

**SignalVu-PC**  
**Vector Signal Analysis Software**  
**Printable Help**



077-0720-06

**Tektronix**







**SignalVu-PC**  
**Vector Signal Analysis Software**  
**Printable Help**



Copyright © Tektronix. All rights reserved. Licensed software products are owned by Tektronix or its subsidiaries or suppliers, and are protected by national copyright laws and international treaty provisions.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specifications and price change privileges reserved.

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

Application help version: 076-0281-06

### **Contacting Tektronix**

Tektronix, Inc.  
14150 SW Karl Braun Drive  
P.O. Box 500  
Beaverton, OR 97077  
USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit [www.tektronix.com](http://www.tektronix.com) to find contacts in your area.



# Table of Contents

## Welcome

Welcome .....	1
---------------	---

## Software and documentation

How to install product software.....	3
How to activate and purchase new application licenses (options) .....	3
How to install a license.....	4
How to return a license.....	5
How to move a license to a different host.....	6
How to activate legacy options (application licenses).....	7
How to activate options in free trial (evaluation) mode .....	9
How to manage legacy option licenses.....	10
Available application options.....	10
Documentation and support	
Available product documentation .....	12
Video tutorials.....	12

## Orientation

Selecting Files for Analysis .....	15
Right-Click Action Menu .....	15
Elements of the Display.....	17

## Using SignalVu-PC

Restoring Default Settings.....	21
Presets.....	21
Settings Options .....	29
Connectivity.....	30

## Using the Measurement Displays

Selecting Displays .....	37
--------------------------	----

## Available Measurements

Measurements	
Available Measurements .....	39

## General Signal Viewing

Overview .....	49
DPX	



DPX Display Overview .....	49
DPX Display .....	49
DPX Settings .....	54
Time Overview	
Time Overview Display .....	59
Time Overview Settings .....	60
Navigator View .....	62
Spectrum	
Spectrum Display .....	65
Spectrum Settings .....	67
Spectrogram	
Spectrogram Display .....	68
Spectrogram Settings .....	71
Amplitude Vs Time	
Amplitude Vs Time Display .....	75
Amplitude Vs Time Settings .....	76
Frequency Vs Time	
Frequency Vs Time Display .....	77
Frequency Vs Time Settings .....	78
Phase Vs Time	
Phase Vs Time Display .....	79
Phase Vs Time Settings .....	80
RF I & Q Vs Time	
RF I & Q vs Time Display .....	81
RF I & Q vs Time Settings .....	82
Common Controls for General Signal Viewing Displays	
General Signal Viewing Shared Measurement Settings .....	83

## Analog Modulation

Overview .....	93
AM	
AM Display .....	93
AM Settings .....	94
FM	
FM Display .....	99
FM Settings .....	101
PM	
PM Display .....	107
PM Settings .....	109

## RF Measurements

Overview .....	117
----------------	-----



Channel Power and ACPR	
Channel Power and ACPR (Adjacent Channel Power Ratio) Display .....	117
Channel Power and ACPR Settings .....	120
Signal Strength Display	
Signal Strength Display .....	123
Signal Strength Settings .....	124
MCPR	
MCPR (Multiple Carrier Power Ratio) Display .....	130
MCPR Settings .....	134
Occupied BW & x dB BW	
Occupied BW & x dB BW Display .....	140
Occupied BW & x dB BW Settings .....	143
Spurious	
Spurious Display .....	144
Spurious Display Settings .....	148
CCDF	
CCDF Display .....	155
CCDF Settings .....	156
Settling Time Measurements	
Settling Time Measurement Overview .....	158
Settling Time Displays	
Settling Time Displays .....	162
Settling Time Settings .....	170
Common Controls for Settling Time Displays	
Settling Time Displays Shared Measurement Settings .....	170
SEM (Spectrum Emission Mask)	
SEM Display .....	178
Spectrum Emission Mask Settings .....	182
Common Controls for RF Measurements Displays	
RF Measurements Shared Measurement Settings .....	190

## WLAN Measurements

WLAN Overview .....	197
WLAN Chan Response	
WLAN Channel Response Display .....	199
WLAN Channel Response Settings .....	201
WLAN Constellation	
WLAN Constellation Display .....	202
WLAN Constellation Settings .....	203
WLAN EVM	
WLAN EVM Display .....	204
WLAN EVM Settings .....	205



WLAN Mag Error	
WLAN Magnitude Error Display .....	206
WLAN Magnitude Error Settings.....	207
WLAN Phase Error	
WLAN Phase Error Display .....	208
WLAN Phase Error Settings.....	209
WLAN Power vs Time	
WLAN Power vs Time Display .....	210
WLAN Power vs Time Settings.....	212
WLAN Spectral Flatness	
WLAN Spectral Flatness Display.....	213
WLAN Spectral Flatness Settings .....	214
WLAN Summary	
WLAN Summary Display .....	215
WLAN Summary Settings .....	219
WLAN Symb Table	
WLAN Symbol Table Display .....	220
WLAN Symbol Table Settings .....	222
Common Controls for WLAN Analysis Displays	
WLAN Analysis Shared Measurement Settings .....	222

## OFDM Analysis

Overview .....	233
OFDM Chan Response	
OFDM Channel Response Display .....	233
OFDM Channel Response Settings.....	235
OFDM Constellation	
OFDM Constellation Display .....	236
OFDM Constellation Settings .....	237
OFDM EVM	
OFDM EVM Display .....	237
OFDM EVM Settings .....	238
OFDM Flatness	
OFDM Spectral Flatness Display .....	239
OFDM Spectral Flatness Settings.....	240
OFDM Mag Error	
OFDM Magnitude Error Display .....	241
OFDM Magnitude Error Settings .....	242
OFDM Phase Error	
OFDM Phase Error Display .....	243
OFDM Phase Error Settings.....	244
OFDM Power	



OFDM Power Display .....	245
OFDM Power Settings .....	246
OFDM Summary	
OFDM Summary Display.....	247
OFDM Summary Settings .....	248
OFDM Symb Table	
OFDM Symbol Table Display.....	249
OFDM Symbol Table Settings .....	250
Common Controls for OFDM Analysis Displays	
OFDM Analysis Shared Measurement Settings.....	250

## Pulsed RF

Overview .....	259
Pulse Table Display	
Pulse Table Display.....	259
Pulse Table Settings .....	260
Pulse Trace Display	
Pulse Trace Display.....	261
Pulse Trace Settings .....	263
Pulse Statistics	
Pulse Statistics Display.....	263
Pulse Statistics Settings .....	265
Common Controls for Pulsed RF Displays	
Pulsed RF Shared Measurement Settings .....	266

## APCO P25 Analysis

APCO P25 Analysis.....	277
Overview .....	277
P25 Standards Presets .....	278
P25 Displays .....	279
P25 Measurements.....	280
P25 Test Patterns.....	288
P25 Constellation	
P25 Constellation Display .....	291
P25 Constellation Settings .....	293
P25 Eye Diagram	
P25 Eye Diagram Display .....	293
P25 Eye Diagram Settings .....	295
P25 Power vs Time	
P25 Power vs Time Display .....	296
P25 Power vs Time Settings.....	297
P25 Summary	



P25 Summary Display .....	298
P25 Summary Settings .....	301
P25 Symbol Table	
P25 Symbol Table Display.....	301
P25 Symbol Table Settings .....	303
P25 Frequency Deviation Vs Time	
P25 Frequency Dev vs Time Display.....	304
P25 Frequency Dev Vs Time Settings.....	306
Common Controls for P25 Analysis Displays	
P25 Analysis Shared Measurement Settings.....	307

## **LTE Analysis**

LTE Analysis.....	319
Overview .....	319
LTE Standards preset test setups .....	320
LTE displays.....	325
LTE measurements .....	325
LTE Status Messages .....	332
LTE ACLR	
LTE ACLR display .....	332
LTE ACLR Settings .....	334
LTE Channel Spectrum	
LTE Channel Spectrum display .....	335
LTE Channel Spectrum Settings .....	337
LTE Constellation	
LTE Constellation display .....	337
LTE Constellation Settings .....	339
LTE Power vs Time	
LTE Power vs Time display .....	339
LTE Power vs Time Settings .....	341
Common Controls for LTE Analysis Displays	
LTE Analysis Measurement Settings .....	341

## **Bluetooth Analysis**

Bluetooth Analysis .....	359
Overview .....	359
Bluetooth Standards presets .....	360
Bluetooth displays .....	363
Bluetooth measurements and test setups .....	363
Bluetooth Status Messages .....	368
Bluetooth (BT) Constellation	
Bluetooth Constellation display.....	369



BT Constellation Settings.....	371
Bluetooth (BT) Eye Diagram	
Bluetooth Eye Diagram display .....	372
BT Eye Diagram Settings.....	374
Bluetooth (BT) CF Offset and Drift	
Bluetooth Carrier Frequency Offset and Drift display.....	375
BT CF Offset and Drift Settings .....	377
Bluetooth (BT) Summary	
Bluetooth Summary display .....	377
BT Summary Settings .....	382
Bluetooth (BT) Symbol Table	
Bluetooth Symbol Table display .....	382
BT Symbol Table Settings .....	385
Bluetooth (BT) Frequency Deviation Vs Time	
Bluetooth Frequency Dev vs Time display .....	386
BT Frequency Dev Vs Time Settings.....	390
Bluetooth (BT) 20dB Bandwidth	
Bluetooth 20dB Bandwidth display.....	390
BT 20dB BW settings .....	392
Bluetooth (BT) InBand Emission	
Bluetooth InBand Emission display .....	393
Common Controls for Bluetooth Analysis Displays	
Bluetooth Analysis Measurement Settings.....	395

## Audio Analysis

Overview .....	409
Audio Spectrum	
Audio Spectrum Display .....	410
Audio Spectrum Settings.....	411
Audio Summary	
Audio Summary Display.....	412
Audio Summary Settings .....	413
Common Controls for Audio Analysis Displays	
Audio Analysis Measurement Settings.....	414

## GP Digital Modulation

Overview .....	425
Constellation	
Constellation Display.....	426
Constellation Settings .....	427
Demod I & Q vs Time	
Demod I & Q vs Time Display.....	428



Demod I & Q vs Time Settings .....	430
EVM vs Time	
EVM vs Time Display.....	430
EVM vs Time Settings .....	431
Eye Diagram	
Eye Diagram Display.....	432
Eye Diagram Settings .....	434
Frequency Deviation vs Time	
Frequency Deviation vs Time Display .....	434
Frequency Deviation vs Time Settings .....	436
Magnitude Error vs Time	
Magnitude Error vs Time Display .....	437
Magnitude Error vs Time Settings.....	438
Phase Error vs Time	
Phase Error vs Time Display .....	439
Phase Error vs. Time Settings.....	440
Signal Quality	
Signal Quality Display .....	441
Signal Quality Settings.....	446
Symbol Table	
Symbol Table Display.....	447
Symbol Table Settings.....	448
Trellis Diagram	
Trellis Diagram Display.....	449
Trellis Diagram Settings .....	451
Common Controls for GP Digital Modulation Displays	
GP Digital Modulation Shared Measurement Settings .....	451
Standard Settings Button.....	452
Symbol Maps	
Symbol Maps.....	469
User Filters	
Overview: User Defined Measurement and Reference Filters.....	474
User Filter File Format .....	475

## Marker Measurements

Using Markers	
Using Markers.....	479
Controlling Markers with the Right-Click Actions Menu.....	479
Measuring Frequency and Power in the Spectrum Display .....	481
Common Marker Actions	
Marker Action Controls .....	482
Peak.....	482



Next Peak .....	482
Marker to Center Frequency .....	482
Define Markers Control Panel	
Enabling Markers and Setting Marker Properties .....	482
Markers Toolbar	
Using the Markers Toolbar .....	484
Noise Markers in the Spectrum Display	
Measuring Noise Using Delta Markers in the Spectrum Display .....	485

## Mask Testing

The Mask Test Tool .....	489
Mask Test Settings .....	489
Define Tab (Mask Test) .....	489
Actions Tab .....	494

## Analyzing Data

Analysis Settings	
Analysis Settings .....	495
Analysis Time Tab .....	495
Spectrum Time Tab .....	497
Frequency Tab .....	497
Units Tab .....	500
Analyzing Data Using Replay	
Replay Overview .....	501
Replay Menu .....	503
Acq Data .....	504
DPX Spectra .....	504
Replay All Selected Records .....	504
Replay Current Record .....	504
Replay from Selected .....	505
Pause .....	505
Stop .....	505
Select All .....	505
Select Records from History .....	505
Replay Toolbar .....	505

## Amplitude Corrections

Amplitude Settings .....	507
External Gain/Loss Correction Tab .....	507
External Gain Value .....	507
External Loss Tables .....	507



## Controlling the Acquisition of Data

Acquisition Controls in the Run Menu	
Continuous Versus Single Sequence.....	511
Run .....	511
Resume.....	511
Abort .....	512
Acquisition Controls in the Acquire Control Panel	
Acquire.....	512
Acquisition Data .....	513
IQ Sampling Parameters .....	514
Frequency Reference .....	515
Record.....	515
Playback .....	517
Triggering	
Triggering.....	518
Trigger Settings .....	520
Event Tab .....	521
Advanced Tab (Triggering).....	522
Actions Tab (Triggering).....	523

## GNSS, Antenna, and Map It Features

How to set up GNSS .....	525
How to use the Antenna feature.....	527
How to use Map It.....	531

## Signal Database and Channel Navigation

How to use the Signal Database .....	535
Channel Navigation toolbar .....	538

## Signal Classification

Signal Classification.....	541
How to classify a signal.....	541
Signal Survey toolbar .....	549
The Signal Survey Editor .....	550
The Define Survey control panel.....	551
The Declare Region window (classify).....	553

## Managing Data, Settings, and Pictures

Saving and Recalling Data, Settings, and Pictures.....	555
Data, Settings, and Picture File Formats .....	562
Printing Screen Shots .....	566



## Reference

Application Help .....	567
About the Vector Signal Analysis Software .....	567
Mapping Measurements	
Mapping Measurements.....	568
Menus	
Main menu overview .....	568
File Menu	
File Menu .....	570
View Menu	
View Menu .....	574
Run Menu	
Run Menu.....	577
Replay	
Replay Menu .....	578
Markers Menu	
Markers Menu.....	578
Setup Menu	
Setup Menu .....	578
Presets Menu	
Presets Menu .....	579
Tools Menu	
Tools Menu .....	579
Connect menu	
Connect menu .....	580
Window Menu	
Window Menu.....	581
Help Menu	
Help Menu .....	581
Favorites bar	
Favorites bar menus .....	582
Troubleshooting	
Error and Information Messages .....	582
Displaying the Windows Event Viewer .....	589
Upgrading the Product Software	
How to Find Out if Software Upgrades are Available .....	590
Changing Settings	
Settings.....	590

## Glossary

## Index







## Welcome

This help provides in-depth information on how to use the SignalVu-PC Vector Signal Analysis Software.

Using the signal analysis engine of the RSA5100 and RSA6100 Series real-time signal analyzer, SignalVu-PC vector signal analysis software helps you move your analysis of acquisitions off the instrument.

With SignalVu-PC's Connect feature, you can connect to an RSA306 USB Spectrum Analyzer or an MDO4000B/C series oscilloscopes, acquiring live data. (The optional CON application license is required to connect to an instrument.) Several features and settings become available in SignalVU-PC once connected to one of these instruments. These are noted where appropriate throughout the help system.

This help is also available in a PDF format for printing.

---

**NOTE.** *Many of the screen illustrations in this document are taken from the vector signal analysis software version that runs on the RSA51000 Series Real-time Signal Analyzers. These instruments support additional hardware-based functionality and buttons that are not present in the SignalVu™ or SignalVu-PC application.*

---







## How to install product software

The SignalVu-PC product software is made up of the base software and any additionally purchased applications software (licensed optional software). The base software provides access to the standard SignalVu-PC applications. It is available for download, free of charge, from the Tektronix Web site at [www.tektronix.com/downloads](http://www.tektronix.com/downloads). Once you have the base version, you can purchase licenses for optional SignalVu-PC applications or choose to activate 30-day free trials of those applications.

Tektronix is working to make it easier for you to manage the options you purchase for SignalVu-PC. If you purchase an optional license after December 4, 2015, you will set up a product license account that allows you to manage your product licenses. However, you can still activate or reactivate any options you have already purchased using the same option keys in the same way.

---

**NOTE.** *Options purchased prior to December 4, 2015 are referred to as legacy options.*

---

You will find the information you need to activate currently held legacy option licenses, newly purchased option licenses, and free trial licenses in the Help topics below:

- [How to activate and purchase new application licenses \(options\) \(see page 3\)](#)
- [How to activate legacy options \(application licenses\) \(see page 7\)](#)
- [How to activate options in free trial evaluation mode \(see page 9\)](#)
- [How to manage legacy option licenses \(see page 10\)](#)
- [List of available application options \(see page 10\)](#)

## How to activate and purchase new application licenses (options)

To purchase optional application licenses after December 4, 2015, contact your local Tektronix Account Manager. After purchasing a license, you will receive an email with a list of the applications purchased and the URL to the Tektronix Product License Web page, where you will create an account and can then manage your licenses: <http://www.tek.com/products/product-license>.

The product license page provides an inventory of the license(s) in your account. It enables you to check out or check in a license and view the history of licenses.

Optional applications are enabled by one of the following license types.

License type	Description
Node locked item (NL)	This license is permanently assigned to a specific host id.
Floating License item (FL)	This license can be moved between different host ids.



You can view a list of the currently installed application licenses and options in your SignalVu-PC product as follows:

- Select **Tools > Licenses > Manage** from the SignalVu-PC main toolbar.
- Select **Help > About Tektronix Real Time Signal Analyzer** to view a list of the installed options.

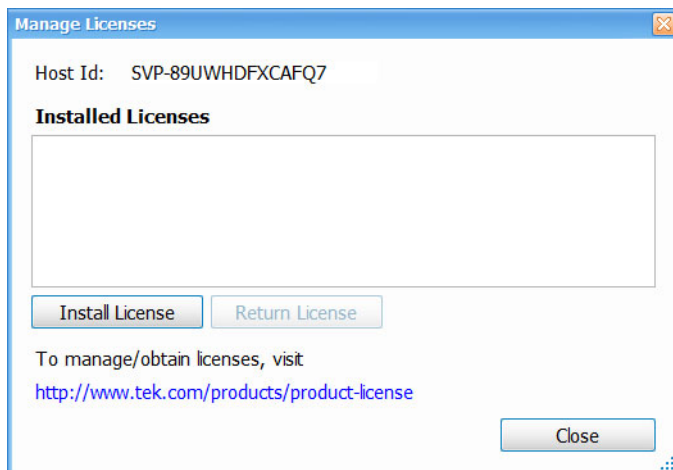
## How to install a license

Before installing a purchased application license, you must first have purchased one through your local Tektronix Account Manager, created an account on the Tektronix Product License Web page, and downloaded the license to your PC or a portable memory device.

(See [List of available application options](#).)

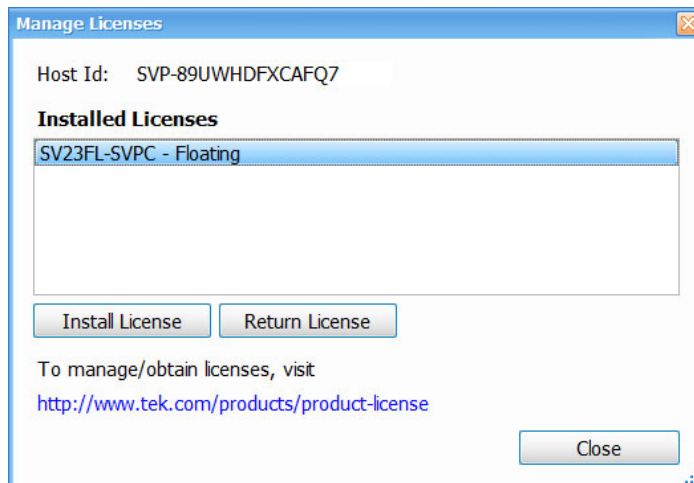
(See <http://www.tek.com/products/product-license>.)

1. Select **Tools > Licenses > Manage** to open the Manage Licenses window.



2. In the **Manage Licenses** window, click **Install License**. An Explorer window will open.
3. Navigate to the location of the license file (\*.lic) you downloaded from your [Tektronix Product License account page](#).
4. Click **Open**. The new license should now appear in the Installed Licenses list.



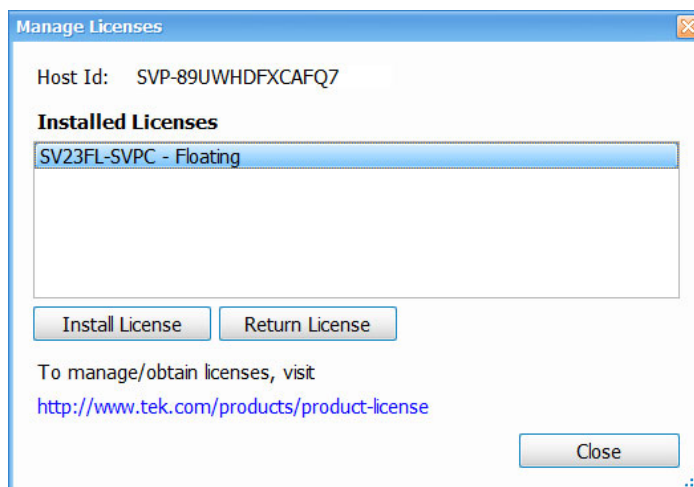


5. Click **Close**.

## How to return a license

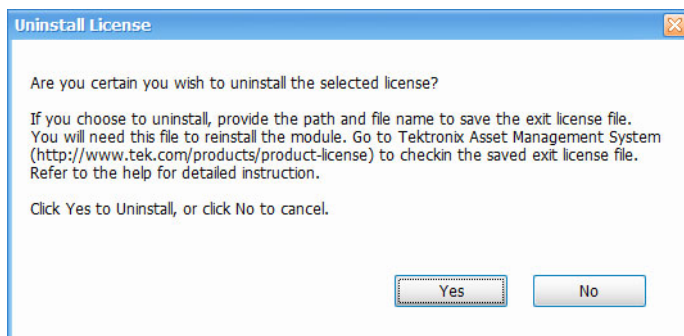
You can return (uninstall) a license from a particular PC as follows:

1. Select **Tools > Licenses > Manage** to open the Manage Licenses window.
2. In the **Manage Licenses** window, select the license you want to return.



3. Click **Return License**. The following window will appear.





4. Click **Yes** to uninstall the license. You will then be prompted to save an exit license file. This is the file you will check into (return to) your [Tektronix Product License account](http://www.tek.com/products/product-license).
5. Save the exit license file to the desired location.
6. Click **Close**.
7. Navigate to your [Tektronix Product License account page](http://www.tek.com/products/product-license) and check in the saved exit license file.

## How to move a license to a different host

You can return a purchased license and then reassign it to a different host, as indicated below. See the [Available application options](#) topic for a list of available application licenses.

- **Node locked license (NL):** This license type can be reassigned no more than two times. This allows you to reassign the license in the case of an upgrade to a new Windows platform, for example.
- **Floating license (FL):** This license type can be reassigned an unlimited number of times.

When assigning a floating license, you need to specify the host id and the duration the feature is to be enabled on the host. After the license expires, the feature is automatically disabled on that host and the license is then available to be assigned to a different host.

- **Free trial license (FT):** This license type expires after 30 days.

### See also:

<http://www.tek.com/products/product-license>

[How to install a license.](#)

[How to return a license.](#)

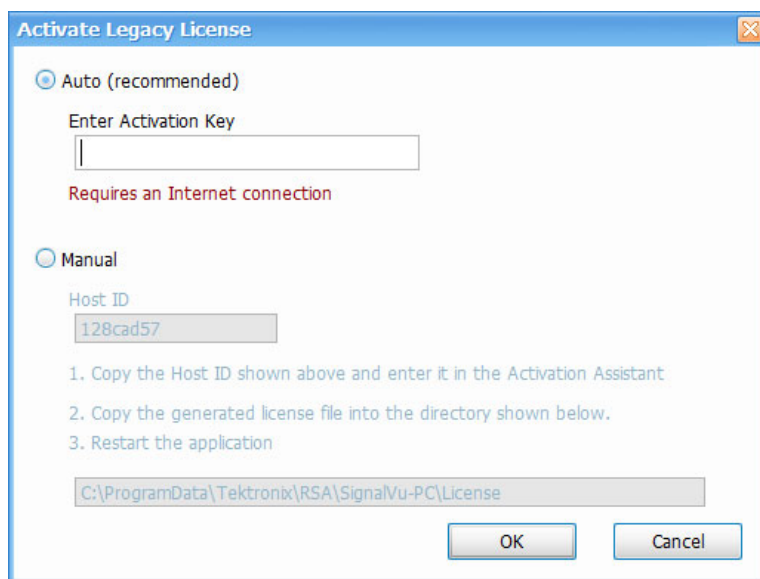


## How to activate legacy options (application licenses)

Activating options requires internet access. However, you can activate options on a PC that does not have internet access by using a second PC that does have internet access to contact the license server and use it to download a license file. The license file can then be transferred to the PC on which the option is to be activated. In order to use any options you have purchased for SignalVu-PC, you must activate each option individually one of the following two ways:

### To activate an option with Internet access

1. Launch the SignalVu-PC application.
2. Select **Tools > Licenses > Legacy > Activate...** to view the Activate Legacy License dialog.
3. In the dialog, select **Auto**.



4. In the **Enter Activation Key** text box, enter the option activation key provided when you purchased the option.
5. Click **OK**. SignalVu-PC will contact the license server and install a license file provided by the license server.
6. Repeat the steps above to activate each option, using the activation key specific to each option.

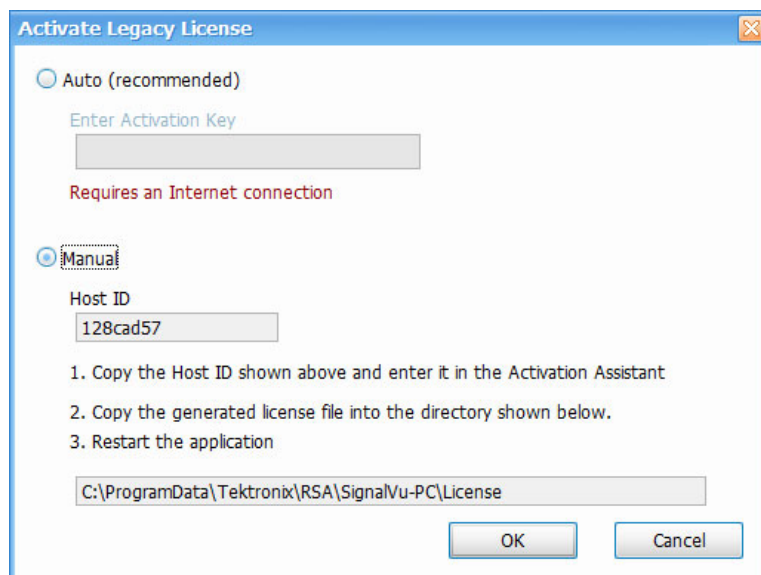
### To activate an option without Internet access

To activate options on a PC without internet access, you need use the Offline Activation Tool. The tool is provided with SignalVu-PC as a separate installation file.



1. Launch the SignalVu-PC application.
2. Select **Tools > Licenses > Legacy > Activate...** to view the Activate Legacy License dialog.

In the dialog, select **Manual**.



3. Write down the **Host ID** shown in your Activate Legacy License dialog, and then click **Cancel** to close the window.
4. Install the **Activation Assistant** software on a PC that has internet access.

The Activation Assistant software is located at:

- If you installed SignalVu-PC from a DVD or USB flash drive, navigate to the device, open the Offline Activation Tool folder, and run the Setup file located there.
  - If you downloaded SignalVu-PC from the Web, navigate to the location you extracted the installation files. Open the Offline Activation Tool folder and run the Setup file located there.
5. Launch the Activation Assistant application and follow the instructions to generate a license file. Repeat this step for each option that you have purchased. You will also need the option activation key you received.

Activation keys are specific to each option, therefore you must acquire a license file for each option purchased.

6. Copy the license file (or files) to the following location the PC on which SignalVu-PC is to be activated:  
`C:\ProgramData\Tektronix\RSA\SignalVu-PC\License`
7. Restart the SignalVu-PC application.



## How to activate options in free trial (evaluation) mode

If you don't have a license for one (or any) SignalVu-PC options, you can activate each option in evaluation mode for 30 days.

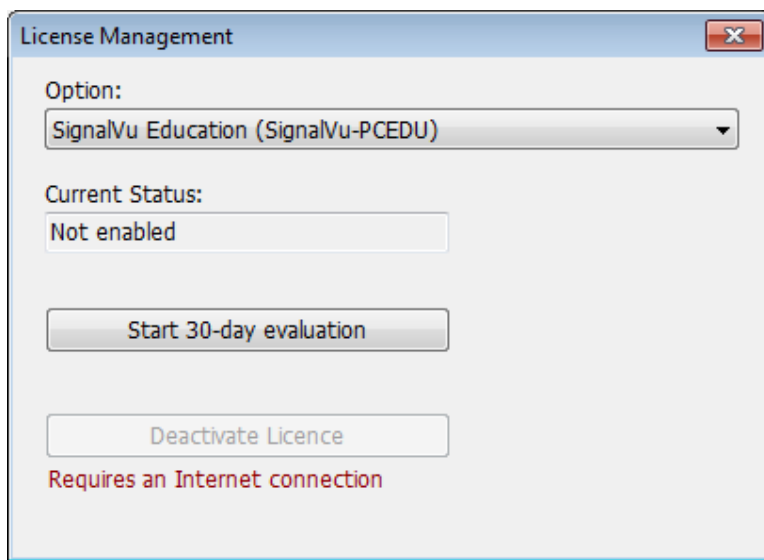
---

**NOTE.** *Each option has its own evaluation period.*

---

To activate an option in evaluation mode:

1. Launch **SignalVu-PC**.
2. Select **Tools > Licenses > Legacy > Manage...** to view the Manage Legacy License dialog.
3. Select the option you want to evaluate, and then select **Start 30-day evaluation**.



The Current Status box will change to display the number of days remaining for evaluation. Repeat this procedure for each of the SignalVu-PC options you wish to evaluate.

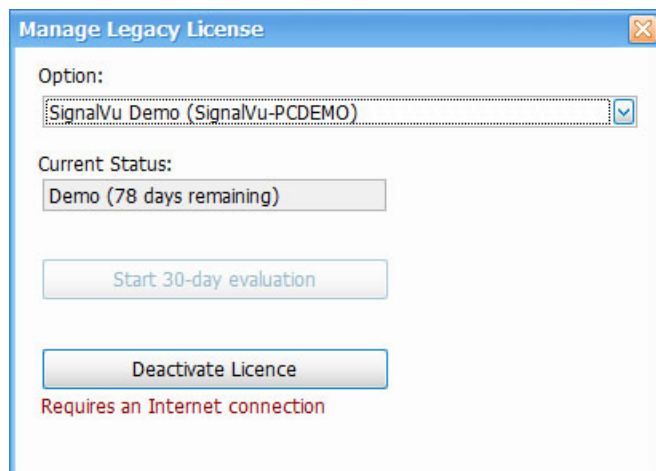


## How to manage legacy option licenses

Options are licensed for use on a single PC. However, you can move SignalVu-PC and its options from one PC to another PC by deactivating each option on the current installation and reactivating them on another PC. Each activated option needs to be deactivated as follows:

1. Launch the application.
2. Select **Tools > Licenses > Legacy > Manage...** to view the Manage Legacy License dialog.
3. Use the drop-down list under Option to select one of the SignalVu-PC options that is activated on the PC. For example: **OFDM Measurements (SignalVu-PC SVO)**.
4. Starting with each installed option, click **Deactivate License**. Continue selecting options and clicking Deactivate License until all the SignalVu-PC options have been deactivated.

SignalVu-PC options are now deactivated. You can now install SignalVu-PC on another PC and activate the options in the new installation.



---

**NOTE.** You can view already installed and activated options from the **Tools > Licenses > Legacy > Manage...** window.

---

## Available application options

The following table shows available optional applications and the license type associated with that application option.



Application description	Application (option)	License type
AM/FM/PM/Direct Audio Analysis	SVANL-SVPC	Node Locked
	SVAFL-SVPC	Floating
Settling Time (frequency and phase) measurements	SVTNL-SVPC	Node Locked
	SVTFL-SVPC	Floating
General Purpose Modulation Analysis to work with analyzer of acquisition bandwidth $\leq 40$ MHz	SVMNL-SVPC	Node Locked
	SVMFL-SVPC	Floating
Pulse Analysis to work with analyzer of acquisition bandwidth $\leq 40$ MHz	SVPNL-SVPC	Node Locked
	SVPFL-SVPC	Floating
Flexible OFDM Analysis	SVONL-SVPC	Node Locked
	SVOFL-SVPC	Floating
WLAN 802.11a/b/g/j/p measurement to work with analyzer	SV23NL-SVPC	Node Locked
	SV23FL-SVPC	Floating
WLAN 802.11n measurement (Requires SV23NL-SVPC or SV23FL-SVPC)	SV24NL-SVPC	Node Locked
	SV24FL-SVPC	Floating
WLAN 802.11ac measurement to work with analyzer of acquisition bandwidth $\leq 40$ MHz (Requires SV23NL-SVPC or SV23FL-SVPC and SV24NL-SVPC or SV24FL-SVPC)	SV25NL-SVPC	Node Locked
	SV25FL-SVPC	Floating
APCO P25 measurement	SV26NL-SVPC	Node Locked
	SV26FL-SVPC	Floating
Bluetooth measurement to work with analyzer of acquisition bandwidth $\leq 40$ MHz <sup>1</sup>	SV27NL-SVPC	Node Locked
	SV27FL-SVPC	Floating
Mapping	MAPNL-SVPC	Node Locked
	MAPFL-SVPC	Floating
Playback of recorded files	SV56NL-SVPC	Node Locked
	SV56FL-SVPC	Floating
SignalVu-PC connection to the MDO4000B/C series	CONNL-SVPC	Node Locked
	CONFL-SVPC	Floating
WLAN 802.11a/b/g/j/p/n/ac and live link to RSA306 and MDO4000B/C to work with analyzer of acquisition bandwidth $\leq 40$ MHz (Requires one of each of the following: SV23NL-SVPC or SV23FL-SVPC, SV24NL-SVPC or SV24FL-SVPC, SV25NL-SVPC or SV25FL-SVPC, and CONNL-SVPC or CONFL-SVPC)	SV2CNL-SVPC	Node Locked
	SV2CFL-SVPC	Floating
LTE Downlink RF measurement to work with analyzer of acquisition bandwidth $\leq 40$ MHz <sup>2</sup>	SV28NL-SVPC	Node Locked
	SV28FL-SVPC	Floating



Application description	Application (option)	License type
Signal survey and classification	SV54NL-SVPC	Node Locked
	SV54FL-SVPC	Floating
Education-only version of all modules for SignalVu-PC	EDUFL-SVPC	Floating

<sup>1</sup> Bluetooth is a registered trademark of Bluetooth SIG, Inc.

<sup>2</sup> LTE is a trademark of ETSI.

## Available product documentation

In addition to the application Help, the following documents are available. For the most up to date documentation, visit the Tektronix Web site [www.tektronix.com/downloads](http://www.tektronix.com/downloads).

- **SignalVu-PC Quick Start User Manual** (Tektronix part number 077-1024-XX). This PDF document (located on the software USB that shipped with your product or in the downloaded software archive) explains how to install and activate the SignalVu-PC software. The instructions also provide a brief overview of the SignalVu-PC application to get you started. It is also available for download at [www.tektronix.com/manuals](http://www.tektronix.com/manuals).
- **SignalVu-PC Programmer Manual** (077-0721-XX). This PDF document provides detailed descriptions of the remote commands for the SignalVu-PC software and explains how to use the programming interface for SignalVu-PC.
- **SignalVu-PC Printable Help Document (PDF)** (077-0720-XX). A PDF file version of this Help that can be easily printed.

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.

## Video tutorials

You can browse the Tektronix YouTube channel ([www.youtube.com/user/tektronix](http://www.youtube.com/user/tektronix)) to find video tutorials about various topics related to your product. You can also subscribe to the Tektronix YouTube channel to keep up with new postings.

### Searching for topics

For example, you can watch a video tutorial about WLAN Presets and, with Option CON enabled, connecting to an MDO4000B/C series oscilloscopes or an RSA306 spectrum analyzer. To find a video on this topic, do the following. The following image shows you what the Tektronix YouTube Channel looks like.

1. Click on the search icon located just above the video you see when the page first loads.



---

**NOTE.** This icon allows you to search the Tektronix YouTube channel specifically. The search icon located at the top of the page allows you to search all of YouTube .

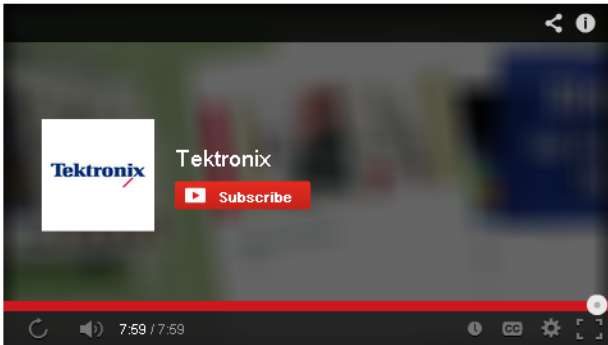
---

2. Type in the keyword “WLAN” in the search field.
3. Click the search icon to start the search.
4. Videos related to the topic will appear. Click a video to view it.

**Tektronix** Subscribe 1,518

[Home](#) [Videos](#) [Discussion](#) [About](#)

---





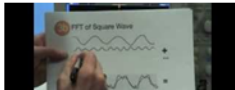


**How to use an oscilloscope**  
119,684 views · 2 years ago

Tony and Ian from Tektronix walk through what is an oscilloscope, how to use an oscilloscope, and other oscilloscope basics. You'll see how you might use an oscilloscope to look at an RC circuit, something many engineers encounter early in their studies. From there, learn about the most important oscilloscope controls and how to use them.

What is an Oscilloscope?  
At its heart, an oscilloscope is a device that sho...  
[Read more](#)

---

**Tektronix Tutorials**  
Tektronix explains the basics about every day test and measurement equipment that play an important role for engineers.







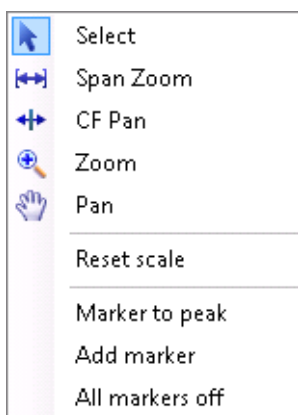


## Selecting Files for Analysis

The SignalVu-PC software can analyze waveform files saved by Tektronix oscilloscopes and real-time signal analyzers. SignalVu-PC can open several file types, including .wfm, .tiq, .iqd and .mat files. For more detailed information on opening the supported file types, see [Recalling Waveforms with SignalVuPC \(see page 556\)](#).






## Right-Click Action Menu

You can change marker settings and how waveforms are displayed by using the right-click Actions menu.



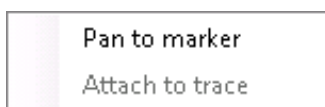
To use the right-click Actions menu, right-click in the graph area.



Icon	Menu	Description
	Select	Selects markers and adjusts their position.
	Span Zoom	Zooms the graph area about the selected point. Right-click in 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.
	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.
-	Add marker	Defines a new marker located at the horizontal center of the graph.
-	All markers off	Removes all markers.

### SignalVu-PC Markers Menu

The SignalVu-PC Markers menu appears when you right-click on a marker. The SignalVu-PC Markers menu enables you to assign a marker to a different trace and pan the trace to place the marker at the measurement frequency.

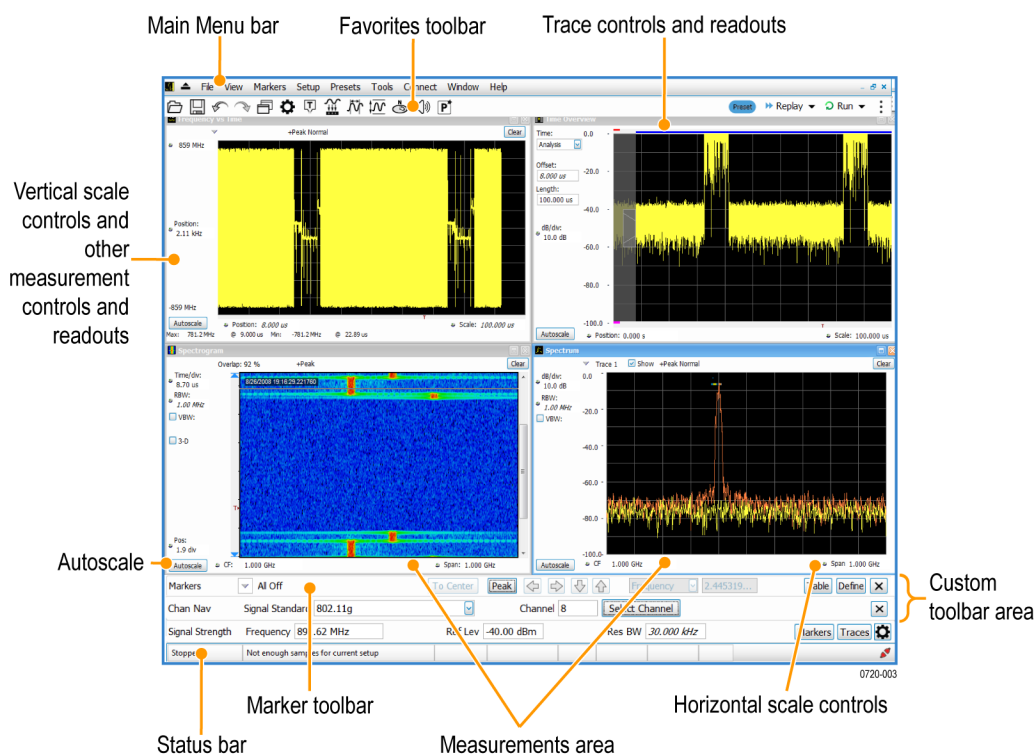


Icon	Menu	Description
-	Pan to marker	Adjusts horizontal position of the waveform to locate the selected marker at the measurement frequency.
-	Assign to trace	Assigns the selected marker to Trace 1, Trace 2, Trace 3 or the Math trace. A trace must be enabled to assign a marker to it.



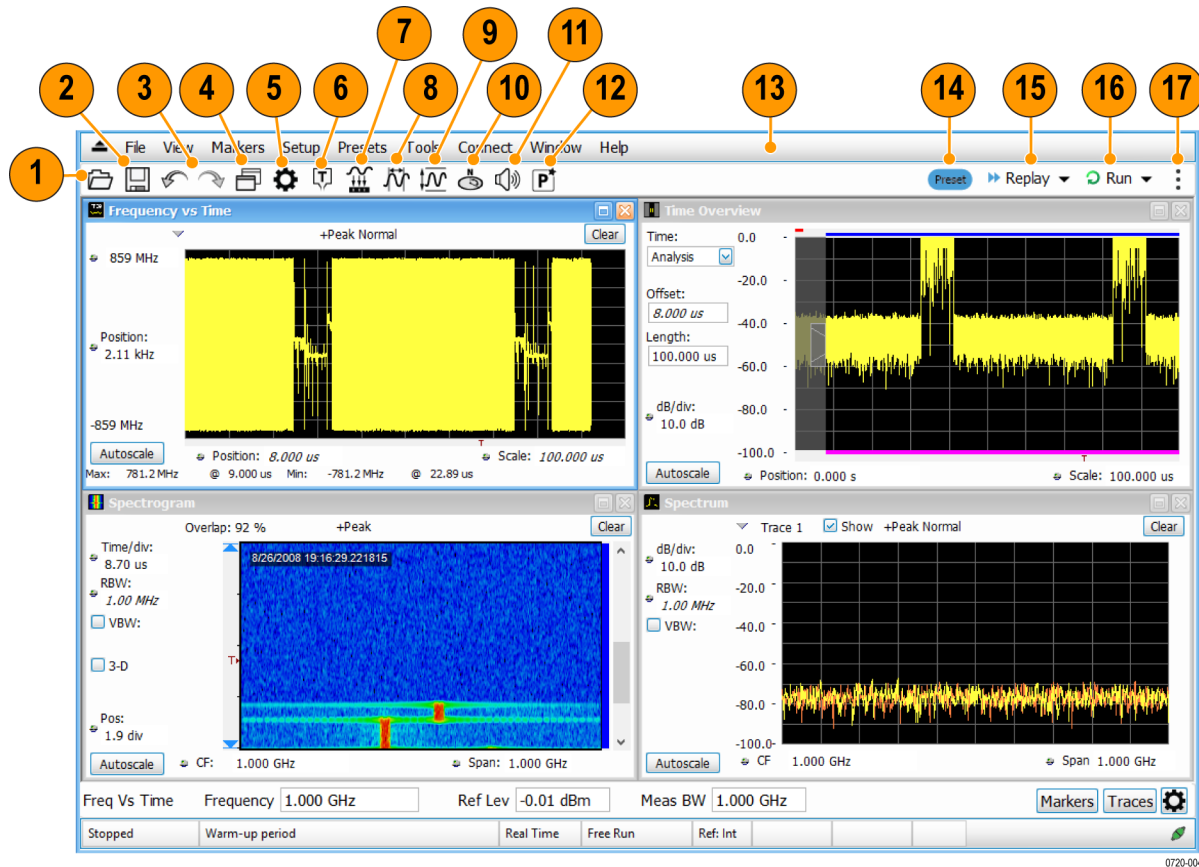
## Elements of the Display

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



**Specific elements of the application display window.** Specific elements of the display are shown in the following figure. More detailed information is available in the [Menus](#) section.



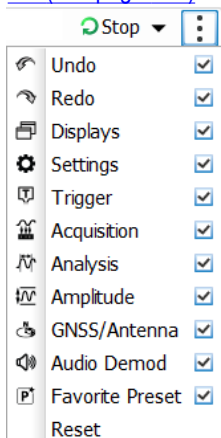


Ref number	Setting	Description
1	Recall	Displays the Open window in order to recall setup files, acquisition data files, or trace files.
2	Save	Opens the Save As dialog in order to save setup files, pictures (screen captures), acquisition data files, or export measurement settings.
3	Undo/Redo	Undoes or redoes the previous edit to a display or measurement settings, a preset, or a measurement change.
4	Displays	Opens the Select Displays dialog box so that you can select measurement displays.
5	Settings	Opens the Settings control panel for the selected display. Each display has its own control panel.
6	Trigger (Only available when connected to an RSA306 or MDO4000B/C.)	Opens the Trigger control panel so that you can define the instrument trigger settings.
7	Acquire	Opens the Acquire control panel, which displays the Sample Rate and Record length of the recalled waveform file.



Ref number	Setting	Description
8	Analysis	Opens the Analysis control panel so that you can define the analysis settings such as frequency, analysis time, and units.
9	Amplitude	Opens the Amplitude control panel so that you can define the Reference Level, configure internal attenuation, and specify external gain/loss corrections.
10	GNSS/Antenna	Opens the GNSS/Antenna control panel so that you can configure and activate an external GNSS receiver and antenna.
11	Audio Demodulation	Opens the Audio control panel so that you can define the audio demodulation settings for the RSA306.
12	Favorite User Presets	Click to select from a list of custom favorite User presets and load the selected preset. For more detailed information, see the <a href="#">Make a User preset a Favorite preset (see page 24)</a> topic.
13	Main menu bar	Contains access to menus. For detailed information, see the <a href="#">Main Menu (see page 568)</a> topic.
14	Preset	Recalls the <a href="#">Main</a> preset.
15	Replay	Runs a new measurement cycle on the existing acquisition data record using any new settings. See the <a href="#">Replay menu</a> topic for more details.



Ref number	Setting	Description
16	Run and Run/Stop toolbar (Only available when connected to an RSA306 or MDO4000B/C.)	<ul style="list-style-type: none"> <li>■ Run menu and Run/Stop toolbar Starts and stops data acquisitions and specifies the run conditions. For example, if you select Single in the Run/Stop toolbar (or Run Single in the Run menu), a single measurement cycle is run. If you select Continuous in the Run/Stop toolbar (or Run Continuous in the Run menu), the data acquisition runs until stopped.</li> <li>■ Run menu The Run menu also includes Resume and Abort. Resume restarts data acquisition, but does not reset accumulated results, such as Average or MaxHold. This allows you to stop acquisitions temporarily, then continue. Abort immediately halts the current acquisition/measurement cycle. In-process measurements and acquisitions are not allowed to complete. See the <a href="#">Run menu</a> topic for more details.</li> </ul>
17	⋮	<p>The Edit Favorites icon allows you access the below menu, which allows you to edit the contents of the Favorites bar. For more information, see the <a href="#">Favorites bar (see page 582)</a> topic.</p> 



## Restoring Default Settings

To restore the software to its factory default settings:

1. Select **Presets > Preset Options**.
2. In the Presets tab of the Options control panel, click to view the **Preset type** drop down menu and select **Main**.
3. Click to view the **Presets** drop down menu and select **Original**.
4. Click the red X icon in the top right corner of the Options control panel to close the panel.
5. Select **Presets > Main** from the menu bar to return the software to its original factory default settings.

---

**NOTE.** You can also click the **Preset** button on the right-hand side of the menu bar to load the Main preset.

---

## Presets

### Menu Bar: Presets

SignalVu-PC includes a set of standard configurations that are tailored to specific applications or types of analysis. These configurations, referred to as Presets, open selected displays and load settings that are optimized to address specific application requirements. You can also make your own User presets to fit your application. Any User preset can be added to the Favorites bar, enabling one-button access to your most used setups.

### Available Presets

Select **Presets** from the menu bar to access the following types of factory presets: Main, DPX, Standards, Application, and User. (DPX is only available when connected to an RSA306 or MDO4000B/C.) In addition to three factory defined User presets, you can create your own User presets. All of these preset types and their subtypes are described in the following table. Subtypes are managed in the Presets > Preset Options menu.

### Preset Options

Select the **Presets > Preset Options** menu to open the Options control panel. This panel does the following. Once you have chosen these settings, you can access any preset or list of presets from **Presets** on the menu bar.



- **Preset type:** Select the Preset type.
- **Presets:** Select the specific preset you want to display for the selected preset type.
- **Preset action:** Selecting a preset from the Preset drop down menu results in one of two actions depending on which item you choose in the **Preset action** list: **Recall selected preset** will immediately execute a preset when it is selected from the Presets menu. **Show list** will display a list of presets subtypes from which you can then select the preset you want to recall.

Preset	Description
<b>Main</b>	
Current	This Preset sets the analyzer to display a Spectrum display with settings appropriate for typical spectrum analysis tasks.
<a href="#">Original</a>	This Preset is the original factory preset used with your original SignalVu-PC software. This version of the factory preset is included to allow you to maintain compatibility with existing remote control software.
<b>DPX</b>	
(Only available when an RSA306 or MDO4000B/C is connected.)	
Open the DPX display	The Open the DPX display opens the DPX display without closing existing displays.
Swept	The DPX Swept Preset displays the DPX Spectrum display with the span set to maximum and the center frequency set to 1/2 the span.
Real Time	The DPX Real Time Preset displays the DPX Spectrum display with the center frequency set to 1.5 GHz and the span set to the maximum available real-time bandwidth.
<b>Standards</b>	
<a href="#">WLAN</a>	This preset sets the analyzer to display the WLAN Summary, WLAN Constellation, and SEM displays. After you select the standards and bandwidth, the software configures these displays to apply the parameters appropriate for typical WLAN analysis tasks.
<a href="#">APCO P25</a>	This preset sets the analyzer to display the P25 MCPR, Summary, P25 Constellation, and Time Overview displays. After you select the standard and modulation type, the software configures these displays to apply the parameters appropriate for typical P25 analysis tasks.
<a href="#">Bluetooth</a>	This preset loads a set of Bluetooth displays and test setup to perform Bluetooth SIG RF tests. The software configures these displays to apply the parameters appropriate for Bluetooth analysis tasks.
<a href="#">LTE</a>	This preset loads a set of LTE displays and a test setup, frame structure, and channel bandwidth to perform LTE tests. The software configures these displays to apply the parameters appropriate for LTE analysis tasks.
<b>Application</b>	
<a href="#">Modulation Analysis</a>	The Modulation Analysis setup application preset provides you with the most common displays used during modulation analysis. Only present when Option 21 is installed.
<a href="#">Pulse Analysis</a>	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.
<a href="#">Time-Frequency Analysis</a>	The Time-Frequency preset configures the analyzer with settings suited to analyzing signal behavior over time.
<a href="#">Spectrum Analysis</a>	The Spectrum Analysis application preset provide you with the settings commonly used for general purpose spectrum analysis.



<a href="#">Spur Search Multi Zone 9k-1GHz</a>	The Spur Search application preset sets the analyzer to display all spurs that exceed the Threshold and Excursion values for the entire 9 k through 1 GHz range.
<b>User (Favorites)</b>	
<a href="#">User Preset 1</a>	This preset sets the analyzer to show these displays: Frequency vs Time, Time Overview, Spectrogram, and Spectrum. Settings commonly used for general purpose analysis are loaded.
<a href="#">User Preset 2</a>	This preset sets the analyzer to show the Spurious display. Settings commonly used for spur analysis are loaded.
<a href="#">Interference Hunting</a>	This preset sets the analyzer to show the DPX and Signal Strength displays.
<a href="#">Other user presets</a>	User presets you create and save will appear in the Preset drop down menu of the User Presets window. Any User preset that you have designated as a Favorite will be marked with an *.

## Recalling a Preset

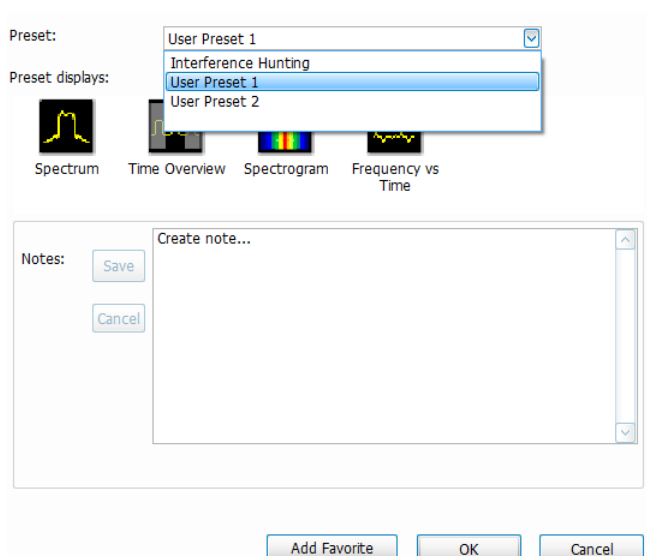
To recall a preset, select **Presets** and then the desired preset type.

**NOTE.** You can set which presets to recall from the Presets > [Preset Options](#) control panel.

**NOTE.** You can also click the Preset button on the top right side of the menu bar to load the Main preset.

## User Presets

Select the **Presets** > **User** menu to open the User Presets window. The Presets drop-down list shows the three default user presets provided with the software.





- **User Preset 1:** Sets up the Spectrum, Time Overview, Spectrogram, and Frequency vs Time displays.
- **User Preset 2:** Sets up the Spurious display.
- **Interference Hunting:** Sets up the DPX and Signal Strength displays.

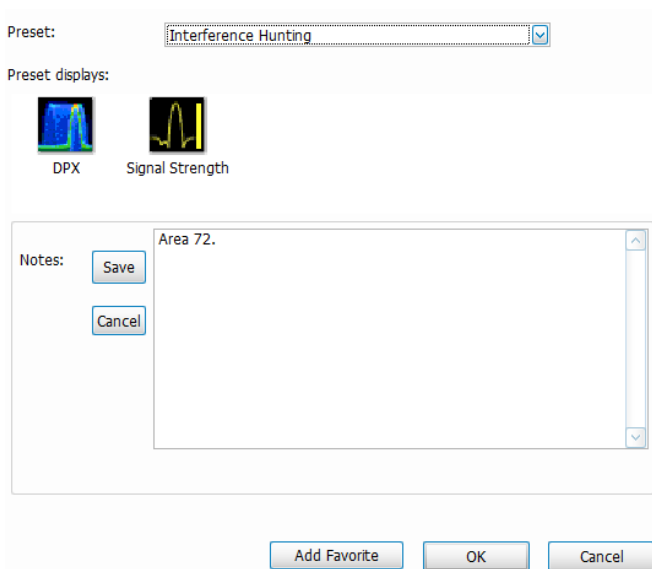
### Make a User preset

You can add your own User presets to the list that appears in the User Presets dialog box as follows:

1. Select **Save As** from the **File** menu to open the **Save As** dialog box.
2. Select to save to C:\SignalVu-PC Files\User Presets.
3. Enter a file name. The name you give the file will appear in the User Presets dialog box list.
4. Select Setup file to save from the **Save as type** drop-down list.
5. Click **Save**.

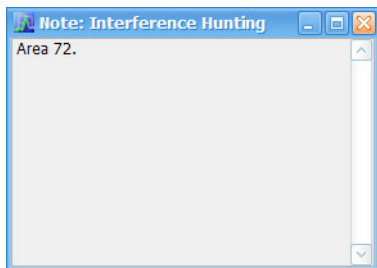
**Make a User preset a Favorite preset.** You can place one or more User presets on the Favorites bar as a Favorite preset for quick access. Do this as follows:



1. Select **Presets > User** to open the User Presets window.
2. Select the desired preset from the Presets drop-down list.
3. Click the **Add Favorite** button. The preset will now have an \* next to it. You can do this for more than one preset.

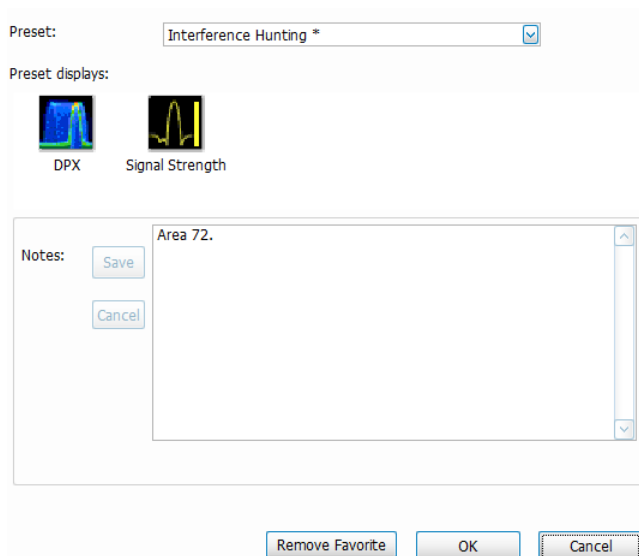


4. If desired, add a note for this preset in the Notes field and then click the **Save** button. Whenever you recall this preset, this note will appear in a separate window, as shown below.





5. Click the **OK** button in the User Presets window.
6. Click on the  icon on the Favorites bar and you will see the recently added Favorite preset listed.
7. When you are ready to recall a Favorite preset, click  and select the preset from the list that appears.
8. To remove a Favorite preset, select it from the User Presets window and click the **Remove Favorite** button. The \* should disappear from the list.



## Standards Presets

The Standards presets allow you to recall preconfigured displays for the standards that you select. You can select from the following standards groups.

### Application Preset: Modulation Analysis

The Modulation Analysis application preset opens the following displays:



- DPX display: Shows you a continuous spectrum monitoring of the specified carrier frequency.
- 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 (assuming the Preset action is set to Show list in the Presets tab of the Options control panel):

1. Select **Presets > Application**. Select **Modulation Analysis** and then click **OK**.
2. Set the reference level so that the peak of your signal is about 10 dB below the top of the DPX display.
3. 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 selecting **Tools > Settings**.

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

### Application Preset: Pulse Analysis

The Pulse Analysis application preset opens the following displays:

- DPX: The DPX display is opened with the maximum available span.
- Time Overview: Shows amplitude vs. time over the analysis period.
- Pulse Table: This shows a full report for the user-selected pulse measurements.
- Pulse Trace: Shows the trace of the selected pulse and a readout of the selected measurement from the pulse table.

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-Max BW
- 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.

---

- Power threshold to detect pulses: This is set to –10 dBc.



- Minimum OFF time between pulses: This is set to 400.000 ns to ensure a good probability of catching several pulses for typical signals.
- Max number of pulses: Check this box to limit the number of pulses to measure.

To use the Pulse Analysis preset (assuming the Preset action is set to Show list in the Presets tab of the Options control panel):

1. Select **Presets > Application**. Select **Pulse Analysis** and then 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 in the Trigger control panel. ("Trig" button). Using the Power trigger type with the RF Input source 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.

### Application Preset: Spectrum Analysis

The Spectrum Analysis application preset opens a Spectrum display and sets several parameters. The Spectrum Analysis preset sets the analyzer as follows.

- **Spectrum Analysis** : Sets the frequency range to maximum for the analyzer, and sets the RF/IF optimization to **Minimize Sweep Time**.

To use the Spectrum Analysis preset (assuming the Preset action is set to Show list in the Presets tab of the Options control panel):

1. Select **Presets > Application**. Select **Spectrum Analysis** and then click **OK**.
2. Set the measurement frequency using the front-panel knob or keypad.
3. Adjust the span to show the necessary detail.

### Application Preset: 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 its 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 (scale) is set to 5 ms.

To use the Time-Frequency Analysis preset (assuming that Time-Frequency Analysis is the selected preset on the list of Application Presets and Preset action is set to Recall selected preset):

1. Select **Presets > Application**. Select **Time-Frequency Analysis** and then 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. Connect to an MDO4000B/C series oscilloscope or and RSA306 spectrum analyzer and use their triggering functions to capture the signal. (Option CON is required to connect to an MDO4000B/C.)

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.

### Application Preset: Spur Search Multi Zone 9k-1GHz

The Spur Search Multi Zone 9k-1GHz application preset opens the Spurious display, which is set to display all spurs that exceed the Threshold and Excursion values for the entire 9 k through 1 GHz range.

To use the Spur Search Multi Zone 9k-1GHz preset (assuming that Preset action is set to Recall selected preset):

1. Select **Presets > Application**. Select **Spur Search Multi Zone 9k-1GHz** and then click **OK**.
2. Click **Setup > Settings** when the preset's display and settings have all been recalled and acquisitions are running.
3. Select the **Ranges and Limits** tab in the Spurious Settings control panel to view the spur information. You can click the **Expand** button to view the table in a separate window.

---

**NOTE.** You can read more about the [Spurious display \(see page 144\)](#) and its various parameters and settings in the RF Measurements section.

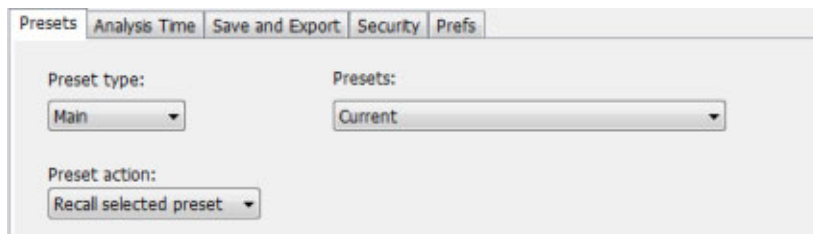
---



## Settings 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
Presets	Use this tab to configure Presets. You can select Presets and specify the action to take when a preset is recalled.
Analysis Time	Use this tab to specify the method used to automatically set the analysis and spectrum offsets when the <a href="#">Time Zero Reference (see page 495)</a> is set to Trigger.
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.
Security	Selecting the <b>Hide Sensitive readouts</b> check box causes the instrument to replace measurement readouts with a string of asterisks.
Prefs	Use this tab to select different color schemes for the measurement graphs and specify how markers should react when dragged.

### Presets

The Presets tab in the Options control panel allows you to specify actions taken when you press the Preset button. You can read more about this tab [here \(see page 21\)](#).

### Analysis Time

The Analysis Time tab in the Options control panel is used to specify the method used to automatically set the analysis and spectrum offsets when the [Time Zero Reference \(see page 495\)](#) is set to Trigger. The available settings are:

- Include trigger point – Selects an algorithm that uses the measurements to determine how far in advance of the trigger to set the analysis offset. The analyzer tries to ensure that data about the trigger point is included in the analyses.
- Start at trigger point (legacy) – The method used by the instrument in prior versions, which sets the Analysis Offset to zero when possible. The analyzer tries to ensure that data following the trigger point is included in the analyses. Use this method if your measurements or procedures depend on past behavior of the Auto Analysis Offset function.



## 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.
- Save TIQ file now: Invokes the Save As dialog box with the Save as type drop-down list set to TIQ.

## Security

The Security tab enables you to hide sensitive readouts in displays with readouts, such as the OFDM Summary display.

## Prefs

The Prefs tab enables you to set properties that apply to all displays.

# Connectivity

The Connect feature allows you to connect your PC (with SignalVu-PC installed) to the following instruments:

- RSA306 Spectrum Analyzer via USB 3.0
- MDO4000B/C Series instrument via USB, wireless, or LAN (optional CON application license for SignalVu-PC required)

---

**NOTE.** *Multiple instruments may be connected to the PC that runs SignalVu-PC, but only one instrument at a time can be connected to SignalVu-PC.*

---





## Connecting to an RSA306 Spectrum Analyzer

**USB3 connection.** Establishing a connection to an RSA306 is as simple as connecting the USB cable from the PC to the RSA306, either before or after starting the SignalVu-PC application. During the connection process, SignalVu-PC indicates that it is finding and connecting to the instrument. Please wait for the connection process to complete before using the software.

---

**NOTE.** *Your PC may notify you that it has found a new USB device and has loaded the device drivers. If you see these notifications, wait until the drivers are loaded before continuing.*

---

The SignalVu-PC application always monitors the USB ports. Anytime an RSA306 is discovered, a connection is immediately established causing the Connect status indicator to turn green (). Disconnecting the RSA306 from the PC also disconnects the SignalVu-PC application, causing the Connect status indicator to turn red (.

If the SignalVu-PC application is already connected to another instrument (either USB or network), an automated connection will not take place. In this situation, do the following:

1. Select **Disconnect From Instrument** to end the existing connection.
2. Select **Connect To Instrument**. You should see the USB connected RSA306 in the instrument list.
3. Select the instrument.



---

**NOTE.** *RSA306 devices require SignalVu-PC version 3.4.0253 or higher. The latest version of software is available from the Tektronix web site [www.tektronix.com/downloads](http://www.tektronix.com/downloads).*

---

4. A Connect Status dialog box will appear to confirm the instrument is connected and SignalVu-PC can receive live data from the instrument.

---

**NOTE.** *You can quickly verify connection status by looking at the **Connected** indicator icon. It is green () when an instrument is connected. It is red () when it is not. You can also view the name of the instrument that is connected by hovering the pointer over the connection icon.*

---

5. When you want to connect to a different instrument, select **Disconnect From Instrument** to end the current connection.

## Connecting to an MDO4000B/C Series instrument

---

**NOTE.** *You can watch a video tutorial about using Connect (Option CON) to connect to an MDO4000B/C Series instrument and about WLAN Presets at [www.youtube.com/user/tektronix](http://www.youtube.com/user/tektronix). Learn more about the Tektronix YouTube channel [here \(see page 12\)](#).*

---



**USB connection.** To establish a connection using USB, perform the following procedures in the order given.

1. Check that the MDO4000B/C is on.
2. Connect a USB cable to the MDO.
3. Connect the other end of that USB cable to the PC.

---

**NOTE.** *Your PC may notify you that it has found a new USB device and has loaded the device drivers. If you see these notifications, wait until the drivers are loaded before continuing.*

---

4. Double click the SignalVu-PC icon on the Desktop to start the application.
5. Click **Connect** on the menu bar to view the drop down menu.

---

**NOTE.** See [Elements of the Display \(see page 17\)](#) for information about menus and toolbars.

---

6. Select **Connect To Instrument**. You should see the USB connected MDO in the Connect To Instrument list.




---

**NOTE.** *If the PC is currently connected by LAN or USB to another instrument, that connection will also show in the Connect To Instrument list. You must select **Disconnect From Instrument** to end that connection before connecting to the newly found instrument.*

---

7. If you do not see the USB MDO, click **Search for Instrument**. TekVISA is now searching for instruments. A notification will briefly appear stating that the instrument was found. Check that the newly found instrument now appears in the **Connect To Instrument** list.
8. Select the instrument.
9. A Connect Status dialog box will appear to confirm the instrument is connected and SignalVu-PC can receive live data from the instrument.

---

**NOTE.** *You can quickly verify connection status by looking at the **Connected** indicator square at the bottom of the screen. It is green (  ) when an instrument is connected. It is red (  ) when it is not. You can also view the name of the instrument that is connected by hovering the pointer over the .*

---

10. Use SignalVu-PC to configure the MDO. Frequency, Amplitude, Span, Bandwidth, and Time Scaling parameters for the RF channels can only be changed using SignalVu-PC.



---

**NOTE.** Press *F1* on your keyboard to open the SignalVu-PC help for information about configuring and using the application. You can also click on *Help > User Manual* in the SignalVu-PC menu bar to open the help.

---

11. When you are ready to connect to a different instrument, select **Disconnect From Instrument** to first end the current connection.

---

**NOTE.** For more search options using TekVISA, go to the Visa Resource Manager (double click in the applications tray).

---



**LAN or wireless connection.** To establish a connection using a LAN or wireless connection, perform the following procedures in the order given.

1. Check that the PC has a working LAN or wireless network connection.
2. Use an Ethernet cable to connect the MDO to the network.
3. Check that the MDO is on and wait for the IP Address to display on the screen. Write down the IP address to help you identify the MDO in the SignalVu-PC application.
4. Double click the SignalVu-PC icon on the Desktop to start the application.
5. Click **Connect** on the menu bar to view the drop down menu.

---

**NOTE.** See [Elements of the Display \(see page 17\)](#) for information about menus and toolbars.

---

6. Select **Search For Instrument**. TekVISA is now searching for instruments.
7. A notification will briefly appear stating that the instrument was found. Check that the newly found instrument now appears in the **Connect To Instrument** list and then click on the instrument name to connect.




---

**NOTE.** If the PC is currently connected by LAN/wireless or USB to another MDO4000B/C, that connection will also show in the Connect To Instrument list. You must select **Disconnect From Instrument** to end that connection before connecting to the newly found instrument.

---

8. If you do not see the LAN address of the MDO, click **Manually Search for LAN Instrument**. You will then need to enter the IP address of the MDO into the IP Address dialog box and click **Connect**.
9. A Connect Status dialog box will appear to confirm the instrument is connected and SignalVu-PC can receive live data from the instrument.

---

**NOTE.** You can quickly verify connection status by looking at the **Connected** indicator square at the bottom of the screen. It is green () when an instrument is connected. It is red () when it is not. You can also view the name of the instrument that is connected by hovering the pointer over the .

---

10. Use SignalVu-PC to configure the MDO. Frequency, Amplitude, Span, Bandwidth, and Time Scaling parameters for the RF channels can only be changed using SignalVu-PC.

---

**NOTE.** Press F1 on your keyboard to open the SignalVu-PC help for information about configuring and using the application. You can also click on Help > User Manual in the SignalVu-PC menu bar to open the help.

---

11. When you are ready to connect to a different instrument, select **Disconnect From Instrument** to first end the current connection.



---

**NOTE.** *For more search options using TekVISA, go to the Visa Resource Manager (double click in the Windows applications tray).*

---





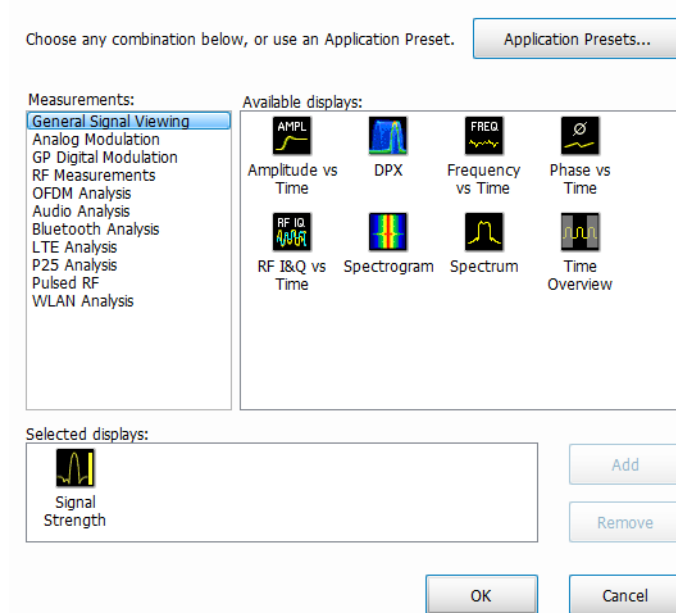


## Selecting Displays

**Menu Bar:** Setup > Displays

**Application Toolbar:** 

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



To select displays:

1. Select **Setup > Displays** or click the displays icon.
2. Select one of the choices under **Measurements**. The measurement 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**.







## Available Measurements

Available automatic measurements include RF power measurements, OFDM analysis, WLAN analysis, APCO P25 analysis, Bluetooth analysis, LTE analysis, audio analysis, analog modulation measurements, digital modulation measurements, and pulsed RF measurements.

See the specific measurement topic in this document for information about how to take a measurement.

### Power measurements

Measurement	Description
Channel Power	The total RF power in the selected channel (located in the Chan Pwr and ACPR display).
Adjacent Channel Power Ratio (ACPR)	Measure of the signal power leaking from the main channel into adjacent channels.
Multi-Carrier Power Ratio (MCPR)	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.



## OFDM analysis

Measurement	Description
Channel Response	Plots the channel response (magnitude or phase) versus the subcarrier or frequency. Here, the channel refers to all sources of signal frequency response impairment up to the analyzer input, including the transmitter itself, as well as any transmission medium through which the signal travels between the transmitter and the analyzer.
Constellation	Shows the WLAN signal modulation amplitude and phase in I (horizontal) versus Q (vertical) form. For multicarrier WLAN OFDM signals, the points show all data symbol subcarriers' modulation. For single-carrier 802.11b, each point corresponds to a single modulated chip.
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.
Flatness	Ratio of the peak power in the transmitted signal to the average power in the transmitted signal
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.
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.
Power	shows the data symbols' individual subcarrier Power values versus symbol interval (time) and subcarrier (frequency).



## WLAN measurements

Measurement	Description
Channel Response	Plots the channel response (magnitude or phase) versus the subcarrier or frequency. Here, the channel refers to all sources of signal frequency response impairment up to the analyzer input, including the transmitter itself, as well as any transmission medium through which the signal travels between the transmitter and the analyzer.
Constellation	Shows the WLAN signal modulation amplitude and phase in I (horizontal) versus Q (vertical) form. For multicarrier WLAN OFDM signals, the points show all data symbol subcarriers' modulation. For single-carrier 802.11b, each point corresponds to a single modulated chip.
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.
Flatness	Ratio of the peak power in the transmitted signal to the average power in the transmitted signal
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.
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.
Power vs Time	The signal power amplitude versus time. For 802.11b signals, the packet Power-On and Power-Down ramp times are also measured.
Summary	Shows several measurements of WLAN signal quality.
Symbol Table	Shows decoded data values for each data symbol in the analyzed signal packet. For OFDM (non-802.11b) signals, results are presented with subcarrier (frequency) indices in the horizontal dimension and symbol (time) intervals in the vertical dimension. For 802.11b signals, the Preamble, Header, and Data (PSDU) symbol values are presented sequentially, with symbol indices in the left column.



## Digital 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 SQPSK modulation types**

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.
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**

Measurement	Description
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**

Measurement	Description
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.

**Analog Modulation measurements****Measurements for AM modulation**

Measurement	Description
+AM	Positive peak AM value.
-AM	Negative peak AM value.
Total AM	Total AM value, which is equal to the peak-peak AM value divided by 2.

**Measurements for FM modulation**

Measurement	Description
+Pk	Positive peak frequency deviation.
-Pk	Negative peak frequency deviation.
RMS	RMS value of the frequency deviation.
Pk-Pk/2	Peak-to-peak frequency deviation divided by 2.
Pk-Pk	Peak-to-peak frequency deviation.



**Measurements for PM modulation**

Measurement	Description
+Pk	Positive peak phase deviation.
-Pk	Negative peak phase deviation.
RMS	RMS value of the phase deviation.
Pk-Pk	Peak-to-peak phase deviation.

**APCO P25 measurements**

Measurement	Description
RF output power	Measure of RF output power when the transmitter is connected to the standard load during defined duty cycle.
Operating frequency accuracy	Measure of the ability of the transmitter to operate on its assigned frequency.
Unwanted emissions (ACPR)	Ratio of the total power of a transmitter under prescribed conditions and modulation to that of the output power that falls within a prescribed bandwidth centered on the nominal frequency of adjacent channels.
Frequency deviation	Measurement of the amount of frequency deviation that results for a Low Deviation and High Deviation test pattern.
Modulation fidelity	Measures the degree of closeness to which the modulation follows the ideal theoretical modulation determined by the rms difference between the actual deviation and the expected deviation for the transmitted symbols.
Symbol rate accuracy	Measures the ability of the transmitter to operate at the assigned symbol rate (4.8 kHz for Phase 1, 6 kHz for Phase 2).
Transmitter power and encoder attack time	Measures the time required for a transmitter to prepare and transmit information on the radio channel after changing state from standby to transmit (applies to conventional mode).
Transmitter power and encoder attack time with busy/idle operations	Measures the time required for a transmitter to prepare and transmit information on the radio channel after the receiving channel changes state from busy to idle.
Transmitter throughput delay	Measures the time it requires for audio changes in the microphone to be encoded and transmitted over the air.
Transient frequency behavior	Measures the difference of the actual transmitter frequency and assigned transmitter frequency as a function of time when the RF output power is switched on or off.
HCPM transmitter logical channel time alignment	Measures the ratio of total transmitter power under prescribed conditions and modulation to the peak power that falls in a prescribed bandwidth centered on the nominal frequency of the adjacent channel during the transmitter power ramping interval.

**Bluetooth measurements**

Measurement	Description
Modulation characteristics	Verifies that the modulation characteristics of the transmitted signal are correct. This measurement can only be done if the payload has the bit pattern 10101010 or 11110000.
Carrier frequency offset and drift	Verifies that the carrier frequency offset and carrier drift of the transmitted signal is within the specified limits for the Basic Rate and Low Energy standards. This test can be done only if the payload contains 10101010 bit pattern.



Measurement	Description
Output power	Verifies the maximum peak and average power emitted from the EUT. The standard recommends this test be done for a PRBS payload pattern.
In-band emission / ACPR	Verifies that the in-band spectral emission is within limits. The standard document recommends that this measurement be done with Hopping off, finding the integrated power in 1 MHz band (with RBW 100 kHz) in 80 channels starting from 2401 MHz to 2481 MHz. The integrated power values calculated in the adjacent channels are compared against recommended limits (except the three channels around transmitted frequency). This measurement is referred to as ACPR in the Basic Rate standards document.
20 dB bandwidth	Verifies if the emissions inside the operating frequency range are within limits. This measurement is done with Hopping off. The difference between frequency points at which the power level drops to 20 dB below the peak power of the emission is found as 20 dB bandwidth.
Frequency range	These measurements verify if the emissions inside the operating frequency range are within the limits.
Power density	This measurement verifies the maximum RF output power density.
Out-of-band spurious emission	This measurement can be done for FCC or ETSI masks using the Spurious display.
Relative power	Verifies the relative power in the GFSK and PSK part of the Enhanced Data Rate signal. This measurement is supported only when an Enhanced Data Rate signal is detected.

## LTE measurements

Measurement	Description
Cell ID detection	The Cell ID is detected from the input LTE signal. For TDD and FDD.
Adjacent Channel Leakage Ratio (ACLR)	The Adjacent Channel integrated power is calculated and shown. The relative power compared to the reference signal is also computed. The computed power is compared against limits suggested by the selected standard and pass/fail is reported. For TDD and FDD.
Channel Power	The channel power is calculated in the channel bandwidth. For TDD and FDD.
Occupied Bandwidth	The Occupied bandwidth is calculated as bandwidth containing 99% of the total integrated power in the selected span around the selected center frequency. For TDD and FDD.
Operating Band Unwanted Emission	The power in the offset regions is calculated and presented and compared against limits set in the offset and limits table and pass/fail is reported. For TDD and FDD.
T <sub>OFF</sub>	The power in off-slot region is computed and compared against selected limits. For TDD only.

## Pulse measurements

Measurement	Description
Average ON Power	The average power transmitted during pulse on.
Peak Power	Maximum power during pulse on.



Measurement	Description
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.
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 604)</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.



Measurement	Description
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.
Delta Frequency (Non-chirped pulse)	<p>The Delta Frequency measurement is the difference from the measurement frequency to each pulse frequency. Pulse frequency is calculated across the time defined by the Frequency Domain Linearity setting in the Define tab.</p> <p>The measurement is available for modulation types CW (Constant Phase), CW (Changing phase), and Other (manual) setting in the Freq Estimation tab.</p> <p>The measurement is not specified for chirp or other signals and no answer is returned when frequency estimation is set to Chirp.</p> <p>If frequency estimation is set to Other, then Frequency Offset must be set to 0 Hz and the Range can be set to <math>\pm 40\%</math> of the acquisition bandwidth.</p> <p>A least-square fit of slope of phase vs. time over the measurement period is used for the measurement of the individual pulse frequency. Frequency difference is calculated as the difference between the reference frequency and the calculated frequency of the pulse.</p>
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 General Signal Viewing (Displays > Measurements > General Signal Viewing) are:

- Amplitude vs Time
- DPX Spectrum
- 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.

## DPX Display Overview

The DPX display enables you to see how traces change over time and thus displays signal events that cannot be seen on a swept spectrum analyzer. A DPX Spectrum indicates how traces change in two ways. First, it uses color shading to show how consistent the shape of a trace is. Second, it uses persistence to hold signals on the screen so you can see them longer.

## DPX Display

The DPX display works by using a two-dimensional array to represent points on the display. Each time a trace writes to a point on the display, a counter in the array is incremented. A color is assigned to each point in the display based on the value of its counter. Thus, as acquisitions occur over time, a colored waveform, the Bitmap, develops on the display that shows how frequently each display point has been written to.

An important feature of the DPX display is dot persistence. Dot persistence sets how long a point on the display will be visible. You can set the Dot Persistence to be Variable or Infinite. In variable persistence mode, you specify a decay period that limits how long a point will be displayed. In infinite persistence mode, once a point in the display has been written to, it will remain visible indefinitely.

The DPX display can plot the trace in the following views:

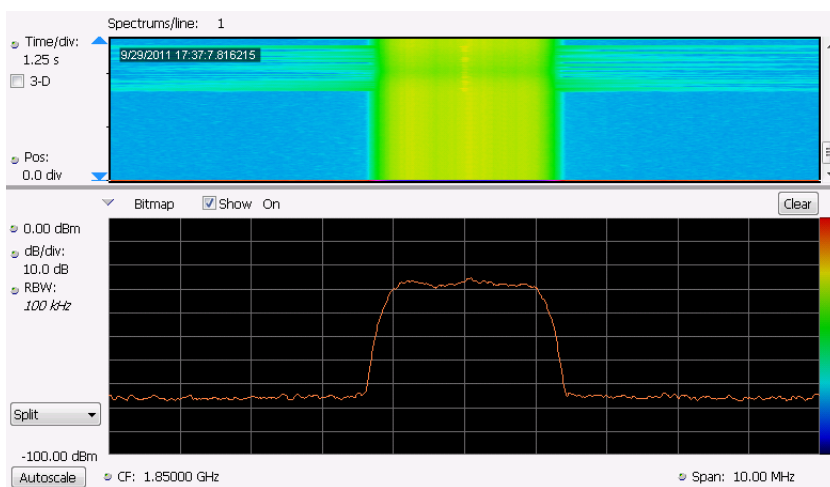


- **Spectrum** – This view plots power on the vertical axis versus frequency on the horizontal axis. This display is similar to a standard Spectrum display. In SignalVu-PC, this display appears as part of the Split view. In the Split view, the only trace that can be displayed is the Ogram Line.
- **DPXogram** - This view is a spectrogram version (time plotted along the vertical axis versus frequency on the horizontal axis) of the DPX Spectrum trace. DPX spectrogram (on the instrument that created the DPX acquisition data) creates the spectrogram in real time, and does not require an acquisition to be transferred into memory and analyzed. Because of this real time processing, there are no gaps in the spectral lines, even for monitoring periods that can last for several days.
- **Split** - This view consists of two DPX views. A DPXogram view appears on the top half of the display and a DPX Spectrum view appears on the bottom half of the display.

