. Cells in the results area with a red background identify the measurement that exceeded a limit.

### Rearranging the Columns in the Spur Table

You can rearrange the order of the columns in the Spur Table. To move a column, click on the column heading and drag it to the desired position.

### Sorting the Rows in the Spur Table

You can sort the rows in the Spur table by clicking on the column heading. For example, if you click on the Freq Abs heading, the results in the Spur table will be sorted by frequency. If you click on Range, the rows will be sorted by range. Clicking a second time on the same heading reverses the order.

[Changing the Spurious Display Settings \(see page 106\)](#)

## Spurious Display Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

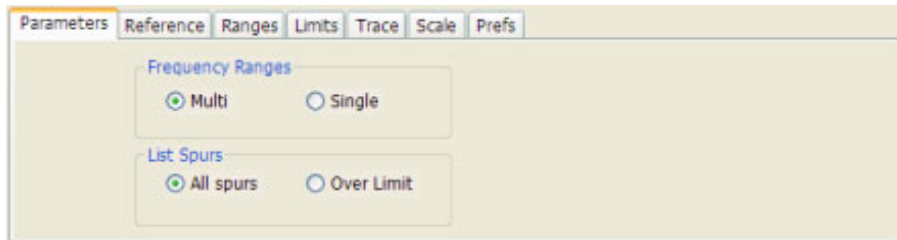
The control panel tabs for the Spurious display are shown in the following table.

Settings tab	Description
<a href="#">Parameters (see page 107)</a>	Specifies whether the graph displays one range or multiple ranges. Specifies whether all spurs are shown or only spurs over specified limits. Enables the use of CISPR filters and detectors.
<a href="#">Reference (see page 107)</a>	Specifies the Power Reference level.
<a href="#">Ranges (see page 110)</a>	Specifies start and stop frequencies of ranges and which ranges to take measurements in. Sets parameters that define a spur. Review, save and load the Range table from this tab.
<a href="#">Limits (see page 112)</a>	Specifies Pass/Fail limit parameters.
<a href="#">Trace (see page 120)</a>	Specifies the trace Function.
<a href="#">Scale (see page 122)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 123)</a>	Specifies the appearance features of the graph area.

**Restore Defaults.** Sets the Spurious parameters to their default values.

## Parameters Tab

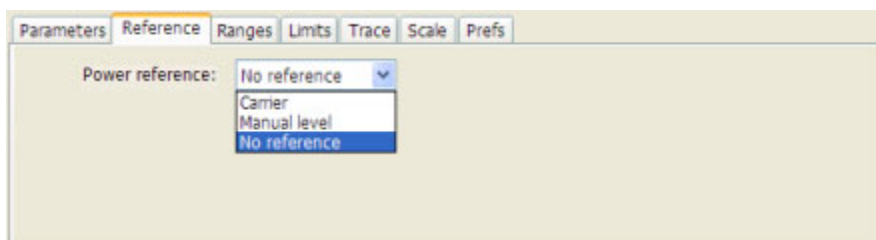
The Parameters tab enables you to specify settings that control the Spurious measurement.



Setting	Description
<b>Frequency Ranges</b>	
Multi	Enables the instrument to display all enabled ranges in the graph.
Single	Limits the graph to the display of only one range. The displayed range is set to the range that contains the selected spur.
<b>List Spurs</b>	
All spurs	Displays any spur that exceeds the Threshold and Excursion values set on the Ranges tab.
Over Limit	Displays only spurs that exceed both the Threshold and Excursion values set on the Ranges tab and the limits specified on the Limits tab.

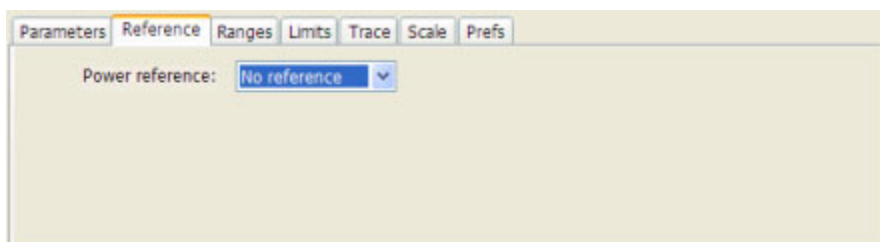
## Reference Tab

The Reference tab enables you to specify the Power Reference parameter. The Power reference parameter is used to calculate relative values in the Spur table and to calculate relative amplitude limits.



Setting	Description
Power Reference	Specifies the power reference level used for relative values and limits.
No reference	Power level readings are calculated only for absolute values, no relative values are calculated.
Manual level	The reference level for relative measurements is specified by the Reference power level setting.
Carrier	The reference level for relative measurements is based on the power level calculated at the specified carrier frequency.

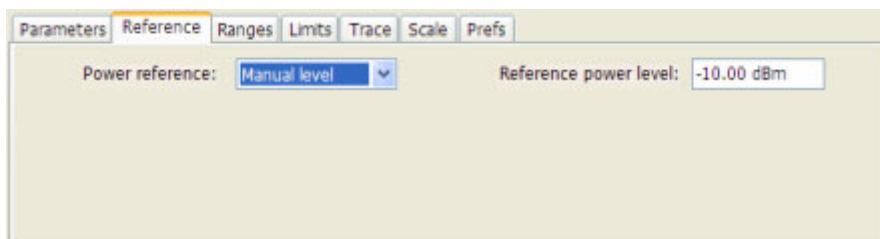
### Setting the Power Reference Level to No Reference



To set the power reference to No Reference:

- Select **No reference** from the **Power reference** drop-down list.

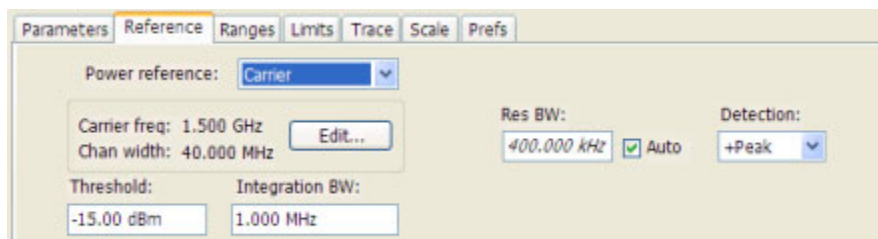
### Setting the Power Reference Level to Manual Level



To set the power reference to manual level:

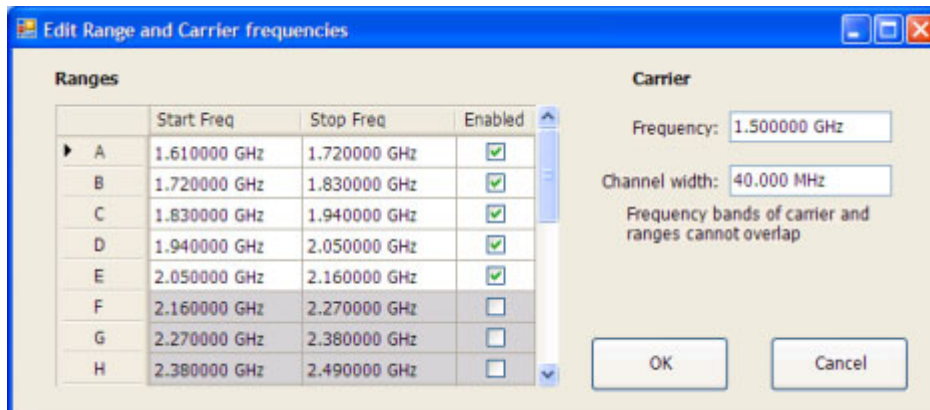
1. Select **Manual level** from the **Power reference** drop-down list. This displays the **Reference power level** entry box.
2. Specify the desired power level in the **Reference power level** entry box.

## Setting the Power Reference Level to Carrier



To set the power reference to Carrier:

1. Select **Carrier** from the **Power reference** drop-down list. This displays several parameters.
2. To set the Carrier frequency, click **Edit**. This displays the **Edit Range and Carrier frequencies** dialog box.



3. Specify the necessary values in the **Frequency** and **Channel width** entry boxes under **Carrier**. Click **OK**.
4. Specify the **Threshold** level.
5. Specify the **Integration BW**. The Integration BW is the bandwidth over which the carrier is measured.
6. Although Auto is the recommended setting, you can specify the Resolution Bandwidth by changing the value in the **Res BW** entry box.
7. Set the **Detection** method. Select either **+Peak** or **Average**.

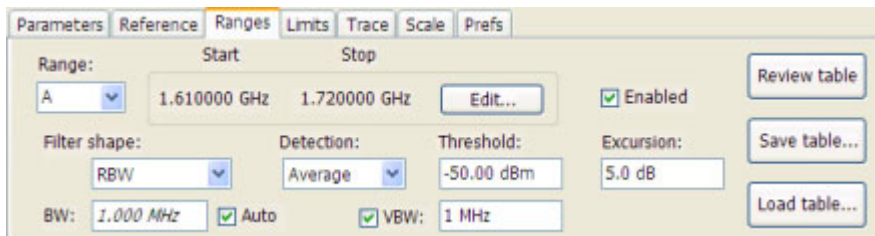
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**NOTE.** If the power level measured over the Integration BW about the carrier frequency is below the threshold level, the instrument concludes that no carrier is present and no relative measurements will be taken. Absolute measurements will still be taken.

---

## Ranges Tab

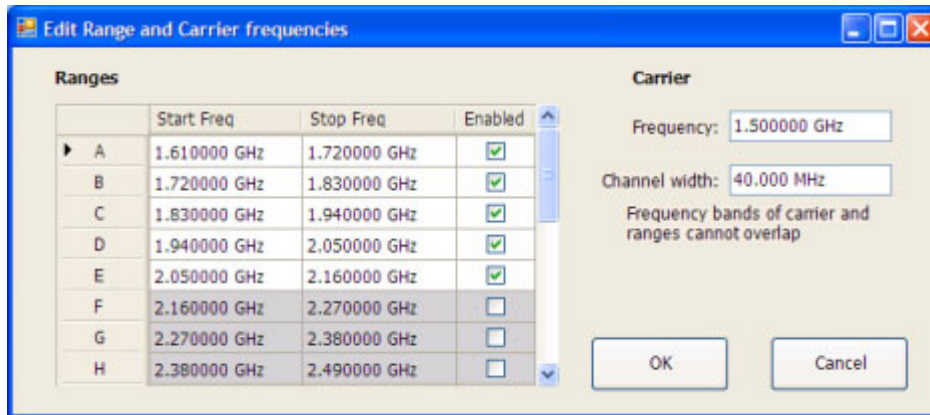
Use the Ranges tab to specify the parameters that control the Spurious measurement. From the Ranges tab, you specify the start and stop frequencies for ranges, whether or not a range is enabled, the parameters that specify what constitutes a spur, measurement filter shape and bandwidth, and the detection method used for processing signals.



Setting	Description
Range	Selects the frequency range to which the settings on this tab are applied.
Start	Readout of the start frequency for the selected range.
Stop	Readout of the stop frequency for the selected range.
Edit	Click this button to edit the Spurious Frequency Plan, which defines the range frequency values and whether or not a signal is measured in a range (enabled/disabled).
Enabled	Specifies whether or not measurements are taken in the specified range.
Filter shape	Specifies the filter shape used for the Spurious measurement.
BW	Specifies the bandwidth used for the selected filter shape.
Auto	Sets the BW automatically. If CISPR is selected for Filter shape, this control is disabled.
Detection	Sets the processing method used for compressing excess intermediate data into the desired number of trace points.
Threshold	Specifies the level that must be exceeded for a signal peak to be recognized as a spur. A signal peak must also exceed the Excursion setting to be considered a spur.
Excursion	Specifies the peak to peak magnitude that must be exceeded for a signal peak to be recognized as a spur. A signal transition must also exceed the Threshold setting to be considered a spur.
VBW	Adjusts the VBW (Video Bandwidth) value. VBW Maximum: RBW current value; VBW Minimum: 1/10,000 RBW setting. Disabled when Filter shape is set to CISPR.
Review table	Click to display the Ranges table. The Ranges Table shows the enabled ranges, and all the settings specified on the Ranges and Limits tabs associated with the enabled ranges.
Save table	Click to save the current Range table to a file.
Load table	Click to load a saved Range table from a file.



## Changing the Range Start and Stop Frequencies



To change the range start and stop frequencies, edit the Spurious Frequency Plan:

1. Click the **Edit** button on the **Settings > Range** tab.
2. Click the **Enabled** box for a range to take measurements in the range.
3. Click on the frequency setting to change it. Type in a number for the frequency and a letter as a multiplier, then press **Enter** on the front panel. You can use k, m, or g to set the frequency multiplier.
4. Click **OK** to save your changes.

You can enable a range on the Ranges control panel tab by selecting the range from the Range drop-down list and clicking the Enabled check box. If you need to change the frequency of a range, you must edit the spurious frequency plan using the Edit button.

## Specifying Spur Requirements

A spur is a signal peak that exceeds both the Threshold and Excursion settings on the Ranges tab. The Threshold and Excursion settings are absolute values; they are not calculated relative to a reference. The Threshold and Excursion settings are specific to the selected range. If you want to use different settings for spurs in different ranges, you have to set the values separately for each range. The Excursion control is used to avoid interpreting a single spur as multiple narrower spurs by requiring the amplitude to drop by the Excursion amount between spurs. Raising the Threshold value means that fewer, larger signals will be identified as spurs.

To specify the spur requirements for a range:

1. Select the **Range** for which you want to specify the spur requirements.
2. Set the **Threshold** value.
3. Set the **Excursion** value.

## Limits Tab

Use the Limits tab to specify the pass/fail parameters for the Spurious measurement. When the Mask setting is set to any value except off, the instrument identifies any signal peak that exceeds the specified limits as a violation and displays Fail on the screen. If no signal peak exceeds the limits, the instrument displays Pass on the screen.

The screenshot shows the 'Limits' tab in a software interface. The tab is highlighted in orange. The interface includes several sections:

- Range:** A dropdown menu set to 'A', with 'Start' at 1.610 GHz and 'Stop' at 1.720 GHz. An 'Edit...' button is next to the stop frequency.
- Enabled:** A checked checkbox labeled 'Enabled'.
- Mask:** A dropdown menu set to 'Abs'. Buttons for 'Review table', 'Save table...', and 'Load table...' are on the right.
- Absolute ampl:** Two input fields, both set to '-50.00 dBm', with a 'Same' checkbox between them.
- Relative ampl:** Two input fields, both set to '-10.000 dB', with a 'Same' checkbox between them.

Setting	Description
Range	Selects the frequency range to which the settings on this tab are applied.
Start	Readout of the start frequency for the selected range.
Stop	Readout of the stop frequency for the selected range.
Edit	Click this button to edit the Spurious Frequency Plan, which defines the range frequency and whether or not measurements are taken in a range (enabled/disabled).
Enabled	Specifies whether or not measurements are taken in the specified range.
Mask	Selects the type of limits used for Pass/Fail testing. Spurs that exceed the mask settings are considered violations.
Abs	Spurs that exceed the Absolute limits settings are identified as violations.
Rel	Spurs that exceed the Relative limits settings are identified as violations.
Abs & Rel	Spurs that exceed both the Absolute and Relative limits settings are identified as violations.
Abs OR Rel	Spurs that exceed either the Absolute or Relative limits settings are identified as violations.
Off	Turns off limit testing for the selecting range. Measurements are still taken in the range, but violations are not flagged. Signal peaks that exceed the Threshold and Excursions values will still be identified as spurs.
Absolute ampl	Absolute amplitude limits are not based on the measured carrier amplitude or manual reference. Start and stop values can be different.
Start	Specifies the limit at the start frequency of the range.
Stop	Specifies the limit at the stop frequency of the range.
Same	Sets the limit at the start and stop frequencies to the value set for the start frequency.
Relative ampl	Relative amplitude limits are calculated from the Power Reference. If the Power Reference is set to the Carrier level, the relative amplitude limits will change with the carrier level. Start and stop values can be different.
Start	Specifies the limit at the start frequency of the range.
Stop	Specifies the limit at the stop frequency of the range.
Same	Sets the limit at the stop frequency to the value set for the start frequency.
Review table	Click to display the Ranges table. The Ranges Table shows the enabled ranges, and all the settings specified on the Ranges and Limits tabs associated with the enabled ranges.
Save table	Click to save the current Range table to a file.
Load table	Click to load a saved Range table from a file.

### Performing Pass/Fail Limit Testing

To set limits:

1. Press **Settings** to display the **Spurious Settings** panel.
2. Press **Limits** to display the Limits tab.
3. Press **Edit** to display the **Range and Carrier Frequencies** dialog box.
4. Adjust the start and stop frequencies as required for each range you want to test.

5. For ranges that you wish to test, verify that the Enabled box is checked. Click **OK**.
6. Select a range you want to test from the **Range** drop-down list.
7. Select the desired **Mask** type from the drop-down list.
8. Set the limits as desired in the **Absolute ampl** and **Relative ampl** boxes. The values you can edit depend on the mask type you select.
9. Repeat steps 5, 6 and 7 for each range you want to test.
10. Verify that the **Threshold** and **Excursion** values on the [Ranges \(see page 110\)](#) tab are set as required. These are the values that define a spur.
11. Press the close box to remove the Settings panel.
12. Click **Run** to begin testing.

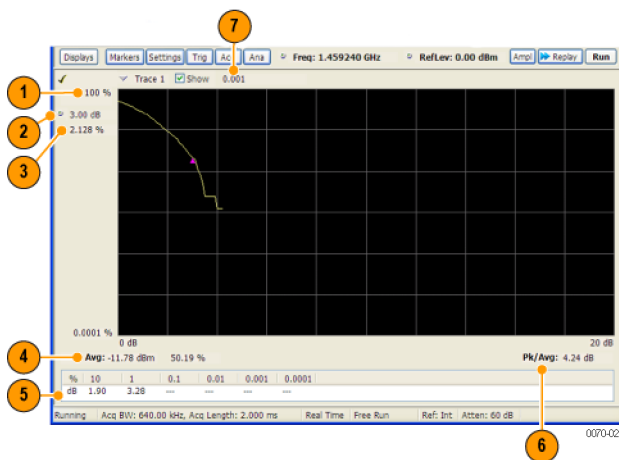
## CCDF Display

The CCDF (Complementary Cumulative Distribution Function) is a statistical characterization that plots power level on the x-axis and probability on the y-axis of a graph. Each point on the CCDF curve shows what percentage of time a signal spends at or above a given power level. The power level is expressed in dB relative to the average signal power level. The CCDF Display also shows the Average power level and the Peak/Average ratio.

To show the CCDF display:

1. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **RF Measurements**.
3. Double-click the **CCDF** icon in the **Available Displays** box. This adds the CCDF icon to the **Selected displays** box.
4. Click the **OK** button.

### Elements of the CCDF Display



Item	Display element	Description
1	100%	The top of the graph represents the 100% probability that the signal will be at or above the average signal level.
2	Power level select	Adjust to display the value of the CCDF curve at a specific power level. The selected power level is indicated by a small triangle on the CCDF curve.
3	CCDF value	Readout of the value of the CCDF curve at the selected power level.
4	Avg	Readout of the Average power level and the CCDF value at the Average power level.
5	Readout Table	Readout of the CCDF curve at six points.
6	Pk / Avg	Readout of the Peak to Average power ratio.
7	Measurement time	Readout of the length of time used for the measurement. Displays --- s when the Measurement time is set to continuous.

[Changing the CCDF Display Settings \(see page 116\)](#)

## CCDF Settings

**Menu Bar: Setup > Settings**

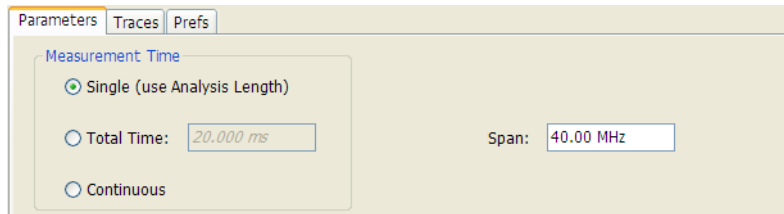
The control panel tabs for the CCDF Display are shown in the following table.

Settings tab	Description
<a href="#">Parameters (see page 117)</a>	Specifies the time to be measured.
<a href="#">Traces (see page 120)</a>	Select the trace to be measured and select reference trace for display.
<a href="#">Prefs (see page 123)</a>	Specifies whether or not certain display elements are shown.

**Restore Defaults.** Sets the CCDF parameters to their default values.

## Parameters Tab

The Parameters tab enables you to specify several parameters that control signal acquisition for the CCDF Display.



Setting	Description
Single	When Single is selected, the CCDF measurement is based on the Analysis Time parameters set on Analysis control panel (Setup > Analysis > Analysis Time), shared by all displays. In Single, CCDF is time-correlated with the other open displays.
Total Time	When Total Time is selected, you can adjust its value. The value set here does not affect the Analysis Length value set in the Analysis control panel. If the Total Time value is longer than the Analysis Length, CCDF uses multiple acquisitions to collect signal data.
Continuous	When Continuous is selected, the CCDF measurement combines each new record (Actual Analysis Length) into the existing result. It does not erase and start over until user presses STOP or CLEAR.
Span	Specifies the range of frequencies used for analysis.

### Single

To have statistically meaningful results, CCDF works best when calculated on at least 1 ms of data. Depending on the Analysis Time setting, the CCDF display may present error messages:

- If the Actual Analysis Time is greater than 1 ms, the CCDF Display will calculate the trace without any problems.
- If the Actual Analysis time is less than 1 ms, the CCDF Display will measure the data as best it can, but if it receives fewer than 20 samples, the CCDF display will clear the trace and report "Not enough samples".

## RF Measurements Shared Measurement Settings

The control panel tabs in this section are shared by the displays in the RF Measurement folder (Setup > Displays). With few exceptions, each display maintains separate values for each of the controls on these tabs. For example, Scale values are independent for each of the displays.

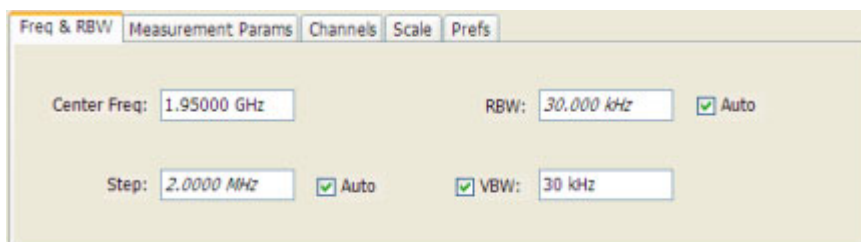
### Common controls for RF measurement displays

Settings tab	Description
<a href="#">Freq &amp; RBW (see page 119)</a>	Allows you to specify the Center Frequency, Step size and RBW.
<a href="#">Traces (see page 120)</a>	Specifies trace parameters such as detection method and whether smoothing is enabled. Traces can also be saved and loaded for reference from this tab.
<a href="#">Scale (see page 122)</a>	Specify vertical and horizontal scale settings.
<a href="#">Prefs (see page 123)</a>	Specify appearance features of the graph area.



## Freq & RBW Tab

The Freq & RBW tab specifies frequency parameters for the RF Measurements displays.



Setting	Description
Center Freq	Specifies the center/measurement frequency.
Step	The Step control sets the increment/decrement size for the adjustment of the center frequency. If Auto is enabled, the analyzer will adjust the Step size as required.
RBW	Select Auto or Manual. Adjusts the RBW for the entire measurement. This setting is independent of the Spectrum view's RBW setting.
VBW	Adjusts the VBW (Video Bandwidth) value. VBW Maximum = current RBW value. VBW Minimum = 1/10,000 RBW setting.

**NOTE.** While the center frequency and step settings on this control tab are shared between ACPR, MCPR and Occupied Bandwidth, the RBW setting is not shared. The RBW setting is unique for each measurement.

### VBW

The VBW setting enables/disables the Video Bandwidth filter. VBW is used in traditional swept analyzers to reduce the effect of noise on the displayed signal. The VBW algorithm in the analyzer emulates the VBW filters of traditional swept analyzers.

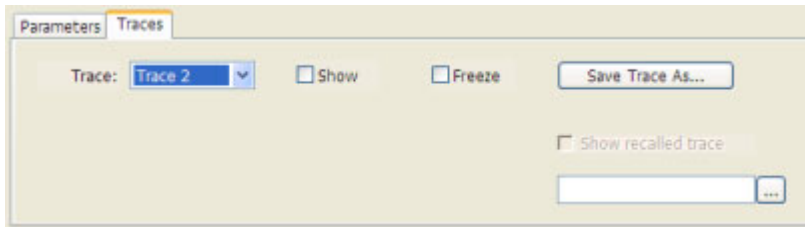
The maximum VBW value is the current RBW setting. The minimum VBW value is 1/10,000 of the RBW setting.

**NOTE.** If you are following a procedure that says to "set VBW to three times the RBW value or greater", it means that the test should be conducted with no VBW effects. In the SignalVu software, this condition is met by disabling the VBW function.

## Traces Tab

The Traces tab enables you to select traces for display. You can choose to display a live trace, a saved trace, and a reference trace.

**NOTE.** *Not all RF Measurements support multiple traces and/or save and recall of traces.*

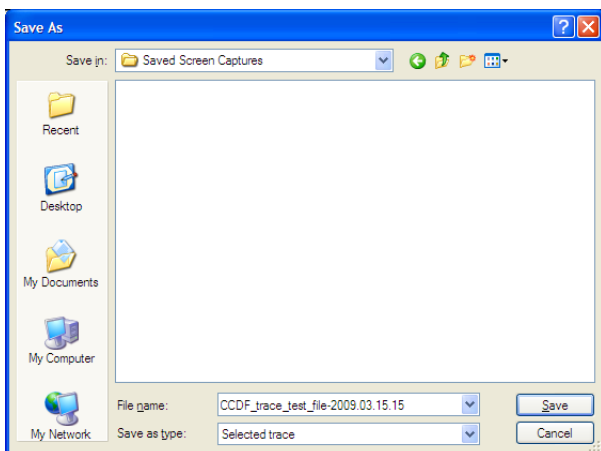


Setting	Description
Trace	Selects a trace for display. Choices are Trace 1, 2, and Gaussian (CCDF display only). Trace 1 and 2 can be saved traces.
Show	Shows / hides the selected trace.
Freeze	Halts updates to the selected trace.
Save Trace As...	Saves the selected trace to a file for later recall and analysis.
Show recalled trace	Used to select a saved trace for display.

### Saving Traces

To save a trace for later analysis:

1. Select the **Save Trace As** button. This displays the Save As dialog box.



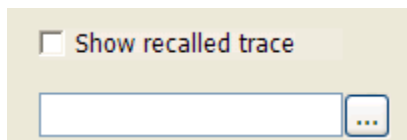
2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

### Recalling Traces

You can recall a previously saved trace for analysis or comparison to a live trace.

To select a trace for recall:

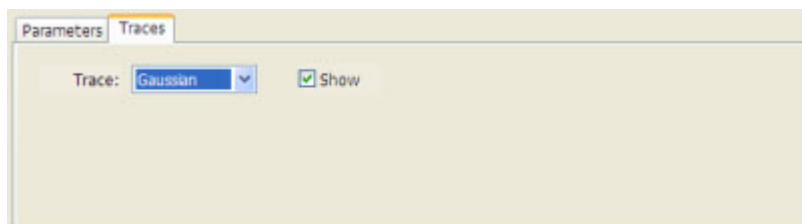
1. Select the trace into which the recalled trace will be loaded, from the Trace drop-down list.
2. Check the **Show** check box.
3. Click the ... button to display the Open dialog box.



1. Navigate to the desired file and click **Open**.
2. Check the **Show Recalled Trace** check box.
3. Verify that the trace's **Show** check box is selected (either on this tab or next to the drop-down list located at the top-left corner of the graph).

### Gaussian Trace

The Gaussian trace is a reference trace that you can compare your trace against. Because the Gaussian trace is for reference, there are no settings for the trace other than whether or not it is shown.



## Scale Tab

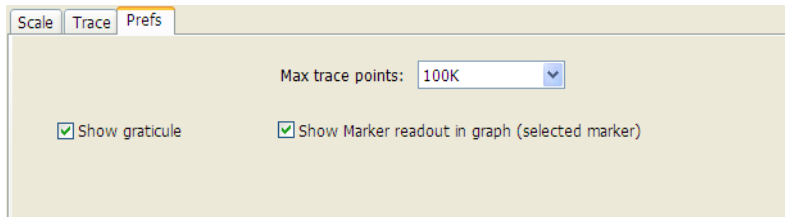
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Center Frequency.



Setting	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale units. This is only accessible when the vertical units are set to dBm.
Offset	Adjusts the Reference Level away from the top of the trace display.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Horizontal	Controls the span of the trace display and position of the trace.
Scale	Allows you to, in effect, change the span.
Offset	Allows you to pan a zoomed trace without changing the Measurement Frequency. Offset is only enabled when the span, as specified by Freq / div , is less than the acquisition bandwidth.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Log (Spurious only)	Resets the display to show the frequency axis in a logarithmic scale.

## Prefs Tab

The Prefs tab enables you to change parameters of the measurement display. The parameters available on the Prefs tab vary depending on the selected display, but include such items as enabling/disabling Marker Readout, switching the Graticule display on/off, and Marker Noise mode. Some parameters appear with most displays while others appear with only one display.



## Overview

The displays in the Pulsed RF folder (Displays > Folders > Pulsed RF) are:

- Pulse Statistics
- Pulse Table
- Pulse Trace

The Pulse measurements provide deep insight into pulse train behavior.

### Pulse Measurements

The analyzer takes the following pulse measurements: Average ON Power, Peak Power, Average Transmitted Power, Pulse Width, Rise Time, Fall Time, Repetition Interval (Sec), Repetition Rate (Hz), Duty Factor (%), Duty Factor (Ratio), Ripple, Droop, Pulse-Pulse Phase Difference, Pulse-Pulse Frequency Difference, RMS Frequency Error, Maximum Frequency Error, RMS Phase Error, Maximum Phase Error, Frequency Deviation, Phase Deviation, and Time. See [Available Measurements \(see page 17\)](#) for definitions.

## Pulse Table Display

The Pulse Table lists selected measurements in a spreadsheet format, showing the pulse numbers and all the results for each measurement on all the detected pulses. Pulses are numbered from one.

	Width	Rise	Fall	Rep Int	Ripple dB	Oshoot dB	IPR Ampl	IPR Time
1	10.001226 us	22.053223 ns	34.480795 ns	20.000085 us	0.500779 dB	0.176477 dB	-39.64314 dB	100.00000 ns
2	10.001189 us	22.832031 ns	35.475260 ns	19.999978 us	0.497091 dB	0.122775 dB	-39.56451 dB	100.00000 ns
3	10.001240 us	22.910971 ns	35.525716 ns	19.999967 us	0.560992 dB	0.164884 dB	-39.58826 dB	100.00000 ns
4	10.001219 us	21.879883 ns	36.684572 ns	20.000123 us	0.541672 dB	0.167976 dB	-39.47545 dB	100.00000 ns
5	10.001149 us	21.840821 ns	34.536132 ns	19.999965 us	0.508522 dB	0.198757 dB	-39.63313 dB	100.00000 ns
6	10.001152 us	22.536621 ns	36.062826 ns	19.999999 us	0.505952 dB	0.194506 dB	-39.52799 dB	100.00000 ns
7	10.001105 us	22.299805 ns	34.923502 ns	20.000067 us	0.542245 dB	0.152452 dB	-39.52675 dB	100.00000 ns
8	10.001093 us	22.267253 ns	36.049805 ns	20.000098 us	0.534221 dB	0.159783 dB	-39.59387 dB	100.00000 ns
9	10.000954 us	22.619629 ns	37.154948 ns	19.999834 us	0.495824 dB	0.145826 dB	-39.39031 dB	100.00000 ns
10	10.001165 us	23.014323 ns	37.138673 ns	20.000016 us	0.524665 dB	0.140490 dB	-39.67612 dB	100.00000 ns
11	10.001151 us	22.158204 ns	36.031903 ns	20.000040 us	0.544542 dB	0.165281 dB	-39.72642 dB	100.00000 ns
12	10.001099 us	22.856446 ns	35.429689 ns	19.999970 us	0.501713 dB	0.156311 dB	-39.68145 dB	100.00000 ns
13	10.001137 us	22.525228 ns	35.724284 ns	20.000027 us	0.565740 dB	0.225843 dB	-39.35123 dB	100.00000 ns
14	10.001128 us	21.625164 ns	36.617838 ns	20.000010 us	0.508027 dB	0.193701 dB	-39.95389 dB	100.00000 ns
15	10.001120 us	23.391927 ns	35.553384 ns	20.000014 us	0.508053 dB	0.236307 dB	-39.55756 dB	100.00000 ns
16	10.001083 us	22.629395 ns	36.399740 ns	19.999979 us	0.526863 dB	0.258777 dB	-39.53174 dB	100.00000 ns
17	10.001089 us	33.373212 ns	37.202149 ns	19.999919 us	0.578999 dB	0.247955 dB	-39.45967 dB	100.00000 ns
18	10.001199 us	22.643230 ns	36.319989 ns	20.000138 us	0.568612 dB	0.147240 dB	-39.54891 dB	100.00000 ns
19	10.001146 us	22.121583 ns	34.513349 ns	19.999938 us	0.489073 dB	0.159303 dB	-39.52242 dB	100.00000 ns
20	10.001148 us	23.132325 ns	36.113281 ns	20.000049 us	0.535096 dB	0.168757 dB	-39.45103 dB	100.00000 ns
21	10.001089 us	22.142741 ns	35.911459 ns	19.999970 us	0.521983 dB	0.159270 dB	-39.21722 dB	100.00000 ns
22	10.001105 us	22.137858 ns	35.638021 ns	19.999947 us	0.529781 dB	0.173036 dB	-39.57577 dB	100.00000 ns

### Displaying the Pulse Table

1. Press the **Displays** button or select **Setup > Displays**.
2. Select **PulsedRF** in the Folders box.
3. **Double-click Pulse Table** in the **Available displays** box to add the display to the Selected displays box.
4. Click **OK**.