To display a DPX view:

1. Recall a DPX waveform acquisition data file.
2. Select **Frequency** and set the measurement frequency.
3. Select the **Displays** icon or **Setup > Displays**. This displays the **Select Displays** dialog box.
4. From the **Measurements** box, select **General Signal Viewing**.
5. Select **DPX** from the **Available displays** box.
6. Click the **Add** button. This will add the DPX icon to the Selected Displays box (and remove it from the Available displays box).
7. Click the **OK** button. This displays the DPX Spectrum view.

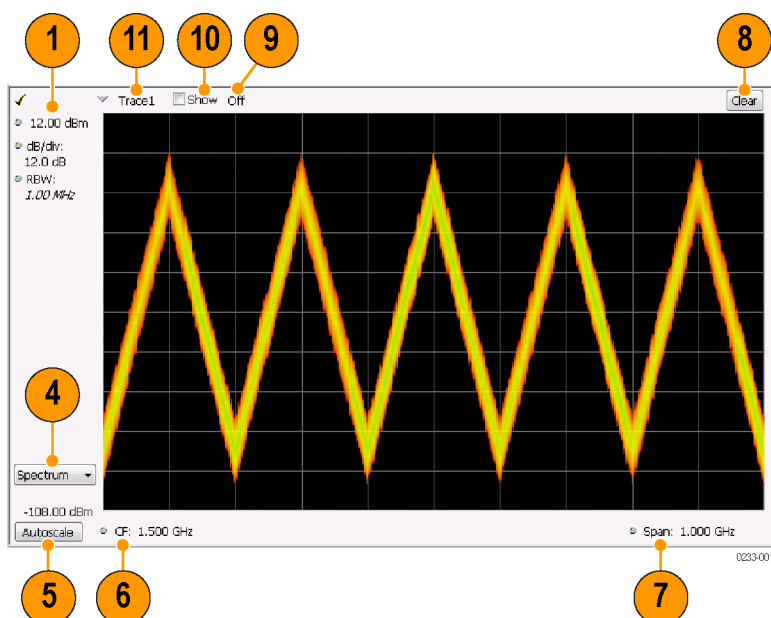
SignalVu-PC will display the Split view of the recalled acquisition data.



DPX Split View



## Elements of the DPX Display

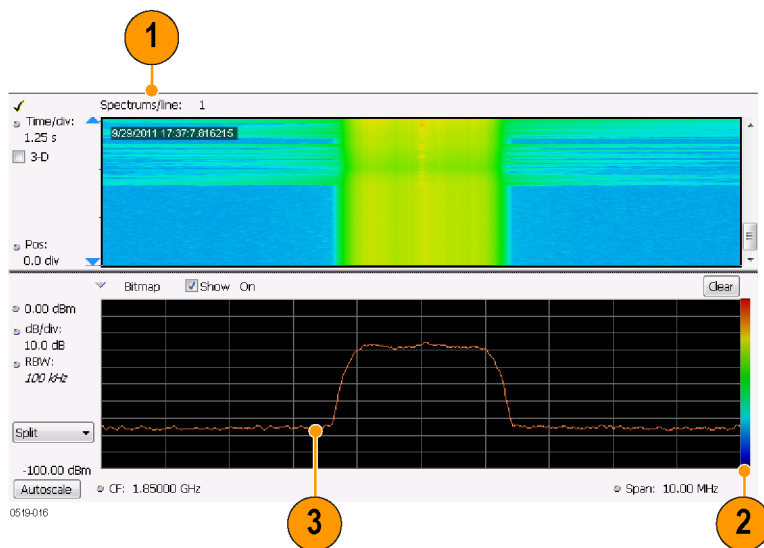


Item	Display element	Description
1	Vert Position	Sets the top of graph value. This is only a visual control for panning the graph. The Reference Level is adjusted in the Toolbar and the Ampl control panel. By default, Vert Position = Ref Level.
2	dB/div	Sets the vertical scale value. The maximum value 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	DPX view	Selects the DPX view. Choices are Spectrum, Zero Span, Frequency, Phase, DPXogram, and Split.
5	Autoscale	Adjusts the Vertical and Horizontal scaling to display the entire trace on screen.
6	Pos/CF	Spectrum: Center Frequency - Adjusts the analyzer center frequency. For Zero Span, Frequency, or Phase the Position is in seconds.
7	Span/Scale, Sweep/Scale	Spectrum display: Span - Adjusts frequency range of the measurement. Scale - If Horizontal scale has been manually adjusted in Settings > Scale, then this control adjusts the visual graph scaling without affecting the Span. Zero Span, Frequency, Phase displays: Sweep - adjusts the trace duration in seconds. Scale - adjusts the visual graph scaling without affecting the Sweep time.
8	Clear	Erases the bitmap and traces in the graph and restarts multi-trace functions (Avg, Hold).
9	Function	Readout of the Detection and Function selections for the selected trace.



Item	Display element	Description
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.

### Additional Elements of the DPXogram Split Display



Item	Display element	Description
1	Spectrums/line	Appears only when the display is stopped. Readout of the number of spectrum lines represented by each line of the DPXogram display. This value changes when the Time/div or Time resolution settings are changed.
2	Color scale	Legend at the right side of the DPX Spectrum display. This element illustrates the relationship between the colors in the DPXogram plot and the amplitude axis of the DPX Spectrum plot. This scale changes with Color (DPXogram) palette selection and Max and Min settings on the Ampl Scale tab.
3	DPXogram trace	The selected line in the DPXogram graph can be shown in the DPX Spectrum graph of the Split view. The most recent DPXogram line, usually at the bottom of the graph, is selected by default. If any markers are on, the selected marker determines the selected line.

### Time Resolution of DPXogram Display

Due to the large amount of data produced by the DPX hardware during acquisitions, a compressed version of the plot is shown while running. This plot is limited to 500 lines, with each line having 267 points. However, a much longer record, with higher frequency resolution is being collected. As soon as the instrument is stopped, this underlying data is shown, replacing the temporary version. There are 50 lines in each vertical division of the 2-D DPXogram plot, so the time resolution of the graph is Time/div



divided by 50. However, you can set the instrument to collect multiple spectra per line, allowing you to zoom in later on this high-time-resolution data.

$$\text{Time Resolution} = \frac{10 \times \text{Time/Division}}{500}$$

When the DPXogram display is stopped, the analyzer can display the full resolution of the captured data. The Time Resolution readout applies only when the DPXogram is running.

**Effects of Changing Time Resolution.** The Time Resolution control affects acquisition parameters for the DPX hardware. This means that if you change the Time Resolution value while the instrument is stopped, the new value applies to the NEXT acquisition, and might not represent the results currently shown in the display.

Time resolution can be changed either directly, by manually adjusting the Time Resolution control, or automatically, by changing the Time/div control. Auto is the default, yielding one spectrum per line in the display. When the Time Resolution is decreased below its auto value, multiple spectra are collected to create each line in the DPXogram graph. Once you stop the instrument, you can decrease the Time/div value or use Zoom to see increased time resolution.

If the time resolution is set to a very small number while the Time/div is set to a large value, you might notice that there is a limit to the number of spectra that can be collected. This limit depends on the number of trace points selected. For 801-point spectra, 60,000 underlying spectra can be collected. The number of 2401-point spectra collected is 20,000, and for 4001-point spectra the number is 12,000. When the limit is reached, the oldest spectra are discarded as newer spectra are captured.

### 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.
Click on a marker to select and then use the arrow keys to move the marker	Adjust the setting associated with the Marker.
Click and drag a marker	Changes marker position to the "drop point". You can use Tools > Options > Prefs to change whether markers jump from one peak to the next while dragging or move smoothly along the trace.

### Available Traces for Display in SignalVu-PC

The DPX display shows two types of displays, the DPXogram and Split display. The Split display consists of a DPXogram display on the top half of the display and a DPX Spectrum display on the bottom half of the display.

For the DPXogram display, only one trace is available – the DPXogram trace.

For the Split display, the DPX Spectrum display shows only the Ogram Line (the selected line in the DPXogram display) on the bottom half of the display.

**Reference.** [Changing the DPX Spectrum Display Settings \(see page 411\)](#)



## DPX Settings

**Menu Bar:** Setup > Settings

**Front Panel / Application Toolbar:** Settings

The measurement settings for the DPX display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 84)</a>	Sets frequency and span parameters for the DPX display. This tab appears for the Spectrum and DPXogram displays.
<a href="#">BW (see page 88)</a>	Sets Resolution Bandwidth.
<a href="#">Traces Tab</a>	Allows you to select the number and types of traces to display and their functions.
<a href="#">Amplitude Scale Tab (see page 57)</a>	The Amplitude Scale tab allows you to change the vertical scale and offset, enable the 3-D Waterfall display, and set the color scheme used for the DPXogram trace.
<a href="#">Time &amp; Freq Scale Tab (see page 58)</a>	The Time and Freq Scale tab allows you to change the vertical and horizontal scale settings, number of points in the trace, and Time resolution.
<a href="#">Prefs (see page 91)</a>	Specifies whether certain display elements are visible.

## Traces Tab

The Traces Tab allows you to set the display characteristics of the DPXOgram and Ogram traces in the DPX display.

The screenshot shows the 'Traces' tab in the settings window. It contains a 'Trace:' dropdown menu currently set to 'DPXogram'. To the right of this are two checkboxes: 'Show' (which is checked) and 'Freeze' (which is unchecked). Below the 'Trace:' dropdown is a 'Detection:' dropdown menu set to '+Peak'.

Setting	Description
Trace drop-down list	Selects which trace to configure. In SignalVu-PC, the only configurable traces are DPXogram and Ogram.
Show	Specifies whether or not the trace shown in the Trace setting is displayed.
Freeze	Halts updates to the selected trace.
Detection	Sets the Detection method used for the trace. Available detection methods are +Peak, -Peak, and Avg (VRMS).
Save Trace As	Saves the Ogram trace to a file for later recall and analysis.



## 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 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.

---

**NOTE.** *The Detection setting does not affect the trace until the spectrum length is longer than the Auto setting.*

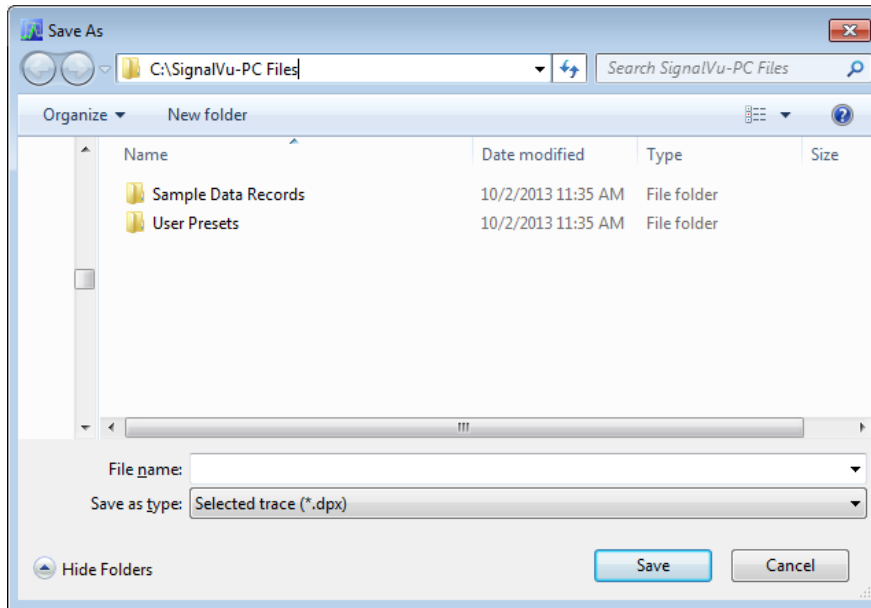
---

## Saving Traces

To save an Ogram trace for later analysis:

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





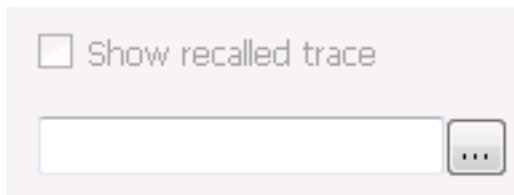
2. Type a name for the saved trace and click **Save**.

## Recalling Traces

You can recall a previously saved trace for comparison to a live trace. First, specify a trace for recall and second, enable Show Recalled 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 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).



## Amplitude Scale Tab

The Amplitude Scale tab allows you to change the vertical and horizontal scale settings, enable the 3-D Waterfall display, and set the color scheme used for the DPXogram trace.

Setting	Description
Height	Height controls apply only to the 3-D Waterfall display.
Scale	Changes the vertical scale for trace Amplitude in the graph (not the vertical scale for Time).
Position	Specifies the level displayed at the bottom edge of the graph. (Bottom front edge in the 3-D view).
Autoscale	Adjusts the vertical position bottom for linear units like Amps and Volts. Adjust the vertical position top for log units like dBm. dBm is the default.
3-D Waterfall	Displays the DPXogram in a 3-D format.
Northeast	Shifts the perspective of the 3-D graph so that the oldest traces move back and to the right.
Northwest	Shifts the perspective of the 3-D graph so that the oldest traces move back and to the left.
Reset Scale	Resets the Height and Color settings to their default values.
Color (DPXogram)	
Color	Displays a drop-down list that allows you to set the color scheme used for the DPXogram trace.
Max	Sets the power level represented by the top of the color scale.
Min	Sets the power level represented by the bottom of the color scale.



## Time & Freq Scale Tab

The Time and Freq Scale tab allows you to change the vertical and horizontal scale settings, set the time resolution and number of trace points of the DPXogram display.

Setting	Description
<b>Vertical (time)</b>	
Time/div	For most Spectrogram applications. Primary time scale control is Time/div. Time scale can be zoomed in or out when acquisitions are stopped.
Position	The position of the DPXogram record at the bottom of the display. Position cannot be changed while acquisitions are active, and is reset to zero when acquisitions are started again.
Time at position	Displays the time of the DPXogram line shown at the bottom of the graph. This time is relative to the Time Zero Reference of the current acquisition. If Position is set to a negative value, the Time at position readout will be blanked.
Reset Scale	Sets the Time/div and Position settings to their default values.
Trace Points	Sets the number of trace points computed for each DPXogram line. These are the points used for marker measurements and for results export.
Time resolution	Specifies the length of time represented by each line in the graph.
Auto	Sets the time represented by each line in the graph to be adjusted by the analyzer checked) or manually (when unchecked). When Auto is enabled, Time Resolution change based on Time/div.
Capacity	Readout of the total length of time that can be captured. This readout is provided so that you can see how changing the Trace Points and Time resolution affects the amount of data that can be captured. Capacity is represented in the format dd:hh:mm:ss.
<b>Horizontal (frequency)</b>	
Scale	Sets the displayed frequency range of the graph. This control affects only visual scaling, and does not change the acquisition or analysis parameters.
Position	Sets the frequency displayed at the center of the graph. Changing this value does not change the Frequency setting.
Autoscale	Sets the frequency scale to the Spectrogram Span value.



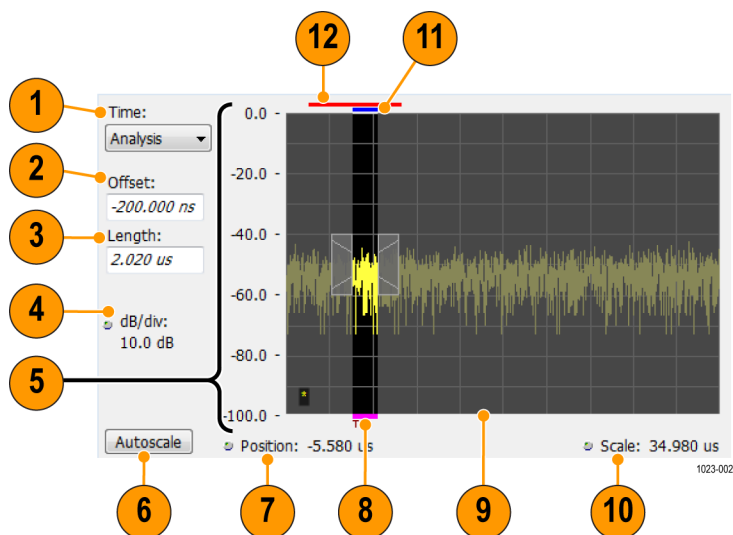
## Time Overview Display

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 Time Overview Display





Item	Element	Description
1	Time	Select the type of time analysis to be performed. You can select Analysis, Spectrum, or Linked.
2	Offset	Sets the offset of the selected analysis time control.
3	Length	Sets the length of the selected analysis time control.
4	Position and Scale	Adjusts the vertical scale and position.
5	Scale indicators	Shows the vertical scale.
6	Autoscale button	Resets the horizontal scale to display the entire acquisition record and the vertical scale to show all trace points.
7	Horizontal offset	Adjusts the horizontal offset.
8	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.
9	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.
10	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.
11	Spectrum Length and Offset Indicator (red line, top of graph)	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.
12	Analysis Length and Offset Indicator (blue line, top of graph below red line)	The 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.

**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 \(see page 60\)](#)

## Time Overview Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

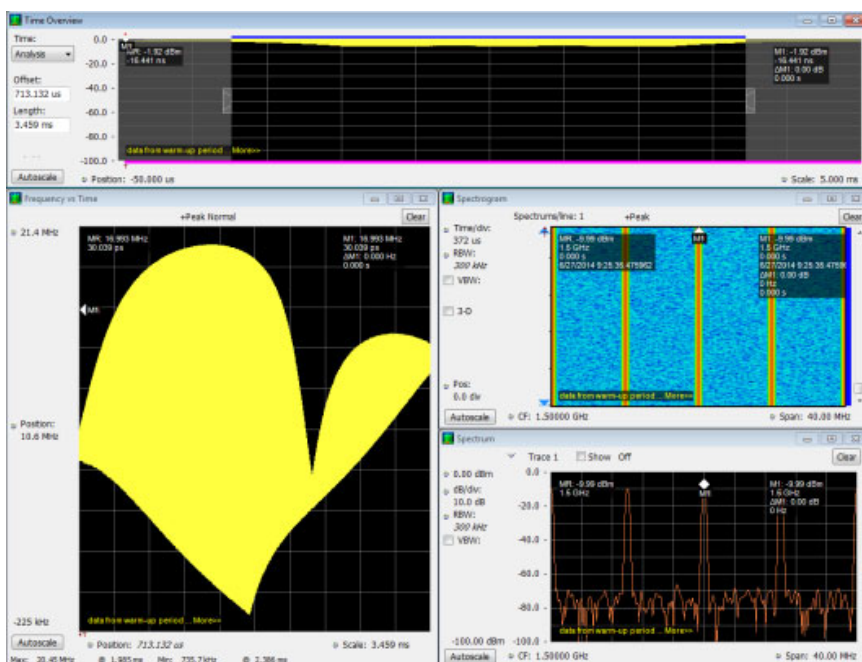


Settings tab	Description
<a href="#">Scale (see page 90)</a>	Adjusts the vertical and horizontal scale and offset of the display.
<a href="#">Trace (see page 63)</a>	Allows you to select the types of trace to display and its function.
<a href="#">Prefs (see page 91)</a>	Specifies whether or not certain display elements are shown.



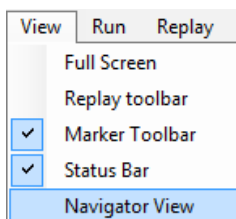
## Navigator View

The Time Overview Navigator View places the Time Overview display across the top of the application screen. This allows you to adjust the area of interest in the Navigator View and see the results simultaneously in the other displays. For example, in the following image, adjusting the mask in the Navigator View moves the trace and markers in all of the other displays.



### Show Navigator View

To show the Navigator View, select **View > Navigator View**. To remove the Navigator View, deselect Navigator View in the View menu.





## Trace Tab

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

The screenshot shows the 'Trace' tab in a software interface. It contains several controls: a 'Show' checkbox (checked), a 'Freeze' checkbox (unchecked), and a 'Save Trace As...' button. Below these are two rows of settings. The first row has a 'Detection:' dropdown menu set to '+Peak', a 'Count' checkbox (checked), and a 'Show recalled trace' checkbox (unchecked). The second row has a 'Function:' dropdown menu set to 'Avg (VRMS)', a text input field containing '10', and a button with three dots '...'.

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 icon . 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**.

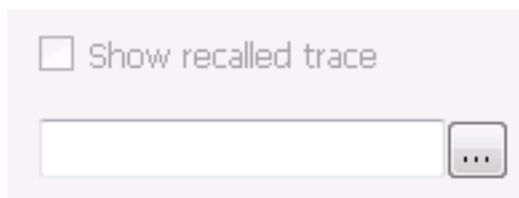
## Recalling Traces

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).

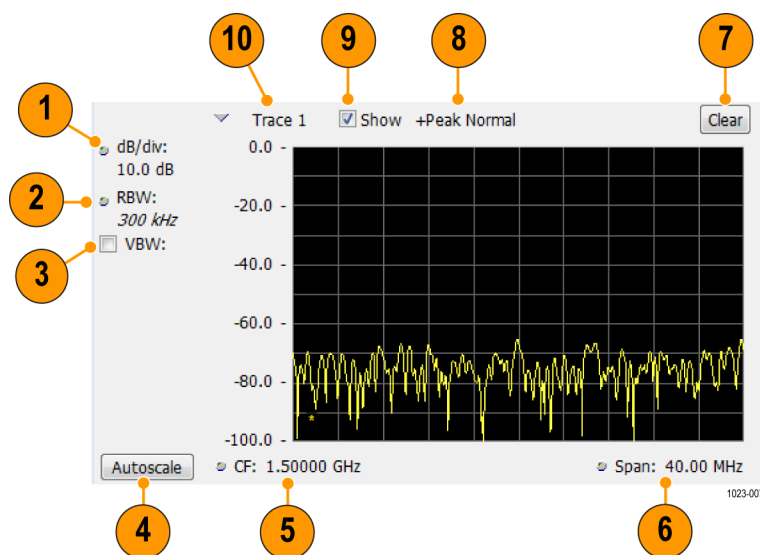
## Spectrum Display

To display a spectrum:

1. Click the **Displays** button or select **Setup > Displays**.
2. From the Measurements 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	dB/div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
2	RBW	Sets the resolution bandwidth. Note that when the RBW is set to Auto, its value is italicized.
3	VBW	Enables the VBW (Video Bandwidth) filter. See Setup > Settings > <a href="#">BW Tab (see page 88)</a> .
4	Autoscale	Adjusts the Vertical and Horizontal scaling to display the entire trace on screen.
5	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.
6	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.
7	Clear	Restarts multi-trace functions (Avg, Hold).
8	Function	Readout of the Detection and Function selections for the selected trace.
9	Show	Controls whether the selected Trace is visible or not. When trace is Off, the box is not checked.
10	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.



[Changing the Spectrum Display Settings \(see page 67\)](#)

## Spectrum Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

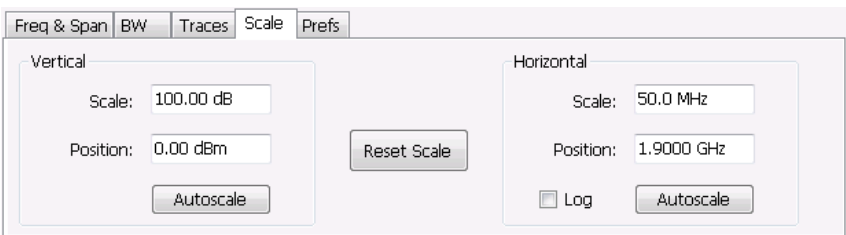
The settings for the Spectrum display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; Span (see page 84)</a>	Sets frequency and span parameters for the Spectrum Analysis display.
<a href="#">BW (see page 88)</a>	Sets Resolution Bandwidth and windowing parameters.
<a href="#">Traces (see page 85)</a>	Sets Trace display parameters.
<a href="#">Traces (Math) (see page 88)</a>	Sets the traces used to create the Math trace.
<a href="#">Scale Tab (see page 68)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs Tab (see page 91)</a>	Specifies whether or not certain display elements are 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 Measurement Frequency. In effect, these controls operate like pan and zoom controls.



Setting	Description
<b>Vertical</b>	
Scale	Changes the vertical scale.
Position	Vertical Position adjusts the top of graph amplitude value. This control allows you to move ("pan") the traces up and down in the graph without changing the Reference Level.
Autoscale	Resets the Offset so that the trace appears below the top of the graph.
<b>Horizontal</b>	
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.

The spectrogram can also be displayed in a 3-D waterfall format. In the 3-D waterfall format, the spectrogram displays the time axis along a simulated Z-axis.

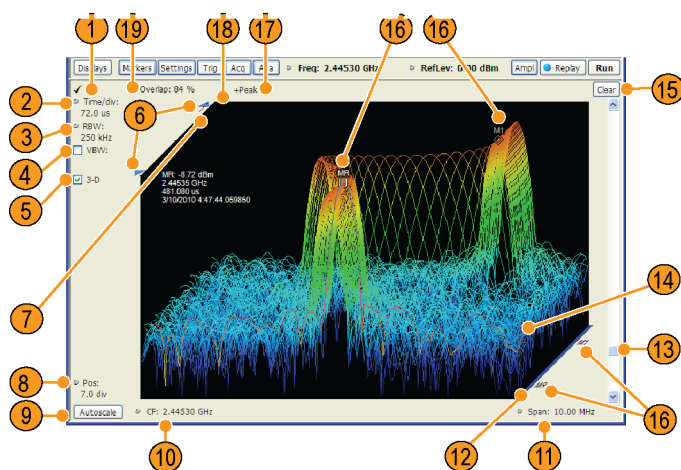
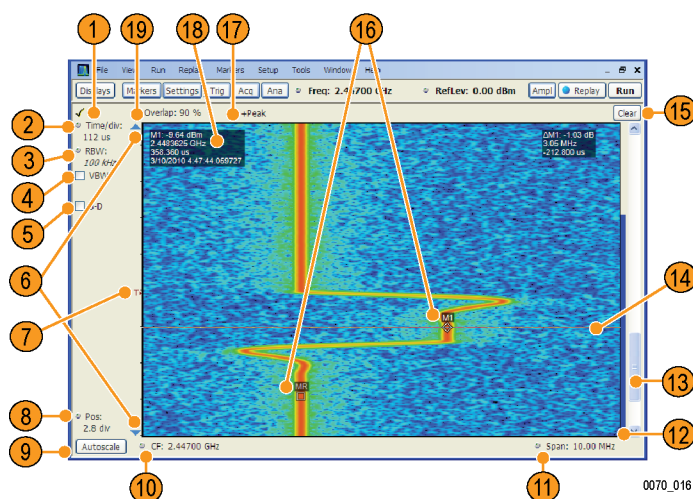
**NOTE.** Spectrogram data is shared with the Spectrum display. There is no linkage between DPX and Spectrogram.



To display a Spectrogram:

1. Select the **Displays** button or select **Setup > Displays**. This displays the **Select Displays** dialog box.
2. From the **Measurements** 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.
5. To display a 3-D version of the spectrogram, select the 3-D checkbox.

### 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
2	Time/div	Sets the length of time represented by each vertical division. Divisions are indicated by tick marks along the left edge of the graph.
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 88)</a> .
5	3-D checkbox	Enables and disables the 3-D view.
6	Selected records indicators	Shows the 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. Note that these are not visible while acquisitions are running; the instrument must be stopped for the indicators to be visible.
7	T	Trigger indicator. This icon indicates the trigger point within the current acquisition.
8	Pos	Position indicates the bottom line visible in graph. Changing this setting scrolls the window up and down through the displayed acquisition records.
9	Autoscale	Resets Vertical and Horizontal scale and Pos to default values.
10	CF	Sets the Center Frequency.
11	Span	Sets the span of the spectrogram display.
12	Current data record indicator	A 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 appears more like a blue bar.
13	Position scroll bar	Changes the position of the trace in the window. Changing the position scroll bar is the same as adjusting the Pos setting.
14	Selected indicator	This inverse-colored line indicates the Spectrogram line that will appear in the Spectrum display when the Spectrogram trace is enabled. This line is attached to the selected marker.
15	Clear	Clears the spectrogram display; however, data records in acquisition history remain in memory and are available for replay. To clear memory, select <b>File &gt; Acquisition Data Info &gt; Delete All Data</b> .
16	Marker indicators	These icons indicate the position of markers in the spectrogram. You can move markers by dragging the desired marker indicator.
17	Detection setting	Displays the selected Detection method (see <a href="#">Settings &gt; Trace (see page 72) tab</a> ).



Item	Display element	Description
18	Marker readout	Marker readout for the selected marker. In the Spectrogram display, the marker readout includes a date and timestamp. The time is displayed in a 24-hour format. The timestamp readout can be shown or hidden independently of the other marker readouts (see <a href="#">Settings &gt; Prefs (see page 91)</a> ).
19	Time Scale status readout	Three readouts can appear here depending on settings: Time/update, Spectrums/line, and Overlap. See <a href="#">Time Scale Status Readout (see page 71)</a> .

## Time Scale Status Readout

Three types of readouts can appear in the display depending on settings:

- Time/update – Displays minutes:seconds when Spectrum Monitor is selected in the **Settings > Time & Freq Scale** tab in the **Vertical (Time)** section.
- Spectrums/line – Displays an integer number when vertical scale is Normal and each line contains the results from one or more frequency transforms (whether zoomed out or not).
- Overlap – Displays the overlap percentage when vertical scale is Normal and each line's transform shares some points with the transforms of lines before and after it (zoomed in). Overlap can only be done when the Analysis Length > 2x RBW frame length.

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 \(see page 71\)](#)

# Spectrogram Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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 84)</a>	Sets frequency and span parameters for the Spectrogram display.
<a href="#">BW (see page 88)</a>	Sets Resolution Bandwidth and windowing parameters.
<a href="#">Trace (see page 72)</a>	Sets Trace display parameters.
<a href="#">Amplitude Scale (see page 73)</a>	Selects between 2-D and 3-D, sets height scale, position and orientation for 3-D display. Sets color parameters for the spectrogram trace.
<a href="#">Time &amp; Freq Scale (see page 73)</a>	Sets the vertical and horizontal scale parameters for the spectrogram trace. The Spectrum Monitor controls are also on this tab.
<a href="#">Prefs (see page 91)</a>	Specifies whether or not certain display elements are shown.



## Trace Tab

The Spectrogram Trace tab controls let you specify the Detection method, save traces, and recall saved traces for display. The Spectrogram Trace tab does not have all the controls that other Trace tabs contain, however, it does have a unique display element, the Selected Line readout. For details on Detection, Freeze, and saving and recalling traces, see the [Traces Tab \(see page 85\)](#).



The screenshot shows the 'Trace' tab selected in a software interface. The tab bar at the top includes 'Freq & Span', 'BW', 'Trace', 'Amplitude Scale', 'Time & Freq Scale', and 'Prefs'. The 'Trace' tab content area has a light purple background. It features a 'Selected Line:' label with the value '6/30/2006' below it. To the right of this is a 'Freeze' checkbox, which is currently unchecked. Further right is a 'Save Trace As...' button. Below the 'Selected Line:' label is a 'Detection:' label followed by a dropdown menu showing '+Peak'. To the right of the dropdown is a 'Show recalled trace' checkbox, also unchecked. At the bottom right of the tab area is a text input field with a small button containing three dots.

### 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.



## Amplitude Scale Tab

The Amplitude Scale tab allows you to change the vertical and horizontal scale settings, enable the 3-D Waterfall display, and set the color scheme used for the spectrogram trace.

The screenshot shows the 'Amplitude Scale' tab in a software interface. It contains several controls:
 

- Height (3-D only)**: A section with 'Scale' set to '100.00 dB' and 'Position' set to '-5.00 dBm'. Below these is an 'Autoscale' button.
- 3-D Waterfall**: A checked checkbox.
- Perspective**: A dropdown menu currently set to 'Northeast'.
- Reset Scale**: A button.
- Color (Power)**: A section with a 'Color' dropdown set to 'Temperature', a 'Max' value of '0.00 dBm', and a 'Min' value of '-100.00 dBm'. To the right is a vertical color bar showing a gradient from blue at the bottom to red at the top.

Setting	Description
Height (3-D only)	
Scale	Changes the vertical scale for trace Amplitude in the graph (not the vertical scale for Time).
Position	Specifies the level displayed at the bottom edge of the graph. (Bottom front edge in the 3-D view).
Autoscale	Adjusts the vertical position and scale of the trace lines to bring them into the visible portion of the graph.
3-D Waterfall	Displays the spectrogram in a 3-D format.
Northeast	Shifts the perspective of the 3-D graph so that the oldest traces move back and to the right.
Northwest	Shifts the perspective of the 3-D graph so that the oldest traces move back and to the left.
Reset Scale	Resets the Height and Color settings to their default values.
Color (Power)	
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.

## Time & Freq Scale Tab

The Time and Freq Scale tab allows you to change the vertical and horizontal scale settings, enable the 3-D Waterfall display, and set the color scheme used for the spectrogram trace.



The screenshot shows the 'Time & Freq Scale' tab with the following settings:

- Vertical (Time):**
  - Mode: ☒ Normal
  - Time/div: 72.0 us
  - Overlap: 94 %
  - Visible elapsed time: 396.7 us
  - Position: 12.3 div
  - Time at position: 1.261 ms
  - Time/update: 0 m : 1 s
  - Buttons: Reset Scale, Autoscale
- Horizontal (Frequency):**
  - Scale: 10.00 MHz
  - Position: 2.44530 GHz
  - Button: Autoscale

Setting	Description
<b>Vertical (Time)</b>	
Normal	For most Spectrogram applications. Primary time scale control is Time/div. Time scale can be zoomed in or out.
Spectrum Monitor	For long-term signal monitoring applications. In spectrum monitor mode, each line in the spectrogram represents the period of time specified by the Time/update parameter. Time scale can be zoomed out, but not zoomed in (no overlap).
Time/update	Sets the time, in minutes and seconds, represented by each line of the spectrogram. Only available in Spectrum Monitor.
Reset Scale	Resets the Time/div and Pos settings to their default values.
Autoscale	Scales the vertical (time) axis to compress all existing trace lines into the visible area of the graph. Resets the Position value to zero, placing the most recent spectrogram line at the bottom of the spectrogram display. Only Position is affected by Autoscale when Spectrum Monitor is selected.
Time/div	Sets the time displayed per division.
Visible elapsed time	Displays the length of time visible in the display. This does not represent the total time available to view.
Position	Adjusts vertical position of the trace within the graph area. Setting represents the offset, in divisions, between the bottom of the graph and the bottom (most recent) line in the results trace.
Time at position	Displays the time of the spectrogram line shown at the bottom of the graph. This time is relative to the Time Zero Reference of the current acquisition.
<b>Horizontal (Frequency)</b>	
Scale	Sets the frequency range of the graph without changing the Span value.
Position	Sets the frequency displayed at the center of the graph. Changing this value does not change the Freq setting.
Autoscale	Sets the frequency scale to the Spectrogram Span value.

## Spectrum Monitor

Spectrum Monitor performs long term monitoring. The monitor mode compresses time into each line of the spectrogram, which enables you to monitor long periods of time (from 1 second per line up to 600 minutes per line). With extended memory (Option 53) installed in the instrument, you can capture up to 125,000 lines. With standard memory installed in the instrument, the maximum number of lines you can capture is 31,250.

During each line's collection period, spectrum transforms are computed for each acquisition taken by the instrument. As each transform completes, it is incorporated into the current spectrogram line. How each



line of the spectrogram is created in spectrum monitor mode depends on the detection setting (Settings > Trace). For example, if Detection is set to +Peak, each spectrogram line is effectively a peak hold display of all the spectral data captured since the prior line.

## Amplitude Vs Time Display

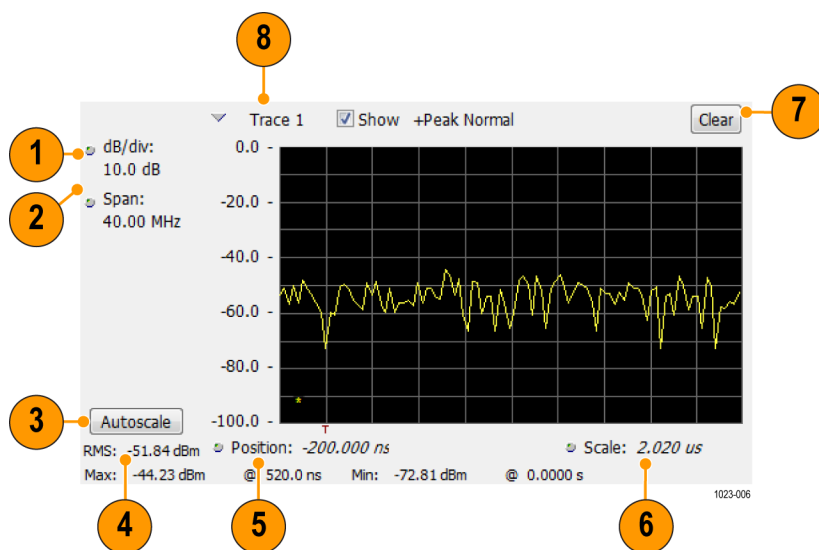
The Amplitude vs. Time display plots the signal amplitude against time. The amplitude appears on the vertical axis while time is plotted along the horizontal axis.

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

Reference. [Changing Amplitude vs Time Display Settings \(see page 76\)](#)

## Amplitude Vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

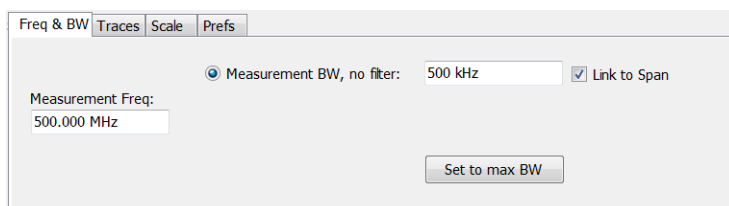
The settings for the Amplitude vs. Time display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; BW (see page 77)</a>	Sets the Bandwidth Method used for setting the measurement bandwidth.
<a href="#">Traces (see page 85)</a>	Allows you to select the type of trace to display and their functions.
<a href="#">Traces (Math) (see page 88)</a>	Sets the traces used to create the Math trace.
<a href="#">Scale (see page 90)</a>	Sets the vertical and horizontal scale parameters.
<a href="#">Prefs (see page 91)</a>	Specifies whether certain display elements are visible.



## Freq & BW Tab

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



### Settings Description

## Frequency Vs Time Display

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

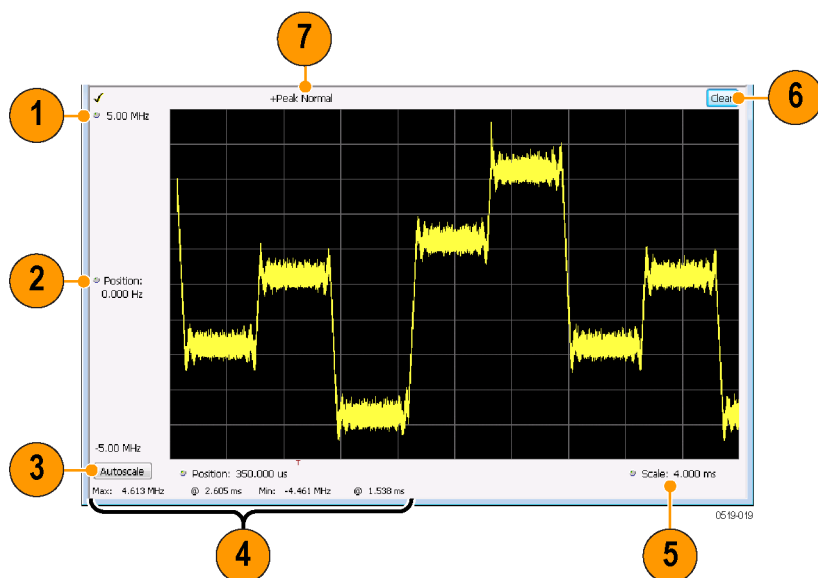
Note that the trace(s) in the Frequency vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, 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 **Measurements** 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 \(see page 78\)](#)

## Frequency Vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Freq &amp; BW (see page 83)</a>	Sets the frequency and bandwidth parameters.
<a href="#">Trace (see page 85)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 90)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 91)</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.

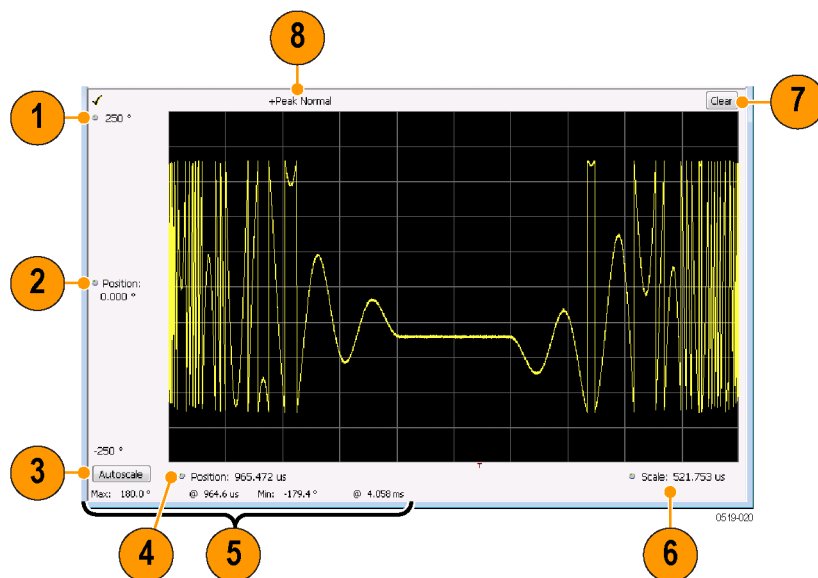
Note that the trace(s) in the Phase vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, the 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 **Measurements** 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 \(see page 80\)](#)

## Phase Vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Freq &amp; BW (see page 83)</a>	Sets the frequency and bandwidth parameters.
<a href="#">Trace (see page 85)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 90)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 91)</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.

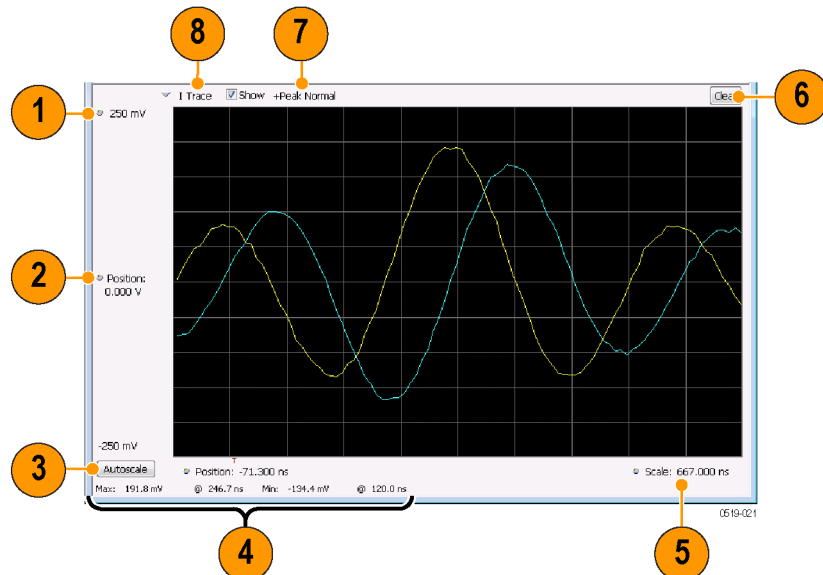
Note that the trace(s) in the RF I & Q vs. Time display can be set to a maximum of 100,000 points (however, the actual number of trace points can extend up to 1,000,000 points if Max trace points is set to Never Decimate). If the Analysis Length includes more than the selected Max trace points value, 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 **Measurements** 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 \(see page 82\)](#)

## RF I & Q vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Freq &amp; BW (see page 83)</a>	Sets the frequency and bandwidth parameters.
<a href="#">Trace (see page 85)</a>	Sets the trace display parameters.
<a href="#">Scale (see page 90)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 91)</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 84)</a>	Sets the frequency and span parameters.
<a href="#">Trace (see page 85)</a>	Sets the trace display parameters.
<a href="#">Traces – Math (see page 88)</a>	Sets the traces used to create the Math trace.
<a href="#">BW (see page 88)</a>	Sets the Bandwidth Method used for setting the measurement bandwidth.
<a href="#">Scale (see page 90)</a>	Sets the Vertical and Horizontal scale and offset parameters.
<a href="#">Prefs (see page 91)</a>	Specifies whether certain display elements are visible.

## Freq & BW Tab — Freq vs Time, Phase vs Time, RF I & Q vs Time Display

The Freq & BW tab provides access to settings that control frequency settings for the Freq vs Time, Phase vs Time, RF I & Q vs Time display.

The screenshot shows the 'Freq & BW' tab selected in a software interface. The tab bar includes 'Freq & BW', 'Traces', 'Scale', and 'Prefs'. The main area contains the following controls:

- Measurement Freq:** A text box containing '1.000 GHz'.
- Measurement BW, no filter:** A text box containing '500 MHz'.
- Link to Span:** A checked checkbox.
- Set to max BW:** A button.



Setting	Description
Measurement Freq	The frequency at the which measurements are made. This value is the same as the setting for Frequency in the Application bar.
Measurement BW	This control limits the bandwidth of measurements. You use the measurement bandwidth setting to improve the signal-to-noise ratio of the measurement, resulting in lower measurement uncertainty. However, if the measurement bandwidth is set too low, resulting in fewer samples per second, it can reduce the number of points within the measurement length below the 256 stable samples required, thus causing the analysis to fail.
Link to Span	When enabled, the measurement bandwidth of the RF I & Q display is determined by the span of the analyzer. When unchecked, the measurement bandwidth is specified by the user, and no additional filter is applied.
Set to max BW	Sets the measurement bandwidth to the maximum acquisition bandwidth of the instrument.

## 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.
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 Spectrogram 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 is used to reduce the results of a measurement to the desired number of trace points. For example, if the maximum number of trace points is 100,000, and a measurement over the selected analysis length yields 200,000 points, the measurement must decimate these 200,000 trace points by 2 to prevent exceeding the 100,000 trace point limit. Since only one value can be represented for each trace point, an algorithm must be used to select (detect) the appropriate value to use.

The results array from an analysis can be detected (or “decimated”) in a variety of ways. The number of results points produced for each trace point varies with both analysis length and trace length. For



example, the frequency transform used for the Spectrum display produces just one output value for each desired trace point. In this case, the detection method chosen has no effect, as no decimation is required. Increasing the Analysis Length (or for the Spectrum display, the Spectrum Length), causes the available detection method's output traces to differ from each other 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** – The highest value is selected from the results to be compressed into a trace point.
- **-Peak** – The lowest value is selected from the results to be compressed into a trace point.
- **+/-Peak** – Both the highest and lowest values are selected from the results to be compressed into a 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 results values it includes. When displayed in either linear (Volts, Watts) or Log (dB, dBm), the correct RMS value results.
- **Avg (of logs)** – The detector is used to emulate legacy spectrum analyzer results and for the specification of displayed average noise level. In older swept analyzers, a voltage envelope detector is used in the process of measuring signal level, and the result is then converted to Watts and then to dBm. Averaging is then applied to the resultant traces.

For CW signals, this method results in an accurate power measurement. However, with random noise and digitally modulated carriers, errors result from this 'average of logs' method. For random noise, the average of logs methods results in power levels -2.51 dB lower than that measured with a power meter, or with a signal analyzer that measures the rms value of a signal, and performs averaging on the calculated power in Watts and not dBm or other log-power units.

This detector should be used when following a measurement procedure that specifies it, or when checking the Displayed Averaged Noise Level (DANL) of the instrument. The 'average of logs' detection and trace function is used for DANL specification to provide similar results to other spectrum/signal analyzers for comparison purposes. Use of the Average of Logs method of measurement is not recommended for digitally modulated carriers, as power measurement errors will occur.

---

**NOTE.** *The Detection setting does not affect the trace until the spectrum length is longer than the Auto setting.*

---

- **Sample** – The first value is selected from the set of results to be compressed into a 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, which will contain just 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, additional traces contribute to the running average, except in Single Sequence run mode. In the case of Single Sequence, the instrument stops running after the specified number of traces have been averaged together. The **Number of Traces** setting specifies how many traces are averaged. The averaging is performed on the linear (Voltage) values, resulting in the correct RMS average).
- **Max Hold** - Displays the maximum value in the trace record for each display point. Each new trace's 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's 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:

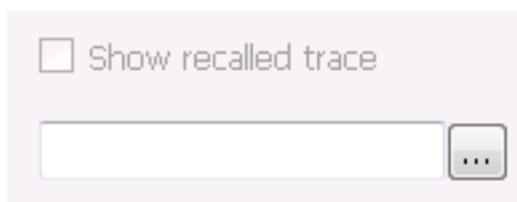
1. Select the **Save Trace As** button. This displays the Save As dialog box.
2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

### 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.



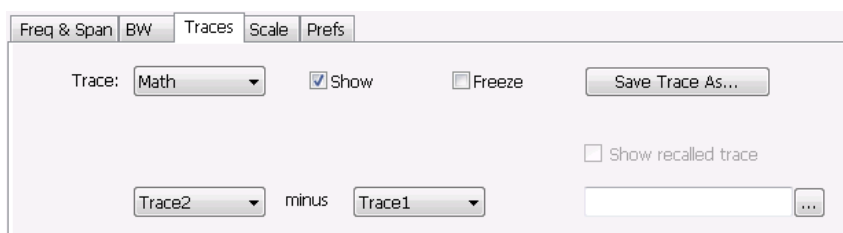
4. Navigate to the desired file and click **Open**.



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).

## 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.

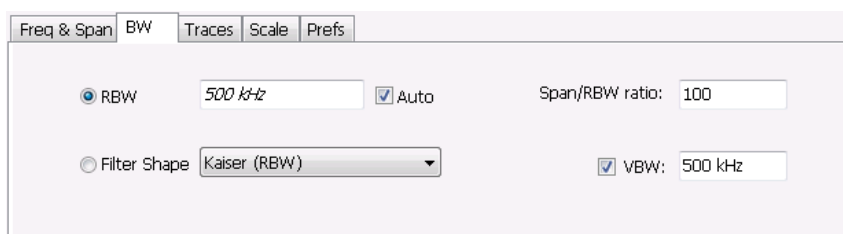


Trace 4 is a mathematically-derived trace defined as Trace A minus Trace B. You can select Trace 1, 2, or 3 to serve as either Trace A or Trace B.

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, and set the windowing method used by the transform process by selecting a filter shape (not present for all displays).





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.
Flat-Top	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.

## 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.

The screenshot shows the 'Scale' tab in a software interface. It has two main sections: 'Vertical' and 'Horizontal'. The 'Vertical' section includes a 'Scale' input field set to '100.00 dB', a 'Position' input field set to '0.00 dBm', and an 'Autoscale' button. The 'Horizontal' section includes a 'Zoom Start' input field set to '1.857 GHz', a 'Zoom Stop' input field set to '1.942 GHz', a 'Log' checkbox, and an 'Autoscale' button. A 'Reset Scale' button is located between the two sections. At the top, there are tabs for 'Freq & Span', 'BW', 'Traces', 'Scale' (which is selected), and 'Prefs'.

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.
Zoom Start	Sets the starting frequency for ...
Zoom Stop	Sets the stop frequency for ...
Log	Resets the scale of the horizontal axis to contain the complete trace.
Reset Scale	Resets all settings to their default values.

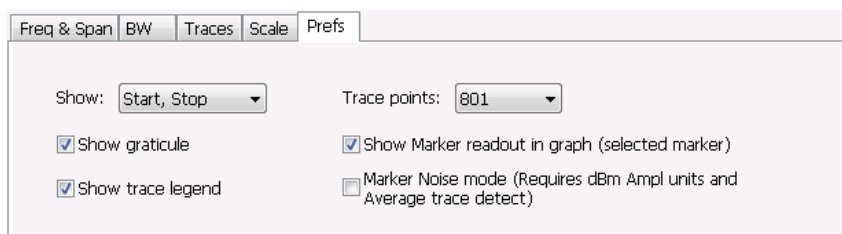


## Prefs Tab

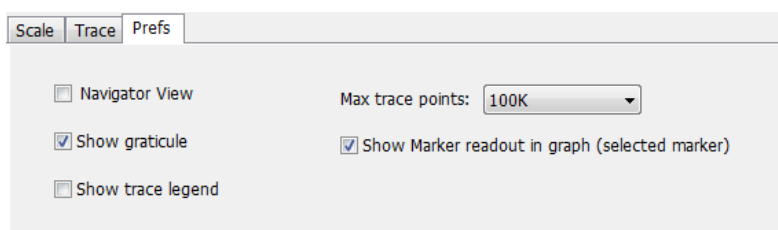
The Prefs tab enables you to change parameters of the measurement display. The parameters available on the Prefs tab vary depending on the selected display, but include such items as enabling/disabling Marker Readout, switching the Graticule display on/off, and Marker Noise mode.

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, in the following image, 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 image shows the Prefs tab for the Time Overview display.



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.
Trace points	Sets the number of trace points used for marker measurements and for results export.
Max trace points (Time Overview Display only)	Sets the maximum 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.
Navigator View (Time Overview Display only)	Places the Time Overview display across the top of the application window, above all other active displays.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Show timestamp in graph (selected line)	For spectrogram displays, this readout shows or hides the timestamp associated with the selected line or marker position.
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 485)</a> .



## Overview

The displays in Analog Modulation (Displays > Measurements > Analog Modulation) are:

- AM
- FM
- PM

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

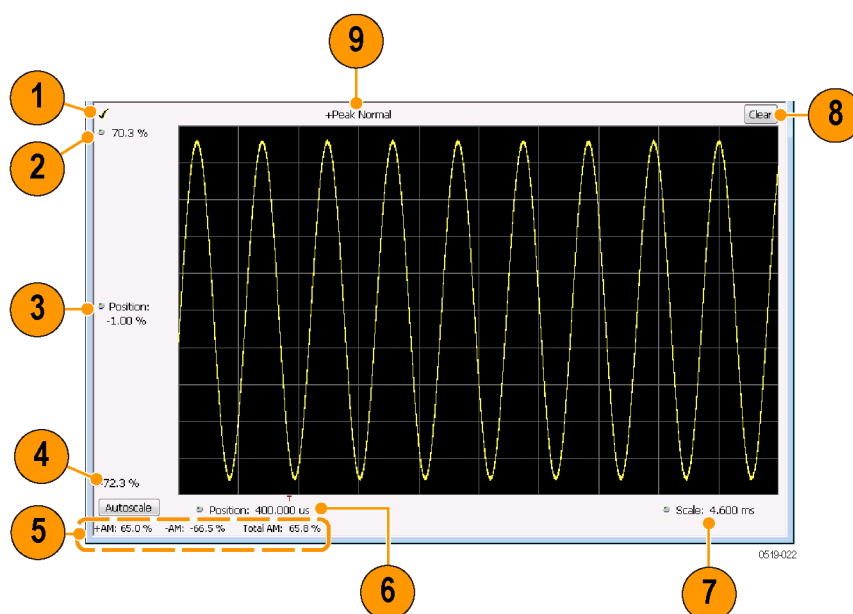
## AM Display

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 **Measurements** 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 value because the graph scales about vertical center. 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.

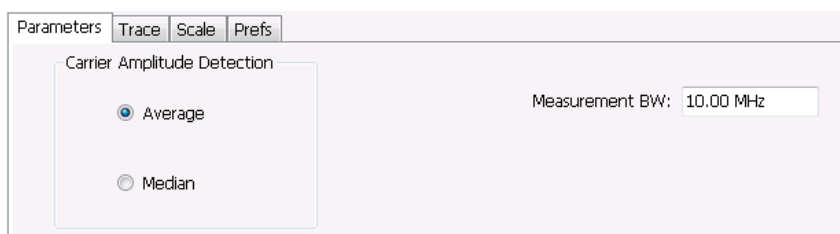
[Changing the AM Settings \(see page 94\)](#)

## AM Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

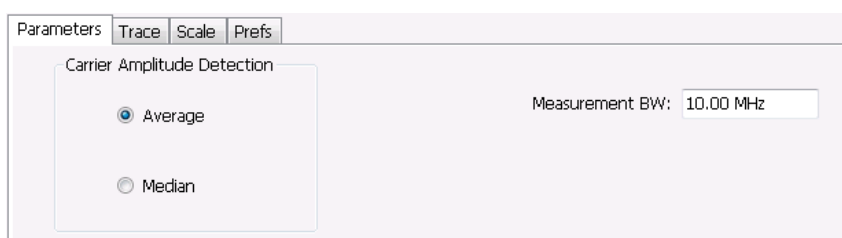




Setting	Description
<a href="#">Parameters (see page 95)</a>	Sets the Carrier Amplitude Detection method. You can choose either Average or Median.
<a href="#">Trace (see page 96)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 98)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 99)</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

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

#### Median Method

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

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.

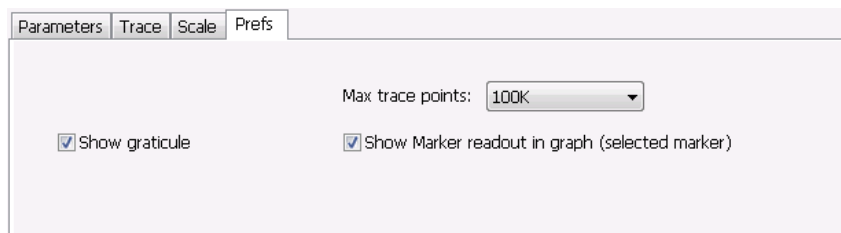
The screenshot shows the 'Scale' tab in a software interface. It has four tabs: 'Parameters', 'Trace', 'Scale' (selected), and 'Prefs'. The 'Scale' tab is divided into two sections: 'Vertical' and 'Horizontal'. Each section contains a 'Scale' input field, a 'Position' input field, and an 'Autoscale' button. In the 'Vertical' section, the Scale is set to '143 %' and the Position is set to '-1.00 %'. In the 'Horizontal' section, the Scale is set to '4.600 ms' and the Position is set to '400.000 us'.

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

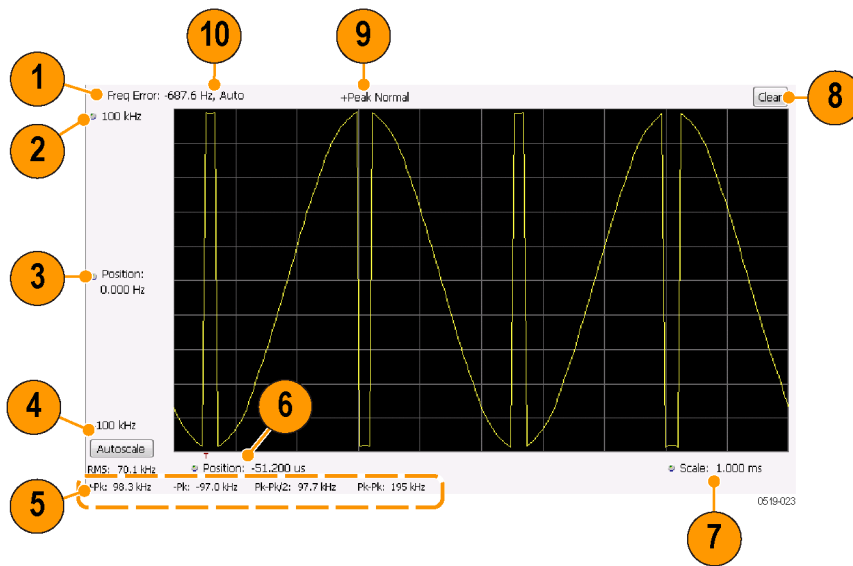
The Frequency Modulation Display shows Frequency Deviation vs. Time. The vertical axis units are Hertz and the horizontal axis units are seconds. When taking measurements, only the first burst in the Analysis period is analyzed. No trace points are shown for data outside the first detected burst, nor 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 **Measurements** 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
2	Top of Graph control	Sets the frequency indicated at the top of the graph. Since the Position value at the vertical center of this graph remains constant as the Top of Graph value is adjusted, the Vertical Scale increases as the Top of Graph value increases, which also affects the bottom of graph readout. Vertical Scale can also be controlled from the Settings control panel's Scale tab.
3	Position	Specifies the frequency shown at the center of the graph display. Changing this value moves the trace up and down in the graph, which affects the Top of Graph and Bottom of Graph values as well.
4	Bottom of Graph Readout	Displays the frequency value at 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 time range of the graph. By decreasing the scale (full-scale time over 10 divisions), the graph essentially becomes a window that you can move over the acquisition record by adjusting the horizontal 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 \(see page 101\)](#)

## FM Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Parameters Trace Scale Prefs

Burst detect threshold: -100 dBc

Frequency offset: -50.54 Hz ☒ Auto

Measurement BW: 100.0 kHz

Setting	Description
<a href="#">Parameters (see page 414)</a>	Sets the burst detection threshold, measurement bandwidth, and carrier frequency detection method.
<a href="#">Trace (see page 104)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 106)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 107)</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.

The screenshot shows the 'Parameters' tab selected in a software interface. It contains four input fields and one button:
 

- Burst detect threshold:** A text box containing '-100 dBc'.
- Measurement BW:** A text box containing '100.0 kHz'.
- Frequency offset:** A text box containing '-50.54 Hz'.
- Auto:** A checked checkbox.
- Load from marker:** A button located below the Frequency offset field.

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 carrier signal's offset from the instrument's measurement frequency. 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 offset 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:  $-(\text{Measurement BW} \times 1.1)/2$  to  $+(\text{Measurement BW} \times 1.1)/2$ . If the **Load 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 traces.



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.

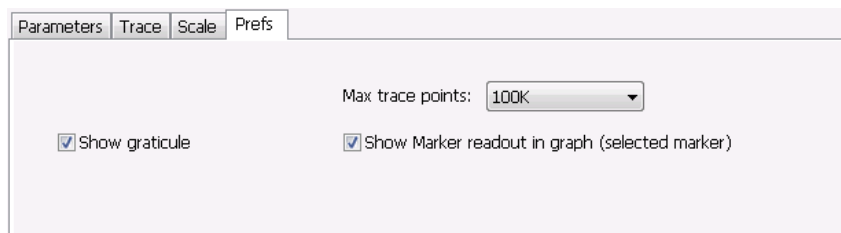
The screenshot shows the 'Scale' tab in a software interface. It has four tabs at the top: 'Parameters', 'Trace', 'Scale' (selected), and 'Prefs'. The 'Scale' tab is divided into two main sections: 'Vertical' and 'Horizontal'. Each section contains a 'Scale' input field, a 'Position' input field, and an 'Autoscale' button. In the 'Vertical' section, the Scale is set to '10.0 kHz' and the Position is '0.000 Hz'. In the 'Horizontal' section, the Scale is set to '35.280 us' and the Position is '92.160 us'.

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.



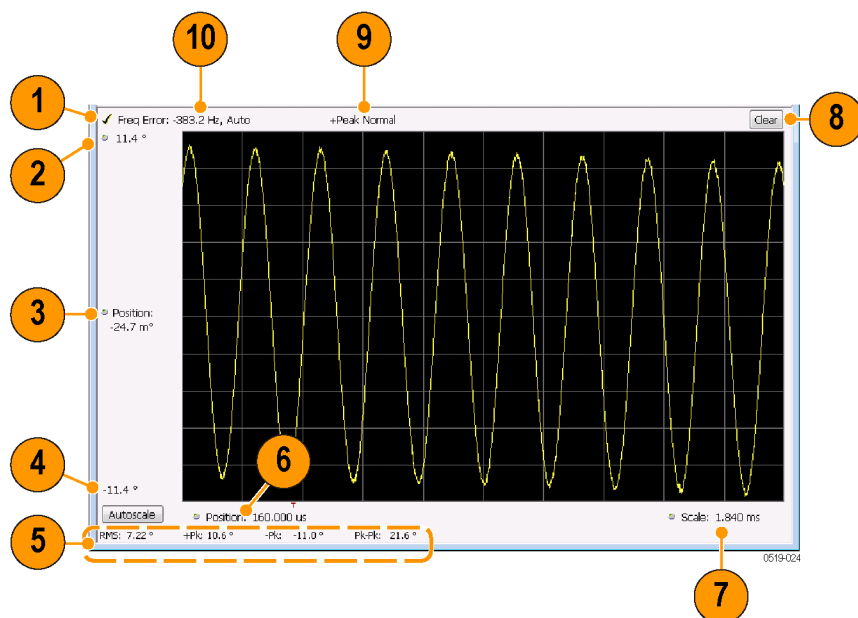
Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Max trace points	The trace in the FM display can be set to a maximum of 100,000 points (however, the actual number of trace 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
2	Top of Graph control	Sets the phase value indicated at the top of the graph. Since the Position value at the vertical center of this graph remains constant as the Top of Graph value is adjusted, the Vertical Scale increases as the Top of Graph value increases, which also affects the bottom of graph readout. Vertical Scale can also be controlled from the Settings control panel's Scale tab.
3	Position	Specifies the phase shown at the center of the graph display. Changing this value moves the trace up and down in the graph, which affects the Top of Graph and Bottom of Graph values as well.
4	Bottom of Graph Readout	Displays the phase value at 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 time range of the graph. By decreasing the scale (full-scale time over 10 divisions), the graph essentially becomes a window that you can move over the acquisition record by adjusting the horizontal position.
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 \(see page 109\)](#)

## PM Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Parameters

Trace

Scale

Prefs

Burst detect threshold: -100 dBc

Frequency offset: -383.2 Hz ☐ Auto

Load Δ from marker

Measurement BW: 1.000 MHz

Phase offset: 128 ° ☐ Auto

Load from marker

Setting	Description
<a href="#">Parameters (see page 110)</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 111)</a>	Sets Trace display parameters.
<a href="#">Scale (see page 114)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 115)</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.

Parameters

Trace

Scale

Prefs

Burst detect threshold: -100 dBc

Frequency offset: -383.2 Hz ☐ Auto

Load Δ from marker

Measurement BW: 1.000 MHz

Phase offset: 128 ° ☐ Auto

Load from marker



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 carrier signal's frequency offset from the instrument's Measurement Frequency. 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 offset using Frequency Offset.
Load $\Delta$ from Marker	Pressing this button disables the Auto Frequency Offset function and sets the Frequency offset to the frequency offset calculated from the difference between MR (the marker reference) and the selected marker (or M1 if MR is currently the selected marker).
Phase offset	Displays the phase offset. When Auto is selected, the instrument determines the phase offset. When Auto is deselected, the user sets the phase offset with this control.
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 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:  $-(\text{Measurement BW} \times 1.1)/2$  to  $+(\text{Measurement BW} \times 1.1)/2$ . 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 marker. Range:  $-180$  to  $+180^\circ$ .

## Trace Tab

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



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.

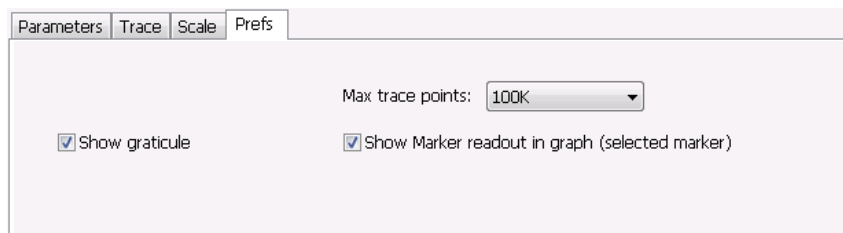
The screenshot shows the 'Scale' tab in a software interface. It has four tabs at the top: 'Parameters', 'Trace', 'Scale' (selected), and 'Prefs'. The 'Scale' tab is divided into two main sections: 'Vertical' and 'Horizontal'. Each section contains a 'Scale' input field, a 'Position' input field, and an 'Autoscale' button. In the 'Vertical' section, the Scale is set to '22.8 °' and the Position is set to '-24.7 m°'. In the 'Horizontal' section, the Scale is set to '1.840 ms' and the Position is set to '160.000 us'.

Setting	Description
Vertical	
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.
Horizontal	
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 RF Measurements (Displays > Measurements > RF Measurements) are:

- CCDF
- Channel Power and ACPR
- Frequency and Phase Settling Time (Option SVT)
- MCPR
- Occupied Bandwidth
- Spurious
- Signal Strength

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

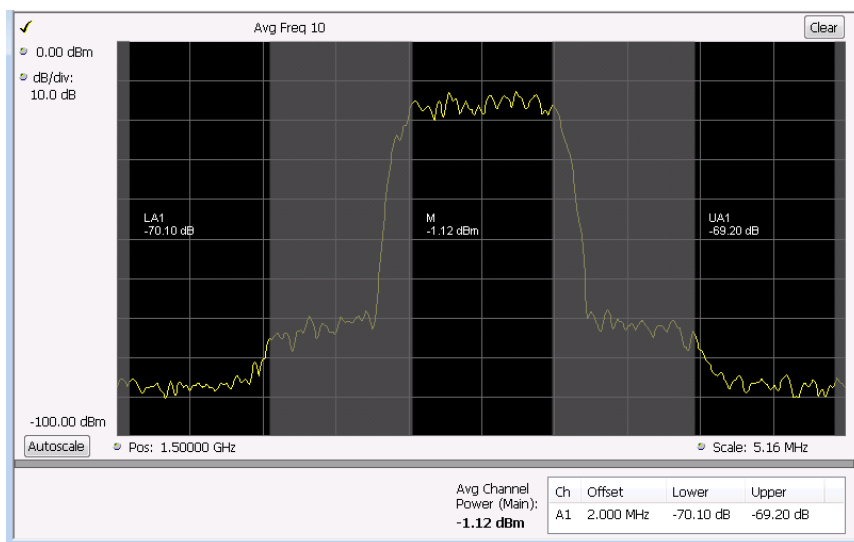
### Power Measurements

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. Recall the acquisition data file you wish to analyze.
2. Select the **Displays** button.
3. Select **RF Measurements** from the **Measurements** box.
4. Double-click **Chan Power and ACPR** in the Available displays box. Click **OK** to complete your selection.
5. Press the front-panel **Freq** button and use the front panel keypad or knob to adjust the frequency to that of your main channel.
6. 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).

Chan Power & ACPR Settings

Number of adjacent pairs: 1

Channel Bandwidth: 1.000 MHz


Channel Spacing: 2.000 MHz

Restore Defaults

7. 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.



8. To set the spacing between channel centers, enter the required value in the **Channel Spacing** value box.
9. To set the channel bandwidth, enter the required value in the **Channel Bandwidth** value box.
10. 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.
11. Press **Replay** to take measurements on the recalled acquisition data.

## 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.

Channel Power (Main): -1.94 dBm	Ch	Offset	Lower	Upper
	A1	2.000 MHz	-65.69 dB	-64.82 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 \(see page 120\)](#)

## 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

**Application Toolbar:** 

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



Freq & RBW | Measurement Params | Channels | Scale | Prefs

Meas Freq: 1.50000 GHz      RBW: 30.000 kHz      ☒ Auto

Step: 2.0000 MHz      ☒ Auto      ☐ VBW:

Settings tab	Description
<a href="#">Freq &amp; RBW (see page 136)</a>	Specify the frequency and resolution bandwidth used for the ACPR measurement.
<a href="#">Measurement Params (see page 127)</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 121)</a>	This tab specifies the BW and offset parameters of the Channels for the selected ACPR measurement.
<a href="#">Scale (see page 195)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 130)</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.

Freq & RBW | Measurement Params | Channels | Scale | Prefs

Number of adjacent pairs: 1

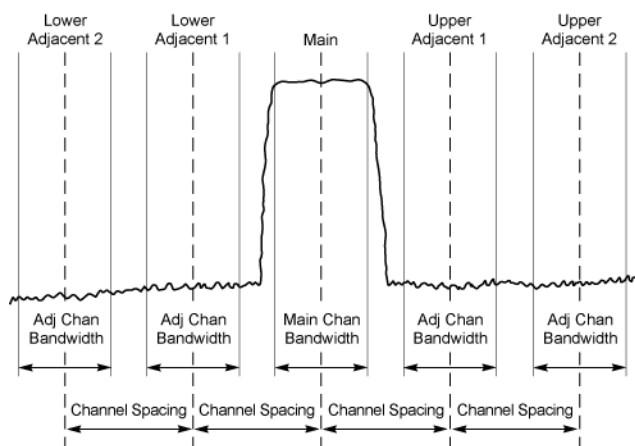
Channel Bandwidth: 1.000 MHz

Channel Spacing: 2.000 MHz

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.

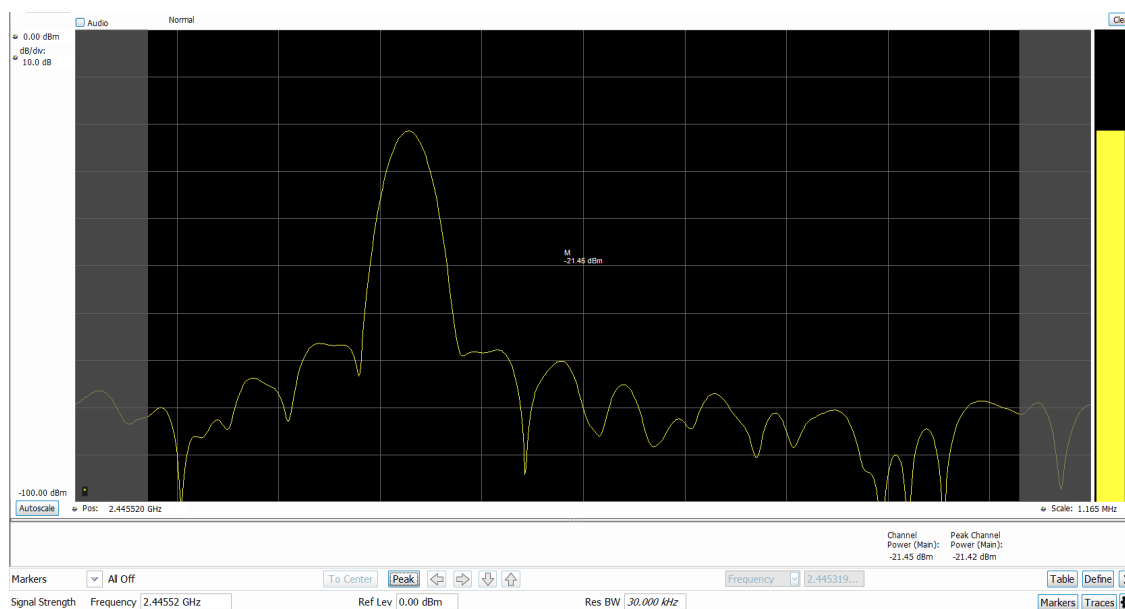


**NOTE.** As you change the value for the number of adjacent pairs, the analyzer will update the display to indicate the channel bandwidth.

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

## Signal Strength Display

Use the **Signal Strength** display to measure signal strength (channel power and peak channel power).



### Measuring channel power and field strength

1. Select the **Displays** button.
2. Select **RF Measurements** from the **Measurements** box.
3. Double-click **Signal Strength** in the Available displays box. Click **OK** to complete your selection.
4. Tune the analyzer to the channel. To do this, you can enter the frequency directly into the Frequency field on the Basic Toolbar (see the bottom of the above image), or you can use the **Select Channel** button on the Channel Navigation toolbar.
5. Press the **Run** button to take the measurements.
6. If you are measuring a signal with a directional antenna, select the **Audio** checkbox located above the graph, on the left side.



When Audio is checked, the analyzer sounds a tone that varies in frequency with the channel power. If you change the direction of the antenna and the channel power drops, the frequency of the audio tone will also drop. If the channel power increases, the audio tone frequency will also increase.

As channel power changes, the vertical channel power bar graph located on the far right side of the measurement display will rise and fall with the channel power.

## Viewing Results

Measurement results are displayed below the graph and within the graph itself (the latter of which can be enabled/disabled in the Signal Strength Settings > Prefs tab).

Channel Power (Main):	Peak Channel Power (Main):
-10.00 dBm	14.09 dBm

Results for Signal Strength measurement

Heading	Description
Channel Power (Main)	The integrated power measured for the Main channel.
Peak Channel Power (Main)	The maximum integrated power measured for the Main channel.

[Signal Strength Settings \(see page 124\)](#)

# Signal Strength Settings

**Menu Bar:** Setup > Settings

**Basic Control Toolbar:** 

The settings for the Signal Strength display are shown in the following table.

Freq & RBW	Measurement Params	Channels	Scale	Prefs
<div> <div>Meas Freq: 1.50000 GHz</div> <div>RBW: 30.000 kHz <input checked="" type="checkbox"/> Auto</div> </div> <div> <div>Step: 2.0000 MHz <input checked="" type="checkbox"/> Auto</div> <div><input type="checkbox"/> VBW:</div> </div>				



Settings tab	Description
<a href="#">Freq &amp; RBW (see page 126)</a>	Specify the frequency and resolution bandwidth used for the signal strength measurements.
<a href="#">Measurement Params (see page 127)</a>	Specify several parameters that control the measurement, such as channel filter, chip rate, averaging, and correcting for noise floor.
<a href="#">Channels (see page 128)</a>	This tab specifies the BW and offset parameters of the Channels for the Channel Power and ACPR measurements.
<a href="#">Scale (see page 129)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 130)</a>	Specifies whether certain display elements are visible.



## Freq & RBW Tab for Signal Strength display

The Freq & RBW tab specifies frequency parameters for the signal strength measurements.

The screenshot shows the 'Freq & RBW' tab with the following settings:

- Meas Freq: 1.00000 GHz
- Step: 2.0000 MHz
- RBW: 30.000 kHz
- VBW: (empty)
- Auto checkboxes are checked for Step and RBW.

Setting	Description
Meas 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 application, this condition is met by disabling the VBW function.



## Measurement Params Tab for Signal Strength display

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

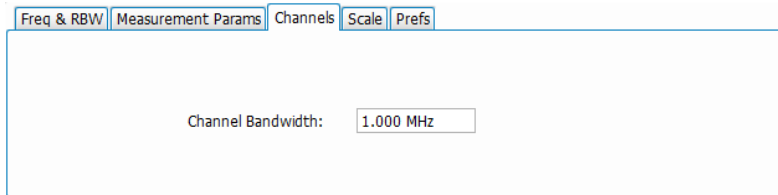
The screenshot shows the 'Measurement Params' tab selected. It contains a dropdown menu for 'Average' with options 'Frequency Domain', 'Time Domain', and 'Off'. A 'Number' field is set to '10'. There are two buttons: 'Amplitude Units' and 'Ext Corrections'.

Parameter	Description
Average	Enables/disables measurement averaging. Averaging can be enabled in either the Frequency Domain or Time Domain.
Frequency-domain	This setting takes the average linear value of the traces (so that rms values are preserved). The number of averages is user-defined. Frequency domain averaging is available in spans larger (or smaller) than the maximum real time bandwidth. This is the mode to use unless you need to extract maximum dynamic range from an ACPR measurement.
Time-domain	This setting takes the average linear value of the traces. It is useful if you need to extract maximum dynamic range from an ACPR measurement. The number of traces is user defined. But, the signals must be triggered and repeating. That is, the signal needs to be exactly the same for each acquisition. When this condition is met, each waveform contains the same signal, but the random noise changes from acquisition to acquisition and the average value of the random noise is lowered, while the signal value remains constant. Time domain averaging is not available in spans wider than the maximum real-time bandwidth.
Number	Specifies the number of acquisitions to be averaged when Averaging is set to Frequency Domain. Specifies the number of successive capture records that are averaged when Averaging is set to Time Domain.
Amplitude Units	Opens the <a href="#">Amplitude Units (see page 500)</a> dialog box.
Ext Corrections	Opens the <a href="#">External Gain/Loss Correction (see page 507)</a> dialog box.



## Channels Tab for Signal Strength display

The Channels tab is where you specify the channel bandwidth measured in the Signal Strength display.



The screenshot shows a software interface with five tabs at the top: 'Freq & RBW', 'Measurement Params', 'Channels', 'Scale', and 'Prefs'. The 'Channels' tab is currently selected. Below the tabs, there is a label 'Channel Bandwidth:' followed by a text input field containing the value '1.000 MHz'.

### Changing the Channel Bandwidth

1. Select the **Channel Bandwidth** number entry box.
2. Enter a value for the channel bandwidth.
3. Select the Close box when you have finished making changes.



## Scale Tab for Signal Strength display

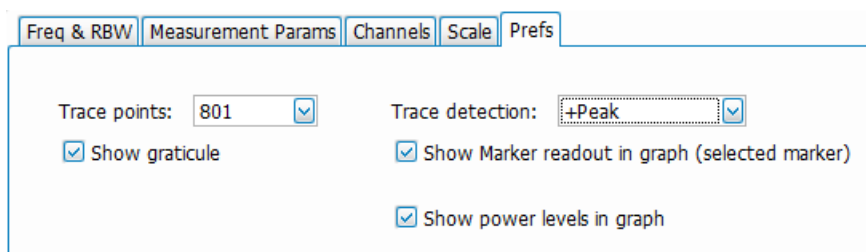
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Center Frequency.

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.



## Prefs Tab for Signal Strength display

The Prefs tab enables you to change parameters of the measurement display. The parameters include enabling/disabling Marker Readout, switching the Graticule display on/off, and trace points and detection.



Setting	Description
Trace Points	Sets the number of trace points computed for each line. These are the points used for marker measurements and for results export.
Show graticule	Shows or hides the graticule.
Trace Detection	<b>+Peak:</b> Shows the peak power in a bin (of chosen RBW) if there are multiple points to choose from within a bin. <b>Avg (VRMS):</b> Shows the average power in a bin (of chosen RBW) if there are multiple points to choose from within a bin.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.

## MCPR (Multiple Carrier Power Ratio) Display

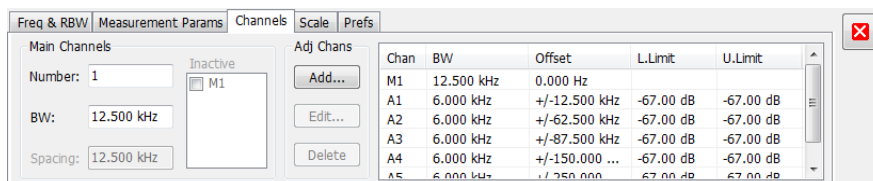
Use the MCPR measurement to measure adjacent channel power ratio for multiple main channels or when adjacent channel pairs have different offsets and/or bandwidths. The MCPR display show the Reference Power and the ratio of each adjacent channel to the Reference Power. You can select whether the Reference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

### Measuring Multiple Carrier Power Ratio

1. Recall an appropriate acquisition data file.
2. Press the front-panel **Displays** button.
3. From the **Select Displays** window, select **RF Measurements** or **P25 Analysis** from the Measurements box.
4. Double-click the **MCPR** icon in the **Available displays** box. Click **OK** to complete your selection.



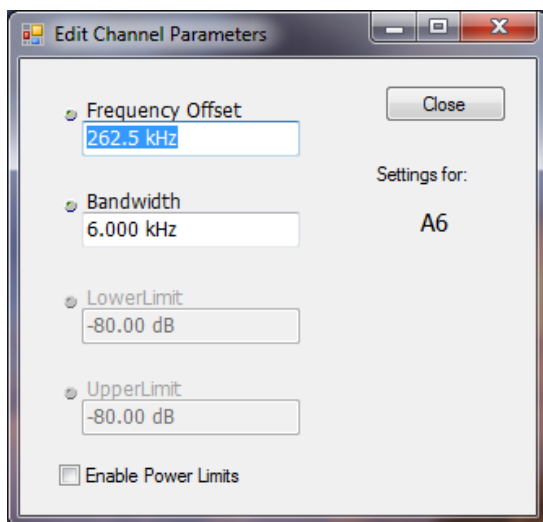
5. Press the front-panel **Freq** button and use the front panel keypad or knob to adjust the frequency to that of the main channel. Select **Meas. Freq** to set the measurement frequency. Use the front panel knob to adjust the frequency.
6. Press the **Settings** button. This displays the control panel for MCPR (the tab displayed will be the tab displayed the last time the Settings panel was opened).



7. 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.

8. To set the bandwidth of all main channels, enter a value in the **BW** value box.
9. To set the spacing between the main channels, enter a value in the **Spacing** value box.
10. 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.
11. To add adjacent channels, click the **Add** button under **Adj Chans**.



12. 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.

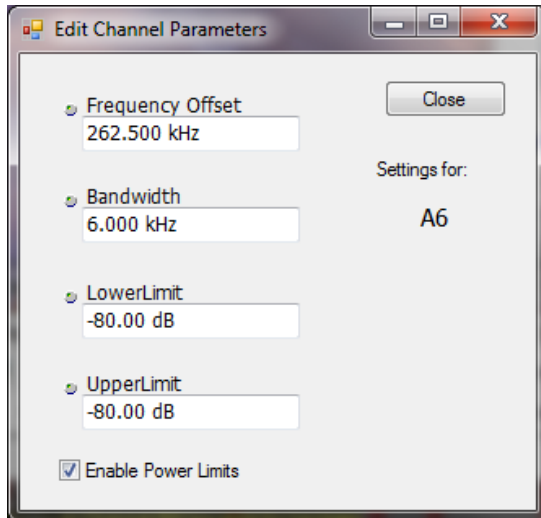



---

**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.*

---

13. To enable and define power limits, check the **Enable Power Limits** box and enter the desired Upper and Lower limits. You can read more about power limits [here \(see page 133\)](#).



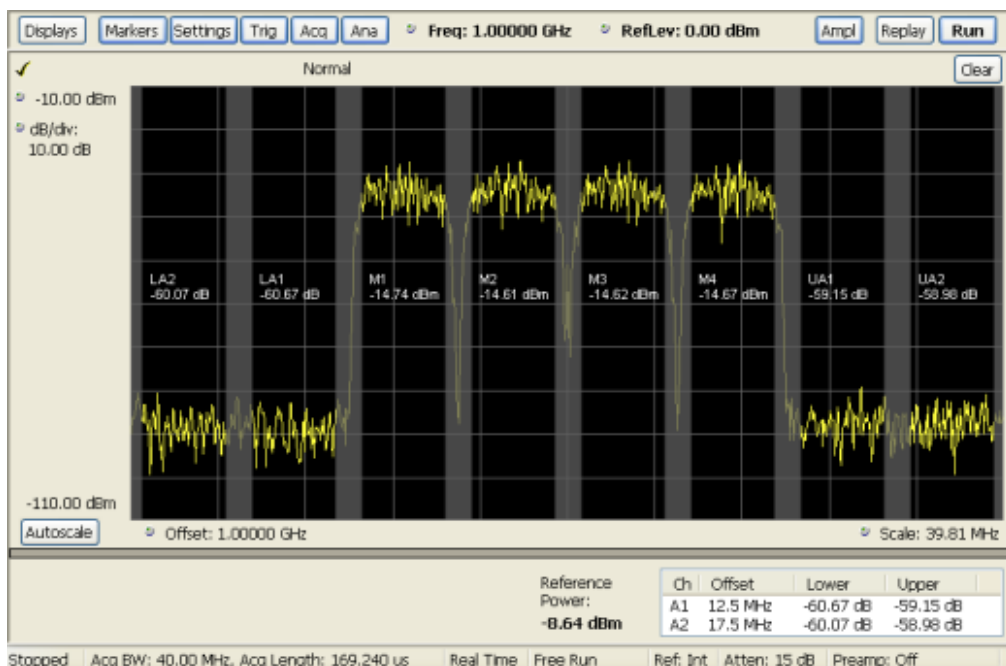
14. After you have configured the Main and Adjacent channels, click the close button (  ) in the Settings panel or the **Settings** button to remove the settings panel.

15. Click the Replay button to take measurements on the recalled acquisition data file.

## 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 closet 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.
L. Limit	Displays the lower power limit.
U. Limit	Displays the upper power limit.
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.

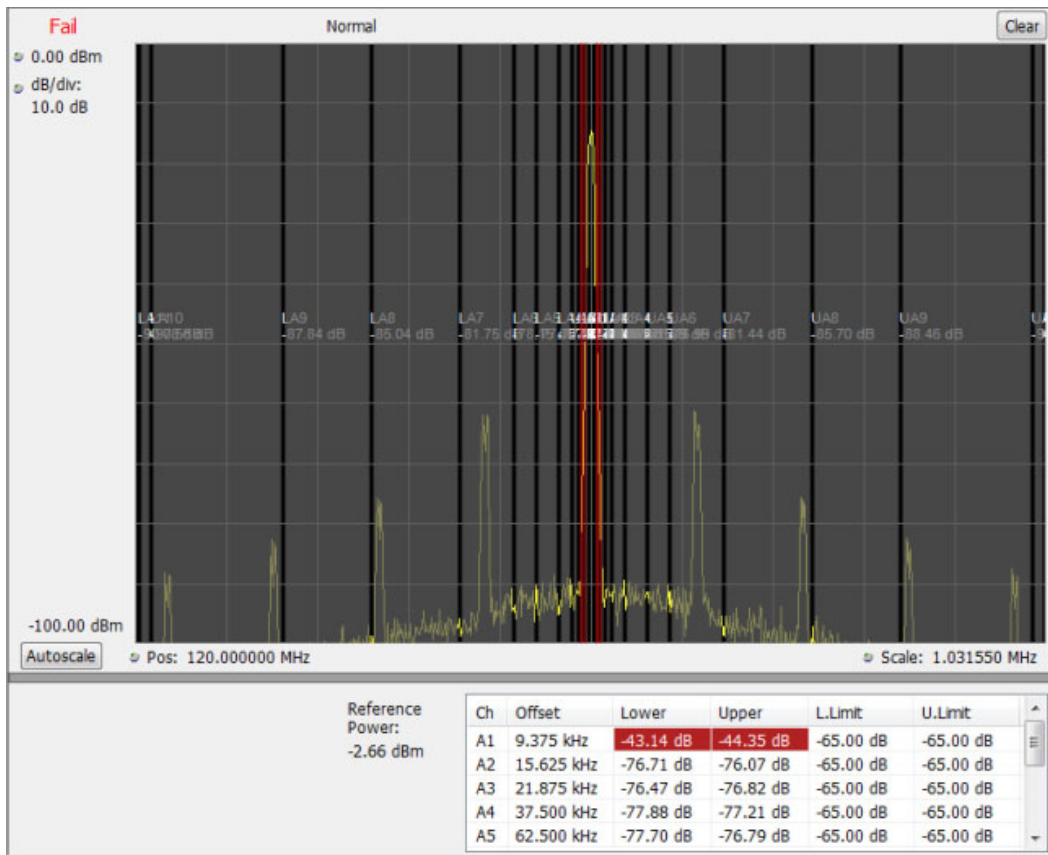
[Setting MCPR Measurement Parameters \(see page 127\)](#)

### Setting Power Limits

When power limits are enabled (**Settings > Channels > Add**), the comparison of the actual results of an adjacent channel is done against the limits. If there is a failure, the Lower and Upper power cells in the MCPR table will be red and the failure segments of the trace display will be red. The words **Fail** in red



will also appear in the top left corner of the display (even if one adjacent band fails). See the following image for an example.



## 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

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



Chan	BW	Offset	L.Limit	U.Limit
M1	12.500 kHz	0.000 Hz		
A1	6.000 kHz	+/-12.500 kHz	-67.00 dB	-67.00 dB
A2	6.000 kHz	+/-62.500 kHz	-67.00 dB	-67.00 dB
A3	6.000 kHz	+/-87.500 kHz	-67.00 dB	-67.00 dB
A4	6.000 kHz	+/-150.000 ...	-67.00 dB	-67.00 dB
A5	6.000 kHz	+/-250.000 ...	-67.00 dB	-67.00 dB

**Settings tab****Description**[Freq & RBW \(see page 136\)](#)

Specify the frequency and resolution bandwidth used for the MCPR measurements.

[Measurement Params \(see page 127\)](#)

Specifies parameters controlling how the MCPR measurement is made.

[Channels \(see page 138\)](#)

Specifies the parameters of the channels to be measured.

[Scale \(see page 195\)](#)

Specifies the vertical and horizontal scale and offset values.

[Prefs \(see page 130\)](#)

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
Meas 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.

# Measurement Params for ACPR and MCPR Displays

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



Freq & RBW | **Measurement Params** | Channels | Scale | Prefs

*Requires triggered synchronous signal*

Average: **Time Domain** | Number: 10 | Channel Filter: **Root-raised Cosine**

☐ Correct for Noise Floor

Power Reference: **Total (active channels)** | Filter Parameter: 0.22

Chip Rate: 3.84 MHz

Freq & RBW | **Measurement Params** | Channels | Scale | Prefs

Average: **Frequency Domain** | Number: 10 | Channel Filter: **Root-raised Cosine**

☐ Correct for Noise Floor

Filter Parameter: 0.35

Chip Rate: 1 MHz

Parameter	Description
Average	Enables/disables measurement averaging. Averaging can be enabled in either the Frequency Domain or Time Domain.
Frequency-domain	This setting takes the average linear value of the traces (so that rms values are preserved). The number of averages is user-defined. Frequency domain averaging is available in spans larger (or smaller) than the maximum real time bandwidth. This is the mode to use unless you need to extract maximum dynamic range from an ACPR measurement.
Time-domain	This setting takes the average linear value of the traces. It is useful if you need to extract maximum dynamic range from an ACPR measurement. The number of traces is user defined. But, the signals must be triggered and repeating. That is, the signal needs to be exactly the same for each acquisition. When this condition is met, each waveform contains the same signal, but the random noise changes from acquisition to acquisition and the average value of the random noise is lowered, while the signal value remains constant. Time domain averaging is not available in spans wider than the maximum real-time bandwidth.
Number	Specifies the number of acquisitions to be averaged when Averaging is set to Frequency Domain. Specifies the number of successive capture records that are averaged when Averaging is set to Time Domain.
Power Reference	Specifies power against which the results are compared. Choices available are each of the existing main channels and "Total (active 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 Root-raised Cosine.
Chip Rate	Value entry box for the Root-raised Cosine chip rate. Present only when the Channel Filter is set to Root-raised Cosine.

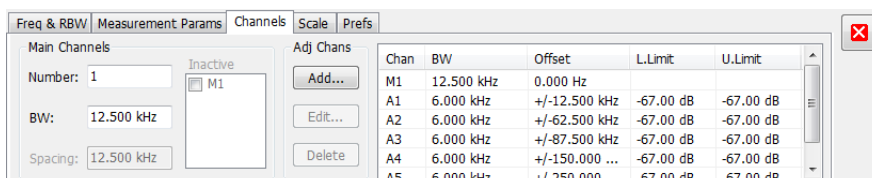


## Channels Tab for MCPR

**Path:** Setup > Settings > Channels

**Application Toolbar / Front Panel: Settings**

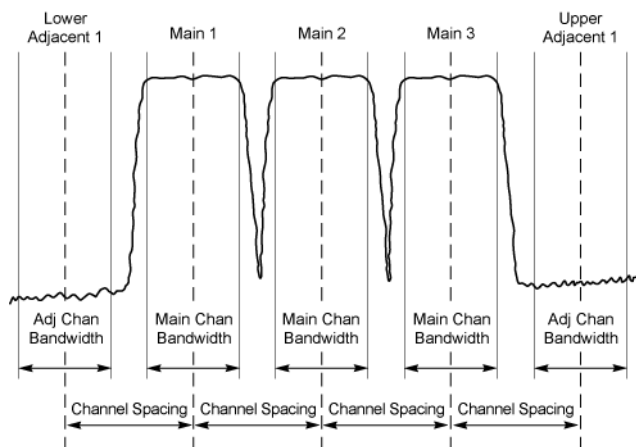
The Channels tab is where you specify the parameters for the channels measured in the MCPR display.



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.
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. You can set the upper and lower limits by clicking on the Add button.

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. Click the Close button 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**, **Bandwidth**, and upper and lower **Limits**, as required.
4. Click the Close button 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. Click the Close button 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**, **Bandwidth**, and upper and lower **Limits**, as required. The Frequency Offset is measured from the Meas Frequency of the Main channels.
3. Click the Close button 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. Click the Close button 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. Click the Close button when you have finished making changes.

## Occupied BW & x dB BW Display

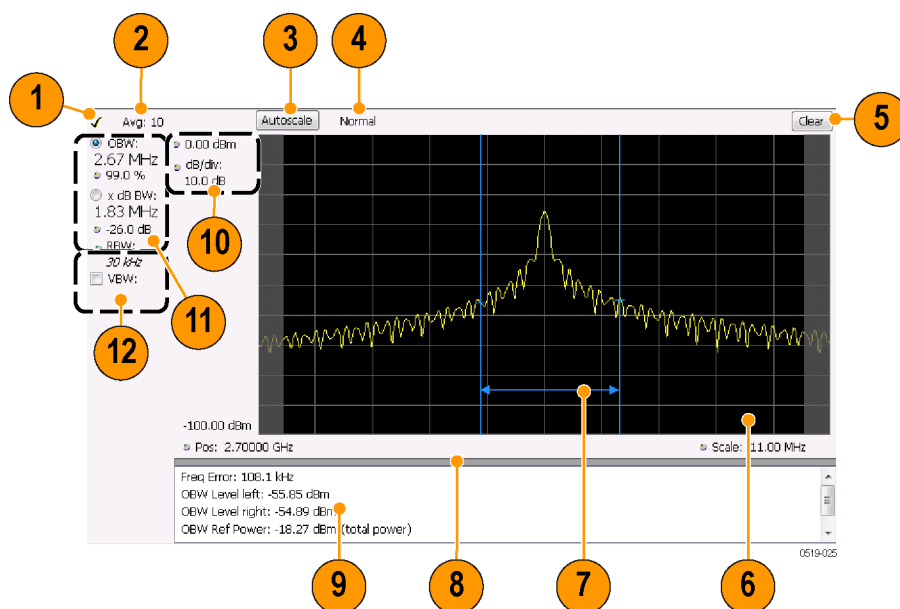
The Occupied BW display shows the bandwidth within which 99% (a user-defined value, the default is 99%) of the power transmitted within the measurement bandwidth falls.

To show the Occupied BW display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **RF Measurements** in the **Measurements** box.
4. 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.
5. Click **OK** to display the Occupied Bandwidth.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 136)</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 \(see page 143\)](#)

## 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**

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 191)</a>	Allows you to specify the Center Frequency, Step size and RBW.
<a href="#">Parameters (see page 144)</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 195)</a>	Allows you to set the vertical and horizontal scale parameters.
<a href="#">Prefs (see page 130)</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 in a software interface. It contains several input fields and checkboxes. The 'Occupied BW % Power' is set to 99.0 %. The 'x dB level' is set to -26.0 dB. The 'Measurement BW' is set to 10.00 MHz. There are two checkboxes: 'Max Hold spectral data' and 'Average results', both of which are checked. The 'Count' is set to 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. Recall an appropriate acquisition data file.
2. Click the **Displays** button or select **Setup > Displays**.



- From the Measurements box, select **RF Measurements**.
- 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.
- Click the **OK** button.
- Press the **Replay** button to take measurements on the recalled acquisition data file.

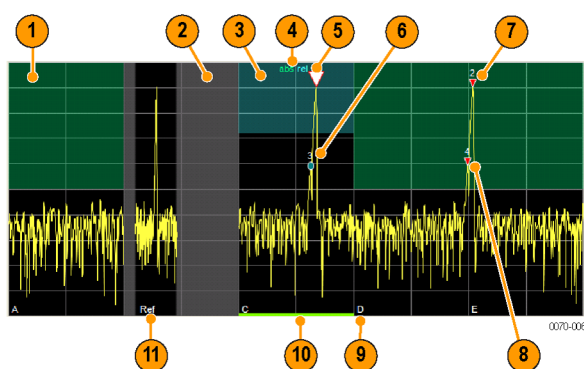
### Elements of the Spurious Display












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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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; Ranges and Limits tab (see page 151)</a> .
7		A violation marker. Indicates a spur that exceeds the mask settings. See the <a href="#">Settings &gt; Ranges and Limits tab (see page 151)</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; Ranges and Limits (see page 151)</a> tab.
11	Ref	Indicates the location of the power reference. See <a href="#">Settings &gt; Reference (see page 149)</a> .

### Elements of the Spur Table

Spur	Range	Freq Abs	Freq Rel	Ampl Abs	Ampl Rel	Limit Abs	Limit Rel
1	B	1.751145 GHz	– Hz	-5.91 dBm	4.09 dB	-15.00 dBm	-15.00 dB
2	E	2.053875 GHz	– Hz	-8.99 dBm	1.01 dB	-15.00 dBm	-10.00 dB
3	D	1.903950 GHz	– Hz	-10.48 dBm	-0.48 dB	-50.00 dBm	-57.00 dB
4	A	1.748826 GHz	– Hz	-39.57 dBm	-29.57 dB	-57.00 dBm	-30.00 dB
5	D	1.899062 GHz	– Hz	-40.31 dBm	-30.31 dB	-50.00 dBm	-57.00 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; Ranges and Limits tab (see page 151)</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; Ranges and Limits tab (see page 151)</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 \(see page 148\)](#)

## Spurious Display Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

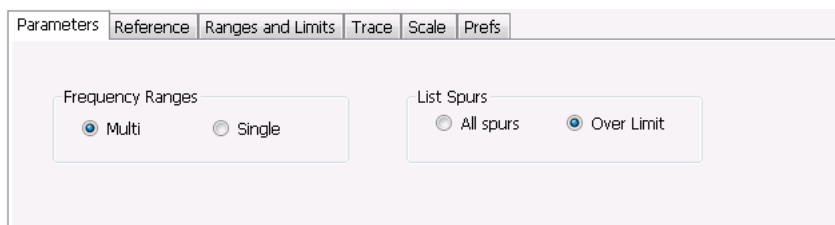


Settings tab	Description
<a href="#">Parameters (see page 149)</a>	Specifies whether the graph displays one range or multiple ranges. Specifies whether all spurs are shown or only spurs over specified limits.
<a href="#">Reference (see page 149)</a>	Specifies the Power Reference level.
<a href="#">Ranges (see page 151)</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 151)</a>	Specifies Pass/Fail limit parameters.
<a href="#">Trace (see page 192)</a>	Specifies the trace Function.
<a href="#">Scale (see page 195)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 130)</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.



Parameters Reference Ranges and Limits Trace Scale Prefs

Power reference: Manual level Carrier Manual level No reference

Reference power level: -10.00 dBm

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

Parameters Reference Ranges and Limits Trace Scale Prefs

Power reference: 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

Parameters Reference Ranges and Limits Trace Scale Prefs

Power reference: Manual level

Reference power level: -10.00 dBm

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

Parameters		Reference	Ranges and Limits	Trace	Scale	Prefs
Power reference:	Carrier					
Frequency:	1.466000 GHz		Res BW:	85 kHz		
Channel width:	8.500 MHz			<input checked="" type="checkbox"/> Auto		
Threshold:	-10.00 dBm		Integration BW:	2 MHz		
				Detection: +Peak		

To set the power reference to Carrier:

1. Select **Carrier** from the **Power reference** drop-down list.
2. To set the Carrier frequency, specify the necessary values in the **Frequency** and **Channel width** entry boxes .
3. Specify the **Threshold** level.
4. Specify the **Integration BW**. The Integration BW is the bandwidth over which the carrier is measured.
5. If necessary, specify the Resolution Bandwidth by changing the value in the **Res BW** entry box. Auto is the recommended setting.
6. Set the **Detection** method. Select **+Peak**, **Avg (VRMS)**, or **Avg (of logs)**.

---

**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 and Limits Tab

Use the Ranges and Limits tab to specify the parameters that control the Spurious measurement. From the Ranges and Limits 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, as well as the pass/fail parameters for Limit Testing.



Parameters Reference Ranges and Limits Trace Scale Prefs										
	On	Start (Hz)	Stop (Hz)	Filter Shape	BW (Hz)	Auto	Detector	VBW (Hz)	VBW On	
▶ A	X	1.492500G	1.507500G	RBW	100.000k	X	+Peak	100k		
B	X	1.512500G	1.537500G	RBW	200.000k	X	+Peak	200k		
C		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
D		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
E		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		

**Setting****Description**

Expand	Displays the Ranges and Limits Table in a new, resizeable window.
Reset layout	You can reorder columns in the Ranges and Limits Table by dragging the columns to a new position. Clicking Reset Layout returns the column order to the factory default order.
Load	Click to load a saved Ranges and Limits table from a file.
Save	Click to save the current Ranges and Limits table to a file.

To specify the ranges and limits for the Spurious measurement:

- Edit the values in the Ranges and Limits table.

You can edit the Ranges and Limits table in two ways:

- Edit values directly from the Ranges and Limits tab. You will need to scroll the table to access all settings.
- Click the **Expand** button. This displays the Ranges and Limits Table in a new window that can be sized to the fullscreen.

Ranges and Limits Table										
	On	Start (Hz)	Stop (Hz)	Filter Shape	BW (Hz)	Auto	Detector	VBW (Hz)	VBW On	
▶ A	X	1.492500G	1.507500G	RBW	100.000k	X	+Peak	100k		
B	X	1.512500G	1.537500G	RBW	200.000k	X	+Peak	200k		
C		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
D		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
E		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
F		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
G		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
H		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
I		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
J		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
K		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
L		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
M		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
N		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
O		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
P		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
Q		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
R		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
S		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		
T		0.000000	0.000000	RBW	1.000M	X	+Peak	1M		

The following table describes the parameters that are set in the Ranges and Limits Table.



### Ranges and Limits Table Settings

Setting	Description
On	Specifies whether or not measurements are taken in the specified range.
Start (Hz)	Readout of the start frequency for the selected range.
Stop (Hz)	Readout of the stop frequency for the selected range.
Filter shape	Specifies the filter shape used for the Spurious measurement.
BW (Hz)	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.
Detector	Sets the processing method used for compressing excess intermediate data into the desired number of trace points.
VBW (Hz)	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.
VBW On	Specifies whether the VBW filter is applied.
Thrshld (dBm)	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.
Excrsn (dB)	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.
Mask	Selects the type of limits used for Pass/Fail testing. Spurs that exceed the mask settings are considered violations. The available choices are shown below.
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.
(Abs Start and Abs Stop)	Absolute amplitude limits are not based on the measured carrier amplitude or manual reference. Start and stop values can be different.
Abs Start (dBm)	Abs Start specifies the limit at the start frequency of the range.
Abs Stop (dBm)	Abs Stop specifies the limit at the stop frequency of the range.
Abs Same	Sets the limit at the start and stop frequencies to the value set for the start frequency.
(Rel Start and Rel Stop)	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.
Rel Start (dB)	Specifies the limit at the start frequency of the range.
Rel Stop (dB)	Specifies the limit at the stop frequency of the range.
Rel Same	Sets the limit at the stop frequency to the value set for the start frequency.
Save As	Click to save the current Ranges and Limits table to a file.
Load	Click to load a saved Ranges and Limits table from a file.
Done	Save changes and close the Ranges and Limits Table window.



## Changing the Range Start and Stop Frequencies

To change the range start and stop frequencies, edit the Start and Stop frequencies in the Ranges and Limits Table:

1. Click the **Expand** button on the **Settings > Range and Limits** tab. This displays the Ranges and Limits Table.
2. Click the **On** box for a range to take measurements in the range.
3. Click on the Start or Stop frequency setting to change it. Type in a number for the frequency and a letter as a multiplier. You can use k, m, or g to set the frequency multiplier.
4. Click **Done** to save your changes.

## Specifying Spur Requirements

A spur is a signal peak that exceeds both the Threshold and Excursion settings in the Ranges and Limits table. 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. Click the **Expand** button on the **Range and Limits** tab. This displays the Ranges and Limits Table.
2. Select the **Range** (A–T) for which you want to specify the spur requirements.
3. Set the **Thrshld** value.
4. Set the **Excrsn** value.

## Setting Limits

Use the Limits settings in the Ranges and Limits Table 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.

## Performing Pass/Fail Limit Testing

To set limits:

1. Click the **Expand** button on the **Range and Limits** tab. This displays the Ranges and Limits Table.
2. Adjust the Start and Stop frequencies as required for each range you want to test.
3. For ranges that you wish to test, verify that the **On** box is checked.



4. For each range you wish to test, select the desired **Mask** type from the drop-down list.
5. Set the limits as desired in the **Abs Start**, **Abs Stop**, **Rel Start**, and **Rel Stop** boxes. The values you can edit depend on the mask type you select.
6. Verify that the **Thrshld** and **Excrsn** values are set as required. These are the values that define a spur.
7. Click **Done** to save your changes and close the Range and Limits Table window.
8. Click **Run** to begin testing.

## CCDF Display

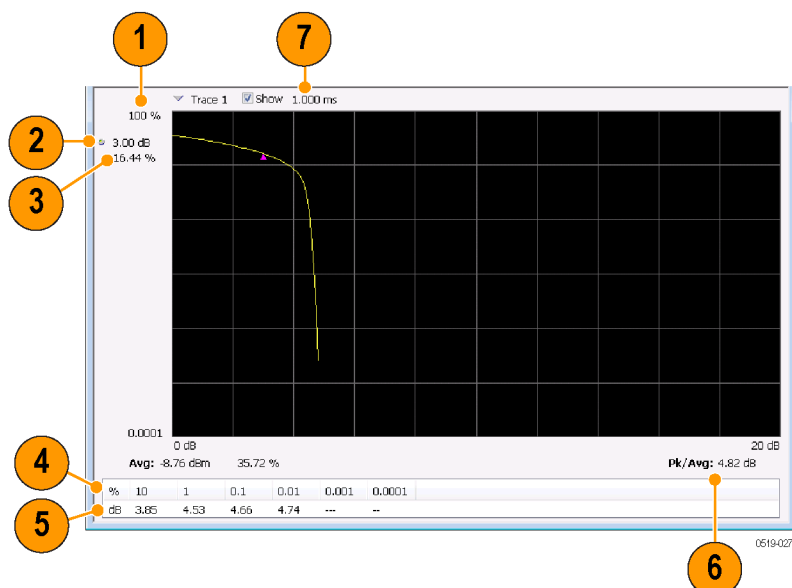
The CCDF (Complementary Cumulative Distribution Function) is a statistical characterization that plots power level on the x-axis and probability on the y-axis of a graph. Each point on the CCDF curve shows what percentage of time a signal spends at or above a given power level. The power level is expressed 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. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **RF Measurements**.
4. Double-click the **CCDF** icon in the **Available Displays** box. This adds the CCDF icon to the **Selected displays** box.
5. Click the **OK** button.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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 \(see page 156\)](#)

## CCDF Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Parameters (see page 157)</a>	Specifies the time to be measured.
<a href="#">Traces (see page 192)</a>	Select the trace to be measured and select reference trace for display.
<a href="#">Prefs (see page 130)</a>	Specifies whether on 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.

The screenshot shows the 'Parameters' tab of the CCDF Display. It has three sub-tabs: 'Parameters', 'Traces', and 'Prefs'. The 'Parameters' sub-tab is active. Inside, there's a 'Measurement Time' section with three radio buttons: 'Single (use Analysis Length)' (selected), 'Total Time' (with a text input field showing '20.000 ms'), and 'Continuous'. To the right of this section is a 'Span' label with a text input field showing '85.0 MHz'.

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".



## Settling Time Measurement Overview

The Settling Time measurement (Option SVT) is used to measure frequency and phase settling time of frequency-agile oscillators and subsystems. Automated measurements can reduce user-to-user measurement variations, improve repeatability and measurement confidence, and save time in gathering results.

### Measurement Definitions

**Settling time.** The time measured from a reference point to when the signal of interest settles to within user-defined tolerance.

**Settled frequency.** The final reference frequency, determined automatically or manually. The tolerance band is centered about this settled frequency.

**Settled phase.** The final reference phase, determined automatically or manually. The tolerance band is centered about this settled phase.

### Mask Testing

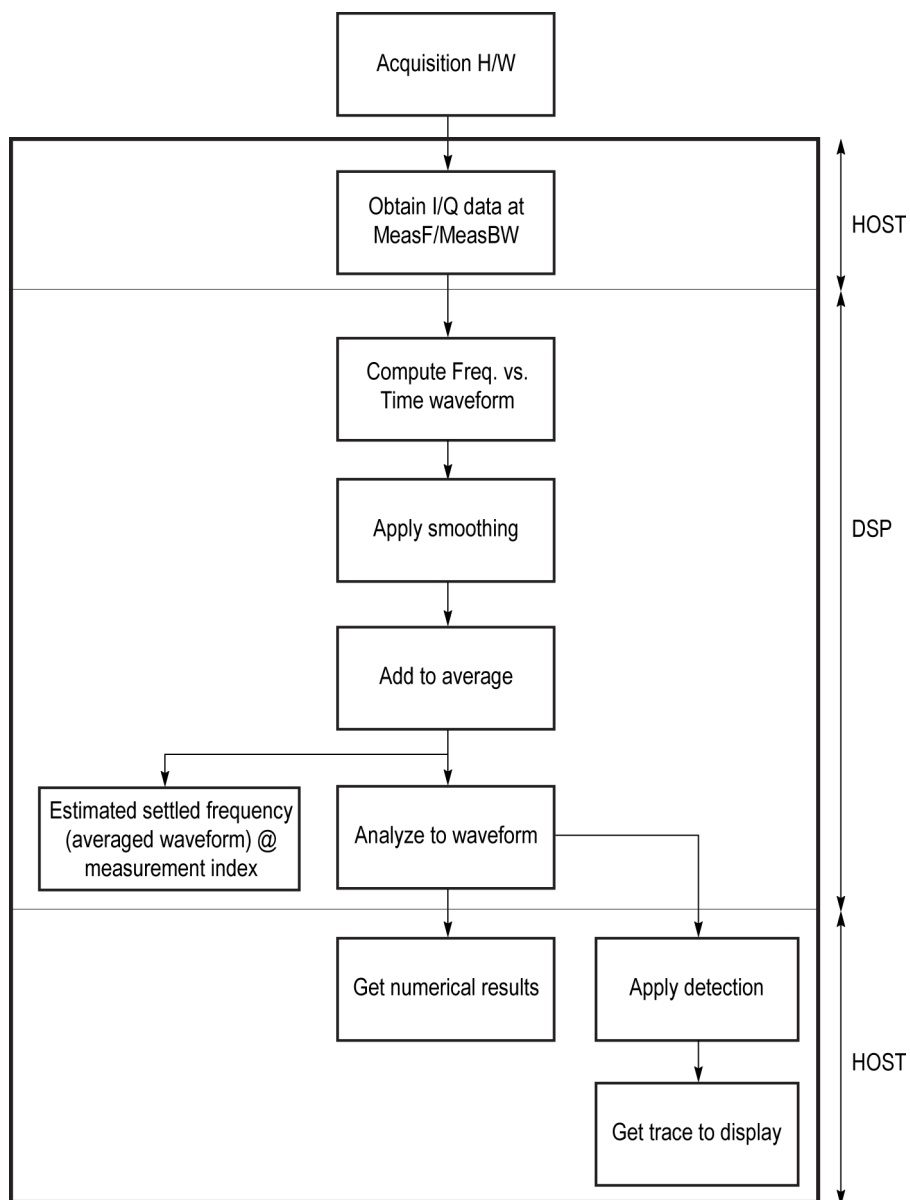
Mask testing is a tool to automatically determine the pass/fail state of the Device-Under-Test. The mask is defined over three or fewer user-defined time zones, with an independent limit band for each time zone. If the mask is violated, the area of violation is highlighted in red on screen, and a Fail message is displayed. The pass/fail status of the mask test can be queried over GPIB for rapid results. To configure Mask testing, see the [Mask tab \(see page 174\)](#).

The instrument's Search function can watch the Settling Time measurement for either pass or fail results, and perform actions such as stopping or saving data when the defined condition occurs. See [Mask Test Limits Settings \(see page 489\)](#) for details on configuring Mask Test.

### Frequency Settling Time Theory of Operation

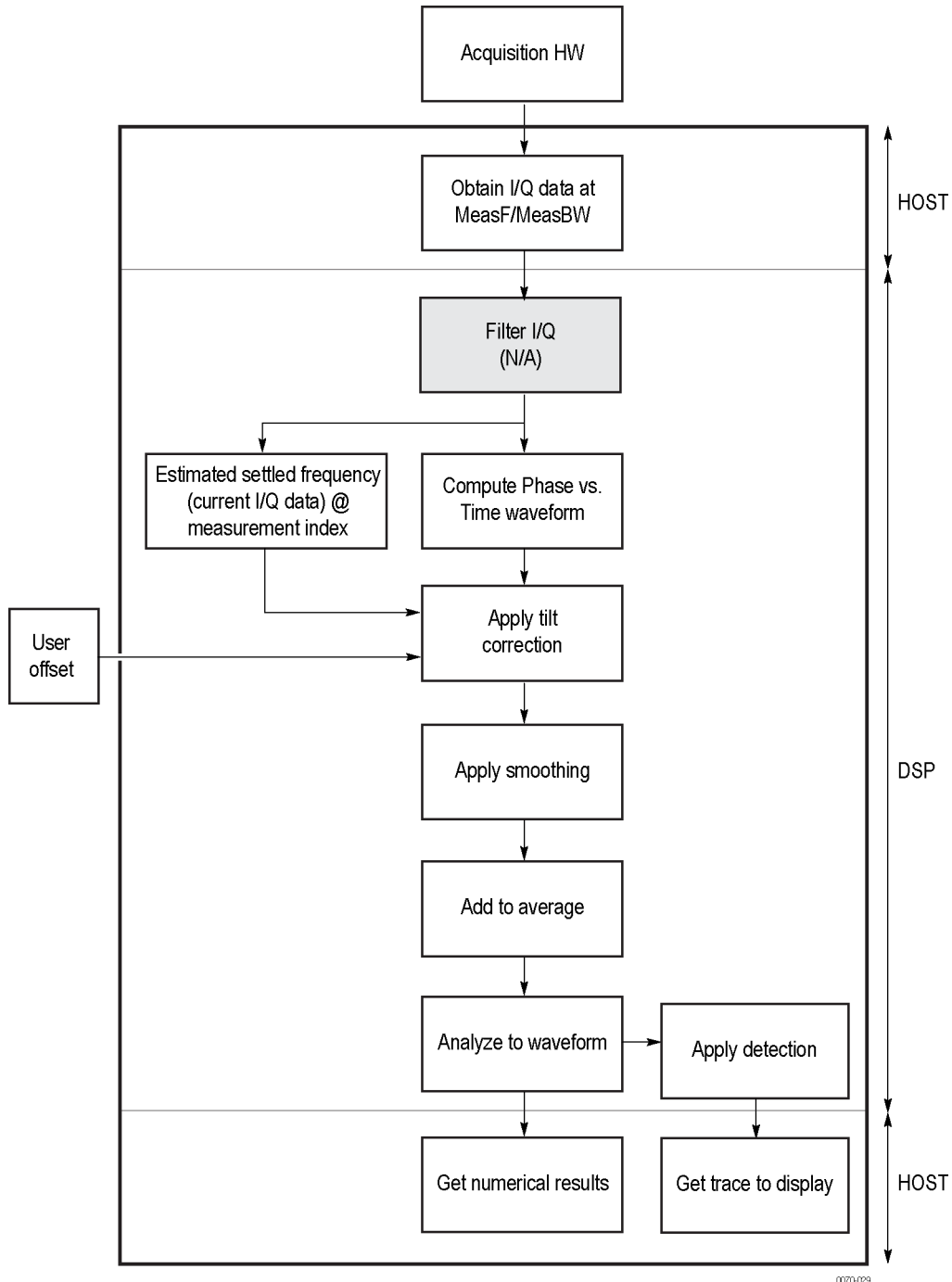
The following paragraphs describe how a frequency and phase settling measurement is made.





Frequency settling time flow diagram





Phase settling time flow diagram

Acquisition hardware collects I and Q samples at the measurement frequency. Sample Rate is based on the measurement bandwidth setting.

The instantaneous phase is computed as:

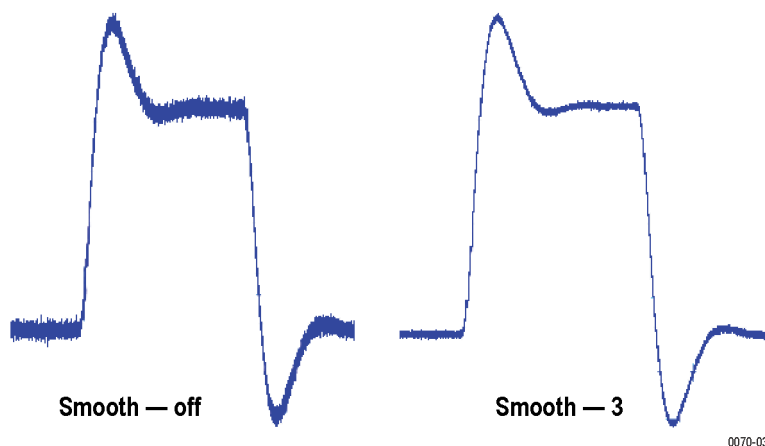


$$Ph_{(n)} = atan\left(\frac{Q_{(n)}}{I_{(n)}}\right)$$

The instantaneous frequency is the derivative of the phase:

$$Fr_{(n)} = (Ph_{(n-1)} - Ph_{(n+1)}) \times \left(\frac{F_{sampling}}{(2 \times 2\pi I)}\right)$$

Data smoothing is applied (if selected by the user). This filtering method uses  $\pm n$  adjacent samples to produce an average value that is used to replace the values of the original  $2n$  samples. An example is shown below.



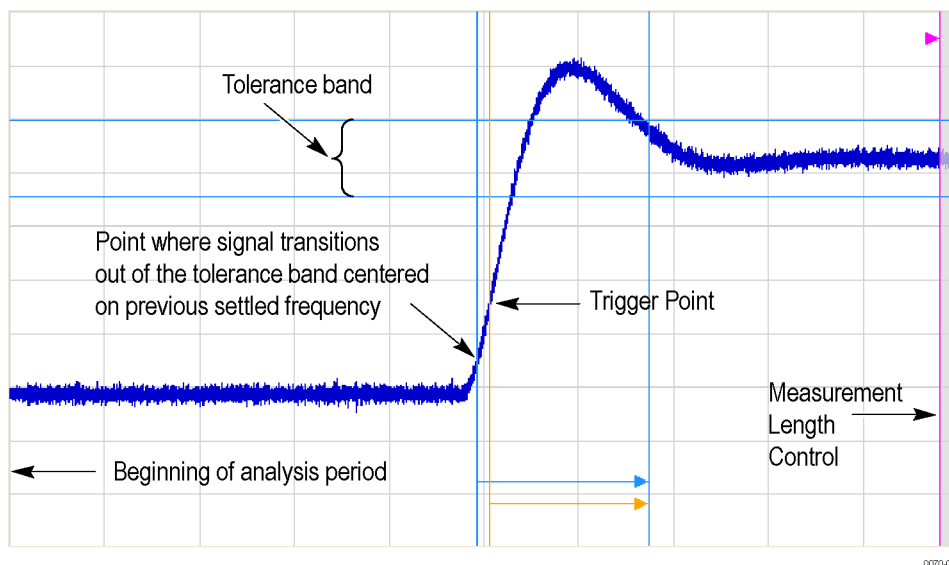
If averaging is turned on, the smoothed data array is averaged with data arrays of previous acquisitions on a point-by-point basis. Smoothing has the advantage of reducing noise-like variations in the measurement, but carries the risk of masking real measurement data. The amount of smoothing applied must be determined by evaluating the waveform you see for artifacts that result from the process.

Next, Settled Frequency is calculated. Settled frequency is the average frequency determined by looking back in time from the point set by the Measurement Length control over a minimum of 256 samples. This value is used to determine the frequency level about which to center the Tolerance range. The measurement then searches backward through the data until it finds the first point that exceeds the tolerance range. A maximum of 20 million acquisition data samples can be processed by the measurement.

Settling Time is measured as the time from the start reference to the point where the frequency remains within the tolerance band. The start reference can be any of three points:

- The trigger point
- The beginning of the analysis period. This result can only be computed when the instrument can find a previous settled state within the measurement period
- The point at the end of the previous frequency hop where the frequency first leaves the tolerance band. This result can only be computed when the instrument can find a previous settled state within the measurement period.





### Settling time start reference points

All measurements are now complete and the numeric settling time values can be sent to the display. However, no result traces have been produced yet. Detection is used to reduce the measured points (which can number up to 10 million) to a number more easily processed by the display processor. +/- Peak detection is always used, preserving the maximum positive and negative excursions for display. Reducing the number of points in the result reduces the time resolution of the markers. If averaging is on, the measurement results are computed on the average of the undecimated results.

### Phase Settling Time Overview

Phase settling time is determined, as described previously, with the addition of tilt correction.

The instrument estimates tilt (or slope of the phase) using linear least square fitting over (at least) 256 samples of the phase vs. time waveform, looking backwards from the point set by the Measurement Length. The instrument adjusts the phase waveform so that its phase is of zero value at the point set by the Measurement Length.

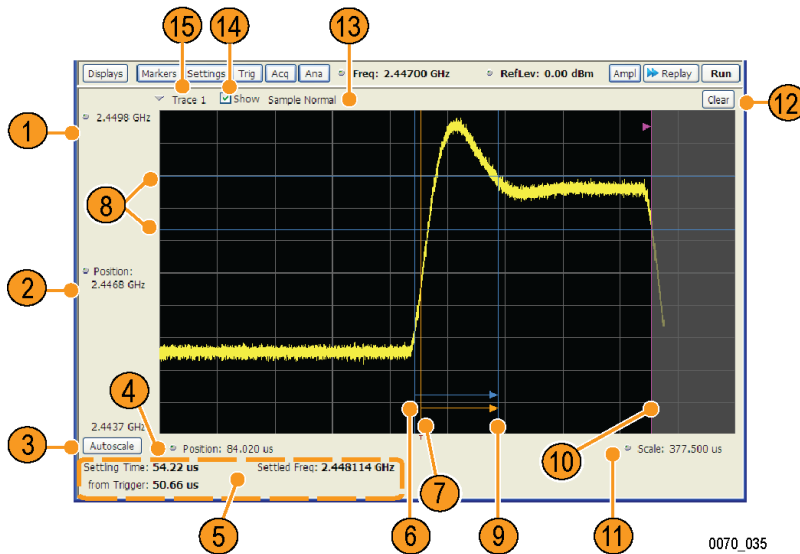
## Settling Time Displays

The Frequency Settling Time measurement is used to measure the frequency settling time of frequency-agile oscillators and subsystems. The Phase Settling Time measurement is used to measure the phase settling time of phase-agile oscillators and subsystems. Automated measurements can reduce user-to-user measurement variations, improving repeatability and measurement confidence and saving time in gathering results. To measure phase settling, a phase reference is required. This means that the measurement tool must be frequency- referenced to the device under test, or must act as the frequency reference to the device under test. To lock the reference to an external source, go to Setup > Configure In/Out > Frequency Reference and choose **External**. Values from 1 MHz to 25 MHz in 1 MHz steps can be used as an external reference.



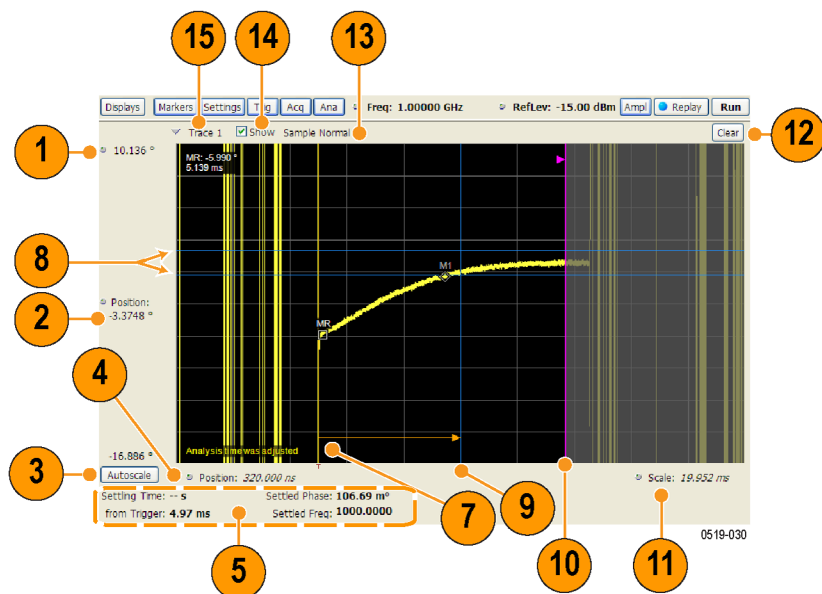
To show a Settling Time display:

1. Recall an appropriate acquisition data file.
2. Click the **Displays** button or select **Setup > Displays**.
3. From the Measurements box, select **RF Measurements**.
4. Double-click the **Freq Settling** icon or the **Phase Settling** icon in the **Available displays** box. This adds the selected display to the **Selected displays** box (and removes it from the Available displays box).
5. Click the **OK** button.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



Frequency settling time display





Phase settling time display



## Elements of the Display

Item	Display element	Description
1	Top of graph	Sets the frequency/phase that appears at the top of the graph. However, note that the top of graph setting, vertical scale setting (Settings > Scale tab), and Vertical Position settings interact. Adjusting this value changes the frequency/phase at the top of the graph by adjusting the scale setting. <b>Phase Settling Time:</b> Sets
2	Vertical Position	Sets the frequency/phase value at the vertical center of the graph.
3	Autoscale	Adjusts the Vertical and Horizontal scaling to display the entire trace on screen.
4	Horizontal Position	Sets the horizontal position of the trace on the graph.
5	Measurement readouts	Displays measurement results. See <i>Measurement Readout Text Color</i> below.
6	Signal transition start indicator	A blue vertical line that indicates the starting point of the Settling Time measurement that is based on the signal transition away from the previous settled state, if a previous settled state is found within the measurement period.
7	Trigger point indicator	An orange line and "T" (which appears below the graph) that indicates the location of the trigger point in time.
8	+/- Tolerance indicators	A pair of blue horizontal lines that show the tolerance range.
9	Settled time indicator	A blue vertical bar that shows the point on the trace at which the measurement has determined the signal frequency or phase to be settled.
10	Measurement length indicator	A magenta vertical line that specifies the end of the allowed measurement period. This is a control, not a result.
11	Scale	Adjusts the horizontal (time) scale of the graph.
12	Clear	Restarts multi-trace functions (Avg, Hold) and erases the trace.
13	Function	Displays the Detection and Function selections for the selected trace. (Detection is always +/-Peak for Settling Time measurements.)
14	Show	Controls whether the selected Trace is visible or not. When trace is Off, the box is not checked.
15	Trace	Selects a trace. Touching here displays a menu that shows the available traces and whether they are enabled or not. If you select a trace that is not currently enabled, it will be enabled.

## Measurement Readout Text Color

The measurement readouts can appear in either black text or red text. Measurement results that appear in black text indicate:

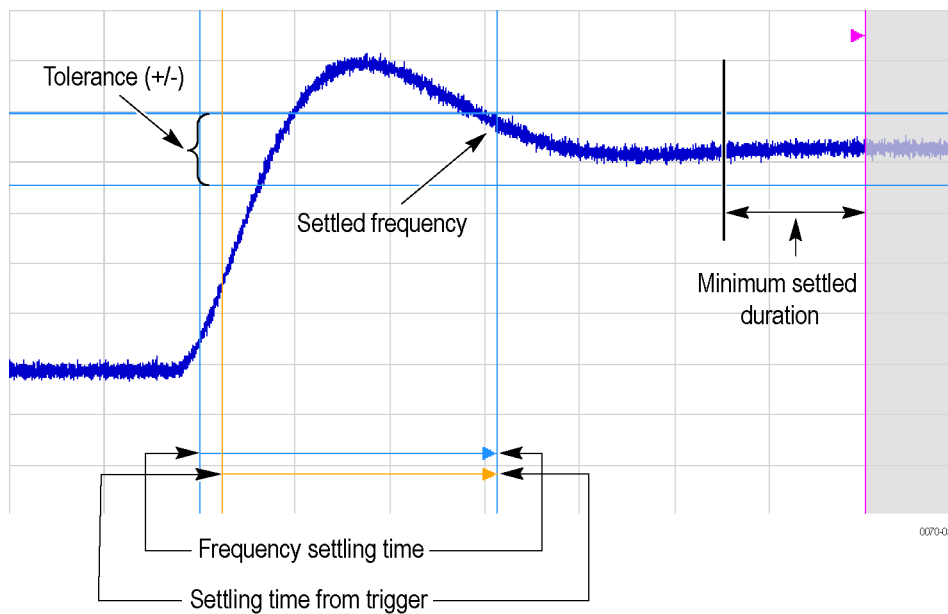
- the signal is settled AND
- the signal is settled longer than the minimum settled duration AND
- the settling time is valid OR the settling time from trigger is valid

If any of the conditions listed are not met, the measurement results text is red.



### Elements of the Frequency Settling Time Graph

The following illustration shows the various indicators that appear in the Frequency Settling Time graph.

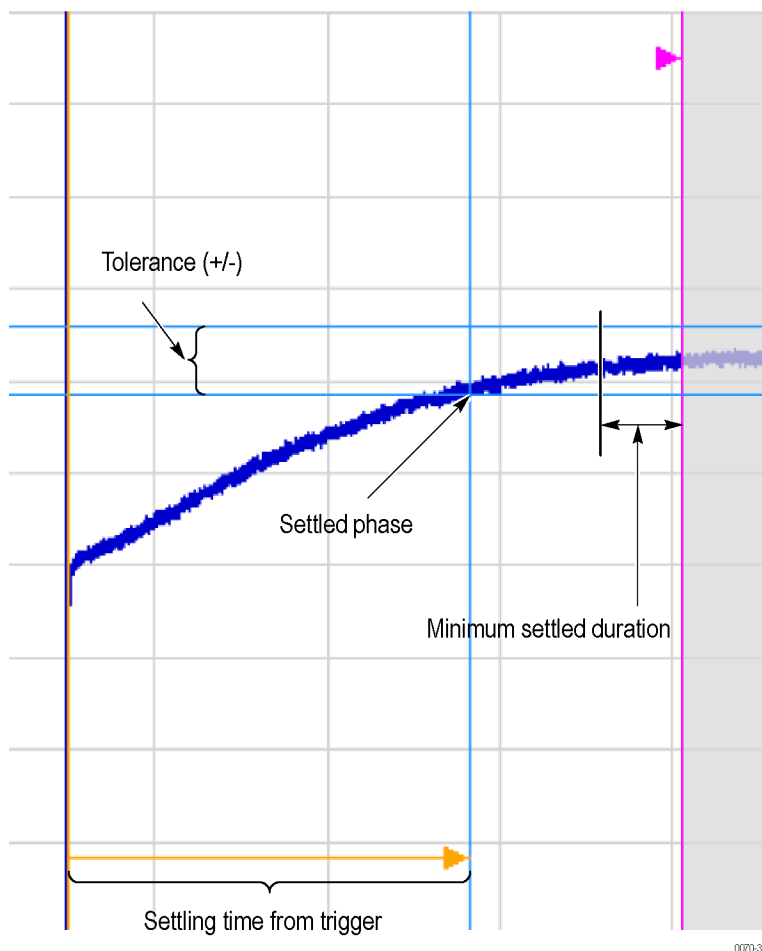


**NOTE.** The blue vertical bar that indicates the end of the previous settled state may not always appear. For frequency settling time, this can happen because the starting frequency is outside the measurement bandwidth.

### Elements of the Phase Settling Time Graph

The following illustration shows the various indicators that appear in the Phase Settling Time graph. For most phase settling time measurements, there is not a previous settled state within the measurement period, making it impossible to measure the settling time from the previous settled value. However, the settling time from trigger is typically available.





**NOTE.** The blue vertical bar indicating the measurement start time may not appear. Zero phase is referenced to the measured hop, as the phase will not typically have a settled value during the previous hop.

### Measuring Settling Time

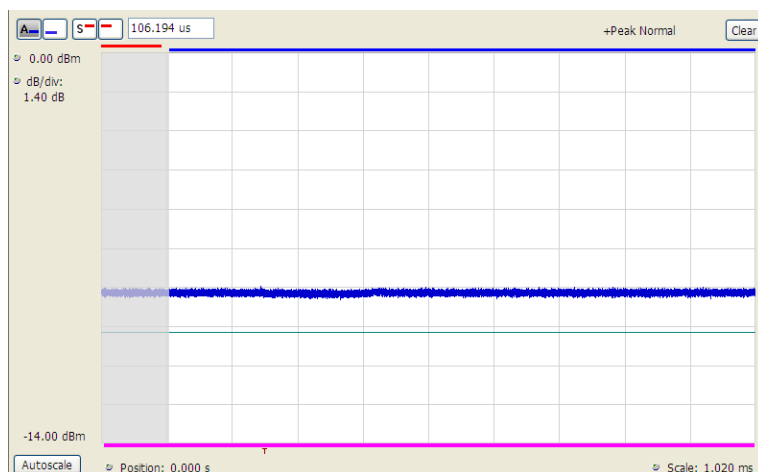
1. Select the **Displays** button.
2. Select **RF Measurements** from the **Measurements** box.
3. Double-click the **Freq Settling** icon or **Phase Settling** icon in the Available displays box. Click **OK** to complete your selection.
4. Select **General Signal Viewing** from the **Measurements** box.
5. Double-click the **Time Overview** icon in the Available displays box. Click **OK** to complete your selection.
6. Press the front-panel **Freq** button and use the front-panel keypad or knob to adjust the frequency to that of the signal you want to measure.



7. Select the Trig button.
8. In the Trigger control panel, select Triggered. Configure the trigger settings as needed to achieve a triggered signal.

For the next step in measuring settling time, you must set the starting point of the measurement. To do this, you will use the Time Overview display.

9. Select the Time Overview display.
10. At the left edge of the graph, drag across the graph to adjust the analysis offset. Adjust the Analysis Offset to locate the start of the settling time measurement just ahead of the signal transition where you want to measure the settling time. Any portion of the signal in the gray area will be excluded from the settling time measurement.



#### Setting the starting point of the settling time measurement

Even if the signal transition is difficult to see on the Time Overview display, you can set the starting point based on the location of the Trigger indicator below the graph. Or open the Frequency vs. Time graph to see the frequency transition.

11. Click in the Settling Time display to select it.
12. Select the **Settings** button to display the **Settling Time Settings** control panel.
13. On the **Define** tab, adjust the [Meas BW \(see page 171\)](#) to improve the signal-to-noise ratio as appropriate. Make sure the bandwidth covers the settled frequency, particularly when the instrument Measurement Frequency is not locked to the spectrum Center Frequency (Analysis control panel > Frequency tab).
14. Set the [Target reference \(see page 172\)](#) to Auto or Meas freq as appropriate. If you select Meas freq, also set Offset to fine-tune the measurement frequency if necessary.
15. Set the [Tolerance \(see page 172\)](#) as required for your measurement.

If your signal must be settled for a period of time before it is considered settled, you can specify a minimum settled duration for the settling time measurement.

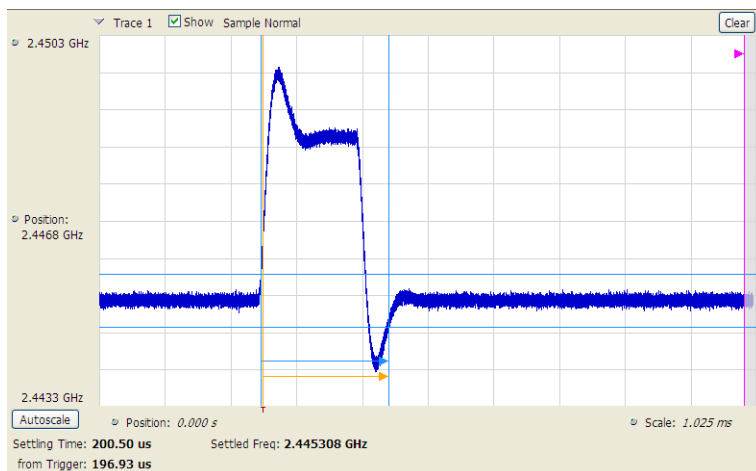


16. Select the Time Params tab. Adjust the [Min settled duration \(see page 173\)](#) as required.

To get the measurement made in the correct location on the signal, you must adjust the measurement length. You do this by dragging the magenta line in the Settling Time graph.

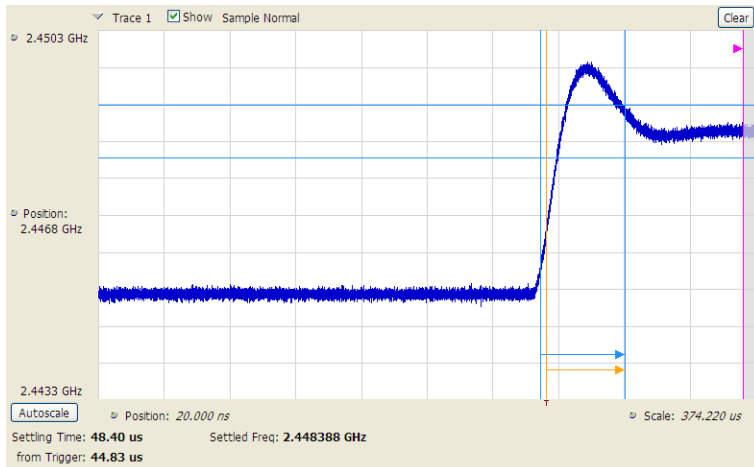
17. Drag the measurement length indicator (magenta line) to the correct location on the signal. Choose a point at which the signal appears to be well settled. The measurement will then find the exact time at which the signal actually settled to within the specified tolerance.

Note the difference in the settling time in the two illustrations that follow. In both examples, the Target reference is set to Auto. The only difference is the measurement length, as shown by the magenta line.



Frequency settling time display before setting the measurement length





Frequency settling time display after setting the measurement length

# Settling Time Settings

## Application Toolbar:

The settings for the Frequency and Phase Settling Time displays are shown in the following table.

Settings tab	Description
<a href="#">Define (see page 171)</a>	Sets the measurement parameters that characterize the settling time measurement.
<a href="#">Time Params (see page 173)</a>	Sets measurement end-time and minimum settled duration parameters.
<a href="#">Mask (see page 174)</a>	Enable or disables mask testing and sets the parameters that specify the three zones used for mask testing.
<a href="#">Trace (see page 174)</a>	Specifies trace display characteristics and which traces are displayed.
<a href="#">Scale (see page 195)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs (see page 130)</a>	Specifies whether or not to show certain display elements, the maximum number of points in the exported trace, and the displayed precision of the settling time measurement.

# Settling Time Displays Shared Measurement Settings

The control panel tabs in this section are shared by the Frequency and Phase Settling Time displays. These control panel tabs are not shared with other RF Measurement displays. With few exceptions, each display shares values for each of the controls on these tabs. For example, Vertical Scale values are independent for each of the displays (degrees for Phase Settling Time and Hertz for Frequency Settling Time).



### Common controls for settling time measurement displays

Settings tab	Description
<a href="#">Define (see page 171)</a>	Specifies the parameters that characterize the settling time measurement.
<a href="#">Time Params (see page 173)</a>	Specifies the Measurement length and minimum settled duration for the settling time measurement.
<a href="#">Mask (see page 174)</a>	Specifies the parameters used for Mask testing.
<a href="#">Trace (see page 174)</a>	Specify which traces to show and how they are computed.
<a href="#">Scale (see page 177)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 178)</a>	Specifies display parameters of the Settling Time displays.

## Define Tab for Settling Time Displays

The Define tab for the Frequency Settling Time measurement controls several parameters that affect how the measurement is made.

Define | Time Params | Mask | Trace | Scale | Prefs

Meas Freq: 2.44700 GHz    Target reference: Auto    Offset: 0.0000 Hz

Meas BW: 40.00 MHz    Tolerance (+/-): 500.0 kHz

actual: 40.00 MHz

### Meas Freq

Select the frequency of the signal to be measured. Measurement Frequency can be selected as the target frequency (see *Target Reference*).

**NOTE.** *If Lock Center Frequency of Spectrum Display to Measurement Frequency is unchecked, then Measurement Frequency is independent of Center Frequency) Range: Entire input frequency of the instrument*

### Meas BW

This control limits the bandwidth of the Settling Time measurement. You use the measurement bandwidth setting to improve the signal-to-noise ratio of the measurement, resulting in lower measurement uncertainty. However, if the measurement bandwidth is set too low, resulting in fewer samples per second, it can reduce the number of points within the measurement length below the 256 stable samples required, thus causing the analysis to fail. The measurement bandwidth depends on the oscilloscope on which the recalled file was acquired. To see the effect of measurement bandwidth on measurement uncertainty, see the *RSA6100B Series Specifications and Performance Verification Reference*, Tektronix part number 077-0647-XX. This manual can be downloaded from [www.tek.com/manuals](http://www.tek.com/manuals).



## Target Reference

The target reference is a calculated or user-specified value of final settled frequency within the measurement period. When set to **Auto**, the instrument determines this value by averaging at least the last 256 samples at the end of the measurement period. When set to **Meas freq**, the Target Reference is set to the Measurement Frequency of the instrument. You can enter a manual offset from the target frequency to fine-tune the Target Reference when **Meas freq** is selected.

## Tolerance(+/-)

The Tolerance is the frequency or phase range within which the signal must remain to be considered settled. This is set as a  $\pm$  value by the user. In the frequency settling time measurement, the tolerance band is centered about the target value. In the phase settling time measurement, the tolerance band is centered about the settled phase value.

The target frequency depends on the Target reference value setting:

- If Target Reference is set to **AUTO**, then the target value is the settled value (the frequency at which the signal is considered settled).
- If Target Reference is set to MeasFreq, then the Target value = **Meas Frequency** + **Offset**.

## Offset

Offset is used for fine-tuning the Target Reference when **Meas freq** is selected. The value for Offset is entered manually.



## Time Params Tab for Settling Time Displays

The Time Params tab is used to set the Measurement length and minimum settled duration parameters.

The screenshot shows the 'Time Params' tab selected in a software interface. The 'Define' tab is also visible. The 'Measurement length' is set to 1.000 ms, with a note '(from Analysis Offset to End of Measurement Marker)' and an 'actual' value of 938.4 us. The 'Min settled duration' is set to 0.0000 s, with a note '(from Settled Point to End of Measurement Marker)'.

### Measurement Length

Measurement length locates the end of the measurement period for settling time. This value is set independently of the analysis period for other measurements in the analyzer. This allows other measurements to display multiple frequency hops during an analysis, while focusing the settling time analysis on a single hop. You can set the measurement length either by entering a value in the entry box, or by dragging the magenta bar to the desired location in the graph. Traces and the display to the right of the measurement time are shown in grey to indicate that this section of the waveform is not being used in the measurement. If your signal does not settle to within your tolerance band, make sure that the measurement time ends during the settled portion of the waveform. The beginning of the settling time measurement is set with the analysis offset control, the same as other measurements in the instrument. Use analysis offset to exclude earlier hops from the measurement. See [Analysis Time \(see page 495\)](#) for setting the analysis offset control.

If there is more than one phase or frequency hop in the signal to be analyzed, use the Measurement Length control to instruct the analyzer which hop to measure. First, adjust the main Analysis Offset control to a point in time slightly earlier than the transition you wish to measure. Do this in the Time Overview display or the Analysis Settings control panel. Then adjust the Measurement Length so the end of the Settling Time measurement falls within the apparent settled period after the signal transition. The reason it is important for the user to set this control is that the Settling Time measurements start at this point and look backwards in time (towards the signal transition) to find the latest trace point that is not inside the tolerance band.

---

**NOTE.** *If your signal does not settle to within your tolerance bands, make sure that the measurement time ends during the settled portion of the waveform.*

---

### Min Settled Duration

The minimum settled duration is the amount of time the signal must remain within the tolerance band to be considered settled. Some user specifications require that the signal be settled for a minimum period. If this is not required in your application, set this value to the default of 0 seconds.



## Mask Tab for Settling Time Displays

The Mask tab is used to specify the parameters used for Mask testing.

### Enable Mask Test

Enables or disables mask testing.

### Start 1, 2, 3

Sets the starting point for the time zone of interest. If you don't want to use all three zones, set the Start Time for the unneeded zones to a time after the end of the Measurement Length.

### Stop

Sets the end point for the final time zone of interest.

### Limit (+/-)

Sets the mask violation limits for each time zone.

### Mask Time Reference

When mask testing is enabled, the Mask time reference selection specifies the starting point of the mask. You can choose to start the mask test at the trigger point or at the point on the trace where the signal began its transition from its previous settled frequency or phase level to the level you intend to measure.

This capability is useful because some applications do not have a trigger signal available. For those situations where a trigger signal is available, the specification for the device-under-test may require that measurements be referenced to that signal.

## Trace Tab for Settling Time Displays

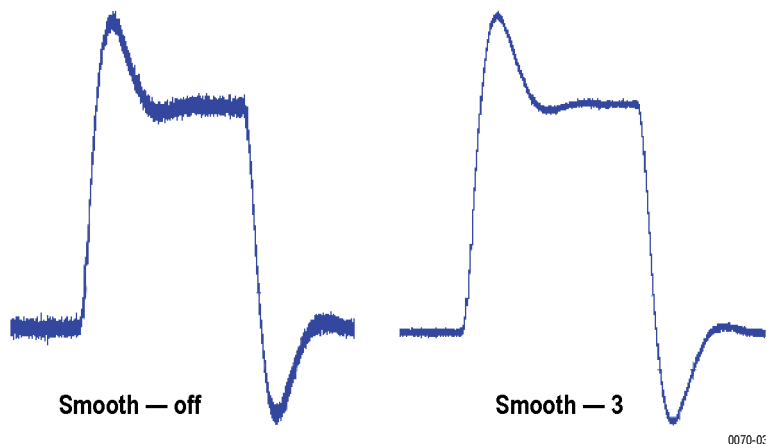
The Traces Tab allows you to set the display characteristics of displayed traces.



Define	Time Params	Mask	Trace	Scale	Prefs
<input type="checkbox"/> Smooth: (points) 2 <input type="checkbox"/> Average: (count) 2			Trace: Trace 1 <input checked="" type="checkbox"/> Show <input type="checkbox"/> Freeze <input type="checkbox"/> Show recalled trace <input type="text"/> ... <input type="button" value="Save Trace As..."/>		

## Smooth

Smooth is a low-pass filter function that uses  $n$  points in the trace to determine the smoothed value. For example, in the case of  $n=3$ , 3 consecutive points are averaged to determine the result of the smoothed output. This is very useful for single-shot signals that contain significant noise where multiple trace averages cannot be used. However, smoothing does have limits, and the user should visually determine whether smoothing is removing noise from the measurement, or if it is affecting the signal. The following illustration shows the effect smoothing has on the displayed trace.



The range for the Smooth function is 2–1000. The setting resolution is 1. arrow keys increment it in steps of 1, 2, 5, 10. When smoothing is enabled, it applies to both traces. Smooth is turned off by default.

## Average

This sets the number of acquisitions to be averaged together to produce the result. Averaging reduces random variations but maintains the correct waveshape for repeating signal aberrations. To use averaging, the signal must be repetitive. For example, the tuning direction must always be same for each measurement to be averaged. Signals that vary in tuning direction will tend to average positive-going effects with negative-going effects and the settling time characteristics will cancel out.



The range for the Average function is 2–10000. The setting resolution is 1. arrow keys increment it in steps of 1, 2, 5, 10. When smoothing is enabled, it applies to both traces. Smooth is turned off by default.

## Trace

Selects a trace for display. Choices are Trace 1 and 2. Either trace can be a recalled trace.

## 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).



## Scale Tab for Settling Time Displays

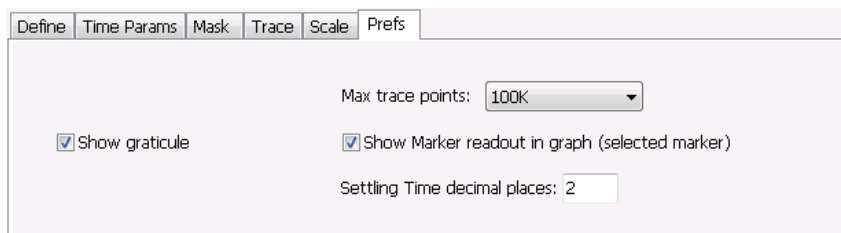
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.

Setting	Description
Vertical	
Scale	Changes the vertical scale or span of the graph.
Position	Sets the frequency (or phase) at the vertical center of the graph.
Relative Freq	Sets the vertical (position) display readouts to show frequency values relative to the center frequency or as absolute values.
Autoscale	Resets the Scale and Position to center the trace in the graph.
Horizontal	
Scale	Sets the range of time shown in the graph.
Position	Allows you to pan the graph left and right.
Autoscale	Resets Scale and Position to the automatically determined settings.



## Prefs Tab for Settling Time Displays

The Prefs tab allows you to change display parameters of the Settling Time displays.



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

Setting	Description
Max trace points	Sets the number of trace points used for marker measurements and for results export.
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.
Settling Time decimal places	Specifies the precision of the settling time measurement readout that appears below the graph. This setting does not affect the precision of internal calculations.

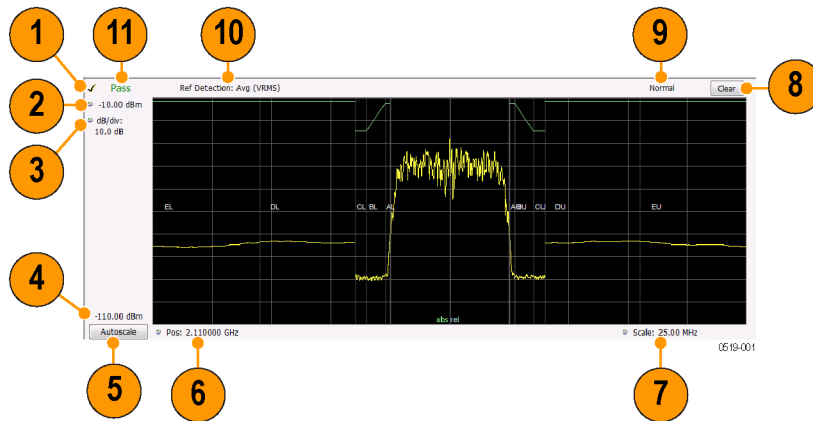
## SEM Display

The SEM (Spectrum Emission Mask) display measures out-of-band emissions immediately outside the channel bandwidth that result from the modulation process and non-linearity in the transmitter. The Spectrum Emission Mask display allows you to define up to six pair of masks, or offsets, that specify the limits for out-of-band emissions and performs a pass/fail tests of the signal against the defined offsets and limits.

To show the Spectrum Emission Mask display:

1. Recall an appropriate acquisition data file.
2. Select **Displays** or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **RF Measurements** or **WLAN Analysis** in the Measurements box.
4. In the Available displays box, double-click the **SEM** icon or select the icon and click **Add**. The SEM icon will appear in the Selected displays box and will no longer appear under Available displays.
5. Click **OK** to show the Spectrum Emission Mask display.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.







## Elements of the Display

Item	Display element	Description
1	Check mark indicator	Indicates the display for which the acquisition hardware is optimized.  <b>NOTE.</b> When <i>Best for multiple windows</i> is selected in the <i>Amplitude control</i> panel's <i>RF &amp; IF Optimization control</i> , none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
2	Top-of-graph setting	Sets the level that appears at the top of the graph.
3	dB/div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
4	Bottom-of-graph readout	Indicates the amplitude at the bottom of the graph. This value changes with the dB/div and Vertical Position settings.
5	Autoscale	Properly offsets the peak of the display from the top of the screen. If the screen has been enlarged through a manual vertical (dB/div) setting entry, the view is not vertically rescaled when Autoscale is used.
6	CF / Pos	Default function is CF - center frequency (equivalent to the Measurement Freq setting). If Horizontal scaling has been manually adjusted in Setup > Settings > Scale, then Pos replaces CF as the setting at the bottom-left corner of the screen. Adjusting Pos shifts the trace left or right in the graph, but does not change the measurement frequency.
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	Erases the current results from the display.
9	Function readout	Readout of the Function selection for the Reference channel (Setup > Processing > Function). Spurious
10	Detection readout	Readout of the Detection selection for the Reference channel (Setup > Processing > Detection).
11	Pass / Fail readout	Readout indicating whether any part of the trace has exceeded the any of the limits defined in the Offsets & Limits table (Setup > Settings > Offsets & Limits Table).

## Pass / Fail Readout

This readout displays either **Pass** or **Fail XX%**. When the signal exceeds the mask in any offset, it is considered a mask violation, and results in **Fail XX%** being displayed. If there are no mask violations, **Pass** is displayed.

**How the fail percentage is determined.** Each offset has two sides, one lower and one upper. For example, Offset A has two sides: AL (lower side) and AU (upper side). In the SEM display, there is a maximum of six offsets (A-F) and each offset can have a maximum of two sides (if Both is selected for Side in the Offsets & Limits table). This results in a total of six offsets multiplied by two sides per offset, which results in 12 offsets. Mask violations can occur in any of these offsets. The failure percentage is calculated as follows:

Fail percentage = Number of offsets with mask violations x 100 / Total number of enabled offsets



For example: Assume there are three enabled offsets: A, B, C, and all these offsets have both lower and upper sides. Thus, the total number of enabled offsets is equal to six. Suppose there are mask violations in the offsets AL and CU, then the number of offsets having mask violations is equal to 2. Therefore, Fail percentage =  $2 * 100 / 6 = 33\%$ .

## Results Display

The Results Display shows the measurement results for the SEM display.

Ref: Total Power	Row	Offset	Start Freq	Stop Freq	Peak Abs (dBm)	Margin Abs (dB)	Peak Rel (dB)	Margin Rel (dB)	@Freq	Integ Abs (dBm)
-16.93 dBm	1	EL	-12.500 MHz	-8.000 MHz	-73.83	-62.33	-91.81	--	-8.010000 MHz	-68.44
	2	DL	-8.000 MHz	-4.000 MHz	-73.17	-61.67	-91.16	--	-7.460000 MHz	-67.61
	3	CL	-4.000 MHz	-3.515 MHz	-87.63	-63.13	-105.62	--	-3.965444 MHz	-77.11
	4	BL	-3.515 MHz	-2.715 MHz	-87.77	-75.17	-105.76	--	-2.722000 MHz	-75.14
	5	AL	-2.715 MHz	-2.515 MHz	-70.18	-57.68	-88.16	--	-2.515000 MHz	-70.74
	6	AU	2.515 MHz	2.715 MHz	-70.73	-58.23	-87.67	--	2.515000 MHz	-70.54
	7	BU	2.715 MHz	3.515 MHz	-87.66	-67.24	-104.59	--	3.243000 MHz	-74.72
	8	CU	3.515 MHz	4.000 MHz	-88.01	-63.51	-106	--	3.976356 MHz	-77.04

### Readout

### Description

Ref:	A two-part readout to the left of the table that displays information about the Reference Channel. The first part of the readout displays the Measurement Type selected on the Parameters tab. The second part of the readout displays the measurement result for the Reference channel.
Row	A sequence number for ordering the offsets. Click to organize by row number, resort rows from high to low or low to high.
Offset	The Offset name. A combination of the offset (A-F) and the location (U for upper and L for Lower).
Start Freq	The start frequency of the offset (relative to the Measurement Freq).
Stop Freq	The stop frequency of the offset (relative to the Measurement Freq).
Peak Abs	Absolute power peak power at worst case margin of the offset
Margin Abs	The worst case difference between the trace and the absolute limit line. Note that an offset can have different start and stop levels, thus, the margin can vary if the offset start and stop levels are different.
Peak Rel	Relative peak power of worst case margin of the offset. Relative with respect to the reference power level.
Margin Rel	The worst-case difference between the trace and the relative limit line. Because an offset can have different start and stop levels, the margin can vary if the offset start and stop levels are different.
@Freq	The frequency at which the worst margin occurs.
Integ Abs	The absolute integrated power of the offset.
Integ Rel	The relative integrated power of the offset (with respect to the reference power).

**Reordering results in the results table.** You can sort the results in the Results table by clicking the column heading containing the values you want to sort on. You can sort results for the following columns: Row, Offset, Start Frequency, Stop Frequency, Peak Abs, and Peak Rel.



**Rearranging columns in the results table.** You can rearrange the order of the columns and their size. To rearrange columns, select the column heading you want to move and drag it to the new position; the new location is indicated by a dark blue bar that appears between column headings.

You can resize the columns by selecting the divider between columns and dragging it to a new position.

## Spectrum Emission Mask Settings

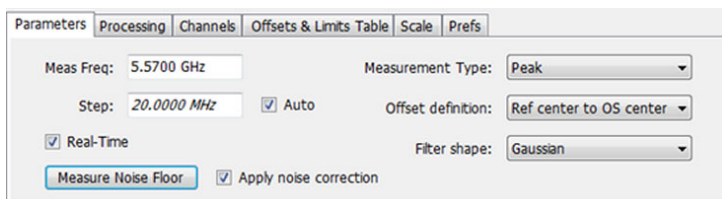
### Application Toolbar:

The settings for the Spectrum Emission Mask display are visible when SEM is the selected display. To display the SEM Settings, select **Setup > Settings**.

Settings tab	Description
<a href="#">Parameters Tab (see page 182)</a>	Specifies several characteristics that control how the measurement is made.
<a href="#">Processing Tab (see page 185)</a>	Specifies settings for detection on the Reference channel and the offsets. Specifies the function setting.
<a href="#">Ref Channel Tab (see page 186)</a>	Specifies how the measurements on the reference channel are performed.
<a href="#">Offsets &amp; Limits Table (see page 186)</a>	Specifies characteristics of offsets and mask limits.
<a href="#">Scale Tab (see page 189)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs Tab (see page 190)</a>	Specifies the appearance features of the graph area and the maximum trace points.
<a href="#">Standards Presets (see page 21)</a> button	Click this button to access the Standards Presets options dialog window. You can select the standard and bandwidth to apply to the standard you select. Click on the link to the left for information about standards presets.

## Parameters Tab - SEM

The Parameters tab specifies several characteristics that control how the Spectrum Emission Mask measurements are made.



Parameters Processing Channels Offsets & Limits Table Scale Prefs

Meas Freq: 5.5700 GHz Measurement Type: Peak

Step: 20.0000 MHz ☒ Auto Offset definition: Ref center to OS center

☒ Real-Time Filter shape: Gaussian

☒ Apply noise correction



Setting	Description
Meas Freq	Specify the frequency of the signal to be measured.
Step	Sets the increment size when changing the Frequency using the knob or mouse wheel.
Auto	When Auto is enabled, the step size is adjusted automatically based on the span setting.
Real-Time	When Real-Time mode is enabled, the entire SEM span is measured using a real-time/contiguous acquisition. Not all described parameters are available in Real-Time mode.
Noise correction controls	<b>NOTE.</b> The following two noise correction controls are only available when SignalVu-PC is connected to an MDO4000B/C instrument.
Measure Noise floor	Takes preliminary acquisitions to measure the instrument noise floor. This initiates a noise correction. A noise correction signal is created by switching off the RF input to the MDO4000B/C and performing acquisitions of the instrument's internal noise. Fifty acquisitions are averaged to create the noise reference signal. The noise reference signal is measured for the Reference channel and each Offset is defined by the measurement settings.
Apply noise correction	<p>This item is enabled and the check box automatically checked after the noise reference signal is taken when the Measure Noise floor button is clicked. This initiates noise reference subtraction from the incoming signal power for each region to create the corrected result. All calculations are performed in Watts and then converted to the desired units.</p> <p>The amount of noise correction is limited to 20 dB to avoid the possibility of a negative power measurement. This is a rare condition that could occur if the subtraction of the reference power from the channel power results in a negative value (or "infinite" dBm). The noise reference for a region is subtracted from each trace point in the channel, rather than offsetting the entire region by a single amount. This produces a smooth trace with no discontinuities at the region edges.</p> <p><b>NOTE.</b> If any relevant settings (such as reference level, frequency, span, RBW) are changed once the noise reference is measured, the following warning message will be displayed to notify you that Noise Correction was not applied:</p> <p><i>Noise correction not applied - select Measure Noise Floor for new noise correction.</i></p>
Measurement Type	Specifies the type of measurement for the reference channel; used as a reference for the offsets.
Total Power	Sets the reference to the integrated power of the reference channel within the reference's integration bandwidth.
PSD	Sets the reference to the mean of the power spectral density (dBm/Hz) of the reference channel. The trace and the absolute and relative limits line are also in dBm/Hz
Peak	Sets the reference to the Peak power of the reference channel.
Offset definition	Defines the relative position of the start/stop frequency of an offset. Choose the offset definition based on the standard.
Ref center to OS center	Specifies that the start/stop frequencies are defined from the center frequency of the reference channel to the center of the filter BW.
Ref center to OS edge	Specifies that the start/stop frequencies are defined from the center frequency of the reference channel to the center of the (inner) edge of the filter BW of the offset.
Ref Edge to OS center	Specifies that the start/stop frequencies are defined from the edge of the reference channel to the center of the filter BW of the offset.

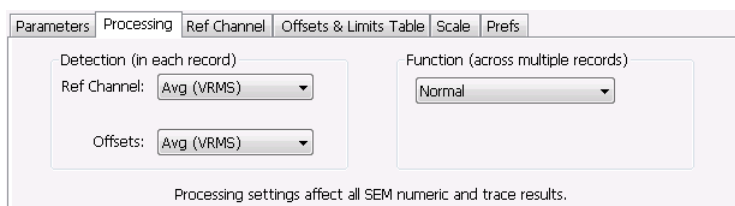


Setting	Description
Ref Edge to OS edge	Specifies that the start/stop frequencies are defined from the edge of the reference channel to the (inner) edge of the filter BW of the offset.
Filter Shape	Specifies the shape of the filter determined by the window that is applied to the data record, in the spectrum analysis, to reduce spectral leakage. 3GPP specifies a Gaussian window shape be applied to the reference channel measurements.
Gaussian	This filter shape provides optimal localization in the frequency domain.
Rectangular	This filter shape provides the best frequency, worst magnitude resolution. This is essentially the same as no window.



## Processing Tab - SEM

The Processing tab controls the Detection settings for the Reference Channel and Offsets, as well as selecting the Function.



Parameters Processing Ref Channel Offsets & Limits Table Scale Prefs

Detection (in each record)

Ref Channel: Avg (VRMS)

Offsets: Avg (VRMS)

Function (across multiple records)

Normal

Processing settings affect all SEM numeric and trace results.

Settings tab	Description
Detection (in each sweep)	
Ref Channel	Specifies the Detection method used for the Reference Channel. Detection is used to produce the desired measurement result (peak or average) and to reduce the results of a measurement to the desired number of trace points.
Avg (VRMS)	For each sweep, each point of the trace is the result of determining the RMS voltage value for the last 'n counts' of the collected traces for the same point. When 'n count' has not been reached, partial averaging results are displayed.
+Peak	Selects the +Peak detection method. With this method, the highest value is selected from the results to be compressed into a trace point.
Offsets	Specifies the detection method used for the offsets.
Avg (VRMS)	Selects the Average Vrms detection method. With this method, each point on the trace in each offset is the result of determining the RMS Voltage value for all of the results values it includes.
+Peak	Selects the +Peak detection method. With this method, the highest value in each offset is selected from the results to be compressed into a trace point.
Function (across multiple sweeps)	
Function	Selects the trace processing method. Available settings are: Normal, Avg (VRMS), and Hold.
Normal	When a new trace has been computed, it replaces the previous trace.
Max Hold	With each sweep, each trace point in the new trace is compared to the point's value in the old trace and the greater value is retained for display and subsequent comparisons.
Avg (VRMS)	For each sweep, each point on the trace is the result of determining the RMS Voltage value for all of the collected traces' values for the same point.



## Ref Channel Tab

The Ref Channel tab controls how the measurement of the Reference channel is performed.

Settings tab	Description
Power Reference	The value used to calculate relative measurements.
Auto	When Auto is unchecked, you can enter a value for the reference power, and the measured reference power is not used or displayed
RBW	Sets the RBW for the Reference Channel.
VBW	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. When the checkbox next to VBW is not checked, the VBW filter is not applied. SEM standards specify what value of VBW should be applied, if any.
Channel width	Specifies the width of the reference channel.
Integration BW	Specifies the integration bandwidth used to compute the total power in the reference channel.
Channel Filter	Specifies the measurement filter used in the Reference Channel. Choices are None and Root-raised Cosine.
Filter param	Specifies the alpha value (or roll-off factor) of the Root-raised cosine filter. Present only when Channel Filter is set to Root-raised Cosine.
Chip rate	Specifies the chip rate used for the Root-raised Cosine filter. Present only when Channel Filter is set to Root-raised Cosine.