### Selecting the Measurements to Show

1. With the Pulse Table selected, press the **Settings** button.
2. In the Pulse Table Settings control panel, select the **Measurements** tab.



3. Select the measurements you wish to take from the list of measurements.
4. Click the close box ( ) to remove the Settings control panel.

[Changing the Pulse Table Display Settings \(see page 126\)](#)

## Pulse Table Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

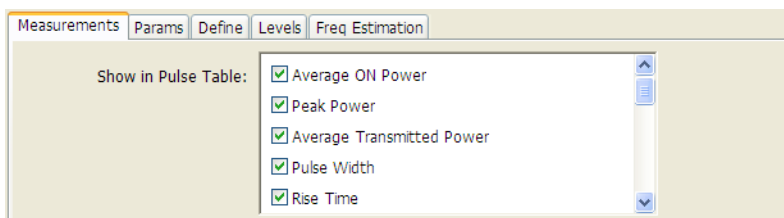
The Settings control panel tabs for the Pulse Table Display are shown in the following table.

Settings tab	Description
<a href="#">Measurements (see page 126)</a>	Selects the measurements to be show in the Pulse Table.
<a href="#">Params (see page 132)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 133)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 138)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 139)</a>	Specifies the reference used for computing frequency errors.

**Restore Defaults.** Sets the Pulse Table parameters to their default values.

## Measurements Tab

The Measurements tab is used to specify the measurements that appear in the Pulse Table.



### Show in Pulse Table

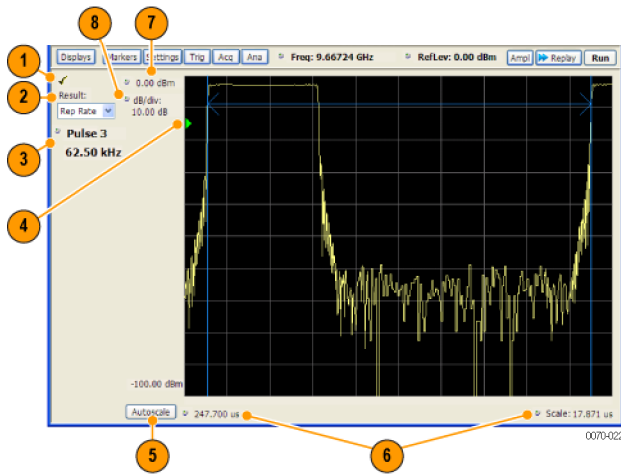
Checked measurements appear in the Pulse Table.



## Pulse Trace Display

The Pulse Trace display shows one measurement result and a trace graph illustrating that measurement for a selected pulse number. You can also choose to display arrows and lines in the graph that illustrate where on the pulse the measurement is being taken.

### Elements of the Pulse Trace Display



Item	Display element	Description
1	Optimized indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Pulse Trace display is the optimized display.
2	Result	Use this list to select the measurement to show. The measurement chosen here selects the same result to be displayed in the Statistics view and highlighted in the Table view. Selecting a result in any of these views causes the same result to be selected in all of them.
3	Pulse	Selects which pulse result is shown. Like the Result, this selection is shared with the Statistics and Table views. The maximum number of pulses that can be measured is limited to 10000.
4	Pulse threshold indicator	This green triangle indicates the power threshold used to detect pulses. See Settings > Params > Power threshold to detect pulses.
5	Autoscale	Set the axes to values that show all trace points.
6	Horizontal offset and scale	Located along the bottom edge of the trace display, these controls specify the offset and scale on the horizontal axis.
7	Top of graph adjustment	Sets the power level shown at the top of the graph. If the number is greater than the Ref Level, a white line will appear in the graph to indicate the Ref Level.
8	Vertical scale	Sets the vertical scale value.

[Changing the Pulse Trace Display Settings \(see page 128\)](#)

## Pulse Trace Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

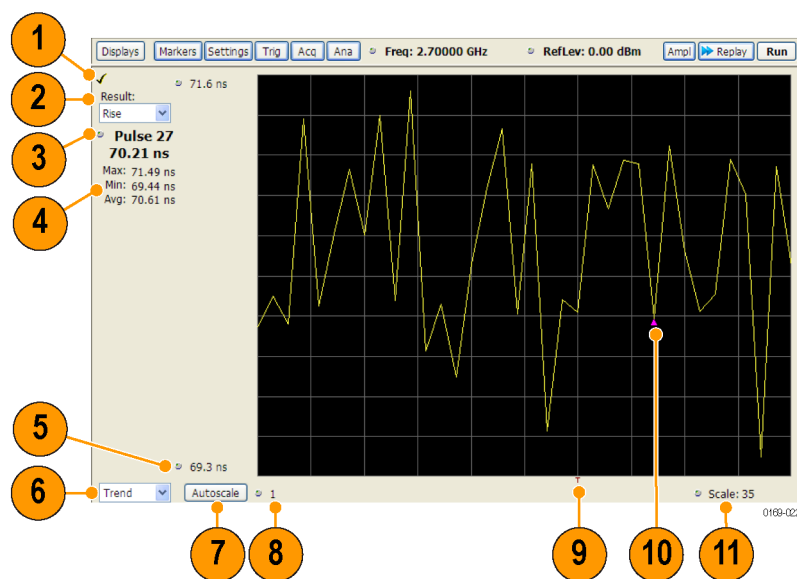
The Setup settings for the Pulse Trace display are shown in the following table.

Settings tab	Description
<a href="#">Params (see page 132)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 133)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 138)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 139)</a>	Specifies the reference used for computing frequency error.
<a href="#">Scale (see page 140)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 141)</a>	Specifies whether or not certain display elements are shown.

## Pulse Statistics Display

The Pulse Statistics view displays a plot of a pulse measurement's values for every pulse in the analysis period. For example, the Pulse Statistics display will show the rise time measurement for each of 30 pulses, with rise time on the Y axis and pulse number on the X axis. Alternatively, the Statistics Display can show an FFT trace for the values of a measurement over all the pulses analyzed. Numeric readouts of Max, Min, and Average in this display summarize results for the selected pulse measurement.

### Elements of the Pulse Statistics Display



Item	Display element	Description
1	Optimized indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Pulse Statistics display is the optimized display.
2	Result	Use this list to select which measurement statistics to display. The measurement chosen here selects the same result to be displayed in the Pulse Trace display and the Pulse Table display. Selecting a result in any of these views causes the same result to be selected in all of them.
3	Pulse	Selects which pulse's result is shown. Like the Result, this selection is shared with the Statistics and Table views.
4	Statistics summary	Display of measurement statistics for the selected Result.
5	Vertical range	Located at the top of the left graph edge and at the bottom of the left graph edge, use these controls to adjust the values at the top of the graph and the bottom of the graph.
6	Plot	Selects from Trend, Time Trend, FFT, and Histogram for the graph.
7	Autoscale	Set the axes to values that show all trace points.
8	Horizontal offset	Adjusting this value moves the graph right or left.
9	Trigger indicator	Indicates the trigger point on the pulse train if the trigger occurred during the time frame of the pulse measurements.
10	Pulse indicator	For Trend and Time Trend plot types, this indicates the pulse selected by the Pulse setting. For the FFT plot type, this indicator marks the trace point at the selected frequency. For Histogram plot types, this indicator marks the selected results bin.
11	Scale	Adjusts the horizontal scale.

[Changing the Pulse Statistics Display Settings \(see page 131\)](#)

## Pulse Statistics Settings

**Menu Bar: Setup > Settings**

**Application Toolbar: Settings**

The settings for the Pulse Statistics Display are shown in the following table.

Settings tab	Description
<a href="#">Params (see page 132)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 133)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 138)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 139)</a>	Specifies the reference used for computing frequency errors.
<a href="#">Scale (see page 140)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 141)</a>	Specifies whether or not certain elements of the display are shown.

## Pulsed RF Shared Measurement Settings

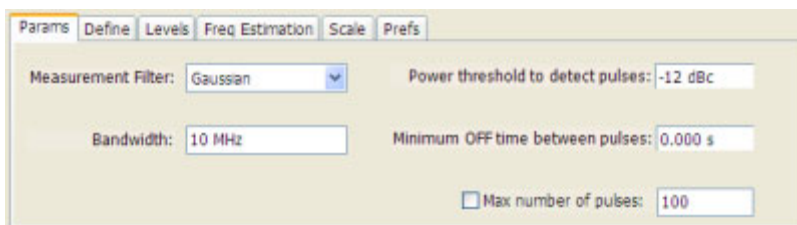
The control panel tabs in this section are shared by the displays in the Pulsed RF folder (Setup > Displays). Changing a setting on one tab changes that setting for all the Pulsed RF displays.

### Common controls for pulsed RF displays

Settings tab	Description
<a href="#">Params (see page 132)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 133)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 138)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 139)</a>	Specifies the reference used for computing frequency errors.
<a href="#">Scale (see page 140)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 141)</a>	Specifies whether or not certain elements of the display are shown.

## Params Tab

The Params tab enables you to adjust several measurement parameters for Pulsed RF displays.



Setting	Description
Measurement Filter	Specify whether a filter is used to limit the bandwidth of the input signal.
Bandwidth	Sets the bandwidth of the measurement filter.
Power threshold to detect pulses	Specifies the level used for locating pulses in the data.
Minimum OFF time between pulses	Specifies the time the signal must fall below the power threshold for two pulses to be considered separate pulses.
Max number of pulses	Specifies the number of pulses to measure within the analysis time.

## Measurement Filter

Three choices are available for the measurement filter:

- **No Filter - Max BW:** The widest acquisition bandwidth available is used. The **Bandwidth** setting is disabled, but shows the value in use.
- **No Filter:** - This is the default. The Bandwidth control is enabled for you to specify an acquisition bandwidth.
- **Gaussian** - The Bandwidth control is enabled for you to specify a value. The instrument uses an acquisition bandwidth two times wider than the entered value.

## Power Threshold to Detect Pulses

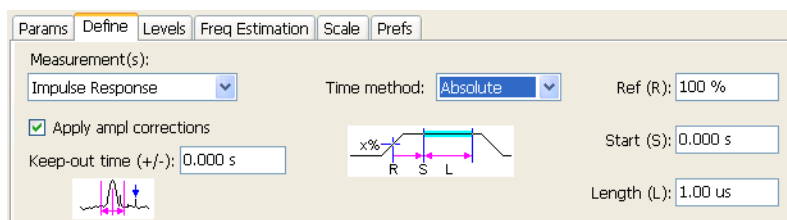
Specifies the minimum power level the trace must exceed to be detected as a pulse. The range for this setting is: -3 to -70 dBc. The setting resolution is 1 dB. The default value is -10 dB.

## Max Number of Pulses

If the Analysis Time contains fewer pulses than specified, the analyzer will measure all the pulse within the analysis time. If there are more pulses in the Analysis Time, than the specified number, the analyzer measures the specified number of pulses and ignores the rest. The range for this setting is: 1 - 10000. The setting resolution is: 1. If this setting is not checked, the analyzer will measure all pulses within the Analysis Time, up to a maximum of 10000 pulses.

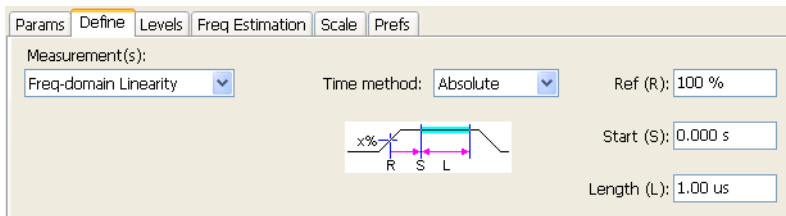
## Define Tab

The Define tab enables you to specify parameters that control where measurements are made on a pulse. The settings available depend on the measurement selected.



The following paragraphs describe the settings that appear on the Define tab according to the Measurement(s) selection.

### Freq-Domain Linearity

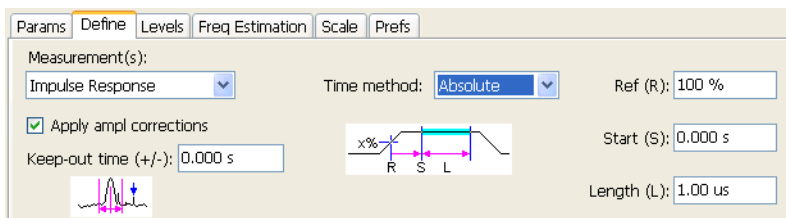


#### Setting

#### Description

Time method	Specifies how the measurement's duration is determined. The choices are Absolute and Relative.
Absolute time method	
Ref (R)	Ref specifies the level along the pulse rising edge that is defined as the point from which Start time is counted. Choices: 50%, 60%, 70%, 80%, 90% 100%; Default: 100%
Start (S)	Start specifies the time the instrument waits after the rising-edge reference before starting to measure the pulse. The Start time is measured from the point along the pulse rising edge specified by the Ref setting. Start Range: $\pm 100$ ms; Resolution: 3 digits; inc/dec small: 1 ns, large: 1,2,5,10...; Default: 0
Length (L)	Length specifies the period of time that is used for pulse measurements The measurement time begins at the Start point and continues for the amount of time specified by Length.
Relative time method	
Length	In the Relative time method, Length specifies the percentage of the top of the pulse that is used for measurements. The instrument automatically determines the pulse top. The measurement length is centered within the pulse ON time.

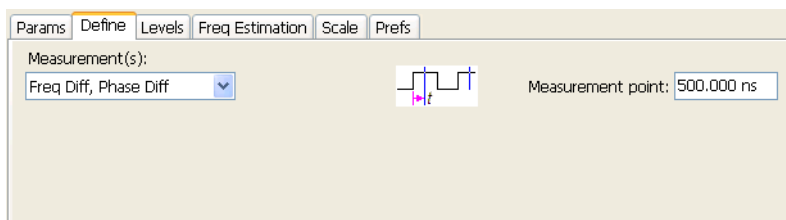
### Impulse Response





Setting	Description
Apply ampl corrections	Enable/disable corrections that remove errors due to the window function and to the time offset of the side lobe.
Keep-out time (+/-)	The Keep-out time specifies a region that is ignored when the trace is analyzed for side lobes. The setting defines a region to the left and to the right of the center of the main lobe. Lobes that fall within this time region are not eligible to be the "highest side lobe".
Time method	Specifies how measurement parameters are determined. The choices are Absolute and Relative.
Absolute time method	
Ref (R)	Ref specifies the level along the pulse rising edge that is defined as the point from which Start time is counted. Choices: 50%, 60%, 70%, 80%, 90% 100%; Default: 100%
Start (S)	Start specifies the time the instrument waits after the rising-edge reference before starting to measure the pulse. The Start time is measured from the point along the pulse rising edge specified by the Ref setting. Start Range: $\pm 100$ ms; Resolution: 3 digits; inc/dec small: 1 ns, large: 1,2,5,10...; Default: 0
Length (L)	Amount of time that should be included in the measurement. The measurement time begins at the Start point and continues for the amount of time specified by Length.
Relative time method	
Length	In the Relative time method, Length specifies the percentage of the top of the pulse that is used for measurements. The instrument automatically determines the pulse top. The measurement length is centered within the pulse ON time.

### Freq Diff, Phase Diff



Setting	Description
Measure point	Specifies the period in time after the 50% rising edge at which frequency and phase difference measurements are made.

## Ripple

Params **Define** Levels Freq Estimation Scale Prefs

Measurement(s):  
 Ripple Time method: Relative Ref (R): 100 %

Start (S): 0.000 s  
 Length (L): 50.0 %

### Setting

### Description

Setting	Description
Length	Length specifies the percentage of the top of the pulse that is used for measurements. The instrument automatically determines the pulse top. The measurement length is centered within the pulse ON time. Only the Relative Time method is available for Ripple.

## Overshoot

Params **Define** Levels Freq Estimation Scale Prefs

Measurement(s):  
 Overshoot Time method: Relative Ref (R): 100 %

Start (S): 0.000 s  
 Length (L): 25.0 %

Setting	Description
Time method	Specifies how measurement parameters are determined. The choices are Absolute and Relative.
Absolute time method	
Ref (R)	Ref specifies the level along the pulse rising edge that is defined as the point from which Start time is counted. Choices: 50%, 60%, 70%, 80%, 90% 100%; Default: 100%
Start (S)	Start specifies the time the instrument waits after the rising-edge reference before starting to measure the pulse. The Start time is measured from the point along the pulse rising edge specified by the Ref setting. Start Range: $\pm 100$ ms; Resolution: 3 digits; inc/dec small: 1 ns, large: 1,2,5,10...; Default: 0
Length (L)	Amount of time that should be included in the measurement. The measurement time begins at the Start point and continues for the amount of time specified by Length.
Relative time method	
Ref	Ref specifies the level along the pulse rising edge that is defined as the point from which Start time is counted. Choices: 50%, 60%, 70%, 80%, 90% 100%; Default: 100%
Start	Start specifies the time the instrument waits after the rising-edge reference before starting to measure the pulse. The Start time is measured from the point along the pulse rising edge specified by the Ref setting. Start Range: $\pm 100$ ms; Resolution: 3 digits; inc/dec small: 1 ns, large: 1,2,5,10...; Default: 0
Length	In the Relative time method, Length specifies the percentage of the top of the pulse that is used for measurements. The instrument automatically determines the pulse top. The measurement length is centered within the pulse ON time.

## Levels Tab

Use the Levels tab to set parameters that control the method and levels used to calculate some pulse values.



Setting	Description
100% Level	Specifies the method used to determine the 100% level(s).
50% Level	Specifies the method used to determine the 50% level on the pulse.
Rise/Fall Levels	Select whether to use the 10% to 90% or 20% to 80% points (based on voltage level) to define the rise and fall times.

### 100% Level

Use the 100% Level settings to select the method used to determine the 100% level(s) used for calculating pulse parameters, for example, Rise, Fall, and Width.

The Pulse Average Amplitude defines the pulse top as the average of the values of all the points along the pulse top. This average is used as the 100% level, from which the 10, 20, 50, 80 and 90% levels are calculated. Pulse measurements are referenced against these various levels. For example, Rise is the time between the 10 and 90% (or 20 and 80%) levels on the rising edge of the pulse. When the Pulse Average Amplitude method is selected, the same 100% level is used for both rising and falling edges.

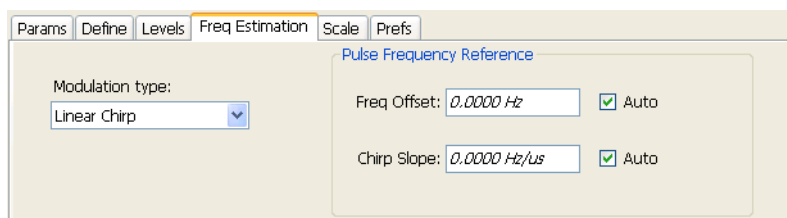
Because some RF pulse types have droop (a height difference between the beginning and ending points of the pulse top), the 100% percent level on the rising edge may not be equal to the 100% level on the falling edge. The Independent method of pulse point location is designed for pulses with different 100% levels at their rising and falling edges. The Independent method calculates the 100% level for the rising edge separately from the 100% level of the falling edge. As a result, the 10, 20, 50, 80 and 90% levels are also different for the rising and falling edges, allowing for more accurate measurements on pulses with droop.

### 50% Level

Select Voltage to use -6 dB as the 50% point. Select Power to use -3 dB as the 50% level.

## Freq Estimation Tab

Use the Freq Estimation tab to specify parameters used for determining frequency offset.



Setting	Description
Modulation type	Specifies which algorithm to use for estimating frequency error.
Pulse Frequency Reference	Specifies the method used to determine the pulse frequency error and if applicable, the chirp slope.
Auto	Selecting Auto causes the instrument to calculate the frequency offset and if applicable, the chirp slope.
Freq Offset	If Auto is not enabled, specify the value for frequency offset here. If Auto is enabled, the offset is set to zero and this readout displays the calculated frequency error.
Chirp BW	If Auto is not enabled, specify the value for Chirp Slope here. If Auto is enabled, this readout displays the calculated Chirp slope. This setting is used only when the modulation type is set to Linear Chirp.

### Modulation Type

Frequency estimation is performed by the instrument using selectable methods, depending on signal type. The selections for modulation type are CW (constant phase), CW (changing phase), Linear Chirp and Other. Select the method of frequency method based upon a best match to your signal based on the following descriptions:

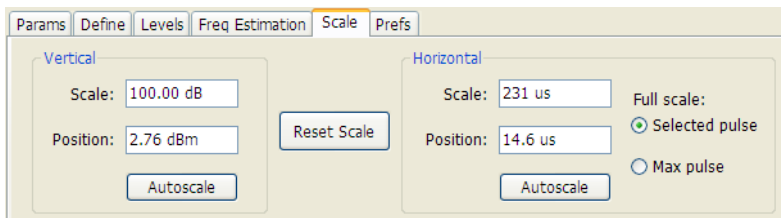
- CW (constant phase): The signal is not designed to change in either frequency or phase during the measured pulse train.
- CW (changing phase): The signal does not change the carrier phase within each pulse, although it could change the phase from one pulse to another pulse. The signal is not designed to make frequency changes.
- Linear Chirp: The signal changes frequency in a linear manner during each pulse. The signal has the same carrier phase at the same time offset from the rising edge of the pulse.
- Other: The signal is not one of the listed types. You must manually enter the Frequency Offset value.

The following table maps the appropriate signal type selection with the signal characteristics.

Signature	Phase offset from one pulse to another	
	Zero	Any (unknown)
CW	CW Constant Phase	CW Changing Phase
LFM	Linear Chirp	N/A

## Scale Tab

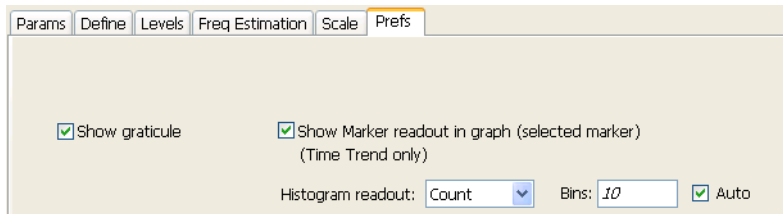
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale. The units for this setting depend on the statistic selected from the Result drop-down list in the Pulse Statistics display.
Position	Adjusts the Reference Level away from the top of the trace display. The units for this setting depend on the statistic selected from the Result drop-down list in the Pulse Statistics display.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Horizontal	Controls the span of the trace display and position of the trace.
Scale	Allows you to change the span.
Position	Allows you to pan a zoomed trace.
Full Scale (Pulse Trace display only)	Specifies the Horizontal scale default.
Selected	Sets the horizontal scale default to be based on the result value for the currently-select pulse.
Max Pulse	Sets the horizontal scale default to be based on the largest value for the selected pulse measurement.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Plot (Pulse Statistics display only)	Specifies the FFT, Trend, Time Trend, or Histogram plot.
Reset Scale	Restores all settings to their default values.

## Prefs Tab

The Prefs tab enables you to change parameters of the measurement display. The parameters available on the Prefs tab vary depending on the selected display.



### Settings on the Pulsed RF Displays Prefs Tab

The following table describes the settings that appear on the Prefs tab of the Pulsed RF displays: Pulse Statistics and Pulse Trace. There is no Prefs tab for the Pulse Table display.

Setting	Description
Show graticule	Displays or hides the graticule in the trace display.
Show Marker readout in graph	When a marker is enabled, this setting displays or hides the maker readout, but not the maker itself, on Time Trend plots.
Histogram readout (present only when Histogram is the selected plot type)	Controls the parameters Histogram readout and Bins. Histogram readout can be set to either Count or %. Count indicates the number of hits that fell into each bin. % indicates percentage of the total count (for the acquisition) that fell into each bin.
Bins	Specifies how many "bins" or histogram bars the results are distributed into.

## Overview

The displays in the General Purpose (GP) Digital Modulation folder (Displays > Folders > GP Digital Modulation) are:

- Constellation
- Demod I & Q vs Time
- EVM vs Time
- Eye Diagram
- Frequency Deviation vs Time
- Magnitude Error vs Time
- Phase Error vs Time
- Signal Quality
- Symbol Table
- Trellis Diagram

The General Purpose Digital Modulation Analysis (Option 21) provides vector signal analyzer functionality. A wide variety of modulation types are supported, allowing you to view your signals in Constellation, Eye and Trellis diagrams, measure the quality of the modulation, display time-domain waveforms for demodulated I & Q signals, EVM, Phase Error, Magnitude Error, and more.

### Modulation Measurements

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**NOTE.** *A maximum of approximately 80,000 samples can be analyzed by the General Purpose Digital Modulation measurements (the actual value varies with modulation type).*

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<b>Measurement</b>	<b>Description</b>
EVM	The normalized RMS value of the error vector between the measured signal and the ideal reference signal over the analysis length. The EVM is generally measured on symbol or chip instants and can be reported in units of percent or dB. EVM is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed.
Phase Error	The RMS phase difference between the measured signal and the ideal reference signal.
Magnitude Error	The RMS magnitude difference between the measured signal and the ideal reference signal.
IQ Origin Offset	The magnitude of the DC offset of the signal measured at the symbol times. It indicates the magnitude of the carrier feed-through signal.
Gain Imbalance	The gain difference between the I and Q channels in the signal generation path. Constellations with gain imbalance show a pattern with a width that is different from height.
Rho $\rho$	The normalized correlated power of the measured signal and the ideal reference signal. Like EVM, Rho is a measure of modulation quality. The value of Rho is less than 1 in all practical cases and is equal to 1 for a perfect signal measured in a perfect receiver.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the analyzer.
Quadrature Error	The orthogonal error between the I and Q channels. The error shows the phase difference between I and Q channels away from the ideal 90 degrees expected from the perfect I/Q modulation. Constellations with quadrature error will show some leakage of I into Q and vice versa.

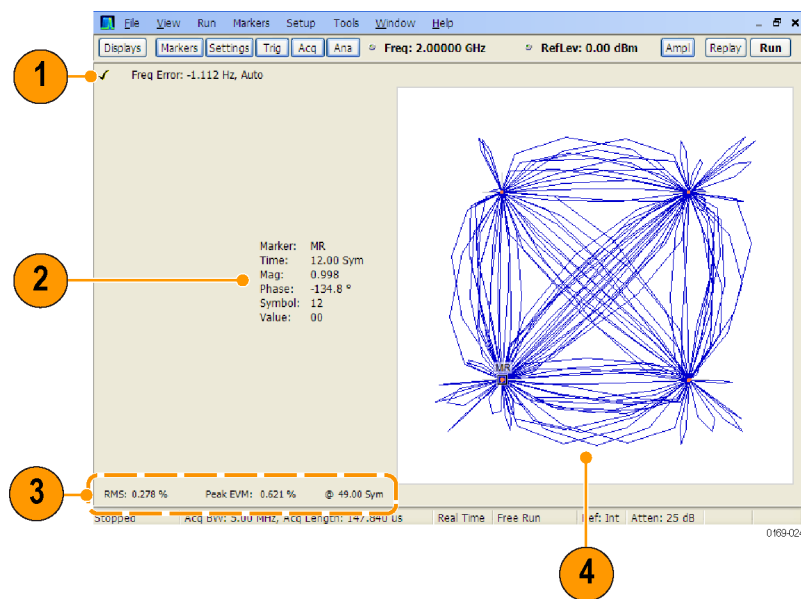
## Constellation Display

The Constellation Display shows a digitally-modulated signal in constellation form.

To show the Constellation Display:

1. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **Constellation** icon in the **Available Displays** box. This adds the Constellation icon to the **Selected displays** box.
4. Click the **OK** button. This shows the Constellation display.

### Elements of the Constellation Display



Item	Display element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Constellation display is the optimized display.
2	Marker Readout	Located to the left of the constellation plot or below it, depending on the size of the window. If markers are enabled, the marker readout shows the time, mag, phase, symbol marker and symbol value of the point with the selected marker.
3	EVM Readouts	The EVM readouts are located below the Constellation plot. The readout shows EVM Peak (%) and location, RMS (%).
4	Plot	Constellation graph.

[Changing Constellation Settings \(see page 145\)](#)

## Constellation Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings.

The settings for the Constellation view are shown in the following table.

**NOTE.** You might be able to save time configuring the Constellation display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button. \(see page 175\)](#)

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation, symbol rate, and filters to be used in demodulating the input signal.
<a href="#">Freq &amp; BW (see page 180)</a>	Sets values for frequency error/offset, measurement bandwidth, and frequency deviation (not every control is present for every modulation type).
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters that are less frequently used.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

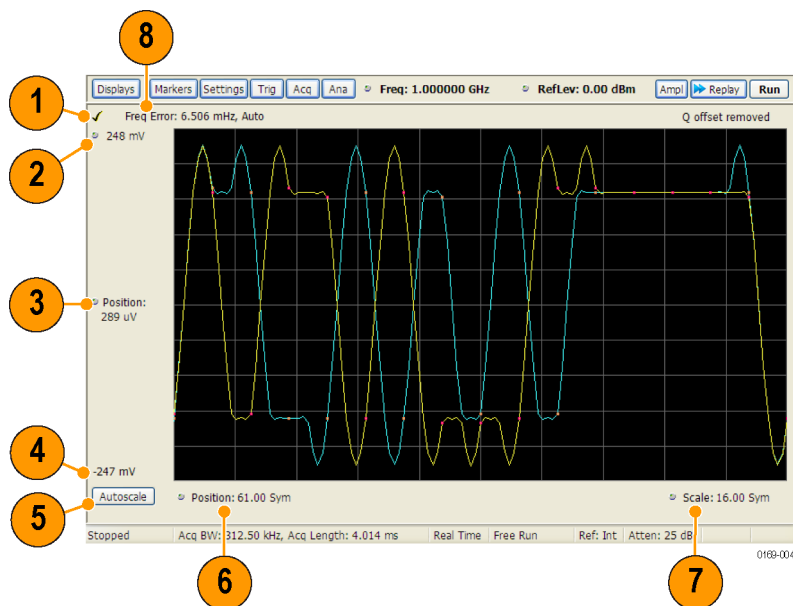
## Demod I & Q vs Time Display

The Demod I & Q vs Time displays demodulated I and Q vs. Time. You can choose to display I only, Q only, or both.

### Elements of the Display

To show the Demod I & Q vs Time display:

1. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **Demod I&Q vs Time** icon in the **Available Displays** box. This adds the Demod I&Q vs Time icon to the **Selected displays** box.
4. Click the **OK** button. This shows the Demod I&Q vs Time display.



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Demod I & Q vs Time display is the optimized display.
2	Top of Graph	Sets the I and Q amplitude value indicated at the top of the graph. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable) such that the range between the top and bottom of the graph increases or decreases automatically.
3	Position	Specifies the I and Q amplitude value shown at the center of the graph display.
4	Bottom Readout	Displays the I and Q amplitude value shown at the bottom of graph.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Position	Specifies the horizontal position of the trace on the graph display.
7	Scale	Adjusts the span of the graph. By decreasing the scale (time per division), the graph essentially becomes a window that you can move over the acquisition record by adjusting the offset.
8	Freq Error	This readout can show Freq Error or Freq Offset. When it displays Freq Error, it shows the difference between the instrument Frequency setting and the measured value of the signal's carrier frequency. When it displays Freq Offset, it shows the frequency offset specified on the <a href="#">Settings &gt; Freq &amp; BW (see page 180)</a> tab. If Freq Error is displayed, it also indicates that the Carrier frequency detection setting is Auto. If Freq Offset is displayed, it indicates that the Carrier frequency detection setting is manual.

[Changing Demod I&Q Settings. \(see page 148\)](#)

## Demod I & Q vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings.

The settings for the Demod I & Q vs Time display are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Demod I & Q display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

## EVM vs Time Display

The EVM vs. Time Display shows the Error Vector Magnitude plotted over Time.

---

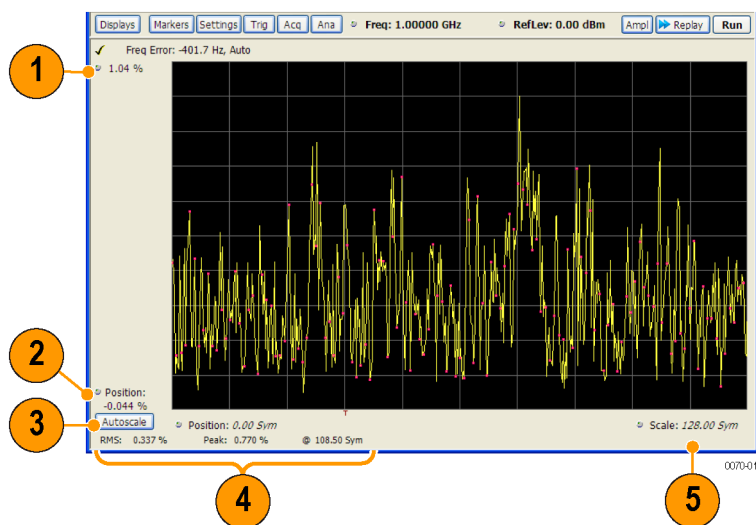
**NOTE.** A maximum of approximately 80,000 samples can be analyzed by the General Purpose Digital Modulation measurements (the actual value varies with modulation type).

---

To show an EVM vs. Time display:

1. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **EVM vs. Time** icon in the **Available Displays** box. This adds the EVM vs. Time icon to the **Selected displays** box.
4. Click the **OK** button. This displays the EVM vs. Time view.

### Elements of the EVM vs Time Display



Item	Display element	Description
1	Top of graph adjustment	Use the knob to adjust the vertical scale.
2	Position	Adjusts the vertical position.
3	Autoscale	Adjusts the Horizontal and Vertical scale to show the entire trace.
4	Peak and RMS value readout	Shows the maximum result, the time it occurred, and the RMS of the result over the entire analysis length.
5	Scale	Sets the length of time shown in the graph.

[Changing the EVM vs Time Display Settings \(see page 150\)](#)

## EVM vs Time Settings

**Menu Bar: Setup > Settings**

The settings for the EVM vs. Time display are shown in the following table.