## Offsets & Limits Table Tab - SEM

The Offsets & Limits Table tab is used to specify parameters that define Offsets and masks.



	On	Start (Hz)	Stop (Hz)	Side	RBW (Hz)	n (RBWs)	Filter BW (n x RBW)	VBW (Hz)	VBW On	Mask
▶ A	✓	9.000000M	11.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel
B	✓	11.000000M	20.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel
C	✓	20.000000M	30.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel
D	✓	30.000000M	50.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel
E		50.000000M	100.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel
F		100.000000M	150.000000M	Both	100.000k	1	100.000k	30.000k	✓	Rel

Expanded display of Offsets &amp; Limits Table



Setting	Description
<b>Buttons</b>	
Expand	Displays the Offsets & Limits Table in a new, resizable window.
Reset Layout	You can reorder columns in the Offsets & Limits Table by dragging the columns to a new position. Clicking Reset Layout returns the column order to the factory default order.
Load	Click to load a saved Offsets & Limits table from a file.
Save As	Click to save the current Offsets & Limits table to a file.
Done	When the table is expanded, click Done when you have finished editing the table to save your changes and close the expanded table display.
<b>Table columns</b>	
On	Specifies whether or not measurements are taken in the specified offset.
Start (Hz)	Start Frequency of the selected offset.
Stop (Hz)	Stop Frequency of the selected offset.
Side	Specifies whether the specified range appears on both side of the carrier frequency or just one side (left or right).
RBW (Hz)	Specifies the RBW for the selected range.
n (RBWS)	An integer value that specifies how many times to multiply the RBW to set the Filter bandwidth.
Filter BW (n x RBW)	Displays the Filter BW. Filter BW is the equivalent BW of each point in the offset. When $n > 1$ , an integration technique is used to achieve the Filter BW using narrower RBWs. For most SEM measurements, this value is set to 1. The 3GPP standard suggests n greater than 1.
VBW (Hz)	Adjusts the VBW (Video Bandwidth) value. VBW Maximum: RBW current value; VBW Minimum: 1/10,000 RBW setting.
VBW On	Specifies whether the VBW filter is applied.
Mask	Select the type of limits used for Pass/Fail testing. Signal excursions that exceed the mask settings are considered violations. The available choices are shown below.
Abs Start (dBm)	Specifies the mask level at the inner edge of the selected offset.
Abs Stop (dBm)	Specifies the mask level at the outer edge of the selected offset.
Abs Same	Specifies whether the value for the inner and outer edges of the offset must be the same value. When enabled, the Abs Stop cell is grayed-out and set to the value of the Abs Start cell.
Rel Start (dBm)	Specifies the mask level for the Relative mask at the inner edge of the selected offset.
Rel Stop (dBm)	Specifies the mask level for the Relative mask at the outer edge of the selected offset.
Rel Same	Specifies whether the inner and outer edges of the offset must be the same value. When enabled, the Rel Stop cell is grayed-out and its value is set to the value of the Rel Start cell.



## Scale Tab - SEM

Use the Scale tab to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display. 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 units.
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	Specifies the frequency range displayed in the graph
Position	Specifies the frequency shown at the center of the graph.
Autoscale	Resets the scale of the horizontal axis to optimize the display of the trace.
Reset Scale	Resets all settings to their default values.



## Prefs Tab - SEM

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.

Parameters Processing Ref Channel Offsets & Limits Table Scale Prefs

Max Trace points: 801 (per range)

☒ Show graticule

☒ Show Marker readout in graph (selected marker)

Show limits: Line only

Setting	Description
Show graticule	Controls the vertical position and scale of the trace display.
Max Trace points (per range)	When the spectrum analysis produces more than the selected maximum number of points, the method specified in Detection control is used to decimate the result. This setting applies to both the Reference channel and offsets.
Show Marker readout in graph	Adjusts the reference level away from top of the graph.
Show limits	Controls the appearance of mask limits in the graph.
Shaded	Shows limits using a shaded area. Green shading is used to identify Absolute limits. Blue shading is used to indicate Relative limits.
Line only	Shows limits using only a line. A green line is used to identify Absolute limits. A blue line is used to indicate Relative limits.
None	No lines or shading are used to indicate limits in the graph. Violations of the mask are still identified by red shading.

## RF Measurements Shared Measurement Settings

The control panel tabs in this section are shared by multiple 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 191)</a>	Allows you to specify the Center Frequency, Step size and RBW.
<a href="#">Traces (see page 192)</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 195)</a>	Specify vertical and horizontal scale settings.
<a href="#">Prefs (see page 130)</a>	Specify appearance features of the graph area.

## Freq & RBW Tab

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

The screenshot shows the 'Freq & RBW' tab selected in a software interface. The tab bar includes 'Freq & RBW', 'Measurement Params', 'Channels', 'Scale', and 'Prefs'. The main area contains four input fields: 'Meas Freq' set to '1.00000 GHz', 'RBW' set to '30.000 kHz', 'Step' set to '2.0000 MHz', and a 'VBW' field. There are checkboxes for 'Auto' (checked) and 'VBW' (unchecked).

Setting	Description
Meas Freq	Specifies the 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.

**NOTE.** While the measurement 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.



## Traces Tab

The Traces tab enables you to select traces for display. You can choose to display live traces and/or recalled traces. The [Trace tab \(see page 174\)](#) for Settling Time displays is described in the Settling Time controls section.

---

**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 recalled 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.
Function	Selects the trace processing method (Spurious display only). Possible settings are: Normal, Average (VRMS), Avg (of logs), and Max Hold.

### Trace Processing

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

- **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.
- **Normal** - Displays the trace record for each display point without additional processing.
- **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.
- **Avg (of logs)** – This is a trace function used to emulate legacy spectrum analyzer results and for the specification of displayed average noise level. In older swept analyzers, a voltage envelope detector is



used in the process of measuring signal level, and the result is then converted to Watts and then to dBm. Averaging is then applied to the resultant traces.

For CW signals, this method results in an accurate power measurement. However, with random noise and digitally modulated carriers, errors result from this 'average of logs' method. For random noise, the average of logs methods results in power levels -2.51 dB lower than that measured with a power meter, or with a spectrum analyzer that measures the rms value of a signal, and performs averaging on the calculated power in Watts and not dBm or other log-power units.

This detector should be used when following a measurement procedure that specifies it, or when checking the Displayed Averaged Noise Level (DANL) of the instrument. The 'average of logs' detection and trace function is used for DANL specification to provide similar results to other spectrum/signal analyzers for comparison purposes. Use of the Average of Logs method of measurement is not recommended for digitally modulated carriers, as power measurement errors will occur.

---

**NOTE.** *The Detection setting does not affect the trace until the spectrum length is longer than the Auto setting.*

---

## Saving Traces

To save a trace for later analysis:

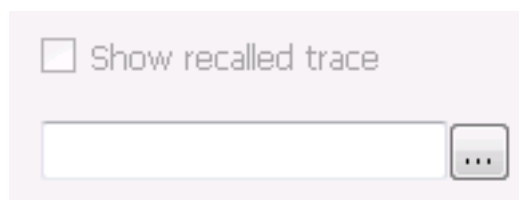
1. Select the **Save Trace As** button. This displays the Save As dialog box.
2. Navigate to the desired folder or use the default.
3. Type a name for the saved trace and click **Save**.

## 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.

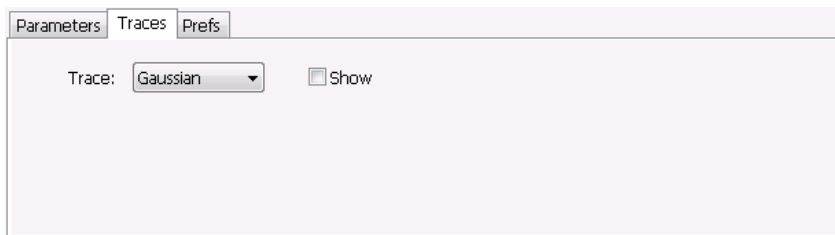




1. Navigate to the desired file and click **Open**.
2. Check the **Show Recalled Trace** check box.
3. Verify that the trace's **Show** check box is selected (either on this tab or next to the drop-down list located at the top-left corner of the graph).

### 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.

The screenshot shows the 'Scale' tab in the software interface. It contains two main sections: 'Vertical' and 'Horizontal'. The 'Vertical' section has a 'Scale' input set to '100.00 dB' and a 'Position' input set to '0.00 dBm', with an 'Autoscale' button below. The 'Horizontal' section has a 'Scale' input set to '39.00 MHz' and a 'Position' input set to '1.50000 GHz', with an 'Autoscale' button below. A 'Reset Scale' button is located between the two sections. The top of the window has tabs for 'Freq & RBW', 'Measurement Params', 'Channels', 'Scale', and 'Prefs', with 'Scale' being the active tab.

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.

The screenshot shows the 'Prefs' tab selected in a software interface. The tab bar at the top includes 'Freq & Span', 'BW', 'Traces', 'Scale', and 'Prefs'. The main area contains several settings:

- Show:** A dropdown menu set to 'Start, Stop'.
- Trace points:** A dropdown menu set to '801'.
- ☒ **Show graticule**
- ☒ **Show trace legend**
- ☒ **Show Marker readout in graph (selected marker)**
- ☐ **Marker Noise mode (Requires dBm Ampl units and Average trace detect)**

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	In general, time-domain traces can include up to 100K points and frequency-domain traces can include up to 10K points. When the analysis produces a results array longer than the selected trace length, 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.
Settling Time decimal places (Frequency and Phase Settling Time displays only)	Specifies the number of decimal places shown in the results readout below the graph. This setting does not affect the precision of internal calculations.
Show trace legend (CCDF (Complementary Cumulative Distribution Function) display only)	Displays or hides the trace legend.



## WLAN Overview

The WLAN Analysis option allows you to evaluate WLAN signals, performing standards based transmitter measurements in the time, frequency, and modulation domains. WLAN measurements can be made on signals defined by 802.11a/b/g/j/n/p (standard IEEE 802.11-2012) and 802.11ac (draft IEEE P802.11ac-D4.0 or later). User controls allow you to modify signal parameters for analysis of signals. The analysis results give multiple views of WLAN signal characteristics to allow the diagnosis of signal imperfections and impairments quickly and easily. Display controls allow you to selectively display the analysis results to help locate trouble-spots in the signal.

### WLAN Standards

The following options support the given standards:

- **Option SV23:** Supports IEEE 802.11a, g, j, and p OFDM signals and 802.11b DSSS/CCK signals
- **Option SV24:** Supports IEEE 802.11n signals with bandwidths of 20 MHz and 40 MHz
- **Option SV25:** Supports IEEE 802.11ac signals with bandwidths of 20, 40, 80, and 160 MHz

### WLAN Standards Presets

The **Standards Presets** button located on the WLAN Settings Control Panel allows you to recall preconfigured displays for the standards and bandwidths that you select. You can also access these presets from **Presets** on the display menu bar. You can read more information about the [Standards Presets \(see page 21\)](#).

The following table shows the center frequency and displays that are automatically loaded for each of the listed standards and bandwidths. SEM masks are also loaded and are explained [here \(see page 279\)](#).



**Table 1: WLAN presets standards, bandwidths, center frequencies, and displays**

Standard	Bandwidth (MHz)	Center frequency (GHz)	Displays loaded
802.11a	20	5.18	SEM, Time Overview, WLAN Constellation, WLAN Summary
802.11g	20	2.412	
802.11j	10	5.18	
	20		
802.11p	5	5.8	
	10		
	20		
802.11n	20	2.412	
	40		
802.11ac	20	5.18	
	40	5.19	
	80	5.21	
	160	5.25	
802.11b		2.412	

**SEM mask parameters.** The SEM wireless standard masks that are applied to the WLAN signal depend on the standard you select when you configure the preset. Once you select a standard and bandwidth, the application will automatically load the mask that best fits the signal for which the standard applies. All mask parameters are derived from IEEE standards and loaded for you. This provides you the assurance that you are evaluating the signal with the most appropriate mask.

## WLAN Displays

The displays in WLAN Analysis (Setup > Displays > Measurements) are:

- [SEM \(see page 178\)](#)
- [WLAN Channel Response \(see page 199\)](#)
- [WLAN Constellation \(see page 202\)](#)
- [WLAN EVM \(see page 204\)](#)
- [WLAN Magnitude Error \(see page 206\)](#)
- [WLAN Phase Error \(see page 208\)](#)
- [WLAN Power versus Time \(see page 210\)](#)
- [WLAN Spectral Flatness \(see page 213\)](#)



- [WLAN Summary \(see page 215\)](#)
- [WLAN Symbol Table \(see page 220\)](#)

## WLAN Channel Response Display

The WLAN Channel Response display plots the channel response (magnitude and phase) versus the subcarrier or frequency. Here, the channel refers to all sources of signal frequency response impairment up to the analyzer input, including the transmitter itself, as well as any transmission medium through which the signal travels between the transmitter and the analyzer.

---

**NOTE.** *WLAN Channel Response is only available for OFDM (non-802.11b) signals.*

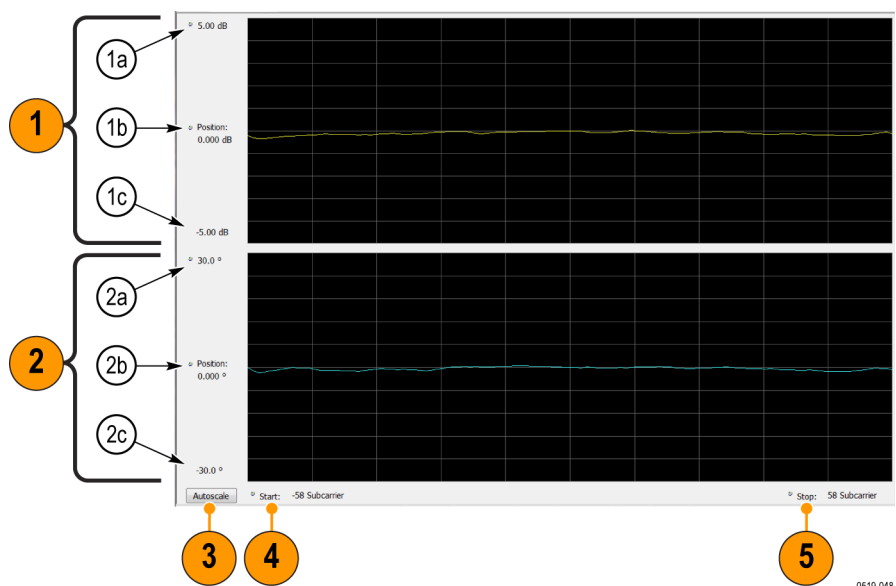
---

To show the WLAN Channel Response display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Chan Response** icon or select the icon and click **Add**. The WLAN Chan Response icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Chan Response display.
6. Set the Frequency appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the Modulation Params tab. Set the Standard, Guard Interval, Subcarrier Spacing, and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



0519-048



Item	Display element	Description
<b>1</b>	<b>Magnitude graph (top graph)</b>	
1a	Top of graph	Sets the level that appears at the top of the magnitude graph. 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.
1b	Position (dB)	Sets the vertical position value. The maximum value is 20.00 dB. The readout indicates the subcarrier (for non-b standards only) or frequency shown at the bottom of the display.
1c	Bottom of graph readout	Indicates the magnitude at the bottom of the top graph. This value changes with the dB and vertical Position settings.
<b>2</b>	<b>Phase graph (bottom graph)</b>	
2a	Top of graph	Sets the phase value indicated at the top of the graph. Since the Position value at the vertical center of this graph remains constant as the Top of Graph value is adjusted, the Vertical Scale increases as the Top of Graph value increases, which also affects the bottom of graph readout.
2b	Position (°)	Specifies the phase shown at the center of the graph display. Changing this value moves the trace up and down in the graph, which affects the Top of Graph and Bottom of Graph values as well.
2c	Bottom of bottom graph readout	Indicates the phase at the bottom of the bottom graph. This value changes with the Position setting.
3	Autoscale	Adjusts the Vertical and Horizontal scaling to optimize the trace display on screen.
4	Start (Position)	Shifts the trace left or right in the graph. The readout indicates the subcarrier (for non-b standards only) or frequency shown at the left edge of the display.
5	Stop (Scale)	Specifies the number of subcarriers (for non-b standards only) shown in the graph.

## WLAN Channel Response Settings

The WLAN Channel Response Settings control panel provides access to settings that control parameters of the Channel Response Display.

Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range Tab (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the time units (Symbols or Seconds) for WLAN Analysis displays.



Settings tab	Description
<a href="#">Traces Tab (see page 228)</a>	Enables you to select from magnitude or phase trace, save a trace, and recall an trace
<a href="#">Scale Tab (see page 229)</a>	Specifies the Zoom scale, and vertical and horizontal positions of the display.
<a href="#">Prefs Tab (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Constellation Display

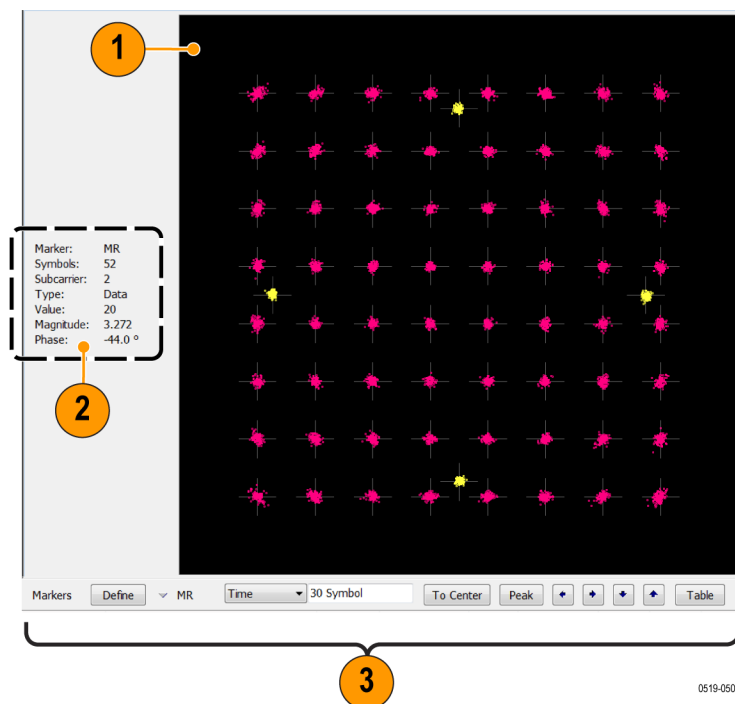
The WLAN Constellation Display shows the WLAN signal modulation amplitude and phase in I (horizontal) versus Q (vertical) form. For multicarrier WLAN OFDM signals, the points show all data symbol subcarriers' modulation. For single-carrier 802.11b, each point corresponds to a single modulated chip.

To show the WLAN Constellation display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Constellation** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Constellation** icon or select the icon and click **Add**. The WLAN Constellation icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Constellation display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval, Channel Bandwidth, and Subcarrier Spacing controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Plot	Constellation graph.
2	Marker readout	If markers are enabled, the marker readout shows the selected Marker, Symbol, Subcarrier, Type, Value, Magnitude, and Phase for the symbol at the marker location. Located to the left of the constellation plot or below it, depending on the size of the window.
3	Marker controls	Define and position markers.

## WLAN Constellation Settings

### Application Toolbar:

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



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace Tab (see page 228)</a>	Enables you to freeze the display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 229)</a>	Specifies the Zoom scale, and vertical and horizontal positions of the display.
<a href="#">Prefs Tab (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN EVM Display

The WLAN EVM display shows the data symbols' individual subcarrier Error Vector Magnitude values versus symbol interval (time) and subcarrier (frequency).

---

**NOTE.** For 802.11b analysis, the subcarrier graph is not displayed.

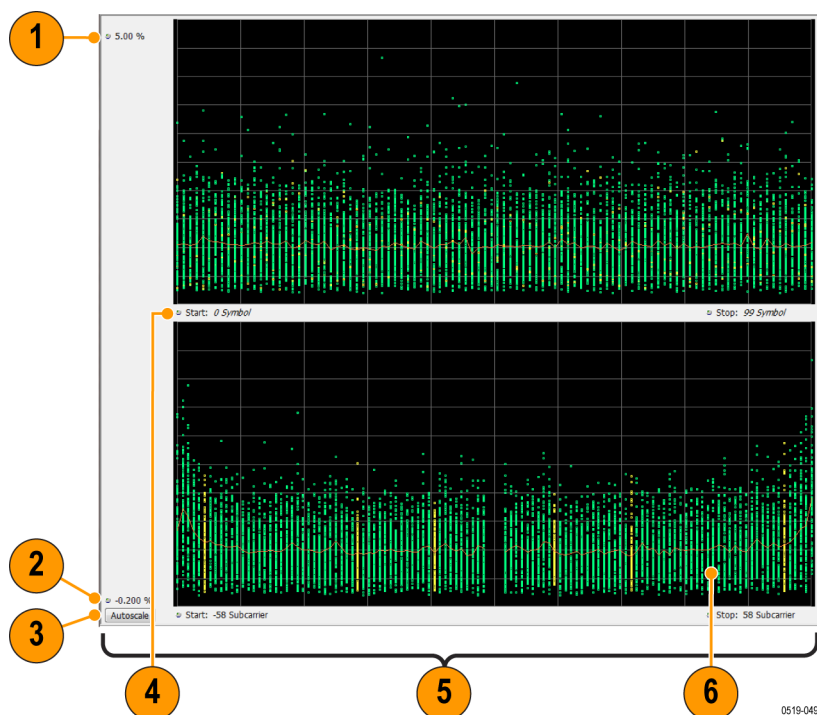
---

To show the WLAN EVM display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN EVM** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN EVM** icon or select the icon and click **Add**. The WLAN EVM icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN EVM display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard as appropriate. Set the Standard, Guard Interval, Channel Bandwidth, and Subcarrier Spacing controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the EVM value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the EVM value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Start (Position)	Specifies the horizontal position of the trace on the graph display.
5	Stop (Scale)	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## WLAN EVM Settings

### Application Toolbar:

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



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace (see page 228)</a>	Enables you to freeze the display or hide the measurement or average trace.
<a href="#">Scale (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only) and symbols scale and position settings.
<a href="#">Prefs (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Magnitude Error Display

The WLAN Magnitude Error display shows the data symbols' individual subcarrier Magnitude Error values versus symbol interval (time) and subcarrier (frequency).

---

**NOTE.** For 802.11b analysis, the subcarrier graph is not displayed.

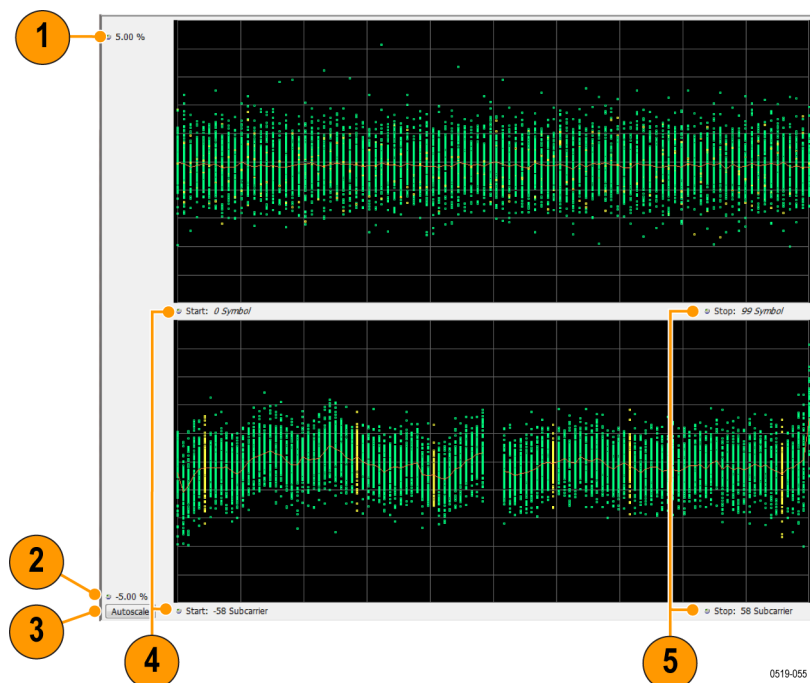
---

To show the WLAN Magnitude Error display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Mag Error** icon or select the icon and click **Add**. The WLAN Mag Error icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Mag Error display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the Magnitude Error value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the Magnitude Error value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## WLAN Magnitude Error Settings

### Application Toolbar:

The settings for the WLAN Mag Error display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace (see page 228)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only), and symbols scale and position settings.
<a href="#">Prefs Tab (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Phase Error Display

The WLAN Phase Error display shows the data symbols' individual subcarrier Phase Error values versus symbol interval (time) and subcarrier (frequency).

---

**NOTE.** For 802.11b analysis, the subcarrier graph is not displayed.

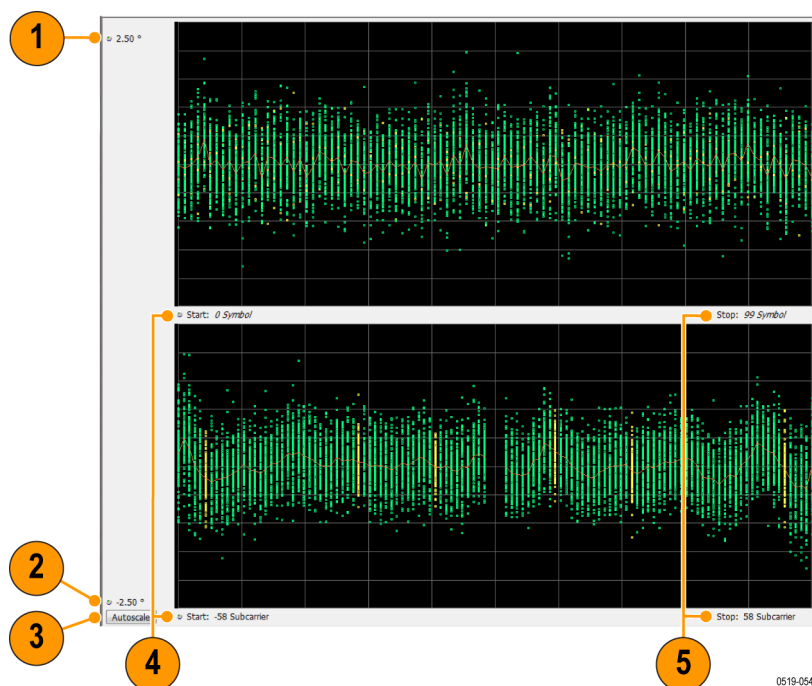
---

To show the WLAN Phase Error display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Phase Error** icon or select the icon and click **Add**. The WLAN Phase Error icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Phase Error display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the Phase Error value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the Phase Error value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## WLAN Phase Error Settings

### Application Toolbar:

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



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace (see page 228)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only), and symbols scale and position settings.
<a href="#">Prefs Tab (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Power vs Time Display

The WLAN Power vs Time display shows the signal power amplitude versus time. For 802.11b signals, the packet Power-On and Power-Down ramp times are also measured.

To show the WLAN Power vs Time display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Power vs Time** icon or select the icon and click **Add**. The WLAN Power vs Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Power vs Time display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display





Item	Display element	Description
1	Top of graph, first setting	Sets the Power level that appears at the top of the graph, in dBm. This is only a visual control for panning the graph.
2	Top of graph, second setting	Sets the vertical Scale of the graphs, in dB/div. This is only a visual control for panning the graph.
3	View	<p>Selects the specific view of the packet burst within the display:</p> <ul style="list-style-type: none"> <li>- Full Burst displays the entire packet, with vertical lines indicating length of the packet</li> <li>- Rising Edge zooms the display into the interval around the packet rising edge, with vertical lines indicating the 10% to 90% Power-On Ramp time</li> <li>- Falling Edge zooms the display into the interval around the packet falling edge, with vertical lines indicating the 90% to 10% Power-Down Ramp time</li> </ul>
4	Bottom of graph readout	Shows the Power level at the bottom of the graph in dBm.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Bottom of graph, left side	Sets the starting time of the graph in seconds
7	Bottom of graph, right side	Sets the scale (width) of the graph in seconds
8	Table below graph	<ul style="list-style-type: none"> <li>- Burst Power: Average power of the burst packet, in dBm</li> <li>- Burst Width: Measured time width of the burst packet from Power-On to Power-Down (or end of waveform, if that occurs before Power-Down), in seconds</li> </ul> <p><b>NOTE.</b> Power-On Ramp Time and Power-Down Ramp Time values are only available for 802.11b analysis.</p> <ul style="list-style-type: none"> <li>- Power-On Ramp Time: Time interval for signal level to increase from 10% to 90% of maximum packet power, in seconds</li> <li>- Power-Down Ramp Time: Time interval for signal level to decrease from 90% to 10% of maximum packet power, in seconds. This value is not available if the analysis record does not include the packet power-down portion.</li> </ul>

## WLAN Power vs Time Settings

### Application Toolbar:

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



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Scale (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only), and symbols scale and position settings.
<a href="#">Prefs (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Spectral Flatness Display

The WLAN Spectral Flatness display shows the average power levels of subcarriers across the signal bandwidth and indicates if they remain within the limits defined for a particular standard.

The averaged subcarrier level is shown as a line on the display, while the individual subcarrier levels are shown as points. The Pass or Fail result indicates whether the average line remains between the upper and lower limit mask boundaries.

---

**NOTE.** *WLAN Spectral Flatness is only available for OFDM (non-802.11b) signals.*

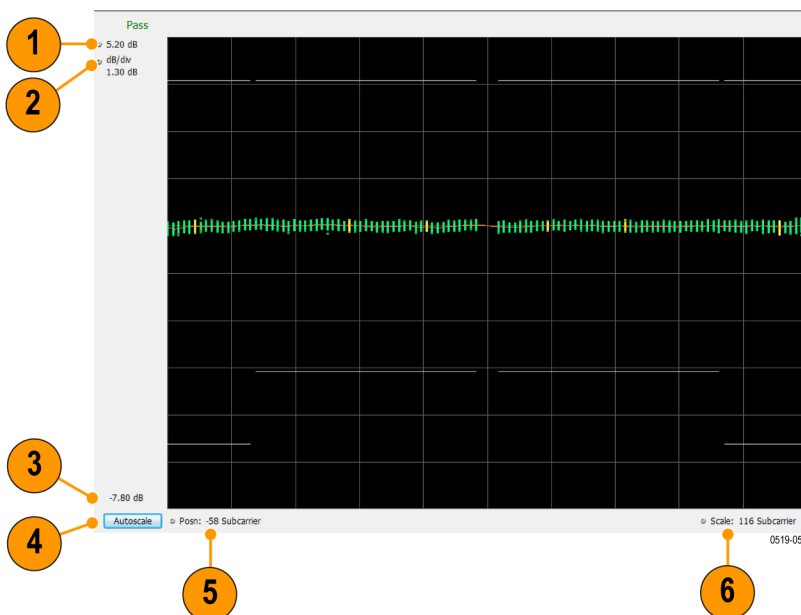
---

To show the WLAN Spectral Flatness display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Flatness** icon or select the icon and click **Add**. The WLAN Flatness icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Flatness display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval, Subcarrier Spacing, and Channel Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph, first setting	Sets the Flatness value that appears at the top of the graph in dB. This is only a visual control for panning the graph.
2	Top of graph, second setting	Sets the lower range of the Flatness value that appears at the top of the graph in dB/div. This is only a visual control for panning the graph.
3	Bottom of graph	Shows the Flatness value set at the bottom of the graph.
4	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
5	Posn	Specifies the horizontal position of the trace on the graph display.
6	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## WLAN Spectral Flatness Settings

### Application Toolbar:

The settings for the WLAN Spectral Flatness display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis.  <b>NOTE.</b> The Units control on this tab only affects the Analysis Length (AFAIK). Use the Units control in the Prefs tab to affect the displays.
<a href="#">Trace (see page 228)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only), and symbols scale and position settings.
<a href="#">Prefs Tab (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Summary Display

The WLAN Summary display shows several measurements of WLAN signal quality. The summary display and its contents will vary by standard selected. Not all of the display contents are provided in this section.

To show the WLAN Summary display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Summary** icon or select the icon and click **Add**. The WLAN Summary icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Summary display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## WLAN Summary Display for 802.11a/g/j/p/n/ac Signals

<b>Standard:</b> 802.11n		<b>Bandwidth:</b> 40 MHz		<b>Guard Interval:</b> Auto from SIG		<input type="button" value="Clear"/>	
<b>Burst Power:</b>	-0.01 dBm	<b>Peak-to-Average:</b>	9.80 dB	<b>L-SIG Data</b>			<b>Parity:</b> Pass
<b>Burst Index:</b>	1	<b>IQ Origin Offset:</b>	-82.25 dB	<b>Rate</b>	13	<b>Reserved</b>	0
<b>Frequency Error:</b>	-140.27 mHz	<b>Common Pilot Error:</b>	0.337 %	<b>Length</b>	312	<b>Parity</b>	1
<b>Symbol Clk Error:</b>	-0.070 ppm			<b>Tail</b>	0		

<b>EVM</b>			
	<b>All</b>	<b>Pilots</b>	<b>Data</b>
<b>RMS</b>	-39.91 dB	-40.40 dB	-39.89 dB
<b>Peak</b>	-27.33 dB	-31.09 dB	-27.33 dB
<b>Pk@Sym/Sub</b>	32 / 58	85 / 53	32 / 58
<b>Avg RMS</b>	-39.91 dB		
1 of 1 Bursts			
<b>Max RMS</b>	-39.91 dB		

<b>Packet Format:</b> HT_MF		<b>Data Modulation:</b> BPSK	
		<b>Guard Interval:</b> 1/4	
<b>Symbols</b>	<b>EVM</b>	<b>Avg Power</b>	
<b>L-STF</b>	2	-44.57 dB	0.00 dBm
<b>L-LTF</b>	2	-40.02 dB	-0.01 dBm
<b>L-SIG</b>	1	-40.43 dB	-0.26 dBm
<b>HT-SIG</b>	2	-40.34 dB	-0.47 dBm
<b>HT-STF</b>	1	-44.08 dB	-0.01 dBm
<b>HT-LTF</b>	1	-42.43 dB	0.00 dBm
<b>Data</b>	100	-39.91 dB	0.01 dBm

<b>HT-SIG Data</b>		<b>CRC:</b> Pass	
<b>MCS</b>	0	<b>CBW</b>	1
<b>Length</b>	672	<b>Smoothing</b>	0
<b>Not Sound</b>	0	<b>Reserved</b>	1
<b>Aggregation</b>	0	<b>STBC</b>	0
<b>FEC Coding</b>	0	<b>Short GI</b>	0
<b>Ness</b>	0	<b>CRC</b>	1
<b>Tail</b>	0		



### Elements of the Display for 802.11a/g/j/p/n/ac Signals

Measurement	Description
Standard	Display of the standard selected on the Setup > Settings > Modulation Params tab.
Bandwidth	Display of the channel bandwidth selected on Setup > Settings > Modulation Parameters tab.
Burst Power	The average power of all symbols in the packet, including Preamble and Data segments.
Peak-to-Average	The ratio of the highest instantaneous signal power level to the average signal power.
Burst Index	The index of the analyzed packet within the analysis record.
IQ Origin Offset	The average magnitude of the DC subcarrier level relative to total signal power. It indicates the level of carrier feedthrough detected at the center (DC) subcarrier.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the measurement frequency setting.
Common Pilot Error	The RMS magnitude error of the pilots over all data symbols.
Symbol Clk Error	The symbol clock error in parts per million.
EVM	<p>The RMS and Peak values of the normalized subcarrier Error Vector Magnitude values. The normalized subcarrier EVM values are calculated as the difference between the detected received signal subcarrier constellation points and ideal reference points estimated by the instrument from the received signal. Values are reported in units of percent or dB. Peak values include the symbol and subcarrier location.</p> <p>RMS and Peak values are displayed for groupings of all subcarriers, Pilots only and Data only. Results are calculated over all Data symbols in the packet.</p> <p>Average RMS and Peak RMS values are accumulated over multiple packet analysis cycles. The Clear button on the display resets these values by clearing the result memory.</p>
Packet Format	Displays the packet format: AG, HT_MF, HT_GF, VHT.
Data Modulation	Displays the modulation used in the Data symbols: BPSK, QPSK, 16QAM, 64QAM, 256QAM.
Guard Interval	Displays the Guard Interval used by the Data symbols: 1/4, 1/8.
Symbols, EVM, Avg Power	Displays the type and number of symbols, EVM-RMS and average power of the Preamble and Data portions of the packet.
SIG Data L-SIG Data HT-SIG Data VHT-SIG Data	Displays the decimal values of the received packet SIGNAL, HT-SIGNAL and VHT-SIGNAL symbols' fields. The Pass/Fail result in each heading line indicates whether the calculated Parity or CRC value matches the received Parity or CRC value of the corresponding SIGNAL symbol grouping.



## WLAN Summary Display for 802.11b Signals

<b>Standard:</b> 802.11b		<b>Packet Format:</b> Auto Detect <input type="button" value="Clear"/>	
<b>Burst Power:</b>	-1.22 dBm	<b>Peak-to-Average:</b>	1.50 dB
<b>Burst Index:</b>	1	<b>IQ Origin Offset:</b>	-39.12 dB
<b>Frequency Error:</b>	-2.34 Hz		

<b>EVM</b>		
	<b>All</b>	<b>1k Chips</b>
<b>RMS</b>	-39.12 dB	-39.02 dB
<b>Peak</b>	-30.29 dB	-30.32 dB
<b>Pk @ Chip</b>	2992	66
<b>Avg RMS</b>	-39.12 dB	
1 of 1 Bursts		
<b>Max RMS</b>	-39.12 dB	

<b>Packet Format:</b> DSSS 2M		<b>Data Modulation:</b> DSSS 2M	
	<b>Chips</b>	<b>EVM</b>	<b>Avg Power</b>
<b>Preamble:</b>	1584	-38.96 dB	-1.72 dBm
<b>Header:</b>	528	-39.06 dB	-1.23 dBm
<b>Data:</b>	4400	-39.19 dB	-1.23 dBm

<b>Header Data</b>		<b>CRC:</b> Pass	
<b>Signal</b>	20	<b>Service</b>	0
<b>Length</b>	400	<b>CRC</b>	17735



### Elements of the Display for 802.11b Signals

Measurement	Description
Standard	Display of the standard selected on the Setup > Settings > Modulation Parameters tab.
Burst Power	The average power of the entire packet.
Peak-to-Average	The ratio of the highest instantaneous packet signal power level to the average signal power.
Burst Index	The index of the analyzed packet within the analysis record.
IQ Origin Offset	The amount of power at the signal carrier frequency relative to the total power of the signal.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the measurement frequency setting.
EVM	<p>The RMS and Peak values of the normalized Error Vector Magnitudes taken at signal chip intervals. The normalized EVM values are calculated as the difference between the detected received signal constellation points and ideal reference points estimated by the instrument from the received signal. Values are reported in units of percent or dB. Peak values indicate the associated chip locations.</p> <p>RMS and Peak values are displayed for groupings of All chips, and the first 1000 (1k) chips.</p> <p>Average RMS and Peak RMS values are accumulated over multiple packet analysis cycles. The Clear button on the display resets these values by clearing the result memory.</p>
Packet Format	Displays the packet format: DSSS 1M, DSSS 2M, CCK 5.5M or CCK 11M.
Data Modulation	Displays the modulation used in the PSDU/Data packet segment.
Chips, EVM, Avg Power	Displays the number of chips, EVM-RMS and average power of the Preamble, Header and Data portions of the packet.
Header Data	Displays the decimal values of the received packet Header's Signal, Service, Length, and CRC fields. The CRC Pass/Fail result indicates if the received CRC value is equal to the CRC value computed from the received Signal, Service and Length values.

## WLAN Summary Settings

### Application Toolbar:

The settings for the WLAN Summary display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">EVM (see page 231)</a>	Specifies the EVM units (dB or %) and Max Bursts to Avg. The EVM is generally measured on symbol or chip instants and is usually measured after best-fit estimates of the frequency error and a fixed phase offset have been removed.
<a href="#">Prefs (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Symbol Table Display

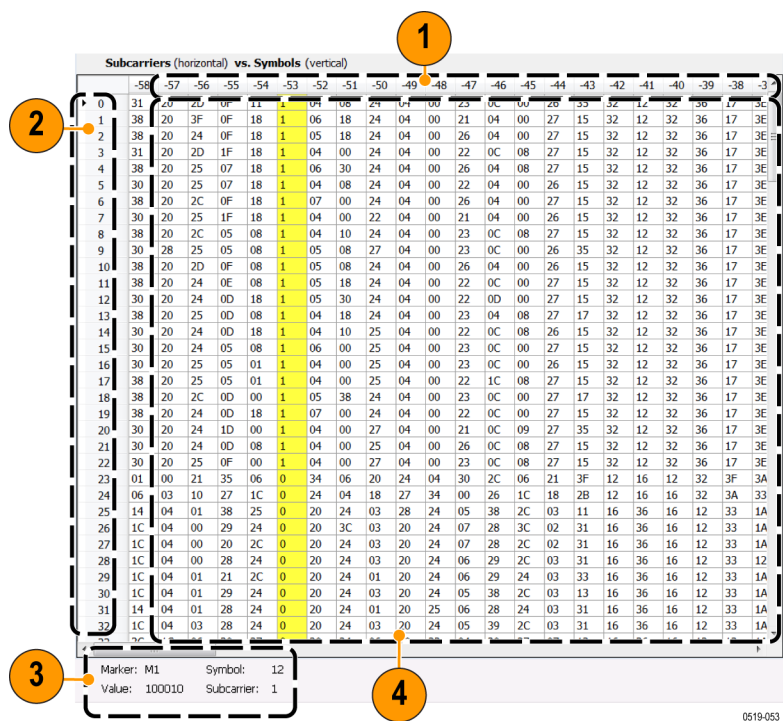
The WLAN Symbol Table display shows decoded data values for each data symbol in the analyzed signal packet. For OFDM signals (all standards except 802.11b), results are presented with subcarrier (frequency) indices in the horizontal dimension and symbol (time) intervals in the vertical dimension. For 802.11b signals, the Preamble, Header, and Data (PSDU) symbol values are presented sequentially, with symbol indices in the left column.

To show the WLAN Symbol Table display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **WLAN Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **WLAN Symb Table** icon or select the icon and click **Add**. The WLAN Symbol icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the WLAN Symbol Table display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## WLAN Symbol Table for OFDM signals



Item	Description
1	Subcarrier identifiers (OFDM only). Yellow column indicates Pilot subcarrier locations.
2	Symbol identifiers.
3	Subcarrier data values.
4	Marker readout when markers are enabled.

## WLAN Symbol Table for 802.11b signals

Symbols	(Preamble, Header, Data)															
130	0	0	0	1	0	1	1	1	0	0	1	1	1			
143	1															
144	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
157	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0
170	0	0	0	0	0	0	1	1	1	0	0	0	0	1		
183	0	1	0	1	0	0	0	1	0							
192	0	2	0	2	1	3	1	1	1	0	1	1	1	1	1	1
205	3	0	0	0	3	0	2	3	3	3	2	0	1			
218	0	1	3	0	0	3	3	1	3	0	0	1	3			
231	0	2	1	1	1	2	1	1	2	2	2	2	2	2	2	2
244	2	2	3	0	1	2	3	2	2	1	3	0	3			
257	0	0	2	3	1	2	2	0	3	3	3	1	1			
270	3	0	1	0	3	3	2	0	0	3	3	1	3			
283	2	3	0	3	2	0	0	3	1	1	2	2	3			
296	0	0	2	1	2	2	3	2	0	2	2	2	1			
309	3	3	3	2	0	1	0	0	1	2	1	3	2			
322	3	1	0	1	2	1	2	0	0	0	2	1	0			
335	1	0	0	0	0	1	1	1	2	0	1	2	1			
348	2	1	2	3	1	1	2	1	3	3	1	1	2			
361	0	3	1	3	3	1	2	3	1	1	3	2	1			
374	1	2	3	2	3	2	2	0	2	2	1	2	0			
387	3	2	2	1	3	3	2	0	0	0	2	3	2			



Item	Description
1	Symbol number index (from beginning of packet or segment) of first Symbol data value on the line.
2	Symbol values, with the value in column 2 of each row corresponding to the symbol number index in column 1, and then the symbol value in column 3 corresponding to the next symbol number index, etc., to the end of each row.  For example: The symbol number index 130 = 0 in column 2. The symbol number index for column 3 is 131, which equals 0. The symbol number index for column 4 is 132, which equals 1. This pattern continues to the end of the row.

## WLAN Symbol Table Settings

### Application Toolbar:

The settings for the WLAN Symbol Table display are shown in the following table.

Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Prefs (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## WLAN Analysis Shared Measurement Settings

### Application Toolbar:

The control panel tabs in this section are shared between the displays in the WLAN Analysis folder (Setup > Displays). Some tabs are shared by all the displays, some tabs are shared by only a subset of displays. The settings available on some tabs change depending on the selected display.

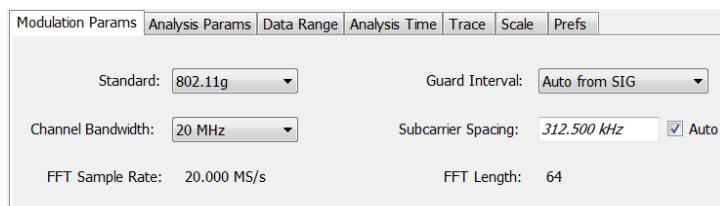


### Common controls for WLAN analysis displays

Settings tab	Description
<a href="#">Modulation Params (see page 223)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Analysis Params (see page 224)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 226)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 227)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace (see page 228)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale (see page 229)</a>	Specifies the vertical, subcarrier (for non-b standards only), and symbols scale and position settings.
<a href="#">EVM (see page 231)</a>	Specifies the EVM units and max burst averages.
<a href="#">Prefs (see page 232)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## Modulation Params Tab - WLAN

The Modulation Params tab specifies the type of modulation used by the input signal and other parameters that define the signal format.



Modulation Params Analysis Params Data Range Analysis Time Trace Scale Prefs

Standard: 802.11g Guard Interval: Auto from SIG

Channel Bandwidth: 20 MHz Subcarrier Spacing: 312.500 kHz ☒ Auto

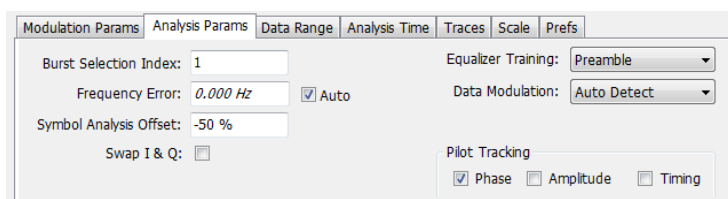
FFT Sample Rate: 20.000 MS/s FFT Length: 64



Settings	Description
Standard	Specifies the standard used for the input signal. Choices are 802.11a/b/g/j/n/p/ac.
Guard Interval	Specifies the guard interval used in the input signal. You can select the following: <ul style="list-style-type: none"> <li>– Auto from SIG uses the Guard Interval value extracted from the signal</li> <li>– 1/8 allows setting the value manually</li> <li>– 1/4 allows setting the value manually</li> </ul>
Channel Bandwidth	Specifies the nominal channel bandwidth. This setting affects the Subcarrier Spacing value when the Subcarrier Spacing Auto box is checked.
Subcarrier Spacing	Specifies the spacing between subcarriers. When Auto is selected, this setting is automatically calculated according to the Channel Bandwidth value. If Auto is unchecked, a custom subcarrier spacing value can be entered for nonstandard signal definition.
FFT Sample Rate	Indicates the FFT sample rate, based on the bandwidth or subcarrier setting.
FFT Length	Indicates the fixed FFT length.

## Analysis Params Tab - WLAN

The Analysis Params tab contains parameters that control the analysis of the input signal.



The screenshot shows the 'Analysis Params' tab in the software interface. It contains several configuration options:

- Burst Selection Index:** A text box containing the value '1'.
- Frequency Error:** A text box containing '0.000 Hz' and a checked 'Auto' checkbox.
- Symbol Analysis Offset:** A text box containing '-50 %'.
- Swap I & Q:** An unchecked checkbox.
- Equalizer Training:** A dropdown menu set to 'Preamble'.
- Data Modulation:** A dropdown menu set to 'Auto Detect'.
- Pilot Tracking:** A section with three checkboxes: 'Phase' (checked), 'Amplitude' (unchecked), and 'Timing' (unchecked).



Settings	Description
Burst Selection Index	Allows specifying the burst you want to measure when multiple bursts are present in an acquisition. Index number of the first burst is 1, second burst is 2, etc.
Frequency Error	When the Auto box is checked, the analysis determines the Frequency Error and the measured Frequency Error is displayed. When the Auto box is unchecked, the entered value is used by the analysis as a fixed frequency offset. This is useful when the exact frequency offset of the signal is known.
Symbol Analysis Offset	Specifies the analysis offset in the symbol interval. This value is a percentage of the Guard Interval. The allowable range is -100% to 0%. -100% positions the FFT to start at the beginning of the Guard Interval, 0% positions it to start at the end of the Guard Interval. Default value is -50% which usually gives the best measurement results.
Swap I & Q	Select the checkbox to swap the I and Q components of a signal. This compensates the input signal for spectral inversion.
Equalizer Training	Specifies the method used to estimate channel frequency response and equalization. This control can be used to diagnose changes in frequency response over the signal packet.
Preamble	The instrument uses only the Preamble to estimate channel frequency response. This response is then used to equalize the entire signal packet.
Preamble + Data	The instrument makes an initial channel frequency response estimate from the Preamble. It then estimates the channel response for each data symbol using the decoded data content to derive equalization for each symbol individually. This allows compensation for time-varying channel response over the packet.
Data Modulation	Allows choice of automatic or manual method of data symbol modulation identification, as follows: <ul style="list-style-type: none"> <li>– Auto Detect estimates the modulation from the data symbol IQ content.</li> <li>– Auto from SIG sets the modulation as indicated by the embedded SIG preamble symbol format data.</li> <li>– Manual allows specifying the modulation type regardless of the signal content.</li> </ul>
Pilot tracking	Specifies if pilot subcarriers should be used to correct amplitude, phase, and symbol timing variations over the packet. The choices available are Phase, Amplitude, and Timing. The default setting is Phase correction enabled, Amplitude and Timing correction disabled..
Subcarrier derotation	Allows some displays to show subcarriers with or without Gamma subcarrier phase rotation removed. Gamma phase rotation is applied to 802.11n and 802.11ac subcarriers in defined subranges depending on the selected Channel Bandwidth >40 MHz. Only Constellation and Symbol Table results are affected by this control. <p>When the box is unchecked, the rotation is not removed, which provides a direct view of the physical modulation on the channel.</p> <p>When the box is checked, the rotation is removed, allowing easier decoding of the underlying data content.</p>



## Data Range Tab - WLAN

The Data Range tab enables you to control how much signal is analyzed, as well as specify the range of results that are displayed for the WLAN Constellation, EVM, Flatness, Magnitude Error, Phase Error, and Symbol Table graphs. The tab contents vary by standard.

Data Range tab for non-b standards.

Settings	Description
Symbols	Specifies which symbols are displayed in the graphs.
All	Select All to display all symbols.
Range	Select Range to specify a subset of symbols for display.
Start	Specifies the first symbol to include in the display.
Stop	Specifies the last symbol to include in the display.
Single	Select Single to display a single symbol.
Index	Use Index to specify the symbol you want to display.
Subcarriers	Specifies which subcarriers are displayed.
All	Select All to display all subcarriers in the signal.
Pilots	Select Pilot to display only pilot subcarriers.
Data	Select Data to display only data subcarriers.
Single	Specifies a specific subcarrier for display.
Index	Specifies the specific subcarrier to be displayed.
Range	Specifies a range of subcarriers to be displayed.
Start	Specifies the start value of the range to be displayed.
Stop	Specifies the ending value of the range to be displayed.
Max symbols to analyze	Specifies how many symbols are analyzed. You can use this setting to speed analysis by limiting the number of symbols being analyzed.

Data Range tab for 802.11b standards.



Settings	Description
Chips	Specifies which symbols are displayed in the graphs.
All	Select All to display all chips.
Preamble Only	Select to include only the Preamble in the display.
Header Only	Select to include only the Header in the display.
Data Only	Select to include only the Data in the display.
Max number of chips to analyze	Specifies how many chips are analyzed. You can use this setting to speed analysis by limiting the number of chips being analyzed. Check this box and then enter the maximum number of chips to analyze.

## Analysis Time Tab - WLAN

The Analysis Time tab contains parameters that define how the signal is analyzed in the WLAN Analysis displays.

Modulation Params | Analysis Params | Data Range | **Analysis Time** | EVM | Prefs

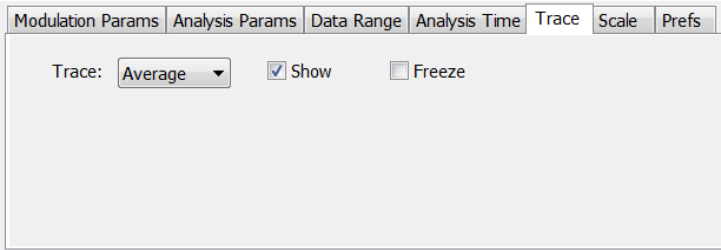
Analysis Length:  ☒ Auto Units:

Settings	Description
Analysis Length	Specifies the length of the analysis period to use in measurements. Length is specified in either symbols or seconds, depending on the Units setting. Use this to specify how long a period of time is analyzed. – Range: minimum value depends on modulation type – Resolution: 1 symbol
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
Units	Specifies the units of the Analysis Length in either Symbols or Seconds.



# Trace Tab - WLAN

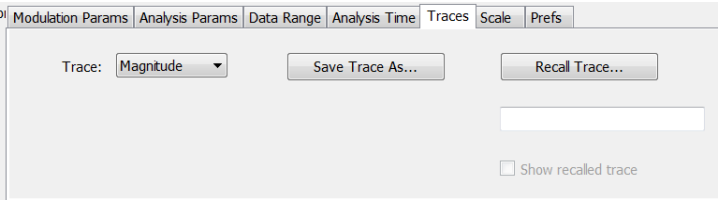
The Trace tab allows you to set the trace display characteristics of the selected display. This tab is not available for all WLAN displays.



Settings	Description
Trace	Use this drop-down list to select whether or not the Average trace or the measurement trace is displayed. The measurement trace depends on the selected display.
Show Symbols	Select or deselect this checkbox to show or hide symbols.
Freeze	Selecting Freeze halts updates to the symbols.

# Traces Tab - WLAN Channel Response

The Traces tab allows you to set the trace display characteristics of the WLAN Channel Reponse display.



Settings	Description
Trace	Selects the Magnitude or Phase trace for saving or recalling.
Save Trace As . . .	Select to save a trace.
Recall Trace . . .	Select to recall a trace.



## Scale Tab - WLAN

The Scale tab allows you to change the scale settings that control how the trace appears on the display but does not change control settings such as Measurement Frequency. There are four versions of the Scale tab for WLAN displays. One version is used for the Constellation display, one for the Spectral Flatness display, one for the Power vs Time display, and one for the EVM, Magnitude Error, Phase Error, and Channel Response displays.

The image shows the 'Scale' tab for the WLAN Power vs Time display. The tab bar at the top includes 'Modulation Params', 'Analysis Params', 'Data Range', 'Analysis Time', 'Scale', and 'Prefs'. The 'Scale' tab is active. It contains two main sections: 'Vertical' and 'Horizontal Full Burst'. The 'Vertical' section has a 'Scale' field set to '100.00 dB' and a 'Position' field set to '-11.00 dBm'. Below these are 'Reset' and 'Autoscale' buttons. The 'Horizontal Full Burst' section has a 'Scale' field set to '100.000 us' and a 'Position' field set to '0.000 s'. Below these are 'Autoscale' and 'Reset' buttons.

Scale tab for the WLAN Power vs Time display

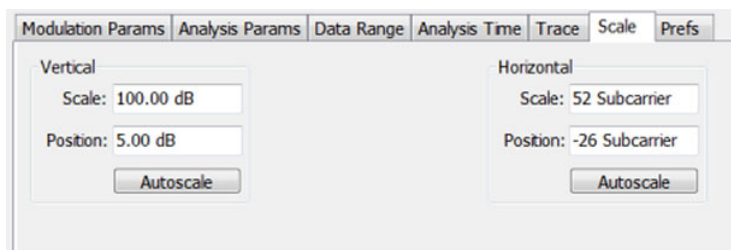
The image shows the 'Scale' tab for the WLAN EVM, Magnitude Error, Phase Error, and Channel Response displays. The tab bar at the top includes 'Modulation Params', 'Analysis Params', 'Data Range', 'Analysis Time', 'Trace', 'Scale', and 'Prefs'. The 'Scale' tab is active. It contains three main sections: 'Vertical', 'Horizontal Symbol', and 'Horizontal Subcarrier'. The 'Vertical' section has a 'Scale' field set to '7.80 °' and a 'Position' field set to '-3.90 °'. Below these are 'Reset' and 'Autoscale' buttons. The 'Horizontal Symbol' section has a 'Start' field set to '0 Symbol' and a 'Stop' field set to '99 Symbol'. Below these are 'Reset' and 'Autoscale' buttons. The 'Horizontal Subcarrier' section has a 'Start' field set to '-58 Subcarrier' and a 'Stop' field set to '58 Subcarrier'. Below these are 'Reset' and 'Autoscale' buttons. There is also an 'Auto' checkbox which is checked.

Scale tab for WLAN EVM, Magnitude Error, Phase Error, and Channel Response displays

The image shows the 'Scale' tab for the WLAN Constellation display. The tab bar at the top includes 'Modulation Params', 'Analysis Params', 'Data Range', 'Analysis Time', 'Trace', 'Scale', and 'Prefs'. The 'Scale' tab is active. It contains a 'Zoom' section with a 'Scale' field set to '3'. Below this are 'Vertical Position' and 'Horizontal Position' fields, both set to '0'. There are 'Reset' and 'Autoscale' buttons for each of these fields.

Scale tab for WLAN Constellation display





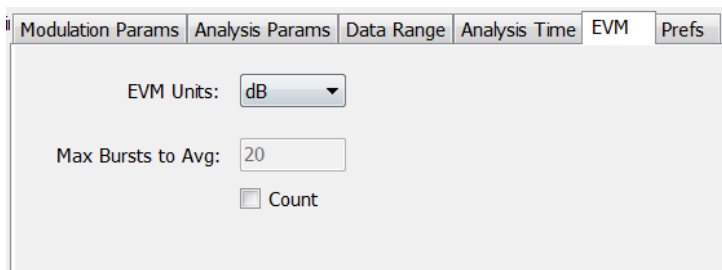
Scale tab for WLAN Spectral Flatness display

Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale of the graph.
Position	Adjusts the reference level away from top of the graph.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Subcarrier	Controls the scale of the subcarrier graph and position of the trace.
Scale	Specifies how many subcarriers are displayed horizontally.
Position	Specifies the subcarrier that appears at the left edge of the subcarrier graph.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Symbols	Controls the scale of the Symbols graph.
Scale	Specifies the number of symbols that appear in the symbols graph.
Position	Specifies the symbol that appears at the left edge of the Symbols graph.
Autoscale	Resets the scale and position settings to optimize the display.
Auto	When Auto is checked, the scale and position values for the Symbols graph are automatically adjusted to maintain the optimal display.
Zoom	Sets the Constellation display size and position.
Scale	Sets the magnification value for the Constellation display.
Vertical Position	Sets the vertical location of the Constellation display within the graph. Range is -3.7 to +3.7.
Horizontal Position	Sets the horizontal location of the Constellation display within the graph. Range is -3.7 to +3.7.



## EVM Tab - WLAN

The EVM Tab enables you to choose between dB and percent for the EVM units and to select to set the maximum bursts to average. The EVM Tab is only available for the WLAN Summary display.



The screenshot shows the EVM Tab interface with the following settings:

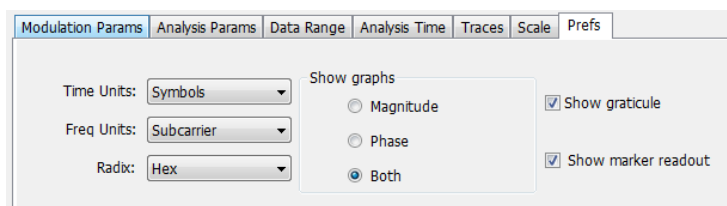
- EVM Units:** A dropdown menu currently set to 'dB'.
- Max Bursts to Avg:** A text input field containing the value '20'.
- Count:** An unchecked checkbox.

Settings	Description
EVM units	Specifies whether the displayed EVM units are dB or percent.
Max Bursts to Avg	Specifies the maximum number of bursts to average when Count is selected.
Count	Enables the Max Bursts to Avg function.



## Prefs Tab - WLAN

The Prefs tab enables you to change appearance characteristics of the WLAN Analysis displays. Not all settings on the Prefs tab shown below appear for every WLAN display.



Settings	Description
Time units	Specifies whether the displayed time units are seconds or symbols.
Freq units	Specifies whether the displayed frequency units are frequency (Hz) or subcarrier channel.
Radix	Specifies whether symbol values are displayed in binary or hex format (for example, in the Symbol Table or markers readouts).
Show graphs	Specifies which graphs are displayed. Select from Symbols, Subcarriers or Both, Magnitude, Phase, or Both. Disabled (no masks), Shaded Region, or Line Only. These selections are only available for OFDM signals.
Show graticule	Specifies to show the graticule on the display when checked.
Show marker readout	Specifies to show the marker readout when checked.



## Overview

The OFDM Analysis option provides measurements for OFDM signals specified by 802.11a/g/j (Wifi) and 802.16 (2004) (commonly known as Fixed WiMAX) standards. User controls allow you to modify signal parameters for analysis of non-standard signals. The analysis results give multiple views of OFDM signal characteristics to allow diagnosing signal imperfections and impairments quickly and easily. Display controls provide the ability to selectively display the analysis results to help locate trouble-spots in the signal.

The displays in OFDM Measurements (Displays > Measurements > OFDM Measurements) are:

- [OFDM Channel Response \(see page 233\)](#)
- [OFDM Constellation \(see page 236\)](#)
- [OFDM EVM \(see page 237\)](#)
- [OFDM Spectral Flatness \(see page 239\)](#)
- [OFDM Mag Error \(see page 241\)](#)
- [OFDM Phase Error \(see page 243\)](#)
- [OFDM Power \(see page 245\)](#)
- [OFDM Summary \(see page 247\)](#)
- [OFDM Symbol Table \(see page 249\)](#)

## OFDM Channel Response Display

The OFDM Channel Response display plots the channel response (magnitude or phase) versus the subcarrier or frequency. Here, the channel refers to all sources of signal frequency response impairment up to the analyzer input, including the transmitter itself, as well as any transmission medium through which the signal travels between the transmitter and the analyzer.

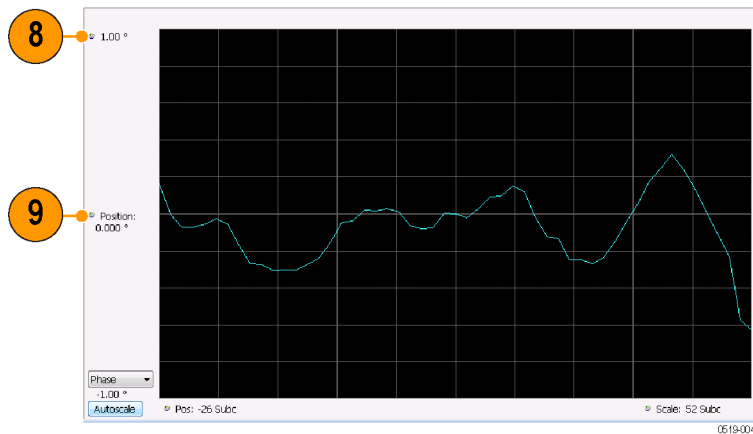
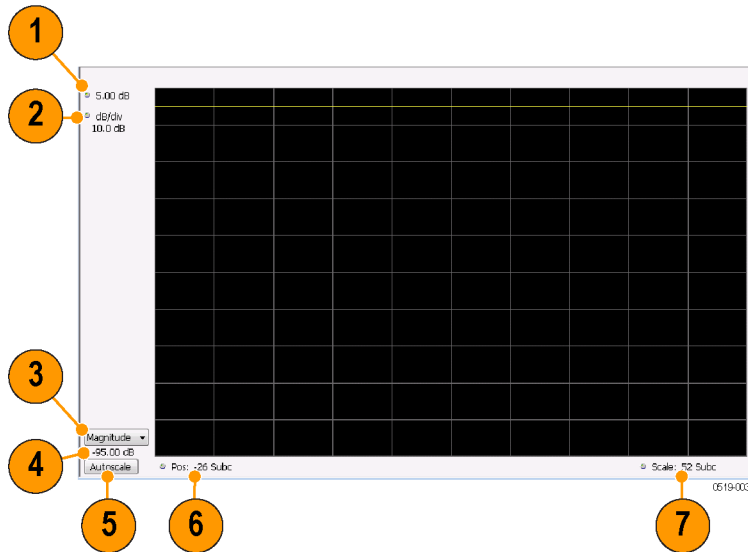
To show the OFDM Channel Response display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Chan Response** icon or select the icon and click **Add**. The OFDM Chan Response icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Chan Response display.
6. Set the Frequency appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.



8. Select the Modulation Params tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display





Item	Display element	Description
1	Top-of-graph (magnitude)	Sets the level that appears at the top of the magnitude graph. 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.
2	dB/div (magnitude)	Sets the vertical scale value. The maximum value is 20.00 dB/division.
3	Display selector	Selects the display type. Channel Response Magnitude or Phase can be displayed as a Magnitude or Phase graph.
4	Bottom-of-graph readout (magnitude)	Indicates the amplitude at the bottom of the graph. This value changes with the dB/div and Vertical Position settings.
5	Autoscale	Adjusts the Vertical and Horizontal scaling to display the optimize the trace display on screen.
6	Pos	Shifts the trace left or right in the graph. The readout indicates the subcarrier or frequency shown at the left edge of the display.
7	Scale	Specifies the number of subcarriers shown in the graph.
8	Top-of-graph (phase)	Sets the phase value indicated at the top of the graph. Since the Position value at the vertical center of this graph remains constant as the Top of Graph value is adjusted, the Vertical Scale increases as the Top of Graph value increases, which also affects the bottom of graph readout.
9	Position (phase)	Specifies the phase shown at the center of the graph display. Changing this value moves the trace up and down in the graph, which affects the Top of Graph and Bottom of Graph values as well.
10	Bottom-of-graph (phase)	Indicates the phase at the bottom of the graph. This value changes with the Position setting.

## OFDM Channel Response Settings

The OFDM Channel Response Settings control panel provides access to settings that control parameters of the Channel Response Display.

Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range Tab (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the time units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Prefs Tab (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.



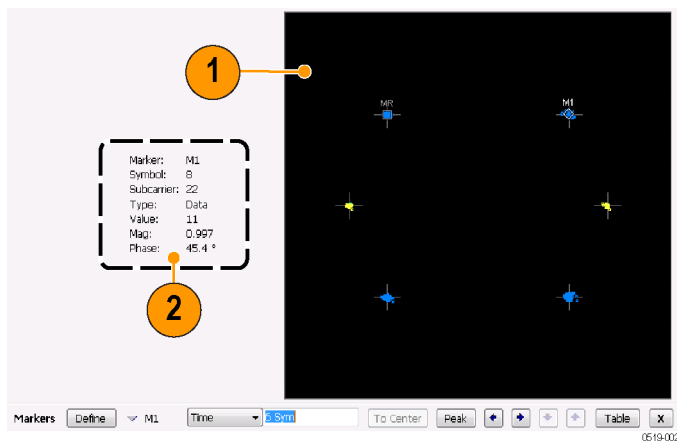
## OFDM Constellation Display

Display shows the OFDM signal subcarriers' amplitude and phase in IQ constellation form.

To show the OFDM Constellation display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Constellation** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Constellation** icon or select the icon and click **Add**. The OFDM Constellation icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Constellation display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display





Item	Display element	Description
1	Plot	Constellation graph.
2	Marker Readout	If markers are enabled, the marker readout shows the selected Marker, Symbol, Subcarrier, Type, Value, Magnitude, and Phase for the symbol at the marker location. Located to the left of the constellation plot or below it, depending on the size of the window.

## OFDM Constellation Settings

### Application Toolbar:

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

Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to freeze the display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 255)</a>	Specifies the Zoom scale, and vertical and horizontal positions of the display.
<a href="#">Prefs Tab (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM EVM Display

The OFDM EVM display shows the data symbols' individual subcarrier Error Vector Magnitude values versus symbol interval (time) and subcarrier (frequency).

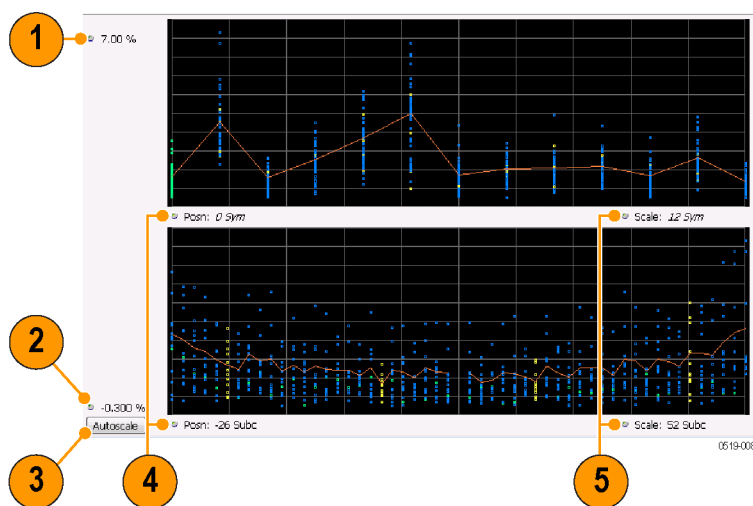
To show the OFDM EVM display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM EVM** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM EVM** icon or select the icon and click **Add**. The OFDM EVM icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM EVM display.



6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard as appropriate. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the EVM value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the EVM value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## OFDM EVM Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to freeze the display or hide the measurement or average trace.
<a href="#">Scale (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Spectral Flatness Display

The OFDM Spectral Flatness display shows the average power levels of subcarriers across the signal bandwidth and indicates if they remain within the limits defined for a particular standard.

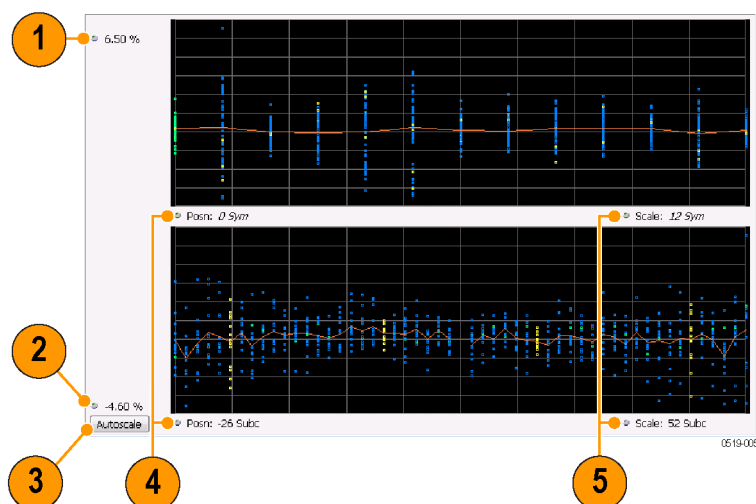
The averaged subcarrier level is shown as a line on the display, while the individual subcarrier levels are shown as points. The Pass or Fail result indicates whether the average line remains between the upper and lower limit mask boundaries.

To show the OFDM Spectral Flatness display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Flatness** icon or select the icon and click **Add**. The OFDM Flatness icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Flatness display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval, Subcarrier Spacing and Channel Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the Flatness value that appears at the bottom of the graph in dB. This is only a visual control for panning the graph.
2	Bottom of graph	Shows the Flatness value set at the top of the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## OFDM Spectral Flatness Settings

### Application Toolbar:

The settings for the OFDM Spectral Flatness display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for WLAN Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs Tab (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Magnitude Error Display

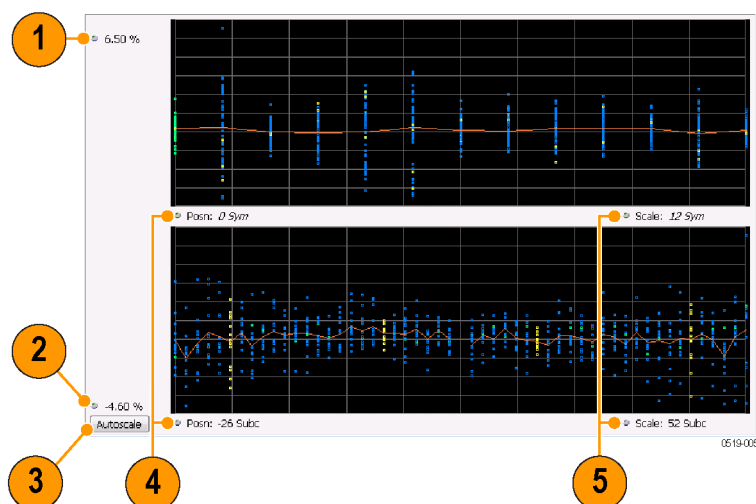
The OFDM Mag Error display shows the data symbols' individual subcarrier Magnitude Error values versus symbol interval (time) and subcarrier (frequency).

To show the OFDM Magnitude Error display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Mag Error** icon or select the icon and click **Add**. The OFDM Mag Error icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Mag Error display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the Magnitude Error value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the Magnitude Error value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## OFDM Magnitude Error Settings

### Application Toolbar:

The settings for the OFDM Mag Error display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs Tab (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Phase Error Display

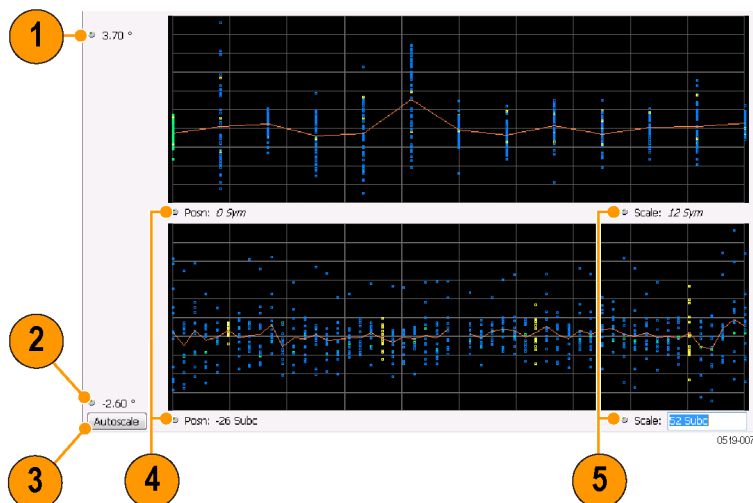
The OFDM Phase Error display shows the data symbols' individual subcarrier Phase Error values versus symbol interval (time) and subcarrier (frequency).

To show the OFDM Phase Error display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Phase Error** icon or select the icon and click **Add**. The OFDM Phase Error icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Phase Error display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph	Sets the Phase Error value that appears at the top of the graph. This is only a visual control for panning the graph.
2	Bottom of graph	Sets the Phase Error value that appears at the bottom of the graph. This is only a visual control for panning the graph.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## OFDM Phase Error Settings

### Application Toolbar:

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



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time Tab (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale Tab (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs Tab (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Power Display

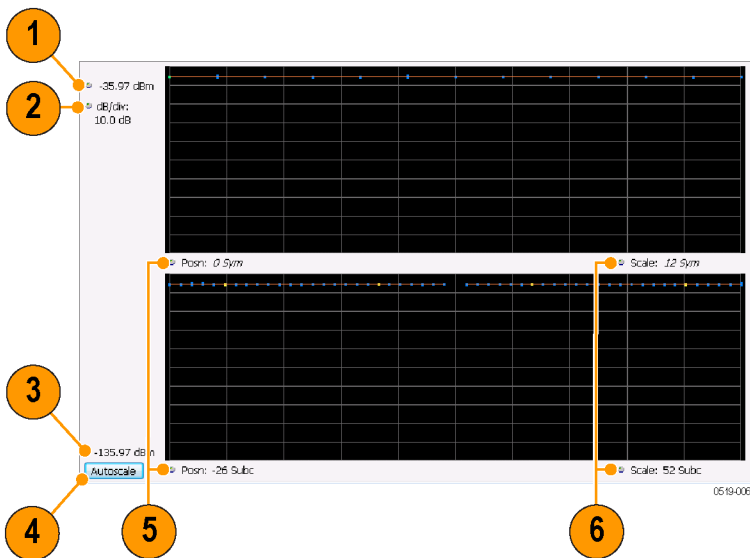
The OFDM Power display shows the data symbols' individual subcarrier Power values versus symbol interval (time) and subcarrier (frequency).

To show the OFDM Power display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Power** icon or select the icon and click **Add**. The OFDM Power icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Power display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.



### Elements of the Display



Item	Display element	Description
1	Vertical 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.
2	dB/div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
2	Bottom of graph readout	Indicates the amplitude at the bottom of the graph. This value changes with the dB/div and Vertical Position settings.
3	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
4	Pos	Specifies the horizontal position of the trace on the graph display.
5	Scale	Adjusts the horizontal range of the graph. By decreasing the scale, the graph essentially becomes a window that you can move over the analysis results by adjusting the position.

## OFDM Power Settings

### Application Toolbar:

The settings for the OFDM Power display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Summary Display

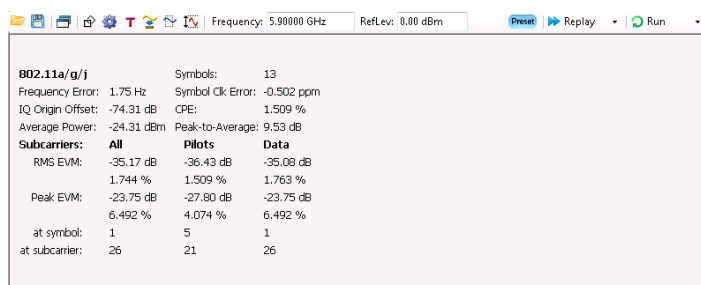
The OFDM Summary display shows several measurements of OFDM signal quality.

To show the OFDM Summary display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Summary** icon or select the icon and click **Add**. The OFDM Summary icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Summary display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Measurement	Description
Standard	Display of the standard selected on the Setup > Settings > Modulation Params tab.
Frequency Error	The frequency difference between the measured carrier frequency of the signal and the measurement frequency setting.
IQ Origin Offset	The average magnitude of the DC subcarrier level relative to total signal power. It indicates the level of carrier feedthrough detected at the center (DC) subcarrier.
Average Power	The average power of all symbols in the analysis. Calculated over only the data symbols in the packet.
Symbols	How many symbols were analyzed.
Symbol Clk Error	The symbol clock error in parts per million.
CPE	CPE, Common Pilot Error, is the RMS magnitude error of the pilots over all analyzed symbols.
Peak-to-Average	The ratio of the highest instantaneous signal power level to the average signal power. Calculated over only the data symbols in the packet.
EVM	<p>The RMS and Peak values of the normalized subcarrier Error Vector Magnitude values. The normalized subcarrier EVM values are calculated as the difference between the detected received signal subcarrier constellation points and ideal reference points estimated by the instrument from the received signal. Values are reported in units of percent and dB. Peak values include the symbol and subcarrier location.</p> <p>RMS and Peak values are displayed for groupings of all subcarriers, Pilots only and Data only. Results are calculated over the entire signal packet analyzed, covering the number of Symbols indicated in the Summary display.</p>

## OFDM Summary Settings

### Application Toolbar:

The settings for the OFDM Summary display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Prefs (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

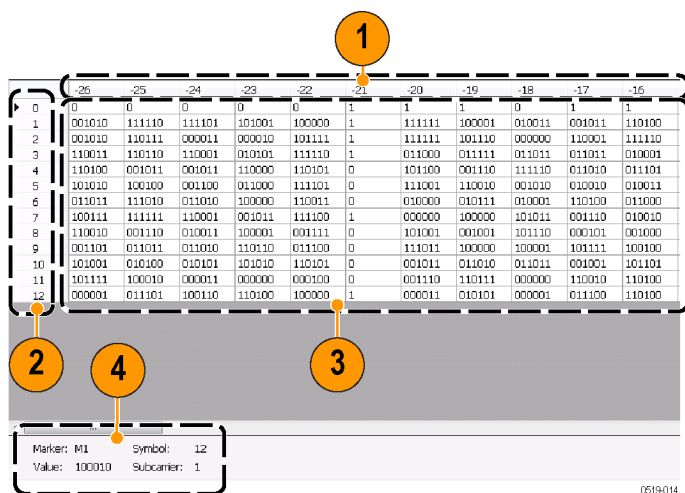
## OFDM Symbol Table Display

The OFDM Symbol Table display shows decoded data bits for each subcarrier in each symbol in the analyzed signal packet. Results are presented with subcarrier (frequency) indices in the horizontal dimension and symbol (time) intervals in the vertical dimension.

To show the OFDM Symbol Table display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **OFDM Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **OFDM Symb Table** icon or select the icon and click **Add**. The OFDM Symbol icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the OFDM Symbol Table display.
6. Set the **Frequency** appropriate for the signal.
7. Select **Setup > Settings** to display the control panel.
8. Select the **Modulation Params** tab. Set the Standard, Guard Interval and Spacing and Bandwidth controls as appropriate for the input signal.
9. If you are analyzing a stored data file, press the **Replay** button to take measurements on the recalled acquisition data file.





Item	Description
1	Subcarrier identifiers.
2	Symbol identifiers.
3	Subcarrier data values.
4	Marker readout when markers are enabled.

## OFDM Symbol Table Settings

### Application Toolbar:

The settings for the OFDM Symbol Table display are shown in the following table.

Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Prefs (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## OFDM Analysis Shared Measurement Settings

### Application Toolbar:



The control panel tabs in this section are shared between the displays in the OFDM Analysis folder (Setup > Displays). Some tabs are shared by all the displays, some tabs are shared by only a couple of displays. The settings available on some tabs change depending on the selected display.

### Common controls for OFDM analysis displays

Settings tab	Description
<a href="#">Modulation Params (see page 251)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Advanced Params (see page 252)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Data Range (see page 253)</a>	Specifies which symbols and subcarriers of the signal to display.
<a href="#">Analysis Time (see page 253)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for OFDM Analysis displays.
<a href="#">Trace (see page 255)</a>	Enables you to display or hide the measurement or average trace.
<a href="#">Scale (see page 255)</a>	Specifies the vertical, subcarrier, and symbols scale and position settings.
<a href="#">Prefs (see page 257)</a>	Specifies the units of the display and whether elements of the graphs are displayed.

## Modulation Params Tab - OFDM

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

Settings	Description
Standard	Specifies the standard used for the input signal. Choices are 802.11a/g/j and 802.16 (2004).
Guard Interval	Specifies the guard interval used in the input signal. Choices are 1/4, 1/8, 1/16, 1/32, and User. When you select User, you can enter a percentage value to specify the size of the guard interval as a percentage of the useful symbol interval. The Guard Interval range is 0–100%.
Spacing and Bandwidth	Specifies the spacing between subcarriers and the nominal channel bandwidth. Only one of these settings can be set at a time, the other setting is automatically calculated.
Sample Rate	Indicates the FFT sample rate, based on the bandwidth or subcarrier setting.



## Advanced Params Tab - OFDM

The Advanced Params tab contains parameters that control the analysis of the input signal.

The screenshot shows the 'Advanced Params' tab with the following settings:

- Constellation determination:** Auto Detect
- Channel Estimation:** Preamble
- Pilot tracking:**
  - ☒ Phase
  - ☐ Amplitude
  - ☐ Timing
- Symbol analysis offset:** -0.5 %
- Swap I & Q:** ☐

### Settings

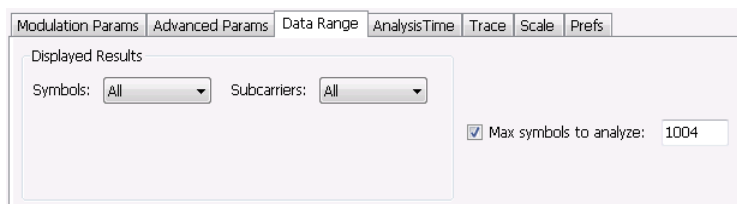
### Description

Constellation determination	Specifies the method used to detect the constellation. Auto Detect analyzes the signal to determine the appropriate constellation, Manual allows you to specify the constellation type. Manual choices are: BPSK, QPSK, 16QAM, and 64QAM.
Symbol analysis offset	Specifies the analysis offset in the symbol interval. This value is a percentage of the Guard Interval. The allowable range is -100% to 0%. -100% positions the FFT to start at the beginning of the Guard Interval, 0% positions it to start at the end of the Guard Interval. Default value is -50% which usually gives the best measurement results.
Channel Estimation	Specifies the method used to estimate channel frequency response and equalization. This control can be used to diagnose changes in frequency response over the signal packet.
Preamble	When you select Preamble, the instrument uses only the Preamble to estimate channel frequency response. This response is then used to equalize the entire signal packet.
Preamble + Data	When you select Preamble + Data, the instrument makes an initial channel frequency response estimate from the Preamble. Then estimates the channel response for each data symbol using the decoded data content to derive equalization for each symbol individually. This allows compensation for time-varying channel response over the packet.
Pilot tracking	Specifies if pilot subcarriers should be used to correct amplitude, phase, and symbol timing variations over the packet. The choices available are Phase, Amplitude, and Timing. The default setting is Phase.
Swap I & Q	Select the checkbox to swap the I and Q components of a signal. This compensates the input signal for spectral inversion.



## Data Range Tab - OFDM

The Data Range tab enables you to control how much signal is analyzed, as well as specify the range of results that are displayed in the Constellation, EVM, Magnitude Error, Phase Error, Power and Symbol Table graphs.



Settings	Description
<b>Symbols</b>	Specifies which symbols are displayed in the graphs.
All	Select All to display all symbols.
Range	Select Range to specify a subset of symbols for display.
Start	Specifies the first symbol to include in the display.
Number	Specifies how many symbols to display in the graphs.
Single	Select Single to display a single symbol.
Index	Use Index to specify the symbol you want to display.
<b>Subcarriers</b>	Specifies which subcarriers are displayed.
All	Select All to display all subcarriers in the signal.
Pilots Only	Select Pilot to display only pilot subcarriers.
Data Only	Select Data to display only data subcarriers.
Single	Specifies a specific subcarrier for display.
Index	Specifies the specific subcarrier to be displayed.
Range	Specifies a range to subcarriers to be displayed.
Start	Specifies the start value of the range to be displayed.
Stop	Specifies the ending value of the range to be displayed.
<b>Max symbols to analyze</b>	Specifies how many symbols are analyzed. You can use this setting to speed analysis by limiting the number of symbols being analyzed.

## Analysis Time Tab - OFDM

The Analysis Time tab contains parameters that define how the signal is analyzed in the OFDM Analysis displays.



Modulation Params	Advanced Params	Data Range	AnalysisTime	Trace	Scale	Prefs
Analysis Offset: <input type="text" value="-0.668 Sym"/> <input checked="" type="checkbox"/> Auto      Time Zero Reference: <input type="text" value="Trigger"/>						
Analysis Length: <input type="text" value="66.000 Sym"/> <input checked="" type="checkbox"/> Auto      Units: <input type="text" value="Symbols"/>						
Actual: 66.000 Sym						

Settings	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 symbols or seconds, depending on the Units setting.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
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).
Time Zero Reference	Specifies the zero point for the analysis time.
Units	Specifies 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. 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.



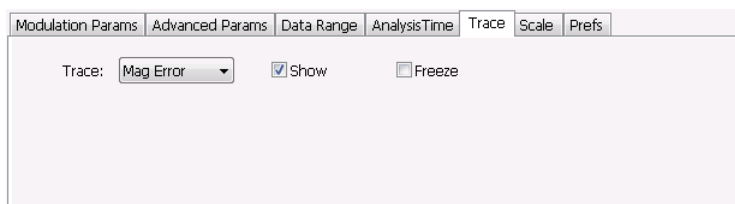
## Time Zero Reference

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 - OFDM

The Trace tab allows you to set the trace display characteristics of the selected display. This tab is not available for all OFDM displays.



Settings	Description
Trace	Use this drop-down list to select whether or not the Average trace or the measurement trace is displayed. The measurement trace depends on the selected display.
Show	Select or deselect this checkbox to show or hide the trace selected in the Trace drop-down list.
Freeze	Selecting Freeze halts updates to the trace.

## Scale Tab - OFDM

The Scale tab allows you to change the scale settings that control how the trace appears on the display but does not change control settings such as Measurement Frequency. There are two versions of the Scale tab for OFDM displays. One version is used only for the Constellation display and the other version is used for the OFDM EVM, OFDM Magnitude Error, OFDM Phase Error, and OFDM Power displays.



Modulation Params | Advanced Params | Data Range | AnalysisTime | Trace | **Scale** | Prefs

**Vertical**  
 Scale: 41.8 %  
 Position: -21.9 %  
 Autoscale

**Subcarrier**  
 Scale: 200 Subc  
 Position: -100 Subc  
 Autoscale

**Symbols**  
 Scale: 12 Sym  
 Position: 0 Sym  
☒ Auto Autoscale

Scale tab for OFDM EVM, OFDM Mag Error, OFDM Phase Error, and OFDM Power displays

Modulation Params | Advanced Params | Data Range | AnalysisTime | Trace | **Scale** | Prefs

**Zoom**  
 Scale: 3  
 Vertical Position: 0  
 Horizontal Position: 0

Scale tab for OFDM Constellation display

Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale of the graph.
Position	Adjusts the reference level away from top of the graph.
Autoscale	Resets the scale of the vertical axis to contain the complete trace.
Subcarrier	Controls the scale of the subcarrier graph and position of the trace.
Scale	Specifies how many subcarriers are displayed horizontally.
Position	Specifies the subcarrier that appears at the left edge of the subcarrier graph.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Symbols	Controls the scale of the Symbols graph.
Scale	Specifies the number of symbols that appear in the symbols graph.
Position	Specifies the symbol that appears at the left edge of the Symbols graph.
Autoscale	Resets the scale and position settings to optimize the display.
Auto	When Auto is checked, the scale and position values for the Symbols graph are automatically adjusted to maintain the optimal display.
Zoom	Sets the Constellation display size and position.
Scale	Sets the magnification value for the Constellation display.
Vertical Position	Sets the vertical location of the Constellation display within the graph. Range is -3.7 to +3.7.
Horizontal Position	Sets the horizontal location of the Constellation display within the graph. Range is -3.7 to +3.7.



## Prefs Tab - OFDM

The Prefs tab enables you to change appearance characteristics of the OFDM Analysis displays. Not all settings on the Prefs tab shown below appear for every OFDM display.

The screenshot shows the 'Prefs' tab in the OFDM Analysis software. The tab is selected, and the settings are as follows:

- Time units: Symbols
- Freq units: Subcarrier
- Radix: Binary
- Show graphs: Both (selected), Subcarriers, Symbols
- Show graticule: ☒
- Show marker readout: ☒

Settings	Description
Time units	Specifies whether the displayed time units are seconds or symbols.
Freq units	Specifies whether the displayed frequency units are frequency (Hz) or subcarrier channel.
Radix	Specifies whether symbol values are displayed in binary or hex format (for example, in the Symbol Table or markers readouts).
Show graphs	Specifies which graph types are displayed.
Both	Displays both the Subcarrier and Symbol graphs.
Subcarriers	Displays only the subcarrier graph.
Symbols	Displays only the symbol graph.
Show graticule	Displays or hides the graticule in the graphs.
Show marker readout	Displays or hides the marker readouts in the graphs.







## Overview

The displays in Pulsed RF (Displays > Measurements > 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, Delta Frequency, Phase Deviation, and Time. See [Available Measurements \(see page 39\)](#) 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.

✓ Freq Error: 169.1 Hz (Auto)		Freq: 2.700000169 GHz								
	Avg ON	Peak	Avg Tx	Width	Rise	Fall	Rep Int	Rep Rate	Ri	^
1	-2.3542 dBm	-2.2729 dBm	-18.732 dBm	5.1147485 us	70.286255 ns	69.794922 ns	220.95078 us	4.525895 kHz	0.1	
2	-2.3518 dBm	-2.2345 dBm	-18.187 dBm	7.2183543 us	70.688479 ns	70.083004 ns	275.67105 us	3.627512 kHz	0.1	
3	-2.3510 dBm	-2.2595 dBm	-18.619 dBm	5.2991536 us	71.052249 ns	69.774167 ns	223.23629 us	4.479559 kHz	0.1	
4	-2.3551 dBm	-2.2816 dBm	-18.731 dBm	5.1165252 us	70.684202 ns	70.438233 ns	220.96363 us	4.525632 kHz	0.1	
5	-2.3513 dBm	-2.2713 dBm	-18.192 dBm	7.2066669 us	71.347657 ns	70.579837 ns	275.49471 us	3.629834 kHz	0.1	
6	-2.3531 dBm	-2.2518 dBm	-18.587 dBm	5.4644311 us	70.315551 ns	70.734863 ns	228.46991 us	4.376944 kHz	0.1	
7	-2.3537 dBm	-2.2510 dBm	-18.727 dBm	5.1185839 us	71.486205 ns	70.560304 ns	220.90306 us	4.526873 kHz	0.1	
8	-2.3530 dBm	-2.3067 dBm	-18.157 dBm	7.2754278 us	70.033572 ns	69.621585 ns	275.90856 us	3.624389 kHz	0.1	
9	-2.3547 dBm	-2.2646 dBm	-18.667 dBm	5.1216639 us	70.291136 ns	69.699709 ns	218.00389 us	4.587074 kHz	0.1	
10	-2.3505 dBm	-2.2762 dBm	-18.735 dBm	5.1066654 us	69.887697 ns	70.510254 ns	220.97585 us	4.525381 kHz	0.1	
11	-2.3541 dBm	-2.2895 dBm	-18.198 dBm	7.1933723 us	70.523072 ns	70.412597 ns	275.21345 us	3.633543 kHz	0.1	
12	-2.3528 dBm	-2.2509 dBm	-18.556 dBm	5.7297557 us	70.941773 ns	69.781493 ns	237.95580 us	4.202461 kHz	0.1	
13	-2.3561 dBm	-2.2638 dBm	-18.444 dBm	6.0395946 us	71.277462 ns	70.528564 ns	244.25826 us	4.094027 kHz	0.1	
14	-2.3530 dBm	-2.3083 dBm	-18.730 dBm	5.1135430 us	70.236204 ns	69.981688 ns	220.97836 us	4.525330 kHz	0.1	
15	-2.3500 dBm	-2.3191 dBm	-18.193 dBm	7.2002217 us	71.079711 ns	71.169431 ns	275.33952 us	3.631880 kHz	0.1	
16	-2.3559 dBm	-2.2768 dBm	-18.572 dBm	5.6117051 us	69.582519 ns	70.191653 ns	233.68913 us	4.279189 kHz	0.1	
17	-2.3563 dBm	-2.3134 dBm	-18.668 dBm	5.1218622 us	70.316162 ns	69.885253 ns	218.00520 us	4.587046 kHz	0.1	
18	-2.3558 dBm	-2.2804 dBm	-18.740 dBm	5.1066395 us	70.247189 ns	69.825440 ns	220.96526 us	4.525598 kHz	0.1	
19	-2.3564 dBm	-2.2648 dBm	-18.195 dBm	7.2042967 us	71.071774 ns	70.909422 ns	275.35643 us	3.631656 kHz	0.1	
20	-2.3509 dBm	-2.2886 dBm	-18.573 dBm	5.6055314 us	70.825806 ns	70.736085 ns	233.68525 us	4.279260 kHz	0.1	
21	-2.3566 dBm	-2.2565 dBm	-18.669 dBm	5.1220964 us	71.097411 ns	70.708005 ns	218.00013 us	4.587153 kHz	0.1	
22	-2.3541 dBm	-2.2646 dBm	-18.735 dBm	5.1116199 us	71.083370 ns	69.742434 ns	220.97304 us	4.525439 kHz	0.1	

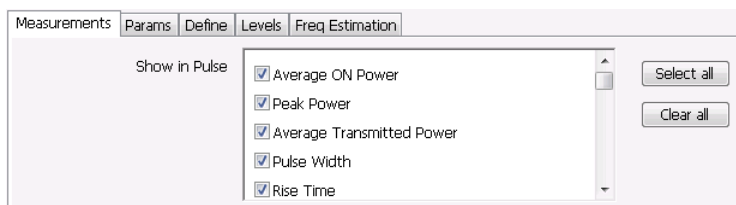


## Displaying the Pulse Table

1. Press the **Displays** button or select **Setup > Displays**.
2. Select **Pulsed RF** in the Measurements 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 or click **Select all** to choose all measurements.
4. Click the close box ( ) to remove the Settings control panel.

[Changing the Pulse Table Display Settings \(see page 260\)](#)

# Pulse Table Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

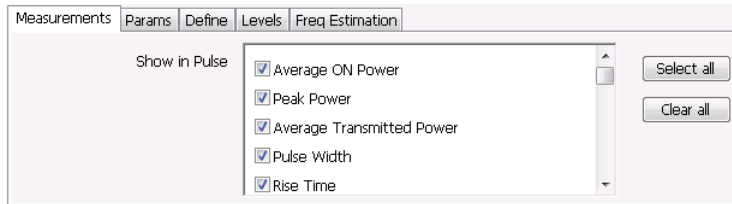
Settings tab	Description
<a href="#">Measurements (see page 261)</a>	Selects the measurements to be show in the Pulse Table.
<a href="#">Params (see page 266)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 268)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 273)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 273)</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

Checked measurements appear in the Pulse Table.

### Select all

Click **Select all** to choose all measurements for display in the Pulse Table.

### Clear all

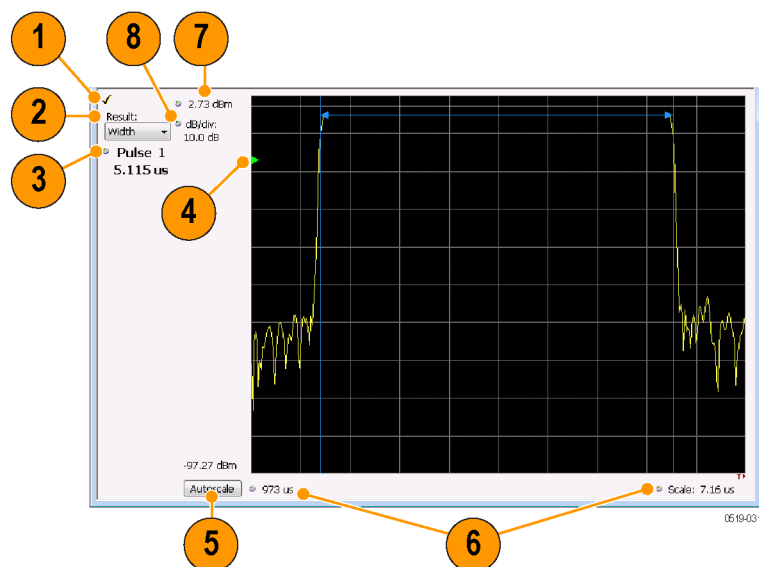
Click **Clear all** to remove all measurements from the Pulse Table display.

## 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	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Pulse Trace display is the optimized display.  <b>NOTE.</b> When <i>Best for multiple windows</i> is selected in the <i>Amplitude control</i> panel's <i>RF &amp; IF Optimization</i> control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 263\)](#)

## Pulse Trace Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

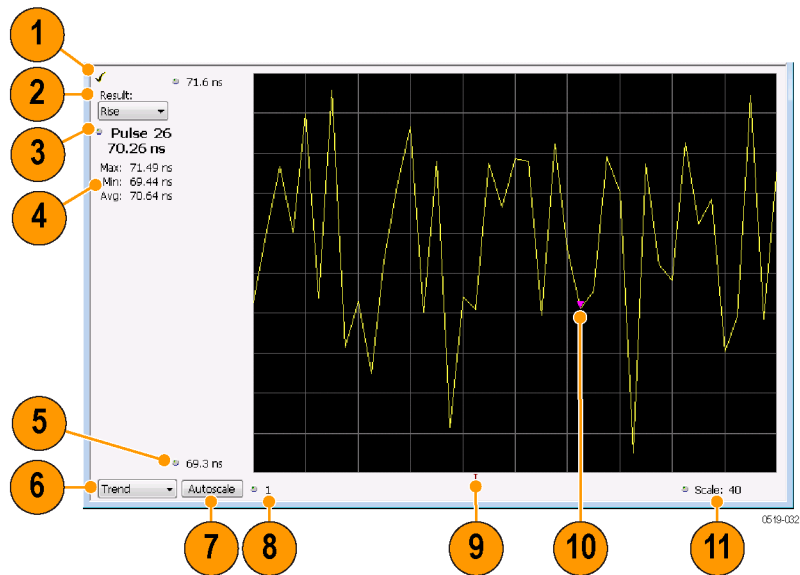
Settings tab	Description
<a href="#">Params (see page 266)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 268)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 273)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 273)</a>	Specifies the reference used for computing frequency error.
<a href="#">Scale (see page 275)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 276)</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	Check mark indicator	The check mark indicator in the upper, left-hand corner of the display shows when the Pulse Statistics display is the optimized display.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 265\)](#)

## Pulse Statistics Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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



Settings tab	Description
<a href="#">Params (see page 266)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 268)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 273)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 273)</a>	Specifies the reference used for computing frequency errors.
<a href="#">Scale (see page 275)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 276)</a>	Specifies whether or not certain elements of the display are shown.

## Pulsed RF Shared Measurement Settings

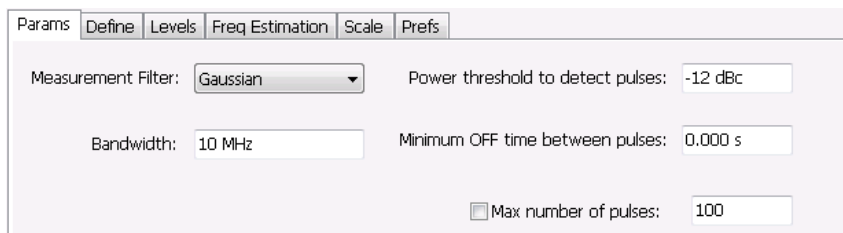
The control panel tabs in this section are shared by the displays in the Pulsed RF folder (Setup > Displays). Changing a setting on one tab changes that setting for all the Pulsed RF displays.

### Common controls for pulsed RF displays

Settings tab	Description
<a href="#">Params (see page 266)</a>	Specifies several parameters that control how pulses are counted and defined.
<a href="#">Define (see page 268)</a>	Specifies parameters that control where measurements are taken on a pulse.
<a href="#">Levels (see page 273)</a>	Specifies parameters that control the method and levels used to calculate some pulse values.
<a href="#">Freq Estimation (see page 273)</a>	Specifies the reference used for computing frequency errors.
<a href="#">Scale (see page 275)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 276)</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.



Params Define Levels Freq Estimation Scale Prefs

Measurement Filter: Gaussian Power threshold to detect pulses: -12 dBc

Bandwidth: 10 MHz Minimum OFF time between pulses: 0.000 s

☐ Max number of pulses: 100



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.

To determine the maximum number of pulses that can be analyzed, use the following equation:

$$\text{Max number of pulses that can analyzed} = \text{Pulse Rate} \times \text{capacity}$$

where:

- Pulse rate is the number of pulses per second (frequency).
- Capacity is a length of time which is displayed on the **Acquire > Sampling Parameters** tab.

Note that the maximum number of pulses is affected by several parameters. For example, measurement bandwidth affects the sample rate. The measurement algorithm also can reduce the maximum number of pulses that can be analyzed (by increasing the sample rate) based on the characteristics of the signal.

Additionally, when FastFrame is enabled, determining the maximum number of pulses is even more challenging. In FastFrame mode, the signal analyzer samples the signal around events of interest and



ignores the signal between events of interest. Thus, if the instrument is only looking at pulses and ignoring the signal between pulses, the number of pulses that can be analyzed depends strongly on the characteristics of the pulse itself (for example, fewer wide pulses can be analyzed than narrow pulses, all other things being equal).

## 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 screenshot shows the 'Define' tab for the 'Impulse Response' measurement. The 'Measurement(s):' dropdown is set to 'Impulse Response'. The 'Time method:' dropdown is set to 'Absolute'. The 'Ref (R):' is set to '100 %'. The 'Start (S):' is set to '0.000 s'. The 'Length (L):' is set to '1.00 us'. There is a checkbox for 'Apply ampl corrections' which is checked. The 'Keep-out time (+/-):' is set to '0.000 s'. A diagram of a pulse is shown with markers R, S, and L. A small waveform icon is also present.

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

### Freq-Domain Linearity

The screenshot shows the 'Define' tab for the 'Freq-domain Linearity' measurement. The 'Measurement(s):' dropdown is set to 'Freq-domain Linearity'. The 'Time method:' dropdown is set to 'Absolute'. The 'Ref (R):' is set to '100 %'. The 'Start (S):' is set to '0.000 s'. The 'Length (L):' is set to '1.00 us'. A diagram of a pulse is shown with markers R, S, and L.



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

Params

Define

Levels

Freq Estimation

Scale

Prefs

Measurement(s):  

Impulse Response

☒ Apply ampl corrections

Keep-out time (+/-): 0.000 s

Time method: 

Absolute

Ref (R): 100 %

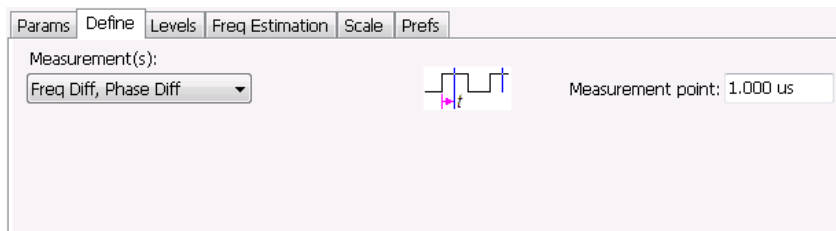
Start (S): 0.000 s

Length (L): 1.00 us



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.

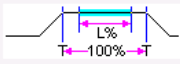
## Freq Diff, Phase Diff



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 %			

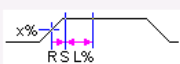
### Setting

### Description

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 %			

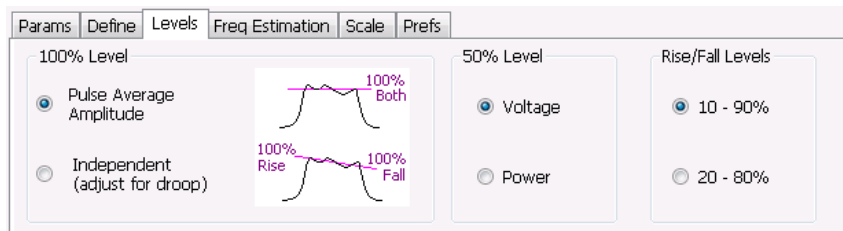


Setting	Description
Time method	Specifies how measurement parameters are determined. The choices are Absolute and Relative.
Absolute time method	
Ref (R)	Ref specifies the level along the pulse rising edge that is defined as the point from which Start time is counted. Choices: 50%, 60%, 70%, 80%, 90% 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.



Params Define Levels Freq Estimation Scale Prefs

Modulation type:  
Linear Chirp

Pulse Frequency Reference

Freq Offset: 169.1 Hz ☒ Auto

Chirp Slope: 0.0000 Hz/us ☒ Auto

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

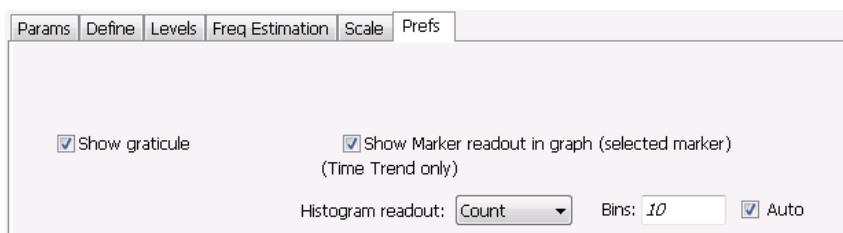
The Scale tab allows you to change the vertical and horizontal scale settings. Changing the scale settings changes how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls.

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.



Params Define Levels Freq Estimation Scale Prefs

☒ Show graticule

☒ Show Marker readout in graph (selected marker)  
(Time Trend only)

Histogram readout: Count Bins: 10 ☒ Auto

### 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.



# APCO P25 Analysis

## Overview

The Association of Public Safety Communication Officials (APCO) P25 Compliance Testing and Analysis option allows you to evaluate radio signals to ensure they meet the standards set for the public safety communications community for interoperable LMR equipment. This complete set of push-button Telecommunication Industry Association TIA-102 standard-based transmitter measurements includes modulation measurements, power measurements, and timing measurements. These measurements are also compared with the limits that best fit the signal for which the standard applies to provide pass/fail results.

The P25 measurements available with this option can be made on signals defined by the Phase 1 (C4FM) and Phase 2 (HCPM, HDQPSK) P25 standards. With this test suite, test engineers can simplify the execution of a number of transmitter tests while still allowing for controls to modify signal parameters for signal analysis. The analysis results give multiple views of P25 signal characteristics to allow the diagnosis of signal imperfections and impairments quickly and easily. Display controls allow you to selectively display the analysis results to help locate trouble-spots in the signal.

## P25 Topics

The following information about the P25 Analysis option is available:

- [Reference Table of Supported P25 Measurements \(see page 277\)](#)
- [P25 Standards Presets \(see page 278\)](#)
- [P25 Displays \(see page 279\)](#)
- [P25 Settings \(see page 341\)](#)
- [P25 Measurements \(see page 280\)](#)
- [P25 Test Patterns \(see page 288\)](#)

## Reference Table of Supported P25 Measurements

TIA-102 transmitter measurement	Tektronix measurement display(s) (value name if different from TIA-102 measurement name)	Phase 1	Phase 2
RF output power	P25 Summary P25 Power vs Time	Yes	Yes
Operating frequency accuracy	P25 Summary (Operating Freq Accuracy)	Yes	Yes
Modulation emission spectrum	SEM (The SEM display can be found in Select Displays > RF Measurements)	Yes	Yes
Unwanted emissions: Non spurious adjacent channel power ratio	MCPR (The MCPR display can be found in Select Displays > P25 Analysis)	Yes	Yes



TIA-102 transmitter measurement	Tektronix measurement display(s) (value name if different from TIA-102 measurement name)	Phase 1	Phase 2
Frequency deviation	P25 Summary (Freq Dev)	Yes	HCPM
Modulation fidelity	P25 Summary P25 Constellation	Yes	Yes
Symbol rate accuracy	P25 Summary	Yes	Yes
Transmitter power and encoder attack time	P25 Summary (Phase1 Tx Attack Time) P25 Power vs Time (Power Attack Time and Encoder Attack Time)	Yes	N/A
Transmitter power and encoder attack time with busy/idle operations	P25 Summary (Phase1 Tx Attack Time (Busy/Idle)) P25 Power vs Time (Power Attack Time Busy Idle and Encoder Attack Time Busy Idle)	Yes	N/A
Transmitter throughput delay	P25 Summary (Phase1 Tx Throughput Delay)	Yes	N/A
Transient frequency behavior	P25 Freq Dev vs. Time	Yes	N/A
HCPM transmitter logical channel peak adjacent channel power ratio	P25 Summary (HCPM Tx Logic Ch Pk ACPR)	N/A	HCPM
HCPM Transmitter logical channel off slot power	P25 Power vs Time (Off Slot Power) P25 Summary (HCPM Tx Logic Ch Off Slot)	N/A	HCPM
HCPM Transmitter logical channel power envelope	P25 Power vs Time (Power Info) P25 Summary (HCPM Tx Logic Ch Pwr Env Limits)	N/A	HCPM
HCPM Transmitter logical channel time alignment	P25 Summary (HCPM Tx Logic Ch Time Alignt)	N/A	HCPM

## P25 Standards Presets

The P25 standards preset allows you to access displays preconfigured for the P25 standards you select. You can read more about how Presets work [here](#).

The P25 standards preset allows you to access displays preconfigured for the P25 standards you select. You can read more about how Presets work [here \(see page 21\)](#).

The following table shows the bandwidth, modulation type, and displays that are automatically loaded for each of the listed standards. MCPR masks are also loaded and are explained [here \(see page 279\)](#).

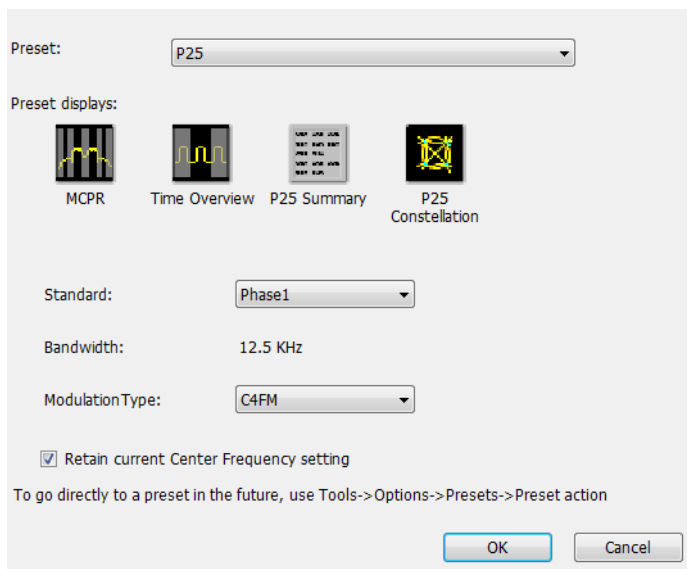
**Table 2: P25 standards, modulation type, bandwidth, and displays**

Standard	Modulation type	Bandwidth (kHz)	Displays loaded with preset
Phase 1	C4FM	12.5	MCPR, Time Overview, P25 Constellation, P25 Summary
Phase 2	HCPM (inbound)	12.5	MCPR, Time Overview, P25 Constellation, P25 Summary
	HDQPSK (outbound)	12.5	



## Retain Current Center Frequency

This setting becomes available when P25 is the selected preset in the Standards Preset window. You can access this window by selecting **Presets > Standards** and then selecting **P25** from the **Preset** drop down menu. To activate the **Retain current Center Frequency Setting**, check the box. This setting allows you to retain the previously used center frequency. By default, the box is unchecked and therefore the four P25 preset displays will load with a center frequency of 850 MHz.



The default adjacent channels table for MCPR is different for RF frequencies in the range of 769 to 806 MHz (called 700 MHz band) and for frequency ranges outside it. The option of retaining center frequency in Standards Preset is therefore useful if you want to load the default table for center frequencies in the 700 MHz band.

**MCPR channel and limit parameters.** The MCPR (ACPR) standard channel and limit parameters that are applied to the P25 signal depend on the standard you select when you configure the preset. Once you select a standard and center frequency, the application will automatically load the parameters and default limits recommended for best performance comparison by the Standard document. All channel and limit parameters are derived from the TIA-102 standard and loaded for you. This provides you the assurance that you are evaluating the signal with the most appropriate parameters.

---

**NOTE.** *Changing analysis and display parameters recalculates the measurement results, but does not affect acquisitions.*

---

## P25 Displays

The displays in P25 Analysis (Setup > Displays > Measurements: P25 Analysis) are:

- [MCPR](#)
- [P25 Constellation \(see page 291\)](#)



- [P25 Power vs Time \(see page 296\)](#)
- [P25 Eye Diagram \(see page 293\)](#)
- [P25 Frequency Dev Vs Time \(see page 304\)](#)
- [P25 Symbol Table \(see page 301\)](#)
- [P25 Summary \(see page 298\)](#)
- [Time Overview \(see page 59\)](#)

## P25 Measurements

The following topics contain important information you should know about specific P25 measurements.

### RF Output Power (Phase 1 and Phase 2)

This is a measure of RF output power when the transmitter is connected to the standard load during defined duty cycle. This measurement is presented as a scalar result in the P25 Summary display. Power variation is shown in the P25 Power vs Time display.

Information of note about this measurement:

- For bursty HCPM (Phase 2 Inbound) signals, the RF Output Power is measured only during the on slot regions centered at the middle of the on slot.
- The result shown in the P25 Summary Display is the average RF Output Power of all the bursts selected in the analysis window.
- If only one on slot region is chosen in the analysis window, then the RF Output Power of only the chosen on slot is reported.
- For non-bursty data, the entire duration of analysis window is considered to obtain RF Output Power.
- The result shown in the P25 Summary display does not account for any attenuation introduced by a user. Ensure that this attenuation is accounted for when you enter limits for comparison.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when Trigger Measurements are selected.

---

**NOTE.** Read about important information related to HCPM bursty data measurements [here \(see page 290\)](#).

---

### Operating Frequency Accuracy (Phase 1 and Phase 2)

The Operating Frequency Accuracy is the ability of the transmitter to operate on its assigned frequency. This measurement is presented as a scalar result in the P25 Summary display.



- For bursty HCPM (Phase 2 Inbound) signals, the operating frequency accuracy is measured only during the on slot regions centered at the middle of the on slot.
- The result shown in the P25 Summary display is the average of all the bursts selected in the analysis window.
- If only one on slot region is chosen in the analysis window, then the operating frequency accuracy of only the chosen on slot is reported.
- For non-bursty data, the entire duration of the analysis window is considered to obtain the operating frequency accuracy.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when Trigger Measurements are selected.

### Unwanted Emissions (ACPR) (Phase 1 and Phase 2)

This measurement is the ratio of the total power of a transmitter under prescribed conditions and modulation to that of the output power that falls within a prescribed bandwidth centered on the nominal frequency of adjacent channels. This measurement is shown in the MCPR display.

- For HCPM signals, Adjacent Channel Power Ratio analysis is only done on the first on slot region. When the Modulation Type is set to HCPM from any P25 display or from Standards Presets, there will be a search for bursts before ACPR analysis is done. If a burst is found, then analysis is done only on first burst. If a burst is not found, it will show the results of the entire analysis length. The Main Preset will remove the HCPM modulation Type setting, allowing MCPR to work in its regular mode.
- The MCPR display will only have one Main channel for P25 signals in addition to relevant adjacent channels.
- The default adjacent channels table for Unwanted Emissions (ACPR) as suggested by the standard can be loaded by using the P25 Standards Preset option (for which MCPR is one of the four displays).
- The default adjacent channels table for MCPR is different for RF frequencies in the range of 769 to 806 MHz (called 700 MHz band) and for frequency ranges outside it.
- To load the default adjacent channels table of a 700 MHz band, first set the center frequency. Next, select **Presets > Standards** to view the Standards Preset window. Lastly, check the **Retain current Center Frequency Setting** box.
- By default, the Retain Center Frequency box is unchecked and therefore the four P25 preset displays will load with a center frequency of 850 MHz and load the adjacent channels table for non-700 MHz band.
- By default, only six adjacent channels (on either side) will be shown when 700 MHz band is analyzed in P25 (for visual clarity). However, analysis is done for all the ten channels and results will be available in the table just under the display. You can zoom out to see the remaining bands.



## Frequency Deviation (Phase 1 (C4FM) and Phase 2 (HCPM))

This measurement shows the amount of frequency deviation that results for a Low Deviation and High Deviation test pattern. This measurement is shown in the P25 Summary display.

- This measurement only applies to HCPM and C4FM signals and High Deviation or Low Deviation test patterns. If this measurement is run for any other test patterns or for HDQPSK signals, comparisons for limits (set in the Limits tab of the control panel) will result in N/A being shown, as the measurement will not be valid.
- This measurement is done using a FM demodulator without any filter. As a result, it will not be exactly the same as the result given in the P25 Frequency Deviation vs Time display. That display shows the frequency deviation after complete demodulation and might use relevant shaping filters.
- Measurement results are only available when High Deviation, Low Deviation, or Symbol Rate test pattern is selected.
- The scalar result in the P25 Summary display will be shown as f1 (Positive Peak) and f2 (Negative Peak) when analyzing the High Deviation test pattern (or the Symbol Rate test pattern for C4FM signals).
- The scalar result in the P25 Summary display will be shown as f3 (Positive Peak) and f4 (Negative Peak) when analyzing the Low Deviation test pattern.
- The scalar results in the P25 Summary display do not have a corresponding graphical view. A closely representative display would be the FM display (Setup > Displays > Analog Modulation).
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.

## Modulation Fidelity (Phase 1 and Phase 2)

This measures the degree of closeness to which the modulation follows the ideal theoretical modulation determined by the rms difference between the actual deviation and the expected deviation for the transmitted symbols. This measurement is shown in the P25 Summary and P25 Constellation displays.

- This measurement is done on the first on slot region in the analysis window for bursty HCPM data. The analysis is done on 160 symbols centered at the burst.
- This measurement is done on all of the data chosen in the analysis window for non-bursty modulation types. A warning message is issued if the data is less than 164 symbols (the standard recommends at least 164 symbols be present for the measurement of non-bursty signals).
- This measurement is done by performing the frequency demodulation after taking the signal through relevant shaping filters and comparing it with expected frequency deviation points.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when Trigger measurements are selected.

---

**NOTE.** Read about important information related to HCPM bursty data measurements [here \(see page 290\)](#).

---



## Symbol Rate Accuracy (Phase 1 and Phase 2)

Symbol Rate Accuracy measures the ability of the transmitter to operate at the assigned symbol rate (4.8 kHz for Phase 1, 6 kHz for Phase 2). It is a scalar result shown in the P25 Summary display.

- This measurement result appears in the P25 Summary display and only applies to High Deviation or Low Deviation test patterns. Test patterns are selected in the Test Patterns tab in the Settings control panel.
- To check if the results are consistent with the symbol rate used, the measurement is done based on the number of zero crossings when a High Deviation or Low Deviation test pattern is used.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement only applies to High Deviation or Low Deviation test patterns. If this measurement is run for any other test patterns, comparisons for limits will result in N/A being shown, as the measurement will not be valid.

## Common Trigger Related Measurements

The measurements covered in this subsection have some common information. These measurements are:

- **Transmitter Power and Encoder Attack Time (Phase 1):** This measurement is the time required for a transmitter to prepare and transmit information on the radio channel after changing state from standby to transmit (applies to conventional mode). This measurement result can be seen in the P25 Summary display. A graphical representation of these results can be seen in the P25 Power vs Time display.
- **Transmitter Power and Encoder Attack Time with Busy/Idle Operations (Phase 1):** This measures the time required for a transmitter to prepare and transmit information on the radio channel after the receiving channel changes state from busy to idle. Transmission is inhibited until a status symbol indicates an idle channel. This measurement result can be seen in the P25 Summary display. A graphical representation of these results can be seen in the P25 Power vs Time display.
- **Transmitter Throughput Delay (Phase 1):** This measures the time it requires for audio changes in the microphone to be encoded and transmitted over the air. A calibrated receiver with a known receiver throughput delay is used to monitor the transmitted signal. The aggregate delay of the transmitter under test and calibrated receiver is measured and the desired transmitter throughput delay is then the aggregate delay less the delay of the calibrated receiver. A calibrated Receiver throughput delay from the UI is needed. This measurement result can be seen in the P25 Summary display.
- **Transient Frequency Behavior (Phase 1):** This is a measure of difference of the actual transmitter frequency and assigned transmitter frequency as a function of time when the RF output power is switched on or off. This measurement appears in the P25 Freq Dev vs Time display.
- **HCPM Tx Logical Channel Time Alignment (Phase 2 HCPM):** This measures the ratio of total transmitter power under prescribed conditions and modulation to the peak power that falls in a prescribed bandwidth centred on the nominal frequency of the adjacent channel during the transmitter power ramping interval. This applies only to inbound signals. This measurement result appears in the P25 Summary display.



---

**NOTE.** The following information is important when trigger measurements are taken with SignalVu-PC interfaced with an MDO4000B/C Series instrument: 1) The RF signal should be connected to the RF Input of the MDO. 2) One of the 4 analog channels of the MDO can be set as Trigger input. (Refer to the Trigger Setup section on how to set a channel as trigger in the MDO manual.) 3) In SignalVu-PC, set Triggered mode in the Setup > Acquisition control panel.

---

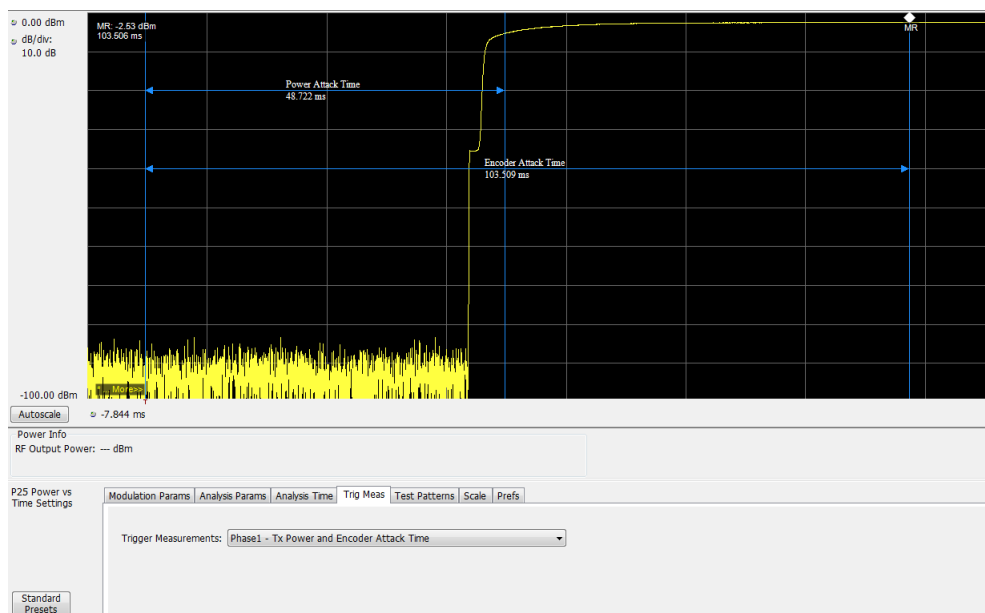
**Common information.** The following information applies to all of the measurements in the previous list.

- Select the relevant Trigger measurement from the Trig Meas tab of the control panel.
- When this measurement is chosen from the Trig Meas tab of the control panel, only this result will be populated in the P25 Summary display and everything else will have no result.
- The Time Zero Reference under the Analysis Time tab in the control panel is forced to Trigger.
- Align the Trigger to the RSA/MDO4000B/C as described in the measurement methods standard document.
- When a trigger measurement is chosen from the Trig Meas tab of the control panel, the following status message will appear: *P25: Set instrument in Triggered Mode.*
- Use the Acquisition control panel to select enough acquisition length to ensure that sufficient data is available when the acquisition is triggered.
- This measurement operates in Single Acquisition mode as the acquisition is triggered.
- You can select to do the same experiment multiple times and this measurement will produce an average result of the last 10 single acquisitions. Clicking the **Clear** button on the P25 Summary display will clear the results and start a new measurement.

**Transmitter Power and Encoder Attack Time and Transmitter Power and Encoder Attack Time with Busy/Idle Operations (Phase 1).** The following information is specific to these two measurements.

- The Transmitter Power Attack Time analysis is done by measuring the time taken from the trigger point to the point where the transmitter output power will reach 50% of its maximum value.
- For Encoder Attack Time, the initial frame synchronization word is searched in the demodulated output and the time taken from trigger to the start of the synchronization word is reported as the result.
- When a clear power ramp up is not available, the analysis will report the following error, indicating that no power ramp was received as expected: *Input data too short.* When the synchronization word is not found, the analysis will report the following error: *IQ Processing error.*
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- The P25 Power vs Time display shows marking from trigger point to 50% ramp point and also up to the Synchronization word for Transmitter Power and Encoder Attack Time. Frequency Dev vs Time can also be used to check for the synchronization word. The following image shows this measurement.





**Transmitter Throughput Delay (Phase 1).** The following information is specific to this measurement.

- Select Tx Throughput Delay from the Trig Meas tab of the Settings control panel to get this measurement.
- The original noise source is connected as input to this trigger and the acquisition is triggered when the input from the noise source exceeds the trigger level set by the user.
- The actual input to the MDO4000B/C comes after the noise signal from the source has passed through the DUT and calibrated receiver as shown in the setup for this measurement in the measurement methods standard document.
- The level in the Trigger control panel set by the user is used for analysis to determine that input to the RSA/MDO4000B/C (after it has gone through the DUT and calibrated receiver) has hit the power levels desired.
- The time difference between the trigger point and the point when the input to the RSA/MDO4000B/C has exceeded the level set by the user for triggering is calculated.
- The calibrated receiver throughput delay entered by the user in the Trig Meas tab in the Settings control panel (this option appears when Throughput Delay is selected) is subtracted from the calculated time difference and reported as Throughput Delay.
- A limit comparison can be performed by selecting the appropriate limits from the Limits tab in the Settings control panel.

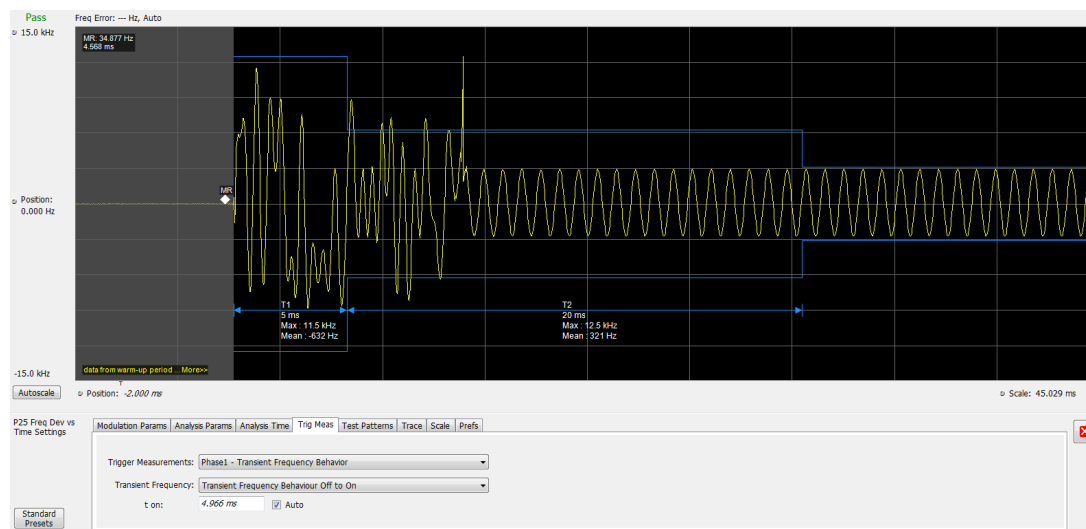
**Transient Frequency Behavior (Phase 1).** The following information is specific to this measurement.

- Select Transmitter Frequency Behavior from the Trig Meas tab of the Settings control panel to get this measurement.
- This measurement can be done for On to Off and Off to On behaviors. Select which behavior to measure by selecting the desired behavior from the Transient Frequency drop down list that appears



when the Transient Frequency Behavior measurement is selected in the Trig Meas tab of the Settings control panel.

- Select enough acquisition length (from the Acquisition control panel) to ensure that sufficient data is available when the acquisition is triggered. For a transient frequency behavior, there is a need for  $t_1+t_2$  amount of time after  $t_{on}$  as defined in the measurement methods standard document. Approximately 100 ms of data after trigger should ensure that all cases are taken care of as suggested by the standard.  $t_1$ ,  $t_2$ , and  $t_3$  durations are fetched based on the RF frequency range.
- The identification of  $t_{on}$  is done by looking for a significant frequency deviation after a certain power level has been achieved. A manual override for the  $t_{on}$  is also provided in the Trigger Meas tab of the Settings control panel when a Transient Frequency Behavior measurement is chosen. This allows you to manually override the  $t_{on}$  that is calculated (by releasing the Auto Option) and place it appropriately based on the P25 Freq Dev vs Time display. The same is true for  $t_{off}$  when the measurement is being done for the On to Off behavior.
- $t_1$  and  $t_2$  regions are identified after  $t_{on}$  and  $t_3$  before  $t_{off}$  (for the On to Off behavior).
- The mean and max frequency deviation is reported in the regions identified.
- A Pass or Fail is also reported by comparing the Mean frequency deviation with the recommended values given in the standard. A red band is shown if a particular region's result is less than the performance recommendation. The following image shows this measurement.



**HCPM Tx Logical Channel Time Alignment (Phase 2 HCPM).** The following information is specific to this measurement. This result can be viewed in P25 Summary and P25 Power vs Time displays.

- This measurement is done in two steps: First by calculating  $tOB\_sync$  using HDQPSK data (the ISCH pattern is looked for) and then by using the result to calculate  $tIB\_sync$  using HCPM data (the SACCH pattern is looked for).

The first step is done by choosing Time Alignment ( $tOB\_sync$  measurement) in the Trig Meas tab in the Settings control panel.



When the second step, Time Alignment ( $t_{\text{error\_0}}$  calculation) or ( $t_{\text{error\_1}}$  calculation) is selected in the Trig Meas tab of the control panel, there is an option to override the  $tOB\_sync$  value calculated in the first step.

- When this measurement is chosen, only this result is provided in the P25 Summary display.
- You must provide the ultraframe boundary to the trigger of the analyzer.
- An autocorrelation of the input RF signal with the reference patterns is performed to get the peak that will determine  $tOB\_sync$  (measured) and  $t_{\text{error\_0}}$  or  $t_{\text{error\_1}}$  from the trigger point.

### HCPM Tx Logical Channel Peak ACPR (Phase 2 HCPM)

This measures the ratio of total transmitter power under prescribed conditions and modulation to the peak power that falls in a prescribed bandwidth centred on the nominal frequency of the adjacent channel during the transmitter power ramping interval. This applies only to inbound signals. This measurement result appears in the P25 Summary display.

- This measurement is done by calculating power in the adjacent channels for the entire duration of data chosen by the user, including the power ramp up and ramp down portions. The standard recommends 360 ms of data for this measurement, unlike the other ACPR measurements for which the analysis is done only for the on slot region.
- The higher and lower adjacent channel power is reported in the P25 Summary display under Power Measurements.
- The two results are then subtracted from the calculated RF output power and the minimum of the two results is presented as the Min Pk ACPR in the P25 Summary display.
- This measurement is only done for bursty HCPM data and not for High Deviation or Low Deviation test patterns.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when trigger measurements are chosen.

---

**NOTE.** Read about important information related to HCPM bursty data measurements [here \(see page 290\)](#).

---

### HCPM Transmitter Logical Channel Off Slot power (Phase 2 HCPM)

This measures the power of a TDMA transmitter during the off portion of the TDMA pulse. This measurement only applies to inbound signals. This result can be viewed in P25 Summary and P25 Power vs Time displays.

- The measurement is done as suggested by the standard to calculate  $P_{\text{ONREL}}$  and  $P_{\text{OFFREL}}$
- $P_{\text{TX}}$  is an input expected from the user and this can be given from the Analysis Params tab in the Settings control panel.
- The absolute level of the off slot power is then calculated as  $P_{\text{OFF}} = P_{\text{TX}} - (P_{\text{ONREL}} - P_{\text{OFFREL}})$  dBm



- This measurement is only done for bursty HCPM data and not for High Deviation or Low Deviation test patterns.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when trigger measurements are chosen.

---

**NOTE.** Read about important information related to HCPM bursty data measurements [here \(see page 290\)](#).

---

### HCPM Transmitter Logical Channel Power Envelope (Phase 2 HCPM)

This is a measure of how well a portable radio controls the transmitter power as it inserts an inbound HCPM TDMA burst into a frame on a voice channel. This measurement applies to inbound signals only.

- All scalar results relevant to this measurement are shown both in P25 Power vs Time display and the P25 Summary display.
- The measurement results and the duration in which the measurements are made are shown graphically in P25 Power vs Time display. The results are grouped under Power Info and Time Info in the table at the bottom of the display.
- This measurement is only done for bursty HCPM data and not for High Deviation or Low Deviation test patterns.
- The Limits tab in the P25 Summary Settings control panel allows you to compare the results against limits set for Pass/Fail.
- This measurement result is not shown in the P25 Summary display when trigger measurements are chosen.

---

**NOTE.** Read about important information related to HCPM bursty data measurements [here \(see page 290\)](#).

---

## P25 Test Patterns

A variety of test patterns are specified in the TIA-102 documents for use in performance testing of transmitters. These test patterns allow the software to compare the measurement result to the standards limit. Test engineers can select from the test patterns described in the following tables.

---

**NOTE.** Although this table gives the test patterns for measurements as recommended by the Standard, other measurement results are also be provided as additional information for a given test pattern. For example, Modulation Fidelity results can also be provided for High Deviation and Low Deviation test patterns.

---



**Table 3: P25 test patterns, Phase 1 C4FM**

<b>TIA-102 Phase 1 C4FM test pattern</b>	<b>Phase 1 (C4FM) measurement</b>
Standard transmitter	RF Output Power
	Operating Frequency Accuracy
	Modulation Emission Spectrum
	Unwanted Emissions (Adjacent Channel Power Ratio)
	Modulation Fidelity
	Transmitter Power and Encoder Attack Time
Standard Busy	Transmitter Power and Encoder Attack Time (With Busy/Idle Operations)
Low Deviation	Operating Frequency Accuracy
	Transient Frequency Behavior
	Frequency Deviation
Standard Idle	Transmitter Power and Encoder Attack Time (With Busy/Idle Operations)
Standard Transmitter Symbol Rate (Same as High Deviation test pattern)	Symbol Rate Accuracy
	Frequency Deviation
C4FM Modulation Fidelity	Modulation Fidelity
Standard Tone	Can be used for measurements such as RF Output Power, Operating Frequency Accuracy, Modulation Fidelity, and ACPR
Other (User created test pattern)	Can be used for measurements such as RF Output Power, Operating Frequency Accuracy, Modulation Fidelity, and ACPR

**Table 4: P25 test patterns, Phase 2 Inbound and Outbound**

<b>TIA-102 Phase 2 test pattern</b>	<b>Phase 2 measurement</b>
Standard Transmitter (Inbound and Outbound)	RF Output Power
	Operating Frequency Accuracy
	Modulation Emission Spectrum
	Unwanted Emissions (Adjacent Channel Power Ratio)
	Modulation Fidelity
Inbound Standard Tone Ch0	Can be used for measurements such as RF Output Power, Operating Frequency Accuracy, Modulation Fidelity, and ACPR
Inbound Standard Tone Ch1	Can be used for measurements such as RF Output Power, Operating Frequency Accuracy, Modulation Fidelity, and ACPR
Outbound Standard Tone	Operational Frequency Accuracy



**Table 4: P25 test patterns, Phase 2 Inbound and Outbound (cont.)**

<b>TIA-102 Phase 2 test pattern</b>	<b>Phase 2 measurement</b>
Inbound Symmetrical Time Slot	RF Output Power
	Modulation Emission Spectrum
	Modulation Fidelity
	HCPM (Peak ACPR)
	HCPM (Off slot power)
	HCPM (Power envelope)
	Unwanted Emissions (Adjacent Channel Power Ratio)
Low Deviation (Inbound)	Frequency deviation for HCPM
	Symbol Rate Accuracy
Low Deviation (Outbound)	Symbol Rate Accuracy
High Deviation (Inbound and Outbound)	Symbol Rate Accuracy
Other (User created test pattern)	Can be used for measurements such as RF Output Power, Operating Frequency Accuracy, Modulation Fidelity, and ACPR

### Analysis of HCPM Bursty Data

It important to take into account the following information when analyzing HCPM bursty data.

- It is mandatory that at least one complete on slot and off slot region (including the ramp up and ramp down portion) have to be included in the analysis window for HCPM measurement results to be analyzed.
- If HCPM is the chosen standard in Standards Presets, then a minimum length of 94 ms is set for the analysis window. This is to ensure that a full on slot and off slot region is available irrespective of the selected analysis offset.
- Do not use the High Deviation or Low Deviation test patterns for bursty signals. Test patterns are selected in the P25 Settings control panel on the Test Patterns tab. If selected, analysis would look for a bursty pattern. High Deviation and Low Deviation test patterns are not bursty and therefore do not have the above analysis length restriction.

If you try to set the analysis length to less than 94 ms, the following status message will display:  
*P25:HCPM:Minimum Analysis Length should be  $\geq 94$  ms.*

- Most measurements that are required to be done on on slot regions are done centered at the on slot region of HCPM bursty data.



When HCPM bursty data is analyzed, the following status message will appear on all relevant displays:  
*P25:HCPM modulation analysis is done only on on slot regions.*

## P25 Constellation Display

The P25 Constellation Display shows the P25 signal modulation amplitude. For the HCPM and HDQPSK standards, you can view this display as frequency deviation or as I and Q. For the C4FM standard, only the frequency deviation applies.

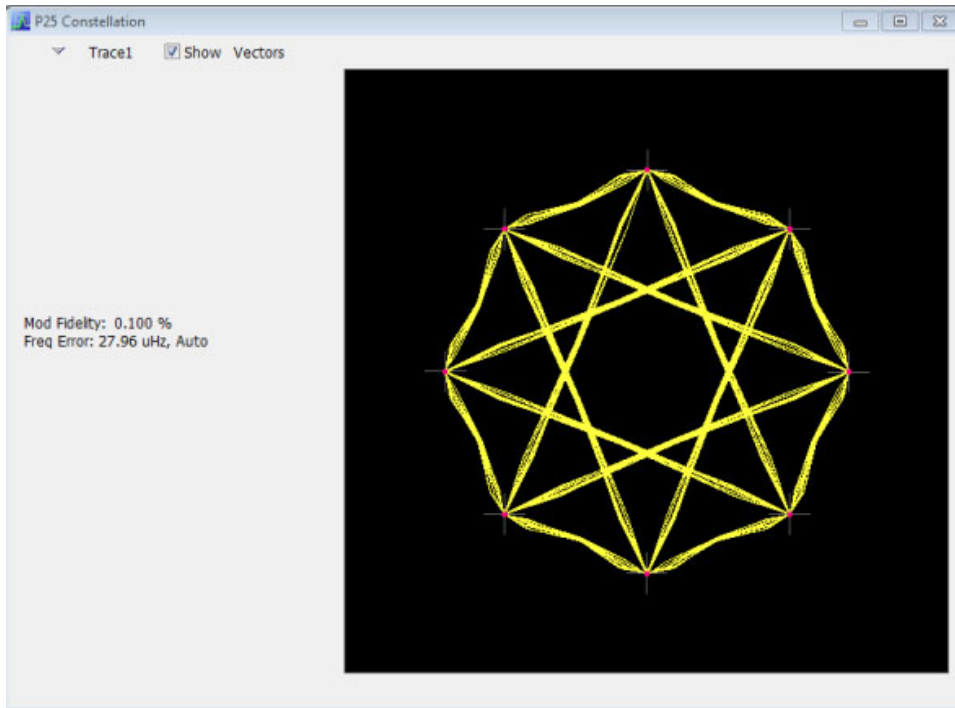
To show the P25 Constellation display you can select **Presets > Standards > P25** or do the following:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **P25 Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **P25 Constellation** icon or select the icon and click **Add**. The P25 Constellation icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the P25 Constellation display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.
8. For Phase 2 signals, select the **Trace** tab and set the **Trace Type** to Freq Dev or IQ.
9. Select the **Test Patterns** tab and select the desired test pattern as appropriate for the input signal.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

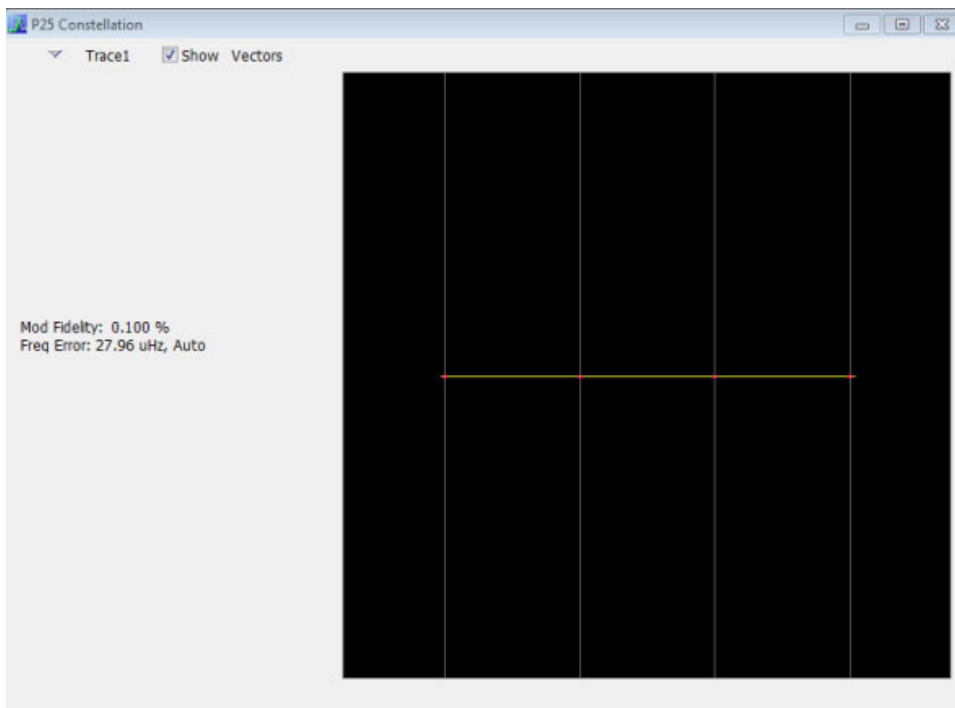
### Elements of the Display

The following image shows the P25 Constellation display set to IQ for a HDQPSK signal.





The following image shows the same signal as the previous image, but with the display set to Frequency Deviation.





Item	Display element	Description
1	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 will show frequency deviation results or IQ results (time, mag, phase, symbol marker and symbol value) of the point with the selected marker.
2	Measurement results readout	These readouts are located to the left or below of the Constellation plot, depending on the window size. The readout shows Modulation Fidelity (%) and Frequency Error (Hz).  The second readout can either be Freq Error where the result is followed by Auto or it could be Freq Offset where the result is followed by Manual. This choice between Freq Error and Freq Offset is made from the Analysis Params tab in the Settings control panel.
3	Plot	Shown as either I vs Q or as Frequency Deviation. The trace type is controlled from the <b>Settings &gt; Trace</b> tab.

## P25 Constellation Settings

### Application Toolbar:

The P25 Constellation Settings control panel provides access to settings that control parameters of the Constellation Display.

Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for P25 Analysis displays.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Trace (see page 314)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout and whether elements of the graphs are displayed.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from several different trigger measurements.

## P25 Eye Diagram Display

The P25 Eye Diagram display shows a digitally modulated signal overlapped on itself to reveal variations in the signal.

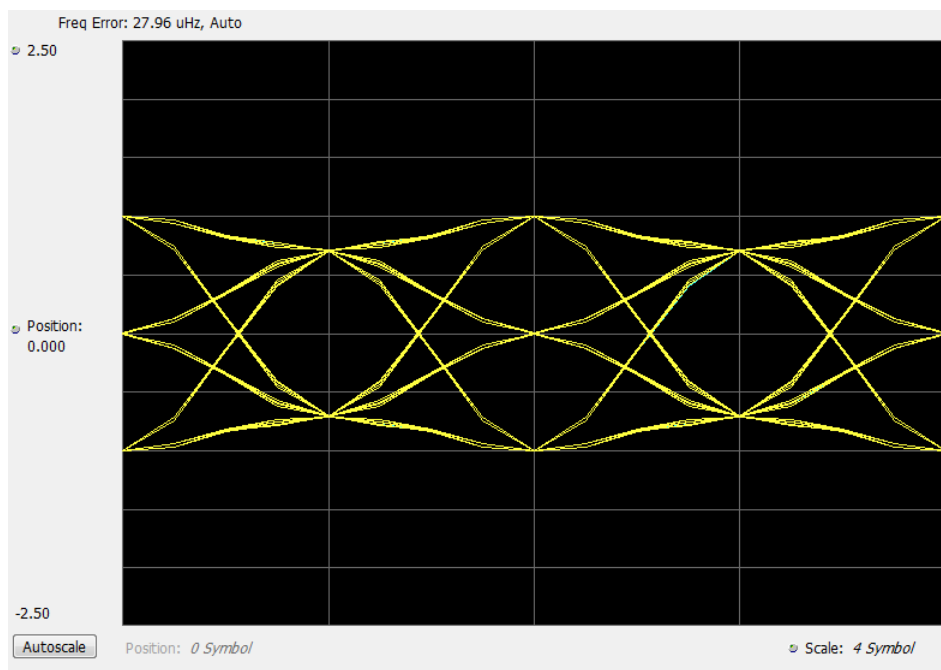


To show the P25 Eye Diagram display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. From the **Measurements** box, select **P25 Analysis**.
4. Double-click the **P25 Eye Diagram** icon in the **Available Displays** box. This adds the P25 Eye Diagram icon to the **Selected displays** box.
5. Click **OK** button. This displays the P25 Eye Diagram view.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.
8. For Phase 2 signals, select the **Trace** tab and set the **Trace Type** to Freq Dev or IQ.
9. Select the **Test Patterns** tab and choose a test pattern appropriate for the input signal.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

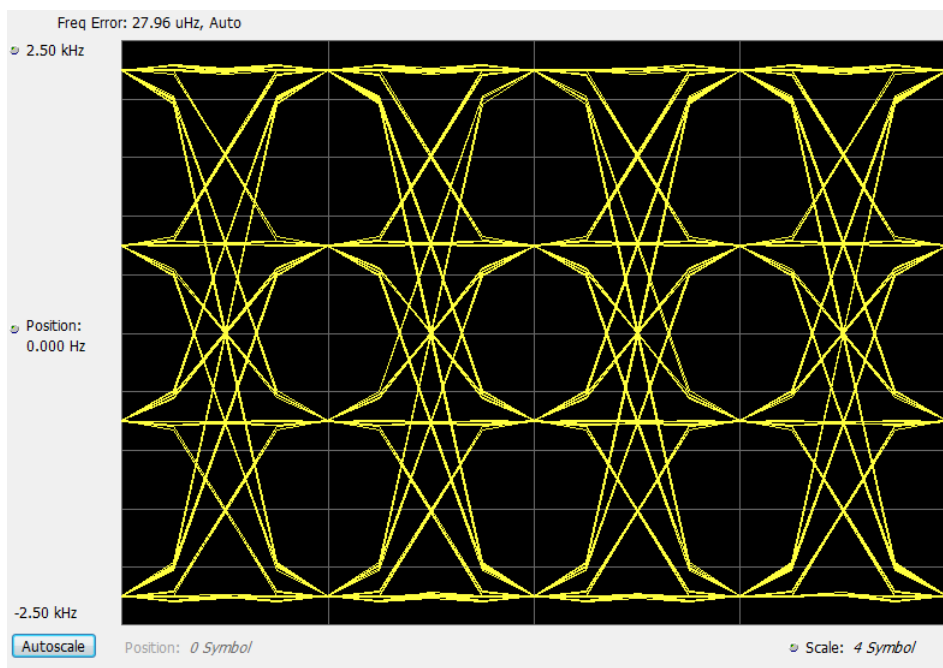
### Elements of the Display

The following image shows the P25 Eye display with Trace Type set to IQ.



The following image shows the P25 Eye display with Trace Type set to Freq Dev.





Item	Display element	Description
1	Top of graph	The vertical scale is normalized with no units (for IQ) and with Hz (for Freq dev).
2	Position	Specifies the value shown at the center of the graph display.
3	Bottom Readout	Displays the value indicated by the bottom of graph.
4	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
5	Position	Displays the horizontal position of the trace on the graph display.
6	Scale	Adjusts the span of the graph in symbols.
7	Freq Error	Displays the difference between the maximum and minimum measured values of the signal frequency during the Measurement Time. The readout can either be Freq Error where the result is followed by Auto or it could be Freq Offset where the result is followed by Manual. This choice between Freq Error and Freq Offset is made from the Analysis Params tab in the Settings control panel.

## P25 Eye Diagram Settings

### Application Toolbar:

The settings for the P25 Eye Diagram display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Trace (see page 314)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ.
<a href="#">Scale (see page 314)</a>	Defines the vertical and horizontal axes.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout and whether elements of the graphs are displayed.

## P25 Power vs Time Display

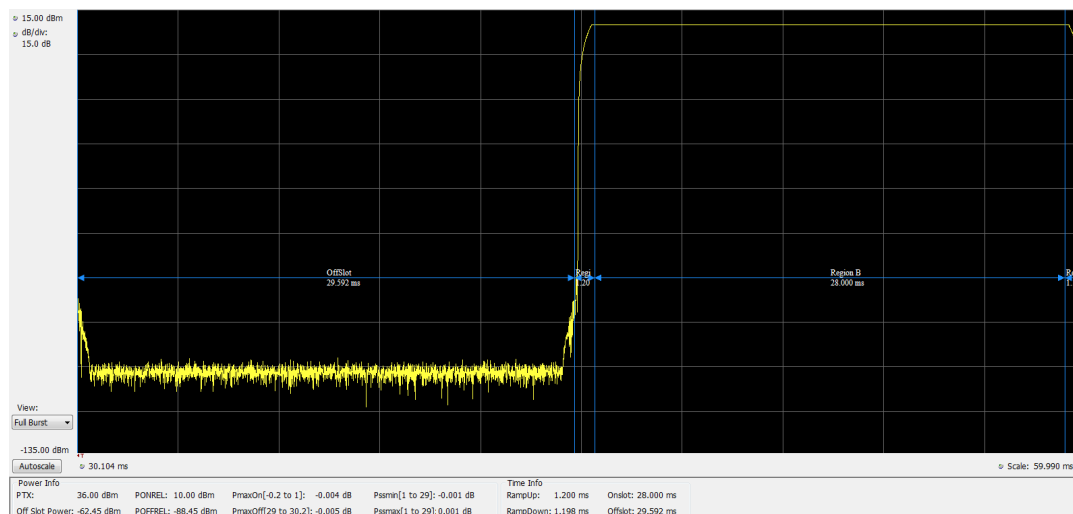
The P25 Power vs Time display shows the signal power amplitude versus time.

To show the P25 Power vs Time display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **P25 Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **P25 Power vs Time** icon or select the icon and click **Add**. The P25 Power vs Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the P25 Power vs Time display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.
8. Select the **Test Patterns** tab and choose a test pattern appropriate for the input signal.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display



Item	Display element	Description
1	Top of graph, first setting	Sets the Power level that appears at the top of the graph, in dBm. This is only a visual control for panning the graph.
2	Top of graph, second setting	Sets the vertical Scale of the graphs, in dB/div. This is only a visual control for panning the graph.
3	View (Only available for bursty HCPM data.)	Selects the specific view of the packet burst within the display: Full Burst displays the entire packet, with vertical lines indicating Power ramp up, On Slot, Power ramp down, and Off slot regions. Ramp Up zooms the display into the interval around the packet rising edge. Ramp Down zooms the display into the interval around the packet falling edge.
4	Bottom of graph readout	Shows the Power level at the bottom of the graph in dBm.
5	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
6	Bottom of graph, left side	Sets the starting time of the graph in seconds
7	Bottom of graph, right side	Sets the scale (width) of the graph in seconds
8	Table below graph	This table shows the following results.  For non-bursty signals: RF output power  For bursty signals: Power Info (Offslot Power and Power Envelope results) and Time Info.

## P25 Power vs Time Settings

### Application Toolbar:

The settings for the P25 Power vs Time display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Scale (see page 314)</a>	Defines the vertical and horizontal axes.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout and whether elements of the graphs are displayed.

## P25 Summary Display

The P25 Summary display shows a summary of all the scalar measurements done on the acquired test pattern. The summary display and contents will vary according to the selected standard.

Pass/Fail information is also provided in this display for all enabled scalar measurements. You can set limits and choose which measurement to compare for Pass/Fail from the Limits tab in the P25 Summary Settings control panel. The default limits come from the performance recommendation limits given by the Standard document. The default limits can be reloaded by selecting the P25 Standards Preset option or by loading the default limits table.

To show the P25 Summary display you can select **Presets > Standards > P25** or do the following:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **P25 Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **P25 Summary** icon or select the icon and click **Add**. The P25 Summary icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the P25 Summary display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.



8. Select the **Test Patterns** tab and select a test pattern. The available test patterns in the drop down list depend of the standard and modulation type you have selected.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

## P25 Summary Display

The Modulation Measurements, Power Measurements, and Trigger Measurements components of this display vary depending on which modulation type is selected.

The following image shows an example of the display for a Phase 1 C4FM signal.

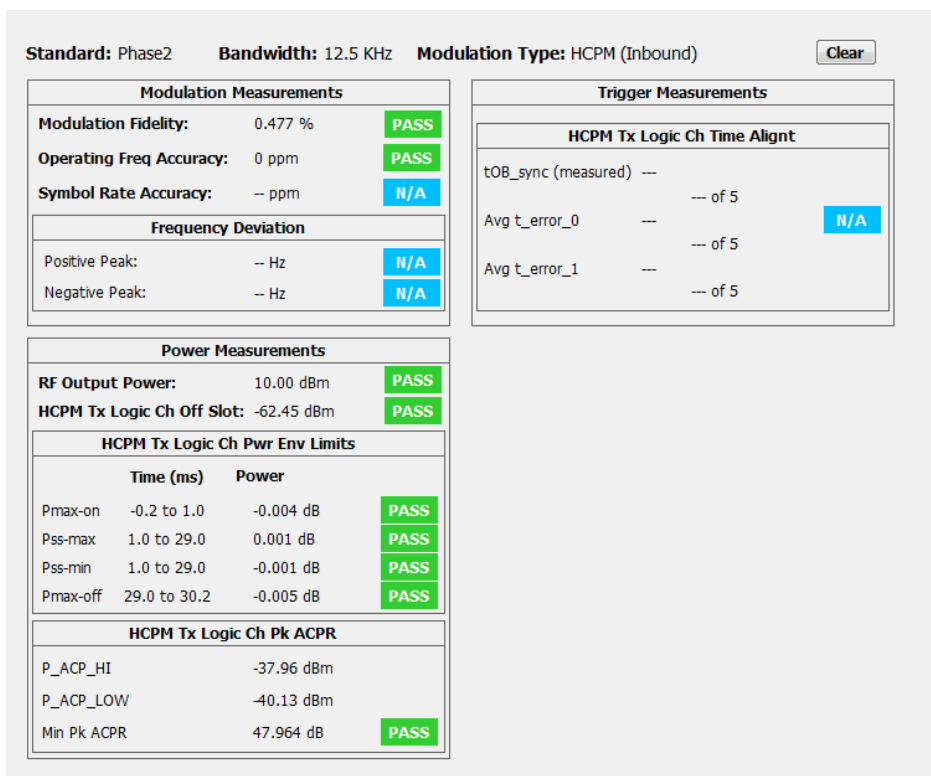
Standard: Phase1    Bandwidth: 12.5 KHz    Modulation Type: C4FM		Clear
<b>Modulation Measurements</b>		
Modulation Fidelity:	0.465 %	PASS
Operating Freq Accuracy:	0 ppm	PASS
Symbol Rate Accuracy:	-- ppm	N/A
<b>Frequency Deviation</b>		
Positive Peak:	-- Hz	N/A
Negative Peak:	-- Hz	N/A
<b>Power Measurements</b>		
RF Output Power:	10.00 dBm	PASS
<b>Trigger Measurements</b>		
<b>Phase1 Tx Attack Time</b>		
Avg Tx Pwr Attack	---	N/A
Avg Tx Encoder Attack	---	N/A
--- of 10		
<b>Phase1 Tx Attack Time (Busy/Idle)</b>		
Avg Tx Pwr Attack	---	
Avg Tx Encoder Attack	---	
--- of 10		
<b>Phase1 Tx Throughput Delay:</b> ---		
--- of 10		

The following image shows an example of the display for a Phase 1 C4FM High Deviation signal.

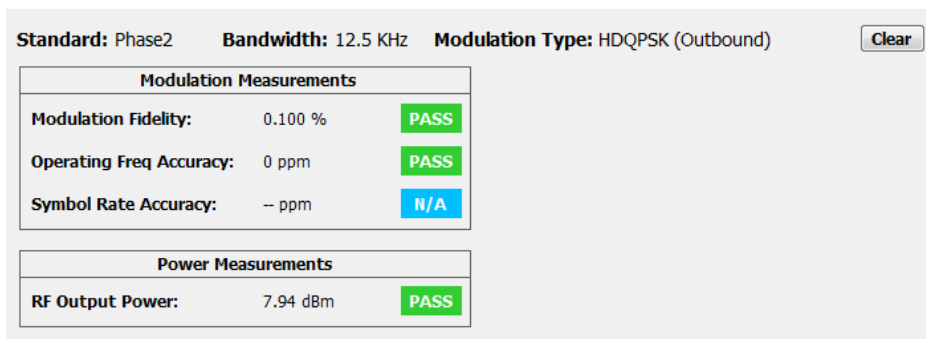
Standard: Phase1    Bandwidth: 12.5 KHz    Modulation Type: C4FM		Clear
<b>Modulation Measurements</b>		
Modulation Fidelity:	0.030 %	PASS
Operating Freq Accuracy:	0 ppm	PASS
Symbol Rate Accuracy:	0.00 ppm	PASS
<b>Frequency Deviation (Symbol Rate Pattern)</b>		
f1 Positive Peak:	2768.93 Hz	PASS
f2 Negative Peak:	-2865.77 Hz	PASS
<b>Power Measurements</b>		
RF Output Power:	10.00 dBm	PASS
<b>Trigger Measurements</b>		
<b>Phase1 Tx Attack Time</b>		
Avg Tx Pwr Attack	---	
Avg Tx Encoder Attack	---	
--- of 10		
<b>Phase1 Tx Attack Time (Busy/Idle)</b>		
Avg Tx Pwr Attack	---	
Avg Tx Encoder Attack	---	
--- of 10		
<b>Phase1 Tx Throughput Delay:</b> ---		
--- of 10		

The following image shows an example of the display for a Phase 2 HCPM (Inbound) signal.





The following image shows an example of the display for a Phase 2 HDQPSK (Outbound) signal.



For more information about specific measurement results, see the P25 Measurements section [here \(see page 325\)](#).



## Elements of the Display

Element	Description
Standard	Display of the standard selected on the Setup > Settings > Modulation Params tab.
Bandwidth	Display of the channel bandwidth which is set based on the standard and modulation type.
Modulation Type	Display of the modulation type selected on Setup > Settings > Modulation Parameters tab.
Clear	Click button to reset measurement. Clears all values.
Modulation Measurements	Shows the modulation measurements associated with the signal.
Power Measurements	Shows the power measurements associated with the signal.
Trigger Measurements	Shows the trigger measurements associated with the signal.

## P25 Summary Settings

### Application Toolbar:

The settings for the P25 Summary display are shown in the following table.

Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Limits (see page 318)</a>	Load and define P25 measurement limits for Pass/Fail comparison. You can save defined limits as a .csv file and also load previously saved .csv files.

## P25 Symbol Table Display

The P25 Symbol Table display shows decoded data values for each data symbol in the analyzed signal packet.

To show the P25 Symbol Table display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **P25 Analysis** in the **Measurements** box.



4. In the Available displays box, double-click the **P25 Symbol Table** icon or select the icon and click **Add**. The P25 Symbol icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the P25 Symbol Table display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.
8. Select the **Test Patterns** tab and select a test pattern. The available test patterns in the drop down list depend on the standard and modulation type you have selected.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

## P25 Symbol Table

The following image shows the P25 Symbol Table for HCPM (bursty) signals. For this signal type, the symbols are arranged as Bursts vs Symbols. The analysis is done only on the on slot regions of the bursty HCPM data and 160 symbols (centered at the middle of the burst) are reported on the symbol table for every on slot region. You can read more about specific measurements [here \(see page 325\)](#).

P25:HCPM modulation analysis is done only on Onslot regions		
	B1	B2
0	1	3
1	3	1
2	2	1
3	1	0
4	2	3
5	3	3
6	0	0
7	3	1
8	2	3
9	1	2
10	0	3
11	2	2
12	3	0
13	1	3
14	2	2
15	2	2
16	0	1
17	0	3
18	0	2
19	3	3
20	2	3
21	1	0
22	3	0
23	1	0

Marker: MR

Symbol: 18

Time: 69.411 ms

Value: 0

The following image shows the P25 Symbol Table for C4FM (non-bursty) signals. For this signal type and for HDQPSK, there is no grouping into bursts and all symbols that are analyzed are shown.



0	3	2	0	0	0	2	1	1	3	2	2	3	0	2	2	1
16	1	3	3	1	1	3	0	2	2	0	0	3	0	0	0	3
32	3	2	0	2	0	0	0	3	1	2	0	3	1	0	3	2
48	3	2	3	3	3	1	3	1	3	1	0	0	1	1	2	3
64	2	1	2	3	3	3	3	0	2	1	0	2	3	3	3	1
80	0	1	3	3	0	1	3	1	0	1	2	3	1	1	2	2
96	0	2	0	0	3	0	1	3	2	3	0	0	2	2	0	3
112	3	2	3	3	1	0	3	3	2	0	3	0	2	0	0	2
128	1	2	2	1	2	2	2	0	3	1	1	2	2	2	1	2
144	3	1	3	1	3	2	2	0	2	1	1	1	2	0	0	3
160	3	2	2	0	2	3	1	1	3	0	2	2	0	2	3	0
176	2	1	1	0	0	0	3	2	1	1	3	1	3	3	3	2
192	3	1	0	3	1	2	2	2	1	3	3	0	3	0	3	0
208	2	3	3	2	1	3	0	3	1	2	2	2	0	0	0	1
224	0	2	1	0	1	0	1	3	2	3	2	2	3	1	2	0
240	3	2	2	0	2	3	2	1	0	1	3	3	2	1	2	0
256	1	2	3	2	0	0	2	0	0	0	1	0	1	1	0	3
272	3	2	0	2	1	3	3	0	0	3	2	0	3	0	3	3
288	3	2	3	0	2	1	1	1	2	0	1	1	1	2	1	3
304	1	2	3	0	1	0	1	3	1	2	2	1	1	3	3	2
320	1	1	3	2	3	2	0	0	1	0	0	0	3	3	2	1

Marker: MR      Symbol: 152  
Time: 39.578 ms      Value: 2

## Elements of the Display

Element	Description
Marker	Displays the selected marker label.
Time	Displays the time in ms or in Symbols based on the Units chosen in the Analysis Time tab of the Settings Control panel.
Symbol	The value shown here reflects the symbol you have selected (highlighted) in the display.
Value	Displays the value of the selected symbol.

## P25 Symbol Table Settings

### Application Toolbar:

The settings for the P25 Symbol Table display are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout.

## P25 Frequency Dev vs Time Display

The P25 Frequency Deviation vs. Time Display shows how the signal frequency varies with time.