---

**NOTE.** You might be able to save time configuring the EVM vs. Time display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button. \(see page 175\)](#)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used in the input signal and other parameters that controls the demodulation of the input signal.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies Freq Offset, Magnitude normalization parameters, and enables swapping I and Q.
<a href="#">Find (see page 184)</a>	The Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 184)</a>	The Analysis Time tab contains parameters that define how the signal is analyzed in the general purpose digital modulation displays.
<a href="#">Trace (see page 186)</a>	Specifies the display characteristics of the displayed trace.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Specifies whether certain display elements are visible.



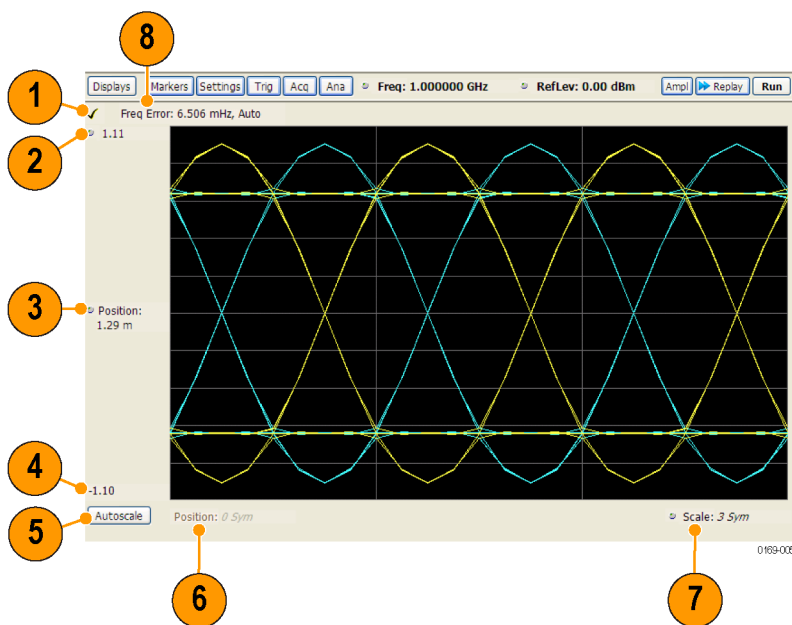
## Eye Diagram Display

The Eye Diagram Display shows a digitally modulated signal overlapped on itself to reveal variations in the signal.

To show an Eye Diagram display:

1. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **Eye Diagram** icon in the **Available Displays** box. This adds the Eye Diagram icon to the **Selected displays** box.
4. Click the **OK** button. This displays the Eye Diagram view.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Frequency Deviation vs Time display is the optimized display.
2	Top of Graph	The vertical scale is normalized with no units (except for nFSK and C4FM modulation types where the vertical units are Hz).
3	Position	Specifies the value shown at the center of the graph display.
4	Bottom Readout	Displays the value indicated by the bottom of graph.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Position	Displays the horizontal position of the trace on the graph display.
7	Scale	Adjusts the span of the graph in symbols.
8	Freq Error	Displays the difference between the maximum and minimum measured values of the signal frequency during the Measurement Time. The displayed frequency error is followed by either <b>Auto</b> or <b>Manual</b> . This indicates the selected carrier frequency detection method (see Settings > Freq & BW).

[Changing Eye Diagram Settings \(see page 153\)](#)

## Eye Diagram Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings.

The settings for the Eye Diagram display are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Eye Diagram display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

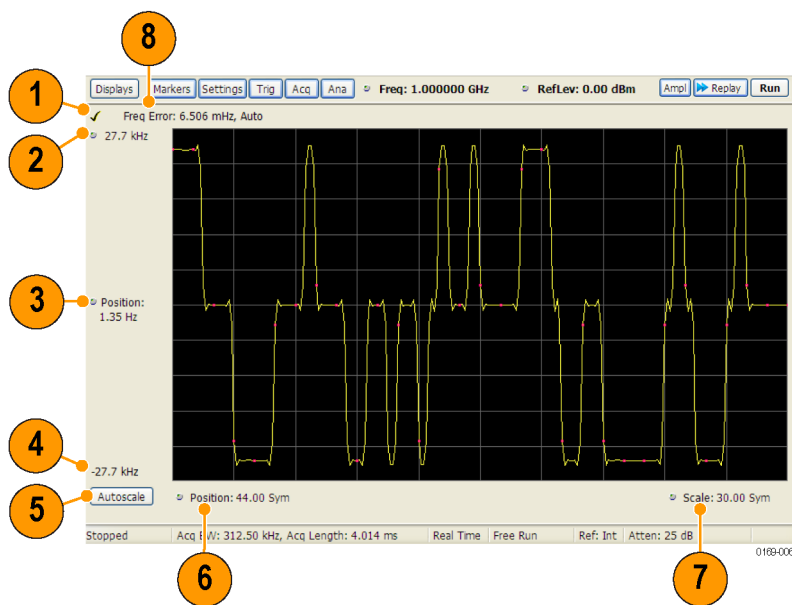
## Frequency Deviation vs Time Display

The Frequency Deviation vs Time display

To show a Frequency Deviation vs Time display:

1. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **Frequency Deviation vs Time**.
3. Double-click the **Frequency Deviation vs Time** icon in the **Available Displays** box. This adds the Frequency Deviation vs Time icon to the **Selected displays** box.
4. Click the **OK** button. This displays the Frequency Deviation vs Time view.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Frequency Deviation vs Time display is the optimized display.
2	Top of Graph	Sets the frequency deviation value indicated at the top of the graph. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable) such that the range between the top and bottom of the graph increases or decreases automatically.
3	Position	Specifies the frequency deviation value shown at the center of the graph display.
4	Bottom Readout	Displays the value of the frequency deviation value shown at the bottom of graph.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Position	Specifies the horizontal position of the trace on the graph display.
7	Scale	Adjusts the span of the graph. By decreasing the scale (time per division), the graph essentially becomes a window that you can move over the acquisition record by adjusting the offset.
8	Freq Error	Displays the difference between the maximum and minimum measured values of the signal frequency during the Measurement Time. The displayed frequency error is followed by either <b>Auto</b> or <b>Manual</b> . This indicates the selected carrier frequency detection method (see Settings > Freq & BW).

[Changing Frequency Deviation vs Time Settings \(see page 156\)](#)

## Frequency Deviation vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup settings for Frequency Deviation vs. Time are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Frequency vs. Time display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button. \(see page 175\)](#)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

## Magnitude Error vs Time Display

The Magnitude Error displays the magnitude of the symbol error. The amplitude appears on the vertical axis while time is plotted along the horizontal axis.

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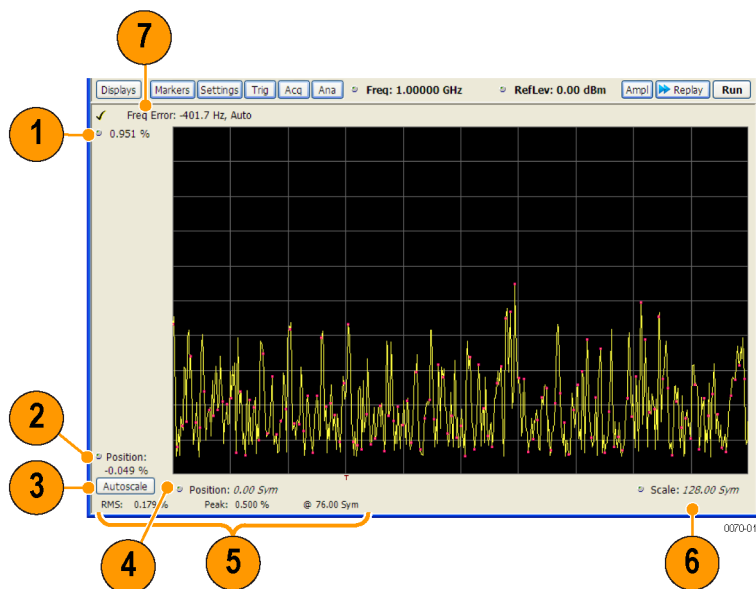
**NOTE.** A maximum of approximately 80,000 samples can be analyzed by the General Purpose Digital Modulation measurements (the actual value varies with modulation type).

---

To display Magnitude Error vs. Time:

1. Select the **Displays** button or **Setup > Displays**. This displays the Select Displays dialog box.
2. Select **GP Digital Modulation** in the **Folders** box.
3. Double-click the **Mag Error vs. Time** icon or select the icon and click **Add**. The icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK**.

### Elements of the Display



Item	Display element	Description
1	Top of graph adjustment	Use the knob to adjust the value of the vertical scale.
2	Position	Adjusts the level shown at the bottom of the display.
3	Autoscale button	Adjusts the vertical and horizontal settings to provide the best display.
4	Horizontal Position	Adjusts the horizontal position of the signal. Units can be either Symbols or Seconds (Settings > Analysis Time tab > Units).
5	Peak and RMS value readout	Displays the Peak value of the magnitude error, the RMS value of the magnitude error, and the time at which it occurs within the acquisition. Units can be either Symbols or Seconds (Settings > Analysis Time tab > Units).
6	Horizontal Scale	Sets the time spanned by the graph. Units can be either Symbols or Seconds (Settings > Analysis Time tab > Units).
7	Freq Error	Freq Error is the difference between the Center Frequency and the measured frequency of the signal being tested. This readout will be Freq Offset if the Freq Offset parameter on the Settings > <a href="#">Advanced Params (see page 181)</a> tab is set to Manual.

[Changing Magnitude Error vs Time Display Settings \(see page 159\)](#)



## Magnitude Error vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup settings for Magnitude Errors vs. Time are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Magnitude vs. Time display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

## Phase Error vs Time Display

The Phase Error vs. Time display shows the phase angle of the symbol error over time. The phase is plotted along the vertical axis while time is plotted along the horizontal axis.

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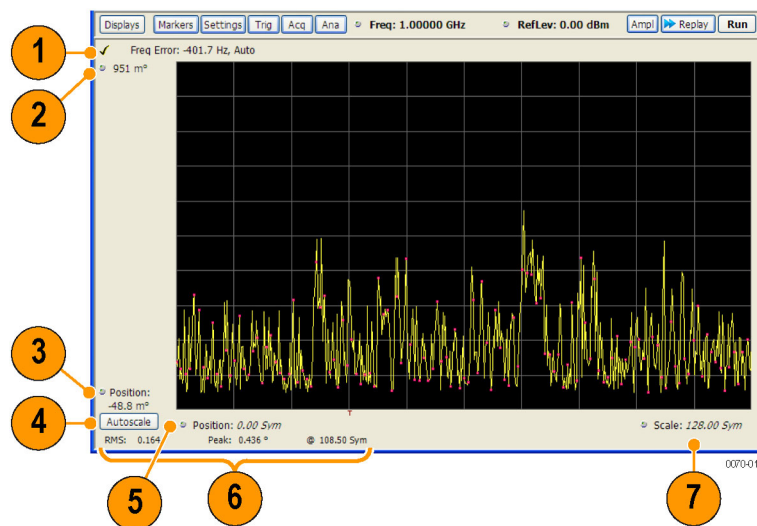
**NOTE.** A maximum of approximately 80,000 samples can be analyzed by the General Purpose Digital Modulation measurements (the actual value varies with modulation type).

---

To show the Phase Error display:

1. Press the **Displays** button or select **Setup > Displays**.
2. In the **Select Displays** dialog, select **GP Digital Modulation** in the **Folders** box.
3. In the **Available displays** box, double-click the **Phase Error** icon or select the icon and click **Add**. The Phase Error icon will appear in the **Selected displays** box and will no longer appear under Available displays.
4. Click **OK** to display the Phase Error.

### Elements of the Phase Error vs Time Display



Item	Display element	Description
1	Freq Error	Freq Error is the difference between the Center Frequency and the measured frequency of the signal being tested. This readout will be Freq Offset if the Freq Offset parameter on the Settings > <a href="#">Advanced Params (see page 181)</a> tab is set to Manual.
2	Top of graph adjustment	Adjusts the phase angle shown at the top of the graph.
3	Position	Adjusts the vertical offset.
4	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
5	Offset	Adjusts the horizontal offset.
6	Peak and RMS readouts	Displays the Peak value of the phase error and the time at which it occurred. Also displays the RMS value over the analysis length.
7	Scale	Sets the time spanned by the graph.

[Changing the Phase Error vs Time Display Settings \(see page 162\)](#)

## Phase Error vs. Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The settings for the Phase Error vs. Time display are shown in the following table.

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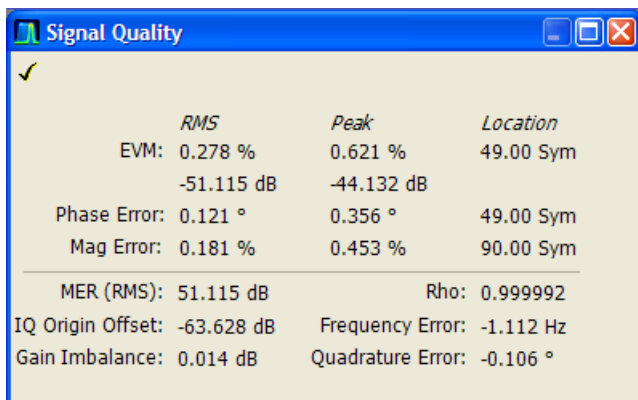
**NOTE.** You might be able to save time configuring the Phase Error vs. Time display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button. \(see page 175\)](#)

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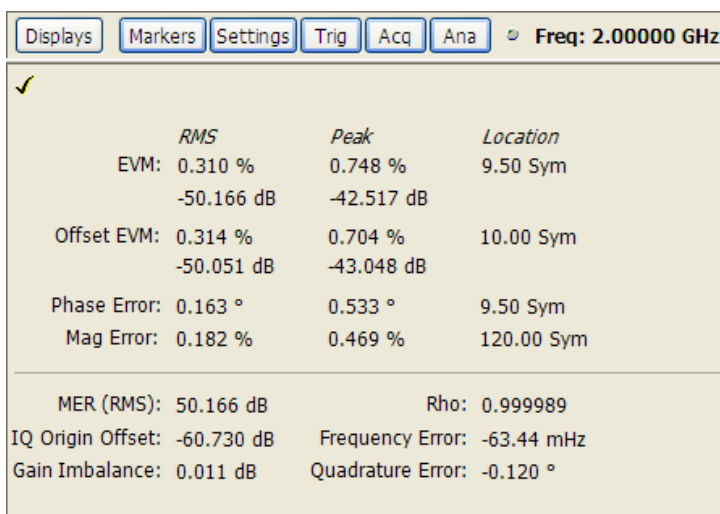
Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

## Signal Quality Display

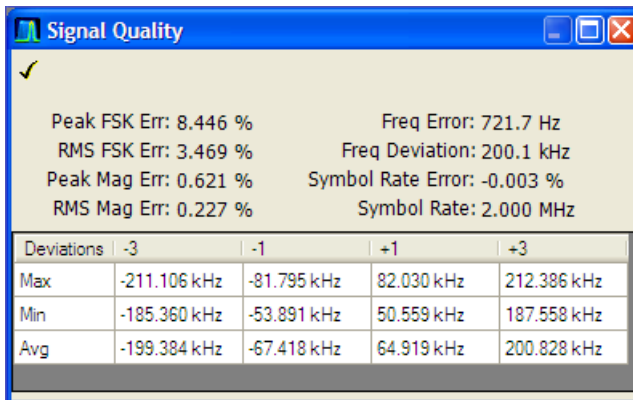
The Signal Quality display shows several measurements of signal quality. The measurements displayed depend on the modulation type. There is a set of measurements displayed for all modulation types except nFSK and C4FM. There is a second set of measurements displayed for nFSK and C4FM modulation types.



Signal Quality display for all modulation types except nFSK, C4FM, OQPSK, and SOQPSK



Signal Quality display for OQPSK and SOQPSK modulation types

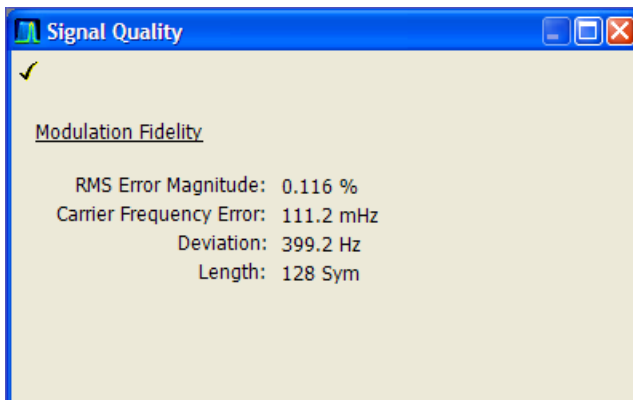


Signal Quality window showing performance metrics for nFSK modulation. The window title is "Signal Quality" and contains a green checkmark icon. The metrics are:

- Peak FSK Err: 8.446 %
- RMS FSK Err: 3.469 %
- Peak Mag Err: 0.621 %
- RMS Mag Err: 0.227 %
- Freq Error: 721.7 Hz
- Freq Deviation: 200.1 kHz
- Symbol Rate Error: -0.003 %
- Symbol Rate: 2.000 MHz

Deviations	-3	-1	+1	+3
Max	-211.106 kHz	-81.795 kHz	82.030 kHz	212.386 kHz
Min	-185.360 kHz	-53.891 kHz	50.559 kHz	187.558 kHz
Avg	-199.384 kHz	-67.418 kHz	64.919 kHz	200.828 kHz

Signal Quality display for nFSK modulation type



Signal Quality window showing performance metrics for C4FM modulation. The window title is "Signal Quality" and contains a green checkmark icon. The metrics are:

- RMS Error Magnitude: 0.116 %
- Carrier Frequency Error: 111.2 mHz
- Deviation: 399.2 Hz
- Length: 128 Sym

Modulation Fidelity

Signal Quality display for C4FM modulation type

## Elements of the Display

### Measurements for all modulation types except nFSK, C4FM, OQPSK and SOQPSK

Measurement	Description
EVM	The normalized RMS value of the error vector between the measured signal and the ideal reference signal over the analysis length. The EVM is generally measured on symbol or chip instants and is reported in units of percent and dB. EVM is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed. These estimates are made over the analysis length. Displays RMS and Peak values with location of Peak value.
Phase Error	The RMS phase difference between the measured signal and the ideal reference signal. Displays RMS and Peak values with location of Peak value.
Mag Error	The RMS magnitude difference between the measured signal and the reference signal magnitude. Displays RMS and Peak values with location of Peak value.
MER (RMS)	The MER is defined as the ratio of I/Q signal power to I/Q noise power; the result is indicated in dB.
IQ Origin Offset	The magnitude of the DC offset of the signal measured at the symbol times. It indicates the magnitude of the carrier feed-through signal.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Gain Imbalance	The gain difference between the I and Q channels in the signal generation path. Constellations with gain imbalance show a pattern with a width that is different from height.
Quadrature Error	The orthogonal error between the I and Q channels. The error shows the phase difference between I and Q channels away from the ideal 90 degrees expected from the perfect I/Q modulation. Not valid for BPSK modulation type.
Rho	The normalized correlated power of the measured signal and the ideal reference signal. Like EVM, Rho is a measure of modulation quality. The value of Rho is less than 1 in all practical cases and is equal to 1 for a perfect signal measured in a perfect receiver.

**Measurements for QPSK and SQPSK modulation types**

<b>Measurement</b>	<b>Description</b>
EVM	The normalized RMS value of the error vector between the measured signal and the ideal reference signal over the analysis length. The EVM is generally measured on symbol or chip instants and is reported in units of percent and dB. EVM is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed. These estimates are made over the analysis length. Displays RMS and Peak values with location of Peak value.
Offset EVM	Offset EVM is like EVM except for a difference in the time alignment of the I and Q samples. For EVM, I and Q samples are collected at the same time, for every symbol decision point (twice the symbol rate for offset modulations). For Offset EVM, the I and Q symbol decision points are time-aligned before collecting the I and Q samples. In this case, one I and one Q sample is collected for each symbol (half as many samples as the same number of symbols for (non-offset) EVM).
Phase Error	The RMS phase difference between the measured signal and the ideal reference signal. Displays RMS and Peak values with location of Peak value.
Mag Error	The RMS magnitude difference between the measured signal and the reference signal magnitude. Displays RMS and Peak values with location of Peak value.
MER (RMS)	The MER is defined as the ratio of I/Q signal power to I/Q noise power; the result is indicated in dB.
IQ Origin Offset	The magnitude of the DC offset of the signal measured at the symbol times. It indicates the magnitude of the carrier feed-through signal.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Gain Imbalance	The gain difference between the I and Q channels in the signal generation path. Constellations with gain imbalance show a pattern with a width that is different from height.
Quadrature Error	The orthogonal error between the I and Q channels. The error shows the phase difference between I and Q channels away from the ideal 90 degrees expected from the perfect I/Q modulation. Not valid for BPSK modulation type.
Rho	The normalized correlated power of the measured signal and the ideal reference signal. Like EVM, Rho is a measure of modulation quality. The value of Rho is less than 1 in all practical cases and is equal to 1 for a perfect signal measured in a perfect receiver.



**Measurements for nFSK modulation types**

<b>Measurement</b>	<b>Description</b>
Peak FSK err	Peak value of the frequency deviation error at the symbol point.
RMS FSK Err	RMS value of the frequency deviation error at the symbol point.
Peak Mag Err	The Peak magnitude difference between the measured signal and the reference signal magnitude.
RMS Mag Err	The RMS magnitude difference between the measured signal and the reference signal magnitude.
Freq Error	The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the instrument.
Freq Deviation	Frequency distance from the center frequency at the symbol point.
Symbol Rate Error	This compares the user-entered symbol rate to the instrument calculated symbol rate of the analyzed signal.
Symbol Rate	When in Auto-symbol rate, the instrument calculates the symbol rate of the signal and the instrument calculates the error between the user entered value and the instrument calculated value.

**Measurements for C4FM modulation type**

<b>Measurement</b>	<b>Description</b>
RMS Error Magnitude	RMS value of the frequency deviation error at the symbol point.
Carrier Frequency Error	Frequency difference between averaged signal frequency and the center frequency.
Deviation	Frequency distance from the center frequency at the symbol point.
Length	Number of symbols in the analysis area.

[Changing the Signal Quality Display Settings \(see page 168\)](#)

## Signal Quality Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup settings for Signal Quality are accessible only when the Signal Quality display is selected.

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**NOTE.** You might be able to save time configuring the Signal Quality display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	The Modulation tab specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	The Advanced Params tab specifies frequency offset, magnitude normalization method and allows you to swap the I and Q signals.
<a href="#">Find (see page 184)</a>	Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 184)</a>	The Analysis Time tab contains parameters that define the portion of the acquisition record that is used for analysis.
<a href="#">Prefs (see page 188)</a>	The Prefs tab enables you to set characteristics of the measurement display.

## Symbol Table Display

The Symbol Table Display is like the Constellation Display except that a text table is used to display data bits at a symbol rather than a graph. The Synch Word characters, if used, are in bold font.

To display the Symbol Table:

1. Select the **Displays** button or select **Setup > Displays**. This displays the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **Symbol Table** icon in the **Available Displays** box. This adds the Symbol Table icon to the **Selected displays** box.
4. Click the **OK** button. This displays the Symbol Table view.

0	10	11	11	01	10	00	01	01	00	10	01	00	10	00	00	10
16	11	00	00	11	00	11	10	10	11	01	01	00	11	01	00	01
32	00	10	10	11	11	01	01	00	00	01	01	01	01	01	10	10
48	11	11	10	01	01	00	00	10	01	00	01	00	01	10	10	11
64	00	10	00	01	01	11	10	00	00	11	11	00	11	11	10	11
80	10	01	10	11	01	11	00	10	10	01	00	00	11	01	00	10
96	00	11	10	10	00	01	00	00	10	10	00	00	00	00	01	10
112	10	00	00	11	00	00	10	11	11	00	10	00	10	01	10	10
128	01	11	11	10	00	01	00	11	10	11	00	01	11	00	00	10
144	00	11	01	10	01	01	01	11	10	11	00	10	11	01	00	11
160	11	11	00	10	11	10	00	10	11	10	11	10	10	10	10	01
176	10	11	10	11	01	10	11	10	00	01	11	11	11	11	01	10
192	11	01	00	00	11	10	00	11	00	10	01	10	01	01	10	11
208	11	11	01	01	11	00	00	01	00	10	01	11	10	01	00	11
224	00	00	01	11	10	00	11	11	10	00	10	00	10	10	10	11
240	01	10	00	10	01	01	10	00	11	10	01	00	00	00	01	01
256	10	01	00	10	11	00	11	11	01	11	11	01	11	00	01	10
272	00	00	01	00	01	01	10	10	00	11	11	01	00	11	00	11
288	01	10	10	01	00	11	11	00	00	11	11	11	11	10	10	10
304	01	01	11	11	11	00	01	11	11	00	11	00	10	10	10	00
320	01	11	00	11	10	01	11	00	01	01	00	01	01	01	10	01
336	11	10	10	00	10	00	01	10	11	11	00	01	00	11	01	11
352	01	01	10	11	00	11	00	01	10	11	00	00	00	10	10	10
368	11	00	01	00	00	01	10	01	00	01	11	01	11	10	10	11
384	10	01	01	11	00	11	01	01	10	00	00	10	00	00	01	11
400	01	00	10	11	11	11	10	01	10	00	01	10	00	11	01	01

Marker: MR      Symbol: 59  
Time: 59.00 Sym      Value: 00

### Using Markers

Markers are indicators in the display that you can position on a trace to measure values such as frequency, power, and time. A Marker always displays its position and, if the Delta readout is enabled, will display the difference between its position and that of the Marker Reference. Within the Symbol Table, colored cells indicate the location of markers. The selected Marker is highlighted with a light green background. All other markers are highlighted with a light gray background. In the Symbol Table, the marker readout below the table shows the marker location in time, symbol numbers and symbol value.

[Changing the Symbol Table Display Settings \(see page 170\)](#)

## Symbol Table Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings

The Setup settings for the Symbol Table view are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Symbol Table display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	The Modulation tab specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	The Advanced Params tab specifies additional parameters.
<a href="#">Find (see page 184)</a>	Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 184)</a>	The Analysis Time tab contains parameters that define the portion of the acquisition record that is used for analysis.
<a href="#">Prefs (see page 188)</a>	The Prefs tab enables you to set characteristics of the measurement display.

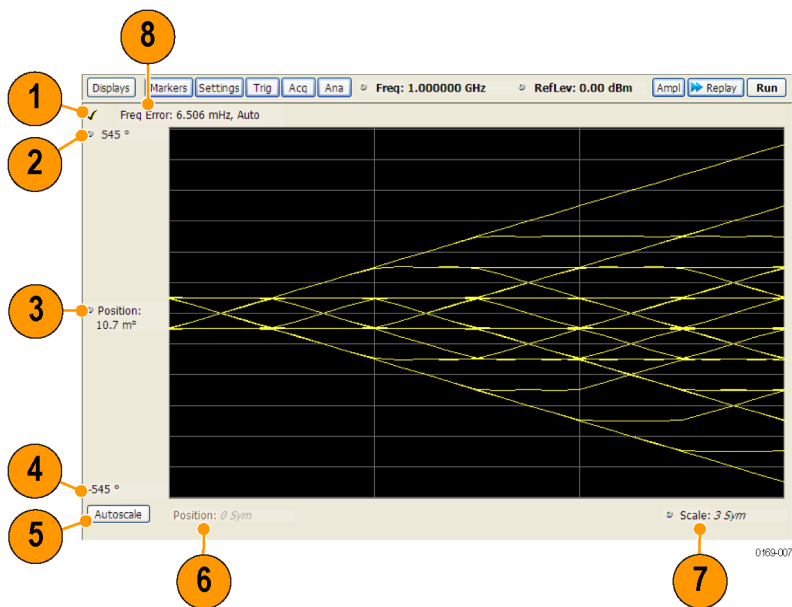
## Trellis Diagram Display

The Trellis Diagram display

To show an Trellis Diagram display:

1. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
2. From the **Folders** box, select **GP Digital Modulation**.
3. Double-click the **Trellis Diagram** icon in the **Available Displays** box. This adds the Trellis Diagram icon to the **Selected displays** box.
4. Click the **OK** button. This displays the Trellis Diagram view.

### Elements of the Display



Item	Element	Description
1	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Frequency Deviation vs Time display is the optimized display.
2	Top of Graph	Sets the phase value indicated at the top of the graph. Changing the top value affects the bottom of graph readout. Also, note that the top of graph setting interacts with the internal vertical scale setting (which is not user settable) such that the range between the top and bottom of the graph increases or decreases automatically.
3	Position	Specifies the phase value shown at the center of the graph display.
4	Bottom Readout	Displays the value of the phase value shown at the bottom of graph.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Position	Displays the horizontal position of the trace on the graph display.
7	Scale	Adjusts the span of the graph in symbols.
8	Freq Error	Displays the difference between the maximum and minimum measured values of the signal frequency during the Measurement Time. The displayed frequency error is followed by either <b>Auto</b> or <b>Manual</b> . This indicates the selected carrier frequency detection method (see Settings > Freq & BW).

[Changing the Trellis Diagram Settings \(see page 173\)](#)

## Trellis Diagram Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** Settings.

The settings for the Trellis Diagram display are shown in the following table.

---

**NOTE.** You might be able to save time configuring the Trellis Diagram display by pressing the Standard Settings button from the Settings control panel. This allows you to select a preset optimized for a standard from the Select Standard dialog box. See [Standard Settings Button](#). (see page 175)

---

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 180)</a>	Specifies settings for frequency error, measurement BW and Frequency Deviation. Each of these settings is set internally when set to Auto. Alternatively, you can specify values appropriate for specific measurement needs.
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 187)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.

## GP Digital Modulation Shared Measurement Settings

The displays in the GP Digital Modulation folder (Setup > Displays) are each a different format for presenting the results of a single underlying analysis. For this reason, all controls that affect the analysis parameters are shared by all the displays in the GP Digital Modulation folder.

Changing a setting on one tab changes that setting for all the GP Digital Modulation displays. For example, if you change the Modulation Type for the Constellation Display, it also changes the Modulation type setting for the Signal Quality display. There are some controls that affect only the way an individual display presents its results, such as graph scaling.

### Common Controls for GP Digital Modulation Displays

Settings tab	Description
<a href="#">Modulation Params (see page 175)</a>	Specifies the type of modulation, symbol rate, and filters to be used in demodulating the input signal.
<a href="#">Freq &amp; BW (see page 180)</a>	Sets values for frequency error/offset, measurement bandwidth, and frequency deviation (not every control is present for every modulation type).
<a href="#">Advanced Params (see page 181)</a>	Specifies additional parameters that are less frequently used.
<a href="#">Find (see page 184)</a>	Used to set parameters for finding a burst within the data record and for entering a Synch word.
<a href="#">Analysis Time (see page 184)</a>	Contains parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Seconds or Symbols) for the GP Digital Modulation displays.
<a href="#">Trace (see page 186)</a>	Allows you to set the trace display characteristics.
<a href="#">Prefs (see page 188)</a>	Enables you to set characteristics of the measurement display.



## Standard Settings Button

On every GP Digital Modulation control panel there is a button labeled Standard Settings. This button is used to recall settings optimized for analyzing the selected standard. See the following table for a list of the standards for which standard settings are available. Choosing a standard from the dialog box changes only settings for GP Digital Modulation displays.

All of the presets in the Standard Settings Dialog make the following settings:

- Analysis Length: Auto
- Points per Symbol: 4
- Data Differential: No
- Burst Mode: Off
- Burst Detection Threshold: -10 dBc

### Parameter values set by presets in the standard settings dialog

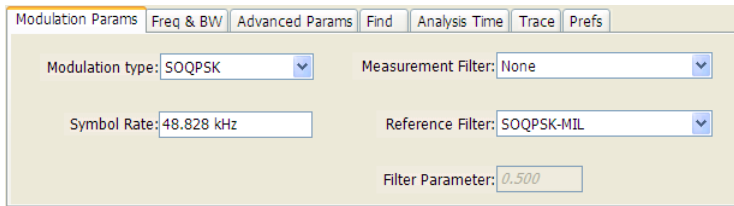
Standard	Modulation	Symbol Rate	Meas. Filter	Reference Filter	Filter Parameter	Other
802.15.4	OQPSK	1e6	None	Half sine	NA	
SBPSK-MIL	SBPSK	2.4e3	None	SBPSK-MIL	NA	
SOQPSK-MIL	SOQPSK	2.4e3	None	SOQPSK-MIL	NA	1
CPM-MIL	CPM	19.2e3	None	None	NA	
SOQPSK-ARTM Tier 1	SOQPSK	2.5e6	None	SOQPSK-ARTM	NA	1
Project25 Phase 1	C4FM	4.8e3	C4FM-P25	RC	0.2	
CDMA2000-Base	QPSK	1.2288e6	IS-95 TXEQ_MEA	IS-95 REF	NA	
W-CDMA	QPSK	3.84e6	RRC	RC	0.22	

<sup>1</sup> Center Symbol Position, Half Shift Removed

## Modulation Params Tab

**Menu bar: Setup > Settings > Modulation Params**

The Modulation Params tab specifies the type of modulation on the input signal and other parameters that control the demodulation of the input signal.