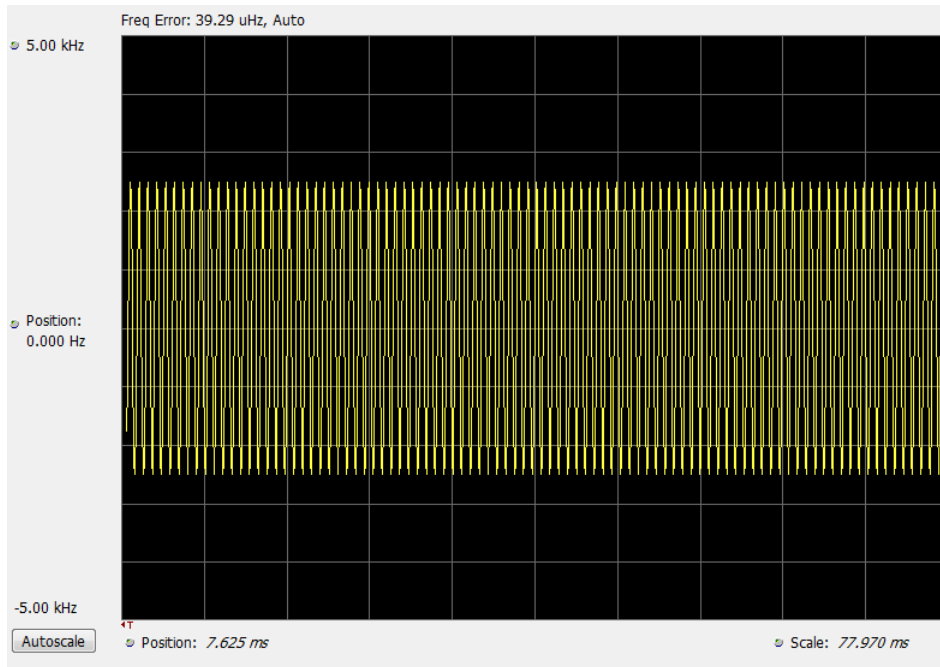
To display the P25 Frequency Dev vs. Time Display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Select the **Displays** button or **Setup > Displays**.
3. In the **Select Displays** dialog, select **P25 Analysis** in the **Measurements** box.
4. In the **Available displays** box, double-click the **P25 Frequency Dev vs. Time** icon or select the icon and click **Add**. The P25 Frequency Dev vs. Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to display the Freq Dev vs. Time display.
6. Select the **Modulation Params** tab. Set the Standard, Modulation Type, and Measurement and Reference filters as appropriate for the input signal.
7. Select the **Test Patterns** tab and select a test pattern. The available test patterns in the drop down list depend of the standard and modulation type you have selected.

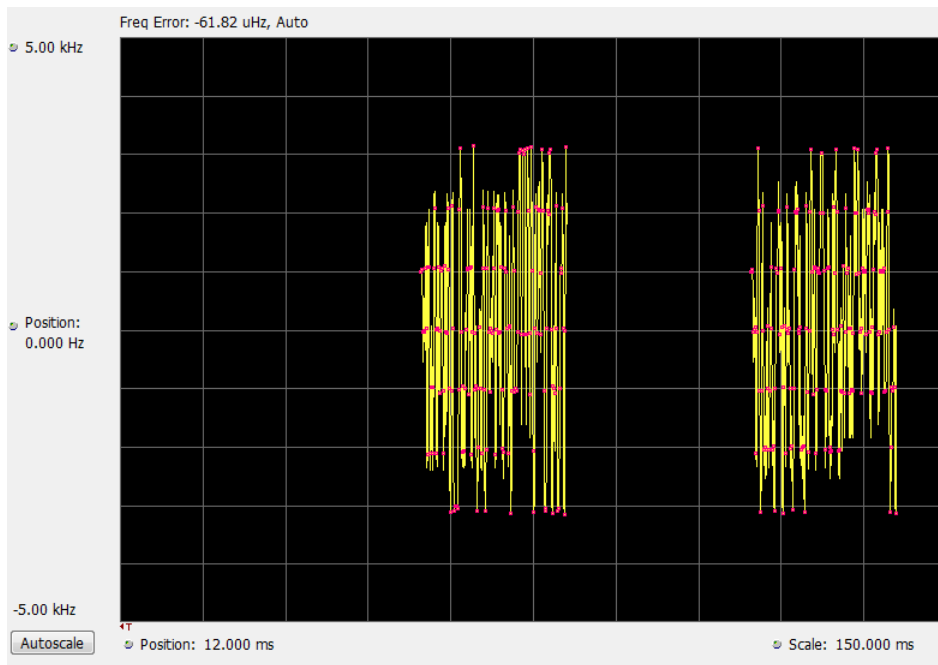
### Elements of the Display

The following image shows the P25 Freq Dev vs Time display for Phase 1 C4FM (non-bursty) High Deviation signals.





The following image shows the P25 Freq Dev vs Time display for Phase 2 HCPM (bursty) signals.





---

**NOTE.** For bursty HCPM signals, frequency deviation analysis is done only on 160 symbols centered at every on slot region in the chosen analysis window and not on off slot regions. That is why there is no information shown during off slot regions. You can read more specific information about P25 measurements [here \(see page 280\)](#).

---

### Elements of the Display

Item	Display element	Description
1	Top of graph adjustment	Adjust the frequency range displayed on the vertical axis.
2	Position (center)	Adjust 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	Position	Displays the horizontal position of the trace on the graph display.
5	Scale	Adjust the horizontal scale (time).

[Changing Frequency vs Time Display Settings \(see page 306\)](#)

## P25 Frequency Dev Vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

The Setup settings for P25 Frequency Dev vs. Time are shown in the following table.



Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the instrument to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Test Patterns (see page 313)</a>	Specifies the type of test pattern being used. Some analysis differs based on the selected test pattern. Available test patterns vary depending on the selected standard and modulation type.
<a href="#">Trace (see page 314)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ.
<a href="#">Scale (see page 314)</a>	Defines the vertical and horizontal axes.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout and whether elements of the graphs are displayed.

## P25 Analysis Shared Measurement Settings

### Application Toolbar:

The control panel tabs in this section are shared between the displays in P25 Analysis (Setup > Displays). Some tabs are shared by all the displays, some tabs are shared by only a subset of displays. The settings available on some tabs change depending on the selected display.

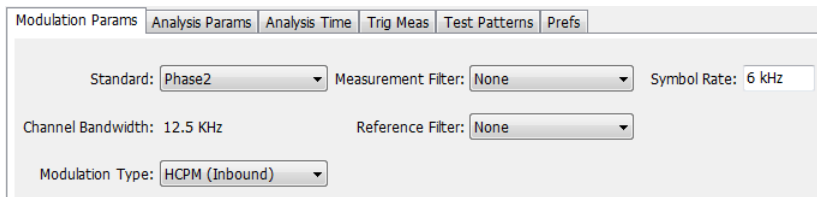


### Common controls for P25 analysis displays

Settings tab	Description
<a href="#">Modulation Params (see page 308)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 311)</a>	Specifies parameters used by the application to analyze the input signal.
<a href="#">Analysis Time (see page 311)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for P25 Analysis displays.
<a href="#">Trace (see page 314)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ.
<a href="#">Scale (see page 314)</a>	Defines the vertical and horizontal axes.
<a href="#">Test Patterns (see page 313)</a>	Enables you to select from eight different test patterns.
<a href="#">Trig Meas (see page 316)</a>	Enables you to select from various trigger measurements. The trigger selections vary by signal type.
<a href="#">Prefs (see page 317)</a>	Specifies the radix of the marker readout and whether elements of the graphs are displayed.

## Modulation Params Tab - P25

The Modulation Params tab specifies the type of modulation used by the input signal and other parameters that define the signal format.



The screenshot shows the 'Modulation Params' tab selected in a multi-tabbed interface. The tabs include 'Modulation Params', 'Analysis Params', 'Analysis Time', 'Trig Meas', 'Test Patterns', and 'Prefs'. The 'Modulation Params' tab contains the following controls:

- Standard:** A dropdown menu set to 'Phase2'.
- Measurement Filter:** A dropdown menu set to 'None'.
- Symbol Rate:** A text input field containing '6 kHz'.
- Channel Bandwidth:** A text input field containing '12.5 KHz'.
- Reference Filter:** A dropdown menu set to 'None'.
- Modulation Type:** A dropdown menu set to 'HCPM (Inbound)'.



Settings	Description
Standard	Specifies the standard used for the input signal: Phase 1, Phase 2.
Channel Bandwidth	This readout shows the nominal channel bandwidth based on the standard.
Modulation Type	Specifies the modulation type of the input signal. Choices vary depending on the selected standard. Modulation types for Phase 2 are HCPM (Inbound) and HDQPSK (Outbound). Phase 1 has only C4FM as the modulation type selection.
Measurement Filter	Specifies the filter used as a measurement.
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)
Symbol Rate	This is a readout that shows the symbol rate for demodulating digitally modulated signals based on the standard. This rate is always 4.8 kHz for Phase 1 signals and 6 kHz for Phase 2 signals.

## Symbol Rate

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

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

The bit rate used for Phase 1 (C4FM) is 9600 bps. For Phase 2 (HCPM and HDQPSK) it is 12000 bps. There are two bits per symbol for all above mentioned modulation types. Therefore, the symbol rate is 4800 Hz for Phase 1 and 6000 Hz for Phase 2.

## Measurement and Reference Filters

The available measurement and reference filters depend on the selected modulation type. The following table shows the recommended filters for the specified modulation types.



**CAUTION.** Although there are other filter types listed in the drop down menu, if you select any filter other than that which is recommended, the measurement results may not be accurate.

Modulation type	Measurement filters	Reference filters
HDQPSK	HDQPSK-P25	None
HPCM	None	None
C4FM	C4FM-P25	RaisedCosine (Filter parameter 0.2)

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 modulation fidelity is calculated.



## How to Select Filters

In a signal transmitter/receiver system, the baseband signal might be filtered for bandwidth limiting or for another kind of necessary shaping that needs to be applied. Normally, a filter in the transmitter ( $F_t$ ) and a filter in the receiver ( $F_r$ ) are applied.

The Measurement Filter setting in the analyzer corresponds to the baseband filter in the receiver ( $F_r$ ): This setting tells the analyzer what filter your receiver uses. When the analyzer is set to the same filter used by the receiver, the analyzer sees the signal as your receiver would. The Measurement Filter setting should be the same as the filter used in the receiver under normal operation (as opposed to testing).

The Reference Filter setting in the analyzer corresponds to the baseband filter in the transmitter-receiver combination ( $F_r * F_t$ ). The baseband filter for the transmitter-receiver combination is often referred to as the *System Filter*. This filter is called the reference filter because it is used to recreate a reference signal that is compared to the received signal. This recreated reference signal is the *ideal signal* with  $F_r * F_t$  applied; differences between this *ideal signal* and the received signal enables the determination of signal quality, such as modulation fidelity measurements.

## Filter Parameter (C4FM only)

The filter parameter specifies the alpha for the Raised Cosine 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. The recommended Reference filter for C4FM is Raised Cosine and the corresponding filter parameter for C4FM is 0.2.



## Analysis Params Tab - P25

The Analysis Params tab contains parameters that control the analysis of the input signal.

Modulation Params Analysis Params Analysis Time Test Patterns Prefs Trig Meas

Frequency Error:  ☒ Auto PTX:

Measurement BW:

Settings	Description
Frequency Error	When the Auto box is checked, the analysis determines the Frequency Error and the measured Frequency Error is displayed. When the Auto box is unchecked, the entered value is used by the analysis as a fixed frequency offset. This is useful when the exact frequency offset of the signal is known.
Measurement BW	Specifies the bandwidth about the center frequency at which measurements are made. Select Manual, Auto, or Link to Span.
PTX	Specifies the RF Output Power as recommended for transmitters. This is only used in the computation of off slot power in HCPM modulated signals.

## Analysis Time Tab - P25

The Analysis Time tab contains parameters that define how the signal is analyzed in the P25 Analysis displays.

Modulation Params Analysis Params Analysis Time Test Patterns Prefs Trig Meas

Analysis Offset:  ☒ Auto Time Zero Reference:

Analysis Length:  ☐ Auto Units:

Available: 31.816 ms



Settings	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 symbols or seconds, depending on the Units setting.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
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).
Time Zero Reference	Specifies the zero point for the analysis time.
Units	Specifies 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. 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.

## Time Zero Reference

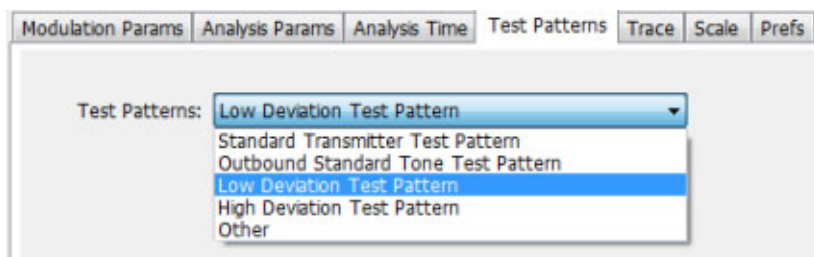
All time values are measured from this point (such as marker position or horizontal position (in Y vs Time displays). Choices are: Acquisition Start or Trigger. When a trigger measurement is chosen from the Trig Meas tab of the Settings control panel, Time Zero Reference is forced to Trigger.

Parameter	Description
Acquisition Start	Time zero starts from the point at which acquisition begins.
Trigger	Time zero starts from the trigger point.



## Test Patterns Tab - P25

Test patterns allow the software to compare the measurement result to the standards limit. The list of available test patterns varies depending on which standard and modulation type is selected.



Settings	Description
Test Patterns	Use this drop-down list to select an appropriate test pattern. The list varies depending on which standard and modulation type is selected.

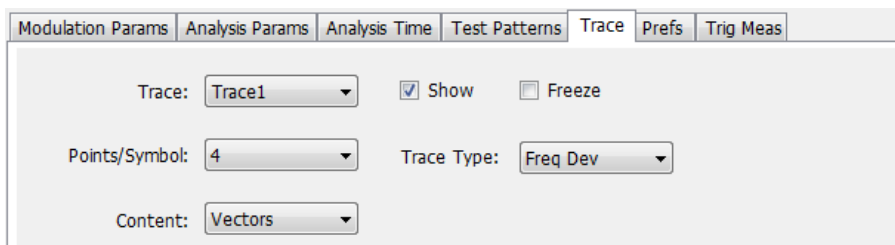
You can read more about test patterns [here \(see page 288\)](#).



## Trace Tab - P25

The Trace tab allows you to set the trace display characteristics of the P25 trace display. The selections vary depending on the selected display.

The following image shows the tab for the Constellation and Eye Diagram displays. For the other trace displays, the Trace Type setting is not available.



Setting	Description
Trace (P25 Constellation and P25 Eye Diagram displays only)	Select the trace to display. P25 Constellation display only: Select the trace that is hidden or displayed based on whether or not Show is selected.
Show (P25 Constellation and P25 Eye Diagram displays only)	Specifies whether the trace selected by Trace is displayed or hidden.
Freeze (P25 Constellation display only)	Halts updates to the trace selected by the Trace setting. Present for the Constellation display only.
Points/Symbol	Select how many points to use between symbols when connecting the dots. Values: 1, 2, 4, 8.
Content (P25 Constellation and P25 Freq Dev & Time displays only)	Select whether to display the trace as vectors (points connected by lines), points (symbols only without lines), or lines (lines drawn between symbols, but no symbols are displayed). The choices available depend on the display.
Trace Type (P25 Constellation and P25 Eye Diagram displays only)	Select to specify whether the plots in the Constellation and Eye Diagram displays are shown as I vs Q or as Frequency Deviation.

## Scale Tab - P25

The Scale tab allows you to change the scale settings that control how the trace appears on the display but does not change control settings such as Measurement Frequency. There are three versions of the Scale tab for P25 displays.



Scale tab for the P25 Eye Diagram display

Scale tab for the P25 Power vs Time display

Scale tab for the P25 Freq Dev vs Time display

Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale of the graph.
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.
Horizontal Full Burst	
Scale	Allows you to, in effect, change the span.
Position	Allows you to pan a zoomed trace without changing the Measurement Frequency.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Auto	When Auto is checked, the scale and position values for the Symbols graph are automatically adjusted to maintain the optimal display.
Reset	Resets the vertical and horizontal settings.

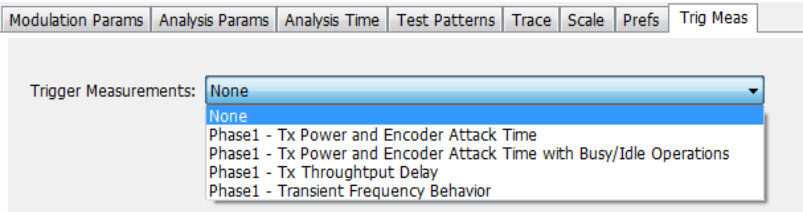


**NOTE.** The Units used for the horizontal scale can be either Seconds or Symbols. To set the units for the horizontal scale, display the Analysis Time tab. On the tab, select the appropriate units from the Units drop-down list.

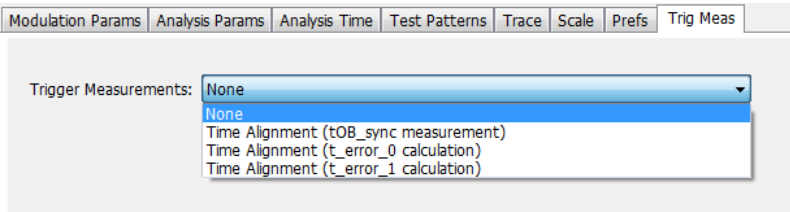
## Trig MeasTab - P25

The Trig Meas tab enables you to chose a trigger measurement. The available measurements in the drop-down menu depend on the standard and modulation type selected in the Modulation Params tab. The Trig Meas tab is not available for Phase 2 HDQPSK (Outbound) signals. You can read more about P25 trigger related measurements [here \(see page 283\)](#).

The following image shows the tab for Phase 1 (C4FM) signals.



The following image shows the tab for Phase 1 (HCPM Inbound) signals.

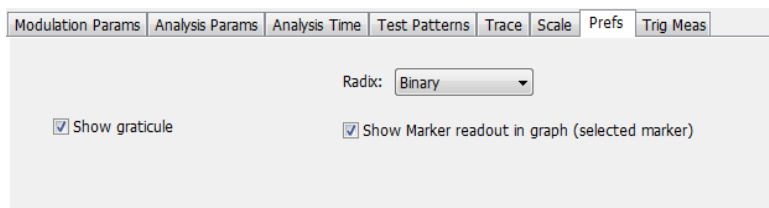


Settings	Description
Trigger Measurements	Select the trigger measurement test.



## Prefs Tab - P25

The Prefs tab enables you to change appearance characteristics of the P25 Analysis displays. Not all settings on the Prefs tab shown below appear for every P25 display. The Summary display does not have a Prefs tab.

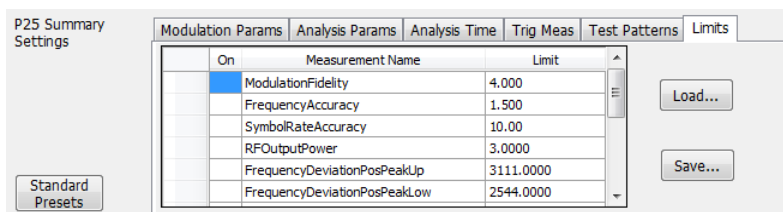


Setting	Description
Show graticule	Shows or hides the graticule.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Radix	Specifies how symbols are displayed in the Symbol Table display and in the Marker readout in the display. There are three choices for Radix: Binary (00,01,10,11), Quaternary (0,1,2,3), and Modulation Symbols (+1,+3,-1,-3).



## Limits Tab - P25

The Limits tab is only available for the P25 Summary display. It enables you to load an existing limits table, save a limits table, or edit limits values.



Setting	Description
Load	Click to load a saved Limits table from a .csv file.
Save	Click to save the current Limits table to a .csv file.

### Edit Limits

To directly edit measurement limits in the table, click on the value in the Limit column that you want to change.

The following table describes the parameters that are set in the Limits Table.

#### Limits Table Settings

Setting	Description
On	Click on the cell in the On column next to the measurement to specify whether or not measurements are selected for limit comparison to indicate Pass or Fail.. A check mark means the measurement will be taken. An empty box means it will not be taken.
Measurement Name	Specifies the name of the measurement related to the limit. (Not editable.)
Limit	Specifies the value of the limit to the related measurement. When the cell is selected, the value is shown along with the units.



# LTE Analysis

## Overview

The Long Term Evolution (LTE) Downlink RF Measurements Analysis option allows you to evaluate RF signals to ensure that they meet 3GPP measurements. These are described in the TS 36.104 Base Station (BS) radio transmission and reception and test specifications TS36.141 Base Station (BS) conformance testing documents version 12.5. This analysis option supports both LTE TDD and LTE FDD frame structures. This analysis option supports the following measurements.

- Channel Power
- Occupied Bandwidth
- Adjacent Channel Leakage Ratio (ACLR)
- Spectral Emission Mask (Operating Band Unwanted Emission)
- Cell ID
- For TDD LTE Transmitter Off Power

These measurements are also compared with the limits provided by the standard to give pass/fail results (except for Channel Power and OBW).

More detailed information about these measurements is available in the [LTE measurements](#) section and the supported measurements [table](#).

You can also select these measurements from four LTE preset test setups. The test setups load pre-configured displays and control setting as suggested by the standard to accelerate the test setup of the analyzer. The following four test setups are available for this analysis option.

- Cell ID
- ACLR
- Channel Power and TDD Toff Power
- SEM

More detailed information about these test setups is available [here](#).

With the LTE downlink RF Measurement Analysis test suite, test engineers can simplify the execution of a number of transmitter tests while still enabled to modify signal parameters for in-depth signal analysis. The analysis results give multiple views of LTE signal characteristics to allow the diagnosis of signal imperfections and impairments quickly and easily. Display controls allow you to selectively display the analysis results to help locate trouble spots in the signal.

## LTE topics in this Help

The following information about the LTE Analysis option is available:



- [Reference table of supported LTE measurements](#)
- [LTE measurements](#)
- [LTE Standards preset test setups](#)
- [LTE displays](#)
- [LTE measurement control settings](#)

## Supported LTE measurements

The following table gives a brief description of the available LTE measurements. More detailed information can be found here. [LTE measurements](#)

LTE measurement	LTE standard(s)	Description
Cell ID detection	TDD FDD	The Cell ID is detected from the input LTE signal.
Adjacent Channel Leakage Ratio (ACLR)	TDD FDD	The Adjacent Channel integrated power is calculated and shown. The relative power compared to the reference signal is also computed. The computed power is compared against limits suggested by the selected standard and pass/fail is reported. The appropriate settings for this measurement are loaded with the ACLR test setup (Presets>Standards>LTE).
Channel Power	TDD FDD	The channel power is calculated in the channel bandwidth.
Occupied Bandwidth	TDD FDD	The Occupied bandwidth is calculated as bandwidth containing 99% of the total integrated power in the selected span around the selected center frequency.
Operating Band Unwanted Emission	TDD FDD	The power in the offset regions is calculated and presented and compared against limits set in the offset and limits table and pass/fail is reported. The appropriate settings for this measurement are loaded with the SEM test setup (Presets>Standards>LTE).
T <sub>OFF</sub>	TDD	The power in off-slot region is computed and compared against selected limits.

## LTE Standards preset test setups

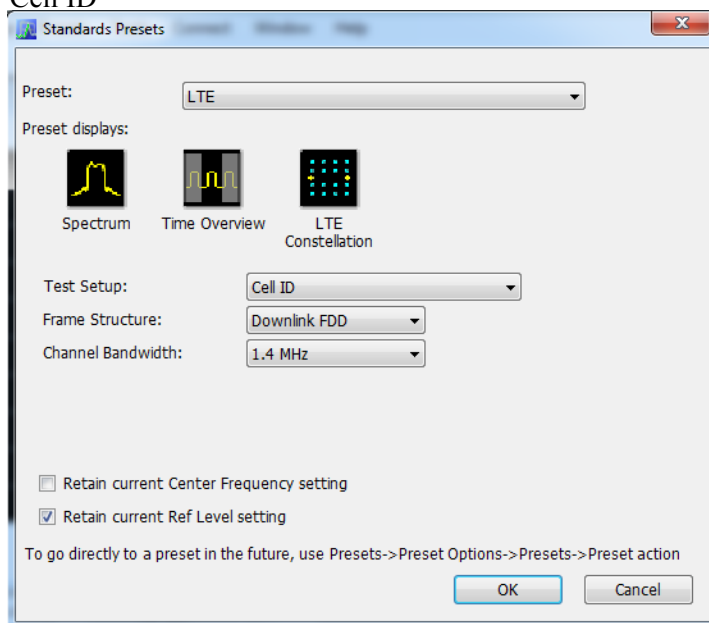
### Presets > Standards

The LTE Standards preset allows you to access displays preconfigured for the test setup you select. The test setups load the displays and control setting options suggested by the LTE standard to perform the measurements. You can read more about how Presets work [here](#).

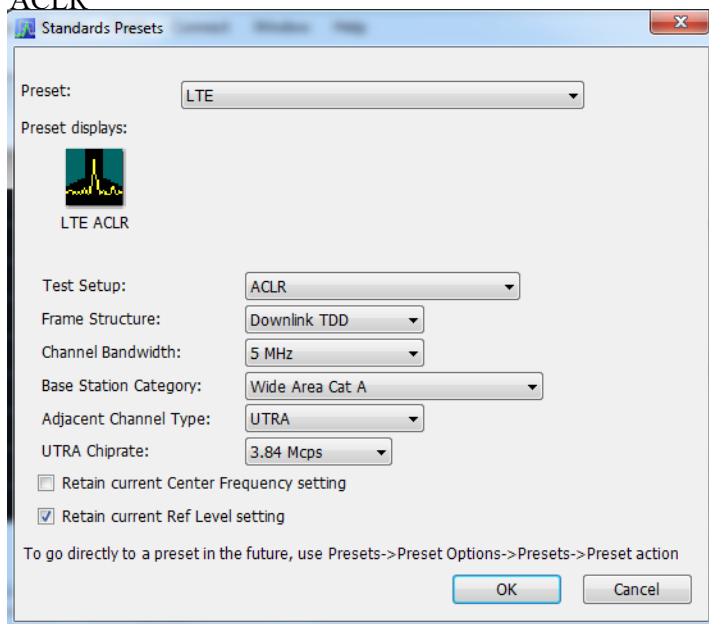


There are four test setups for LTE:

#### ■ Cell ID

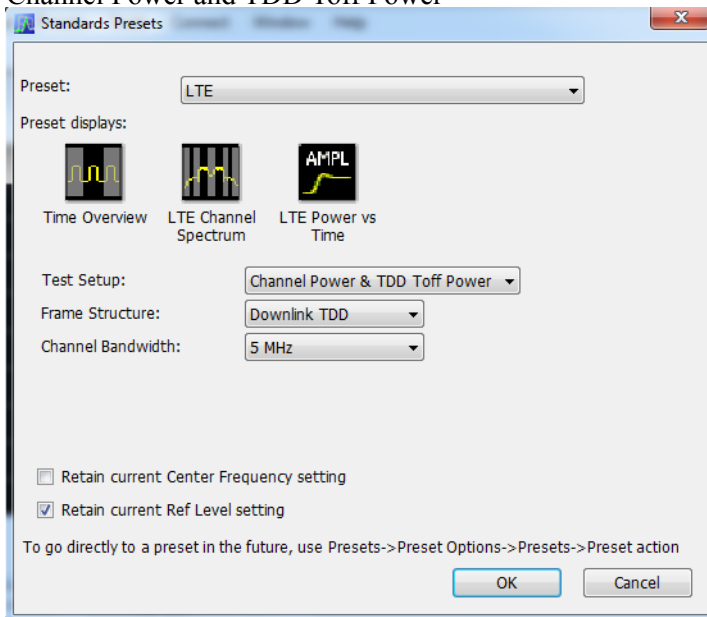


#### ■ ACLR

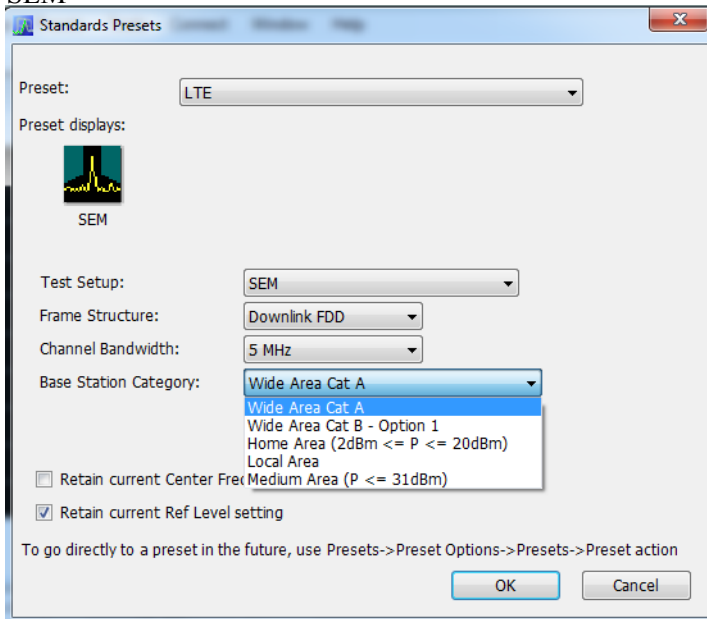




## ■ Channel Power and TDD Toff Power



## ■ SEM





The following table shows what automatically loads with each test setup.

**Table 5: LTE preset test setups**

Test setup		Displays loaded with preset
Cell ID	Frame structure: - Downlink FDD - Downlink TDD (Default is Downlink FDD.)	Spectrum, Time Overview, LTE Constellation
	Channel bandwidth: 1.4, 3, 5, 10, 15, 20 MHz (Default is 1.4 MHz.)	
ACLR	Frame structure: - Downlink FDD - Downlink TDD (Default is Downlink FDD.)	LTE ACLR
	Channel bandwidth: 1.4, 3, 5, 10, 15, 20 MHz (Default is 1.4 MHz.)	
	Base station category: - Wide Area Cat A - Wide Area Cat B — Option 1 - Home Area (P-rated $\leq 20$ dBm) - Local Area (P-rated $\leq 24$ dBm) - Medium Area (P-rated $\leq 38$ dBm) (Default is Wide Area Cat A.)	
	Adjacent channel type: - UTRA - E-UTRA (Default is UTRA.)	
	UTRA chip rate. 1.28 Mcps 3.84 Mcps 7.68 Mcps	
	Chip rate is only displayed under the following conditions: TDD is frame structure Adjacent channel type selected is UTRA Channel bandwidth is $>3$ MHz (Default chip rate is 3.84 Mcps.)	
Channel Power and TDD Toff Power	Frame structure: - Downlink FDD - Downlink TDD (Default is Downlink FDD.)	Time Overview (TDD only), LTE Channel Spectrum, LTE Power vs Time (TDD only)
	Channel bandwidth: 1.4, 3, 5, 10, 15, 20 MHz (Default is 1.4 MHz.)	



**Table 5: LTE preset test setups (cont.)**

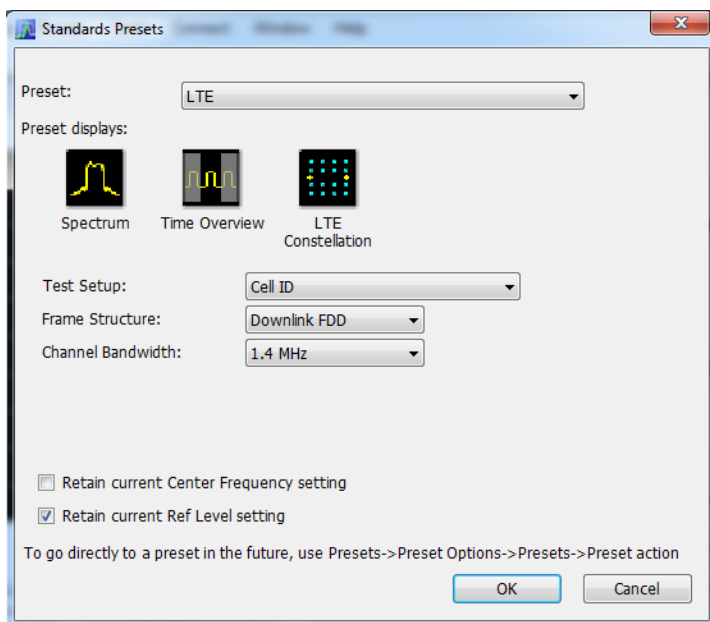
Test setup	Displays loaded with preset
SEM Frame structure: - Downlink FDD - Downlink TDD (Default is Downlink FDD.) Channel bandwidth: 1.4, 3, 5, 10, 15, 20 MHz (Default is 1.4 MHz.) Base station category: - Wide Area Cat A - Wide Area Cat B — Option 1 - Home Area ( $2 \text{ dBm} \leq P \leq 20 \text{ dBm}$ ) - Local Area - Medium Area ( $P \leq 31 \text{ dBm}$ ) (Default is Wide Area Cat A.)	SEM

### Retain current center frequency and reference level settings

The **Retain current Center Frequency setting** appears when the LTE Standards Preset is chosen. This setting allows you to retain the previously used center frequency. By default, the Center Frequency setting box is unchecked and the LTE preset displays will load with 1.96 GHz for FDD and 1.9 GHz for TDD.

The **Retain current Ref Level setting** appears when the LTE Standards Preset is chosen. This setting allows you to retain the previously used reference level. By default, the Ref Level setting box is checked.

To activate these settings, check the box next to the desired setting. The following image shows the **Retain current Ref Level setting** box checked.

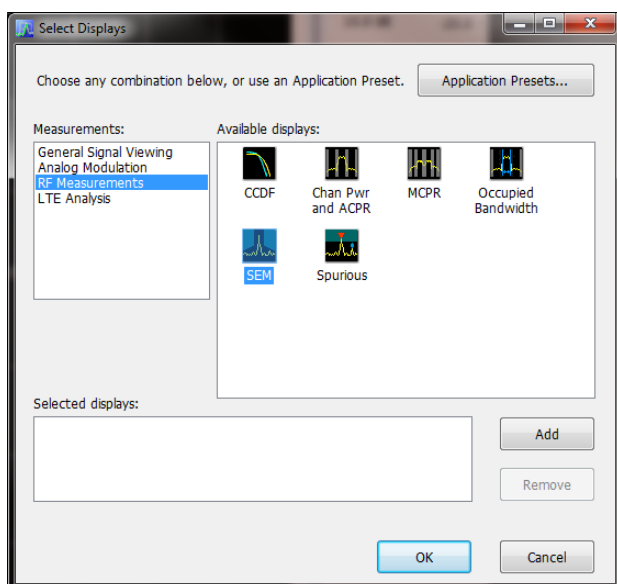




## LTE displays

The displays in LTE Analysis (Setup > Displays > Measurements: LTE Analysis) are:

- [LTE Channel Spectrum](#)
- [LTE ACLR](#)
- [LTE Constellation](#)
- [LTE Power vs Time](#)
- [SEM](#) (This display is not an LTE specific display, but is available when RF Measurements is selected from the Select Displays dialog (Setup > Displays) (see the following image).)



## LTE measurements

LTE Analysis enables RF measurements and detection of Cell ID in the transmitted signal for both TDD and FDD frame structure LTE signals. For TDD signals, the analysis will also do the  $T_{\text{OFF}}$  measurement. The following topics contain important information you should know about specific LTE measurements. You can view a table with all of the available measurements [here](#).

### Channel Power and Occupied Bandwidth (TDD and FDD)

The Channel Power measurement is done by calculating the power in the LTE signal based on the selected channel bandwidth option. The Occupied Bandwidth measurement calculates the frequency range over which 99% of the power is contained in the acquired signal. This measurement is done for the selected channel bandwidth option.



More information about this measurement:

- Select the Channel Power and TDD Toff Power test setup from Presets > Standards > LTE to perform the measurement. This will load the displays found in the [LTE preset test setups table](#).
- This test setup allows you to choose the frame structure and the channel bandwidth.
- The Channel Spectrum display will contain the results of Channel Power and Occupied Bandwidth. The result gives the power in the LTE signal (calculated over the channel bandwidth).
- Results are presented as scalar and are located below the display.
- For TDD signals, the channel power and the occupied bandwidth measurement are done on the on-slot region. If the valid on-slot region is not found, the measurement is done in the selected analysis length.

### ACLR (FDD and TDD)

The Adjacent Channel specification and limits for comparison are set based on selected frame structure, adjacent channel and base station types from Standards Presets. It calculates the integrated power in the different adjacent regions and also indicates pass/fail based on comparison with absolute and relative limits in LTE ACLR display.

More information about this measurement:

- Select the ACLR test setup from Presets > Standards > LTE to perform the measurement. This will load the displays found in the [LTE preset test setups table](#).
- This test setup allows you to select the frame structure, channel bandwidth, base station type, and adjacent channel type with the following restrictions:
  - Frame Structure can be TDD or FDD
  - Channel Bandwidth can be 1.4, 3, 5, 10, 15, or 20 MHz
  - Base station type can be Wide Area Cat A, Wide Area Cat B- Option 1, Home Area (P-rated  $\leq 20$  dBm), Local Area (P-rated  $\leq 24$  dBm), Medium Area (P-rated  $\leq 38$  dBm)
  - Adjacent Channel type can E-UTRA or UTRA
  - UTRA chip rate can be 1.28, 3.84, or 7.68 Mcps

Default rate is 3.84 Mcps for all UTRA adjacent channels of FDD and when channel bandwidth is 1.4 or 3 MHz.

However, you can choose other rates when the frame structure is TDD and when the bandwidth is more than 3 MHz. Otherwise, the standard recommends use of 3.84 Mcps.

- Based on the settings you select from Standards Preset, the offset and bandwidth of the adjacent channels are set in the Offset and Limits tab of the control panel. The settings are different for paired and unpaired spectrum.
- The settings also include the absolute power limit for comparison based on the base station type. The standard recommends the settings in dBm/MHz for each base station type. The power limits are appropriately scaled with the integration bandwidth and presented in dBm in the Offset and Limits table of the display. The integrated power in each adjacent band is compared with the absolute and relative limits as recommended by the standard. The absolute limits are dependent on this choice of



base station type because they apply to different power levels (as the P-rated levels in the drop down menu indicate). The relative limit is also set.

- The results are presented in both tabular and display format. In the tabular display, the reference channel power and the offset, bandwidth, integrated power, and relative power of the adjacent channels are presented. An expanded view format is also available.
- The integrated power in the display is shaded blue in each adjacent channel region.
- Each adjacent channel is clearly shown. Interadjacent channel gaps are shown in gray.
- The limit lines are shown in different colors. Based on the Mask option chosen in the Offset & Limits table, failures in the different bands are shown in red on violation. By default for LTE Standards Presets, the Mask option is Abs & Rel, so the failure is shown only when the calculated power violates both relative and absolute power limits.
- The respective rows that violate both absolute and relative limits are also shown in red. Pass/fail information appears in the top left corner of the display.
- This measurement can be performed in Real Time or Non-Real Time mode. In Real Time mode, a single acquisition required for the entire span needed for this measurement is taken and the measurement is done. In the Non-Real Time mode, a separate acquisition for each adjacent channel region is taken and analyzed.

Non-real time mode is also useful when the bandwidth offered by the instrument does not support the span requirement for this measurement. The span requirement comes from the choice of adjacent channel type and channel bandwidth. In such cases, Non-Real Time mode can be used.

- For UTRA adjacent channels, filtering of the adjacent channels with an RRC filter of the same bandwidth is employed, as suggested by the standard. The chip rate is set to 3.84 Mcps for FDD and when the channel bandwidth is 1.4 or 3 MHz. For TDD, when the channel bandwidth is more than 3 MHz, you can choose the UTRA chip rate from the ACLR test setup (Presets > Standards > LTE). The options are 1.28, 3.84, and 7.68 Mcps.
- The standard recommends this measurement be done on the transmitter ON period when the signal being analyzed is TDD. An on slot detection module in the analysis helps you to do the measurement in the transmitter ON period.
  - If you are doing the measurement in Real Time, you can also load the Time Overview display, which will indicate to you the region in which the measurement is done (a purple line at the bottom). You can see the measurement is done only on the valid transmitter ON period. However, when a bursty data is not available, the measurement is done on the available analysis length.

---

**NOTE.** Real-Time mode can be set from the [Parameters tab](#) of the Settings control panel of the LTE ACLR display. Disabling Real-Time mode is the non-Real-Time setting.

---

- When the measurement is done in non-Real Time mode, separate acquisitions are obtained for each adjacent channel band. In such cases, it cannot be ensured that all the adjacent channel acquisitions are done on the transmitter ON period. It is recommended that you use either Real time mode or an external trigger from the source (when used with non-Real-Time mode) to do the measurement. An external trigger from the source can ensure that all the acquisitions are done just



after the rising edge of the burst. A status message in the display indicates when to use Real-Time mode or external trigger for TDD signals. The status message that is displayed in the LTE ACLR display is "Signal must be triggered or measurement in Real-Time". This message is displayed when TDD is chosen from Standard Presets, when Real-Time is not enabled from the Parameters tab of the control panel, and when the instrument is in Free Run mode.

## Operating Band Unwanted Emission (FDD and TDD)

This measurement finds the power in the offset regions recommended by the standard. The offset channel specification and limits for comparison are set based on the selected channel bandwidth, frame structure, and base station types in Standards Preset. It calculates the integrated power in the different offset regions and also indicates pass/fail information based on comparison with absolute and relative limits in the SEM display.

More information about this measurement:

- Select the SEM test setup from Presets > Standards > LTE to perform the measurement. This will load the displays found in the [LTE preset test setups table](#).
- This test setup allows you to select the frame structure, channel bandwidth, and base station type with the following restrictions:
  - Frame Structure can be TDD or FDD
  - Channel Bandwidth can be 1.4, 3, 5, 10, 15, or 20 MHz
  - Base station type can be Wide Area Cat A, Wide Area Cat B - Option 1, Home Area ( $2 \text{ dBm} \leq P \leq 20 \text{ dBm}$ ), Local Area, Medium Area ( $P \leq 31 \text{ dBm}$ )
- Based on the settings chosen by the user from Standards Presets the offset and bandwidth of the offset channels are set in the Offset and Limits tab of the control panel of SEM display.
- The settings also include the absolute power limit for comparison based on the base station type. The standard recommends the settings in dBm/MHz for each base station type. The power limits are appropriately scaled with the integration bandwidth and presented in dBm in the Offset and Limits table of the display. The integrated power in each adjacent band is compared with the absolute and relative limits as suggested by the standard. The absolute limits are dependent on this choice of base station type as they apply to different power levels (as the P-rated levels in the drop down menu indicate). The relative limit is also set.
- The results are presented both in tabular and display form.
- The Pass/ Fail information is also shown in the top left corner of the display.
- For TDD signals, a detection module in the analysis helps you to do the measurement in the transmitter ON period.
  - If you are doing the measurement in Real Time, you can also load the Time Overview display, which will indicate to you the region in which the measurement is done (a purple line at the bottom). You can see the measurement is done only on the valid transmitter ON period. However, when a bursty data is not available, the measurement is done on the available analysis length.



---

**NOTE.** *Real-Time mode can be set from the [Parameters tab](#) of the Settings control panel of the SEM display. Disabling Real-Time mode is the non-Real-Time setting.*

---

- When the measurement is done in non-Real Time mode, separate acquisitions are obtained for each adjacent channel band. In such cases, it cannot be ensured that all the adjacent channel acquisitions are done on the transmitter ON period. It is recommended that you use either Real-Time mode or an external trigger from the source (when used with non-Real Time mode) to do the measurement. An external trigger from the source can ensure that all the acquisitions are done just after the rising edge of the burst. A status message in the display indicates when to use Real Time mode or external trigger for TDD signals. The status message that is displayed in the LTE SEM display is "Signal must be triggered or measurement in Real-Time". This message is displayed when TDD is chosen from Standard Presets, when Real-Time is not enabled from the Parameters tab of the control panel, and when the instrument is in Free Run mode.



- Settings for all tables provided in the base station conformance testing document (3GPP TS 36.141 v12.5 – for Release 12) has been incorporated from Standards Presets.
  - Wide Area and Local area settings from standard presets are provided as per the standard document.
  - Home Area base station settings loaded from standard presets correspond to Reference power levels between 2 to 20 dBm.
  - Medium Area base station settings loaded from standard presets correspond to reference power levels less than 31 dBm.
- The following settings are provided in a \*.csv file that you can load. These files will be available in the installed directory (Example Files\LTE).
  - Wide Area category B Option 2 (for specific bands specified by the standard). There are three csv files based on operating band and channel bandwidth for Wide Area.
    - LTE\_SEM\_1.4MHz\_CatB\_optn2\_bands\_3\_8.csv
    - LTE\_SEM\_3MHz\_CatB\_optn2\_bands\_3\_8.csv
    - LTE\_SEM\_5to20MHz\_CatB\_optn2\_bands\_1\_3\_8\_32\_33\_34.csv
  - Home Area base station for power level less than 2 dBm. There are six csv files based on operating band and channel bandwidth for Home Area.
    - LTE\_SEM\_1\_4MHz\_above3GHz\_Home2P.csv
    - LTE\_SEM\_1\_4MHz\_below3GHz\_Home2P.csv
    - LTE\_SEM\_3MHz\_above3GHz\_Home2P.csv
    - LTE\_SEM\_3MHz\_below3GHz\_Home2P.csv
    - LTE\_SEM\_5to20MHz\_above3GHz\_Home2P.csv
    - LTE\_SEM\_5to20MHz\_below3GHz\_Home2P.csv
  - Medium Area base station for reference power level between 31 to 38 dBm. There are six csv files based on operating band and channel bandwidth for Medium Area.
    - LTE\_SEM\_1\_4MHz\_above3GHz\_Medium31P38P.csv
    - LTE\_SEM\_1\_4MHz\_below3GHz\_Medium31P38.csv
    - LTE\_SEM\_3MHz\_above3GHz\_Medium31P38.csv
    - LTE\_SEM\_3MHz\_below3GHz\_Medium31P38.csv
    - LTE\_SEM\_5to20MHz\_above3GHz\_Medium31P38.csv
    - LTE\_SEM\_5to20MHz\_below3GHz\_Medium31P38.csv
  - Additional requirements given in Section 6.6.3.5.3 in 3GPP TS 36.141 v12.5 standard document. There are 14 csv files based on the requirements in the standard document. The files are named based on the table numbers of Section 6.6.3.5.3 of the standard document (3GPP TS 36.141 V12.5.0 (2014-09)).



## Cell ID (TDD and FDD)

The dominant Cell ID in the transmitted LTE signal is detected and presented in the Constellation display. Along with the Cell ID scalar results, the group and sector ID are also presented. The constellation of the Primary and Second Synchronization signals are presented too.

More information about this measurement:

- Select the Cell ID test setup from Presets > Standards > LTE to perform the measurement. This will load the displays found in the [LTE preset test setups table](#).
- This test setup allows you to select the frame structure and channel bandwidth with the following restrictions:
  - Frame Structure can be TDD or FDD
  - Channel Bandwidth can be 1.4, 3, 5, 10, 15, or 20 MHz
- Analysis of the LTE signals is done based on the settings you choose in the Standards Presets.
- The constellation for PSS and SSS (Primary and Secondary Synchronization Signals) are shown. You can optionally select to view only the PSS or SSS constellation (selection is made in the Trace tab).
- Equalization based on PSS (Primary Synchronization Signal) data can be enabled using the "Enable Equalization" option (available in the Analysis Params tab of the Settings Control panel.) This Equalization is based on PSS data and applied on other parts of the OFDM symbol.

## TOFF (TDD)

The  $T_{\text{OFF}}$  measurement is done only for the TDD signal. It is a measure of the off slot power in a LTE TDD signal.

More information about this measurement:

- Select the Channel Power and TDD TOFF Power test setup from Presets > Standards > LTE to perform the measurement. This will load the displays found in the [LTE preset test setups table](#).
- This test setup allows you to select the frame structure and channel bandwidth with the following restrictions:
  - Frame Structure can be TDD or FDD
  - Channel Bandwidth can be 1.4, 3, 5, 10, 15, or 20 MHz
- Analysis of the LTE signals is done based on the settings you choose in the Standards Presets.
- By default, the  $T_{\text{OFF}}$  measurement is the average of several non-overlapping and adjoining 70  $\mu\text{s}$  windows in the off slot region. This measurement is done only on the 70  $\mu\text{s}$  window in the center of the off slot region, when the **Average over entire offslot region** option is disabled.
- The scalar result is presented in dBm/MHz.
- The result is compared against limits that can be defined using the Limits tab of the control panel. By default, these limits are set based on the Base Station conformance testing document (3GPP TS 36.141 v12.5 – for Release 12). Pass/fail is shown in the top left corner of the LTE Power vs Time display.



## LTE Status Messages

The following status messages may appear. Each message indicates the related condition (Description) shown in the following table.

Status message	Description
LTE Analysis: Signal must be triggered or measured in Real Time	<p>Shown in the display and status bar when the user attempts to make the ACLR measurement and SEM measurement for TDD signals in non-Real-Time mode and when the instrument is in free run.</p> <p>Since the standard recommends the ACLR measurement to be done in transmitter ON periods only, either the measurement has to be done in Real-Time mode (in which a detection module ensures the measurement is done on the transmitter ON period) or has to be externally triggered if in non-Real-Time mode.</p>
LTE Analysis: Recovery done on PSS/SSS on the center 62 carriers	<p>Shown in the status bar to indicate that the constellation of PSS and SSS shown in the LTE constellation is done based on analysis of PSS and SSS signals in the center 62 carriers of the corresponding OFDM symbols.</p> <p>Therefore, you may see the correct constellation and Cell ID even when a different channel bandwidth is chosen from the control panel because the analysis for PSS and SSS is done only on the center carriers.</p>
LTE Analysis: Analysis Failure - Synchronization Sequence not found	Shown in the status bar to indicate that a valid Cell ID (from PSS and SSS) is not detected.

## LTE ACLR display

The LTE Adjacent Channel Leakage Ratio (ACLR) display shows 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.

To show the LTE ACLR display you can select **Presets > Standards > LTE**.

---

**NOTE.** Loading the LTE ACLR display from the **Presets > Standards > LTE** menu is recommended. This loads the control settings based on the selected options.

---

You can also load the LTE ACLR display as follows:

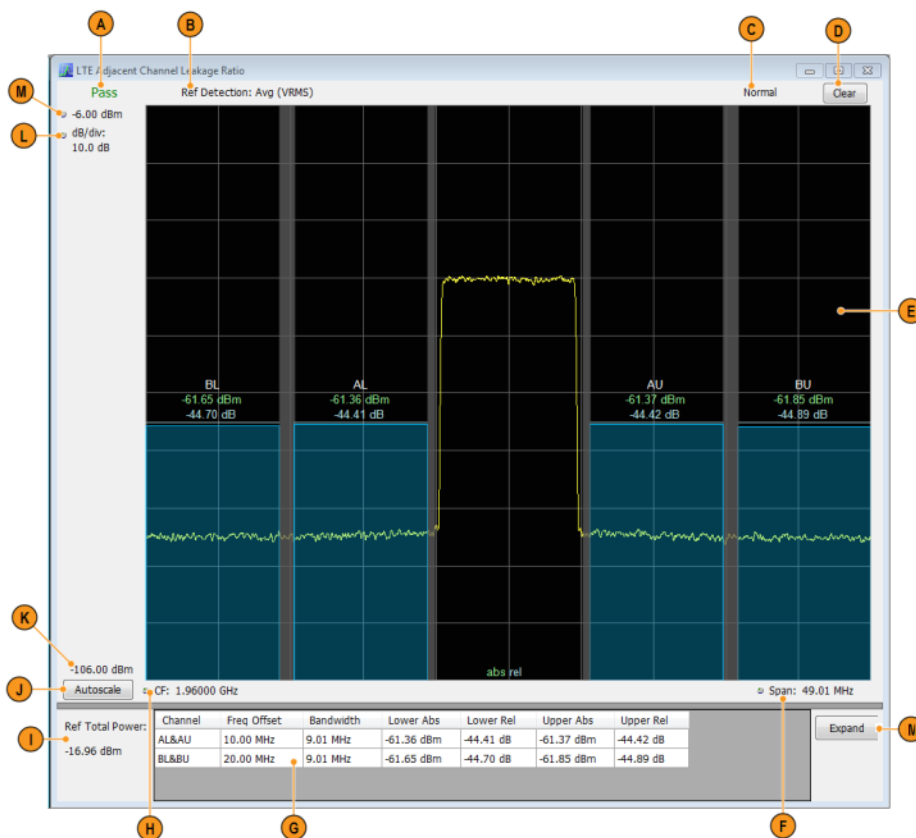
1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** window, select **LTE Analysis** in the **Measurements** box.



4. In the Available displays box, double-click the **LTE ACLR** icon or select the icon and click **Add**. The LTE ACLR icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click the **OK** button to show the display.
6. Select **Setup > Settings** to display the control panel.
7. Select **Replay/Run** to take measurements on the acquired data.
8. If you are analyzing a data file, click the **Replay** button to take measurements on the recalled acquisition data file.

## Elements of the Display

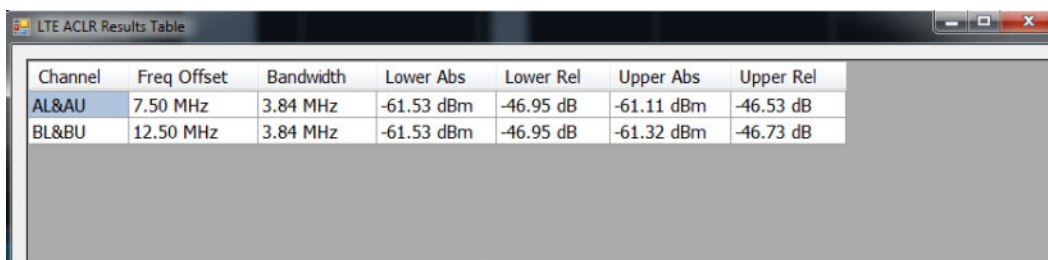
The following image shows the LTE ACLR display.





Item	Display element	Description
A	Pass/Fail	Indicates Pass or Fail based on Absolute and Relative limits set by the user. The failure condition is set by Mask in the Offset and Limits Table tab of the Settings control panel. By default, the mask is set to Abs & Rel, meaning failure is reported only when both absolute and relative results fail against the respective limits.
B	Ref Detection	Set to Avg (VRMS) or +Peak based on the choice made in Processing tab of the Settings control panel.
C	Normal	Indicates how the result is presented over multiple sweeps. This selection is made in the Processing tab of the control panel. Displays Average Count if Avg (VRMS) is checked in the Processing tab in the Settings control panel.
D	Clear	Resets measurement. Clears all values.
E	Plot	Shows the reference channel and adjacent channels and the regions in between them. The Absolute and Relative limit lines are also shown. The integrated power is shown as a band. Scalar results are also shown.
F	Span	Adjust the span of the graph in symbols.
G	Results Table	Tabulates the results in each adjacent band. Table shows the offset, bandwidth, Integrated Absolute and Relative power in the upper and lower adjacent channel regions.
H	CF	Center Frequency at which the measurement is performed.
I	Ref Total Power	Gives the power in the Reference channel.
J	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
K	Bottom readout	Displays the value indicated by the bottom of graph.
L	dB / div	Shows the dB per each division in the Y axis of the plot.
M	Top of graph	The vertical scale is normalized with appropriate power units.
N	Expand button	Shows the results table in its own window with larger font size.

Clicking on the **Expand** button allows you to view the results table in a separate window, as shown in the following image.



Channel	Freq Offset	Bandwidth	Lower Abs	Lower Rel	Upper Abs	Upper Rel
AL&AU	7.50 MHz	3.84 MHz	-61.53 dBm	-46.95 dB	-61.11 dBm	-46.53 dB
BL&BU	12.50 MHz	3.84 MHz	-61.53 dBm	-46.95 dB	-61.32 dBm	-46.73 dB

## LTE ACLR Settings

Application Toolbar: 



The LTE ACLR Settings control panel provides access to settings that control parameters of the LTE ACLR display.

Settings tab	Description
<a href="#">Channels (see page 342)</a>	Allows you to control how the measurement is performed. When in Real Time, the RBW and VBW settings apply for all channels (including offset regions) and the other parameters apply only for the reference channel. When Non-Real Time mode is selected, all information in this tab, including RBW and VBW, only applies to the reference channel.
<a href="#">Parameters (see page 344)</a>	Specifies several characteristics that control how the measurement is made. These parameters are used by the instrument to analyze the input signal.
<a href="#">Processing (see page 346)</a>	Specifies settings for detection on the reference channel and the offsets. Specifies the function setting on how calculations are done across multiple sweeps.
<a href="#">Offsets &amp; Limits Table (see page 347)</a>	Allows you to select the characteristics of offsets and mask limits.
<a href="#">Scale (see page 348)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Prefs (see page 350)</a>	Allows you to select to show or hide the graticule, power level, limits, and marker readouts.

## LTE Channel Spectrum display

The LTE Channel Spectrum display shows the spectrum of the input signal across one channel. Channel power measures the average power within the selected bandwidth and is expressed in dBm. Other units can be selected from the Units tab of the Analysis control panel. The measured occupied bandwidth is calculated as the bandwidth containing 99% of the total integrated power within the selected span around the selected center frequency.

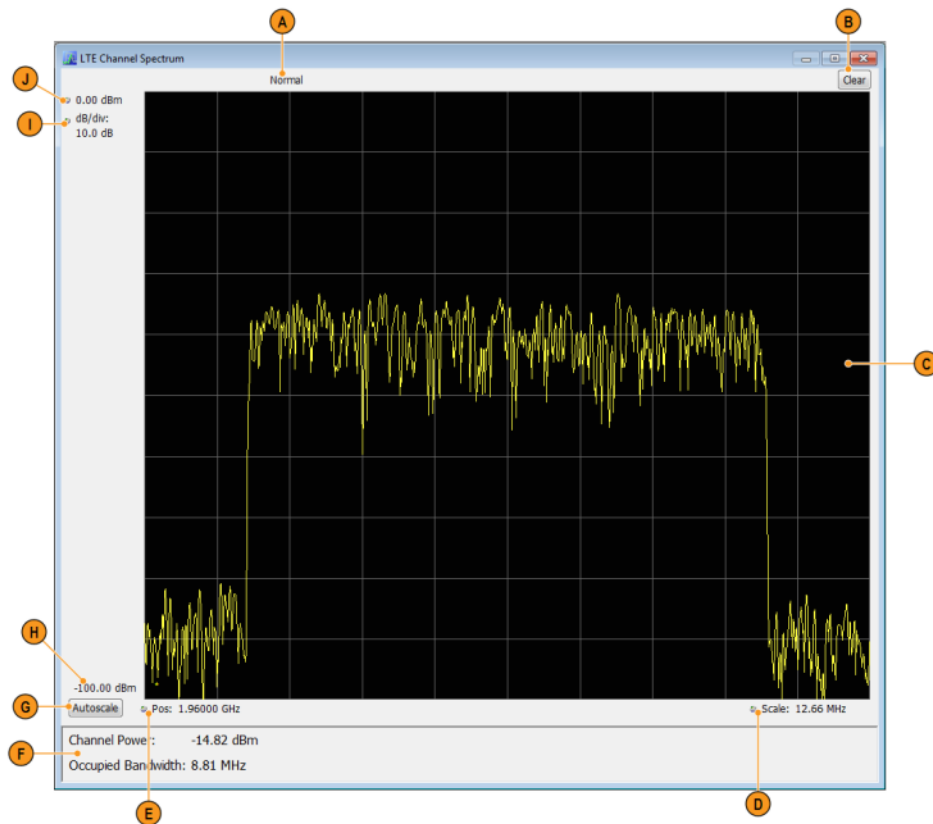
To show the LTE Channel Spectrum display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. From the **Measurements** box, select **LTE Analysis**.
4. Double-click the **LTE Channel Spectrum** icon in the **Available Displays** box. This moves the LTE Channel Spectrum icon to the **Selected displays** box.
5. Click **OK** button to view the display.
6. Select **Setup > Settings** to display the control panel.
7. Select **Replay/Run** to take measurements on the acquired data.
8. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image shows the LTE Channel Spectrum display.







Item	Display element	Description
A	Normal	Displays Average Count if Average is turned on (set to Time Domain or Frequency Domain) from the Measurement Params tab in the Settings control panel.
B	Clear	Resets measurement. Clears all values.
C	Plot	Specifies the value shown at the center of the graph display.
D	Scale	Adjust the span of the graph.
E	Position	Displays the horizontal position of the trace on the graph display.
F	Scalar results	Shows the Channel Power and Occupied Bandwidth measurement results.
G	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
H	Bottom readout	Displays the value indicated by the bottom of graph.
I	dB / div	Shows the dB per each division in the Y axis of the plot.
J	Top of graph	The vertical scale is normalized with appropriate power units.

## LTE Channel Spectrum Settings

### Application Toolbar:

The settings for the LTE Channel Spectrum display are shown in the following table.

Settings tab	Description
<a href="#">Freq &amp; RBW (see page 353)</a>	Allows you to specify the frequency and resolution bandwidth used for the measurement.
<a href="#">Measurement Params (see page 354)</a>	Allows you to set averaging (Time Domain, Off, or Frequency Domain) and to set the number value associated with the Average setting.
<a href="#">Channels (see page 342)</a>	Allows you to set the Channel BW for the Channel Power measurement.
<a href="#">Scale (see page 348)</a>	Allows you to specify the horizontal and vertical scale settings.
<a href="#">Prefs (see page 350)</a>	Allows you to select to show or hide certain display elements.

## LTE Constellation display

The LTE Constellation display shows the constellation of Primary (PSS) and Secondary (SSS) Synchronization Signals. Scalar results include Cell ID, Group ID, Sector ID, and frequency error.

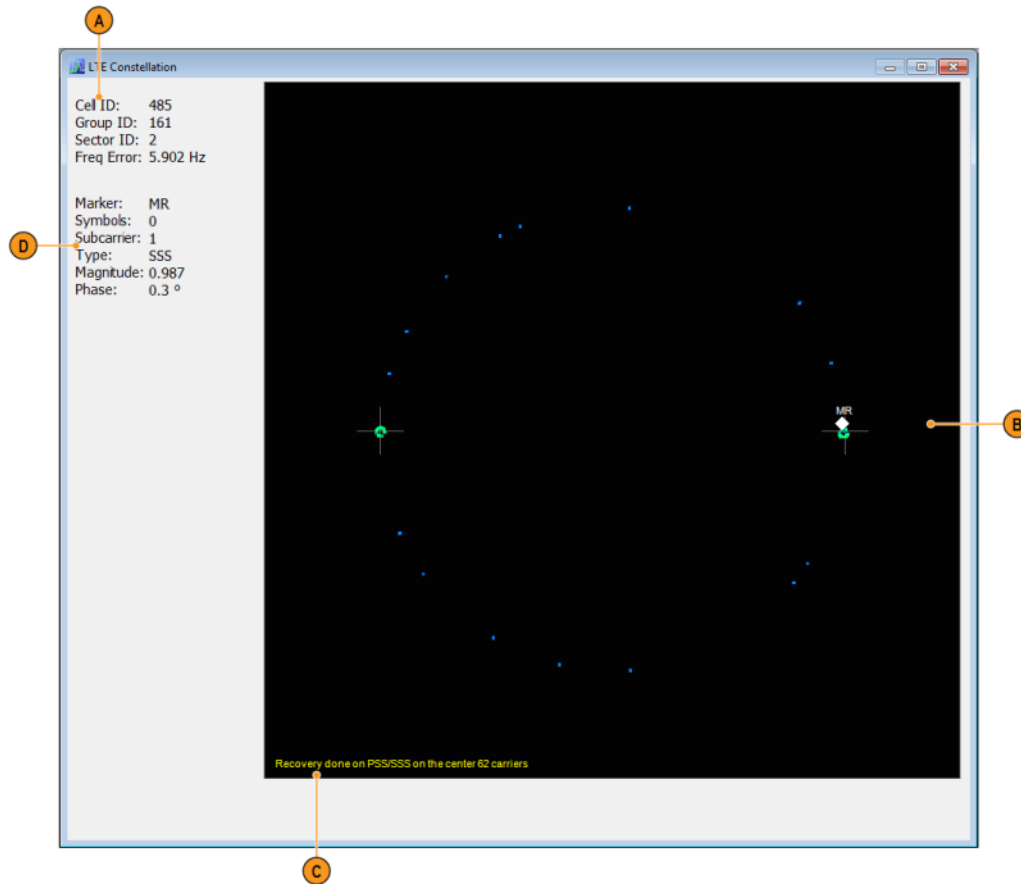
1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **LTE Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **LTE Constellation** icon or select the icon and click **Add**. The LTE Constellation icon will be added to the **Selected displays** box and will no longer appear under Available displays.



5. Click **OK** to show the display.
6. Select Replay/Run to take measurements on the acquired data.
7. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image shows the LTE Constellation display.





Item	Display element	Description
A	Scalar results	Gives results of Cell ID, Group and Sector ID information along with Frequency error.
B	Plot	Displays PSS and SSS (Primary and Second Synchronization Signal) constellation.
C	Status message	Shows relevant status messages. (You can read about status messages <a href="#">here</a> .)
D	Marker readout	Shows marker type, magnitude, phase and subcarrier number.

## LTE Constellation Settings

### Application Toolbar:

The settings for the LTE Constellation display are shown in the following table.

Settings tab	Description
<a href="#">Modulation Params (see page 355)</a>	Specifies the frame structure and channel bandwidth.
<a href="#">Analysis Params (see page 355)</a>	Allows you to enable Equalization based on PSS (Primary Synchronization Signal).
<a href="#">Analysis Time (see page 356)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for LTE Analysis displays.
<a href="#">Trace (see page 357)</a>	Allows you to set the display characteristics of the traces.
<a href="#">Scale (see page 348)</a>	Specifies the vertical and horizontal scale settings.

## LTE Power vs Time display

The LTE Power vs Time display shows the filtered power of the data and marks where the  $T_{\text{OFF}}$  measurement is done. The  $T_{\text{OFF}}$  scalar results are also shown.

You can select **Presets > Standards > LTE** to view the display.

---

**NOTE.** Loading the LTE Power vs Time display from the **Presets > Standards > LTE** menu is recommended. This loads the control settings based on the selected options.

---

You can also load the LTE Power vs Time display as follows:

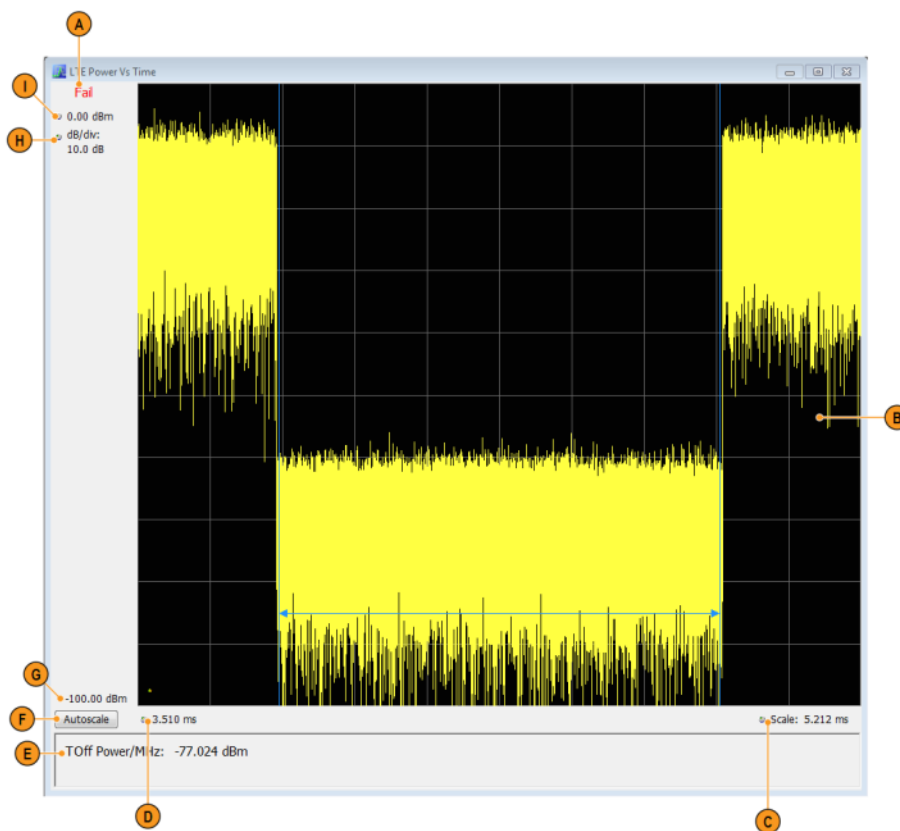
1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **LTE Analysis** in the **Measurements** box.



4. In the Available displays box, double-click the **LTE Power vs Time** icon or select the icon and click **Add**. The LTE Power vs Time icon will be added to the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select **Replay/Run** to take measurements on the acquired data.
7. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

## Elements of the Display

The following image shows the LTE Power vs Time display.





Item	Display element	Description
A	Pass / Fail	Shows Pass or Fail based on whether the $T_{OFF}$ measurement (off slot power) is below the recommended limit set in the Limit tab of the Settings control panel or not. The Pass/Fail information is displayed only when the chosen frame structure is TDD and if a valid off slot is found.
B	Plot	Displays the filtered signal in case of TDD and the region in which the off slot power is measured is graphically shown. When the frame structure is chosen as FDD, the power in the input signal is displayed.
C	Scale	Adjust the span of the graph in symbols.
D	Analysis Start	Gives the start of analysis region.
E	Toff	The $T_{OFF}$ (off slot power) is measured and displayed here when a valid off slot is found for a TDD signal.
F	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
G	Bottom readout	Displays the value indicated by the bottom of graph.
H	dB / div	Shows the dB per each division in the Y axis of the plot.
I	Top of graph	The vertical scale is normalized with appropriate power units.

## LTE Power vs Time Settings

### Application Toolbar:

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

Settings tab	Description
<a href="#">Modulation Params (see page 355)</a>	Specifies the frame structure and channel bandwidth.
<a href="#">Analysis Time (see page 356)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for LTE Analysis displays.
<a href="#">Prefs (see page 350)</a>	Allows you to select to show or hide the graticule and marker readouts.
<a href="#">Scale (see page 348)</a>	Specifies the vertical and horizontal scale settings.
<a href="#">Limit (see page 358)</a>	Specifies the mask limits.

## LTE Analysis Measurement Settings

### Application Toolbar:

The control panel tabs in this section are shared between the displays in LTE Analysis (Setup > Displays). Some tabs are shared by all the displays and some tabs are shared by only a subset of displays. The settings available on some tabs change depending on the selected display.



### Controls for LTE Analysis displays

Settings tab	Description
<a href="#">Modulation Params (see page 355)</a>	Allows you to set the frame structure and channel bandwidth. <i>Available for these displays: LTE Power vs Time, LTE Constellation.</i>
<a href="#">Analysis Params (see page 355)</a>	Allows you to enable Equalization based on PSS (Primary Synchronization Signal).
<a href="#">Analysis Time (see page 356)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for LTE Analysis displays. <i>Available for these displays: LTE Power vs Time, LTE Constellation.</i>
<a href="#">Trace (see page 357)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ. <i>Available for the LTE Constellation display only.</i>
<a href="#">Prefs (see page 350)</a>	Allows preferences with Radix display and marker readouts. <i>Available for these displays: LTE Power vs Time, LTE ACLR, LTE Channel Spectrum, SEM.</i>
<a href="#">Scale (see page 348)</a>	Defines the vertical and horizontal axes. <i>Available for all LTE displays.</i>
<a href="#">Offsets &amp; Limits Table (see page 347)</a>	<b>NOTE.</b> <i>Available for the LTE ACLR display only.</i>
<a href="#">Freq &amp; RBW (see page 353)</a>	Specifies the frequency and resolution bandwidth used for the measurement. <b>NOTE.</b> <i>Available for the LTE Channel Spectrum display only.</i>
<a href="#">Parameters (see page 344)</a>	Specifies several characteristics that control how the measurement is made.
<a href="#">Processing (see page 346)</a>	Specifies settings for detection on the reference channel and the offsets. Specifies the function setting on how calculations are done across multiple sweeps.
<a href="#">Limit (see page 358)</a>	Allows you to define limits for pass/fail comparison with calculated values. The default values are as recommended in the test specification.
<a href="#">Channels (see page 342)</a>	Specifies the Channel BW for the Channel Power measurement. Allows you to set RBW, VBW, power reference, as well. <i>Available for these displays: LTE ACLR, LTE Channel Spectrum.</i>
<a href="#">Measurement Params (see page 354)</a>	Allows you to set averaging (Time Domain, Off, or Frequency Domain) and to set the number value associated with the Average setting.

## Channels tab - LTE

The Channels tab allows you to control how the measurement is performed.

The following image shows the Channels tab for the LTE ACLR display. When in Real Time, the RBW and VBW settings apply for all channels (including offset regions) and the other parameters such as Power Reference, Channel Width, and Integrated bandwidth apply only to the reference channel. When Non-Real Time mode is selected, all information in this tab, including RBW and VBW, only applies to the reference channel.



Settings	Description
Reference	
Power Reference	The value used to calculate relative measurements. When Auto is selected, the calculated reference channel power is displayed. When Auto is unchecked, you can enter a value for the reference power, and the measured reference power is not used or displayed.
Channel Width	Specifies the width of the reference channel.
Integration BW	Specifies the integration bandwidth used to compute the total power in the reference channel.
All Channels (displayed for Real-Time mode)	
Reference Channel (displayed for Non-Real Time mode)	
RBW	Sets the RBW
VBW	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. When the check box next to VBW is not checked, the VBW filter is not applied. The maximum VBW value is the current RBW setting. The minimum VBW value is 1/10,000 of the RBW setting.

The following image shows the Channels tab for the LTE Channel Spectrum display. This tab allows you to set the channel bandwidth, which in turn sets the span for LTE Channel Spectrum.

Settings	Description
Channel Bandwidth	Specifies the Channel Bandwidth, which in turn sets the span of the LTE Channel Spectrum.



## Parameters tab - LTE

The Parameters tab enables you to specify several parameters that control the LTE ACLR measurements are made.

The screenshot shows the 'Parameters' tab of the 'LTE ACLR settings' dialog. The dialog has a sidebar on the left with a 'Standard Presets' button. The main area contains several controls: a 'Meas Freq' field set to '1.00000 GHz', a 'Filter shape' dropdown menu set to 'Gaussian', a 'Step' field set to '2.0000 MHz' with an adjacent checked 'Auto' checkbox, an unchecked 'Real-Time' checkbox, a 'Measure Noise Floor' button, and an unchecked 'Apply noise correction' checkbox. At the top, there is a tabbed interface with 'Parameters' selected, and other tabs labeled 'Channels', 'Processing', 'Offsets & Limits Table', 'Scale', and 'Prefs'.

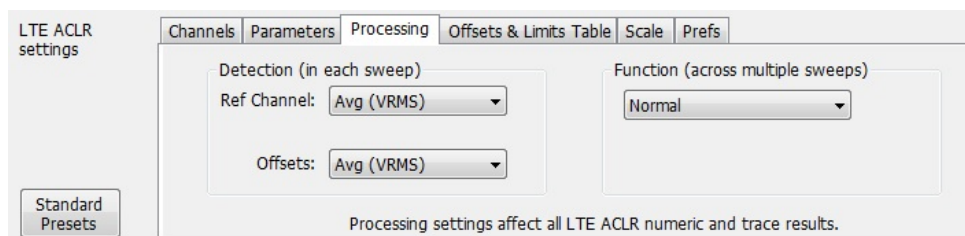


Setting	Description
Meas Freq	Specify the frequency of the signal to be measured.
Step	Sets the increment size when changing the Frequency using the knob or mouse wheel. Auto: When Auto is enabled, the step size is adjusted automatically based on the span setting.
Real-Time	When Real-Time mode is enabled, the entire LTE ACLR span is measured using a real-time/contiguous acquisition. Not all described parameters are available in Real-Time mode.  When Real-Time is disabled (non-Real-Time mode), a separate acquisition for each region is taken and analyzed. Non-Real-Time mode is also useful when the bandwidth offered by the instrument does not support the span requirement for this measurement. The span requirement is guided by the choice of adjacent channel type and channel bandwidth selected in LTE Standards Presets.
Measure Noise Floor	Takes preliminary acquisitions to measure the instrument noise floor. This initiates a noise correction. A noise correction signal is created by switching off the RF input and performing acquisitions of the instrument's internal noise. Fifty acquisitions are averaged to create the noise reference signal. The noise reference signal is measured for the Reference channel and each Offset is defined by the measurement settings.
Apply noise correction	This item is enabled and the check box automatically checked after the noise reference signal is taken when the Measure Noise floor button is clicked. This initiates noise reference subtraction from the incoming signal power for each region to create the corrected result. All calculations are performed in Watts and then converted to the desired units.  The amount of noise correction is limited to 20 dB to avoid the possibility of a negative power measurement. This is a rare condition that could occur if the subtraction of the reference power from the channel power results in a negative value (or "infinite" dBm). The noise reference for a region is subtracted from each trace point in the channel, rather than offsetting the entire region by a single amount. This produces a smooth trace with no discontinuities at the region edges.  <b>NOTE.</b> If any relevant settings (such as reference level, frequency, span, RBW) are changed once the noise reference is measured, the following warning message will be displayed to notify you that Noise Correction was not applied: Noise correction not applied - select Measure Noise Floor for new noise correction.
Filter shape	Specifies the shape of the filter determined by the window that is applied to the data record, in the spectrum analysis, to reduce spectral leakage. 3GPP specifies a Gaussian window shape be applied to the reference channel measurements.  <b>Gaussian:</b> This filter shape provides optimal localization in the frequency domain. <b>Rectangular:</b> This filter shape provides the best frequency, worst magnitude resolution. This is essentially the same as no window.



## Processing tab - LTE

The Processing tab controls the detection settings for the Reference Channel and Offsets, as well as selecting the function for the LTE ACLR display.



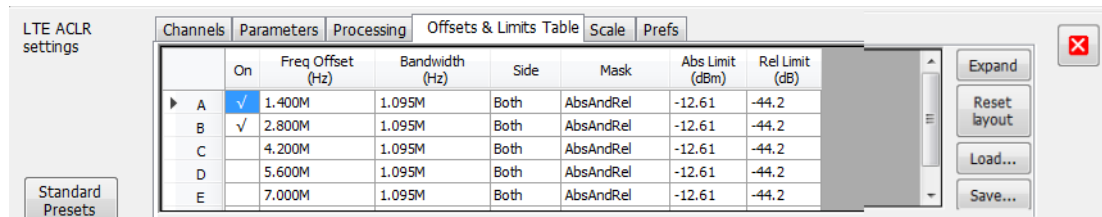
Setting	Description
Detection (in each sweep)	
Reference Channel	Specifies the Detection method used for the Reference Channel. Detection is used to produce the desired measurement result (peak or average) and to reduce the results of a measurement to the desired number of trace points.
Avg (VRMS)	For each sweep, each point of the trace is the result of determining the RMS voltage value for the last 'n counts' of the collected traces for the same point. When 'n count' has not been reached, partial averaging results are displayed.
+Peak	Selects the +Peak detection method. With this method, the highest value is selected from the results to be compressed into a trace point.
Offsets	Specifies the detection method used for the offsets.
Avg (VRMS)	Selects the Average Vrms detection method. With this method, each point on the trace in each offset is the result of determining the RMS Voltage value for all of the results values it includes.
+Peak	Selects the +Peak detection method. With this method, the highest value is selected from the results to be compressed into a trace point.
Function (across multiple sweeps)	
Normal	When a new trace has been computed, it replaces the previous trace.
Max Hold	With each sweep, each trace point in the new trace is compared to the point's value in the old trace and the greater value is retained for display and subsequent comparisons.
Avg (VRMS)	For each sweep, each point on the trace is the result of determining the RMS Voltage value for all of the collected traces' values for the same point.
Count	Enter the Avg (VRMS) value. Displayed only when Avg (VRMS) is selected.



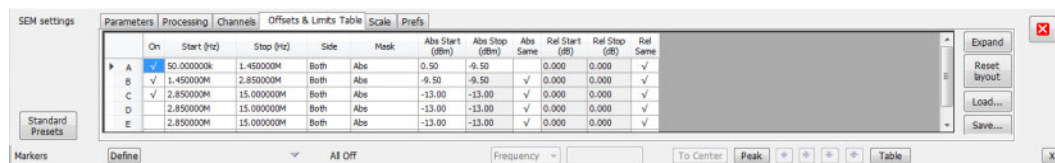
## Offsets and Limits Table tab - LTE

The Offsets and Limits Table tab is used to specify parameters that define Offsets and masks for the LTE ACLR display. The following images show the tab and expanded view of the tab, respectively.

The following image shows the Offsets and Limits Table tab when Real-Time is selected in the Parameters tab.



The following image shows the Offsets and Limits Table tab when Real-Time is not selected in the Parameters tab (referred to as non-Real-Time mode).



The following image shows the expanded view of the Offsets and Limits Table (click the **Expand** button to view).





Setting	Description
<b>Buttons</b>	
Expand (button)	Displays the Offsets and Limits Table in a new, resizable window.
Reset Layout	Allows you to reorder columns in the Offsets & Limits Table by dragging the columns to a new position. Clicking Reset Layout returns the column order to the factory default order.
Load	Click to load a saved Offsets & Limits table from a file.
Save As	Click to save the current Offsets & Limits table to a file.
Done	When the table is expanded, click Done when you have finished editing the table to save your changes and close the expanded table display.
<b>Table columns</b>	
On	Specifies whether or not measurements are taken in the specified offset.
Freq Offset (Hz)	Specifies the frequency offset for the offset region (adjacent channel region) from the Center frequency of the Reference Channel. This offset is always specified from the center frequency of the Reference Channel to the center frequency of the Offset region.
Start (Hz)	Start Frequency of the selected offset.
Stop (Hz)	Stop Frequency of the selected offset.
Bandwidth (Hz)	Specifies the bandwidth of the Offset region.
Side	Specifies whether the specified range appears on both side of the carrier frequency or just one side (left or right).
RBW (Hz)	Specifies the RBW for the selected range.
n(RBWS)	An integer value that specifies how many times to multiply the RBW to set the Filter bandwidth.
Filter BW (n x RBW)	Displays the Filter BW. Filter BW is the equivalent BW of each point in the offset. When $n > 1$ , an integration technique is used to achieve the Filter BW using narrower RBWs.
VBW (Hz)	Adjusts the VBW (Video Bandwidth) value. VBW Maximum: RBW current value; VBW Minimum: 1/10,000 RBW setting.
VBW (On)	Specifies whether the VBW filter is applied.
Mask	Select the type of limits used for Pass/Fail testing. Signal excursions that exceed the mask settings are considered violations. The available choices are Abs, Rel and Abs & Rel.
Abs Limit (dBm)	The offset region integrated power is compared against the Abs Limit value mentioned here.
Rel Limit (dB)	The offset region integrated power relative to the reference channel integrated power is compared with this limit.

## Scale tab - LTE

The Scale tab allows you to change the scale settings that control how the trace appears on the display but does not change control settings. 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 that display. There are three versions of the Scale tab for LTE displays.



The following image shows the Scale tab for the LTE Power vs Time display.

LTE Power vs Time Settings

Modulation Params Analysis Time Prefs **Scale** Limit

Vertical

Scale: 100.00 dB

Position: 0.00 dBm

Reset

Horizontal Full Burst

Start: 100.000 us

Stop: 0.000 s

Reset

Standard Presets

Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale units.
Position	Adjusts the reference level away from top of the graph.
Reset	Resets the scale of the vertical axis to default values.
Horizontal Full Burst	Controls the horizontal span.
Start	Specifies the horizontal axis start point.
Stop	Specifies the horizontal axis end point.
Reset	Resets the scale of the horizontal axis to default values.

The following image shows the Scale tab for the LTE Channel Spectrum and LTE ACLR displays.

LTE Channel Spectrum Settings

Freq & RBW Measurement Params Channels **Scale** Prefs

Vertical

Scale: 100.00 dB

Position: 0.00 dBm

Reset Scale

Autoscale

Horizontal

Scale: 6.27 MHz

Position: 1.00000 GHz

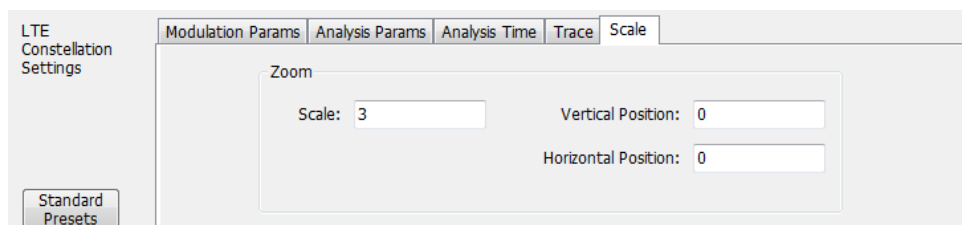
Autoscale

Standard Presets



Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale units.
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 horizontal span of the trace display and position of the trace.
Scale	Specifies the frequency range displayed in the graph
Position	Specifies the frequency shown at the center of the graph.
Autoscale	Resets the scale of the horizontal axis to optimize the display of the trace.
Reset Scale	Resets all settings to their default values.