Parameter	Description
Modulation type	Specifies the type of modulation on the input signal.
Symbol Rate	Specifies the symbol rate in Hertz.
Measurement Filter	Specifies the filter used for measurements.
Reference Filter	Specifies the filter used as a reference.
Filter Parameter	Enter a value used for defining the Reference Filter. (Not present for some filter types)
Modulation index	(Present only for CPM modulation type)

### Modulation Type

The modulation types that can be demodulated and analyzed are:

Modulation type	Description
QPSK	Quadrature Phase Shift Keying
8PSK	8-Phase Shift Keying
D8PSK	Differential Eight Phase Shift Keying
PI/2DBPSK	Pi/2 Differential Binary Phase Shift Keying
DQPSK	Differential Quadrature Phase Shift Keying
PI/4DQPSK	Pi/4 Differential Quadrature Phase Shift Keying
BPSK	Binary Phase Shift Keying
OQPSK	Offset Quadrature Phase Shift Keying
16QAM	16-state Quadrature Amplitude Modulation
32QAM	32-state Quadrature Amplitude Modulation
64QAM	64-state Quadrature Amplitude Modulation
128QAM	128-state Quadrature Amplitude Modulation
256QAM	256-state Quadrature Amplitude Modulation
MSK	Minimum Shift Keying
2FSK	2-Frequency Shift Keying
4FSK	4-Frequency Shift Keying
8FSK	8-Frequency Shift Keying
16FSK	16-Frequency Shift Keying
CPM	Continuous Phase Modulation
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SBPSK	Shaped Binary Phase Shift Keying
C4FM	Constant Envelope 4-Level Frequency Modulation

### Symbol Rate

Specifies the symbol rate for demodulating digitally modulated signals. The symbol rate and the bit rate are related as follows:

$$(\text{Symbol rate}) = (\text{Bit rate}) / (\text{Number of bits per symbol})$$

For example, the number of bits per symbol is 3 for 8PSK.

### Measurement and Reference Filters

The available measurement and reference filters depend on the selected modulation type. If a particular filter is not practical for a selected modulation type, it is not presented as an available filter. To determine which filters are available, make certain that your desired modulation type is selected. See the following table.

Modulation type	Measurement filters	Reference filters
BPSK	None	None
PI/2DBPSK	RootRaisedCosine	RaisedCosine
8PSK	RaisedCosine	Gaussian
D8PSK	Gaussian	User
DQPSK	User	Rectangular (freq)
PI/4DQPSK	Rectangular (freq)	IS-95REF
16QAM	IS-95TX_MEA	
32QAM	IS-95TXEQ_MEA	
64QAM		
128QAM		
256QAM		
QPSK		
MSK	None Root Raised Cosine RaisedCosine Gaussian User Rectangular (freq)	None Gaussian User
OQPSK	None RootRaisedCosine User IS-95TX_MEA IS-95TXEQ_MEA	None Half sine RaisedCosine User IS-95REF
SOQPSK	None User	SOQPSK-MIL SOQPSK-ARTM User
CPM	None User	None User
2FSK	None	None
4FSK	Gaussian	Gaussian
8FSK	RootRaisedCosine	RaisedCosine
16FSK	RaisedCosine Rectangular (freq) User	User
C4FM	C4FM-P25	RaisedCosine User
SBPSK	None User	SBPSK-MIL User

The measurement filter is applied before the demodulation bit is detected and the ideal reference is calculated.

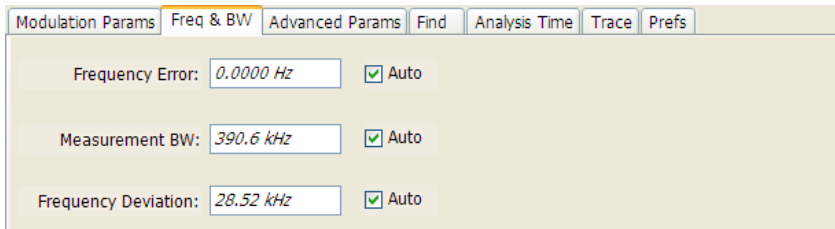
The reference filter is applied to the internally generated ideal reference signal before the EVM is calculated.

### **Filter Parameter**

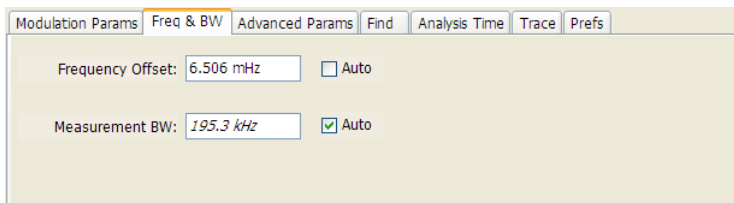
The filter parameter specifies the alpha for the Root Raised Cosine or Raised Cosine filter, or the bandwidth-time product (BT) for the Gaussian filter, when selected as the Reference filter. Some filter types have a fixed parameter value that is specified by industry standard, while other filter types by definition have no filter parameter. For filter types with no filter parameter, there is no filter parameter control present in the control panel.

## Freq & BW Tab

The Freq & BW tab specifies a group of settings that affect how measurements are made.



Freq & BW tab with nFSK or C4FM modulation type selected and Frequency Error readout enabled (Auto selected)

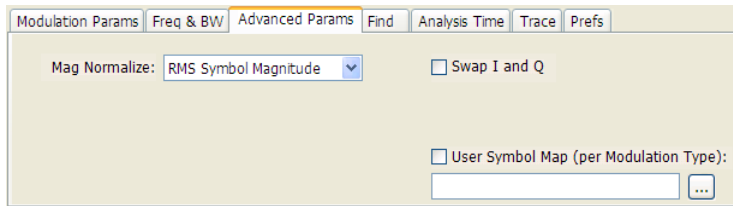


Freq & BW tab with SOQPSK modulation type selected and Frequency Offset enabled (Auto deselected)

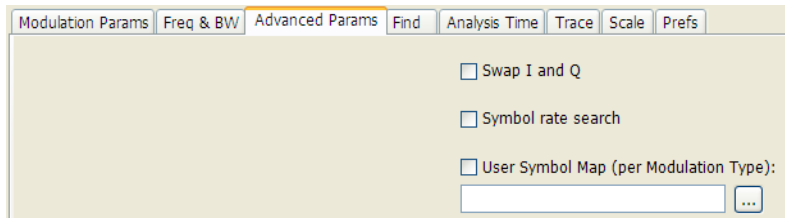
Setting	Description
Frequency Error / Frequency Offset	When Auto is enabled, this readout displays frequency error and the measurement is made at the calculated frequency. When Auto is disabled, this setting changes to Frequency Offset. When set to Frequency Offset, this setting is used to demodulate a signal that is not at the center frequency. The measurement is made at the user-entered offset. The Measurement Filter (if any, specified on the Modulation Params tab) is applied about the offset frequency whether set automatically or manually.
Measurement BW	This setting allows you to override the automatic bandwidth calculation and directly enter a bandwidth value. If you enter a value for the measurement bandwidth, be aware that the actual bandwidth of data provided to the measurement will be at least as wide as the value you request and may be as much as two times wider than requested. This override of the selected measurement bandwidth is done so that the instrument uses sufficient bandwidth relative to the chosen symbol rate to ensure good signal quality measurements.
Frequency Deviation	For nFSK modulation types, this setting specifies the frequency deviation. Select Auto to make the instrument do this automatically. Deselect Auto to enter a value manually. This setting is present for only nFSK and C4FM modulation types.

## Advanced Params Tab

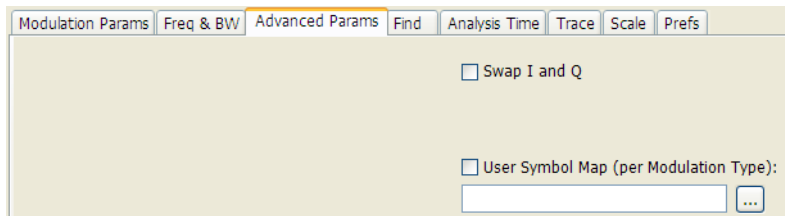
The Advanced Params tab specifies additional parameters that control the demodulation of the signal.



Advanced Params tab for all modulation types except nFSK and C4FM



Advanced Params tab for modulation type nFSK



Advanced Params tab for modulation type C4FM

Parameter	Description
Mag Normalize (not present for nFSK or C4FM modulation types)	Select RMS Symbol Magnitude or Max Symbol Magnitude. This setting applies to Mag Error and EVM.
Swap I and Q	When enabled, the I and Q data are exchanged before demodulating.
Symbol rate search (Present only for nFSK modulation types)	Determines whether to automatically detect or manually set the symbol rate. When selected, automatically detects the symbol rate to perform analysis. The calculated symbol rate is displayed in the Signal Quality display. The Symbol Rate Error is also calculated and displayed when Symbol rate search is enabled.
User Symbol Map (per Modulation Type)	Enables the use of custom symbol maps. This enables you to specify the location of symbols in the display. This control can be set independently for each of the modulation types.

### Mag Normalize

Specifies whether Magnitude Normalization uses the RMS Symbol Magnitude or the Maximum Symbol Magnitude as the basis for normalization. Use RMS Symbol Magnitude on QPSK modulations (equal magnitude symbol locations), and use Maximum Symbol Magnitude for signals that have a large difference in magnitude among the symbol locations (such as 128QAM). It prevents the instrument from using the very low magnitude center symbols when normalizing the constellation. The outer symbols are a better normalization reference than the center in this case.

### Swap I and Q

Use the Swap I and Q control to correct a signal sourced by a downconverter that inverts the frequency of the signal under test.

### User Symbol Map

A User Symbol Map is a text file that specifies the location of symbols in the display. The symbol map is unique for each modulation type. The easiest way to create a custom symbol map is to start with the default symbol map and modify it. The default symbol map file is located at C:\RSA6100A Files. The default symbol map file is named **DefaultSymbolMaps.txt**. See [Symbol Maps \(see page 189\)](#) for illustrations of the default symbol mapping.

To specify a user symbol map:

1. Click the ... button.
2. Navigate to the directory containing the user symbol text file you want to use.
3. Select the desired file in the Open window and click **Open**.
4. Select **User Symbol Map** to enable the user symbol map.

**Editing the User Symbol Map.** The symbol map is a plain text file and can be edited with any plain text editor.





**CAUTION.** Whenever you reinstall the program software, the existing *DefaultSymbolMaps.txt* file will be overwritten. To create a custom symbol map, you should make a copy of the default symbol map file, edit the copy to suit your needs, and save it with a new name. Guidance on how to edit the symbol map file is contained within the default symbol map file.

The following excerpt from the default symbol map file explains the structure of the file and how to edit it.

```
## Symbol Mapping Definitions
## Version 1.2

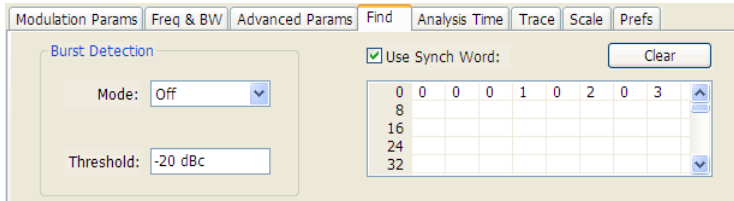
## This file defines the mapping of modulation states to symbol values.
##
## File Format :
## -----
## 1. Comments begin with '##' and may appear after the last field in a line
## 2. A symbol map begins and ends with a line containing the name of the
## modulation type. These names must exactly match the name of one of the
## modulation types in the RSA software
## 3. Empty cells may be included to preserve the constellation shape.
## 4. Blank lines are ignored.
## 5. A modulation type which does not match the name of an existing
## type will be ignored.
##
## Usage :
## -----
## 1. The file is intended to be edited with Notepad or similar text editor
```

The following text is an example of a symbol map.

```
## Symbol Map for 32 QAM
## (Resembles the shape of the constellation)
      32QAM
00011 00010 00001 00000
01001 01000 00111 00110 00101 00100
01111 01110 01101 01100 01011 01010
10101 10100 10011 10010 10001 10000
11011 11010 11001 11000 10111 10110
      11111 11110 11101 11100
      32QAM
```

## Find Tab

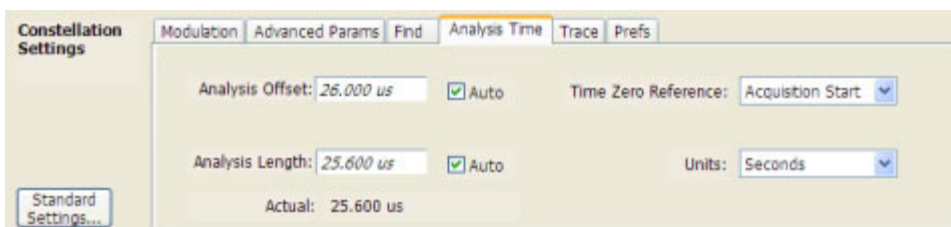
The Find tab is used to set parameters for finding bursts within the data record. This is a post-acquisition operation. Synch Word search controls are also on this tab.



Setting	Description
Burst Detection: Mode	Select whether to analyze bursts <ul style="list-style-type: none"> <li>- Auto: If a burst is found, analyze just that burst period. If a burst is not found, analyze the whole analysis length.</li> <li>- On: If a burst is found, analyze just that burst period. If a burst is not found, display an error message.</li> <li>- Off: Analyze the whole analysis length.</li> </ul> If the signal isn't adequate for demodulation, an error message is shown.
Burst Detection: Threshold	Sets the level required for the signal to qualify as a burst. Enter a value in dBc down from top of the signal.
Use Synch Word	When enabled, specifies the string of symbols to look for. Enter the search string with external keyboard or the on-screen keyboard.
Clear	Blanks the search string field.

## Analysis Time Tab

The Analysis Time tab contains parameters that define how the signal is analyzed in the general purpose digital modulation displays.



The settings values on this tab are the same as those on the main Analysis control panel for the instrument with the only difference being that Analysis Length can be set in either Seconds or Symbols in this location.

Setting	Description
Analysis Offset	Specifies the location of the first time sample to use in measurements.
Auto	When enabled, causes the instrument to set the Analysis Offset value based on the requirements of the selected display.
Analysis Length	Specifies the length of the analysis period to use in measurements. Length is specified in either seconds or symbols, depending on the Units setting. For most modulation types, the Analysis Length set when Auto is enabled is 128 symbols. For some modulation types, a longer length is used.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
Time Zero Reference	Specifies the zero point for the analysis time.
Actual	This is a displayed value, not a setting. It is the Analysis Length (time or symbols) being used by the analyzer; this value may not match the Analysis Length requested (in manual mode).
Units	Sets the units of the Analysis Length to either Symbols or Seconds.

### Analysis Offset

Use analysis offset to specify where measurements begin. Be aware that you cannot set the Analysis Offset outside the range of time covered by the current acquisition data. (all time values are relative to the Time Zero Reference).

You can set the Analysis Length so that the requested analysis period falls partly or entirely outside the current range of acquisition data settings. When the next acquisition is taken, its Acquisition Length will be increased to cover the new Analysis Length, as long as the Sampling controls are set to Auto. If the Sampling parameters are set to manual, or if the instrument is analyzing saved data, the actual analysis length will be constrained by the available data length, but in most cases, measurements are able to be made anyway. The instrument will display a notification when measurement results are computed from less data than requested. Range: 0 to [(end of acquisition) - Analysis Length]. Resolution: 1 effective sample (or symbol).

### Analysis Length

Use the analysis length to specify how long a period of time is analyzed by a measurement. As you adjust this value, the actual amount of time for Analysis Length, in Symbol or Seconds units, is shown below the control in the "Actual" readout. This setting is not available when Auto is checked. Range: minimum value depends on modulation type. Resolution: 1 symbol. A maximum of approximately 80,000 samples can be analyzed (the actual value varies with modulation type).

### Time Zero Reference

All time values are measured from this point (such as marker position or horizontal position (in Y vs Time displays)). Choices are: Acquisition Start or Trigger.

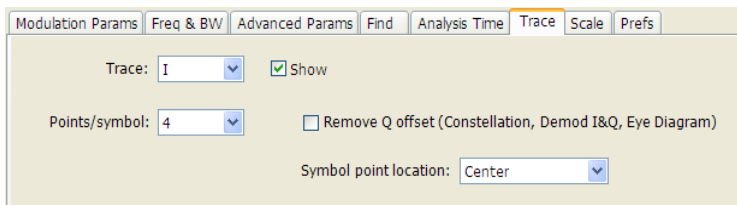
Parameter	Description
Acquisition Start	Offset is measured from the point at which acquisition begins.
Trigger	Offset is measured from the trigger point.

## Trace Tab

**Menu Bar: Setup > Settings > Trace**

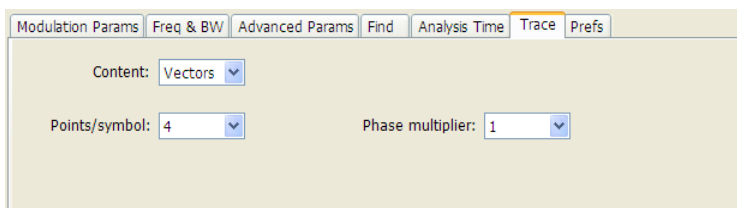
**Application Toolbar/Front Panel: Settings**

The Trace tab allows you to set the trace display characteristics of the selected display.

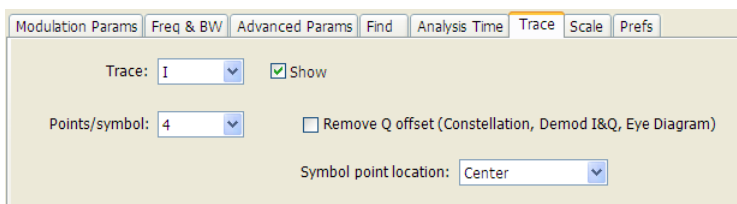


Example trace tab for constellation display

Note that some settings are not present for all modulation types and some settings are not present for all displays.



Example trace tab for constellation display set to CPM modulation type

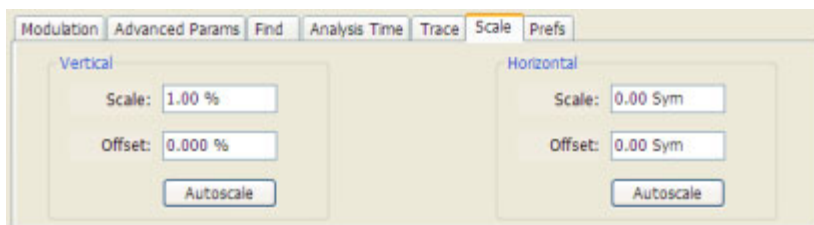


Example trace tab for Demod I&Q display

Setting	Description
Content	Selects whether to draw lines (vectors) between constellation points in the display. Present for the Constellation display only.
Trace	Selects the trace that is hidden or displayed based on whether or not Show is selected.
Show	Specifies whether the trace selected by Trace is displayed or hidden.
Points per Symbol	Select how many points to use between symbols when connecting the dots. Values: 1, 2, 4, 8.
Remove Q offset	The I and Q data traces are normally displayed with an offset of half a symbol. When the modulation type is set to SOQPSK or OQPSK, you can remove this offset by selecting <b>Remove Q offset</b> . Present for Constellation, Demod I&Q, and Eye Diagram displays only.
Symbol point location	Selects whether to evaluate the symbol value at the center or the end of the eye opening. This control is only present for some of the supported modulation types.
Phase Multiplier	Sets the multiplication constant for the phase multiplication display: ×1 (default), ×2, ×4, ×8, ×16, or ×32. The phase multiplication display facilitates observation of noisy CPM signals by multiplying measurement signal phase by the constant to reduce the number of phase states and expand the phase difference between adjacent symbols.

## Scale Tab

The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency.



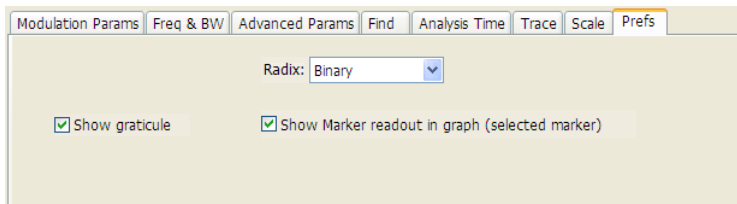
Setting	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale units.
Position	Position adjusts the reference level away from top of the graph.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Horizontal	Controls the span of the trace display and position of the trace.
Scale	Allows you to, in effect, change the span.
Position	Allows you to pan a zoomed trace without changing the Measurement Frequency. Position is only enabled when the span, as specified by Freq/div, is less than the acquisition bandwidth.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.

## A Note About Units

The Units used for the horizontal scale can be either Seconds or Symbols. To set the units for the horizontal scale, display the **Analysis Time** tab. On the tab, select the appropriate units from the **Units** drop-down list.

## Prefs Tab

The Prefs tab enables you to change appearance characteristics of the GP Digital Modulation displays.



Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Radix	Specifies how symbols are displayed in the Symbol Table display and in the Marker readout in the Constellation display.

## Symbol Maps

This topic shows the symbol mapping for each digital modulation technique.

QPSK		OQPSK		SQPSK	
1	3	01	11	01	11
0	2	00	10	00	10

0169-018

**8PSK**

Left		Right		
		3		
	2		1	
6				0
	7		4	
		5		

0169-009

BPSK		SBPSK	
1	0	1	0

0169-019

**D8PSK**

Phase shift (radians)	Symbol value (binary)
0	000
$\pi/4$	001
$\pi/2$	011
$3\pi/4$	010
$\pi$	110
$5\pi/4$	111
$3\pi/2$	101
$7\pi/4$	100

**Pi/2 DBPSK**

Phase shift (radians)	Symbol value (binary)
$+\pi/2$	0
$-\pi/2$	1

**DQPSK**

Phase shift (radians)	Symbol value (binary)
0	00
$\pi/2$	01
$\pi$	11
$3\pi/2$	10

**Pi/4 DQPSK**

Phase shift (radians)	Symbol value (binary)
$+\pi/4$	00
$+3\pi/4$	01
$-\pi/4$	10
$-3\pi/4$	11

**MSK**

Phase shift direction	Symbol value (binary)
-	0
+	1

**16QAM**

Left		Right	
3	2	1	0
7	6	5	4
B	A	9	8
F	E	D	C

0169-010



**32QAM**

	3	2	1	0	
9	8	7	6	5	4
F	E	D	C	B	A
15	14	13	12	11	10
1B	1A	19	18	17	16
	1F	1E	1D	1C	

0169-011

**64QAM**

7	6	5	4	3	2	1	0
F	E	D	C	B	A	9	8
17	16	15	14	13	12	11	10
1F	1E	1D	1C	1B	1A	19	18
27	26	25	24	23	22	21	20
2F	2E	2D	2C	2B	2A	29	28
37	36	35	34	33	32	31	30
3F	3E	3D	3C	3B	3A	39	38

0169-012

**128QAM**

		5D	5F	4F	4D	1A	1B	0B	0A		
		5C	5E	4E	4C	18	19	09	08		
4A	48	54	56	46	44	10	11	15	14	1C	1D
4B	49	55	57	47	45	12	13	17	16	1E	1F
5B	59	51	53	43	41	02	03	07	06	0E	0F
5A	58	50	52	42	40	00	01	05	04	0C	0D
6D	6C	64	65	61	60	20	22	32	30	38	3A
6F	6E	66	67	63	62	21	23	33	31	39	3B
7F	7E	76	77	73	72	25	27	37	35	29	2B
7D	7C	74	75	71	70	24	26	36	34	28	2A
		68	69	79	78	2C	2E	3E	3C		
		6A	6B	7B	7A	2D	2F	3F	3D		

0169-017

**256QAM**

Left															Right
EF	FD	EB	F9	E7	F5	E3	F1	0F	3F	4F	7F	8F	BF	CF	FF
CE	DC	CA	D8	C6	D4	C2	D0	0C	3C	4C	7C	8C	BC	CC	FC
AF	BD	AB	B9	A7	B5	A3	B1	0B	3B	4B	7B	8B	BB	CB	FB
8E	9C	8A	98	86	94	82	90	08	38	48	78	88	B8	C8	F8
6F	7D	6B	79	67	75	63	71	07	37	47	77	87	B7	C7	F7
4E	5C	4A	58	46	54	42	50	04	34	44	74	84	B4	C4	F4
2F	3D	2B	39	27	35	23	31	03	33	43	73	83	B3	C3	F3
0E	1C	0A	18	06	14	02	10	00	30	40	70	80	B0	C0	F0
E1	D1	A1	91	61	51	21	11	01	13	05	17	09	1B	0D	1F
E2	D2	A2	92	62	52	22	12	20	32	24	36	28	3A	2C	3E
E5	D5	A5	95	65	55	25	15	41	53	45	57	49	5B	4D	5F
E6	D6	A6	96	66	56	26	16	60	72	64	76	68	7A	6C	7E
E9	D9	A9	99	69	59	29	19	81	93	85	97	89	9B	8D	9F
EA	DA	AA	9A	6A	5A	2A	1A	A0	B2	A4	B6	A8	BA	AC	BE
ED	DD	AD	9D	6D	5D	2D	1D	C1	D3	C5	D7	C9	DB	CD	DF
EE	DE	AE	9E	6E	5E	2E	1E	E0	F2	E4	F6	E8	FA	EC	FE

0169-013

**2FSK**

Left	Right
0	1

**4FSK**

Left	Right		
0	1	3	2

0169-014

**8FSK**

Left	Right						
0	1	2	3	7	6	5	4

0169-015

**16FSK**

Left

Right

0	1	2	3	4	5	6	7	15	14	13	12	11	10	9	8
---	---	---	---	---	---	---	---	----	----	----	----	----	----	---	---

0163-016

**C4FM**

Left

Right

11	10	00	01
----	----	----	----

0163-020

**CPM**

Phase shift (h = modulation index)	Symbol value (binary)
-3h	11
-h	10
+h	01
+3h	00

## Overview: User Defined Measurement and Reference Filters

The Modulation Parameters control tab for GP Digital Modulation displays enables you to load custom measurement and reference filters. If the existing filters do not meet your requirements, you can create your own filters for use in the measurement and reference settings. This section describes the structure of user filters and provides two examples of customized filters. See [User Filter File Format \(see page 195\)](#).

### Loading a User Measurement Filter

To load a your own measurement filter:

1. From the Modulation Params control tab (Settings > Modulation Params), click on the drop-down list for **Measurement Filter**.
2. Select one of the filter names that starts with **User**. This displays the **Manage user filters** window.
3. Enter a name for the filter in one of the **Name (editable)** boxes. This name will appear in the drop-down list on the Modulation Params tab, prefaced with **User**. The maximum number of characters for the filter name is 20.
4. Click the **Browse...** button and navigate to the directory containing the filter you want to load. Select the filter and click **Open**. If you wish to use a filter that is not in the list, select **User other** and locate and open the file you wish to use.
5. Click **OK** to load the filter and return to the Modulation Params page.

## User Filter File Format

The filter file is selected on the Modulation Params control panel tab used by the GP Digital Modulation displays (Option 21 only). It stores the user-defined measurement or reference filter coefficient data in CSV format. The following figure shows the file structure.

```

# Rate
10
# FilterI,FilterQ
0.97321,0.01947
0.89559,0.04051
0.77497,0.05942
0.62333,0.07202
0.45524,0.07438
0.28614,0.06354
...
0.13045,0.01947

```

Oversampling rate of the filter (samples/symbol)

IQ pairs (1 to 1024) of the filter coefficient in time domain

0169-023

### User filter file structure

A filter file is a plain text file, in comma-separated-variable format. The file extension must be CSV.

The filter file contains the following variables:

**Rate.** Specifies the oversampling rate (the number of samples per symbol). The filter coefficient data will be interpolated by the specified rate.

**FilterI,FilterQ.** Specifies IQ pairs (1 to 1024) of the filter coefficient in time domain.

### Rules for Creating a Filter File

- A line beginning with “#” is a comment line.
- Enter a positive value for the oversampling rate.
- A decimal number can be expressed by fixed point or floating point. For example, 0.01 and 1.0E-2 are both valid.
- “0” (zero) and “,0” (comma zero) can be omitted. For example, “1.5,0”, “1.5,”, and “1.5” are equivalent.
- Lines with only a comma and blank lines are skipped.

**Example filters.** For your reference, two example filters, Raised Cosine and Gaussian, are shown here. Both filters contain 65 data points with an oversampling rate of 8.

**Raised Cosine ( $\alpha = 0.3$ )**

(Row 1 to 18)	(Row 19 to 36)	(Row 37 to 54)	(Row 55 to 68)
# Rate	0.0383599,0	0.973215,0	0.0743803,0
8	0,0	0.895591,0	0.0720253,0
# FilterI,FilterQ	-0.047715,0	0.774975,0	0.0594205,0
0,0	-0.0984502,0	0.623332,0	0.0405144,0
-0.0062255,0	-0.143898,0	0.455249,0	0.0194761,0
-0.0136498,0	-0.174718,0	0.286147,0	0,0
-0.0209294,0	-0.181776,0	0.130455,0	-0.0151973,0
-0.0263419,0	-0.157502,0	0,0	-0.0246357,0
-0.0280807,0	-0.0971877,0	-0.0971877,0	-0.0280807,0
-0.0246357,0	0,0	-0.157502,0	-0.0263419,0
-0.0151973,0	0.130455,0	-0.181776,0	-0.0209294,0
0,0	0.286147,0	-0.174718,0	-0.0136498,0
0.0194761,0	0.455249,0	-0.143898,0	-0.0062255,0
0.0405144,0	0.623332,0	-0.0984502,0	0,0
0.0594205,0	0.774975,0	-0.047715,0	
0.0720253,0	0.895591,0	0,0	
0.0743803,0	0.973215,0	0.0383599,0	
0.063548,0	1,0	0.063548,0	

**Gaussian (BT = 0.5)**

(Row 1 to 18)	(Row 19 to 36)	(Row 37 to 54)	(Row 55 to 68)
# Rate	0.00191127,0	0.978572,0	0.000401796,0
8	0.00390625,0	0.917004,0	0.000172633,0
# FilterI,FilterQ	0.00764509,0	0.822878,0	7.10E--05,0
2.33E-10,0	0.0143282,0	0.707107,0	2.80E-05,0
9.11E-10,0	0.0257149,0	0.581862,0	1.06E-05,0
3.42E-09,0	0.0441942,0	0.458502,0	3.81E-06,0
1.23E--08,0	0.0727328,0	0.345977,0	1.32E-06,0
4.21E-08,0	0.114626,0	0.25,0	4.37E-07,0
1.39E-07,0	0.172989,0	0.172989,0	1.39E-07,0
4.37E-07,0	0.25,0	0.114626,0	4.21E-08,0
1.32E-06,0	0.345977,0	0.0727328,0	1.23E-08,0
3.81E-06,0	0.458502,0	0.0441942,0	3.42E-09,0
1.06E-05,0	0.581862,0	0.0257149,0	9.11E-10,0
2.80E-05,0	0.707107,0	0.0143282,0	2.33E-10,0
7.10E-05,0	0.822878,0	0.00764509,0	
0.000172633,0	0.917004,0	0.00390625,0	
0.000401796,0	0.978572,0	0.00191127,0	
0.000895512,0	1,0	0.000895512,0	



## Using Markers

Markers are indicators in the display that you can position on a trace to measure values for the X and Y axes, such as frequency, power, and time. A Marker always displays its position and, if enabled, will display the difference between its position and that of the Marker Reference (MR).

You can display up to five markers including the marker reference. Markers can all be placed on the same trace or they can be placed on different traces. There are two types of Markers: Reference and Delta Markers. The Marker Reference (labeled MR in the graph) makes absolute measurements and is also used for calculating differences when Delta readouts are enabled. The Delta Markers (labeled M1 to M4 in the graph) are used to measure other points on the trace or the difference between the Marker Reference and the Delta marker.

The following table shows the appearance of the three types of marker readouts.

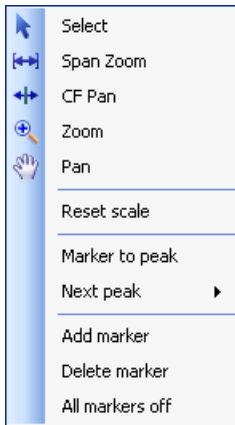
Marker Reference Readout	Absolute Marker Readout	Delta Marker Readout
<p>Reference Marker label</p>	<p>Absolute Marker label</p>	<p>Delta Marker label</p>

The following table shows the appearance of the marker indicators as they appear on the trace.

Marker Reference	Absolute Marker	Delta Marker

## Controlling Markers with the Touchscreen Actions Menu

In addition to controlling the marker actions from the front panel or screen menu items, you can use the touch screen actions menu to move markers or add and delete markers.

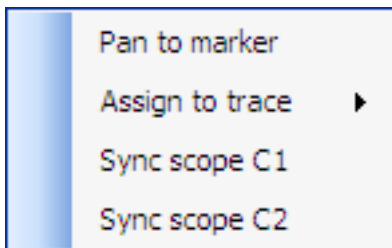


To use the Touchscreen Actions menu, touch the display and hold for one second, then remove your finger. You can also use a mouse to display the Touchscreen Action menu by clicking the right mouse button.

Menu item	Description
Marker to peak	Moves the selected marker to the highest peak. If no marker is turned on, this control automatically adds a marker.
Next Peak	Moves the selected marker to the next peak. Choices are Next left, Next right, Next lower (absolute), and Next higher (absolute).
Add marker	Defines a new marker located at the horizontal center of the graph.
Delete marker	Removes the last added marker.
All markers off	Removes all markers.

### Markers Context Menu

The Markers context menu appears when you right-click (or touch and hold) on a marker. The Markers context menu enables you to assign a marker to a different trace, synchronize markers with oscilloscope cursors and pan the trace to place the marker at the measurement frequency.



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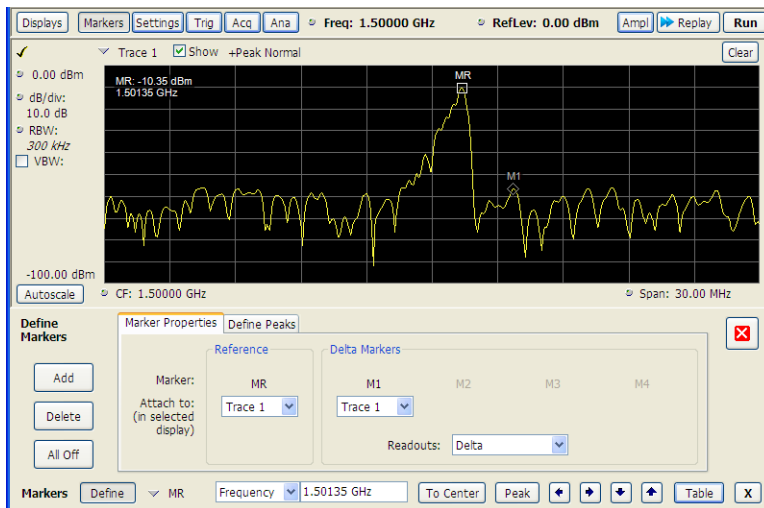
<b>Icon</b>	<b>Menu</b>	<b>Description</b>
-	Pan to marker	Adjusts horizontal position of the waveform to locate the selected marker at the measurement frequency.
-	Assign to trace	Assigns the selected marker to Trace 1, Trace 2, Trace 3 or the Math trace. A trace must be enabled to assign a marker to it.
-	Sync scope C1	Synchronizes the position of oscilloscope Cursor 1 with the location of the selected marker. Turns on cursors if necessary.
-	Sync scope C2	Synchronizes the position of oscilloscope Cursor 2 with the location of the selected marker. Turns on cursors if necessary.

---

## Measuring Frequency and Power in the Spectrum Display

To measure the frequency and power at a point on a Spectrum trace:

1. Select **Markers > Define Markers**.
2. Select the **Marker Properties** tab.
3. Click **Add**. This displays a drop-down list under **MR** (Marker Reference), found inside the **Reference** box. The first marker defined is always designated the Marker Reference. Subsequently defined markers are designated as Delta Markers (you can also select and adjust markers by clicking on an existing marker on a trace).
4. From the drop-down list, select the trace to which you want to assign the marker.



5. Click the close control panel button to remove the Define Markers control panel.
6. Click on the marker on the trace to activate that marker.
7. Drag the marker in the graph using the touchscreen or a mouse to move the marker to the desired location on the trace. You can also click on the marker location text box in the Markers toolbar at the bottom of the screen and adjust it with your mouse wheel. The Peak button in the Markers toolbar and the arrow buttons to the right of it control marker peak searching on the trace.
8. Read the frequency and power level of the marker position on the display.
9. Read the signal density, frequency and power level of the marker position on the display.

## Marker Action Controls

Controls for enabling and moving markers and for initiating marker peak searches are found in several locations. There are buttons for a few of the most common marker activities on the front panel of the instrument, used along with the knob for adjusting marker positions. The Markers menu contains selections for peak searches and the Marker toolbar also has buttons for peak searches. All graphs that support the markers offer a pop-up menu for marker actions.

### Peak

Selecting **Peak** from the Markers menu moves the selected marker to the highest level peak within the acquisition record.

### Next Peak

Selecting Next Peak displays a submenu that enables you to move the selected marker to the next peak.

Setting	Description
Next Left	Moves the selected marker to the next peak to the left of the current marker position.
Next Right	Moves the selected marker to the next peak to the right of the current marker position.
Next Lower (absolute)	Moves the selected marker to the lower level peak (in absolute terms) on the trace.
Next Higher (absolute)	Moves the selected marker to the higher level peak (in absolute terms) on the trace.

### Marker to Center Frequency

Changes the center frequency to match the frequency of the selected marker.

### Sync Scope C1/C2 to Active Marker

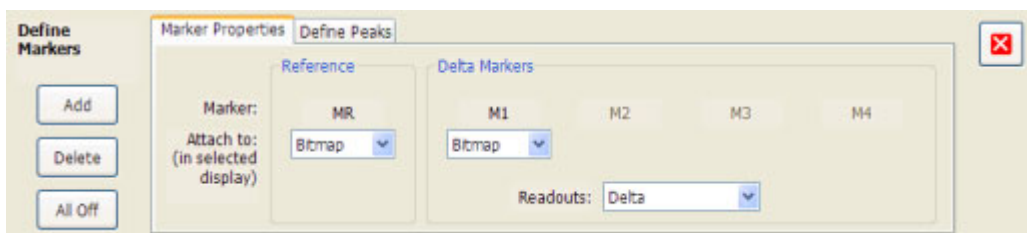
Moves the selected oscilloscope cursor (Cursor 1 or Cursor 2) to the location on the oscilloscope waveform that matches the location of the active marker on the SignalVu active marker. If the oscilloscope cursors are off, this command turns them on. These commands are also available from the Markers context menu.

## Enabling Markers and Setting Marker Properties

The Define Markers Control Panel is used to enable markers and set their properties. You can set up to five markers including the marker reference. Markers are shown in most displays.

Markers have two types of on-screen readouts: Absolute and Delta. When **Readouts** is set to **Absolute**, each readout displays only the marker's position on the trace. In Frequency displays, this means the marker readout shows the frequency and power of the trace at the marker position. When **Readouts** is set to **Delta**, each delta marker (M1-M4) readout displays both the marker's position on the trace and the difference between its position and the position of the Reference Marker (MR).

### Defining Markers



1. Select **Markers > Define Markers** to display the Define Markers control panel.
2. Select **Add** to turn on the next marker. A drop-down list under the marker label allows you to assign the marker to a trace.

---

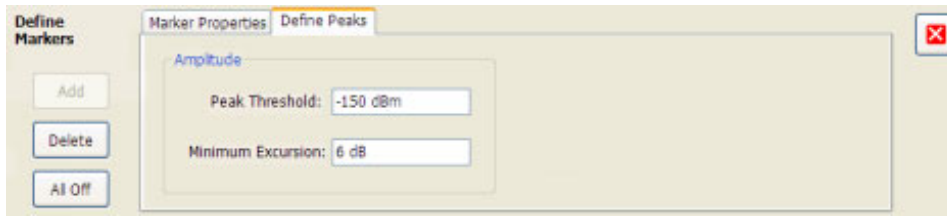
**NOTE.** The first marker defined will always be **MR**. The MR marker is the reference for delta marker readouts.

---

3. Select the trace to which the marker should be attached from the drop-down list.
4. Click **Add** to add additional markers.
5. Click the close button to remove the Define Markers control panel.

### Defining Peaks

You can specify two amplitude values that define peaks.



### Amplitude

Peak Threshold	Peak Threshold specifies the level that the signal must exceed to be considered a peak.
Minimum Excursion	Minimum Excursion specifies how much the signal must decrease and then increase before another peak can be declared.

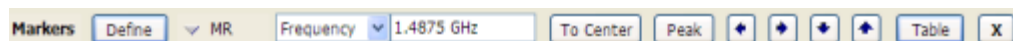
1. Select **Markers > Define Markers** to display the Define Markers control panel.
2. Select the **Define Peaks** tab.
3. To define the level for Peak Threshold, enter a value in the Peak Threshold number entry box.
4. To define the amount the trace must dip, enter a value in the Peak Excursion number entry box.
5. Click the close button to remove the Define Markers control panel.

## Using the Markers Toolbar

### Application toolbar: Markers

#### Menu bar: View > Marker Toolbar

Select **Marker Toolbar** to display or hide the Marker Toolbar in the application window. The Marker Toolbar enables you to operate existing markers or define new markers.



Enabling a marker or adjusting the position of a marker automatically opens the Markers toolbar.

Icon / Readout	Description
	Opens the Define Markers control panel.
	Selected marker readout. This readout shows which marker is selected. The pop-up menu allows you to choose the selected marker, add markers, and turn all markers off.
	Marker position controls. For frequency displays, this readout shows the marker position in Hertz. For time displays, this readout shows the marker position in seconds. The position of the selected marker can be changed by selecting the numeric readout and using the knob to adjust the value.
	Changes the analyzer's Center Frequency to the frequency of the selected marker. Not selectable for time markers.
	Moves the marker to the highest peak on the signal. On displays that scale about zero on the vertical axis (for example, Magnitude Error, EVM, and Frequency vs. Time), the highest peak selected by the Peak button is an "absolute value", therefore, negative peaks are included in the search for the highest peak.
	Moves the selected marker to the next peak to the <b>left</b> of the current position.
	Moves the selected marker to the next peak to the <b>right</b> of the current position.
	Moves the selected marker to the next <b>lower</b> peak value. The peak value here refers to the numeric value of the peak amplitude. Thus, when repeatedly moving the marker, it can move to the right or left depending on the location of the next lower value.
	Moves the selected marker to the next <b>higher</b> peak value. The peak value here refers to the numeric value of the peak amplitude. Thus, when repeatedly moving the marker, it can move to the right or left depending on the location of the next higher value.
	Displays/hides the marker table from the display.
	Removes the Marker Toolbar from the display.



## Using Noise Markers in the Spectrum Display

In the Spectrum display, you can set Markers to Noise Mode to measure noise on the trace. Markers in Noise Mode operate just as they do in normal mode, but the readouts for the markers are in dBm/Hz and dBc/Hz.

dBm/Hz is the power in milliwatts referenced to a 1 Hz bandwidth. To make this measurement, the analyzer assumes that the measured signal is random noise. It then converts the measured power (made at any RBW) to the power that would be measured had a 1 Hz filter been applied for the measurement.

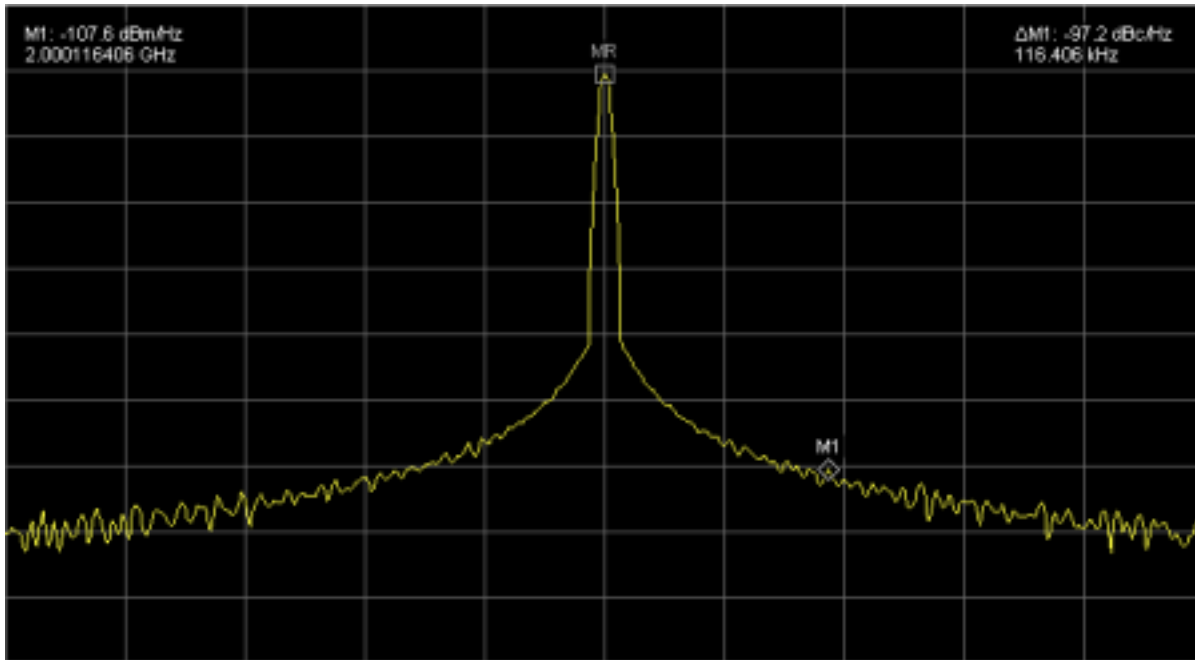
dBc/Hz represents dBm/Hz referenced to a carrier. Here, it is assumed that the carrier is a CW signal, and its signal level does not change when the RBW is changed, so the Reference Marker measurement on the carrier is unchanged from any other marker measurement. However, the delta marker values are converted to dBm/Hz, and then a difference value, in dBc/Hz, is calculated between each delta measurement and the reference.

### Measuring Noise

To measure noise on a Spectrum trace:

1. Select **Markers > Define** to display the Markers control panel.
2. Click **Add**. The first marker defined is always designated the Marker Reference. Subsequently defined markers are designated as Delta Markers (you can also select and adjust markers by clicking on an existing marker in the display).
3. Click **Add** again so that there are at least two markers defined.
4. Check that **Readouts** is set to Delta.
5. If you have more than one trace defined, use the drop-down list for each marker to set it to the trace on which you want to measure noise.
6. Select the **Settings** button to display the Spectrum settings control panel.
7. Click the **Prefs** tab.
8. Click the **Marker Noise Mode** check box so it is checked.
9. Click the **Traces** tab.
10. Verify that Detection is set to **Average** for the trace you are using for this measurement.
11. Click the **Ana** (Analysis) button.
12. Select the **Units** tab.
13. Select **dBm** for the Amplitude units.
14. Click the Close button to remove the control panel.

15. Move the markers to the desired locations on the trace.
16. Read the frequency and power level for the selected marker in the upper corners of the display. To display the delta measurement in dBc/Hz, select the delta marker (M1, M2, M3 or M4) by clicking on it or by selecting it in the drop-down marker list in the Markers toolbar.



## The Search Tool (Limits Testing)

The instrument allows you to specify pass/fail conditions for the Spectrum and Spurious displays. When these conditions are met, the instrument can perform actions such as stopping acquisitions or saving data.

## Search (Limits Testing) Settings

**Menu Bar:** Tools > Search...

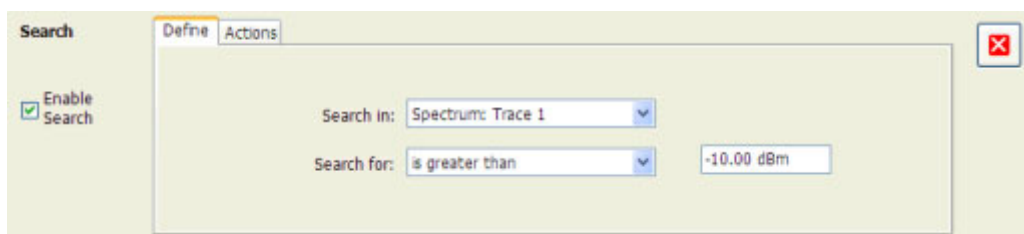
Selecting **Search** displays the Search control panel. These settings define search parameters and specify actions to be performed when the search condition is met.



Setting	Description
Enable Search	Select to perform a search.
<a href="#">Define</a> (see page 209)	Specifies which trace to search and what to search for.
<a href="#">Actions</a> (see page 213)	Specifies the action to take when the search condition is met.

## Define Tab (Search)

The Define tab sets the parameters for a search. From this tab, you specify which trace to search and what kind of violation to search for.





Setting	Description
Search in	Specifies which trace to search.
Search for	Specifies what to search for. You can specify a search based on a signal level or a mask.

### Search In

The choices for **Searching** are: Spectrum Trace 1, Spectrum Trace 2, Spectrum Trace 3, Spectrum Math Trace, Spectrogram Trace, and Spurious.

---

**NOTE.** *If you select a trace in the display that is not the selected trace, you will not see the results of the Search until you select the trace in the spectrum display that is the "Search in" trace.*

---

### Search For

The **Search for** setting has selections that vary based on which display's results you are testing.

### Pass/Fail Searches for Spurious

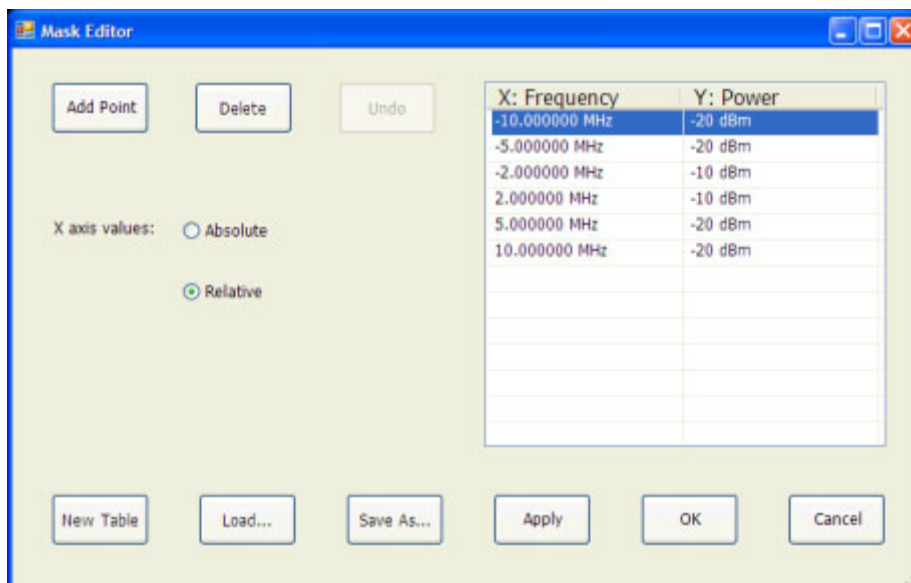
The Spurious measurement can be set up to compare measured spurs against user-adjustable amplitude limits and provide a pass/fail result. Search can be configured to look for either a Pass result or a Fail result from Spurious, then perform your specified Search actions when that result occurs.

### Greater Than/Less Than Searches for Spectrum

If you select a greater than/less than search, you also specify the level that defines a violation. When you select either **is greater than** or **is less than**, a text entry box appears to the right of the drop-down list. Use the text entry box to specify the signal level you wish to search for.

### Mask-Based Searches

If you specify a mask-based search, then you need to edit the mask to specify the levels that define a violation. When you select **is outside mask** or **is inside mask**, an Edit limits button is displayed. Select the Edit limits button to display the Mask Editor.



To edit a search mask:

1. Click **Edit limits...** to display the Mask Editor.
2. Click **New Table** to create a table. This clears the existing points and loads the default table.
3. Select the **X axis values** setting:
  - a. Select **Absolute** to specify mask point locations based on signal frequency.
  - b. Select **Relative** to specify mask point locations as offsets from the center frequency.
4. To edit values in the table:
  - a. To edit an existing value, double-click on the cell you want to edit.
  - b. To add a new point to the table, click on **Add Point**. Edit the values as required and click **Apply** when you are finished with your changes.

To specify a frequency multiplier, you can type K, M, or G. For the power level, you only need to specify a numeric value. The unit is set to the current Units setting (Setup > Analysis > Units).

1. To delete a point from the table, select the point to be removed, and click **Delete**.
2. To close the Mask Editor without saving your changes, click **Cancel** (if you have already clicked Apply, this only cancels changes since the last time Apply was clicked).
3. If Search mode is already enabled and the instrument is in Run mode, you can run a Search using your changed points without closing the Mask Editor, by clicking **Apply**.
4. To save changes and close the Mask Editor, click **OK**.
5. To save the mask to a file for later recall, click **Save As...**
6. From the Save As dialog, name the file and save it in the desired location.

Masks are saved only in CSV (Comma Separated Value) format.

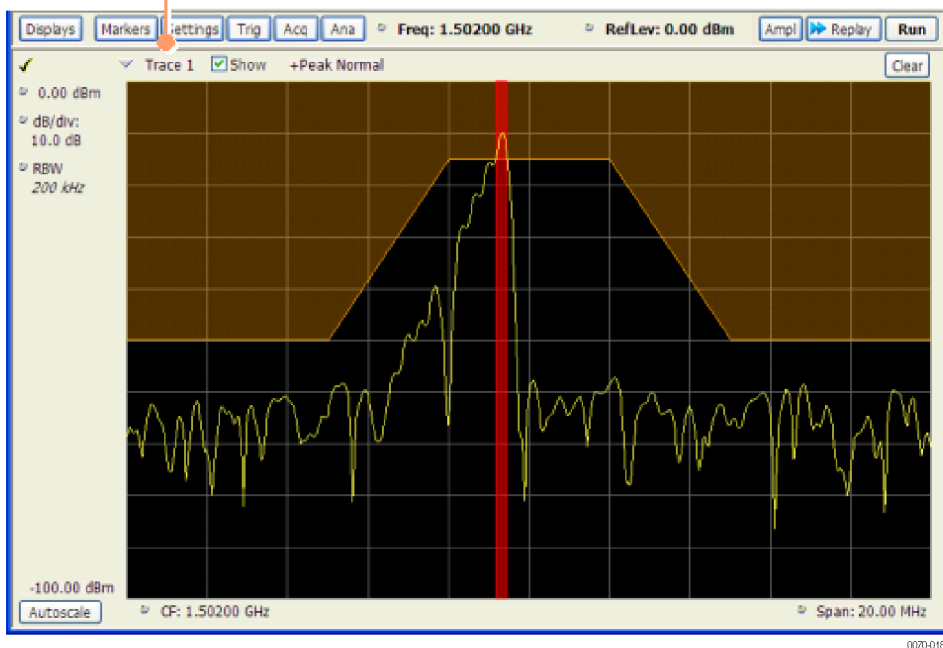
### Performing a Mask-Based Search

To perform a Search using a mask:

1. Select **Tools > Search**.
2. Click the **Enable Search** check box.
3. Select the trace that you wish to search from the **Searching** drop-down list.
4. Verify that the trace you selected to search is the selected trace in the display.
5. Select either **is outside mask** or **is inside mask** from the **Search for** drop-down list.
6. Click the **Edit limits** button.
7. Edit the table as necessary or click **Load** to use a previously saved mask.
8. If you load a saved a mask, use the Open dialog box to locate and open the mask file.
9. Click **OK**.

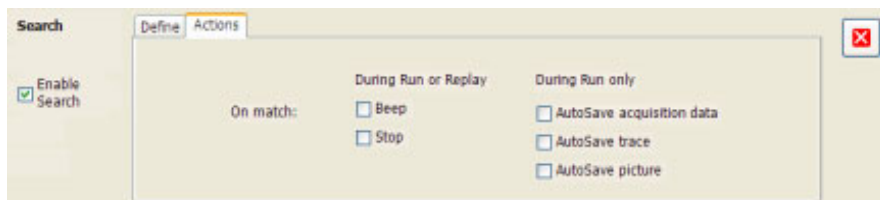
The following figure shows the results of an **is outside mask** Search. The vertical red bar highlights results that match the Search definition.

This readout identifies the selected trace



## Actions Tab

The Actions tab is used to specify an action to be taken when the search condition is met.



Setting	Description
During Run or Replay	Actions specified here will occur in either Run mode or Replay mode.
Beep	The analyzer beeps when the search condition is met. There will be no sound if the instrument hardware does not support audible output.
Stop	The analyzer stops when the search condition is met.
During Run Only	Actions specified here are taken only during Run mode (while acquiring live data).
AutoSave acquisition data	Saves acquisition data to a file when the search condition is met.
AutoSave trace	Saves Trace data to a file when the search condition is met.
AutoSave picture	Saves a screen capture to a file when the search condition is met.

### AutoSave File Naming

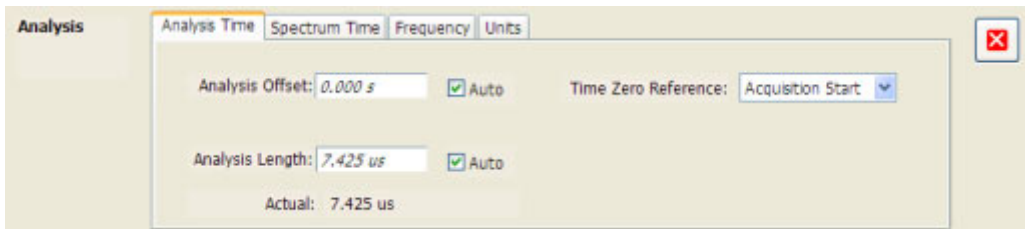
When one of the AutoSave actions is enabled, the name of the saved file is automatically incremented even if the **Automatically generate filenames** option (Tools > Options > Save and Export) is not enabled. When the file is saved, it will be saved to the last location a file was saved. You can check this location by selecting **File > Save As**. The Save dialog will show you the current save location. If you want to save the file in a different location, save a file (any type) in the desired location. This resets the save destination to the new location.

## Analysis Settings

**Menu Bar:** Setup > Analysis

**Application Toolbar:** Ana

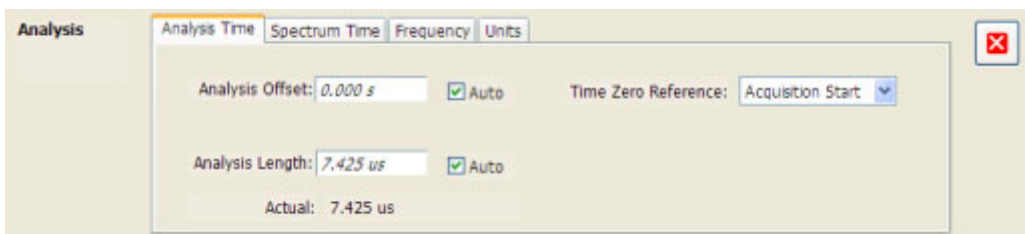
The Analysis control panel provides access to settings that are used by all displays. These settings affect only post processing and they do not control hardware settings.



Setting	Description
<a href="#">Analysis Time (see page 214)</a>	Specifies the length of time to use in measurements.
<a href="#">Spectrum Time (see page 216)</a>	Specifies whether the Spectrum Analysis display uses the same Analysis Time parameters as all the other displays or if it uses a different Offset and Length.
<a href="#">Frequency (see page 216)</a>	Specifies the measurement frequency (center frequency).
<a href="#">Units (see page 219)</a>	Specifies the Power units for all displays.

## Analysis Time Tab

The Analysis Time tab contains parameters that define the portion of the acquisition record that is used for analysis.





Setting	Description
Analysis Offset	Specifies the location of the first time sample to use in measurements.
Auto	When enabled, causes the instrument to set the Analysis Offset value based on the requirements of the selected display.
Analysis Length	Specifies the length of time to use in measurements.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
Time Zero Reference	Specifies the zero point for the analysis time.
Actual	This is a displayed value, not a setting. It is the Analysis Length (time) being used by the analyzer; this value may not match the Analysis Length requested (in manual mode).

### Analysis Offset

Use analysis offset to specify where measurements begin. Range: 0 to [(end of acquisition) - Analysis Length]. Resolution: 1 effective sample (or symbol).

### Analysis Length

Use the analysis length to specify how long a period of time is analyzed by a measurement. After you enter a value, this box changes to show the actual value in use, which is constrained by Acquisition Time. This setting is not available when Auto is checked. Range: minimum value depends on modulation type to Acquisition Length. Resolution: 1 effective sample (or symbol).

### Time Zero Reference

The analysis offset is measured from this point. Choices are: Acquisition Start or Trigger Point.

Parameter	Description
Acquisition Start	Offset is measured from the point at which acquisition begins.
Trigger Point	Offset is measured from the trigger point.

## Spectrum Time Tab

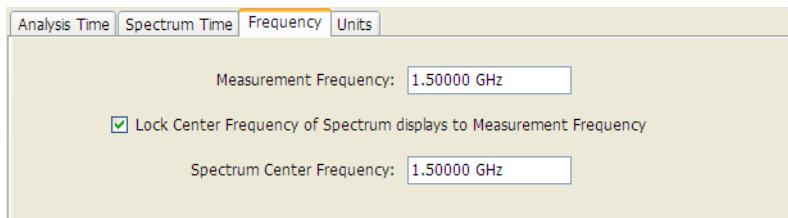
This tab controls whether the Spectrum display uses the same Analysis Time parameters as all the other views or uses a different Offset and Length.



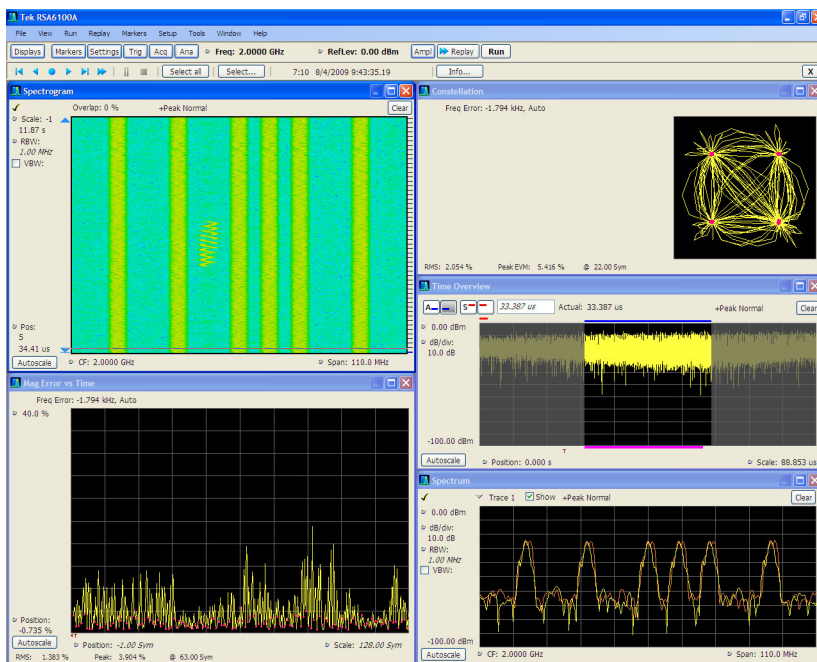
Settings	Description
<b>Spectrum Time Mode</b>	
Independent	Causes the spectrum analysis views to use the settings unique to those displays.
Use Analysis Time settings	Causes the spectrum analysis views to use the settings on the Analysis Time tab.
<b>Spectrum Time (only available when <i>Independent</i> is selected)</b>	
Spectrum Offset	Sets the beginning of Spectrum Time with respect to the selected time reference point (selectable in the Analysis Time tab as either Acquisition Start or Trigger).
Spectrum Length	The amount of data, in terms of time, from which spectrum traces are computed.
Auto	When enabled, causes the instrument to set the Spectrum Length value based on the RBW setting.
Actual	This is a displayed value, not a setting. It is the Spectrum Length (time) being used by the analyzer; this value may not match the Spectrum Length requested (in manual mode). The actual spectrum length is always an integer multiple of the time needed to support the RBW value.

## Frequency Tab

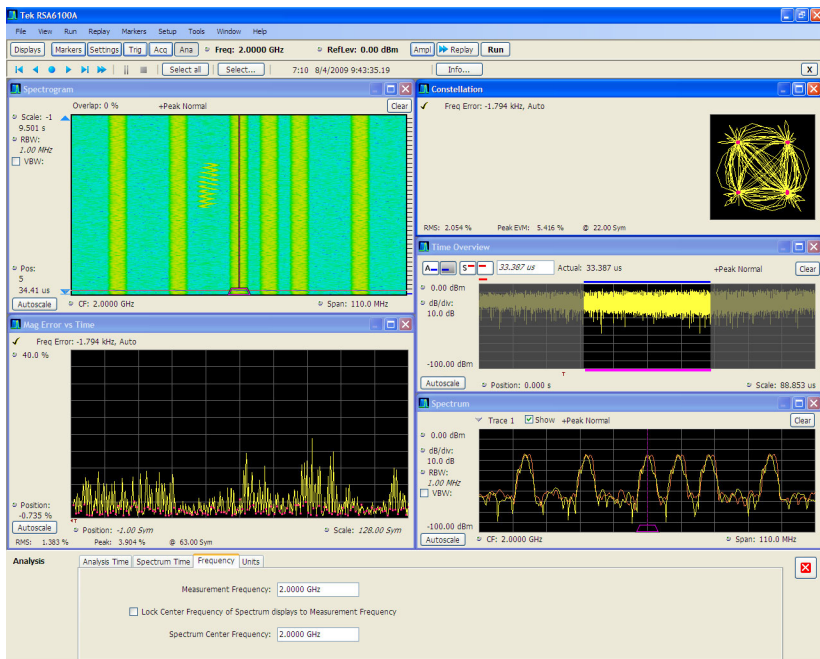
The Frequency tab specifies two frequency values: the Measurement Frequency and the Spectrum Center Frequency. The Measurement Frequency is the frequency at which most displays take measurements. The Spectrum Center Frequency is the center frequency used by the Spectrum, DPX Spectrum, Spectrogram and Time Overview displays.



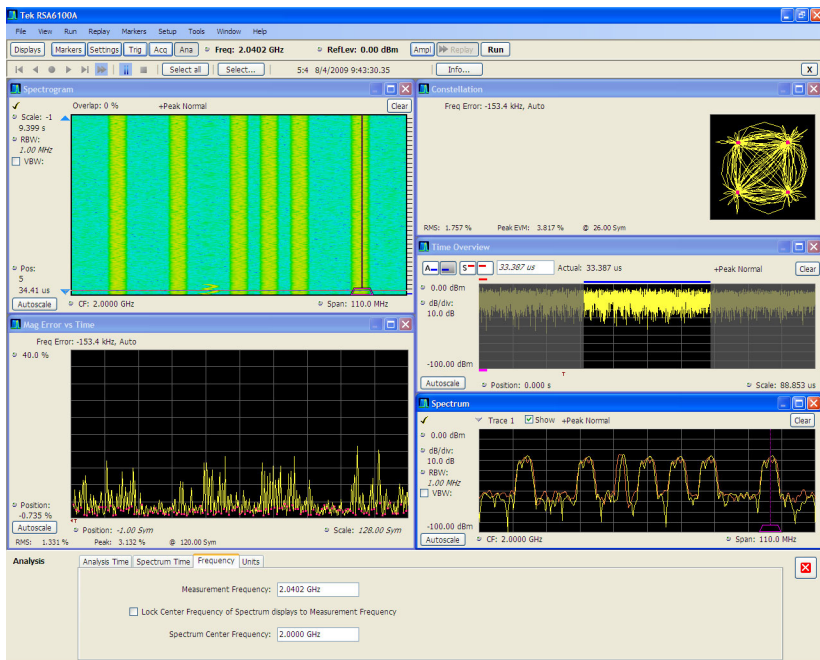
The following screen capture shows a display with both the Measurement Frequency and the Spectrum Center Frequency locked together.



Normally, the Measurement Frequency and the Spectrum Center Frequency are locked together so that both have the same setting. But in some situations, for example, where a signal contains a set of channels, it is useful to unlock the Measurement Frequency from the Spectrum Center Frequency. When the Spectrum Center Frequency is unlocked from the Measurement Frequency, you can adjust the Measurement Frequency so that measurements can be taken at different frequencies without resetting the center frequency. The following screen capture shows the magenta-colored measurement frequency indicator still located at the center frequency.



The following screen capture shows the measurement frequency indicator located at 2.0402 GHz while the Spectrum Center Frequency is still located at 2.0000 GHz.