The following image shows the Scale tab for the LTE Constellation display.



Settings	Description
Zoom	
Scale	Zooms in and out of the constellation. As the scale is increased, it will zoom out.
Vertical Position	Adjusts the vertical position.
Horizontal Position	Adjusts the horizontal position.

## Prefs tab - LTE

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.



The following image shows the Prefs tab for the LTE ACLR display.

The screenshot shows the 'LTE ACLR settings' window with the 'Prefs' tab selected. The window has a sidebar on the left with 'Standard Presets' and a main area with several controls. At the top, there are tabs: 'Channels', 'Parameters', 'Processing', 'Offsets & Limits Table', 'Scale', and 'Prefs'. The 'Prefs' tab contains the following settings: 'Max Trace points' is a dropdown menu set to '801' with '(per range)' to its right; 'Show graticule' is a checked checkbox; 'Show Marker readout in graph (selected marker)' is a checked checkbox; 'Show Power Levels In Graph' is a checked checkbox; and 'Show limits' is a dropdown menu set to 'Line only'. A 'Standard Presets' button is located in the bottom left of the main area.

The following image shows the Prefs tab for the LTE Channel Spectrum display.

The screenshot shows the 'LTE Channel Spectrum Settings' window with the 'Prefs' tab selected. The window has a sidebar on the left with 'Standard Presets' and a main area with several controls. At the top, there are tabs: 'Freq & RBW', 'Measurement Params', 'Channels', 'Scale', and 'Prefs'. The 'Prefs' tab contains the following settings: 'Trace points' is a dropdown menu set to '801'; 'Trace detection' is a dropdown menu set to '+Peak'; 'Show graticule' is a checked checkbox; and 'Show Marker readout in graph (selected marker)' is a checked checkbox. A 'Standard Presets' button is located in the bottom left of the main area.

The following image shows the Prefs tab for the LTE Power vs Time display.

The screenshot shows the 'LTE Power vs Time Settings' window with the 'Prefs' tab selected. The window has a sidebar on the left with 'Standard Presets' and a main area with several controls. At the top, there are tabs: 'Modulation Params', 'Analysis Time', 'Prefs', 'Scale', and 'Limit'. The 'Prefs' tab contains the following settings: 'Average over offslot' is a checked checkbox; 'Show graticule' is a checked checkbox; and 'Show marker readout' is a checked checkbox. A 'Standard Presets' button is located in the bottom left of the main area.



Setting	Description
Show graticule	Shows or hides the graticule.
Trace / Max Trace points	When the spectrum analysis produces more than the selected maximum number of points, the method specified in Detection control is used to decimate the result. This setting applies to both the reference channel and offsets.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Show Power Levels In Graph	This display the power level (calculated integrated power in the offset region) in the graph.
Show limits	
Shaded	Shows limits using a shaded area. Absolute limit and Relative limit shading colors can be set under Presets > Options.
Line only	Shows limits using only a line. Absolute limit and Relative limit line colors can be set under Presets > Options.
None	No lines or shading are used to indicate limits in the graph. Violations of the mask are still identified by red shading.
Average Over Offslot	Enables for averaging of offslot power in non-overlapping 70 $\mu$ s windows in the entire offslot region. If this option is disabled, the off slot power is measured only in the center 70 $\mu$ s window of the offslot region.



## Freq and RBW tab - LTE

The Freq and RBW tab specifies frequency parameters for the Channel Power and ACPR measurements and the MCPR measurement. It is available for the LTE Channel Spectrum display.

LTE Channel Spectrum Settings

Standard Presets

Freq & RBW | Measurement Params | Channels | Scale | Prefs

Meas Freq: 1.00000 GHz RBW: 3.000 kHz ☐ Auto

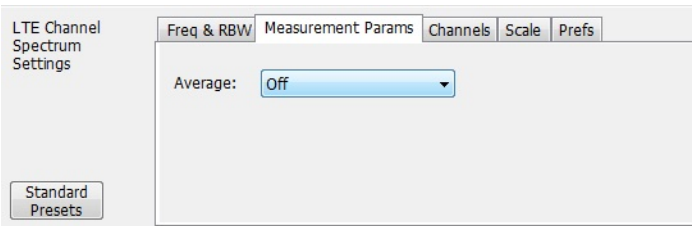
Step: 2.0000 MHz ☒ Auto ☐ VBW:

Settings	Description
Meas Freq	Specifies the center/measurement frequency
RBW	<p>Select Auto or Manual. Adjusts the RBW for the entire measurement. This setting is Independent of the Spectrum view's RBW setting.</p> <p>Auto: When Auto is enabled, the step size is adjusted automatically based on the span setting.</p>
Step	<p>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.</p> <p>Auto: When Auto is enabled, the step size is adjusted automatically based on the span setting.</p>
VBW	<p>Adjusts the Video Bandwidth value.</p> <p>The maximum VBW value is the current RBW setting. The minimum VBW value is 1/10,000 of the RBW setting.</p>



## Measurement Params tab - LTE

The Measurement Params tab allows you to set parameters that control the ACPR and MCPR measurements. This is available for the LTE Channel Spectrum display.

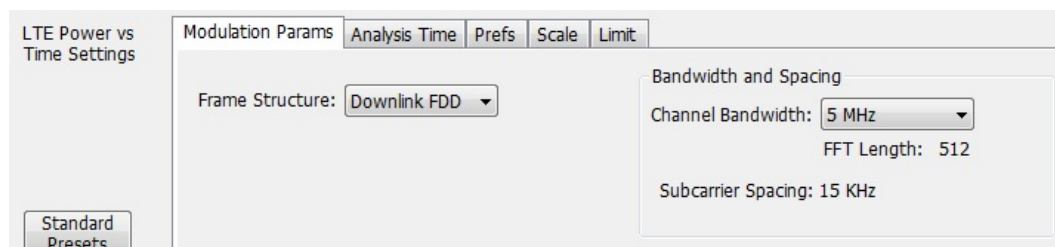


Settings	Description
Average	
Off	
Frequency-domain	This setting takes the average linear value of the traces (so that RMS values are preserved). The number of averages is user-defined. Frequency domain averaging is available in spans larger (or smaller) than the maximum real time bandwidth. This is the mode to use unless you need to extract maximum dynamic range from an ACPR measurement.
Time-domain	This setting takes the average linear value of the traces. It is useful if you need to extract maximum dynamic range from an ACPR measurement. The number of traces is user defined, however, the signals must be triggered and repeating (meaning the signal needs to be exactly the same for each acquisition). When this condition is met, each waveform contains the same signal, but the random noise changes from acquisition to acquisition and the average value of the random noise is lowered, while the signal value remains constant. Time domain averaging is not available in spans wider than the maximum real-time bandwidth.



## Modulation Params tab - LTE

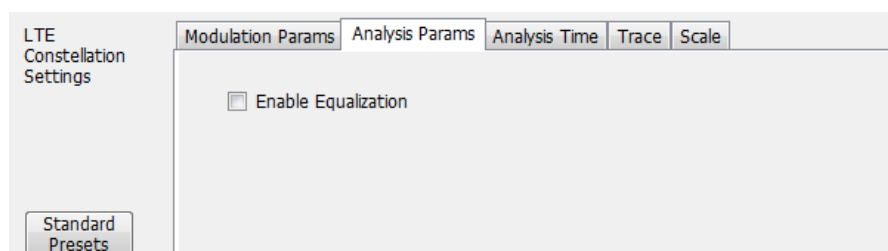
The Modulation Params tab specifies the type of modulation used by the input signal and other parameters that define the signal format. This tab is available for the LTE Constellation and Power vs Time displays.



Settings	Description
Frame Structure	Select the frame structure to set how the demodulation is done.
Downlink FDD	
Downlink TDD	
Bandwidth and Spacing	
Channel Bandwidth	Select from 6 bandwidths: 1.4, 3, 5, 10, 15, 20 MHz
Subcarrier Spacing (readout)	This readout shows the subcarrier spacing. It is always at 15 kHz for LTE.

## Analysis Params tab - LTE

The Analysis Params tab allows you to enable equalization on the demodulated LTE packet. The equalization is based on PSS (Primary Synchronization Signal). This tab is only available for the LTE Constellation display.



Settings	Description
Enable Equalization	Allows you to enable Equalization based on PSS (Primary Synchronization Signal).



## Analysis Time tab - LTE

The Analysis Time tab contains parameters that define how the signal is analyzed in the LTE Analysis displays. This tab is available for the LTE Constellation and Power vs Time displays.

LTE Power vs Time Settings

Modulation Params Analysis Time Prefs Scale Limit

Analysis Offset:  ☒ Auto Time Zero Reference:

Analysis Length:  ☒ Auto Units:

Actual: 0.000 Symbol

Standard Presets

Settings	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 symbols or seconds, depending on the Units setting.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
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).
Time Zero Reference	Specifies the zero point for the analysis time.
Units	Specifies 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. 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 "Available" readout. This setting is not available when Auto is checked. Range: minimum value depends on the standard. Resolution: 1 symbol.

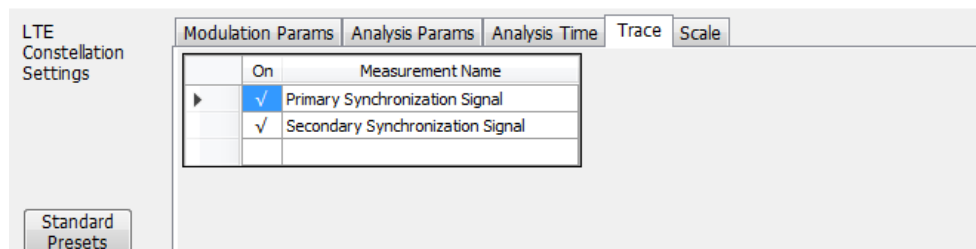
## Time Zero Reference

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	Time zero starts from the point at which the acquisition begins.
Trigger	Time zero starts from the trigger point.

## Trace tab - LTE

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

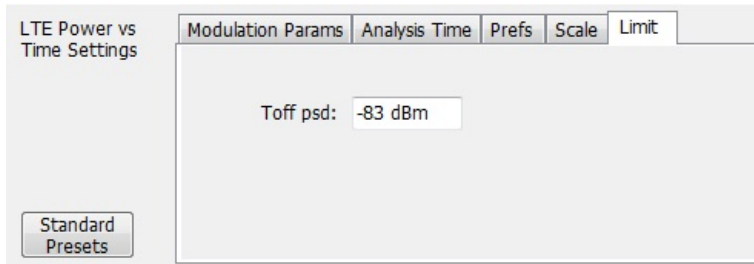


Setting	Description
>	The arrow indicates which measurement name is active so that you can check it (on) or uncheck it (off).
On	Check the box next the measurement name you want to turn on.
Measurement Name	Selections are PSS (Primary Synchronization Signal) or SSS (Secondary Synchronization Signal)



## Limit tab - LTE

The Limit tab is only available for the LTE Power vs Time display. It enables you to specify the limit used for comparison against measured values of  $T_{OFF}$  measurement.



Setting	Description
Toff psd	Specifies the limit that is used for comparison against measured values of $T_{OFF}$ measurement. Pass/ Fail is determined with this limit.



# Bluetooth Analysis

## Overview

The Bluetooth Analysis option allows you to evaluate short range RF signals to ensure that they meet Bluetooth standard per Bluetooth Special Interests Group (SIG) Test Specifications for version 4.1. This analysis option enables measurements and supports detection, demodulation, and decoding of packet information for the following three standards: Basic Rate, Low Energy, and Enhanced Data Rate (EDR). You can also select from three RF test presets for the Low Energy standard and four test presets for the Basic Rate standard. This analysis option includes modulation, power, carrier drift, and spectral measurements as mentioned in the Radio Frequency test specification document by the Bluetooth SIG. These measurements are also compared with the limits provided by the standard to give pass/fail results. (There are no pass/fail results for EDR.)

With the Bluetooth Analysis test suite, test engineers can simplify the execution of a number of transmitter tests while still enabled to modify signal parameters for in-depth signal analysis. The analysis results give multiple views of Bluetooth signal characteristics to allow the diagnosis of signal imperfections and impairments quickly and easily. Display controls allow you to selectively display the analysis results to help locate trouble spots in the signal.

## Bluetooth topics in this Help

The following information about the Bluetooth Analysis option is available:

- [Bluetooth key features \(see page 359\)](#)
- [Reference table of supported Bluetooth measurements](#)
- [Bluetooth measurements and test setups \(see page 363\)](#)
- [Bluetooth status messages \(see page 368\)](#)
- [Bluetooth Standards presets \(see page 360\)](#)
- [Bluetooth displays \(see page 363\)](#)
- [Bluetooth Settings \(see page 395\)](#)

## Bluetooth key features

- Modulation/Carrier Drift/Output Power test setup in Bluetooth Standards Preset that will calculate results and compare against recommended or user defined limits or Basic Rate and Low Energy.
- In-band Emission measurement preset with capability to compare results against recommended or user defined limits for Basic Rate and Low Energy.
- 20 dB Bandwidth and Frequency Range measurement preset with capability to compare results against recommended or user defined limits for Basic Rate.
- Appropriate masks for Out-of-band Spurious measurements for ETSI and FCC specifications.



- Enhanced Data Rate (EDR) demodulation of GFSK and PSK data and relative power measurement preset.
- [Automatic detection of standards \(see page 360\).](#)
- Automatic detection of test pattern.
- Automatic determination of packet type.
- Summary display with decoded preamble, access code, packet header, payload header, and CRC packet information along with other scalar measurements.
- Symbol Table display with color coding to show different regions in the packet.
- Freq Dev vs Time display with zoomed Octet viewing to help you understand how the modulation characteristics measurement is done.
- CF Offset & Drift display with offset (calculated in preamble and 10 bit intervals in payload) and drift results in a tabular view.
- Summary display that allows you to edit pass/fail limits for comparison with actual results. (Default is recommended limits from the Bluetooth SIG Radio Frequency test specification document.)

**Automatic detection of standards.** This function can be enabled from the Standard Parameters control panel. This automatically detects whether the Bluetooth standard is Basic Rate, Low Energy, or Enhanced Data Rate (EDR). This function is not available as a test setup from the Standards Presets window.

### Supported automated Bluetooth measurements

Bluetooth measurement	Bluetooth standard(s)
Modulation characteristics	Basic Rate
	Low Energy
Carrier frequency offset and drift	Basic Rate
	Low Energy
Output power	Basic Rate
	Low Energy
In-band emission /ACPR	Basic Rate
	Low Energy
Out-of-band spurious emission	Basic Rate
	Low Energy
20 dB bandwidth	Basic Rate
Frequency range	Basic Rate
Power density	Basic Rate
Relative power	Enhanced Data Rate (EDR)

## Bluetooth Standards presets

**Presets > Standards**



The Bluetooth Standards preset allows you to access displays preconfigured for the Bluetooth standard and test setup you select. The test setups load the displays and control setting options suggested by the standard to perform the measurements. You can read more about how Presets work [here](#).

There are four test setups for the Low Energy standard and eight test setups for the Basic Rate standard. There is one preset (no test setups) for the EDR standard.

The following table shows the set of Preset displays that load when the specified standards and test setups are selected.

**Table 6: Bluetooth standards, test setups, and Preset displays**

Standard	Test setup	Displays loaded with preset
Low Energy	Modulation/Frequency Offset/Drift/Output Power	BT Eye Diagram, BT Freq Dev vs Time, BT Summary, BT CF Offset and Drift, Spectrum, Time Overview
	In-band Emissions	BT InBand Emission, Spectrum, Time Overview
	Non-compliance	BT Freq Dev vs Time, BT Constellation, BT Summary, Spectrum, Spectrogram, Time Overview
Basic Rate	Modulation/Frequency Offset/Drift/Output Power	BT Eye Diagram, BT Freq Dev vs Time, BT Summary, BT CF Offset and Drift, Spectrum, Time Overview
	In-band Emissions	BT InBand Emission, Spectrum, Time Overview
	Tx Output Spectrum — 20dB Bandwidth	Bluetooth 20 dB BW, Spectrum, Time Overview
	Non-compliance	BT Freq Dev vs Time, BT Constellation, BT Summary, Spectrum, Spectrogram, Time Overview
Enhanced Data Rate (EDR)	Generic	BT Eye Diagram, BT Constellation, BT Summary, BT Symbol Table, Spectrum, Time Overview

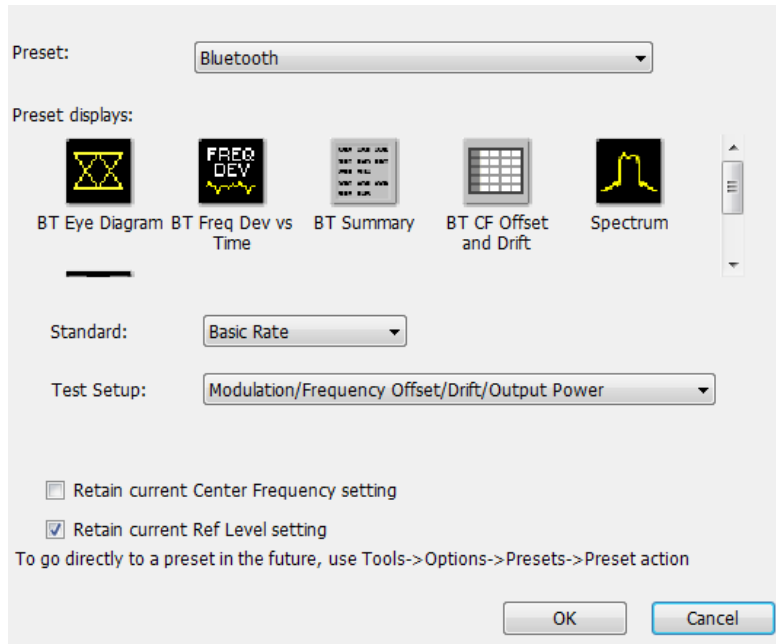
### Retain current center frequency and reference level settings

The **Retain current Center Frequency setting** appears when the Bluetooth Standards Preset is chosen. This setting allows you to retain the previously used center frequency.

The **Retain current Ref Level setting** appears when the Bluetooth Standards Preset is chosen. This setting allows you to retain the previously used reference level.

To activate these settings, check the box next to the desired setting.





By default, the Ref Level setting box is checked.

By default, the Center Frequency setting box is unchecked and the Bluetooth preset displays will load with one of the center frequency values shown in the following table.

**Table 7: Default center frequencies for Bluetooth test setups**

Standard	Test setup	Center frequency
Basic Rate Low Energy	Modulation/Frequency Offset/Drift/Output Power	2.441 GHz
Basic Rate Low Energy	In-band Emissions	2.441 GHz
Basic Rate Low Energy	Out-of-band Spurious Emissions	2.441 GHz
Basic Rate	Tx Output Spectrum — 20dB Bandwidth	2.441 GHz
Basic Rate	Tx Output Spectrum — Power Density	2.441 GHz
Basic Rate Low Energy	Non-compliance	2.441 GHz
Basic Rate	Tx Output Spectrum — Frequency Range Lower	2.402 GHz
Basic Rate	Tx Output Spectrum — Frequency Range Higher	2.480 GHz
Enhanced Data Rate	Generic	2.441 GHz



---

**NOTE.** *Changing analysis and display parameters recalculates the measurement results, but does not affect acquisitions.*

---

## Bluetooth displays

The displays in Bluetooth Analysis (Setup > Displays > Measurements: Bluetooth Analysis) are:

- [Bluetooth 20dB Bandwidth](#)
- [Bluetooth Center Frequency Offset and Drift](#)
- [Bluetooth Constellation](#)
- [Bluetooth Eye Diagram](#)
- [Bluetooth Frequency Dev vs Time](#)
- [Bluetooth InBand Emission](#)
- [Bluetooth Summary](#)
- [Bluetooth Symbol Table](#)
- [Time Overview](#)

## Bluetooth measurements and test setups

A variety of measurements and test setups are provided by the Bluetooth Analysis option for use in performance testing of transmitters. These test setups allow the analyzer to compare the measurement result to the standards limit. Test engineers can select from the test setups and measurements described here. The following topics contain important information you should know about specific Bluetooth measurements and test setups.

---

**NOTE.** *Although the following information describes test setups for measurements recommended by the standard document, other measurement results may also be provided as additional information for a given measurement. For example, carrier frequency offset and drift results may be provided for modulation characteristics test setups.*

---

### Modulation characteristics (Basic Rate and Low Energy)

This measurement verifies that the modulation characteristics of the transmitted signal are correct. The Bluetooth test specification recommends this measurement be done using fixed frequency, also known as *hopping off*, and can be done in Direct Tx mode. This measurement can only be done if the payload has the bit pattern 10101010 or 11110000. This measurement and test setup are set to Free Run mode by default. However, you can set the analyzer to Triggered mode (Setup > Trigger) to do the measurements.

More information about this measurement:

- Select the Modulation/Frequency Offset/Drift/Output Power test setup from Presets > Standards to perform modulation characteristics measurements. This will load the displays found in the [Bluetooth](#)



[standards, test setups, and Preset displays table](#) . Additionally, you can choose to load the BT Symbol Table and BT Constellation displays, which can provide useful information.

- The Bluetooth Analysis splits the frequency deviation results in the payload region into octets (8 bit intervals). If the payload pattern is 10101010, the maximum frequency deviation is calculated in every bit interval within an octet and recorded as  $\Delta f_{max}$ . The  $\Delta f_{max}$  results are averaged to give  $\Delta f_{2avg}$ . The percentage of  $\Delta f_{max}$  values greater than recommended lower limit is also found.
- If the payload is 11110000, the average frequency deviation is found in 4 bit intervals (2, 3, 6 and 7) and the average of these values is calculated as  $\Delta f_{1avg}$ . The ratio of  $\Delta f_{2avg}$  and  $\Delta f_{1avg}$  is also found.
- BT Freq Dev vs Time display has an octet view (zoomed view of the 8 bit intervals in Payload) and also shows the bit intervals in which the  $\Delta f_{max}$  values are computed. The octet view option also allows you to see the regions in which the calculations are done.

---

**NOTE.** *The octet view option is only available when Preamble is detected.*

---

- Specify an octet to view by entering a value in the Octet # field in the BT Freq Dev vs Time display. This also shows the maximum number of octets used for analysis. The start and end point for every octet can be clearly seen using the octet view.
- In the Summary display, the scalar results ( $\Delta f_{1avg}$ ,  $\Delta f_{2avg}$ , Ratio, Percentage of  $\Delta f_{max}$  values greater than a limit) averaged over the last 10 packets analyzed are shown along with the packet count. These averaged results can be compared against limits set in the Limits tab of the Settings control panel.
- The Points/symbol option in the Trace tab can be used to control how many samples per symbol should be used for computation of these measurements. The standard recommends 32 samples per symbol for Low Energy and 4 samples per symbol for Basic Rate. These are the default values provided for the respective standards in the Bluetooth Standards presets.

### Carrier frequency offset and drift (Basic Rate and Low Energy)

This measurement verifies that the carrier frequency offset and carrier drift of the transmitted signal is within the specified limits for the specified standard. The Bluetooth test specification recommends this measurement be done using fixed frequency, also known as *hopping off*, and can be done in Direct Tx mode. This test can be done only if the payload contains 10101010 bit pattern. This measurement and test setup are set to Free Run mode by default. However, you can set the analyzer to Triggered mode (Setup > Trigger) to do the measurements.

More information about this measurement:

- Select the Modulation/Frequency Offset/Drift/Output Power test setup from Presets > Standards to perform carrier frequency offset and drift measurements. This will load the displays found in the



[Bluetooth standards, test setups, and Preset displays table](#) . Additionally, you can choose to load the BT Symbol Table and BT Constellation displays, which can provide useful information.

- This measurement calculates the following:
  - Frequency offset in Preamble (initial Carrier Frequency Offset).
  - Frequency offset in Payload (calculated in 10 bit intervals in Payload).
  - Drift (the difference in frequency offset calculated in Payload from that calculated in Preamble).
  - Drift/50  $\mu$ s (the difference in frequency offset calculated in two 10 bit intervals in Payload separated by 50  $\mu$ s (5 intervals away)).
- The BT CF Offset and Drift display shows all results in a table.
- The measurements shows the following scalar results:
  - Preamble frequency offset (initial carrier frequency offset).
  - Maximum frequency offset in Payload (along with the index number at which the offset is at maximum).
  - Drift of frequency offset from Preamble to first 10 bit interval in Payload ( $f_1 - f_0$ ).
  - Maximum drift between Payload and Preamble ( $f_n - f_0$ ) (along with index number at which the drift is maximum).
  - Maximum drift between two 10 bit intervals spaced 50  $\mu$ s away ( $f_n - f_{n-5}$ ) (along with index number at which the drift is maximum).
- The Preamble region in which the Preamble offset is calculated is shown in the BT Freq Dev vs Time display along with markings to show the region in which maximum drift occurred. Maximum drift between Payload and Preamble is shown from the end of Preamble to the end of 10 bit interval in Payload in which maximum drift occurred. Maximum drift in payload (in 50  $\mu$ s duration) is also shown.
- In the Summary display, the scalar results (mentioned above) averaged over the last 10 packets are shown along with the packet count. The results are compared against recommended limits. You can set these limits in the Limits tab of the Settings control panel.

### In-band Emissions (Basic Rate and Low Energy)

This measurement verifies that the in-band spectral emissions are within limits. The standard document recommends that this measurement be done with Hopping off, finding the integrated power in 1 MHz band (with RBW 100 kHz) in 80 channels starting from 2401 MHz to 2481 MHz. The test can be done in Direct Tx mode. The integrated power values calculated in the adjacent channels are compared against recommended limits (except the three channels around transmitted frequency). This measurement is referred to as ACPR in the Radio Frequency Test Specification for Basic Rate. It is recommended to do this measurement in Free Run mode (set in Setup > Trigger) if the analyzer does not support the required BW (80 MHz). The measurement internally searches for burst and aligns the measurement to the on-slot region.

---

**NOTE.** For analyzers with limited bandwidth, this measurement will be done over multiple acquisitions to generate the data required for the entire span. Therefore, it is important for the user to set an analysis length that will ensure that on slot region is always included.

---



More information about this measurement:

- Select the In-band Emissions test setup from Presets > Standards to perform the in-band emissions measurements. This will load the displays found in the [Bluetooth standards, test setups, and Preset displays table](#).
- The In-band Emissions display will set the Center Frequency to 2.441 GHz by default. When the Retain CF option is not enabled from Standards Presets, 80 bands (each of bandwidth 1 MHz) are analyzed and the integrated power is found (indicated by Blue lines in the plot).
- The integrated power is compared against limits for comparison (shown by white masks) in all bands except the three channels around the transmitted frequency. If any band fails, that band is shown in red color. If more than three channels fail to meet the recommended limits, a FAIL is shown in the top left corner of the display.
- The table below the plot shows the integrated power and also the limit for comparison.
- The limits for comparison are set to the values given by the standard by default, but you can manually set them from the Limits tab of the Settings control panel.
- This measurement is done only on the on slot region if a ramp-up and ramp-down portions are available. However, the measurement is done on the complete analysis region if a ramp up or ramp down is not available. It is recommended that a complete packet is included in the analysis region.
- When the analyzer does not support the 80 MHz bandwidth requirement, multiple acquisitions are taken in different bands and stitched together. This measurement is therefore best done in Free Run mode (set in Setup > Trigger) as Triggered mode might not find a proper edge in an acquisition taken for stitching purposes.

### Output Power (Basic Rate and Low Energy)

This test verifies the maximum peak and average power emitted from the EUT. The standards document recommends this test be done for a PRBS payload pattern. Also, the measurement must be done over the duration of a burst starting at preamble position. The Bluetooth test specification recommends this measurement be done using fixed frequency, also known as *hopping off*, and can be done in Direct Tx mode.

More information about this measurement:

- Select the Modulation/Frequency Offset/Drift/Output Power test setup from Presets > Standards to perform carrier frequency offset and drift measurements. This will load the displays found in the [Bluetooth standards, test setups, and Preset displays table](#).
- Calculates the average power and peak power for any Bluetooth signal. The peak power is the peak power value in the chosen on slot region.
- The measurement is done only on preamble detection; otherwise, it is invalid.
- The BT Summary display shows the averaged result over 10 packets.



## 20dB Bandwidth (Basic Rate)

This measurement verifies if the emissions inside the operating frequency range are within limits. This measurement is done with Hopping off. The difference between frequency points at which the power level drops to 20 dB below the peak power of the emission is found at 20 dB Bandwidth.

More information about this measurement:

- Select the 20dB Bandwidth test setup from Presets > Standards to perform the 20 dB emissions measurements. This will load the displays found in the [Bluetooth standards, test setups, and Preset displays table](#).
- The BT 20 dB BW display allows you to set the relative power level (x dB BW) compared to the peak power at which the frequency points are to be found.
- When you select the 20dB Bandwidth test setup, the center frequency (CF), span, and relative bandwidth (RBW) are set as recommended by the standard document.
- It is recommended this measurement be done over three different center frequencies. You can do this by changing the center frequency as needed.
- From the Params tab of the Settings control panel, you can select that the search for the x dB relative power (20 dB in this case) be performed in one of two modes: from the edges towards the peak power (inwards) or vice versa (outwards). The default for this setting is Inwards (from edges to peak power) when this measurement is chosen from the Standards Preset menu, as recommended.
- The blue markings in the plot indicate the 20 dB bandwidth and the frequency points at which the power level drops down by 20 dB from the peak power.
- The resulting 20 dB bandwidth is compared with the limits recommended by the standard document and Pass/Fail is shown in the top left corner of the plot. This is not user defined.

If the highest power value measured in step d) is equal or higher than 0 dBm:  $f = |f_H - f_L| \leq 1.0 \text{ MHz}$ .

If the highest power value measured in step d) is lower than 0 dBm:  $f = |f_H - f_L| \leq 1.5 \text{ MHz}$ .

## Frequency Range (Basic Rate)

These measurements verify if the emissions inside the operating frequency range are within limits. These measurements are done with Hopping off in two steps. The first measurement is done at the lower frequency spectrum of the Bluetooth band. (Start – 2399 MHz and Stop 2405 MHz). The second is done at the higher frequency spectrum of the Bluetooth band (Start -2475 MHz and Stop at 2485 MHz). The difference between the frequency point at which the power level drops to -30 dBm from the center frequency is measured.  $f_L$  is the difference on the lower side from the center frequency when the lower end of the spectrum is being analyzed.  $f_H$  is the difference from the center frequency on the higher side when the higher end of the spectrum is analyzed.  $f_H - f_L$  is the Frequency Range.

More information about these measurements:

- The BT 20dB BW display allows you to set the absolute power level (x dBm level) from the Parameters tab of the Settings control panel. The Bluetooth SIG Radio Frequency test specification document suggests that this value be set to -30 dBm for doing the Frequency Range measurement. If you chose to set up this measurement using start and stop frequencies and RBW, those should be



set as recommended by the standard. Separate start and stop frequencies are given for the two steps of this measurement.

- You can select for the analysis to find the x dBm frequency difference from the center frequency either on the lower side, higher side, or both sides. This option (Meas Range) can be set from the Params tab of the Settings control panel.
- The blue marking indicates the frequency difference from the center frequency based on the Meas Range option choice. You can set this option to Low while analyzing in the lower range of the frequency spectrum, and set it to High when analyzing the higher range of the frequency spectrum.

### Power Density (Basic Rate)

This measurement verifies the maximum RF output power density.

More information about this measurement:

- This measurement can be done using the Spectrum display (Displays > Measurements > General Signal Viewing) and by setting appropriate parameters as recommended in the Bluetooth SIG Radio Frequency test specification document.
- The Bluetooth test specification recommends this measurement be done using fixed frequency, also known as *hopping off*, and can be done in Direct Tx mode.

### Out-of-band Spurious Emission (Basic Rate and Low Energy)

This measurement can be done for FCC or ETSI masks using the [Spurious](#) display.

### Relative Power (Enhanced Data Rate)

This measurement calculates the relative power in the GFSK and PSK part of the Enhanced Data Rate (EDR) signal. This measurement is supported only when an EDR signal is detected.

Select the Enhanced Data Rate standard from Presets > Standards to perform the measurement. This will load the displays found in the [Bluetooth standards, test setups, and Preset displays table](#).

## Bluetooth Status Messages

The following status messages may appear. Each message indicates the related condition (Description) shown in the following table.



Status message	Description
Bluetooth Analysis: Preamble Not Detected	Shown in the display and status bar when no valid Sync and Preamble are found for the chosen standard. Also shown when no preamble is found for any of the standards in Automatic Standard Detection mode.
Bluetooth Analysis: Low Energy Sequence Detected	Shown in the status bar when the Low Energy standard is detected in Automatic Standard Detection mode.
Bluetooth Analysis: Basic Rate Sequence Detected	Shown in the status bar when the Basic Rate standard is detected in Automatic Standard Detection mode.
Bluetooth Analysis: EDR Signal Detected	Shown in the status bar when the EDR standard is detected in Automatic Standard Detection mode.
Bluetooth Analysis: EDR Sync Word Not Detected	Shown in the display and status bar when EDR Sync Word is not found (when EDR standard is selected).
Bluetooth Analysis: Not enough payload data for Bluetooth measurements	Shown in the display and status bar when Preamble and Access Address/Sync Word is detected but there is not enough payload data for Modulation Characteristics and CF Offset and Drift measurement.
Bluetooth Analysis: Meas BW may be too low	Shown in the InBand Emission display and in status bar when Measurement Bandwidth is too low.
Bluetooth Analysis: BT x dB BW detection failed	Shown in the BT 20 dB BW display when x dB measurement detection fails.
Bluetooth Analysis: BT x dBm BW detection failed	Shown in the BT 20 dB BW display when x dBm measurement detection fails.

## Bluetooth Constellation display

The BT Constellation display shows a digitally modulated signal in constellation form. The constellation can be viewed either as IQ or Freq Dev. The default view is Freq Dev. The frequency deviation result that is shown in the Constellation display is compensated for the frequency error (shown as readout).

To show the BT Constellation display you can select **Presets > Standards > Bluetooth** or do the following:

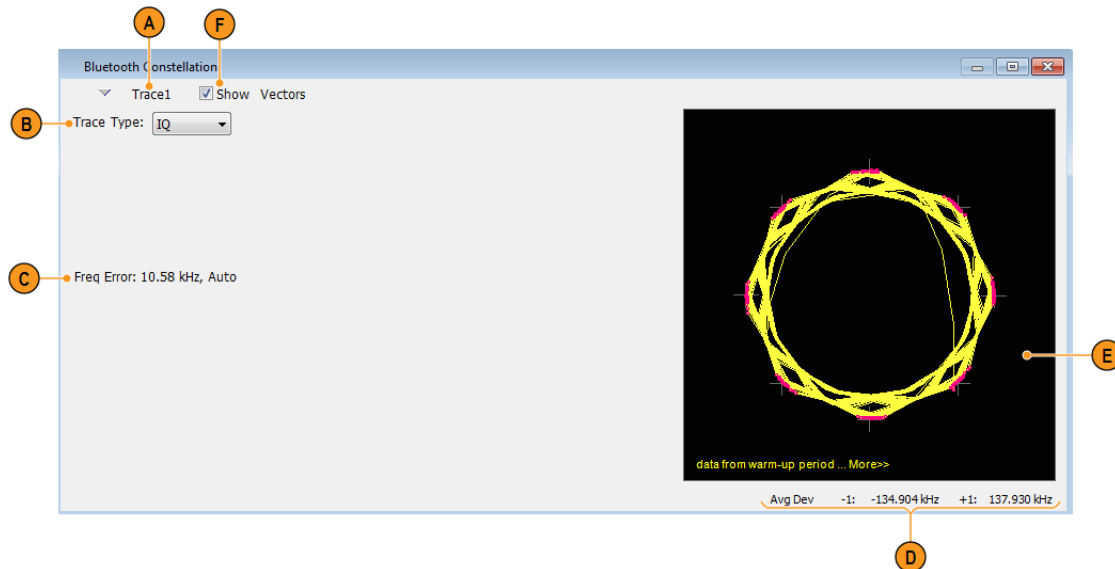
1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** window, select **Bluetooth Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **BT Constellation** icon or select the icon and click **Add**. The BT Constellation icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click the **OK** button to show the display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Standard Params** tab. Set the Standard, Power class (if required), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
8. Select the **Trace** tab and set the **Trace Type** to Freq Dev or IQ, as required.



9. Select Replay/Run to take measurements on the acquired data.
10. If you are analyzing a data file, click the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

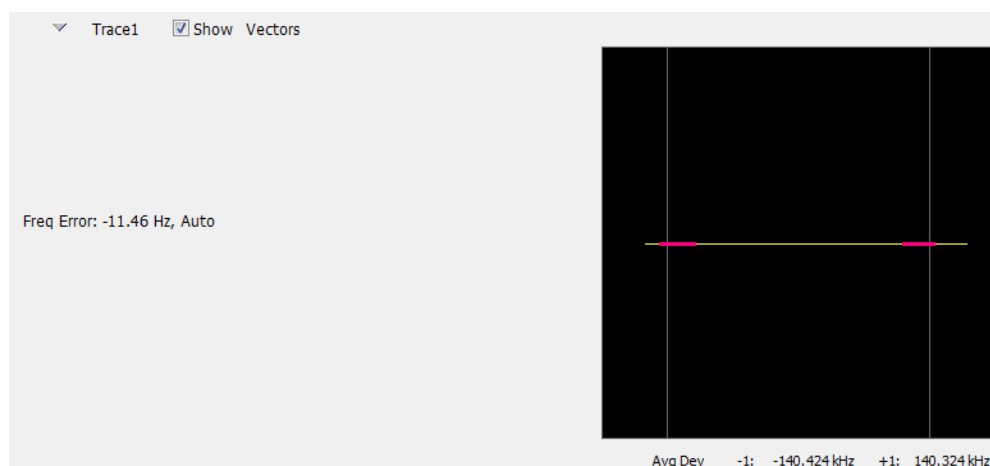
The following image shows the BT Constellation display of QPSK data in an EDR signal. Trace Type is set to IQ.





Item	Display element	Description
A	Trace	Select and enable a trace.
B	Trace Type	Specifies Trace type (choice between Freq Dev and IQ). This option appears only when EDR signal is detected.
C	Freq Error / Freq Offset / marker readouts	<p>The Freq Error, Freq Offset, and marker readout values appear here or below the plot, depending on the display view and size.</p> <p>The Freq Error value is the difference between the maximum and the minimum values of signal frequency during the measurement time. The Freq Error (Auto) value is displayed when the Auto check box is selected in the <b>Analysis Params</b> tab in the Settings control panel.</p> <p>The Freq Offset (Manual) value is displayed when the Auto check box is unselected in the <b>Analysis Params</b> tab in the Settings control panel.</p> <p>When markers are enabled, marker information (including time, magnitude, phase, symbol, and value) is displayed.</p>
D	Avg Dev	Shows the average deviation result at every symbol point.
E	Plot	Bluetooth constellation graph. Shown as either IQ or as Frequency Deviation. The trace type is controlled from the <b>Settings &gt; Trace</b> tab.
F	Show Vectors	Specifies whether to show or hide the selected trace.

The following image shows the BT Constellation display of GFSK data in a Basic Rate signal. Trace Type is set to Freq Dev.



## BT Constellation Settings

### Application Toolbar:

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



Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Trace	Allows you to select the trace to view, the trace type (IQ or Freq Dev), the number of points per symbol (when trace content is set to Vectors or Lines), and to show or freeze the selected trace.
Prefs	Allows you to select to show or hide the graticule and marker readouts.

## Bluetooth Eye Diagram display

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

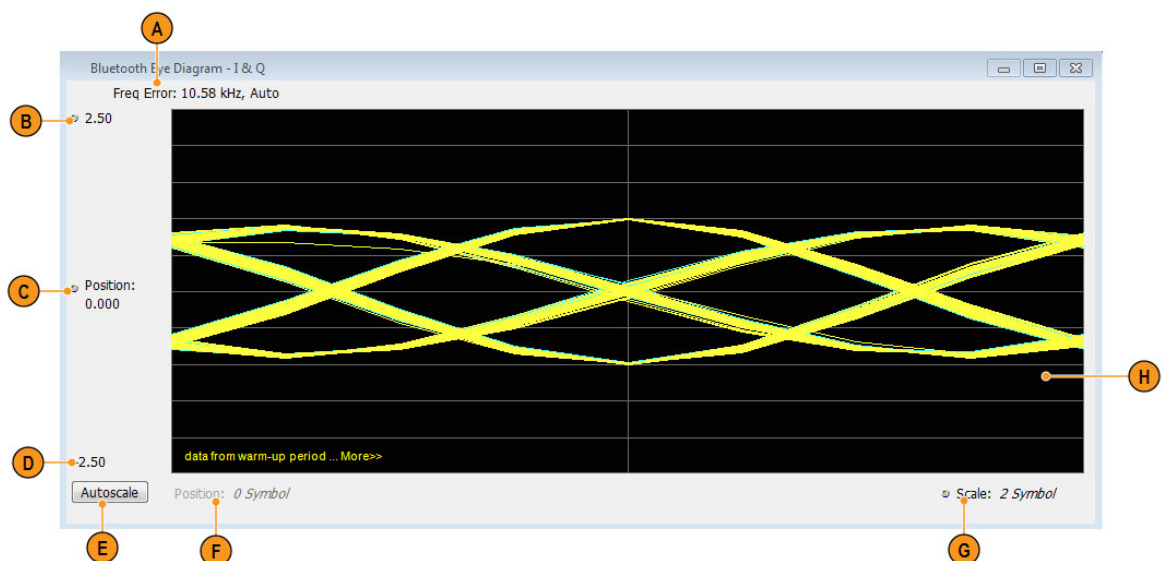
To show the BT Eye Diagram display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. From the **Measurements** box, select **Bluetooth Analysis**.
4. Double-click the **BT Eye Diagram** icon in the **Available Displays** box. This adds the BT Eye Diagram icon to the **Selected displays** box.
5. Click **OK** button. This displays the BT Eye Diagram view.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
8. Select the **Trace** tab and set the **Trace Type** to Freq Dev or IQ, as required..
9. Select **Replay/Run** to take measurements on the acquired data.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image shows the BT Eye display of a basic rate signal with Trace Type set to IQ.

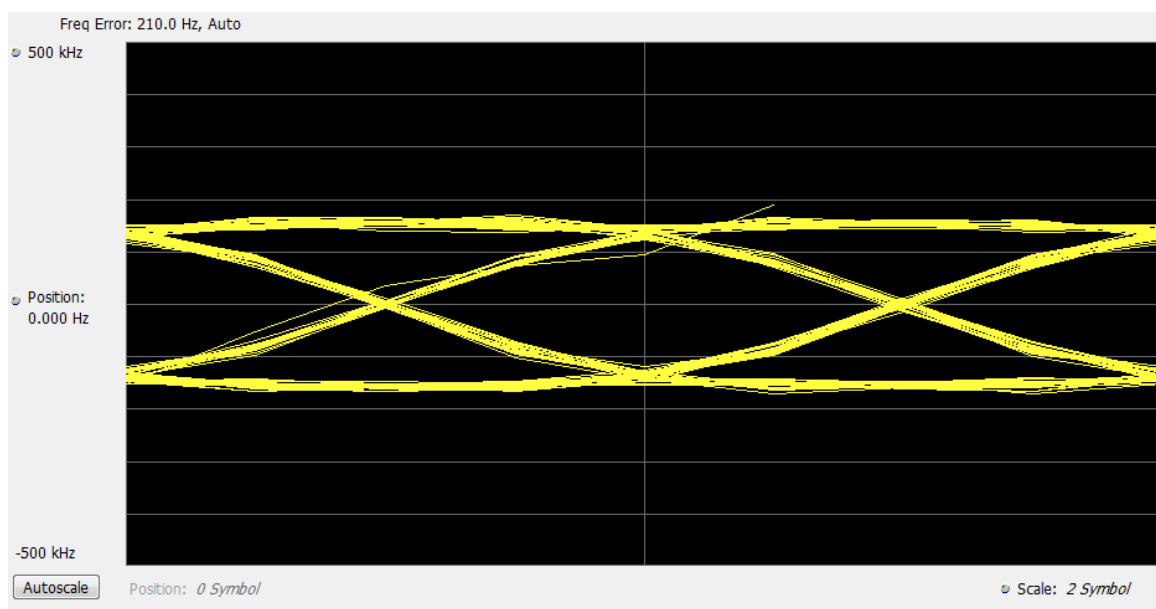




Item	Display element	Description
A	Freq Error / Freq Offset	The Freq Error value is the difference between the maximum and the minimum values of signal frequency during the measurement time. The Freq Error (Auto) value is displayed when the Auto check box is selected in the <b>Analysis Params</b> tab in the Settings control panel. The Freq Offset (Manual) value is displayed when the Auto check box is unselected in the <b>Analysis Params</b> tab in the Settings control panel.
B	Top of graph	The vertical scale is normalized with no units (for IQ) and with Hz (for Freq Dev).
C	Position	Specifies the value shown at the center of the graph display.
D	Bottom Readout	Displays the value indicated by the bottom of graph.
E	Autoscale	Adjusts the vertical and horizontal settings to provide the best display.
F	Position	Displays the horizontal position of the trace on the graph display.
G	Scale	Adjusts the span of the graph in symbols.
H	Plot	Displays the input signal.

The following image shows the BT Eye display of a Basic Rate signal with Trace Type set to Freq Dev.





## BT Eye Diagram Settings

### Application Toolbar:

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

---

**NOTE.** You might save time configuring the BT Eye Diagram display by selecting the *Standard Presets* button in the *Bluetooth Eye Diagram Settings* control panel. This allows you to select a preset optimized for the selected standard.

---



Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Trace	Allows you to select the trace to view, the trace type (IQ or Freq Dev), the number of points per symbol (when trace content is set to Vectors or Lines), and to show or freeze the selected trace.
Scale	Allows you to specify the horizontal and vertical scale settings.
Prefs	Allows you to select to show or hide the graticule and marker readouts.

## Bluetooth Carrier Frequency Offset and Drift display

The BT CF (Carrier Frequency) Offset and Drift display shows the frequency offset preamble, payload regions, and the drift result values are shown in this display. You can also view the values of frequency offset calculated in every ten bit interval in the payload and look for excursions.

To show the BT CF (Carrier Frequency) Offset and Drift display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **Bluetooth Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **BT CF Offset and Drift** icon or select the icon and click **Add**. The BT CF Offset and Drift icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
8. Select the **Limits** tab and set the limits , as required.
9. Select **Replay/Run** to take measurements on the acquired data.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Display

The following image shows the frequency offset and drift values of a basic rate signal in the BT Freq Offset and Drift display.

Limits Interval#	$f_n$ (-150.0kHz to +150.0kHz)	$f_n - f_0$ (-40.00kHz to +40.00kHz) $f_1 - f_0$ (-20.00kHz to +20.00kHz)	$f_n - f(n-5)$ (-20.00kHz to +20.00kHz)
0 (Preamble)	139.2751		
1	-96.15504	-235.4302	
2	7.167774	-132.1074	
3	-0.01093826	-139.2861	
4	0.01212997	-139.263	
5	-0.003742599	-139.2789	
6	0.007567215	-139.2676	96.16261
7	-0.002672958	-139.2778	-7.170447
8	-0.007925415	-139.2831	0.003012847
9	-0.01031799	-139.2855	-0.02244797
10	0.001925276	-139.2732	0.005667677
11	0.001144409	-139.274	-0.006422806
12	-0.004858398	-139.28	-0.00218544
13	0.001594162	-139.2736	0.009519577
14	-0.001327515	-139.2765	0.006990479
15	0.01260147	-139.2625	0.01067619
16	0.008859253	-139.2663	0.007714843
17	-0.003403854	-139.2785	0.001454544
18	-0.0007839203	-139.2759	-0.002378082
19	0.001569366	-139.2736	0.002896881
20	0.007740402	-139.2674	-0.004861068
21	-0.001542282	-139.2767	-0.01040153
22	0.009552765	-139.2656	0.01295662
23	-0.006316376	-139.2815	-0.005532456
24	-0.001724243	-139.2769	-0.00329361
25	-0.01467628	-139.2898	-0.02241669
26	-0.004405975	-139.2796	-0.002863693
27	0.0005382538	-139.2746	-0.009014511
28	-0.01394348	-139.2891	-0.007627105

Marker: MR	Time: 3.133 ms	Interval# 0	Value: 139.2
Freq Offset Preamble: 139.3 Hz	Drift $f_1 - f_0$ : -235.4 Hz	Max Drift $f_1 - f_0 - f_5$ : -127.7 Hz	/ 271
Max Freq Offset (Payload): -127.7 Hz	Max Drift $f_1 - f_0$ : -267.0 Hz		/ 271



Display element	Description
Column 1	Indicates ten bit interval numbers. Zero indicates preamble region and the non-zero number indicate the ten bit intervals in payload.
Column 2	Shows the calculated frequency offset in the preamble and the ten bit intervals in the payload.
Column 3	Shows the drift of offset from the preamble and over a 50 $\mu$ s duration.
Column 4	Shows the drift of offset over a 50 $\mu$ s duration.
—	Results that do not meet the limits are shown with a red colored background, indicating failure. (Limits can be set in the Limits tab from the Settings control panel.)
Scalar results	The scalar results show below the table. They are as follows: Freq Offset Preamble Max Freq Offset (Payload) Drift $f_1-f_0$ Max Drift $f_n-f$ Max Drift $f_n-f_{(n-5)}$

## BT CF Offset and Drift Settings

### Application Toolbar:

The settings for the BT CF Offset and Drift display are shown in the following table.

Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Limits	Allows you to load and define Bluetooth measurement limits for Pass/Fail comparison. You can save defined limits as a .csv file and also load previously saved .csv files. These limits also apply to the Settings control panel Limits tab of the BT Summary display.

## Bluetooth Summary display

The BT Summary display shows a summary of all the scalar measurements done on the acquired test pattern. The summary display and contents will vary according to the selected standard.

Pass/Fail information is also provided in this display for all enabled scalar measurements. You can set limits and choose which measurement to compare for Pass/Fail from the Limits tab of the BT Summary



Settings control panel. The default limits come from the performance recommendation limits given by the Standards document. The default limits can be reloaded by selecting the Bluetooth Standards Preset option.

The results presented in the BT Summary display include scalar results of modulation characteristics, frequency offset and drift and, output power measurements (these are averaged over the last 10 acquired packets). The display also shows packet related information for the current acquired packet.

To show the BT Summary display you can select **Presets > Standards > Bluetooth** or do the following:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **Bluetooth Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **BT Summary** icon or select the icon and click **Add**. The BT Summary icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
8. Select the **Limits** tab and set the limits , as required.
9. Select Replay/Run to take measurements on the acquired data.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the display

The following image shows all average scalar results and packet information for a Basic Rate signal in the BT Summary display. Modulation characteristics, carrier frequency offset and drift, and power measurements, along with packet information, are shown. The packet information will vary depending on the chosen or detected standard. For more information about specific measurement results, see the Bluetooth measurements and test setups section [here \(see page 325\)](#).



Bluetooth Summary

Standard: Basic Rate

Class3

Clear

Modulation Characteristics [10 packet-average]

$\Delta F1_{avg}$ :

-- Hz

-- of 10

$\Delta F2_{avg}$ :

135.4 kHz

$\Delta F2_{Max\%} \geq 115$  kHz:

100.0 %

2 of 10

$\Delta F2_{avg}/\Delta F1_{avg}$ :

--

N/A

Frequency Offset and Drift [10 packet-average]

Freq Offset (Preamble):

139.3 Hz

PASS

Max FreqOffset:

-127.7 Hz

PASS

Drift  $f_1-f_0$ :

-235.4 Hz

PASS

Max Drift  $f_1-f_0$ :

-267.0 Hz

PASS

Max Drift  $f_1-f_1-s_1$ :

-127.7 Hz

2 of 10

Output Power [10 packet-average]

Peak Power Ppk:

-29.72 dBm

PASS

Average Power Pavg:

-30.00 dBm

2 of 10

Packet Information

Packet Type

DH5

Preamble (4 bits)

0101

Sync Word (64 bits)

0x4F36F2CEE85390CB

Packet Header (18 bits)

LT\_ADDR (3 bits)

010

Type (4 bits)

1111

Flow (1 bit)

0

ARQN (1 bit)

1

SEQN (1 bit)

0

HEC (8 bits)

00110001

PayLoad Length

0101010011

CRC (16 bits)

0x9DB0

SignalVu-PC Printable Help

379



Element	Description
Standard	Display of the selected standard or the detected standard (if the Auto Detect Standard setting is chosen in the Standard Params tab of the Settings control panel).
Power class	Display of the Power class in the Standard Params tab of the Settings control panel. Only available when Basic Rate is the selected or detected standard.
Clear	Click button to reset measurement. Clears all values and all results in the queue used for average computation.
Modulation characteristics (ten packet average)	<p>Display of a group of scalar results related to Modulation Characteristics measurements. These scalar results are only populated in the BT Summary display if preamble is detected in the acquired data. The four scalar results are:</p> <p><math>\Delta f1_{avg}</math> is calculated when analyzed test pattern (payload) is 11110000.</p> <p><math>\Delta f2_{avg}</math> and the percentage of <math>\Delta f2_{max}</math> value (greater than a given limit) are calculated only when analyzed test pattern (payload) is 10101010.</p> <p>The ratio of <math>\Delta f2_{avg}</math> and <math>\Delta f1_{avg}</math> is calculated provided both the results are available (or have been done before).</p> <p>All the results given are averaged over the last ten packets. The scalar results can be compared with pass/fail limits set in the Limits tab of the Settings control panel.</p> <p>More information can be found <a href="#">here (see page 325)</a>.</p>
Frequency offset and drift (ten packet average)	<p>Display of a group of five scalar results related to the carrier frequency offset and drift measurement. These scalar results are only populated in the BT Summary display if preamble is detected and if the test pattern payload is a 10101010 pattern. All the results given are averaged over the last ten packets. The scalar results can be compared with pass/fail limits set in the Limits tab of the Settings control panel.</p> <p>The five scalar results are:</p> <p>Preamble offset.</p> <p>Maximum offset in Payload (calculated over 10 bit intervals).</p> <p>Drift (<math>f_1 - f_0</math>)</p> <p>Max Drift (<math>f_n - f_0</math>).</p> <p>Max Drift (<math>f_n - f_n - 5</math>).</p> <p>For more information about this measurement, see the <a href="#">Carrier frequency offset and drift (Basic Rate and Low Energy) (see page 364)</a> topic in <i>Bluetooth Measurements and test setups</i>.</p>
Output power	<p>Display of Average Power and Peak Power scalar results for Output Power. All the results given are averaged over the last ten packets. The scalar results can be compared with pass/fail limits set in the Limits tab of the Settings control panel.</p> <p>For Enhanced Data Rate signals, the relative power in GFSK and PSK regions is measured.</p> <p>For more information about this measurement, see the <a href="#">Output Power (Basic Rate and Low Energy) (see page 331)</a> topic in <i>Bluetooth Measurements and test setups</i>.</p>
Packet information	The Packet information includes the Packet type, Preamble, Synchronization Word or Access Code, Packet Header, Payload length, and CRC details. The decoded bits are shown for the current analyzed packet.



The following image shows all average scalar results and packet information for a Low Energy signal in the BT Summary display.

**Standard: Low Energy** Clear

Modulation Characteristics [10 packet-average]	
$\Delta F1_{avg}$ :	-- Hz -- of 10
$\Delta F2_{avg}$ :	231.9 kHz
$\Delta F2_{Max\%} \geq 185$ kHz:	100.0 % 1 of 10
$\Delta F2_{avg}/\Delta F1_{avg}$ :	--

Frequency Offset and Drift [10 packet-average]	
Freq Offset (Preamble):	-19.59 Hz <span>PASS</span>
Max FreqOffset:	-110.5 Hz
Drift $f_1-f_0$ :	-51.84 Hz
Max Drift $f_1-f_0$ :	-90.95 Hz
Max Drift $f_1-f_1-s_1$ :	-148.5 Hz 1 of 10 <span>PASS</span>

Output Power [10 packet-average]	
Peak Power Ppk:	4.192 dBm <span>PASS</span>
Average Power Pavg:	3.695 dBm 1 of 10 <span>PASS</span>

Packet Information	
Packet Type	BLE_TEST
Preamble( 8 bits)	01010101
Access Address (32 bits)	0x71764129
PDU Header (16 bits)	
PDU Type (4 bits)	0010
Tx Address (1 bit)	0
Rx Address (1 bit)	0
Length (6 bits)	100101
CRC (24 bits)	0x8CB786

The following image shows all average scalar results and packet information for an EDR signal in the BT Summary display.

**Standard: EDR** Clear

Modulation Characteristics [10 packet-average]	
$\Delta F_{avg}$ :	-- Hz 0 of 10

Frequency Offset and Drift [10 packet-average]	
Freq Offset (Preamble):	-- Hz <span>N/A</span>
Max FreqOffset:	-- Hz
Drift $f_1-f_0$ :	-- Hz
Max Drift $f_1-f_0$ :	-- Hz
Max Drift $f_1-f_1-s_1$ :	-- Hz -- of 10 <span>N/A</span>

Output Power [10 packet-average]	
POWER GFSK:	-28.42 dBm
POWER DPSK:	-28.51 dBm 1 of 10

Packet Information	
Packet Type	EDR_2DH1
Preamble (4 bits)	0101
Sync Word (64 bits)	0x4F36F2CEE85390CB
Packet Header (18 bits)	
LT_ADDR (3 bits)	001
Type (4 bits)	0100
Flow (1 bit)	1
ARQN (1 bit)	0
SEQN (1 bit)	1
HEC (8 bits)	11010111
Payload Length	110110
CRC (16 bits)	--



## BT Summary Settings

### Application Toolbar:

The settings for the BT Summary display are shown in the following table.

Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Limits	Allows you to load and define Bluetooth measurement limits for Pass/Fail comparison. You can save defined limits as a .csv file and also load previously saved .csv files. The frequency offset and drift limits set here also apply to the CF Offset and Drift display.

## Bluetooth Symbol Table display

The BT Symbol Table display shows decoded data values for each data symbol in the analyzed signal packet. It is like the BT Constellation display except that a text table is used to display data instead of a graph.

To show the BT Symbol Table display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **Bluetooth Analysis** in the **Measurements** box.
4. In the Available displays box, double-click the **BT Symbol Table** icon or select the icon and click **Add**. The BT Symbol Table icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select **Setup > Settings** to display the control panel.
7. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
8. Select the **Limits** tab and set the limits , as required.



9. Select Replay/Run to take measurements on the acquired data.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Regions of the Display

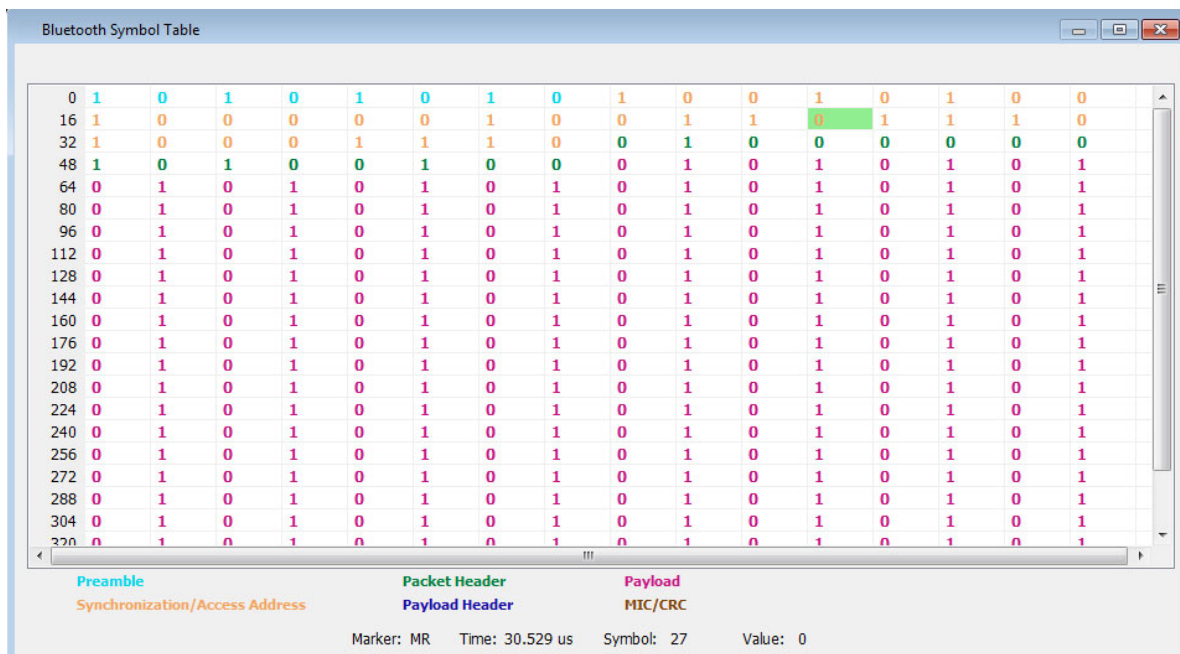
The BT Symbol Table is color coded to indicate different regions of the packet. The legend at the bottom of the symbol table lists the packet contents in their associated colors. The following image shows values for a Basic Rate signal.

Bluetooth Symbol Table																	
0	1	0	1	0	1	1	0	1	0	0	1	1	0	0	0	0	
16	1	0	0	1	1	1	0	0	1	0	1	0	0	0	0	1	
32	0	1	1	1	0	1	1	1	0	0	1	1	0	1	0	0	
48	1	1	1	1	0	1	1	0	1	1	0	0	1	1	1	1	
64	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	
80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
96	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	
112	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	
128	0	1	0	1	0	1	0	0	0	0	1	1	1	1	0	0	
144	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
160	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
176	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
192	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
208	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
Preamble				Packet Header						Payload							
Synchronization/Access Address				Payload Header						MIC/CRC							
Marker:				Time:			Symbol:			Value:							



Packet standard	Associated regions
Basic rate	4 bit preamble 64 bit access code 4 bit trailer 54 bit packet header 8 or 16 bit payload header based on packet type Variable length payload data 16 bit CRC (Cyclic Redundancy Check)
Low energy	8 bit preamble 32 bit access address / synchronization word 16 bit payload header Variable length payload data (37 bytes) 24 bit CRC (Cyclic Redundancy Check)
Enhanced Data Rate (EDR)	4 bit preamble 64 bit access code 4 bit trailer (if present, shown in black) 54 bit packet header Guard region (shown as X) EDR sync sequence (QPSK or 8PSK symbols) 16 bit payload header (QPSK or 8PSK symbols) Variable length payload data (QPSK or 8PSK symbols) 16 bit CRC (Cyclic Redundancy Check) (QPSK or 8PSK symbols)

The following image shows values for a Low Energy signal.





The following image shows values for an EDR signal.

Symbol	0	1	0	1	0	1	1	0	1	0	0	1	1	0	0	0	0
0	1	0	0	1	1	1	0	0	1	0	0	1	1	0	0	0	0
16	1	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	1
32	0	1	1	1	0	1	1	1	0	0	1	1	0	1	0	0	0
48	1	1	1	1	0	1	1	0	1	1	0	0	0	1	1	1	1
64	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	0	0
80	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1
96	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
112	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	X	X
128	X	X	X	0	1	3	1	3	1	3	3	1	1	1	1	2	2
144	3	1	2	0	0	0	1	1	1	1	1	1	1	1	1	1	1
160	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
176	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
192	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
208	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
224	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
240	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
256	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
272	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
288	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
304	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
320	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Preamble (GFSK)      Packet Header (GFSK)      Payload (PSK)  
 Access Address (GFSK)      EDR Sync Sequence (PSK)      MIC/CRC (PSK)

Marker:      Time:      Symbol:      Value:

**Markers and the BT Symbol Table.** 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 Marker (M1-M4) readout is enabled, will display the difference between its position and that of the Marker Reference (MR). In the BT 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 BT Symbol Table, the marker readout below the table shows the marker location in time, symbol numbers and symbol value.

## BT Symbol Table Settings

**Application Toolbar:**

The settings for the BT Symbol Table display are shown in the following table.



Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Prefs	Allows you to select to show or hide the marker readouts and set the radix of shown symbols.

## Bluetooth Frequency Dev vs Time display

The BT Freq Dev vs. Time display shows how the signal frequency varies with time.

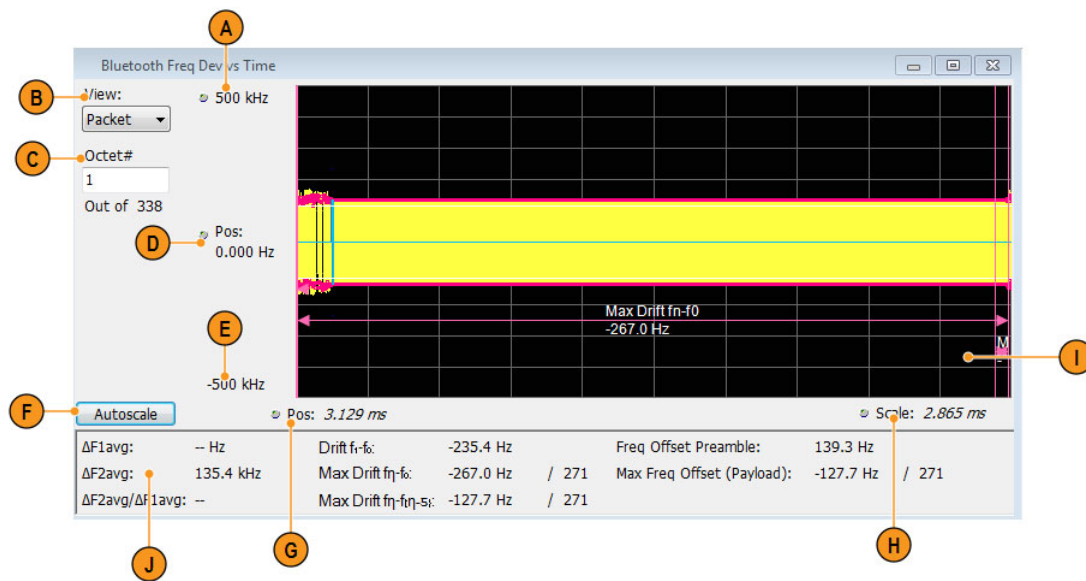
To display the BT Freq Dev vs. Time display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Select the **Displays** button or **Setup > Displays**.
3. In the **Select Displays** dialog, select **Bluetooth Analysis** in the **Measurements** box.
4. In the **Available displays** box, double-click the **BT Freq Dev vs. Time** icon or select the icon and click **Add**. The BT Freq Dev vs. Time icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.
7. Select the **Trace** tab and set the **Content** to Vectors or Points, as required.
8. Select Replay/Run to take measurements on the acquired data.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image shows the frequency deviation of the complete packet of a Basic Rate signal in the BT Freq Dev vs. Time display.







Item	Display element	Description
A	Top of graph	The vertical scale is normalized with Hz.
B	View	<p>(This option is visible only when Preamble is detected.)</p> <p>Select one of the following:</p> <p>Packet: view frequency deviation for an entire packet.</p> <p>Octet: view frequency deviation for a specified octet duration (8 <math>\mu</math>s). The Octet is specified in the Octet # field.</p>
C	Octet # (xx of total)	<p>(This option is visible only when Preamble is detected and Octet is selected as the View.)</p> <p>Specifies the Octet number. (The total number of octets is also indicated.) When View is set to Octet, you can enter a particular octet in the Octet # field for zoom view. The plot will show only 8 <math>\mu</math>s of information corresponding to the octet number chosen in the payload. The regions that are used for doing the exact measurements are highlighted in the Octet View. For F0F0 (Low Deviation) pattern in payload, bit intervals 2,3,6,7 regions are highlighted and for 1010 (high deviation) pattern, all bit regions are highlighted with appropriate results. The offset calculated for every octet region (f1ccf or f2ccf) are also shown.</p>
D	Position (center)	Adjust the frequency shown at the center of the display.
F	Autoscale button	Adjusts the offset and range for both vertical and horizontal to provide the best display.
G	Position	Displays the horizontal position of the trace on the graph display.
H	Scale	Adjusts the horizontal scale (time).
I	Plot	Displays the last analyzed complete packet or the selected octet (Octet zoom view) of the signal.
J	Scalar results	<p>The Scalar results for Modulation Characteristics and Frequency Offset and Drift measurements are captured here. These results are from the last analyzed packet and therefore could be different from the Averaged Scalar results shown in the BT Summary display.</p> <p>For Drift results, the index is also shown where the maximum drift occurred. The Drift results are shown only when the preamble is detected and the test pattern payload detected is 10101010. <math>\Delta F1_{avg}</math> or <math>\Delta F2_{avg}</math> is shown only when the detected test pattern payload is (10101010) or (11110000).</p>

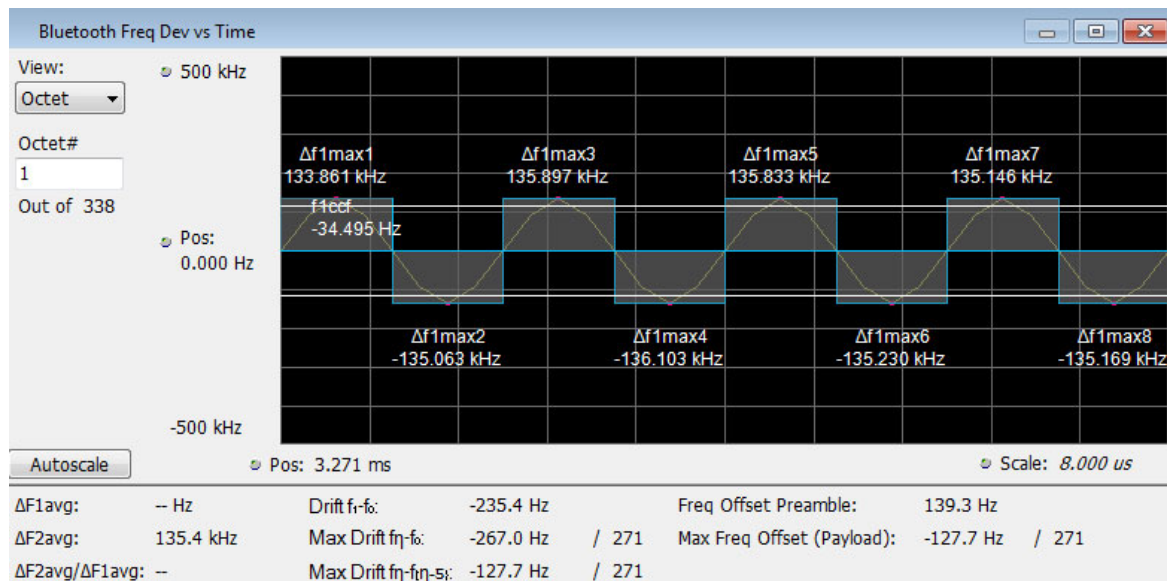
---

**NOTE.** This display shows the frequency deviation results without compensating for the frequency error.

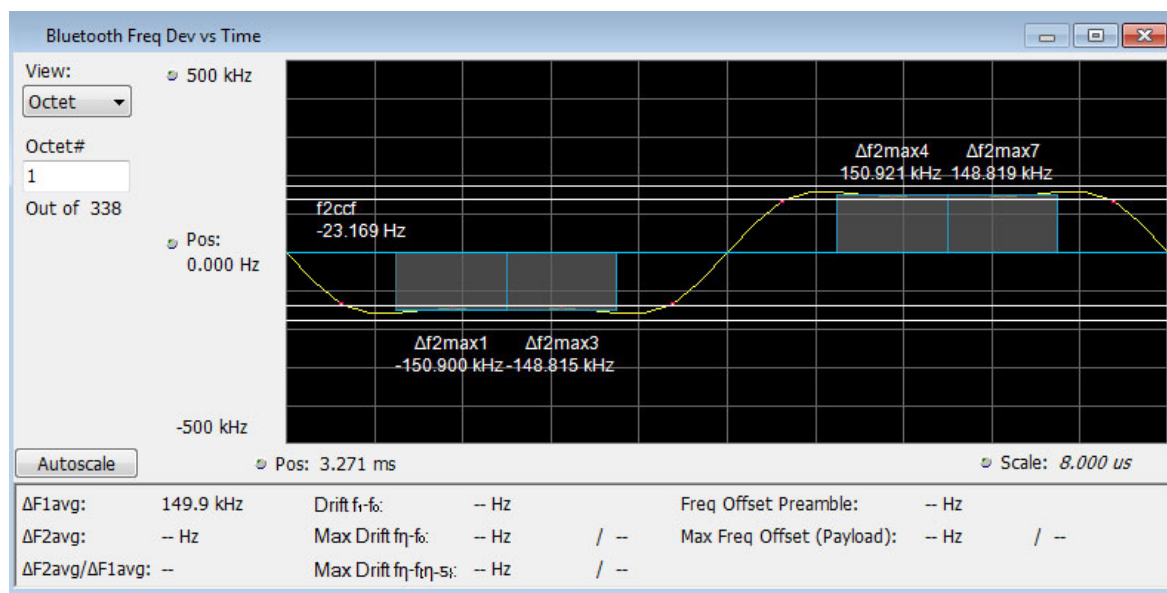
---



The following image shows the frequency deviation of the first octet in the payload of a Basic Rate signal (high deviation).



The following image shows the frequency deviation of the first octet in the payload of a Basic Rate signal (low deviation).





## BT Frequency Dev Vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

The Setup settings for BT Freq Dev vs. Time are shown in the following table.

Settings tab	Description
Standard Params	Select the standard, measurement filters, and power class (when applicable). You can also set the analyzer to auto detect the standard.
Analysis Params	Specifies frequency error, frequency offset, measurement BW, and test patterns. You can also select to auto detect test patterns. These parameters are used by the instrument to analyze the input signal.
Analysis Time	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) and Time Zero Reference (Trigger or Acquisition Start) for Bluetooth Analysis displays.
Trace	Allows you to select the number of points per symbol, content, and to choose between entire packet view or zoom Octet view for a chosen octet number in a packet.
Scale	Allows you to specify the horizontal and vertical scale settings.
Prefs	Allows you to select to show or hide the graticule and marker readouts.

## Bluetooth 20dB Bandwidth display

The BT 20dB BW display shows the results of two Bluetooth measurements: 20dB Bandwidth and Frequency Range. When the xdB BW is chosen, the display shows the x dB bandwidth from the peak power. More detailed information about this measurement is available [here \(see page 325\)](#).

To display the BT 20dB BW display:

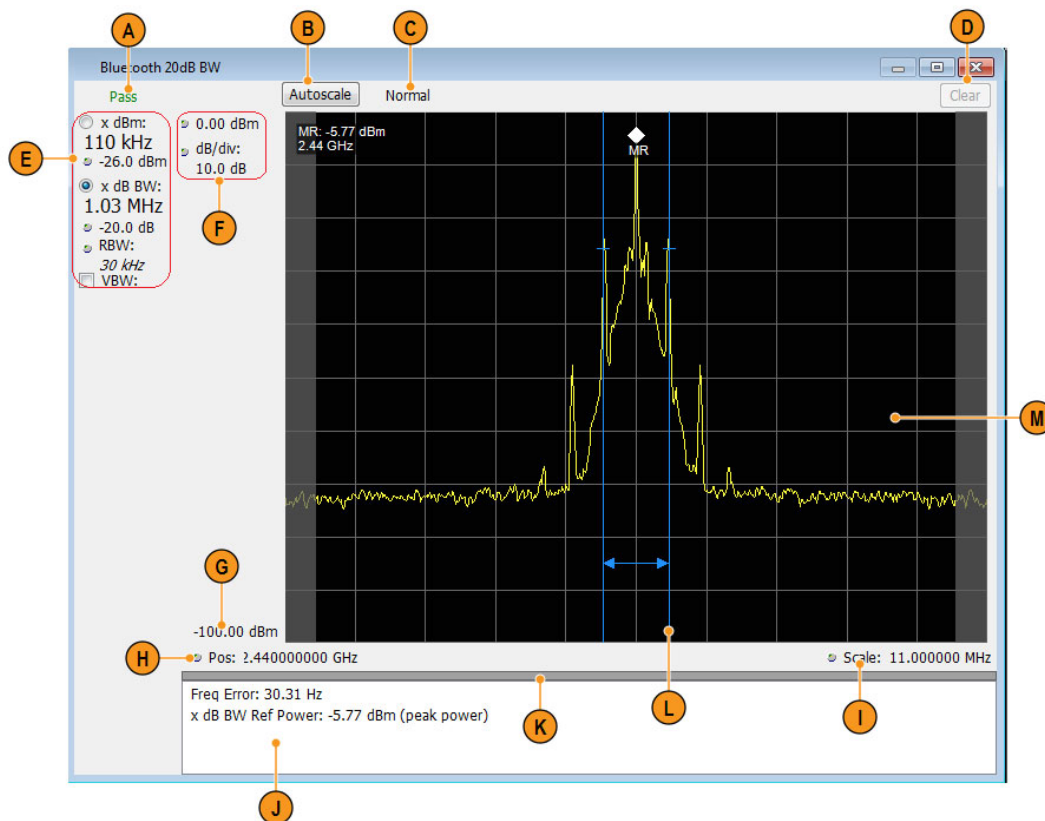
1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Select the **Displays** button or **Setup > Displays**.
3. In the **Select Displays** dialog, select **Bluetooth Analysis** in the **Measurements** box.
4. In the **Available displays** box, double-click the **BT 20dB BW** icon or select the icon and click **Add**. The BT 20dB BW icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select the **Standard Params** tab. Set the Standard, Power class (when appropriate), and Measurement and Reference filters as appropriate for the input signal. You can also check the **Auto Detect Standard** box.



7. Select the **Trace** tab and set the **Content** to Vectors or Points, as required.
8. Select Replay/Run to take measurements on the acquired data.
9. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image of the BT 20dB BW display shows a Basic Rate signal that would allow you to measure 20 dB bandwidth.





Item	Display element	Description
A	PASS / FAIL	Indicates Pass or Fail for the 20 dB BW measurement.
B	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
C	Normal / MaxHold	Indicates whether the measurement is done with a MaxHold or a Normal condition.
D	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.
E	Main results area	Shows the xdBm and xdB results. The requested dB or dBm value can be set in the controls below the result readout. Use the two radio buttons to select which of the two results are illustrated in the graph with the blue lines and arrows. RBW also can be set using the control. VBW enables the VBW (Video Bandwidth) filter. Displays current VBW filter setting. See Setup > Settings > Freq & RBW tab.
F	Position and dB/div	Position sets the top of graph value. The dB/div setting is the vertical scale value.
G	Bottom readout	Displays the value indicated by the bottom of graph.
H	Position	Displays the horizontal position of the trace on the graph display.
I	Scale	Adjust the span of the graph in symbols.
J	Detailed results	Displays the following additional measurements results:  <b>Freq Error:</b> The frequency difference between the measured carrier frequency of the signal and the user-selected center frequency of the analyzer.  <b>x dB BW Ref Power:</b> The peak power measured within the measurement bandwidth.
K	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.
L	Blue lines	Indicates the measurement positions.
M	Plot	Displays the input signal. Shaded areas indicate the measurement bandwidth (Settings > Parameters tab > Measurement BW).

## BT 20dB BW settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

The Setup settings for BT 20dB BW are shown in the following table.



Settings tab	Description
Freq & RBW	Allows you to specify the frequency, resolution bandwidth (RBW), step, and VBW used for the MCPR measurements.
Parameters	Allows you to specify the x dB level, Measurement Direction, Measurement BW, xdBm level, xdBm Range, and to enable averaging and the Max Hold function.
Scale	Allows you to define the vertical and horizontal axes.
Prefs	Allows you to specify the radix of the marker readout and whether elements of the graphs are displayed.

## Bluetooth InBand Emission display

The BT InBand Emission display verifies whether the emissions inside the operating frequency range are within limits. The power in adjacent channels of 1 MHz bandwidth around the frequency of transmission are calculated and compared against limits. The integrated power in the 1 MHz band for the adjacent channels is shown in a table below the plot.

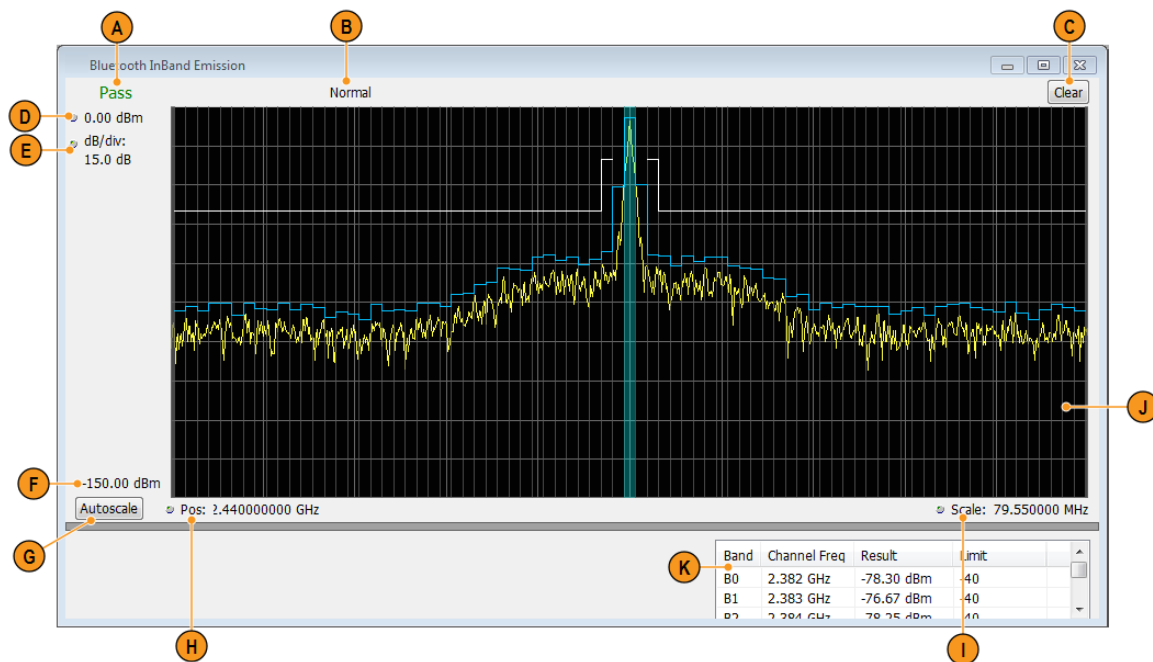
To display the BT InBand Emission display:

1. If you are analyzing a stored data file, recall the data file now. Otherwise, go to the next step.
2. Select the **Displays** button or **Setup > Displays**.
3. In the **Select Displays** dialog, select **BT Inband Emission** in the **Measurements** box.
4. In the **Available displays** box, double-click the **BT Inband Emission** icon or select the icon and click **Add**. The BT Inband Emission icon will appear in the **Selected displays** box and will no longer appear under Available displays.
5. Click **OK** to show the display.
6. Select the **Standard Params** tab and select the appropriate standard.
7. Select the **Measurement Params** tab and turn on averaging, if desired.
8. Select the **Limits** tab and set the desired limits.
9. Select **Replay/Run** to take measurements on the acquired data.
10. If you are analyzing a data file, press the **Replay** button to take measurements on the recalled acquisition data file.

### Elements of the Display

The following image shows the BT Inband Emission display of a Basic Rate signal operating at 2.441 GHz (showing 80 adjacent bands).







Item	Display element	Description
A	PASS / FAIL	Indicates Pass or Fail based on the number of adjacent channels that are below an upper limit. A maximum of 3 adjacent channels can have integrated power higher than an upper limit (Pass); otherwise, Fail is reported.
B	Normal	Displays Average Count if Average is turned on (set to Time Domain or Frequency Domain) from the Measurement Params tab in the Settings control panel.
C	Clear	Resets measurement. Clears all values.
D	Top of graph	The vertical scale is normalized with appropriate power units.
E	dB/div	The vertical scale value.
F	Bottom readout	Displays the value indicated by the bottom of graph.
G	Autoscale	Adjusts the vertical and horizontal settings so that the entire trace fits in the graph.
H	Position	Displays the horizontal position of the trace on the graph display.
I	Scale	Adjust the span of the graph in symbols.
J	Plot	Divides the spectrum into different adjacent channels (each of 1 MHz bandwidth) as suggested in the standard document. You can select to show integrated power by checking the <i>Show power levels in graph</i> box in the Prefs tab in the Settings control panel). The integrated power level is shown in blue and the prescribed limits for comparison (set in the Limits tab of the Settings control panel) are shown in white. The region around the frequency of transmission is shown in a different color.
K	Results table	Reports the integrated power results (Channel frequency, Integrated power, and Limits) from the display in a table.