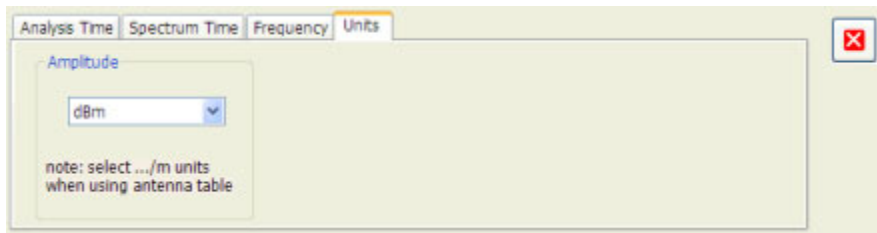


You can drag the Measurement Frequency indicator on the screen to set the measurement frequency. Note the base of the Measurement Frequency indicator. The width of the box indicates the widest measurement

bandwidth in use among the open displays. You can see how the width of this box changes with the measurement bandwidth by, in this example, adjusting the Measurement BW setting for the Constellation display (Settings > Freq & BW tab). As you adjust the setting, you will see how the width of the box at the base of the Measurement Frequency Indicator changes.

## Units Tab

The Units tab specifies the global Amplitude units for all the views in the analysis window.



## Replay Overview

The Replay function enables you to reanalyze data with different settings and even different measurements. You can replay all the acquisitions in memory, a single acquisition, a single frame within an acquisition (if Fast Frame is enabled), or any contiguous set of data records from acquisition history.

### Displaying the Replay Control Panel

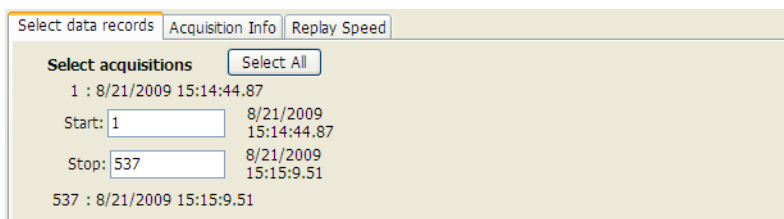
To display the Replay control panel:

- Select **Replay > Select data records from history....**

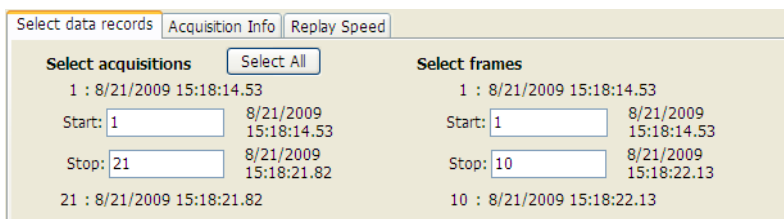
#### Replay control panel tabs

Tab	Description
Select data records	Specifies which data records are replayed when the Replay button is selected.
Acquisition Info	Displays information about acquisition settings and sets the number of decimal places used for displaying the time stamp.
Replay Speed	Sets the speed at which data records are replayed.

#### Select Data Records Tab



Without FastFrame enabled



With FastFrame enabled

The Select data records tab is used to select which data records to replay. A data record is the smallest unit that can be replayed. Note that what constitutes a data record can vary. If FastFrame is not enabled, a data record consists of a single acquisition. If FastFrame is enabled, each acquisition can contain multiple frames, and a data record consists of a single frame.

## Replay Menu

The Replay menu provides controls that let you choose how to replay acquisitions. The replay function enables you to, in effect, “rerun” an analysis while applying different measurements to the same set of acquisition data.

Menu item	Description
Play all selected records	Replays the sequence of records specified by Start and Stop on the Select data records tab.
Play current record	Replays the currently selected acquisition (or frame).
Play from selected	Displays a submenu that you use to specify which records are to be replayed.
First record	Replays the first record within the selected set.
Previous	Replays the previous record within the selected set.
Next	Replays the next record within the selected set.
Last record	Replays the last record within the selected set.
Pause	Suspends replay of the data records as soon as the current record's replay action is completed. Press Pause again to begin replay with the next record in the sequence.
Stop	Halts the replay of acquisitions. If replay is started after Stop has been selected, replay starts from the first acquisition.
Select all	Selects all acquisitions for replay.
Select records from history	Displays the Select data records tab of the Replay control panel. Use the Select data records tab to specify which acquisitions and frames you would like to replay.
Replay toolbar	Displays or hides the Replay toolbar.

## Play All Selected Records

Use this selection to replay all the selected data records. The set of selected records may comprise a single record, all records in acquisition history, or a subset of the records in history.

## Play Current

Selecting **Play current** replays the current data record. You can identify the current acquisition record by looking at the Replay toolbar. The first number to the right of the Select... button identifies the current data record. For example, if the number is 2:10, it means the current record is the tenth frame of the second acquisition in history.

## Play from Selected...

Select **Play from selected** to replay records as selected from the submenu. The records replayed can be from the acquisition memory (history) or from a saved acquisition data file that has already been recalled as the current acquisition data.

## Pause

Select Pause to suspend playback. Selecting Pause again restarts the replay at the point it was paused.

## Stop

Select **Stop** to halt the replay of data. Selecting any Replay action restarts replay of records from the beginning.

## Select All

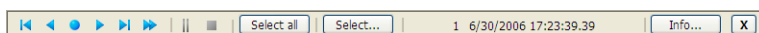
Select **Select all** to select all data records for replay.

## Select Records from History

Selecting **Select records from history** displays the **Select data records** tab of the **Replay** control panel. The Select data records tab allows you to specify which records in the acquisition history will be used when the Replay button is selected.









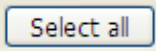
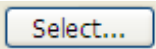

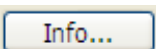
## Replay Toolbar

Displays or hides the Replay toolbar that appears below the main tool bar.



Replay toolbar



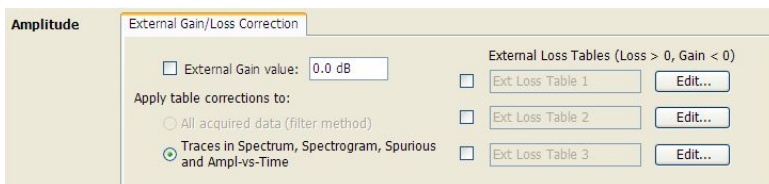
Icon	Description
	Replays the first record in the selected set.
	Replays the previous record in the selected set.
	Replays the current record in the selected set.
	Replays the next record in the selected set.
	Replays the last record in the selected set.
	Replays all records in the selected set.
	Pauses replay. Pressing pause suspends replay with the current record. Selecting pause again starts Replay with the next record.
	Stops replay. Starting any replay action after pressing stop starts a new Replay action rather than continuing from the record at which the previous replay action was stopped.
	Pressing <b>Select all</b> selects all records in history for replay. Selecting <b>Select all</b> resets the <b>Start</b> and <b>Stop</b> values on the Select data records tab of the Replay control panel.
	Pressing <b>Select</b> displays the Select data records tab of the Replay control panel. The Select data records tab allows you to select records from acquisition history for replay.
	This readout shows information about the data record being replayed. The information displayed shows the acquisition and frame number and time stamp for the current data record.
	The Info button display the Acquisition Info tab of the Replay control panel. The Acquisition Info tab displays information about the acquisition data such as acquisition bandwidth, sampling rate and acquisition length. All data records in the acquisition history were acquired with identical parameters. When any of these parameters are changed, all records in history are deleted as soon as the first record acquired under the new parameter values is received.

## Amplitude Settings

**Menu Bar: Setup > Amplitude**

**Application Toolbar: Ampl**

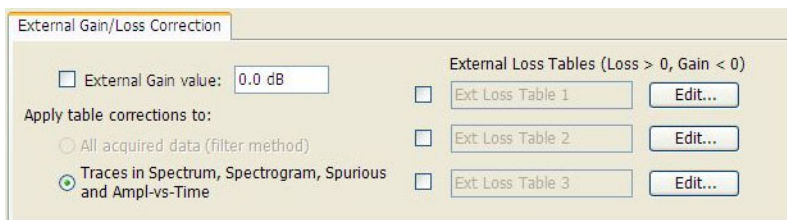
The Amplitude control panel provides access to power-related settings that are used by all displays within the SignalVu application.



Setting	Description
<a href="#">External Gain/Loss Correction (see page 224)</a>	Specifies whether a correction is applied to the signal to compensate for the use of external equipment.

## External Gain/Loss Correction Tab

The External Gain/Loss Correction tab allows you to apply a correction to a signal to compensate for the use of external equipment, such as an amplifier or attenuator.



### External Gain Value

Use the External Gain Value setting to apply a flat gain/loss correction to the signal. Positive values represent a gain and negative values represent a loss. The range is -50 to +30 dB. Resolution is 0.1 dB.

---

**NOTE.** Selecting Preset clears the check box, but it does not change the value.

---

## Apply Table Corrections To

Table corrections can be applied only to *traces* in the Spectrum, Spectrogram, Spurious and Amplitude vs Time displays.

## External Loss Tables

Use an External Loss Table to apply a frequency dependent gain/loss correction to the signal. When an External Loss Table is selected, the analyzer adjusts the signal according to the values in the table. An external loss table allows you to compensate the signal level for variations in cable loss, antenna frequency response or preamp frequency response.

You can create external loss tables from the analyzer application and save them as files. External loss tables are saved as plain text files in CSV (Comma Separated Value) format. The tables have a CSV file extension.

You can change the title for each table. However, note that the title is only a label. It is not tied to the file name of any table you may have loaded or saved.

---

**NOTE.** *If you are using an External Loss Table for antenna corrections, be sure to set the Amplitude units (Setup > Analysis > Units) to dBuA/m or dBuV/m.*

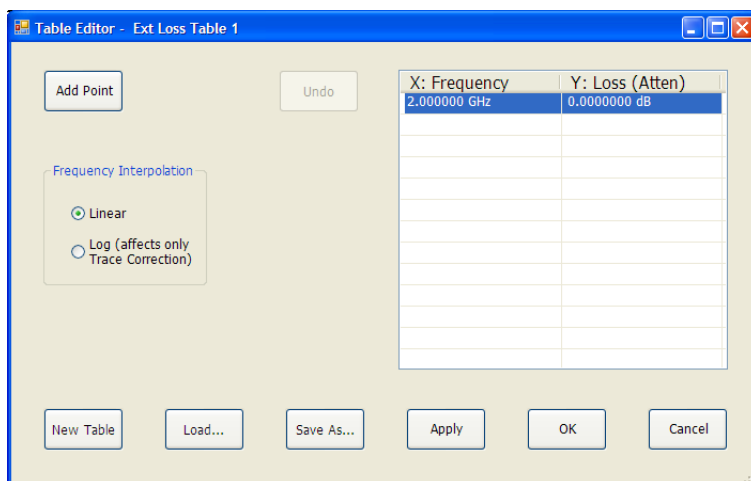
---

## Creating an External Loss Table

You can create an external loss table with the analyzer application. No external application is required.

To create an external loss table:

1. Click **Edit..** to display the Table Editor.



2. Click **New Table** to create a table. This clears all entries in the existing table and loads the default table.

3. To edit values in the table:
  - a. To edit an existing value, double-click on the cell you want to edit.
  - b. To add a new point to the table, click on **Add Point**. Edit the values as required.
  - c. Click **Apply** if you want to test your table without closing the editor (the table must be enabled with the check box in the control panel and measurements must already be running).  
To specify a frequency multiplier, you can type K, M, or G.
4. To delete a point from the table, select the point to be removed, and click **Delete**.
5. Select the Frequency Interpolation method:
  - Select Linear when the frequency scale of the spectrum or spurious measurements are linear.
  - Select Log when the frequency scale of the spectrum is logarithmic.
6. When you have entered all the necessary values, click **Save As...** (to save the table in a file) or click **OK**.
7. From the Save As dialog, name the file and save it in the desired location.  
External loss tables are saved in CSV (Comma Separated Value) format.

### Loading an External Loss Table

To load an external loss table file:

1. Click **Edit...** to display the Table Editor.
2. Click **Load....** to display the Open dialog box.
3. Navigate to the location of the desired file, select it and click Open.
4. Click **OK**.

## Continuous versus Single Sequence

### Menu Bar: Run > Single Sequence / Continuous

Selecting Single Sequence sets the acquisition mode so that when you press Run, a single acquisition sequence is performed and the instrument stops once the acquisition sequence is completed. Selecting **Continuous** sets the acquisition mode so that an acquisition sequence is started as soon as you select Continuous and as one acquisition sequence completes, another begins.

Note that an acquisition sequence can require more than one acquisition. For example, in a spectrum view, the trace function might be set to Average 100 acquisitions. Thus, a complete acquisition sequence would consist of 100 acquisitions that are averaged together to create the trace that is displayed.

## Run

### Menu Bar: Run > Run

### Application Bar: Run

Selecting **Run** begins a new acquisition/measurement cycle.

## Resume

### Menu Bar: Run > Resume

Restarts data acquisition, but does not reset accumulated results, such as Average or MaxHold. This allows you to stop acquisitions temporarily, then continue. If the accumulation is already complete, for example, 10 acquisitions or 10 averages have already been completed, each subsequent Resume command will cause one more acquisition to be taken, and its results added to the accumulation. Not available if instrument settings have been changed.

## Abort

### Menu Bar: Run > Abort

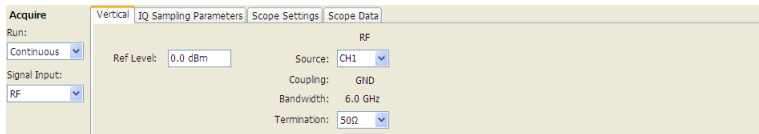
Selecting **Abort** immediately halts the current acquisition/measurement cycle. In-process measurements and acquisitions are not allowed to complete. Visibility and accuracy of results is unspecified after an abort.

## Acquire

**Menu Bar: Setup > Acquire**

**Application Toolbar: Acq**

Selecting **Acquire** displays the Acquire control panel. These settings control the hardware acquisition parameters for the oscilloscope. Normally, sampling parameters are automatically adjusted for selected measurements. You can use Acquire to change these parameters if necessary.



Setting	Description
<a href="#">Vertical (see page 228)</a>	Sets the channel used and reference level.
<a href="#">IQ Sampling Parameters (see page 230)</a>	Set Sampling parameters.
<a href="#">Scope Settings (see page 231)</a>	Sets the SignalVu software to control oscilloscope acquisition parameters or use the current oscilloscope settings.
<a href="#">Scope Data (see page 232)</a>	Displays the sample rate and record length reported by the oscilloscope.

### Run

Run mode specifies whether the analyzer will stop acquiring data after it completes a measurement sequence.

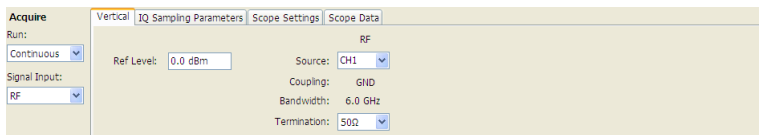
- **Continuous** - In Continuous mode, once the analyzer completes a measurement sequence, it begins another.
- **Single** - In Single mode, once the analyzer completes a measurement sequence, it stops.

**NOTE.** A measurement sequence can require more than one acquisition. If the analyzer is configured to average 100 traces together, the measurement sequence will not be completed until 100 traces have been acquired and averaged.

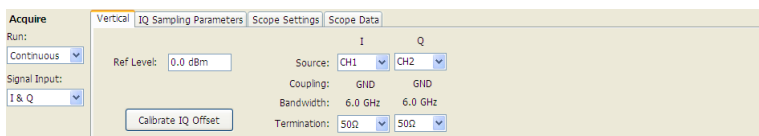
## Vertical

Use the Vertical tab to specify which oscilloscope channel is used for analysis by the SignalVu software. The number of signals analyzed by SignalVu depends on the selected signal input type. The Signal Input can be set to:

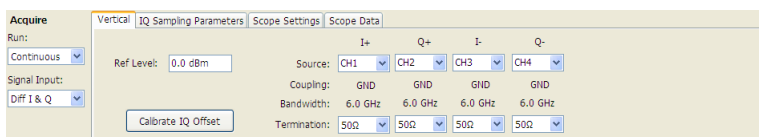
- RF
- I & Q
- Diff I & Q (Differential I & Q)



Vertical tab with signal input set to RF



Vertical tab with signal input set to I&Q



Vertical tab with signal input set to Diff I&Q

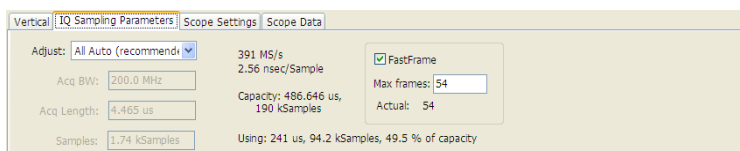
Setting	Description
Signal Input	Specifies the input signal type.
Ref Level	Specifies the Reference Level, which determines the oscilloscope's Vertical Scale setting. If Vertical settings are not enabled in the Scope Settings tab, or while analyzing a recalled data file, the Reference Level control only adjusts vertical display position.
Calibrate IQ Offset	Removes DC offset that may be applied within the oscilloscope to eliminate offset between I and Q channels.
Source	Specifies the input source. Choices available are: CH1, CH2, CH3, CH4, Math1, Math2, Math3, Math4, Ref1, Ref2, Ref3, and Ref4.
Coupling	Display of the coupling setting on the selected channel.
Bandwidth	Display of the oscilloscope bandwidth setting.
Termination	Display of the termination setting for the selected channel.

### Offset Frequency

If the Signal Input is set to I&Q or Diff I&Q, the **Freq:** readout serves as the offset frequency readout. When the Signal Type is set to I&Q or Diff I&Q, the default measurement frequency is 0 Hz. However, for signals that have near-zero IFs, the measurement frequency can be changed by entering an offset frequency value in the measurement frequency entry box (**Freq:** in the application toolbar).

## IQ Sampling Parameters

The IQ Sampling Parameters tab enables you to set the controls for real-time acquisition. Depending on the setting chosen for Adjust, two additional parameters can be set. Normally, the best results are achieved by leaving the Adjust control set to All Auto.



### Sampling Control

There are three acquisition parameters that interact with each other: acquisition bandwidth, oscilloscope acquisition sampling rate, and memory usage. The oscilloscope's sampling rate is displayed in the status bar at the bottom of the SignalVu window. This sample rate is decimated by the SignalVu software to meet the requirements of the current measurement settings (such as the selected span, acquisition bandwidth or resolution bandwidth of a measurement). The resulting decimated sample rate is shown in the figure above (391 MSamples/sec). This is the sample rate of the IQ data analyzed and acquisition data file stored by SignalVu.

Adjust	User Sets		Analyzer Calculates
All Auto	N /A	N /A	All values based on the selected measurement
Acq BW / Acq Samples	Acq BW	Acq Samples	Acq Length
Acq BW / Acq Length	Acq BW	Acquisition Length	Acq Samples

### Acquisition Memory Usage

The center portion of the tab shows how the acquisition memory is used.

Readout	Description
Samples/s, sec/Sample	Readout of the acquisition sample rate and sample period.
Capacity	The maximum period of time and number of samples that can be acquired with the current sampling parameters.
Using	The total amount of acquisition memory that will be used based on the current settings.

### FastFrame

FastFrame is a feature that allows you to segment the acquisition record into a series of frames, or data records. A typical use of FastFrame is to record data samples around signal events of interest, while not wasting memory on irrelevant data between these events. FastFrame acquisitions are only valid for live waveforms and is not supported for Math or Reference Waveforms.

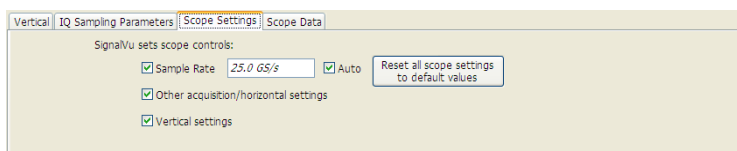


Setting	Description
FastFrame	Enables FastFrame acquisition mode.
Max Frames	Specifies the maximum number of frames to record in a single acquisition process.

The Actual readout shows the actual number of frames that will be acquired into the acquisition memory. This number changes based on the Acq BW, Acq Samples, and Acq Length values. This number will never be greater than the value set by Max Frames.

## Scope Settings

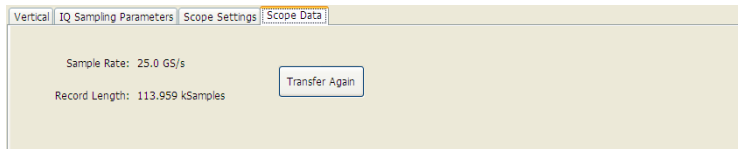
The Scope Settings tab is where you specify which oscilloscope settings are controlled by the SignalVu software.



Setting	Description
Sample Rate	When enabled, SignalVu adjusts the sample rate as required based on measurement settings in the analysis software. Sample rate determines the maximum available measurement bandwidth.
Auto	When Sample Rate is enabled and Auto is enabled, SignalVu adjusts the sample rate automatically. When Sample Rate is enabled and Auto is disabled, you can specify the sample rate using the text entry box. You can set the sample rate to any of the standard oscilloscope sample rate settings. If you choose an arbitrary value, SignalVu will adjust the value to the closest standard sample rate.
Other acquisition/horizontal settings	When enabled, SignalVu adjusts the oscilloscope horizontal and acquisition settings of the oscilloscope as needed to provide the best results. For example, SignalVu sets Sampling Mode to Real Time Only and Horizontal Mode to Manual when it is allowed to control these parameters. Checking these boxes helps reduce variability in the SignalVu results.
Vertical settings	When enabled, SignalVu adjusts the oscilloscope's vertical settings. Vertical settings include Coupling, Bandwidth, Scale and Termination. SignalVu sets these to values appropriate for RF signals. The Scale value sent to the oscilloscope is calculated from SignalVu's Reference Level control value.
Reset all scope settings to default values	Press this button to change all oscilloscope settings to the oscilloscope's default values.

## Scope Data Tab

Displays the sample rate and record length reported by the oscilloscope.



### Transfer Again

The Transfer Again button, selectable only when SignalVu is stopped, causes SignalVu to request the last acquisition made by the oscilloscope be transferred again and analyzed. This enables you to change measurement settings and then reanalyze the acquisition data with the revised measurement settings in effect. If FastFrame is enabled, all frames are replayed when the transfer is completed.

The Transfer Again function is most useful when measurements in SignalVu are set up to require less acquisition bandwidth than what is available from the oscilloscope (based on the sample rate used by the oscilloscope to acquire the waveform record). In this case, the data is decimated before being supplied to SignalVu (because SignalVu doesn't need the excess bandwidth. If you need a wider bandwidth than SignalVu was originally set up for and the original scope acquisition supports the new value, you can change the SignalVu settings, then click **Transfer again**. This time, the waveform data is sent to SignalVu with its bandwidth (sample rate) adjusted to match the current measurement settings.

## Saving and Recalling Data, Settings, and Pictures

You can save different types of data for later recall and analysis.

Data type	Description	Save as type
Setup files	Saves all of the setup information for all displays, except those settings that are not part of Preset.	Setup
Picture of Selected Display (PNG/JPG/BMP)	Saves a capture of the screen in the specified format. This option is useful for including the graphic in reports or other applications. Marker readouts and other information are included.	Picture
Results Export files	Saves the trace and numeric data for the selected display. The trace and numeric data are saved as CSV files.	Results export
Measurement Settings	Saves a list of settings relevant to the selected measurement to a text file. This option is useful for including the measurement settings in reports.	Measurement settings export (TXT)
Trace	Saves a trace for later recall into the display from which it was saved.	Selected trace
Data	Saves data for reanalysis later or as data to use with external software (either CSV (comma-separated value) or MAT (MATLAB format).	Acquisition data with setup; or Acquisition data export (CSV or MAT)

### Saving Files

Saving files follows the same procedure regardless of the type of data being saved. To save setups (including application presets), pictures, results, or acquisition data:

1. Select **Save As. . .** from the **File** menu to open the **Save As** dialog box.
2. Navigate to the folder where you want to save the setups, or use the default location.
  - To save setups so that they appear in the Application Presets window, save your setup in the folder **C:\SignalVu Files\Application Presets**. The saved setup will appear in the Application Presets window with the name you give the file.
3. Enter a file name.
4. Select the type of file to save from the **Save as type** drop-down list.
5. Click **Save**.

## Recalling Files

You can recall three types of files: Setup files, Selected Trace, and Acquisition data with setup. Recalling data follows the same procedure regardless of the type of data being recalled.

1. Select **Recall. . .** from the **File** menu to open the **Open** dialog box.
2. Navigate to the folder containing the file you want to recall.
3. Select the type of file to recall from the **Files of type** drop-down list. This selection determines the files that appear in the Open dialog box.
4. Select the file to recall.
5. Click **Open**.

## Recalling Oscilloscope Waveform Files in SignalVu

You can recall waveform files stored on the oscilloscope using a two-step process.

1. Recall the waveform file using the TekScope application.
2. From the SignalVu application, select **Acq** to display the Acquire control panel.
3. Specify the **Signal Input** as appropriate.
4. Set the **Source** to specify the reference waveform that contains the waveform file you recalled.
5. Click **Replay** to analyze the recalled waveform.

## Setup Files

You can set up the instrument as desired and then save the settings in a setup file. This enables you to quickly setup the instrument by recalling previously saved setups.

## Exporting Results

Save for further analysis of results in other programs, such as MATLAB or Excel.

## Pictures of the Selected Display

You can save pictures of the instrument display for documentation purposes. When saving pictures of the display, you can select from three file types: BMP, JPG, or PNG.

## Measurement Settings

You can save a list of settings relevant to the selected display to a file for documentation purposes. The exported file uses tab characters to separate values. The settings included in the file depend on the selected display. The contents of the file are the same as a Results export except it does not include the results.

### Saving Acquisition Data with Setup

Save for later analysis with the analyzer. Saving the data with setup ensures the analysis parameters are the same when the data is recalled.

### Saving Acquisition Data Export in CSV Format

Save for examining results in other programs, such as MATLAB or Excel.

## Data, Settings, and Picture File Formats

You can save different types of data for later recall and analysis.

### Saved File Types

File type	File extension	Description
Setup files	.setup	Setup files enable you to save instrument settings for later recall. Using these files saves setup time and ensures consistent measurements.
Picture	.png/.jpg/.bmp	Screen capture of SignalVu application window. They are useful for documenting results in test reports.
Results Export	.csv	Results files contain the trace points and numeric values that were produced by the selected measurement. The header of a Results file includes key acquisition and analysis settings to aid in the interpretation of the data. The file is saved as a plain text file, but the contents are formatted as CSV (comma-separated values). Results files can be opened from applications such as Microsoft Excel and MATLAB.
Measurement Settings	.txt	Measurement settings files contain a list of settings that describe how the instrument is set up for the selected measurement. The list contains measurement settings (for example, Span), trace settings (for example, whether or not a trace is selected) and global settings (for example, Frequency and Reference Level). The list of settings contained in the file varies depending on which display is selected.
Selected Trace	varies with display	Trace files contain the trace results data in binary format. These files are only readable by the SignalVu application. Several of the instrument's measurements allow you to recall a Trace file for visually comparing a saved trace to a live trace.
Acquisition Data with Setup	.tiq	These files contain the acquisition data record and complete instrument setup (in binary format). Use these files to save data for later recall and analysis. When you save an Acquisition Data file, the current Setup is always saved with the file. At the time of recall, you will be asked whether you want to restore only the acquisition data or both data and setup. If the instrument is already set up for a specific measurement, you will probably want to recall only the acquisition data. Recalling both data and setup returns the instrument to the same state it was in at the time you saved the file.

File type	File extension	Description
Acquisition Data	.csv	These files contain IQ sample data before it has been processed by a measurement. The acquisition data points are saved as IQ pairs. Use this format to import the acquisition data into Microsoft Excel for further analysis.
Acquisition Data	.mat	These files contain IQ sample data before it has been processed by a measurement. The acquisition data points are saved as IQ pairs. Use this format to import the acquisition data into MATLAB for further analysis.  <b>NOTE.</b> Up to 10 Msamples of an acquisition data record can be exported to MATLAB format files. A free software tool is available to export files larger than 10 MB to the MATLAB format. Contact your Tektronix representative to obtain this software.
Range file	.csv	These files contain a list of settings that describe how the instrument is set up for the Spurious measurement. The file contains the number of ranges enabled, the start and stop frequencies for each enabled range, the limits for each enabled range, the mask type and more.

## Results Export File Format

The Results Export format contains trace points and/or scalar results produced by the measurement. The file contains general information about the measurement settings at the top of the file and the results data in the second part of the file. Groups of settings or results are headed with [text], as described below.

At the top of the file is the measurement name and the date and time data was acquired.

The first group of settings is [Global Parameters]. These settings include the Measurement Frequency, Acquisition Data, Reference Level and others.

The second group of settings is [Parameters]. These settings are specific parameters which vary depending on the measurement.

The next group is [Trace Parameters], which may not be present, depending on the measurement. Within this group, there are parameters specific to a trace. There will be a Trace Parameters group for each trace shown on the display.

The next group is [Results]. These are scalar results for the measurement.

Next is [Traces]. The Traces group consists of one or more [Trace] groups. There is one Trace group for each trace. Each [Trace] group contains background information about the trace (units, number of points, x scaling, and others depending on the measurement) at the top of the group, followed by the trace points.

## Acquisition Data with Setup File (.tiq) Format

The file consists of two parts - the header that is in XML and the data that is in binary format.

**Header.** The header consists entirely of the DataFile element. This element is broken down into sub-elements.

1. DataSetsCollection
2. Setup

**DataSetsCollection.** The DataSetsCollection contains a DataDescription element, a DataSet element, and a ProductSpecific element.

**Binary data.** Binary data is a sequence of Int32 values, which are IQ pairs (I,Q,I,Q, ...) in binary Little Endian format.

To convert these values to volts, multiply the individual values by the Scaling value in the DataDescription.

The binary data starts at an offset into the file == the "offset" attribute in the DataFile element. This offset number will always start at the 19th character into the file (starting with 1), and will always be 9 characters long.

---

**NOTE.** *You should not casually modify the XML header, because this will change the offset to the start of the binary data.*

---

### Acquisition Data Files (.csv)

The acquisition data files have two sections. At the top of the file is the following information:

- SamplingFrequency - The sampling frequency in Hertz.
- NumberSamples - The number of IQ samples in the file.
- DateTime - When the data was acquired.
- Frequency - The center frequency in Hertz.
- AcquisitionBandwidth - The acquisition bandwidth Hz.

Following the AcquisitionBandwidth are the data. The data are IQ pairs, in volts.

Groups of settings or results are headed with [some text].

The first thing in the file is the measurement name and the date/time when the acquisition was taken.

The first group [Parameters] are global parameters. Measurement Bandwidth in this group is the measurement bandwidth used by the General Signal Viewing measurements (Spectrum, Amplitude vs. Time, etc). It also includes some source settings, like Acq BW, Dither, Preamp, and RF Attenuation.

The second group [Parameters] are measurement-specific parameters.

Another group which can occur is [Trace Parameters]. Within this group, there will be a set of parameters, one for each trace that is currently shown.

Another group is [Results]. These are scalar results for the measurement.

Another group is [Traces]. It has [Trace] groups under it, one for each trace. Each [Trace] group has some background information about the trace (units, number of points, x scaling, etc), and the trace points themselves.

### Acquisition Data Files (.mat)

The acquisition data files saved in MatLab format contain the following MatLab variables:

- InputCenter - The center frequency in Hertz.
- XDelta - The sample period in seconds.
- Y - A complex array containing IQ pairs.
- InputZoom - Always 1, and indicates complex data.

## Printing Screen Shots

You can print shots (screen captures) two ways: use File > Print or save a picture file and print the file using a separate graphics program. Printing a screen capture is the same as printing with any windows program. For details on the available file formats for saving a screen capture, refer to [Data, Settings, and Picture File Formats \(see page 235\)](#). For details on saving a picture to a file, see [Saving and Recalling Data, Settings, and Pictures \(see page 233\)](#).

To print a screen from the instrument:

1. Select **File > Print**.
2. Select **File > Print Preview** if you wish to review the screen shot before sending it to the printer.
3. Select **File > Print** to print the file to a printer.



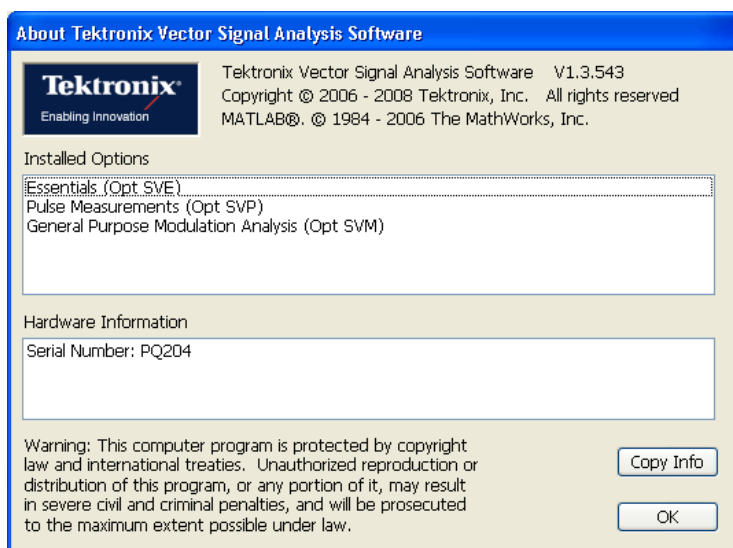
## Online Help

### Menu Bar: Help > User Manual

This menu item displays this online help. The online help is a standard Windows help system. The Online Help menu item is the only method available to display the online help; there are no other links to the online help within the software.

## About the Vector Signal Analysis Software

This window displays information about the SignalVu software and oscilloscope hardware it is running on.



### Version

At the top of the window is a line that displays the version of the vector signal analysis application software.

### Installed Options

This text box lists the software options installed. This window does not list the options installed on the oscilloscope, just those that are installed with the vector signal analysis software.

### Hardware Information

This text box lists the serial number of the oscilloscope on which the software is running.

## Copy Info

The Copy Info button copies information about the instrument to the Windows clipboard. This information may be useful if you need to have your instrument serviced. The following text is an example of the information copied when you click Copy Info:

Tektronix Vector Signal Analysis Software

V1.3.560

### **Installed Options:**

Essentials (Opt SVE)

Pulse Measurements (Opt SVP)

General Purpose Modulation Analysis (Opt SVM)

### **Hardware Information:**

Serial Number: B000001

## Menu Overview

The main menus are:

<b>Menu</b>	<b>Description</b>
<a href="#">File (see page 242)</a>	Select measurements, open and save files, print documents, and preset.
<a href="#">View (see page 247)</a>	Change display size, display the Marker toolbar and Status bar.
<a href="#">Run (see page 249)</a>	Start, stop and abort acquisitions, replay measurements, select single or continuous acquisition mode.
<a href="#">Markers (see page 252)</a>	Define markers and search for signal peaks.
<a href="#">Setup (see page 253)</a>	Change settings for acquisition, analysis, and measurements.
<a href="#">Tools (see page 254)</a>	Perform searches and configure user preferences.
<a href="#">Window (see page 255)</a>	Controls the size and layout of displays within the SignalVu application.
<a href="#">Help (see page 256)</a>	Access the online help, display information about the instrument hardware and software.

## File Menu

Command	Description
<a href="#">Recall... (see page 243)</a>	The Recall dialog enables you to recall saved data, setups and traces.
<a href="#">Save (see page 243)</a>	Saves a file without asking for a file parameters (based on most recent settings).
<a href="#">Save As... (see page 243)</a>	Displays the Save dialog enabling you to specify the parameters of the save operation.
<a href="#">Acquisition save options (see page 15)</a>	Displays the Save and Export tab of the Options control panel which allows you to specify how much data is saved in acquisition files.
Acquisition data info	Displays the Acquisition Info tab of the Replay control panel. The info on this tab describes such acquisition parameters as acquisition bandwidth, sampling rate, RF attenuation, and acquisition length.
<a href="#">Measurement Data Info (see page 245)</a>	Displays the characteristics of the most recently analyzed record in the display.
<a href="#">Print... (see page 245)</a>	Prints the selected display.
<a href="#">Print Preview (see page 246)</a>	Displays a preview of the print output.
<a href="#">Preset (see page 246)</a>	Preset resets the instrument to factory defaults. Acquisition data and settings that have not been saved will be lost.
<a href="#">Application Presets (see page 246)</a>	Displays a dialog box where you can recall presets tailored to specific application areas.
Exit	Closes the SignalVu application. Exit does not shut down the instrument.

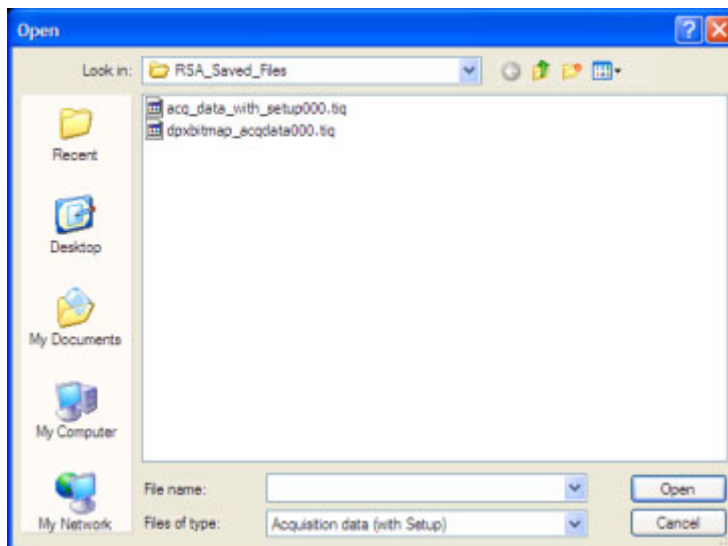
## Recall

### Menu Bar: File > Recall

Use the Recall command to load previously saved acquisition data, setups or trace data.

### To Recall Data or Setups

1. Select **File > Recall**. This displays the **Open** dialog box.



2. Select the file type to be recalled and click **Open**.

## Save / Save As...

### Menu Bar: File > Save / Save As...

Use Save / Save As... to store acquisition data, setups, and traces. Save is also used to export traces, results and pictures of the display for use in other programs.

### Difference Between Save and Save As

Use Save As to specify what kind of data you want to save and where the data should be saved. Use Save to quickly save the same data as you saved the last time you executed a Save, without having to specify the data type and location.

For example, suppose you want to save a picture of a spectrum trace each time you adjust a circuit to document how the adjustments affect the output of the circuit. The first time you want to save a picture of the display, you will need to select Save As. From the Save As dialog box, you specify the type of data you want to save (Picture of Selected Display) and specify the location of the saved file. As long as the [Save and Export option \(see page 14\)](#) is set to automatically name saved files, the next time you want to save a picture of the display, you can just press Save on the front panel and a picture of the selected display will be saved without requiring you to type a file name or the location of the file to be saved.

## What Data Types Can Be Saved

Data type	Description
Acquisition Data	Data collected during acquisition that can be recalled for later analysis. Data is saved in a format readable only by RSA6100A Series instruments or oscilloscopes running SignalVu software.
Setup	Configuration information detailing instrument settings. Data can be saved in a format readable only by RSA6100A Series instruments or oscilloscopes running SignalVu software or in a text file.
Selected Trace	Saves the selected trace for later analysis by the analyzer. Data is saved in a format readable only by RSA6100A Series instruments or oscilloscopes running SignalVu software.
Exported Traces and Numeric Results	Save traces and results in a file format that can be used by other programs.
Pictures of the Display	Save screen images in graphic image file formats that can be used in other programs.
Exported Acquisition Data	Save acquisition data records in a file format that can be used by other programs. Acquisition data can be saved in either comma-separated-variable format or MATLAB format.

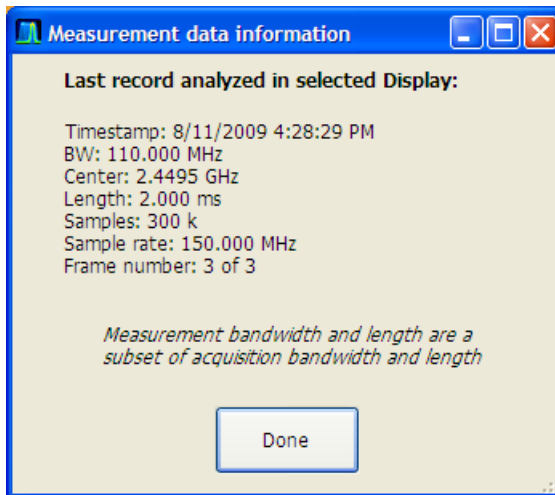
[Data, Settings, and Picture File Formats \(see page 235\)](#).

## Options for Saving Pictures of the Display

Option	Setting	Description
Image Format	PNG	Saves exported screen captures in Portable Network Graphics format.
	JPG	Saves exported screen captures in Joint Photographic Experts Group (JPEG) format.
	BMP	Saves exported screen captures in Windows bitmap format.

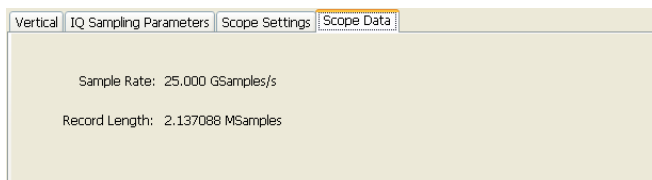
## Measurement Data Info

The Measurement Data Info command in the File menu displays a listing of acquisition-related information about the last data analyzed by the selected measurement. The last data can be from the current acquisition or it could be from a recalled data file.



## Scope Data

The Scope Data tab displays the sample rate and record length of the data received from the oscilloscope or from a recalled oscilloscope waveform file.



## Print

### Menu Bar: File > Print

Print displays the Windows Print dialog box for printing a screen capture of the display. To save ink when printing, use the Colors tab to set the color scheme. See [Options Settings \(see page 14\)](#).

## Print Preview

### Menu Bar: File > Print Preview

Print Preview shows how a print out will appear when it is printed.

## Preset

### Menu Bar: File > Preset

Preset resets settings and clears all acquisition data. Settings and acquisition data that have not been saved will be lost.

After Preset resets the analyzer settings, it displays the Spectrum view.

Preset does not affect time or date settings; the Windows XP operating system settings, or Tools Menu items.

## Application Presets...

SignalVu includes a set of configuration files that are tailored to specific applications. These configuration files, referred to as Application Presets, open selected displays and load settings that are optimized to address specific application requirements. You can add to the default application presets by creating your own application presets. For detailed information about these presets, see [Application Presets \(see page 11\)](#). See [Creating Application Presets \(see page 14\)](#). You access the application presets through the Application Presets menu item.



## View Menu

The View menu enables you to control the display of items in the application window.

Command	Description
<a href="#">Full Screen (see page 247)</a>	Toggles all views between full-screen size and user-selected size.
<a href="#">Marker Toolbar (see page 206)</a>	Shows or hides the Marker toolbar. Enables you to define Markers and perform Peak searches.
<a href="#">Status Bar (see page 248)</a>	Shows or hides the Status bar.

## Full Screen

### Menu Bar: View > Full Screen

When unchecked, clicking **Full Screen** resizes the application window to fill the screen. Full Screen mode maximizes the application window, and turns off the application title bar.

When checked, clicking **Full Screen** restores the application window to its previous size. The application title bar is restored.

## Status Bar

The Status Bar displays information on specific instrument settings. It contains only status information; it does not display any error information. The Status bar has no controls. It can be hidden.

### Elements of the Status Bar

Area within Bar	Description
Run Status	Displays the running state. For example, some run states are Acquiring, Analyzing, Ready, or Stopped.
Status message area	Displays status messages (for example, Data from ADC Overrange). When there no status messages to report, displays current acquisition parameters (for example, Acq Length: 22.320 us).
Acquisition parameters	Displays parameters of the acquisition, such as acquisition bandwidth and acquisition length.
Scope Sample Rate	Displays the oscilloscope sample rate, for example, 25.00 GS/s.

### Run Status Indicators

Indicator	Description
Acquiring	The analyzer is capturing the signal.
Analyzing	The analyzer has captured the signal and is processing the signal record.
Replaying	The analyzer is analyzing recalled waveform or acquisition records.
Stopped	If Stopped is displayed, Signal acquisition has been halted. This can occur because the Run button has been pressed or because a trigger event has occurred, signal acquisition has occurred and Run mode was set to Single.

### Showing or Hiding the Status Bar

- Select **View > Status** to toggle the display of the Status bar.

## Run Menu

The Run menu provides access to commands that control the signal acquisition.

Command	Description
<a href="#">Run (see page 227)</a>	If acquisition mode is Stopped, selecting Run begins a new measurement/acquisition cycle. If acquisition mode is Run, pressing Run halts the current measurement/acquisition cycle after it completes.
Resume	Restarts data acquisition, but does not reset accumulated results, such as Average or MaxHold. This allows you to stop acquisitions temporarily, then continue. If the accumulation is already complete, for example, 10 acquisitions or 10 averages have already been completed, each subsequent Resume command will cause one more acquisition to be taken, and its results added to the accumulation. Resume is not available if instrument settings have been changed.
<a href="#">Abort (see page 227)</a>	Immediately halts the current measurement/acquisition cycle.
<a href="#">Single Sequence (see page 249)</a>	Selects the single-sequence acquisition mode. This is only a mode selector; it does not initiate an acquisition.
<a href="#">Continuous (see page 250)</a>	Selects the continuous acquisition mode. Selecting Continuous does initiate acquisitions.

## Single Sequence Acquisition Mode

### Menu Bar: Run > Single

Selecting **Single** sets the Run mode to Single. In Single mode, as soon as one acquisition sequence completes, acquisition stops.

Note that a single acquisition sequence can require more than one acquisition. For example, in a spectrum view, the trace function might be set to Average 100 acquisitions. Thus, a complete acquisition sequence would consist of 100 acquisitions to produce 100 intermediate traces that are averaged together to create the final trace that is displayed. Once the 100 acquisitions have been completed, acquisition stops.

This is only a mode selector, it does not initiate an acquisition.

## Continuous Acquisition Mode

### Menu bar: Run > Continuous

Selecting **Continuous** places the analyzer in the Continuous acquisition mode. In Continuous mode, the analyzer acquires and displays acquisitions repeatedly. The Continuous and Single Sequence acquisition modes are mutually exclusive.

Selecting Continuous restarts acquisitions.

## Replay Menu

Reruns measurements using the current acquisition data or a saved file. Use this to compute new results for old data after you change settings. If you are working with a recalled oscilloscope waveform file, you should recall the file again rather than using Replay.

## Markers Menu

The Markers menu provides to settings that define and control the location of markers.

Setting	Description
<a href="#">Peak (see page 203)</a>	Moves the selected marker to the highest peak on the trace.
Next Peak >	Moves the selected marker to next peak depending on the setting chosen.
Marker to Center Frequency	Sets center frequency to the frequency of the selected marker.
<a href="#">Define Markers (see page 204)</a>	Displays the Define Marker control panel.
Sync Scope C1 to Active Marker	Moves oscilloscope Cursor 1 to the location on the oscilloscope waveform that matches the location of the active maker on the SignalVu active marker. If the oscilloscope cursors are off, this command turns them on.
Sync Scope C2 to Active Marker	Moves oscilloscope Cursor 2 to the location on the oscilloscope waveform that matches the location of the active maker on the SignalVu active marker. If the oscilloscope cursors are off, this command turns them on.

## Setup Menu

The Setup menu provides access to control panels that specify parameters for numerous vector signal analyzer functions.

Command	Description
<a href="#">Displays (see page 16)</a>	Displays the Displays control panel.
<a href="#">Settings (see page 267)</a>	Displays the Settings control panel for the selected display.
<a href="#">Acquire (see page 228)</a>	Displays the Acquire control panel.
<a href="#">Analysis (see page 214)</a>	Displays the Analysis control panel.
<a href="#">Preset (see page 253)</a>	Initiates the Preset.
<a href="#">Application Presets (see page 246)</a>	Displays the Application Presets window.

## Preset

### Menu Bar: Setup > Preset

Preset resets settings and clears all acquisition data. Settings and acquisition data that have not been saved will be lost.

After Preset resets the analyzer settings, it displays the Spectrum view.

Preset does not affect time or date settings, the Windows XP operating system settings, or Tools Menu items.

## Tools Menu

Provides access to several utilities for controlling instrument functions.

Command	Description
<a href="#">Search...</a> (see page 209)	Enables you to locate and highlight specified signal levels in Spectrum displays.
<a href="#">Options</a> (see page 14)	Displays the Options control panel.
Restore Scope	Moves the SignalVu application to the background and displays the TekScope application in the foreground.



## Arranging Displays

Use the Window menu to arrange how windows are displayed. Displays can be set to appear full screen (one display at a time) or with all (selected) displays visible at once. When all displays are visible at once, you can rearrange the displays by dragging the title bar of a window (deselect Window > Lock Windows to move displays around).

Command	Description
Close View	Closes the selected view.
Cascade	Positions windows in a cascade view (not available when Lock Windows is selected).
Tile Horizontally	Positions widows in a horizontal orientation (top to bottom).
Tile Vertically	Positions widows in a vertical orientation (side by side).
Lock Windows	Locks the windows into their current position, preventing them from being moved. If the windows are locked, the Cascade arrangement is not selectable.
(List of windows)	A numbered list of open windows.

## Help Menu

The Help menu provides access to the online help and version information about the vector signal analyzer software.

<b>Command</b>	<b>Description</b>
Online Help	Displays the online help.
Printable Online Help	Displays a PDF version of the online help.
Quick Start	Displays a PDF version of the SignalVu Reference Manual.
Apps Manual	Displays a PDF version of the SignalVu Application Note.
About Tektronix Vector Signal Analysis Software	Displays information about the vector signal analyzer software and installed options.

## Error and Information Messages

The following list describes some of the common error and information messages that might appear during instrument operation. Messages that apply specifically to one or more measurements appear in the displays. Messages that pertain globally, such as those about hardware status, are shown in the Status Bar at the bottom of the analyzer application window.

### Acq BW too small for current setup

The display needs a wider acquisition bandwidth than what the current data record contains. This can be due to any of the following reasons:

- The sampling parameters are being manually controlled.

In the Acquire control panel > Sampling Parameters tab, set the Adjust control to All Auto to allow the software to pick the sample rate and record length that it needs.

- A display other than the one you intended has been selected. The selected display has requested a smaller acquisition bandwidth to achieve a better accuracy or dynamic range for its particular measurement.

Select the display that contains the message. Click Run if the instrument is not already acquiring data.

- Acquisitions are not running and the measurement now requests a wider bandwidth than the last acquisition.

Click Run to perform a new acquisition with a wider bandwidth.

- The data is from a recalled TIQ file.

There is no way to increase the acquisition bandwidth for saved IQ data. You must adjust the measurement settings so that less bandwidth is required.

- The data is from a recalled oscilloscope waveform file.

In the Acquire control panel, compare the Samples/s readout on the IQ Sampling Parameters tab to the Sample Rate readout on the Scope Data tab. If the sample rate for the oscilloscope data is more than twice the value of the IQ sample rate, it means that the recalled waveform data was decimated for a previous analysis that didn't need the full bandwidth of the oscilloscope waveform. Recall the oscilloscope waveform file again to force the software to perform a new conversion based on your new measurement settings. Each time you change measurement settings in a way that increases the required acquisition bandwidth, you will need to recall the oscilloscope waveform file.

- The current Frequency setting is different than that of the data record, causing the measurement bandwidth to fall at least partly outside the bandwidth of the data.

If you are using a recalled oscilloscope waveform file, try recalling it again with the new Frequency setting. This will force a new conversion from oscilloscope samples to IQ samples.

**Analysis failure:** <description of error>

The instrument is unable to complete a measurement due to difficulty in characterizing the signal. For example, due to either the signal or settings, the instrument may not be able to recognize a pulse so it can compute the pulse measurements.

- Try changing settings to improve analysis. For example, when Pulse Trace is displayed, try changing the settings on the Settings > Params.

#### **Analysis failure: Carrier detection failed**

The instrument was unable to locate a carrier signal. Try adjusting the Carrier Threshold or Integration BW values, if the measurement has these controls.

#### **Analysis Length was limited**

This message appears if the "Results Length", the time over which the measurement computed its results, is less than the Actual Analysis Length reported in the Analysis Time control panel tab and the Time Overview display. The Results Length is indicated by the magenta line below the Time Overview graph. This can occur because the acquisition contained more data samples than a measurement can process (for example, digital demodulation is limited to 80,000 samples) or the measurement had to use some of the first and last samples for pre-measurement processes.

#### **Analysis length too small for current setup**

Increase the Analysis Length or decrease the RBW (Spectrum, ACPR, MCPR).

#### **Avg Tx not available in Volts units**

The Average Transmitted Power measurement is not defined for Volts.

The instrument is unable to create a required cache file. To resolve this issue, use a standard disk management utility to defragment the hard disk. If this error persists, backup your data (including any setup files you have saved), any applications and associated files you have installed and perform an OS restore on the hard disk. After restoring the OS, reinstall the RSA6100A Series product software.

#### **Can't get acquisition data record**

No acquisition record currently exists in memory (run an acquisition or recall a file), or an error has occurred. Repeat the acquisition.

#### **Can't replay data from swept acq**

The measurement could not produce results because it is a real-time only measurement but was asked to reanalyze (Replay) an acquisition taken in swept mode.

#### **Can't replay. Live data needed for swept settings**

The measurement could not produce results because it was asked to reanalyze (Replay) the acquisition but it is in Swept acquisition mode. Swept-mode measurements cannot analyze recalled data.

#### **CISPR accuracy limited by acq memory. Adjust RBW or freq range**

The CISPR function was applied, but the available data did not represent a long enough time to satisfy CISPR requirements. Increasing RBW reduces the amount of time needed for analysis. Reducing frequency range (for example, by reducing Span), decreases sample rate, allowing the available memory to cover a longer time period.

An acquisition was completed even though a hardware failure was detected. This message refers to the acquisition data currently being analyzed, but not necessarily to the current status of the instrument.

If this data is from a saved file, the error cannot be cleared.

#### **Data acquired during RF ADC overrange**

An acquisition was completed but the signal was outside the range of the analog-to-digital converter at the time this data was acquired. This message refers to the acquisition data currently being analyzed, but not necessarily to the current status of the instrument.

If this data is from a saved file, this error cannot be cleared.

#### **Data acquired during RF digital gain overflow**

This data was acquired when the input signal contained peaks greater than 6 dB above the Reference Level setting.

If the data is from a file, this error cannot be cleared.

#### **Data from unaligned instrument**

The acquisition data was captured when the instrument was not aligned. This message refers to the acquisition data currently being analyzed, but not necessarily to the current status of the instrument. Measurements made on this data might not be accurate.

#### **Data from uncalibrated instrument**

The acquisition data was captured when the instrument was not calibrated. This message refers to the acquisition data currently being analyzed, but not necessarily to the current status of the instrument.

If this data is from a file, the error cannot be cleared.

#### **Data acquired with 3 GHz preamp**

This is a warning that signals above 3 GHz are likely to be severely attenuated because the Preamp was on when the data was acquired. The (optional) Preamp is not specified for operation above 3 GHz.

#### **Disabled: data is from swept acquisition**

The display needs to run in real-time mode. The display associated with this message cannot run now because it is not the selected display, and the selected display is performing multiple acquisitions (it is in swept mode).

- Change the settings of the selected display so it is performing real-time acquisitions.
- Select the associated display to make it the selected display. When it is selected, it will force the acquisition parameters to change to meet its own needs.

#### **Needs swept acq or larger AcqBW - Acquire data while display is selected**

The display is not running because it needs to perform multiple acquisitions (it must be in swept mode) but it is not the selected display. Only the selected display can perform multiple acquisitions.

- Select the display showing this message to give it control of acquisitions parameters.

Sometimes, only one display can work and the others will be blank and show errors. This happens when different displays have conflicting demands on the acquisition data record.

**Export failure: file not saved**

An error occurred while exporting Results. The file was not created.

- Export the results again.

**Export failure: unable to open results file for export. File not saved.**

The Export Results file could not be opened for writing, so the export of results was not completed.

- Verify that there is sufficient free space on hard disk.

**Insufficient data for CISPR. Acquire while display is selected**

This message appears when a measurement is not the selected measurement and CISPR filters are selected. Set the measurement to be the selected measurement and reacquire the signal.

**IQ Processing Error: 8012**

This message occurs in GP Digital Modulation displays. The most likely cause for this message is that there are not enough symbols to analyze. This can happen if

- The Analysis Length is set too short. Increase the Analysis Length on the Analysis Time tab.
- The Analysis Offset has pushed the Analysis Time so far out that the actual Analysis Length is too short, even though the user-requested Analysis Length would have been long enough without the excessive offset. Decrease the Analysis Offset on the Analysis Time tab.
- The input signal is bursted, and the burst does not contain enough symbols.

**Needs swept acq or larger Acq BW - Acquire data while display is selected**

The display has one of two problems: It is not the selected display, which prevents it from controlling the hardware acquisition parameters, and setting the acquisition mode to Swept; or its settings require a wider data bandwidth.

- Select the display that you are interested in and it will change the acquisition to meet its own needs.
- Increase the acquisition bandwidth manually or by changing the selected display's settings to cause the wider bandwidth.

**No Math trace: unmatched trace lengths**

A math trace could not be produced because the traces selected to generate the math trace do not have the same number of points. This can easily happen if both traces are recalled, but were saved under different "Points" settings. This can also occur if one of the selected traces is a live trace and the other trace is a recalled trace.

- In a Spectrum display, as long as one trace is live, you can change the "Points" setting (Setup > Settings > Freq & Span tab) to match the recalled trace.
- If you are using two recalled traces to generate the Math trace. You must recreate at least one of the traces.

**No burst detected**

The [Burst Detection Mode \(see page 184\)](#) is On, but no burst was detected in the signal.

- Check that the Threshold setting is properly set.

**Not enough samples for current setup**

The measurement was not able to run because the combination of analysis length, offset, and measurement bandwidth relative to acquisition bandwidth, were such that not enough samples were available for the measurement to analyze. This can occur when two or more displays are shown and one display requires a wide acquisition bandwidth and another display requires a much narrower bandwidth. The display requiring the much narrower bandwidth must decimate and filter the acquisition record which can result in too few samples left for the measurement.

- Increase the Analysis Length to provide more samples.
- Close any displays you don't currently need.

**No FFT (not all pulses have results)**

If a pulse cannot be measured (because its shape is too indistinct or it does not meet the [parameters that define a pulse \(see page 132\)](#)), its results will be "-" for every measurement on that pulse. The instrument cannot compute an FFT.

**No pulses found**

The instrument was unable to find any complete pulses in the signal.

- Make sure the [analysis length \(see page 214\)](#) includes at least one complete pulse cycle, from before one rising edge until after the next rising edge.

**Pulse Detection Error**

The instrument was unable to detect a pulse.

- The pulse [Measurement Filter \(see page 132\)](#) needs to be smaller. Try reducing the bandwidth and/or selecting the Gaussian filter.
- Detection threshold is not set to the proper level for the signal. Adjust the [Power threshold to detect pulses \(see page 132\)](#).
- The pulse interval is too long for the current settings. Try decreasing the [filter bandwidth \(see page 132\)](#), as this may reduce the number of data points to a manageable quantity.

**RBW conflict. Increase Span or Analysis Length**

The measurement is not running because the actual RBW used by the measurement is too large for the current acquisition span. Typically, the analysis length is too short as well.

- Either increase the span or increase the Analysis Length.

**RBW decreased**

The current span or acquisition bandwidth is too small to allow a wider RBW filter.

- Increase the span or acquisition bandwidth if the decreased RBW is not acceptable.

**RBW increased**

The current Spectrum Length (or Analysis Length if Spectrum Length is not Independent) is too small to allow the requested RBW.

- Increase the Spectrum Length (or Analysis Length) if the increased RBW is not acceptable.

**RBW limited by AcqBW to: XX Hz**

The requested RBW is too close to the acquisition BW. Increase the frequency range of the measurement (for example, Span).

**RBW too small/large for current Acq BW**

If the RBW is set manually, it is possible for the acquisition bandwidth to be incompatible with the RBW setting.

- Change the RBW setting.
- Adjust the Acq BW setting, either directly (Setup > Acquire > Sampling Params: select on of the manual modes) or by adjusting the measurement bandwidth of the selected display (Setup > Acquire > Sampling Params: All Auto).

**Recall error: Setup not completely restored**

An error occurred while recalling a Setup file. Thus, the current setup may be a combination of settings from the Setup file and the previous Setup.

- Recall the setup again.

**Recall failure: problem with file or file contents**

An error occurred while recalling a Setup, Trace or Data file. This can occur because of a problem opening the file (operating system error) or because of a problem with the contents of the file.

- Recall the file again.

**Restoring acquisition data...**

This is a status message displayed while data is being restored from a file.

**Save failure: file not saved**

An error occurred while saving a Setup or Data file.

- Save the file again.

**Saving acquisition data...**

This is a status message displayed while data is being saved to a file.

**Selected VBW does not use full Spectrum Length**

This message can occur when the Spectrum Length is greater than required for the VBW filter. If you look at the Time Overview display, the Magenta line for Results Length indicates the part of the Spectrum Length that was actually used. The measurement results are correct, but don't include some of the data in the selected Spectrum Length. To clear this message, you can set the Spectrum Length to Auto.



**Setup error: <description of error>**

When this message appears, it includes text that explains the problem. For example, the ACPR display might show: “Setup error: channels can’t overlap”. Setup errors are the result of conflicts in instrument settings. These types of errors occur when a user makes manual changes to settings. In the example above, the channel settings in the Channel Power and ACPR display have been set so that the channels overlap in frequency.

- Adjust the instrument settings, or change a setting back to Auto, to eliminate the error.

**Setup error: Integration BW exceeds Measurement BW**

When this message appears, it includes text that explains the problem. Setup errors are the result of conflicts in instrument settings. These types of errors occur when a user makes manual changes to settings.

- Adjust the instrument settings, or change a setting back to Auto, to eliminate the error.

**Setup error: Measurement time for Freq & Phase results**

The [Measurement time for Freq & Phase results \(see page 133\)](#) specifies how far across the pulse top the instrument should wait before measuring the Phase Difference and Frequency Difference for each pulse. If this value is set too large for any of the pulses in the signal, the measurement point ends up on the falling edge or during the pulse off time.

- Decrease the Measurement time for Freq & Phase results setting (Settings > Define tab).

**Unexpected software error. Please cycle power and try again. If the problem persists, contact your Tektronix Service Center.**

An unrecoverable error has occurred, and the instrument application software will shut down.

- Switch the instrument off and restart it or relaunch the TekScope and SignalVu applications.

**VBW not applied - Acq BW too small**

Increase VBW or measurement bandwidth. Make sure Sampling Parameters are set to Auto.

**VBW not applied - Spectrum Length too short**

This message occurs when the requested VBW can’t be produced because the Spectrum Length is too short.

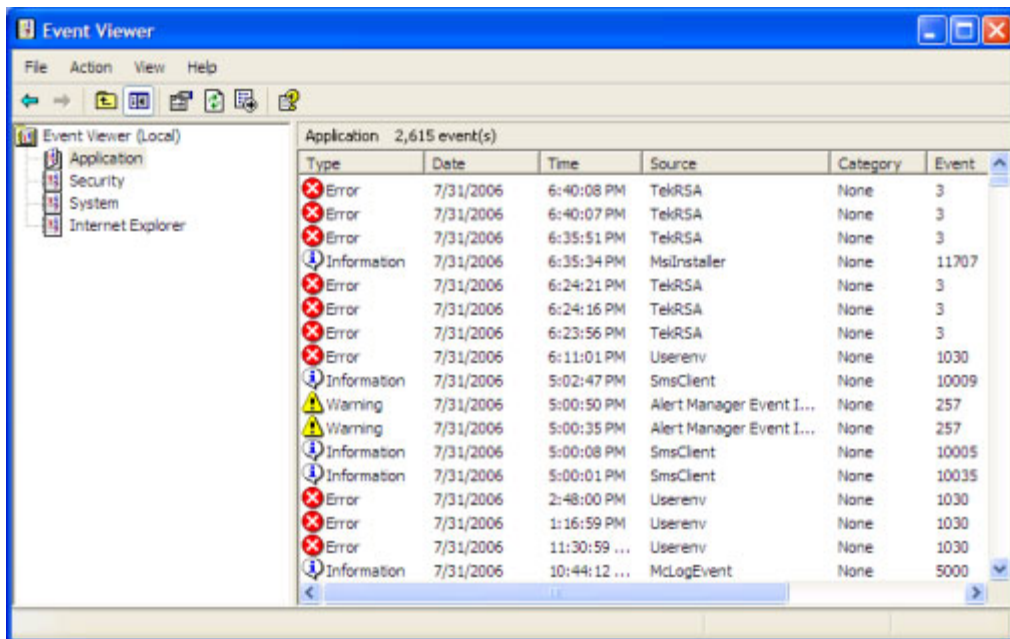
To clear this problem, set the Spectrum Length to Auto or manually increase the Spectrum Length (see Setup > Analysis > Spectrum Time tab). If Spectrum Length is coupled to Analysis Length, set Analysis Length to Auto or manually increase it (see Setup > Analysis > Analysis Time tab).

## Displaying the Windows Event Viewer

When the analyzer generates an error message, information about the error is logged to the Windows Event Viewer.

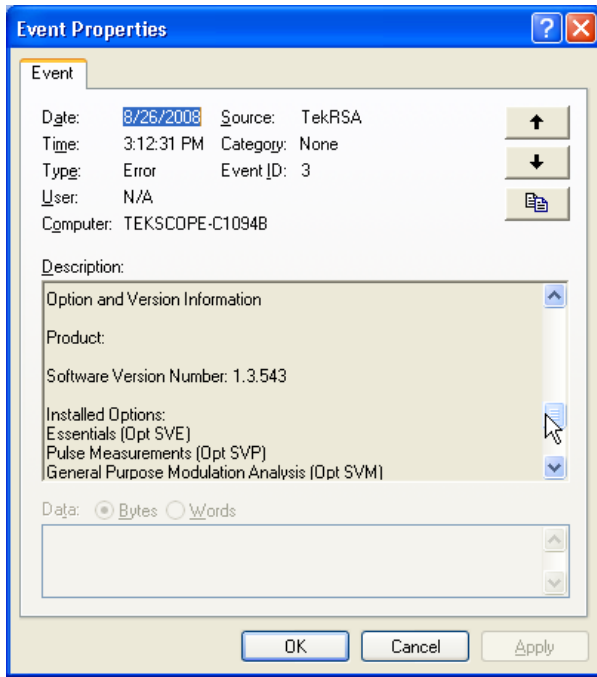
To display the Windows Event Viewer:

1. Select Start > Control Panels.
2. Select Administrative Tools. (If your instrument displays control panels in Category View, select Performance and Maintenance and then select Administrative Tools.)
3. Double-click Event Viewer.
4. From the Event Viewer window, select Application. this displays a list of all errors that have been reported to the operating system from applications.



Errors reported to the Event Viewer from the analyzer application appear under Source as TekRSA.

5. Double-click the last error reported for TekRSA to see details on the most recently reported error. Please note that many items reported as “errors” are simply informational and do not mean that your instrument is impaired. Contact the Tektronix Customer Support Center or Service Center if you are concerned about an error shown in the Event Viewer. Do not send an instrument out for repair based solely on these event reports.



## How to Find Out If Instrument Software Upgrades Are Available

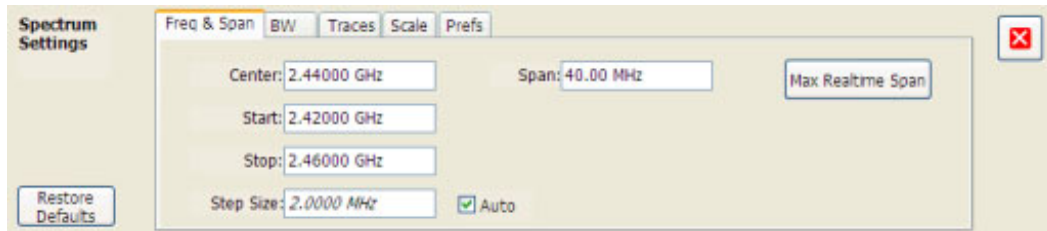
Software upgrades might be available from Tektronix. They can either be downloaded from the Tektronix Web site or they can be ordered from your local Tektronix representative. To see if a software upgrade is available for your instrument, use your browser to go to [www.tektronix.com/software](http://www.tektronix.com/software). Search by the instrument model number.

To add additional software options or features, you will need an option key from Tektronix. When you receive the software from Tektronix, install it on your instrument. When prompted, enter the option key, and then follow the online instructions to complete the upgrade.

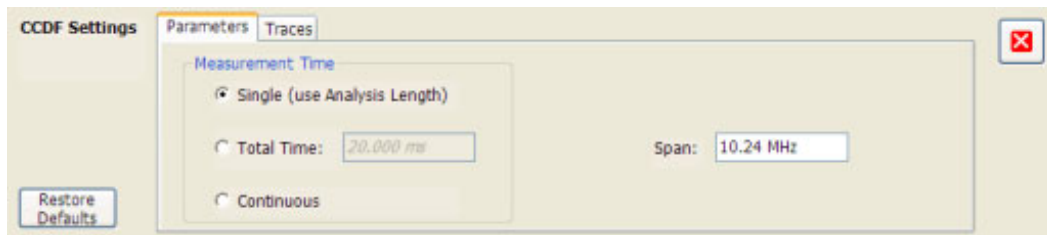
## Settings

### Menu Bar: Setup > Settings

The Settings menu item enables access to control panels that allow you to change settings for the selected display. The control panel that appears when you select **Settings** depends on the selected display. The Settings control panel for the Spectrum display is shown in the following figure.



The control panel for the CCDF display is shown in the following figure.



### Settings Control Panels

[ACPR Settings \(see page 86\)](#)

[Acquire \(see page 228\)](#)

[AM Settings \(see page 60\)](#)

[Amplitude vs Time Settings \(see page 41\)](#)

[Analysis Settings \(see page 214\)](#)

[CCDF Settings \(see page 116\)](#)

[Channel Power and ACPR Settings \(see page 86\)](#)

[Constellation Settings \(see page 145\)](#)

[EVM vs Time Settings \(see page 150\)](#)

[Eye Diagram Settings \(see page 153\)](#)

- [FM Settings \(see page 68\)](#)
- [Frequency Deviation vs Time Settings \(see page 156\)](#)
- [Frequency vs Time Settings \(see page 44\)](#)
- [Magnitude Error Settings \(see page 159\)](#)
- [MCPR Settings \(see page 86\)](#)
- [Occupied Bandwidth Settings \(see page 100\)](#)
- [Phase Error vs Time Settings \(see page 162\)](#)
- [Phase vs Time Settings \(see page 46\)](#)
- [PM Settings \(see page 76\)](#)
- [Pulse Statistics Settings \(see page 131\)](#)
- [Pulse Table Settings \(see page 126\)](#)
- [Pulse Trace Settings \(see page 128\)](#)
- [RF I Q vs Time Settings \(see page 48\)](#)
- [Search \(Limits Testing\) Settings \(see page 209\)](#)
- [Signal Quality Settings \(see page 168\)](#)
- [Spectrogram Settings \(see page 35\)](#)
- [Spectrum Settings \(see page 31\)](#)
- [Spurious Settings \(see page 106\)](#)
- [Symbol Table Settings \(see page 170\)](#)
- [Time Overview Settings \(see page 25\)](#)
- [Trellis Diagram Settings \(see page 173\)](#)

## Accuracy

The closeness of the indicated value to the true value.

## ACLR

Adjacent Channel Leakage power Ratio is the ratio of the RRC (Root Raised Cosine) filtered mean power centered on the assigned channel frequency to the RRC filtered mean power centered on an adjacent frequency (defined in 3GPP).

## ACPR Measurement

Adjacent Channel Power Ratio (ACPR) is the ratio of the mean power centered on the assigned channel frequency to the mean power centered on an adjacent channel frequency. In the 3GPP specification, it is called ACLR (Adjacent Channel Level Ratio) and both the main channel and adjacent channels are required to be filtered with RRC (Root Raised Cosine) filters.

## Acquisition

A series of time-contiguous frames. This is also called a Block.

## Analysis Length

The length of time in the Analysis Time.

## Analysis Time

The portion of the acquisition record over which one or more measurements are calculated.

## ASK

Acronym for Amplitude Shift Keying. The process, or result of a process, in which the amplitude of the carrier is varied in accordance with the state of a digital input signal.

## Block

An integer number of time-contiguous frames. See also: Acquisition.

## Calibrator

A signal generator producing a specified output used for calibration purposes.

## Carrier

The RF signal upon which modulation resides.

## Carrier Frequency

The frequency of the CW component of the carrier signal.

## Carrier Signal

The electrical signal, typically a sine wave, upon which modulation is impressed.

## Carrier-to-Noise Ratio (C/N)

The ratio of carrier signal power to average noise power in a given bandwidth surrounding the carrier; usually expressed in decibels.



## CCDF - Complimentary Cumulative Distribution Function

The Complementary Cumulative Distribution Function (CCDF) represents the probability that the peak power above average power of a measured signal exceeds a threshold.

CCDF is a plot of the percent of time that a signal's power value exceeds its average value versus the amount by which it exceeds the average. The CCDF plot has a log of probability on the Y-axis (100% at the top) and dB above average amplitude on the X-axis (0 at the left).

## CDMA

Acronym for Code Division Multiple Access.

## Center Frequency

The frequency corresponding to the center of a frequency span of the analyzer display.

## Check Mark Indicator

The check mark indicator in the upper-left corner of the display indicates the display for which the acquisition hardware is optimized. When you have more than one display open, the display with the check mark indicator has control over the acquisition hardware. To give a display priority over any others, click its title bar.

## CISPR

International special committee on radio interference. (Comité international spécial des perturbations radioélectriques)

## CW

Acronym for Continuous Wave.

## CW Signal

Continuous wave signal - a sine wave.

## DANL

Acronym for Displayed Average Noise Level. See [Sensitivity \(see page 280\)](#).

## dBfs

A unit to express power level in decibels referenced to full scale. Depending on the context, this is either the full scale of the display screen or the full scale of the analog-to-digital converter (ADC).

## dBm

A unit of expressed power level in decibels referenced to 1 milliwatt.

## dBmV

A unit to express voltage levels in decibels referenced to 1 millivolt.

## dBuV

A unit to express voltage levels in decibels referenced to 1 microvolt.

## Decibel

Ten times the logarithm of the ratio of one electrical power to another.

## Display Reference Level

A designated vertical position representing a specified input level. The level may be expressed in dBm, volts, or any other units.

## Distortion

Degradation of a signal, often a result of nonlinear operations, resulting in unwanted signal components. Harmonic and intermodulation distortion are common types.

## Dynamic Range

The maximum ratio of the levels of two signals simultaneously present at the input which can be measured to a specified accuracy.

## EVM

Acronym for Error Vector Magnitude.

## Export

Save data to a file in a format other than application-native.

## FastFrame

FastFrame segments the acquisition record into a series of frames and then captures acquisitions as single frames. You can then view and measure each frame individually.

## FFT

Fast Fourier Transform - a mathematical process to calculate the frequency spectrum of a discrete number of time domain sample points.

## Filter

A circuit that separates electrical signals or signal components based on their frequencies.

## FM

Acronym for Frequency Modulation.

## Frame

A series of time-contiguous samples, long enough in duration and at a sufficient sample rate to produce a spectrum view of a specified span and RBW.

## Frequency

A series of time-contiguous samples, long enough in duration and at a sufficient sample rate to produce a spectrum view of a specified span and RBW.

## Frequency Band

The continuous range of frequencies extending between two limiting frequencies, expressed in hertz.

## Frequency Domain View

The representation of the power of the spectral components of a signal as a function frequency; the spectrum of the signal.

## Frequency Drift

Gradual shift or change in displayed frequency over the specified time due to internal changes in the analyzer, where other conditions remain constant. Expressed in hertz per second.

## Frequency Mask Trigger

A flexible real-time trigger based on specific events that occur in the frequency domain.

## Frequency Range

The range of frequencies over which the performance of the instrument is specified.

## Frequency Span

A continuous range of frequencies extending between two frequency limits.

## GPIB

Acronym for General Purpose Interface Bus, the common name for the communications interface system defined in IEEE Std. 488.

## Graticule

The calibrated grid overlaying the display screen of analyzers, oscilloscopes, and other test instruments.

## Grayed Out

An on-screen control is “Grayed Out” if it is not adjustable.

## I/Q

Acronym for In-phase / Quadrature.

## IF

Acronym for Intermediate Frequency.

## Import

Bring data into the application from a file of some format other than application-native.

## Impulse Response

The Impulse Response trace display shows normalized power on the vertical axis and time on the horizontal axis.

## Input Impedance

The impedance at the desired input terminal. Usually expressed in terms of VSWR, return loss, or other related terms for low impedance devices and resistance-capacitance parameters for high impedance devices.

## LISN

Acronym for Line Impedance Stabilization Network.

## Local Oscillator (LO)

An oscillator which produces the internal signal that is mixed with an incoming signal to produce the IF signal.

## Marker

A visually identifiable point on a waveform trace, used to extract a readout of domain and range values represented by that point.

## Max Hold

Digitally stored display mode which, at each frequency address, compares the incoming signal level to the stored level and retains the greater level. In this mode, the display indicates the peak level at each frequency after several successive acquisitions.

## MCPR (Multiple Carrier Power Ratio)

The ratio of the signal power in the reference channel or group of channel to the power in adjacent channels.

## Min Hold

Digitally stored display mode which, at each frequency address, compares the incoming signal level to the stored level and retains the lower level. In this mode, the display indicates the minimum level at each frequency after several successive sweeps.

## Modulate

To regulate or vary a characteristic of a signal, typically in order to transmit information.

## Modulating Signal

The signal which modulates a carrier. The signal which varies or regulates some characteristic of another signal.

## Modulation

The process of varying some characteristic of a signal with a second signal.

## Noise

Unwanted random disturbances superimposed on a signal which tend to obscure it.

## Noise Bandwidth (NBW)

The exact bandwidth of a filter that is used to calculate the absolute power in dBm/Hz.

## Noise Floor

The noise intrinsic to a system that represents the minimum limit at which input signals can be observed; ultimately limited by thermal noise (kTB). The analyzer noise floor appears as a “grassy” baseline in the display, even when no signal is present.

## Open (Recall)

Bring data into the application from a file of application-native format.

## OQPSK

Acronym for Offset QPSK (Quadrature Phase Shift Keying).

## PM

Acronym for Phase Modulation.

## Primary Marker

The marker displayed in the Single Marker mode whose frequency and/or position is changed when tuning with the general purpose knob.

## PSK

Acronym for Phase Shift Keying. The process, or result of a process, in which the carrier phase is varied discretely in accordance with a digital code.



## QAM

Acronym for Quadrature Amplitude Modulation. The process, or result of a process, in which the amplitude and phase of the carrier are varied concurrently by synthesizing two orthogonal ASK waves (see ASK).

## Real-Time Analysis

Measurement technique based on triggering on an RF signal, seamlessly capturing it into memory, and analyzing it in the frequency, time, and modulation domains.

## Real-Time Bandwidth

The frequency span over which real-time seamless capture can be performed, which is a function of the digitizer and the IF bandwidth of a Real-Time Spectrum Analyzer.

## Real-Time Seamless Capture

The ability to acquire and store an uninterrupted series of time domain samples that represent the behavior of an RF signal over a long period of time.

## Reference Level

The signal level represented by the uppermost graticule line of the analyzer display.

## Residual FM (Incidental FM)

Short term displayed frequency instability or jitter due to instability in the analyzer local oscillators. Given in terms of peak-to-peak frequency deviation and expressed in hertz or percent of the displayed frequency.

## Residual Response

A spurious response in the absence of an input signal. (Noise and zero pip are excluded.)

## RBW

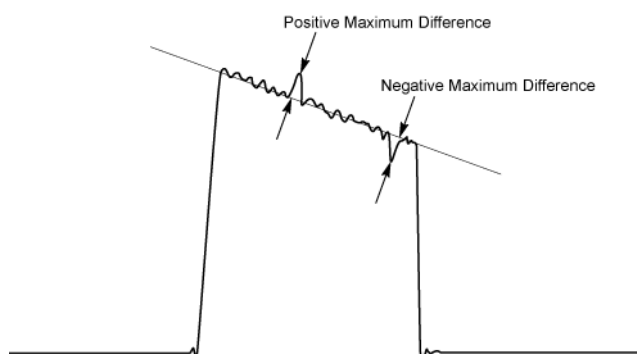
The RBW determines how well the analyzer can resolve or separate two or more closely spaced signal components.

## Ripple

The Ripple measurement is calculated as follows:

$$\text{Ripple} = | \text{Positive Maximum Difference} | + | \text{Negative Maximum Difference} |$$

where the maximum differences are calculated as shown in the following illustration.



## Secondary Marker

The “second” marker displayed only in the Delta Marker mode.

## Sensitivity

Measure of a analyzer’s ability to display minimum level signals, usually expressed as displayed average noise level ([DANL \(see page 272\)](#)).

## Shape Factor (Skirt Selectivity)

The ratio of the frequency separation of the two (60 dB/3 dB) down points on the response curve to the static resolution bandwidth.

## Signal

As used in this online help, the signal refers to the input signal before it is processed. The signal is an input.

## Span

Span is the range of frequencies displayed in a spectrum window. Span, start frequency and stop frequency are related by the following equation:  $\text{Span} = (\text{stop frequency}) - (\text{start frequency})$ . The settings for center, start and stop frequencies are related to the setting for span; when one parameter is changed, the other are changed automatically.

## Span Per Division (Span/Div)

Frequency difference represented by each major horizontal division of the graticule.

## Spectrogram

Frequency vs. time vs. amplitude display where the frequency is represented on the x-axis and time on the y-axis. The power level is indicated by variations in color.

## Spectrum

The frequency domain representation of a signal showing the power distribution of its spectral component versus frequency.

## Spectrum Analysis

The technique or process of determining the frequency content of an RF signal.

## Spectrum Analyzer

A device for determining the frequency components of a signal.

## Spectrum Time

Analysis Time for spectrum analysis views. Spectrum time can be the same as Analysis Time, but it can be different.

## Spur

A spur is a signal peak that exceeds a user-definable threshold (See Spurious > Settings > Ranges) and excursion setting. A spur that also exceeds a limit (either Absolute or Relative) specified on the Settings > Limits tab is considered a violation.

## Spurious Response

A response to a analyzer wherein the displayed frequency is not related to the input frequency.

## Time Measurement

This is the time in seconds relative to the time reference point in the first acquisition record in the data set.

## Time Reference

The point in time during the acquisition record used as the zero point for counting time. The time reference can be set to either the start of the acquisition record or the trigger point.

## Trace

As used in this online help, trace refers to the displayed signal. The displayed signal can be a processed version of the input signal (for example, it may be averaged.) The trace is a result or output.

## Vector Signal Analyzer

Like a spectrum analyzer, a device for determining the frequency components of a signal. However, unlike a standard spectrum analyzer, the vector signal analyzer is optimized for analyzing digitally modulated RF signals.

## Vertical Scale Factor, Vertical Display Factor

The number of dB, volts, etc., represented by one vertical division of a spectrum analyzer display screen.

## Violation

A violation is a spur that exceeds either an Absolute or Relative limit (depending on the selected mask) specified on the Settings > Limits tab. A spur is a signal peak that exceeds a user-definable threshold (See Spurious > Settings > Ranges) and excursion setting.



# Index

## Symbols and Numbers

-6dB RBW (MIL) Filter shape  
Spectrum display BW tab, 54

## A

Abort acquisition, 227  
About the RTSA, 239  
accuracy, 269  
ACLR, 269  
ACLR measurement, 85  
ACPR measurement, 269  
Acquire control panel, 228  
acquisition, 269  
acquisition data  
  saving, 233  
Acquisition data files, 15  
Acquisition Info tab, 220  
acquisition memory usage, 230  
Actions tab  
  Search, 213  
Adjacent Channel Power  
  measurement, 86  
Advanced Params Tab  
  GP Digital Modulation  
  displays, 181  
AM display, 59  
Amplitude control panel, 224  
Amplitude vs. Time display, 40  
Amplitude vs. Time display  
  Settings, 41  
Analysis control panel, 214  
analysis length, 269  
analysis time, 269  
Analysis Time tab  
  GP Digital Modulation  
  displays, 184  
Analysis Time tab (Analysis  
  control panel), 214  
application presets, 11  
  saving, 233  
Apply ampl corrections, 134  
arranging windows, 255  
ASK, 270

automatically generate  
  filenames, 14  
Automatically increment  
  filename/number, 15  
Average Channel Power  
  measurement, 85  
Average ON Power, 20  
Average Transmitted Power, 20

## B

Blackman-Harris 4B Filter Shape  
  Spectrum display BW tab, 54  
Blizzard color scheme, 15  
block, 270  
Blue background (cells), 102  
Burst detect threshold, 76  
BW Tab  
  Amplitude vs. Time  
  display, 42  
  Spectrum display, 54

## C

C4FM modulation type  
  measurements, 20  
C4FM signal quality  
  measurements, 167  
Calibrate IQ Offset, 229  
calibrator, 270  
carrier, 270  
carrier frequency, 270  
Carrier frequency detection, 69  
Carrier Frequency Error, 20  
carrier signal, 270  
carrier-to-noise ratio (C/N), 270  
CCDF - Complimentary  
  Cumulative Distribution  
  Function, 271  
CCDF display, 115  
CDMA, 271  
center frequency, 271  
Channel  
  Acquire control panel, 5  
  Vertical tab, 228

Channel Power and ACPR  
  (Adjacent Channel Power  
  Ratio) display, 83  
Channel Power and ACPR  
  Settings control panel, 86  
Channel Power measurement, 85  
Channels tab  
  Channel Power & ACPR  
  display, 86  
Channels tab (MCPR), 95  
check mark indicator, 8  
CISPR, 271  
CISPR Filter shape  
  Spectrum display BW tab, 54  
Classic color scheme, 15  
Colors tab, 15  
Constellation display, 144  
Constellation display  
  settings, 145  
Continuous Acquisition  
  Mode, 250  
Correct for Noise Floor  
  Channel Power & ACPR  
  display, MCPR  
  display, 94  
correction tables, 224  
creating application presets, 11  
CW, 271  
CW signal, 272

## D

DANL, 272  
Data file formats, 235  
Data properties  
  File menu, 245  
dBfs, 272  
dBm, 272  
dBmV, 272  
dBuV, 272  
decibel, 272  
default settings, restore, 11  
Define Markers, 204  
Define Peaks tab, 204

- Define tab, 209
  - Pulsed RF displays, 133
- Delta Markers, 204
- Demod I&Q vs Time display
  - settings, 148
- description
  - RSA6100A Series, 2
- detect, 120
  - AM display, 62
  - FM display, 70
  - General Signal Viewing displays, 51
  - PM display, 78
  - Time Overview, 26
- detection, 36
  - AM display, 62
  - FM display, 70
  - General Signal Viewing displays, 51
  - PM display, 78
  - Time Overview, 26
- detector, 120
  - AM display, 62
  - FM display, 70
  - General Signal Viewing displays, 51
  - PM display, 78
  - Time Overview, 26
- deviator, 120
  - AM display, 62
  - FM display, 70
  - General Signal Viewing displays, 51
  - PM display, 78
  - Time Overview, 26
- Deviation, 20
- display reference level, 273
- Displays
  - arranging, 16
  - interactions between, 16
  - selecting, 16
- distortion, 273
- documentation, 4
- Droop, 21
- Droop dB, 21
- Duty Factor (%) measurement, 20
- Duty Factor (Ratio) measurement, 20
- dynamic range, 273
- E**
- Elements of the display, 8
- error message
  - Windows Event Viewer, 263
- Error messages, 257
- Event Viewer, 263
- EVM, 273
- EVM vs. Time display, 149
- EVM vs. Time Settings, 150
- export, 273
- External Gain value, 224
- External Gain/Loss Correction tab, 224
- External Loss Tables, 224
- Eye Diagram display settings, 153
- F**
- Fall Time, 20
- FastFrame, 230
- FFT, 273
- File formats, 235
- File Menu, 242
- filter, 274
- Filter Parameter
  - GP Digital Modulation displays, 175
- Filter Shape
  - Spectrum display BW tab, 54
- Find tab
  - GP Digital Modulation displays, 184
- finding bursts in data
  - GP Digital Modulation displays, 184
- FlatTop (CW ampl) Filter Shape
  - Spectrum display BW tab, 54
- FM, 274
- FM display, 66
- FMT (Frequency Mask Trigger), 275
- frame, 274
- Freq & BW Tab
  - GP Digital Modulation displays, 180
- Freq & Span tab
  - General Signal Viewing displays, 50
- Freq Deviation, 21
- Freq Diff, Phase Diff setting, 135
- Freq Error, 20
- Freq Estimation tab
  - Pulsed RF displays, 139
- Freq, Span & RBW tab
  - Channel Power & ACPR display, MCPR display, 93
  - RF Measurements displays, 119
- Freq-domain Linearity setting, 134
- frequency, 274
- frequency band, 274
- Frequency Deviation vs. Time settings, 156
- frequency domain view, 274
- frequency drift, 274
- Frequency Error, 18
  - GP Digital Modulation displays, 180
- Frequency Mask Trigger (FMT), 275
- Frequency Offset
  - GP Digital Modulation displays, 180
- frequency range, 275
- frequency span, 275
- Frequency tab, 216
- Frequency vs. Time display, 43
- Frequency vs. Time Settings, 44
- Full Screen, 247
- G**
- Gain Imbalance, 165
- GPIO, 275
- GPIO tab, 14
- graticule, 275
- Graticule On/Off
  - RF Measurements displays, 123
- grayed out, 275
- H**
- Hanning Filter Shape
  - Spectrum display BW tab, 54
- Help Menu, 256
- Hide sensitive readouts, 14
- Hide Sensitive readouts, 14
- Histogram readout
  - Pulsed RF displays, 141



- I**
- I/Q, 275
  - IF, 276
  - import, 276
  - Impulse Response Amplitude, 21
  - Impulse Response setting, 134
  - Impulse Response Time, 21
  - Information messages, 257
  - input
    - selecting, 5
  - input impedance, 276
  - Installed options, 3
  - Internal attenuator (Internal Settings tab), 224
  - IQ Origin Offset, 165
  - IQ Sampling Parameters Tab, 230
  - IQ vs. time view, 47
  - is greater than (search), 210
  - is inside mask, 209
  - is inside mask (search), 210
  - is less than (search), 210
  - is outside mask, 209
  - is outside mask (search), 210
- K**
- Kaiser (RBW) Filter Shape
    - Spectrum display BW tab, 54
  - Keep-out time, 134
- L**
- Length, 20
  - Levels tab
    - Pulsed RF displays, 138
  - Limit lines, 209
  - Limits tab
    - Spurious display, 112
  - LISN, 276
  - local oscillator (LO), 276
  - Lock Center Frequency of
    - Spectrum displays, 216
  - Log (Horizontal)
    - Spectrum display, 32
- M**
- Mag Error, 166
  - Magnitude Error vs. Time
    - display, 157
  - Magnitude Error vs. Time
    - settings, 159
  - manuals, 4
  - marker, 276
  - Marker Noise mode, 207
  - Marker Properties tab, 204
  - Marker to Center Frequency, 203
  - Markers, 206
    - Marker Toolbar, 206
    - Using Markers, 199
    - Using Markers in Noise Mode, 207
  - Markers menu, 252
  - Mask Editor, 209
  - MATLAB format, 235
  - Max Freq Error, 21
  - max hold, 277
  - Max number of pulses
    - Pulse Table display, 132
  - Max Phase Error, 21
  - Max trace points, 43
  - MCPR (multiple carrier power ratio), 277
  - MCPR display, 89
  - MCPR settings, 92
  - Measurement Filter
    - GP Digital Modulation displays, 175
  - Measurement Frequency, 216
  - Measurement Params tab
    - Channel Power & ACPR display, MCPR display, 94
  - Measurement point, 135
  - Measurement settings export, 233
  - Measurements, 17
  - Measurements tab, 126
  - Menus, 241
  - MER (RMS), 18
  - min hold, 277
  - modulate, 277
  - modulating signal, 277
  - modulation, 277
  - modulation measurements, 18
  - Modulation Params tab
    - GP Digital Modulation displays, 175
  - modulation types supported, 176
  - moving windows, 255
  - Multiple Carrier Power Ratio, 92
- N**
- nFSK modulation type
    - measurements, 20
  - nFSK signal quality
    - measurements, 166
  - noise, 277
  - noise bandwidth (NBW), 278
  - noise floor, 278
  - Noise markers, 207
- O**
- OBW Level Left/Right, 98
  - OBW Ref Power, 98
  - Occupied Bandwidth, 100
  - Occupied Bandwidth
    - settings, 100
  - Occupied BW display, 98
  - Offset EVM, 19
  - offset frequency
    - IQ signal types, 229
  - online help, 239
  - Open (Recall), 278
  - Optimization
    - Channel Power & ACPR display, MCPR display, 94
  - Options
    - installed, 3
  - Options control panel, 14
  - OQPSK, 278
  - OQPSK and SOQPSK modulation
    - type measurements, 19
  - Other acquisition/horizontal
    - settings
      - Scope Settings tab, 231
  - Overshoot, 21
  - Overshoot dB, 21
  - Overshoot settings, 136

- P**
- Parameters tab
    - AM display, 61
    - CCDF display, 117
    - FM display, 69
    - Occupied BW display, 101
    - PM display, 76
    - Spurious display, 107
  - Params tab
    - Pulsed RF displays, 132
  - Pass/Fail searches for
    - Spurious, 210
  - Pause
    - Replay menu, 221
  - Peak Excursion, 204
  - Peak FSK err, 20
  - Peak Mag Err, 20
  - Peak Power, 20
  - Peak Threshold, 204
  - Phase Deviation, 21
  - Phase Error, 18
  - Phase Error vs. Time display, 160
  - Phase Error vs. Time settings, 162
  - Phase vs. Time display, 45
  - Phase vs. Time settings, 46
  - pictures
    - saving, 233
  - Play all selected records
    - Replay menu, 221
  - Play current record
    - Replay menu, 221
  - Play from selected
    - Replay menu, 221
  - PM, 278
  - power measurements, 82
  - Prefs tab
    - AM display, 65
    - FM display, 73
    - General Signal Viewing Displays, 57
    - GP Digital Modulation displays, 188
    - PM display, 81
    - Pulsed RF displays, 141
    - RF Measurements displays, 123
  - Preset (File menu), 246
  - Preset (Settings menu), 253
  - presets
    - application, 11
  - primary marker, 278
  - Print, 245
  - Print Preview, 246
  - Product Description, 2
  - PSK, 278
  - pulse measurements, 20
  - Pulse Statistics display, 129
  - Pulse Statistics display
    - settings, 131
  - Pulse Table display, 125
  - Pulse Table settings, 126
  - Pulse Trace display, 127
  - Pulse Trace display settings, 128
  - Pulse Width, 20
  - Pulse-Pulse Freq Difference, 21
  - Pulse-Pulse Phase Difference, 21
- Q**
- QAM, 279
  - Quadrature Error, 165
- R**
- Range file, 235
  - Ranges Tab
    - Spurious display, 110
  - RBW, 280
  - real-time analysis, 279
  - real-time bandwidth, 279
  - real-time seamless capture, 279
  - Red background (cells), 102
  - Ref Level
    - Vertical tab, 228
  - Ref level (Internal Settings tab), 224
  - Reference Filter
    - GP Digital Modulation displays, 175
  - Reference Level, 279
  - Reference tab
    - Spurious display, 107
  - Repeat, 227
  - Repetition Interval, 20
  - Repetition Rate, 20
  - Replay control panel, 220
  - Replay menu, 221
  - Replay Speed tab, 220
  - Replay toolbar, 222
    - Replay menu, 221
  - Reset all scope settings to default values
    - Scope Settings tab, 231
  - residual FM (incidental FM), 279
  - residual response, 279
  - results
    - saving, 233
  - Resume, 227
  - RF & IF Optimization
    - Spectrum display BW tab, 54
  - RF Channel Power
    - measurement, 85
  - RF I & Q vs. Time display, 47
  - RF I & Q vs. Time settings, 48
  - Rho  $\rho$ , 18
  - Rho  $\rho$ , 165
  - Ripple, 21
  - Ripple dB, 21
  - Ripple measurement
    - calculation, 280
  - Ripple settings, 136
  - Rise Time, 20
  - RMS
    - Detection, 36
  - RMS Error Magnitude, 20
  - RMS FSK Err, 20
  - RMS Mag Err, 20
  - RMS Phase Error, 21
  - Run, 227
  - Run menu, 249
- S**
- Sample Rate
    - Scope Settings tab, 231
  - Save and Export tab, 14
  - saved file types, 233
  - saving
    - acquisition data, 233
    - application presets, 11
    - pictures, 233
    - results, 233
    - setups, 233
  - Saving and Recalling Data, 233
  - Scale tab
    - AM display, 64

- FM display, 72
  - General Signal Viewing displays, 56
  - GP Digital Modulation displays, 187
  - Phase Noise display, 80
  - Pulsed RF displays, 140
  - RF Measurements displays, 122
  - Spectrogram display, 39
  - Spectrum display, 32
  - Scope Data tab, 232
  - Scope Settings tab, 231
  - Search, 209
  - Search control panel, 213
  - Search For, 210
  - Search In, 210
  - search using a mask, 210
  - secondary marker, 280
  - Security tab, 14
  - Select all
    - Replay menu, 221
  - Select data records tab, 220
  - Select records from history
    - Replay menu, 221
  - selecting the input, 5
  - sensitivity, 280
  - settings
    - Constellation display, 145
    - Demod I&Q vs Time display, 148
    - EVM vs. Time display, 150
    - Eye Diagram display, 153
    - Frequency Deviation vs. Time, 156
    - Frequency vs. Time, 44
    - Magnitude Error vs. Time, 159
    - MCPR, 92
    - Occupied Bandwidth, 100
    - Options, 14
    - Phase Error vs. Time, 162
    - Phase vs. Time, 46
    - Pulse Statistics display, 131
    - Pulse Table display, 126
    - Pulse Trace display, 128
    - restoring defaults, 11
    - RF I & Q vs. Time, 48
    - Signal Quality, 168
    - Spectrogram display, 35
    - Spectrum display, 31
    - Spurious display, 106
    - Symbol Table display, 170
    - Time Overview display, 25
    - Trellis Diagram display, 173
  - Settings, 267
    - AM display, 60
    - CCDF display, 116
    - FM display, 68
  - Setup Menu, 253
  - setups
    - saving, 233
  - shape factor (skirt selectivity), 280
  - Show graticule
    - General Signal Viewing Displays, 57
    - Pulsed RF displays, 141
  - Show Marker Readout in Graph
    - General Signal Viewing Displays, 57
    - Pulsed RF displays, 141
    - RF Measurements displays, 123
  - Show recalled trace, 50
    - AM display, 62
    - FM display, 70
    - PM display, 77
    - Time Overview display, 25
  - signal, 281
  - Signal Input, 228
  - Signal Quality display, 163
  - Signal quality measurements, 165
  - Signal Quality settings, 168
  - Single, 249
  - span, 281
  - span per division, 281
  - Span/RBW Ratio
    - Spectrum display BW tab, 54
  - spectrogram, 281
  - Spectrogram display, 33
  - Spectrogram display settings, 35
  - Spectrogram trace
    - Time Overview display, 25
  - spectrum, 281
  - spectrum analysis, 281
  - spectrum analyzer, 281
  - Spectrum Center Frequency, 216
  - Spectrum display, 29
  - Spectrum display settings, 31
  - spectrum time, 282
  - Spectrum Time tab, 216
  - spur, 282
  - Spurious, 102
  - Spurious display settings, 106
  - spurious response, 282
  - Standard Settings button, 175
  - Status Bar, 248
  - Stop
    - Replay menu, 221
  - symbol maps, 189
  - Symbol Rate, 20
  - Symbol Rate Error, 20
  - Symbol Table display, 169
  - Symbol Table display settings, 170
  - Sync Scope C1/C2 to Active Marker, 203
- ## T
- Thunderstorm color scheme, 15
  - Time, 21
  - Time measurement, 282
  - Time Overview, 23
  - Time Overview display settings, 25
  - time reference, 282
  - TIQ acquisition data files, 15
  - TIQ acquisition data files parameters, 14
  - Tools Menu, 254
  - Touch-screen Actions, 5
  - trace, 282
  - Trace tab
    - AM display, 62
    - FM display, 70
    - GP Digital Modulation displays, 186
    - PM display, 77
    - Time Overview display, 25
  - Traces tab
    - General Signal Viewing displays, 50

- RF Measurements
  - display, 120
- Spectrogram display, 35
- Traces tab – Math Trace
  - General Signal Viewing displays, 54
- Transfer Again
  - Scope Data tab, 232
- Transform Window
  - Spectrum display BW tab, 54
- Trellis Diagram display
  - settings, 173

## U

- Uniform (None) Filter Shape
  - Spectrum display BW tab, 54
- Units tab, 219

- User Filters
  - file format, 195
  - loading, 195
- User Symbol Map, 182

## V

- VBW, 29
  - Channel Power & ACPR
    - display, MCPR
    - display, 93
  - RF Measurements
    - displays, 119
  - Spectrum display BW tab, 54
- vector signal analyzer, 283
- vertical scale factor, vertical display factor, 283

- Vertical settings
  - Scope Settings tab, 231
- Vertical tab
  - Acquire control panel, 228
- View Menu, 247
- violation, 283

## W

- Window menu, 255
- Windows Event Viewer, 263

## X

- x dB BW Ref Power, 98
- x dB Level, 101