## Bluetooth Analysis Measurement Settings

### Application Toolbar:

The control panel tabs in this section are shared between the displays in Bluetooth Analysis (Setup > Displays). Some tabs are shared by all the displays, some tabs are shared by only a subset of displays. The settings available on some tabs change depending on the selected display.



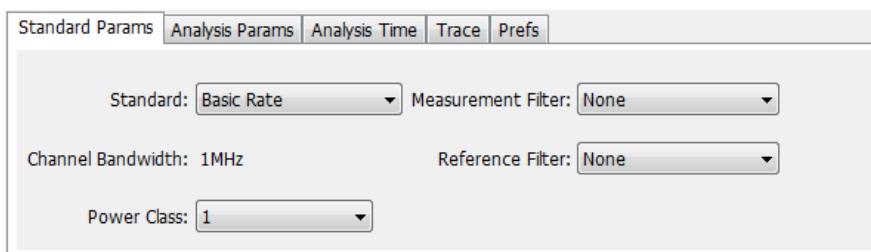
### Common controls for Bluetooth Analysis displays

Settings tab	Description
<a href="#">Standard Params (see page 396)</a>	Specifies the input signal standard and additional user-settable signal parameters.
<a href="#">Analysis Params (see page 398)</a>	Specifies parameters used by the application to analyze the input signal.
<a href="#">Analysis Time (see page 399)</a>	Specifies parameters that define the portion of the acquisition record that is used for analysis. Also allows you to specify the Units (Symbols or Seconds) for Bluetooth Analysis displays.
<a href="#">Trace (see page 402)</a>	Specifies the trace type (Vectors, Points, and Lines), the number of points per symbol when chosen to view as Vectors or Lines, and to control the view as Freq Dev or IQ.
<a href="#">Prefs (see page 404)</a>	Allows preferences with Radix display and marker readouts.
<a href="#">Scale (see page 401)</a>	Defines the vertical and horizontal axes.
<a href="#">Parameters (see page 405)</a>	Specifies parameters used to analyze the signal.
<a href="#">Freq RBW (see page 407)</a>	Allows you to set Frequency and RBW settings for the BT 20 dB BW display.
<a href="#">Limits (see page 400)</a>	Allows you to define limits for pass/fail comparison with calculated values. The default values are as recommended in the test specification.
<a href="#">Measurement Params (see page 408)</a>	Allows you to set average (Time Domain, Off, or Frequency Domain) and to correct for noise floor.

## Standard Params tab - BT

The Standard Params tab allows you to specify the standard, measurement and reference filters, power class (for some standards), and set standard auto detect.

The following image shows the tab for all of the Bluetooth displays except for the BT InBand Emission display. The Power Class menu only appears when Basic Rate is the selected standard.



The following image shows the tab for the BT InBand Emission display.



The screenshot shows a software interface with five tabs: 'Standard Params', 'Analysis Params', 'Analysis Time', 'Trace', and 'Prefs'. The 'Standard Params' tab is active. Below the tabs, there is a label 'Standard:' followed by a dropdown menu that currently displays 'Basic Rate'.

Settings	Description
Standard	Select the appropriate standard: Basic Rate, Low Energy, or Enhanced Data Rate.
Auto Detect Standard	Check box to enable automatic detection of the Bluetooth standard (Basic Rate, Low Energy, or Enhanced Data Rate). A status message will appear indicating which of the three standards is detected and the result will show as Standard selection.
Measurement Filter	Specifies the filter used for measurement. The default filters for the Low Energy and Basic Rate standards are LE-Recommended and BR-Recommended, respectively.
Reference Filter	Specifies the filter used as a reference.
Power Class (only available for Basic Rate)	Select one out of three available power classes. This sets the default limits for comparison (set in the Limits tab of the Settings control panel) for Average and Peak power measurements.

### Power class for the Basic Rate standard

The power class for Basic Rate is the reference receive power range as specified by the standard. It sets the default limits for comparison in the Limits tab of the control panel for Average and Peak power measurements. The power classes are specified as follows:

**Class 1:** max power 20 dBm (100 mW) with mandatory power control.

**Class 2:** max power 6 dBm (4 mW) with optional power control.

**Class 3:** max power 0 dBm (1 mW) with optional power control.

### Recommended measurement and reference filters

The available measurement and reference filters depend on the selected standard. You can use the filters recommended by the standard (shown in following table) or load your own filters by selecting one of the User defined filters from a file.

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.



**CAUTION.** Although there may be other filter types listed in the drop down menu, if you select any filter other than that which is recommended, the measurement results may not be accurate.



Standard	Measurement filters	Reference filters
Basic Rate	BR-Recommended	None
Low Energy	LE-Recommended	None
Enhanced Data Rate	BR-Recommended	None

### How to select filters

In a signal transmitter/receiver system, the baseband signal might be filtered for bandwidth limiting or for another kind of necessary shaping that needs to be applied. Normally, a filter in the transmitter (Ft) and a filter in the receiver (Fr) are applied.

The Measurement Filter setting in the analyzer corresponds to the baseband filter in the receiver (Fr): This setting tells the analyzer what filter your receiver uses. When the analyzer is set to the same filter used by the receiver, the analyzer sees the signal as your receiver would. The Measurement Filter setting should be the same as the filter used in the receiver under normal operation (as opposed to testing).

## Analysis Params tab - Bluetooth

The Analysis Params tab contains parameters that control the analysis of the input signal. The Test Patterns menu only appears when the Auto Detect Test Pattern is not checked. This tab is available for all displays except for the BT 20dB BW and the BT InBand Emission displays.

Settings	Description
Frequency Error	When the Auto box is checked, the analysis determines the Frequency Error and the measured Frequency Error is displayed. When the Auto box is unchecked, the entered value is used by the analysis as a fixed frequency offset. This is useful when the exact frequency offset of the signal is known.
Measurement BW	Specifies the bandwidth about the center frequency at which measurements are made. Select Manual, Auto, or Link to Span.
Auto Detect Test Pattern	When this box is checked, automatic detection of the test pattern is enabled. When this box is unchecked (Manual mode), automatic detection is disabled and you can select the test pattern and specify the $\Delta f_{avg}$ for the other pattern for ratio computation.
Test Pattern	Allows you to select the test pattern to be analyzed. This choice is available only when Auto Detect Test Pattern is disabled.



## Analysis Time tab - Bluetooth

The Analysis Time tab contains parameters that define how the signal is analyzed in the Bluetooth Analysis displays. This tab is available for all displays except for the BT 20dB BW and the BT InBand Emission displays.

Standard Params Analysis Params Analysis Time Trace Prefs

Analysis Offset: 0.000 s ☒ Auto Time Zero Reference: Trigger

Analysis Length: 3.500 ms ☐ Auto Units: Seconds

Available: 0.000 s

Settings	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 symbols or seconds, depending on the Units setting.
Auto	When enabled, causes the instrument to set the Analysis Length value based on the requirements of the selected display.
Available	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).
Time Zero Reference	Specifies the zero point for the analysis time.
Units	Specifies 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. 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 "Available" readout. This setting is not available when Auto is checked. Range: minimum value depends on the standard. Resolution: 1 symbol.

## 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.

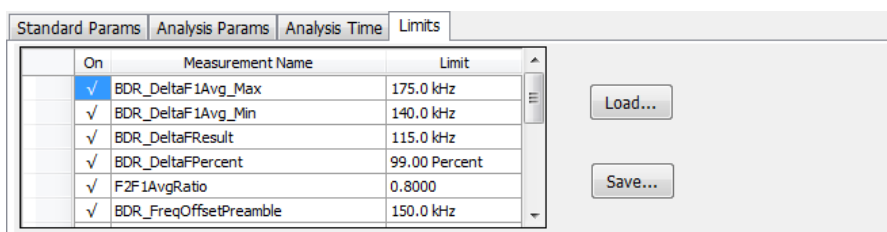
Parameter	Description
Acquisition Start	Time zero starts from the point at which the acquisition begins.
Trigger	Time zero starts from the trigger point.

## Limits tab - Bluetooth

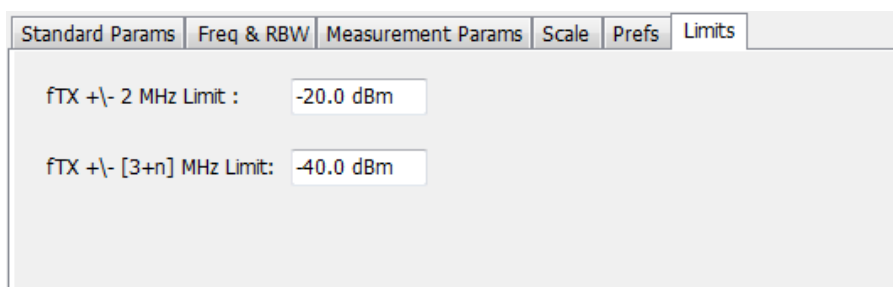
This tab is only available for the BT CF Offset and Drift, BT InBand Emission, and BT Summary displays. It enables you to load an existing limits table, save a limits table, or edit limits values. The content under Measurement Name varies based on the chosen standard and power class.

Some measurements are done only when a specific test pattern is detected. If the specific pattern is not detected, then N/A appears in blue in the BT Summary display because the measurement is not done. If the measurement is done, Pass or Fail is shown in the BT Summary display.

The following image shows the Limits tab for the BT CF Offset and Drift and BT Summary displays.



The following image shows the Limits tab for the BT InBand Emission display.





Settings	Description
Load	Click to load a saved Limits table from a .csv file.
Save	Click to save the current Limits table to a .csv file.

### Edit limits

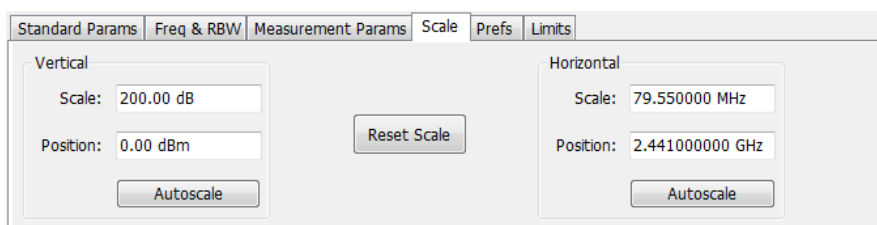
To directly edit measurement limits in the table, click on the value in the Limit column that you want to change. The following table describes the parameters that are set in the Limits Table.

Settings	Description
On	Click on the cell in the On column next to the measurement to specify whether or not measurements are selected for limit comparison to indicate Pass or Fail. A check mark means the measurement will be taken. An empty box means it will not be taken.
Measurement Name	Specifies the name of the measurement related to the limit. (Not editable.) The content under Measurement Name varies based on the chosen standard and power class.
Limit	Specifies the value of the limit to the related measurement. When the cell is selected, the value is shown along with the units.

## Scale tab - Bluetooth

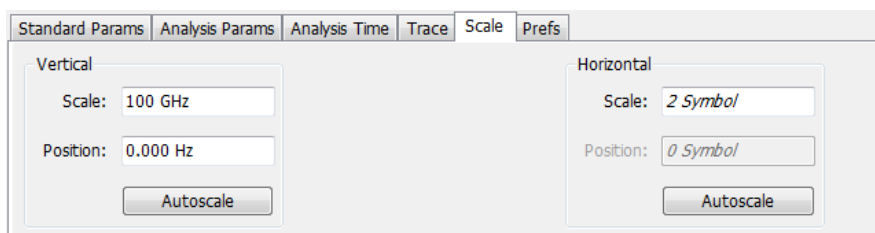
The Scale tab allows you to change the scale settings that control how the trace appears on the display but does not change control settings such as Measurement Frequency. In effect, these controls operate like pan and zoom controls. The Scale tab values are unique to each display. Also, note that each display uses horizontal and vertical units that are appropriate for that display. There are three versions of the Scale tab for Bluetooth displays.

The following image shows the Scale tab for the BT 20dB BW and BT InBand Emission displays.

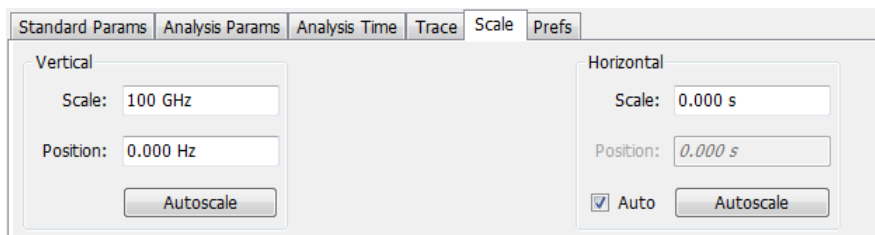


The following image shows the Scale tab for the BT Eye Diagram display.





The following image shows the Scale tab for the BT Freq Dev vs Time display.



Settings	Description
Vertical	Controls the vertical position and scale of the trace display.
Scale	Changes the vertical scale of the graph.
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 horizontal span of the trace display and position of the trace.
Scale	Allows you to, in effect, change the horizontal span.
Position	Allows you to pan a zoomed trace without changing the frequency.
Autoscale	Resets the scale of the horizontal axis to contain the complete trace.
Auto	When Auto is checked, the scale and position values for the Symbols graph are automatically adjusted to maintain the optimal display.
Reset Scale	Resets all settings to their default values.

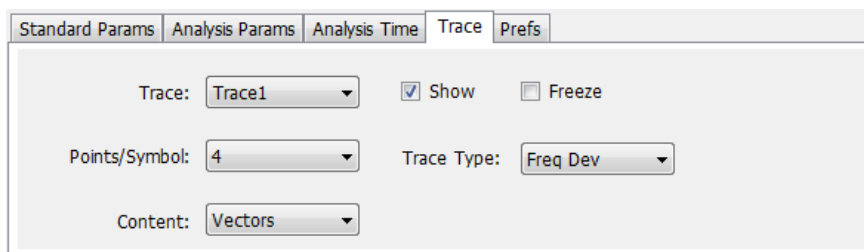
**NOTE.** The Units used for the horizontal scale for the BT Freq Dev vs Time display can be either Seconds or Symbols. To set the units for the horizontal scale, display the Analysis Time tab. On the tab, select the appropriate units from the Units drop-down list.

## Trace tab - Bluetooth

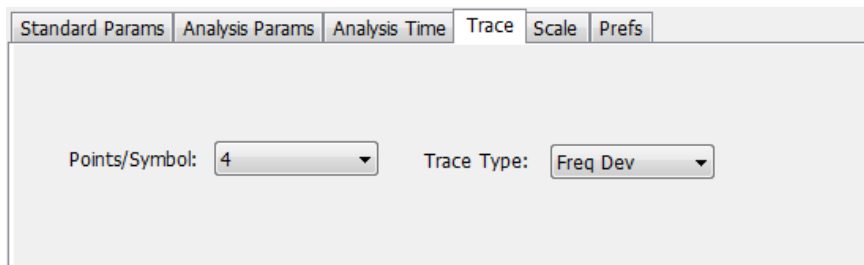
The Trace tab allows you to set the trace display characteristics of the BT Constellation, BT Eye Diagram, and BT Freq Dev vs Time displays. The selections vary depending on the selected display.

The following image shows the tab for the BT Constellation display.

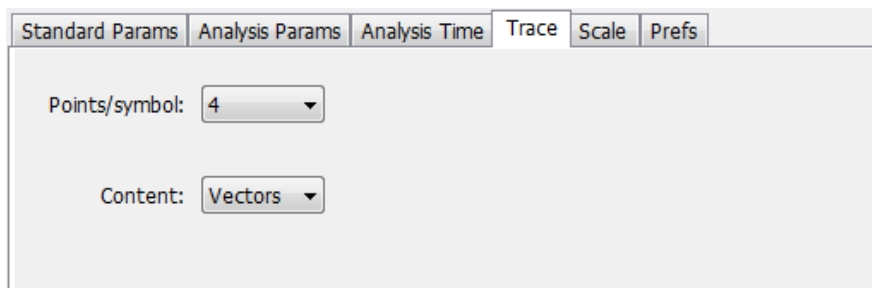




The following image shows the tab for the BT Eye Diagram display.



The following image shows the tab for the BT Freq Dev vs Time display.




Setting	Description
Trace	Select the trace to display.
Show	Shows / hides the selected by trace.
Freeze	Halts updates to the selected trace.
Points/Symbol	Select how many points to use between symbols when connecting the dots. Values: 1, 2, 4, 8, 16, and 32.
Content	Select whether to display the trace as vectors (points connected by lines), points (symbols only without lines), or lines (lines drawn between symbols, but no symbols are displayed). The choices available depend on the display.
Trace Type	Select to specify whether the plot is shown as IQ or as Frequency Deviation.
View	Allows you to see the full packet or only the chosen Octet.
Octet # (of xx)	Allows you to view the specified octet. You can also select from the list of the available number of Payload octets in the packet.



## Comparing two traces in the BT Constellation display

You can use the Traces tab to enable the display of a second trace. The second trace is a version of the current acquisition. You can choose to freeze a trace in order to display the current live trace to an earlier version of itself, you can display the trace as a second trace, or you can choose to display both traces frozen in order to compare the trace to itself at different times.

To display a second trace in the BT Constellation display:

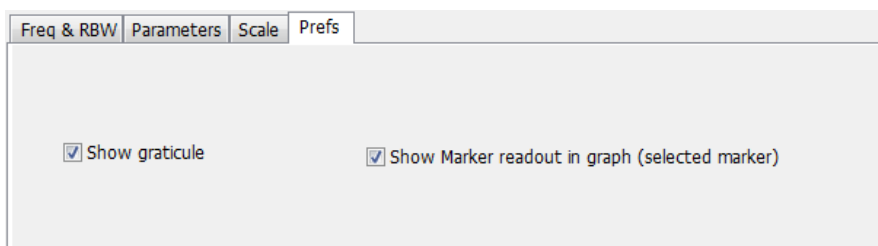
1. If more than one display is present, select the BT Constellation display to ensure it is the selected display.
2. Click .
3. Select the Trace tab.
4. Select Trace 2 from the Trace drop-down list.
5. Click the Show check box so that it is checked.
6. Specify the Content as desired.

The Trace 2 lines will appear in blue to help you distinguish Trace 2 from Trace 1.

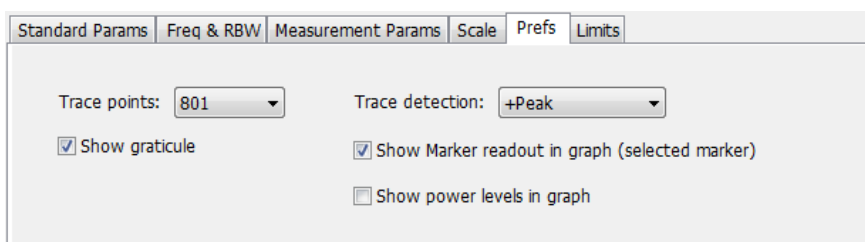
## Prefs tab - Bluetooth

The Prefs tab enables you to change appearance characteristics of some of the Bluetooth Analysis displays.

The following image shows the Prefs tab for the BT 20dB BW, BT Freq Dev vs Time, BT Eye Diagram, and BT Constellation displays.



The following image shows the Prefs tab for the BT InBand Emission display.





The following image shows the Prefs tab for the BT Symbol Table display.

Standard Params Analysis Params Analysis Time **Prefs**

Radix: Binary

☒ Show Marker readout in graph (selected marker)

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 display. There are three choices for Radix: Binary (0,1) and Modulation Symbols (+1,-1). When EDR is detected, the symbol table will always show results in Hex for the PSK region (after guard).
Trace detection	<b>+Peak:</b> Shows the peak power in a bin (of chosen RBW) if there are multiple points to choose from within a bin. <b>Avg (VRMS):</b> Shows the average power in a bin (of chosen RBW) if there are multiple points to choose from within a bin.
Show power levels graph	Displays the calculated power levels in graph in each band.

## Parameters tab - Bluetooth

The Parameters tab enables you to specify several parameters that control signal acquisition in the BT 20dB BW display.

Freq & RBW **Parameters** Scale Prefs

x dB level: -26.0 dB x dBm level: -26.0 dBm ☐ Max Hold spectral data

Meas Direction: Inwards Meas Range: Lower ☐ Average results

Measurement BW: 10.00 MHz Count: 10



Setting	Description
x dB level	x dB level defines the x dB BW level search threshold.
Meas Direction	Specifies which way the search for the x dB level is done. Selecting <b>Inwards</b> directs the search for x dB from the edges towards maximum power. Selecting <b>Outwards</b> directs the search for x dB from maximum power (x dB ref power) to edges.
x dBm level	x dBm level defines the x dBm BW level search threshold.
x dBm range	Specifies the search direction for the x dBm level. The choices are Lower, Higher, or Both.
Measurement BW	Specifies the frequency range used by the measurement.
Max Hold spectral data	Enables the Max Hold function.
Average results	Enables/disables results average across acquisitions. (This is averaging of the results, not of the trace.)
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 bandwidth. The analyzer analyses 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:** -20 dB

### Meas Direction

The search for the x dB level or x dBm level can be done by selecting Inwards or Outwards in Meas Direction. Selecting Inwards directs the search from the edges towards maximum power. Selecting Outwards directs the search from maximum power (x dB ref power or CF for x dBm) to edges.

### x dBm level

The x dBm level determines the x dBm bandwidth. The analyzer analyzes the spectrum trace to locate the frequencies at which the level is x dBm down from the Center frequency. The frequency range is calculated based on the choice of x dBm Range. The value of x dBm is set to -30 dBm when the BT 20dB BW display is launched from the Bluetooth Standards Presets.

### Meas Range (Higher, Lower, Both)

This determines the search range for the x dB level. The options are as follows:

- **Lower:** Indicates the frequency range from center to the lower frequency at which the power level drops to x dBm.
- **Higher:** Indicates the frequency range from center to the higher frequency at which power level drops to x dBm.
- **Both:** Indicates the frequency between the upper and the lower crossing thresholds at which the power level drops to x dBm.



### 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.

## Freq & RBW tab - Bluetooth

The Freq & RBW tab allows you to specify the bandwidth parameters used for setting measurement bandwidth in the BT 20dB BW display. This determines what acquisition bandwidth the measurement will request.

The screenshot shows the 'Freq & RBW' tab with sub-tabs 'Parameters', 'Scale', and 'Prefs'. The 'Parameters' sub-tab is active. It contains the following settings:

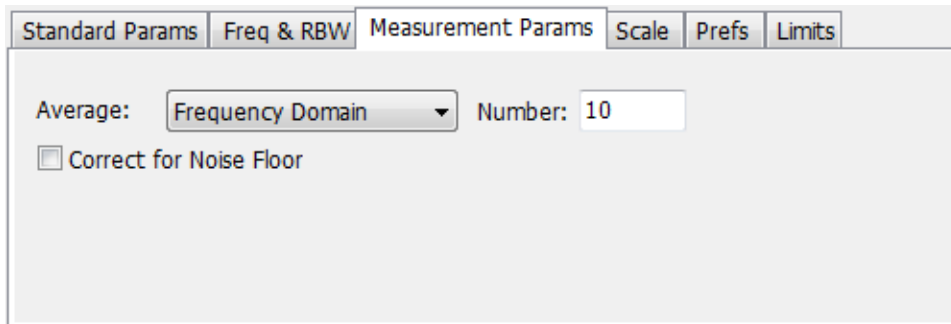
- Meas Freq: 2.44100 GHz
- RBW: 30 kHz
- ☒ Auto (next to RBW)
- Step: 1.0000 MHz
- ☒ Auto (next to Step)
- ☐ VBW:

Setting	Description
Meas Freq	Specifies the measurement frequency.
RBW	Select Auto or Manual. Adjusts the resolution bandwidth for the entire measurement. This setting is independent of the Spectrum display's RBW setting.
Step	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.
VBW	Adjusts the video bandwidth.



## Measurement Params tab - Bluetooth

The Measurement Params tab is only available for the BT InBand Emission display. It allows you to select the average domain and if you want to correct for noise floor.



Standard Params Freq & RBW **Measurement Params** Scale Prefs Limits

Average: Frequency Domain ▼ Number: 10

☐ Correct for Noise Floor

Setting	Description
Average	Specify the average domain (Time Domain, Frequency Domain) or set Average to Off. If a domain is selected, then you can also specify the number.
Number	Specify the number value associated with the Average setting.
Correct for Noise Floor	Check the box next to this setting to correct for noise floor. This is disabled (unchecked) by default.



## Overview

Audio Analysis measures basic time- and frequency-domain parameters of analog audio signals modulated on a carrier (AM, FM and PM modulation) or unmodulated (non-carrier) audio signals (Direct).

For modulated signals, the measurement analysis first demodulates the signal to provide the *Audio signal* waveform. Direct input signals bypass the demodulation step. For FM and PM demodulation, the carrier frequency error is estimated during demodulation.

The Audio signal waveform excursions are then measured to determine the Peak and RMS waveform parameters. Next, the analysis detects the highest-amplitude frequency component within the audio bandwidth, and makes a high-accuracy frequency measurement of the frequency component. This value is called the *Audio Frequency*.

A spectral analysis of the Audio signal waveform is performed to determine the presence and level of harmonically- and/or non-harmonically-related narrowband spurs and wideband noise. The Audio signal, harmonic and non-harmonic spurs, and noise level data are combined to produce signal summary parameters including SINAD, Modulation Distortion, Signal-to-Noise, Total Harmonic Distortion, and Total Non-Harmonic Distortion.

Controls are provided to allow the user to select audio filters of Low Pass, High Pass, FM De-emphasis, or Standard-defined response, as well as completely user-definable filter response. Filtering can be applied as needed to modify the audio spectrum result before measurement to remove unwanted spurs or noise.

Flexible control parameters are provided to allow setting the Audio Bandwidth for analysis, the Resolution Bandwidth (RBW) and RBW filter type of the spectral analysis, and number and level qualifications for Harmonic and Non-harmonic spur detection. Multiple-spectrum averaging can be enabled to provide a smoothed spectrum for results with less variability than single-spectrum results.

The Audio Spectrum display shows the frequency spectrum waveform with detected harmonic and non-harmonic components identified by markers, and a corresponding table of frequency and level values for the spur components. The markers and table provide easy visualization of the significant spurs and their relation to the fundamental Audio frequency signal.

## Audio Demod Tab

**Menu Bar:** Setup > Audio

**Application Toolbar:** 

Selecting **Audio** displays the Audio control panel.

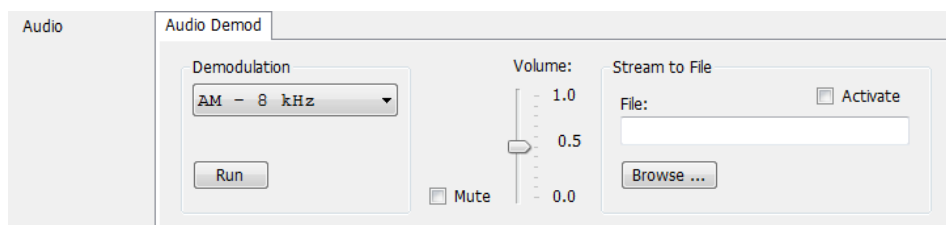
The Audio control panel is only available when SignalVu-PC is connected to an RSA306.

---

**NOTE.** *Audio Demodulation is available only in real-time acquisition mode (not swept acquisition), and the Trigger mode must be set to Free Run (not Triggered).*

---





Setting	Description
Demodulation	Sets both the demodulation type and bandwidth.
Run	Starts and stops the live audio demodulation process.
Volume	Adjusts the volume of the demodulated audio signal played out through the PC speakers.
Mute	Inhibits the audio from playing out through the PC speakers
Stream to File	These controls allow you to stream the demodulated audio file directly to disc. The audio file is saved as a .WAV file.
File:	Displays the current location where the audio file is saved.
Browse:	Use the Browse... button to navigate to a location to save the audio file.
Activate	This enables the Stream to File function. When checked, anytime the Run button is pressed, the audio stream-to-file begins.

## Audio Spectrum Display

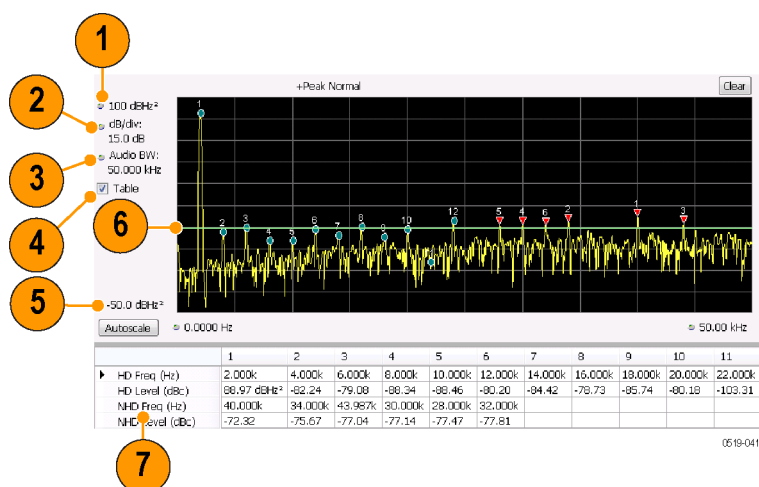
The Audio Spectrum display shows audio modulation characteristics. You can choose to show just the spectrum of the audio signal or show the audio spectrum of the signal and the results of distortion measurements. The Audio Spectrum display can show a table listing the frequency of a Harmonic Distortion (HD) and Non-Harmonic Distortion (NHD) and its level. The Spectrum graph indicates these harmonics and non-harmonics with special markers.

To display the Audio Spectrum display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **Audio Analysis**.
4. Double-click the **Audio Spectrum** icon in the **Available Displays** box. This adds the Audio Spectrum icon to the **Selected displays** box.
5. Click the **OK** button. This shows the Audio Spectrum display.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## Elements of the Audio Spectrum Display



Item	Display element	Description
1	Vertical position	Sets the top of graph value.
2	dB/div	Sets the vertical scale value. The maximum value is 20.00 dB/division.
3	Audio BW	Specifies the measurement bandwidth of the Audio Spectrum display, which in turn can influence the acquisition bandwidth.
4	Table	Displays a table that shows the distortion measurement results and displays indicators on the graph that highlight the location of the harmonics on the trace.
5	Bottom of graph readout	Displays the bottom of graph value.
6	Non-harmonic threshold indicator	Displays the threshold for detecting non-harmonic components.
7	Analysis results	Display of the audio analysis results.

## Audio Spectrum Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:**

The measurement settings for the Audio Spectrum display are shown in the following table.



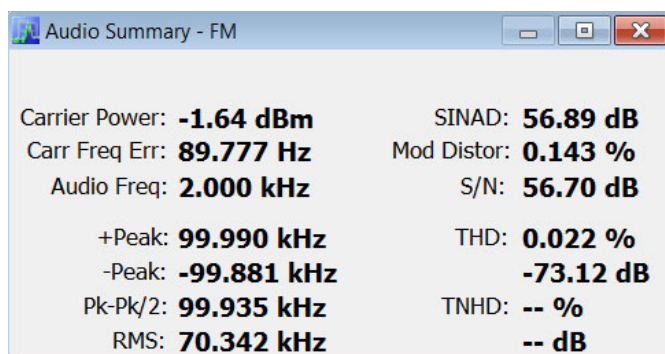
Settings tab	Description
<a href="#">Params1 Tab (see page 414)</a>	Specifies signal type, Audio Bandwidth, RBW, RBW filter, and Ref Audio Frequency.
<a href="#">Params2 Tab (see page 417)</a>	Specifies Harmonics and Non-Harmonics measurement parameters.
<a href="#">Audio Filters Tab (see page 417)</a>	Specifies the audio filter characteristics.
<a href="#">Scale Tab (see page 420)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs Tab (see page 423)</a>	Specifies vertical units, and whether on not some features are displayed in the graph.

## Audio Summary Display

To display the Audio Summary display:

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

### The Audio Summary Display



### Audio Summary Displayed Measurements

Table 8: Audio Summary Measurements

Signal type	Item	Description
AM, FM, PM	Carrier Power	Average power of the carrier signal with modulation removed.
Direct	Signal Power	Average power of the input signal
FM, PM	Carr Freq Err	Carrier frequency error
AM, FM, PM, Direct	Audio Freq	Fundamental audio frequency



Table 8: Audio Summary Measurements (cont.)

Signal type	Item	Description
	+Peak	+Peak modulation excursion (where the modulation excursion readout depends on the signal type) <sup>1</sup>
	-Peak	-Peak modulation excursion (where the modulation excursion readout depends on the signal type) <sup>1</sup>
	Peak-Peak/2	Half peak-peak modulation excursion (where the modulation excursion readout depends on the signal type) <sup>1</sup>
	RMS	RMS modulation excursion (where the modulation excursion readout depends on the signal type) <sup>1</sup>
	SINAD	Signal to noise and distortion
	Mod Distor	Modulation distortion
	S/N	An estimate of the Signal level to Noise (only) level, with the HD and NHD components removed
	THD	Total harmonic distortion
	TNHD	Total non-harmonic distortion
	Ref	Ref is the RMS modulation value stored when the <b>Capture Reference</b> button is pressed. (Displayed only when Hum & Noise is enabled.)
	Diff	Diff is the difference between the current RMS mod value and the Ref value captured previously. (Displayed only when Hum & Noise is enabled.)

<sup>1</sup> For AM signal types, modulation excursion is "% Modulation Depth". For FM signal types, modulation excursion is "Frequency Deviation". For PM signal types, modulation excursion is "Phase Deviation". For Direct, there is no modulation excursion, it is actually "signal excursion".

## Audio Summary Settings

### Application Toolbar:

The measurement settings for the Audio Summary display are shown in the following table.

Settings tab	Description
<a href="#">Params1 Tab (see page 414)</a>	Specifies signal type, Audio Bandwidth, RBW, RBW filter, and Ref Audio Frequency.
<a href="#">Params2 Tab (see page 417)</a>	Specifies Harmonics and Non-Harmonics measurement parameters.
<a href="#">Audio Filters Tab (see page 417)</a>	Specifies the audio filter characteristics.
<a href="#">Hum Noise Tab (see page 422)</a>	Specifies whether or not Hum & Noise is measured and enables the capture of a signal to be used as a reference of the Hum & Noise measurement.



# Audio Analysis Measurement Settings

The control panel tabs in this section are shared by the displays in the Audio Analysis folder (Setup > Displays).

## Common controls for Audio Analysis displays

Settings tab	Description
<a href="#">Params1 Tab (see page 414)</a>	Specifies characteristics about the audio signal and how measurements are made.
<a href="#">Params2 Tab (see page 417)</a>	Specifies parameters that control how measurements are made on harmonics.
<a href="#">Audio Filters Tab (see page 417)</a>	Specifies characteristics of filters applied to the signal before measurements are taken.
<a href="#">Scale Tab (see page 420)</a>	Sets vertical and horizontal scale and position parameters.
<a href="#">Prefs Tab for Audio Analysis (see page 423)</a>	The Prefs tab enables you to change appearance characteristics of the Audio Analysis displays.

## Params1 Tab

The Params1 tab is used to specify characteristics of the audio signal to be measured and how the signal will be measured.

Params1

Params2

Audio Filters

Hum & Noise

Signal Type: 

AM

Audio BW: 20.000 kHz

RBW: 40.0 Hz ☒ Auto

Ref Audio Freq: 2.000 kHz ☒ Auto

RBW Filter: 

Kaiser

Params1 tab for AM signal types



Setting	Description
Signal Type	Specifies the type of signal to be analyzed. The available choices are AM, FM, PM, and Direct.
Audio BW	Specifies the bandwidth used for audio analysis.
Ref Audio Freq	A measured value when Auto is selected. If you want to specify the reference audio frequency, uncheck Auto and enter a value manually. If Ref Audio Freq is set manually, be aware that the automated detection is still performed, but it is limited to a frequency range of $\pm 1\%$ of the Audio BW centered around the manually specified value.
Carrier Freq Error / Carrier Freq Offset	(FM and PM only) A measured value, when Auto is selected. If Auto is unchecked, you can specify the Carrier Frequency Offset.
RBW	Displays the Resolution Bandwidth for Audio measurements. This value is automatically set by default to 1/500 of the measurement bandwidth. To manually specify the RBW, uncheck Auto. The minimum RBW value is limited to the larger of 1 Hz or AudioBW/10000. The maximum is limited to AudioBW/100.
RBW Filter	Specifies the windowing method used for the transform.

### Setting Frequency for Direct Signal Types

Direct (unmodulated) signal analysis is only possible with the instrument Frequency control set to 0 Hz. You will receive a warning to set Frequency to 0 Hz when Direct signal type is selected, if you haven't already done so. Modulated signal types may be selected with Frequency set to 0 Hz, but results are not meaningful in that case. For modulated signals, Frequency should always be set to a value  $\geq$  Audio Bandwidth to avoid self-interference of the signal due to spectral folding.

### Setting Audio Bandwidth

For AM, FM and PM, the Audio Bandwidth control sets not only the demodulated signal bandwidth, but also determines the pre-demodulation bandwidth. Set it to a value at least half the pre-demodulation signal bandwidth, as in this equation:

$$\text{Audio BW} \geq \text{Signal Bandwidth} / 2$$

**NOTE.** When performing audio analysis, you should allow the Audio BW control to automatically set the acquisition bandwidth, rather than manually adjusting the Acq BW control on the Sampling Parameters tab of the Acquire control panel. The audio measurement will cause the Acq BW setting to be  $\geq$  Audio BW (Direct) or  $\geq 2 \times$  Audio BW (AM, FM, PM).

For Direct signals, set Audio Bandwidth large enough to include any significant harmonics/non-harmonics or other signal component of interest. For example, to measure up to the 10th harmonic of a signal with a 5 kHz fundamental component, set Audio Bandwidth to  $10 \times 5 \text{ kHz} = 50 \text{ kHz}$ .

For modulated signals, Audio Bandwidth must be set wide enough to include all significant signal modulation components in addition to the desired audio analysis bandwidth. For AM this is similar to Direct. For example, to measure up to the 10th harmonic of an AM signal with 3 kHz fundamental component, set Audio Bandwidth to  $10 \times 3 \text{ kHz} = 30 \text{ kHz}$ . This ensures that the bandwidth of the data provided by the system to the measurement will be at least of 60 kHz ( $2 \times 30 \text{ kHz}$ ) which is sufficient for this signal and analysis requirement.



FM and PM are more complex. For FM, the analysis bandwidth needs to be at least twice as wide as the the sum of peak Frequency Deviation and the Fundamental Frequency (Carsons rule). This is a parallel condition along with setting Audio Bandwidth large enough for the maximum audio bandwidth to analyze. Therefore, for FM, Audio Bandwidth should be:

$$\text{AudioBW (FM)} = \text{MAX}(\text{MaxAudioAnalysisFreq}, \text{FreqDeviation} + \text{FundamentalFreq})$$

where MaxAudioAnalysisFreq is the highest audio frequency desired in the analysis. For example, for an FM signal with fundamental signal of 5 kHz and peak frequency deviation (one-sided) of 10 kHz, Acquisition Bandwidth should be at least  $(2 \times (10\text{k} + 5\text{k})) = 30\text{ kHz}$ , or an Audio Bandwidth of 15 kHz. Also if the analysis should extend to the 8th harmonic, then the Audio Bandwidth needs to be at least  $8 \times 5\text{ kHz} = 40\text{ kHz}$ . So Audio Bandwidth should be set to 40 kHz. Using the equation:

$$\text{AudioBW(FM)} = \text{MAX}(8 \times 5\text{kHz}, (10 + 5)\text{kHz}) = \text{MAX}(40\text{ kHz}, 15\text{kHz}) = 40\text{ kHz}$$

The formula for PM is:

$$\text{AudioBW (PM)} = \text{MAX}(\text{MaxAudioAnalysisFreq}, \text{PMFreqDeviation} + \text{FundamentalFreq})$$

where

$$\text{PMFreqDeviation} = \text{PMPhaseDeviationInRadians} \times \text{FundamentalFreq}$$

### RBW Filter Shape

Select Kaiser in most cases for best measurement performance. Select Flattop only if you want to use standard markers to measure signal amplitude with highest accuracy.



## Params2 Tab

The Params2 tab is used to specify how the signal harmonics are measured and to control spectrum averaging.

The screenshot shows the Params2 tab with the following settings:

- No. of Harmonics:** 12
- No. of Non-Harmonics:** 12
- ☒ **Averaging:** 10
- Non-Harmonics only** (sub-panel):
  - Ignore region:** 0.0 Hz
  - Threshold:** -65.0 dBc
  - Excursion:** 6.0 dB

Setting	Description
No. of Harmonics	Specifies the number of harmonics to detect. The detected harmonics are tagged with a number on the spectrum trace. The available range is 1–20.
No. of Non-Harmonics	Specifies the number of non-harmonics to detect. The detected non-harmonics are tagged with a number on the spectrum trace. The available range is 0–20.
Averaging	Specifies the number of averages used to compute the results. Range: 2–100.
Ignore region	Specifies the region about the signal frequency where the instrument will ignore non-harmonics.
Non-Harmonic Threshold	Specifies the level which a spectrum peak must exceed to be declared a non-harmonic signal component.
Non-Harmonic Excursion	Specifies the difference in level between a spectrum peak and the average noise level that must be exceeded for the peak to be declared a non-harmonic signal component.

### About Averaging In Audio Analysis Displays

Analysis averaging is implemented using a “block” method. This means that the entire record required for multiple spectrum computations is acquired and analyzed within one analysis cycle. The result of each analysis update is a complete, independent result from a set of N spectrums averaged together, where N is the Averaging control value.. Since each update is a fully averaged result, no partially averaged results are output before a final result is available, so each output is fully valid. However, with large Averaging values, acquisition record sizes and measurement times may become large, so care should be taken to select the minimum amount of averaging needed.

## Audio Filters Tab

The Audio Filters tab is used to specify filters to be applied to the acquired audio signal before measurements are taken. You can select from pre-defined filters or use a filter you define in a text file. You can also specify the de-emphasis time constant applied to the audio signal and the telecom weighting filters used to measure noise.



The screenshot shows the 'Audio Filters' tab with the following settings:

- Pre-defined Filters:** Selected (radio button).
- LPF:** Checked (checkbox), 300 Hz (dropdown).
- HPF:** Unchecked (checkbox), 50 Hz (dropdown).
- De-emphasis:** Unchecked (checkbox), 25  $\mu$ sec (dropdown).
- Standard:** Unchecked (checkbox), CCITT (dropdown).
- File:** Unselected (radio button), with an empty text box and a browse button (...).

## Pre-defined Filters

You can specify low-pass filter (LPF) and high-pass filter (HPF) settings, a de-emphasis time constant and/or a telecom weighting filter to match the response of your receiver. Alternatively, you can create a text file to specify the frequency response points.

To use pre-defined filters:

1. Select the **Pre-defined Filters** option button.
2. Select the LPF, HPF, De-emphasis and Standard check boxes as appropriate.
3. Select the desired filter parameter from the drop-down list for each of the enabled filters or select User from the list if you wish to use a custom value. For LPF and HPF, the listed frequencies represent the 3dB cutoff point of the filter.
4. If you select **User** from the drop-down list, enter a value in the text entry box that appears.

To disable all filtering:

1. Select the **Pre-defined Filters** option button.
2. Deselect all four filter check boxes.

**Table 9: Predefined audio filters**

Filter type	Available settings
LPF (Low Pass Filter) (5th-order Butterworth response)	300 Hz
	3 kHz
	15 kHz
	30 kHz
	80 kHz
	300 kHz
	User <sup>1</sup>
HPF (High Pass Filter) (5th-order Butterworth response)	20 Hz
	50 Hz
	300 Hz
	400 Hz
	User <sup>1</sup>



**Table 9: Predefined audio filters (cont.)**

Filter type	Available settings
De-emphasis (FM only)	25 $\mu$ s
	50 $\mu$ s
	75 $\mu$ s
	750 $\mu$ s
	User. Range: 25 $\mu$ s to 10 ms
Standard	CCITT
	C-message

<sup>1</sup> User-entered values are restricted to maximum of 0.9 \* Audio BW, and will automatically adjust downward to meet this limit (if required) when AudioBW is decreased.

**Standard.** Use this setting to specify the telecom weighting filter. The characteristics of these filters are described in ITU-T Recommendation O.41, Psophometer for Use on Telephone-type Circuits.

### Using Custom Audio Filters

If you want to use audio filters that have a different response shape than the pre-defined filters, you can create a custom audio filter using a text or CSV file to specify the desired filter frequency response.

To use a custom audio filter:

1. Verify that Audio Spectrum or Audio Summary is the selected display.
2. Click the Settings icon or select **Setup > Settings**.
3. Select the **Audio Filters** tab.
4. Click the **File** button.
5. Click the ... button and navigate to the location of the custom audio filter file you wish to use. Select the file you want to use and click Open.
6. Acquire a new trace or replay a saved file to see the effect of the custom filter.

**Creating a Custom Audio Filter.** A custom audio filter file is either a plain text file or a CSV format file. The file contains frequency (in Hz) and amplitude (in dB) value pairs which specify the filter frequency response shape. Each pair must be on a separate line. The filter response between the points is interpolated using a cubic spline fit.

The following table shows the first few lines of a custom audio filter text file.

0,	-100
16.66,	-85
50,	-63
100,	-41
200,	-21
300,	-10.6



400,	-6.3
500,	-3.6
600,	-2
700,	-0.9
800,	0
...	...

Format and rule-checking on custom audio filter files is performed as follows:

- The maximum number of frequency and amplitude pairs is 1000.
- Column 1 (frequency values in Hertz).
  - Non-negative values only (zero is allowed).
  - Strictly increasing order of frequencies (frequency value on each line > frequency value on previous line).
  - There is no upper limit on the frequency value.
- Column 2 (amplitude values in dB units, where gain is a positive value and attenuation is a negative value).
  - Values are restricted to the range -200 to +20 dB.

## 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 acquisition control settings. In effect, these controls operate like pan and zoom controls.

The screenshot shows the 'Scale' tab in a software interface. It has two main sections: 'Vertical' and 'Horizontal'. The 'Vertical' section has a 'Scale' input set to '100 dB' and a 'Position' input set to '101 dBHz²', with an 'Autoscale' button below. The 'Horizontal' section has a 'Left' input set to '0.0000 Hz' and a 'Right' input set to '200.0 kHz', with a 'Log' checkbox and an 'Autoscale' button below. A 'Reset Scale' button is located between the two sections. The top of the window shows tabs for 'Params1', 'Params2', 'Audio Filters', 'Scale', and 'Prefs'.

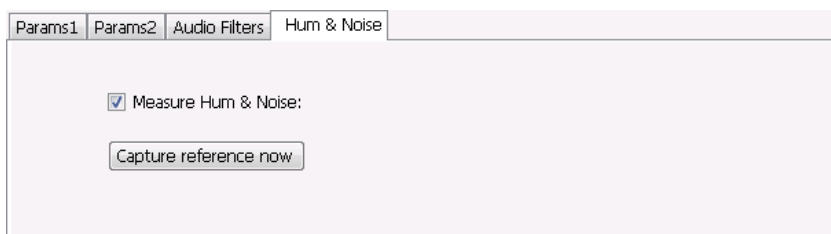


Setting	Description
Vertical	
Scale	Changes the range shown between the top and bottom of the graph.
Position	Adjusts the level shown at the top of the graph for linear units or the top of the graph for log units (for example, dBm).
Autoscale	Resets the Position so that the highest trace points are in the graph. For linear units (Volts, Watts), the Autoscale also adjusts Scale.
Horizontal	
Left	Changes the frequency shown at the left side of the graph.
Right	Changes the frequency shown at the right side of the graph.
Autoscale	Resets the Left and Right settings to show the entire trace.
Log	Sets the graph horizontal axis to a logarithmic scale.
Reset Scale	Resets the Vertical and Horizontal settings to their default values.



## Hum & Noise Tab

Hum & Noise (available only when the Audio Summary display is the active display) is useful for comparing residual power or modulation if the Ref value is captured when the Signal is On (Direct) or modulated (AM/FM/PM). When the signal is turned off (Direct) or modulation turned off (AM/FM/PM), Diff indicates how much residual Hum and Noise are still present in the measurement value.



To display Hum & Noise measurement:

1. Select **Setup > Displays**.
2. In the Select Displays window, select the **Audio Analysis** folder.
3. Double-click the **Audio Summary** icon so that it appears in the **Selected displays** box.
4. Click **OK**
5. With the Audio Summary display selected, select **Setup > Settings**.
6. Select the **Hum & Noise** tab. Click on the **Measure Hum & Noise** checkbox so that it is checked.  
The Hum & Noise values appear at the bottom list of measurements in the Audio Summary display.
7. Acquire an appropriate signal.
8. While the analyzer is analyzing a signal you want to use as a reference, click the **Capture reference now** button to save a reference value.

The Hum & Noise measurement compares the value of a specific signal quantity captured by the **Capture reference now** button with the current measured value of that quantity. For Direct signal types (set on the Params1 tab), the Signal Level is captured and compared. The Diff measurement is:

$$\text{SignalLevel}(\text{current}) - \text{SignalLevel}(\text{Ref})$$

in dB.

For AM, FM, and PM signal types, the RMS modulation value (related to Modulation Depth, Frequency Deviation or Phase Deviation) is captured and compared. The Diff measurement is:

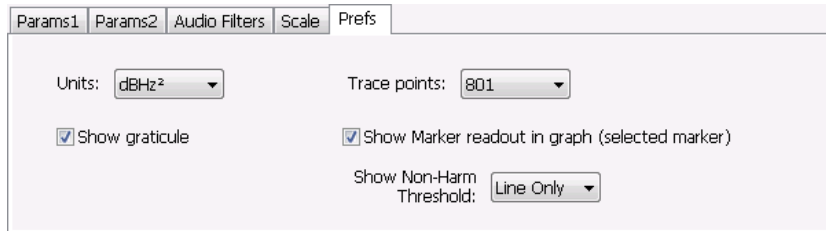
$$20 \times \log_{10}(\text{RMS}(\text{current})/\text{RMS}(\text{Ref}))$$

in dB.



## Prefs Tab

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



The screenshot shows the 'Prefs' tab selected in a software interface. The settings are as follows:

- Units: dBHz<sup>2</sup>
- Trace points: 801
- ☒ Show graticule
- ☒ Show Marker readout in graph (selected marker)
- Show Non-Harm Threshold: Line Only

Setting	Description
Units:	Specifies the vertical scale units. The units available depend on the signal type selected.
Show graticule	Select to display or hide the graticule.
Trace points	Sets the number of trace points used for marker measurements and for results export.
Show Marker readout in graph (selected marker)	Shows or hides the readout for the selected marker in the graph area.
Show Non-Harm Threshold	Shows or hides the non-harmonic threshold line.







## Overview

The displays in General Purpose (GP) Digital Modulation (Displays > Measurements > 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

---

**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).*

---



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 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 p	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

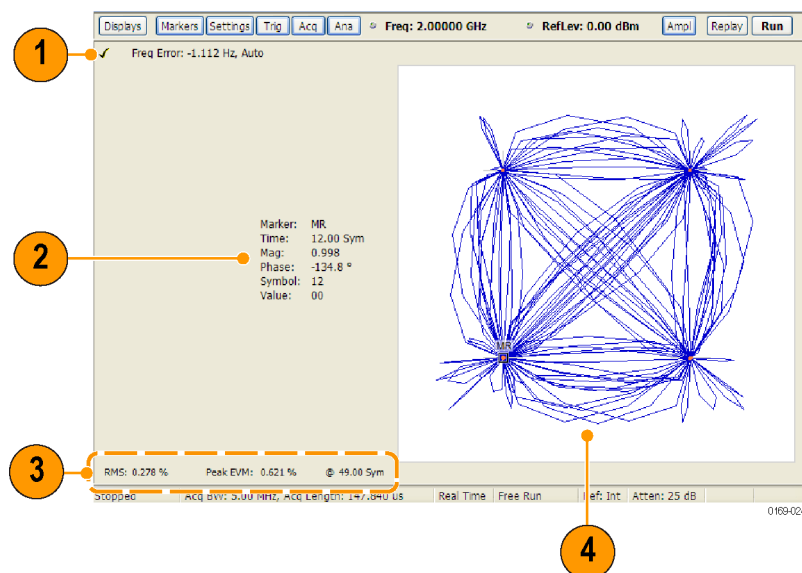
The Constellation Display shows a digitally-modulated signal in constellation form.

To show the Constellation Display:

1. Recall an appropriate acquisition data file.
2. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. Double-click the **Constellation** icon in the **Available Displays** box. This adds the Constellation icon to the **Selected displays** box.
5. Click the **OK** button. This shows the Constellation display.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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. <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 427\)](#)

## Constellation Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:**

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. \(see page 452\)](#)

Settings tab	Description
<a href="#">Modulation Params (see page 453)</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 457)</a>	Sets values for frequency error/offset, measurement bandwidth, and frequency deviation (not every control is present for every modulation type).
<a href="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters that are less frequently used.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Prefs (see page 468)</a>	Enables you to set characteristics of the measurement display.

## Demod I & Q vs Time Display

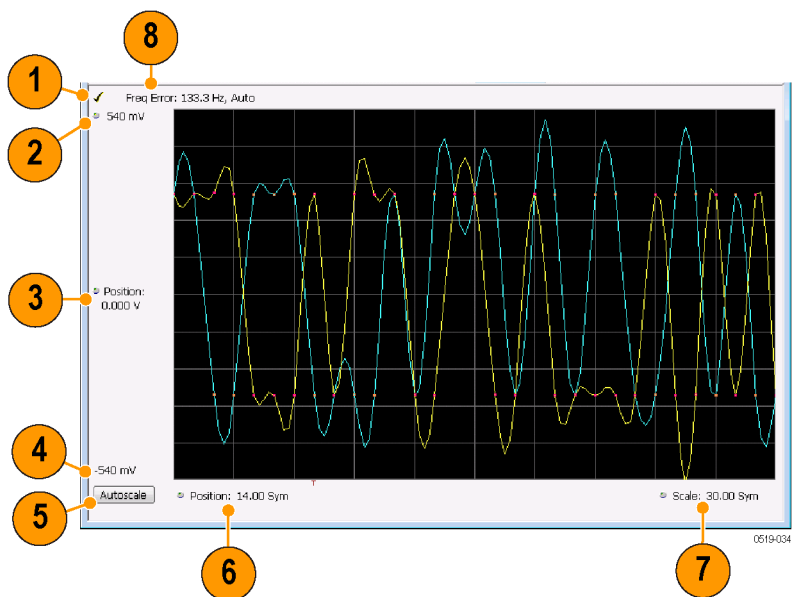
The Demod I & Q vs Time displays demodulated I and Q vs. Time. You can choose to display I only, Q only, or both.

### Elements of the Display

To show the Demod I & Q vs Time display:

1. Recall an appropriate acquisition data file.
2. Select the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. 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.
5. Click the **OK** button. This shows the Demod I&Q vs Time display.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.





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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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</a> (see page 457) 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. \(see page 430\)](#)

## Demod I & Q vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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. \(see page 452\)](#)

---

Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</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).

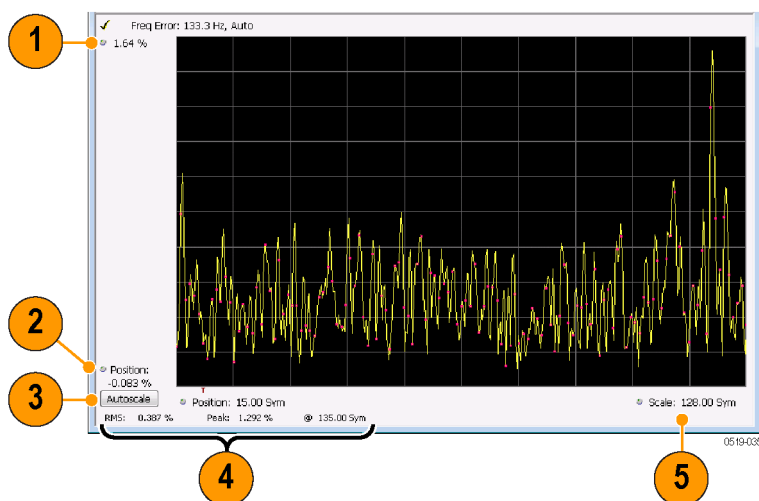
---

To show an EVM vs. Time display:



1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. Double-click the **EVM vs. Time** icon in the **Available Displays** box. This adds the EVM vs. Time icon to the **Selected displays** box.
5. Click the **OK** button. This displays the EVM vs. Time view.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.

### 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 \(see page 431\)](#)

## EVM vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 



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 452)

Settings tab	Description
<a href="#">Modulation Params (see page 453)</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 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies Freq Offset, Magnitude normalization parameters, and enables swapping I and Q.
<a href="#">Find (see page 464)</a>	The Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 464)</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 466)</a>	Specifies the display characteristics of the displayed trace.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</a>	Specifies whether certain display elements are visible.

## Eye Diagram Display

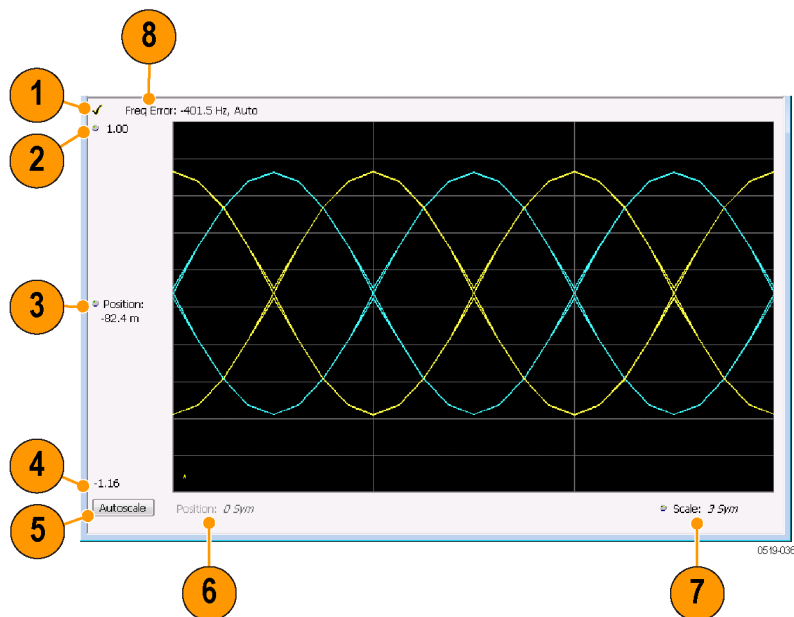
The Eye Diagram Display shows a digitally modulated signal overlapped on itself to reveal variations in the signal.

To show an Eye Diagram display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. Double-click the **Eye Diagram** icon in the **Available Displays** box. This adds the Eye Diagram icon to the **Selected displays** box.
5. Click the **OK** button. This displays the Eye Diagram view.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 434\)](#)

## Eye Diagram Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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. \(see page 452\)](#)

Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</a>	Enables you to set characteristics of the measurement display.

## Frequency Deviation vs Time Display

To show a Frequency Deviation vs Time display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **Frequency Deviation vs Time**.
4. 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.



5. Click the **OK** button. This displays the Frequency Deviation vs Time view.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.

### 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 436\)](#)

## Frequency Deviation vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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. \(see page 452\)](#)



Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</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.

---

**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).*

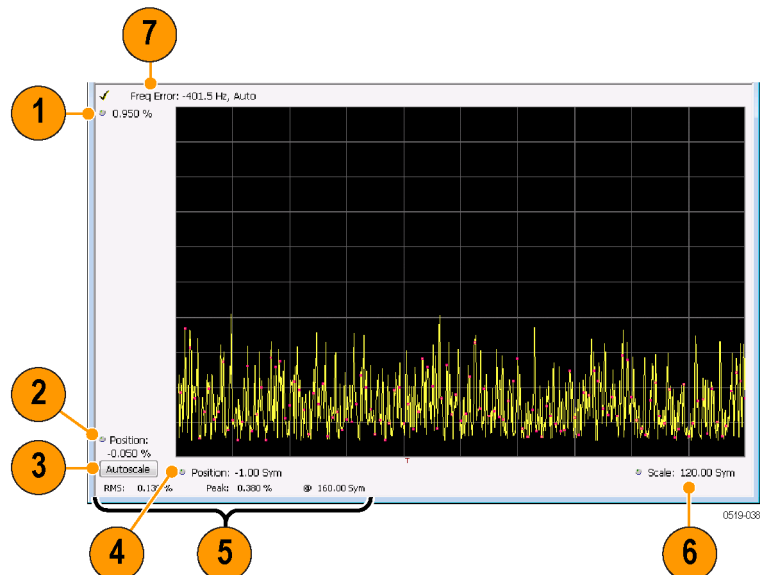
---

To display Magnitude Error vs. Time:

1. Recall an appropriate acquisition data file.
2. Select the **Displays** button or **Setup > Displays**. This displays the Select Displays dialog box.
3. Select **GP Digital Modulation** in the **Measurements** box.
4. 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.
5. Click **OK**.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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</a> (see page 460) tab is set to Manual.

[Changing Magnitude Error vs Time Display Settings \(see page 438\)](#)

## Magnitude Error vs Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 



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. \(see page 452\)](#)

Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</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.

**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).

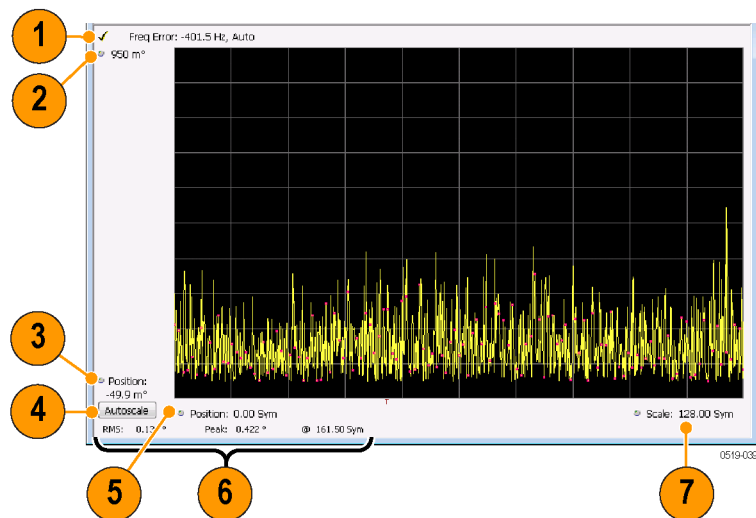
To show the Phase Error display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**.
3. In the **Select Displays** dialog, select **GP Digital Modulation** in the **Measurements** box.
4. 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.



5. Click **OK** to display the Phase Error.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.

### 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 460)</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 \(see page 440\)](#)

## Phase Error vs. Time Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 



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

---

**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. \(see page 452\)](#)

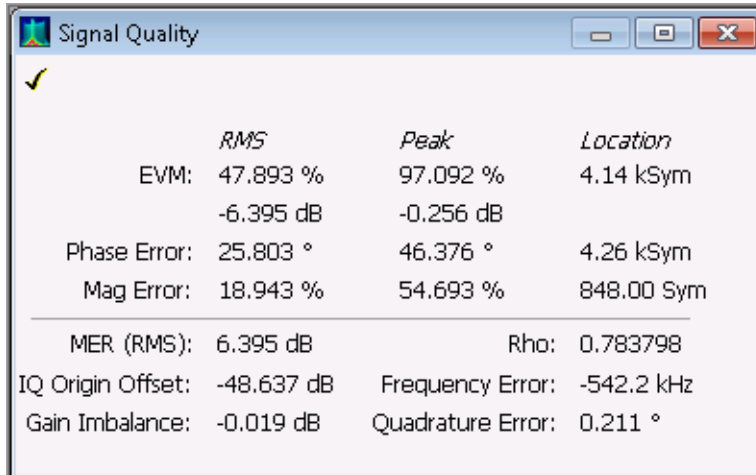
---

Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</a>	Enables you to set characteristics of the measurement display.

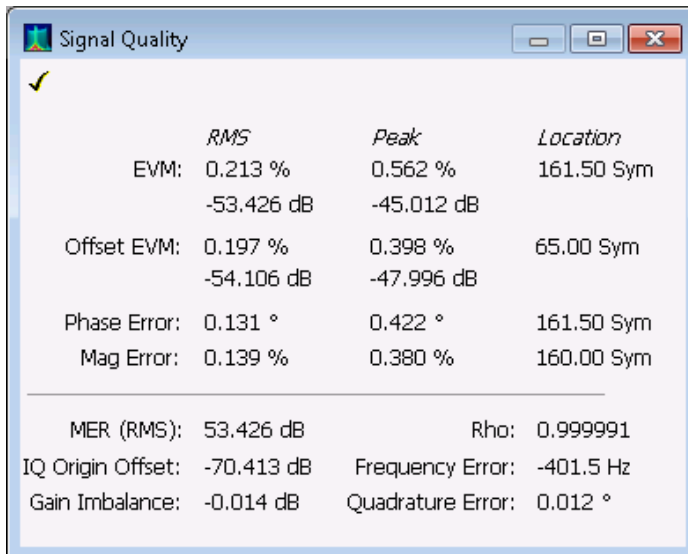
## Signal Quality Display

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.



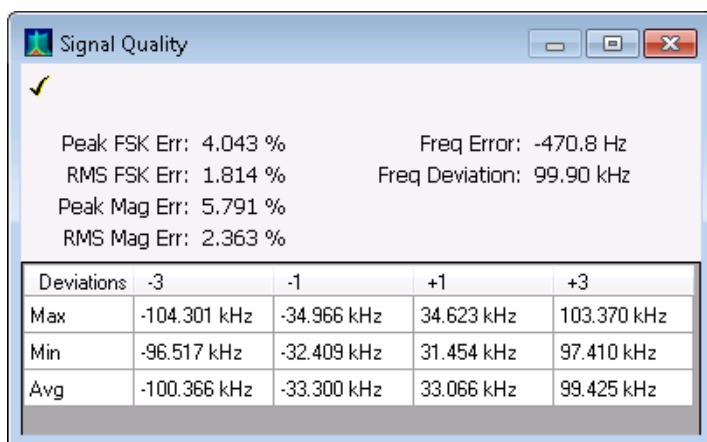


Signal Quality display for all modulation types except nFSK, C4FM, OQPSK, and SOQPSK

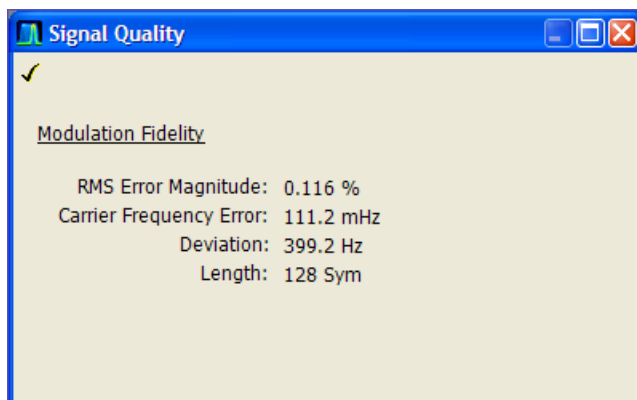


Signal Quality display for OQPSK and SOQPSK modulation types





Signal Quality display for nFSK modulation type



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**

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.
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**

Measurement	Description
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**

Measurement	Description
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 \(see page 446\)](#)

## Signal Quality Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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

---

**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. \(see page 452\)](#)

---



Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	The Modulation tab specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</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 464)</a>	Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 464)</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 468)</a>	The Prefs tab enables you to set characteristics of the measurement display.

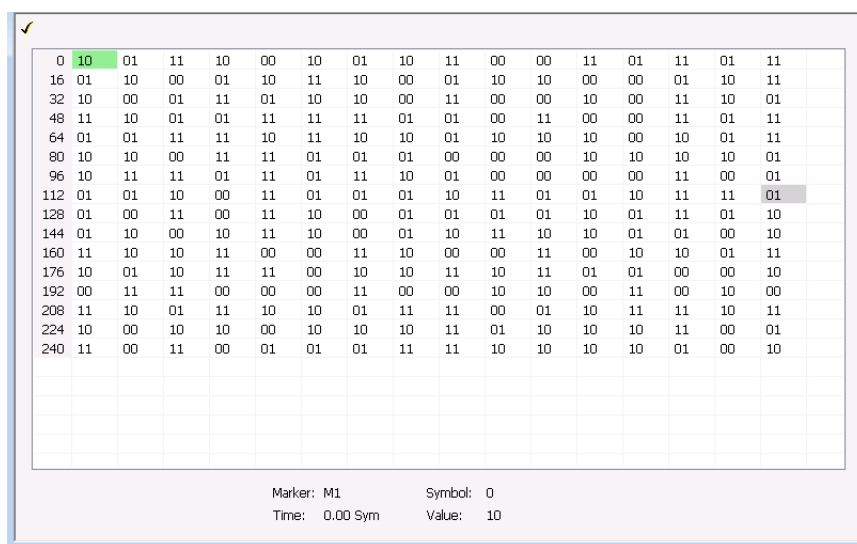
## Symbol Table Display

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. Recall an appropriate acquisition data file.
2. Select the **Displays** button or select **Setup > Displays**. This displays the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. Double-click the **Symbol Table** icon in the **Available Displays** box. This adds the Symbol Table icon to the **Selected displays** box.
5. Click the **OK** button. This displays the Symbol Table view.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.





0	10	01	11	10	00	10	01	10	11	00	00	11	01	11	01	11
16	01	10	00	01	10	11	10	00	01	10	10	00	00	01	10	11
32	10	00	01	11	01	10	10	00	11	00	00	10	00	11	10	01
48	11	10	01	01	11	11	11	01	01	00	11	00	00	11	01	11
64	01	01	11	11	10	11	10	01	10	10	10	00	10	01	11	
80	10	10	00	11	11	01	01	01	00	00	00	10	10	10	01	
96	10	11	11	01	11	01	11	10	01	00	00	00	00	11	00	01
112	01	01	10	00	11	01	01	01	10	11	01	01	10	11	11	01
128	01	00	11	00	11	10	00	01	01	01	01	10	01	11	01	10
144	01	10	00	10	11	10	00	01	10	11	10	10	01	01	00	10
160	11	10	10	11	00	00	11	10	00	00	11	00	10	10	01	11
176	10	01	10	11	11	00	10	10	11	10	11	01	01	00	00	10
192	00	11	11	00	00	00	11	00	00	10	10	00	11	00	10	00
208	11	10	01	11	10	10	01	11	11	00	01	10	11	11	10	11
224	10	00	10	10	00	10	10	10	11	01	10	10	10	11	00	01
240	11	00	11	00	01	01	01	11	11	10	10	10	10	01	00	10

Marker: M1      Symbol: 0  
Time: 0.00 Sym      Value: 10

## 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 \(see page 448\)](#)

## Symbol Table Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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. \(see page 452\)](#)

---



Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	The Modulation tab specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	The Advanced Params tab specifies additional parameters.
<a href="#">Find (see page 464)</a>	Find tab is used to set parameters for finding bursts within the data record.
<a href="#">Analysis Time (see page 464)</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 468)</a>	The Prefs tab enables you to set characteristics of the measurement display.

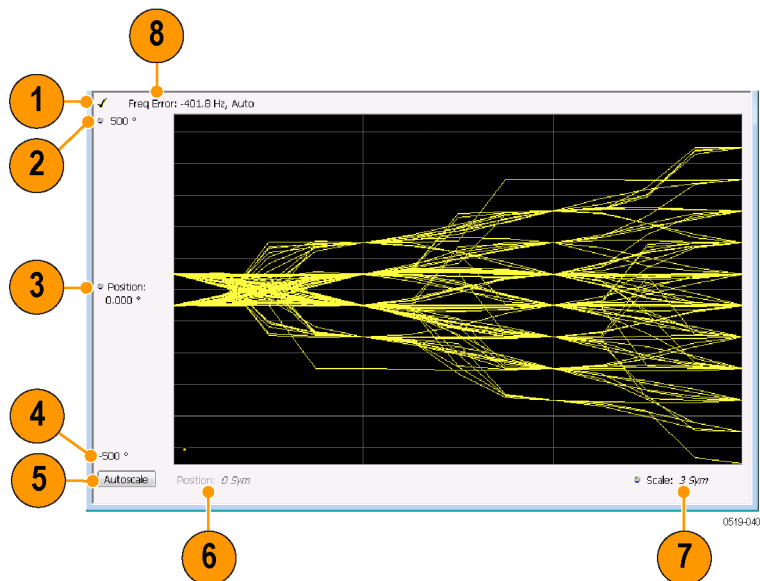
## Trellis Diagram Display

To show an Trellis Diagram display:

1. Recall an appropriate acquisition data file.
2. Press the **Displays** button or select **Setup > Displays**. This shows the **Select Displays** dialog box.
3. From the **Measurements** box, select **GP Digital Modulation**.
4. Double-click the **Trellis Diagram** icon in the **Available Displays** box. This adds the Trellis Diagram icon to the **Selected displays** box.
5. Click the **OK** button. This displays the Trellis Diagram view.
6. Press the **Replay** button to take measurements on the recalled acquisition data file.



## 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.  <b>NOTE.</b> When Best for multiple windows is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.
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 \(see page 451\)](#)

## Trellis Diagram Settings

**Menu Bar:** Setup > Settings

**Application Toolbar:** 

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. \(see page 452\)](#)

Settings tab	Description
<a href="#">Modulation Params (see page 453)</a>	Specifies the type of modulation used for the input signal and other parameters.
<a href="#">Freq &amp; BW (see page 457)</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="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Scale (see page 468)</a>	Specifies the horizontal and vertical scale settings.
<a href="#">Prefs (see page 468)</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 453)</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 457)</a>	Sets values for frequency error/offset, measurement bandwidth, and frequency deviation (not every control is present for every modulation type).
<a href="#">Equalizer Tab (see page 458)</a>	Enable the Equalizer and adjust its parameters.
<a href="#">Advanced Params (see page 460)</a>	Specifies additional parameters that are less frequently used.
<a href="#">Find (see page 464)</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 464)</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 466)</a>	Allows you to set the trace display characteristics.
<a href="#">Prefs (see page 468)</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	<sup>1</sup>
CPM-MIL	CPM	19.2e3	None	None	NA	
SOQPSK-ARTM Tier 1	SOQPSK	2.5e6	None	SOQPSK-ARTM	NA	<sup>1</sup>
Project25 Phase 1	C4FM	4.8e3	C4FM-P25	RC	0.2	
CDMA2000–Base	QPSK	1.2288e6	IS-95 TXE-Q_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.

The screenshot shows the 'Modulation Params' tab with the following settings:

- Modulation type: QPSK (dropdown)
- Measurement Filter: Root raised cosine (dropdown)
- Symbol Rate: 40 kHz (text input)
- Reference Filter: Raised cosine (dropdown)
- Filter Parameter: 0.300 (text input)

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
D16PSK	Differential Sixteen 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	None
	Root Raised Cosine	Gaussian
	RaisedCosine	User
	Gaussian	
	User	
	Rectangular (freq)	
OQPSK	None	None
	RootRaisedCosine	Half sine
	User	RaisedCosine
	IS-95TX_MEA	User
	IS-95TXEQ_MEA	IS-95REF
HDQPSK	HDQPSK-P25	None
		RaisedCosine
		Gaussian
		User
		Rectangular (freq)
SOQPSK	None	SOQPSK-MIL
	User	SOQPSK-ARTM
		User
CPM	None	None
	User	User
2FSK	None	None
4FSK	Gaussian	Gaussian
8FSK	RootRaisedCosine	RaisedCosine
16FSK	RaisedCosine	User
	Rectangular (freq)	
	User	



Modulation type	Measurement filters	Reference filters
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.

### How to Select Filters

In a signal transmitter/receiver system, the baseband signal might be filtered for bandwidth limiting or for another kind of necessary shaping that needs to be applied. Normally, a filter in the transmitter ( $F_t$ ) and a filter in the receiver ( $F_r$ ) are applied.

The Measurement Filter setting in the analyzer corresponds to the baseband filter in the receiver ( $F_r$ ): This setting tells the analyzer what filter your receiver uses. When the analyzer is set to the same filter used by the receiver, the analyzer sees the signal as your receiver would. The Measurement Filter setting should be the same as the filter used in the receiver under normal operation (as opposed to testing).

The Reference Filter setting in the analyzer corresponds to the baseband filter in the transmitter-receiver combination ( $F_r * F_t$ ). The baseband filter for the transmitter-receiver combination is often referred to as the *System Filter*. This filter is called the reference filter because it is used to recreate a reference signal that is compared to the received signal. This recreated reference signal is the *ideal signal* with  $F_r * F_t$  applied; differences between this *ideal signal* and the received signal enables the determination of signal quality, such as EVM measurements.

The following is an example of a hypothetical signal that is transmitted into a vector signal analyzer for analysis:

Assume that a signal is transmitted using a baseband filter ( $F_t$ ). It then travels through a transmission medium (air/cable/etc) where it may be affected by the communication channel ( $F_c$ ). The signal is received and filtered by the receiver's filter ( $F_r$ ). At this point, the signal has passed through  $F_t$  and  $F_r$ , and in addition, the communication channel might have affected it (so:  $F_t * F_r * F_c$ ). This double-filtered signal is demodulated as it was received to determine the symbols/bits in it. The obtained bits are used to regenerate a baseband ideal signal that can be compared against the received signal to determine signal quality. However, to determine the effect of the environment on the signal quality, the ideal signal must be filtered by the REFERENCE FILTER ( $F_t * F_r$ ), so that the ideal signal and the filtered signal differ only by the effect of the environment. So, the received signal is the ideal signal filtered by  $F_t * F_r * F_c$  and the reference signal is the ideal signal filtered by  $F_t * F_r$ , since they only differ by the effect of  $F_c$ , the comparison will show the effect of the communication channel on the signal. The communication channel can also include the hardware path the signal follows after (Tx) or before (Rx) digitizing; this would account for Tx/Rx hardware linear and non-linear distortion.

Common examples of how these filters are used are shown below:



- For Transmit Filter = Root Raised Cosine (RRC), Measurement Filter = RRC, the Reference Filter =  $\text{RRC}^2$  = Raised Cosine
- For Transmit Filter = Raised Cosine (RC), Measurement Filter = None, the Reference Filter = Raised Cosine (When the Measurement Filter = None, the Reference Filter = Transmit Filter)
- For Transmit Filter = Gaussian, Measurement Filter = None, the Reference Filter = Gaussian

### 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.

Modulation Params	Freq & BW	Advanced Params	Find	Analysis Time	Trace	Scale	Prefs
Frequency Error: <input type="text" value="133.3 Hz"/> <input checked="" type="checkbox"/> Auto							
Measurement BW: <input type="text" value="30.72 MHz"/> <input type="text" value="Auto"/>							
Frequency Deviation: <input type="text" value="465.7 kHz"/> <input checked="" type="checkbox"/> Auto							

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

Modulation Params	Freq & BW	Advanced Params	Find	Analysis Time	Trace	Scale	Prefs
Frequency Error: <input type="text" value="-401.8 Hz"/> <input checked="" type="checkbox"/> Auto							
Measurement BW: <input type="text" value="640.0 kHz"/> <input type="text" value="Auto"/>							

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.

## Equalizer Tab

The Equalizer tab enables you to apply an adaptive equalizer to a digitally modulated signal to compensate for linear distortions in the signal. The Equalizer is available only for displays in the GP Digital Modulation folder (Select Displays window). The analyzer implements a decision directed, feed-forward FIR filter to correct linear distortion in the input signal.

Modulation Params | Freq & BW | **Equalizer** | Advanced Params | Find | Analysis Time | Trace | Scale | Prefs

☐ Enable Equalization      Mode: Train      Taps/Symbol: 2

Reset Equalization      Convergence: 0.0005      Taps: 41

☒ Enable EQ Export      Length: 21 Symbol



Parameter	Description
Enable Equalization	This setting turns the Equalizer on and off.
Reset Equalization	Initializes the equalizer filter for training.
Enable EQ Export	Exports a text file with equalizer taps in I/Q pairs.
Mode	Specifies whether the equalizer is in learning (Train) mode or analysis (Hold) mode.
Convergence	Specifies the update rate. Maximum value: 0.002. Default value: 0.0005
Taps/Symbol	The number of filter coefficients per symbol used by the filter. Available choices are 1, 2, 4, and 8.
Taps	The number of filter coefficients. Range: 3 to 100 (you can set a higher number, but 100 is the practical limit).
Length	Specifies the number of symbols analyzed (or filter length).

### Selecting the Mode

When enabled, the Equalizer is in either Train mode or Hold mode. When the equalizer is in Train mode, it will update internal filter parameters whenever you adjust the Convergence, Taps/Symbol, Taps, or Length values. When it is in Hold mode, the Equalizer uses the parameter values (both internal and the values accessible on the Equalizer tab) in effect when it was placed into Hold mode.

---

**NOTE.** *The Equalizer does not need to be retrained if the modulation type is changed. You can train the Equalizer by using a simpler modulation type (such as QPSK), place the Equalizer into Hold mode and can then measure more complex modulation types such as QAM.*

---

### Training the Equalizer

To obtain the desired results using the Equalizer, you must first train the Equalizer. This is an iterative process where you adjust some filter parameters (and the analyzer adjusts internal parameters) to achieve the lowest error possible on the acquired signal.

To configure the Equalizer:

1. Press the **Displays** button or select **Setup > Displays**.
2. In the **Select Displays** window, select **GP Digital Modulation** from **Measurements**.
3. Add **Signal Quality** to the **Selected Displays** and select **OK**.
4. With the Signal Quality display selected, select **Setup > Settings**.
5. Select the **Modulation Params** tab set the parameters as necessary for the signal.
6. Select the **Equalizer** tab.
7. Set the **Convergence** value to 0.0005.
8. Set **Taps/Symbol** to 2.
9. Click the **Reset Equalization** button to reset the equalizer.
10. Set the **Mode** to **Train**.



11. Click **Enable Equalization** so it is checked.
12. On the Signal Quality display, examine the value for EVM.
13. Change the Convergence, Taps/Symbol, and Taps values iteratively to achieve a minimum EVM value.

---

**NOTE.** *Changing the Taps/symbol or Taps values resets the equalizer.*

---

## Using the Equalizer

To use the equalizer:

1. Select and configure a **GP Digital Modulation** display.
2. Select **Setup > Settings**.
3. Select the **Equalizer** tab.
4. Select **Enable Equalization** so it is checked.
5. Verify that Mode is set to **Hold** if you have previously trained the Equalizer. If you have not previously trained the Equalizer, [train the Equalizer \(see page 459\)](#) and then set the Mode to Hold.

## Exporting EQ Files

If the **Enable EQ Export** box is checked, the following outputs files are automatically generated to these locations after each measurement update cycle if the EQ coefficients change: *c:\temp\EqTaps.txt* and *c:\temp\EqTapsHdr.txt*. These files have EQ taps in I/Q pairs (one pair per row).

The *Hdr* version file has a five line header before the EQ tap data. Each line in the five line header of the *Hdr* version file has two data values, with the second one always being "0":

```
<line1>Number_of_Header_Lines 0
<line2>EQ_Sample_Rate_Hz 0
<line3>Demod_Symbol_Rate_Sps 0
<line4>EQ_Samples_per_Symbol 0
<line5>Number_of_EQ_Taps_Following 0
```

## Exporting EQ Files

# Advanced Params Tab

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



Modulation Params Freq & BW Advanced Params Find Analysis Time Trace Scale Prefs

Mag Normalize: **RMS Symbol Magnitude** ☒ Swap I and Q

☐ User Symbol Map (per Modulation Type):

Advanced Params tab for all modulation types except nFSK and C4FM

Modulation Params Freq & BW Advanced Params Find Analysis Time Trace Scale Prefs

☒ Swap I and Q

☒ Symbol rate search

☐ User Symbol Map (per Modulation Type):

Advanced Params tab for modulation type nFSK

Modulation Params Freq & BW Advanced Params Find Analysis Time Trace Scale Prefs

☒ Swap I and Q

☐ User Symbol Map (per Modulation Type):

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:\SignalVu-PC\ExampleFiles. The default symbol map file is named **DefaultSymbolMaps.txt**. See [Symbol Maps \(see page 469\)](#) 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
```

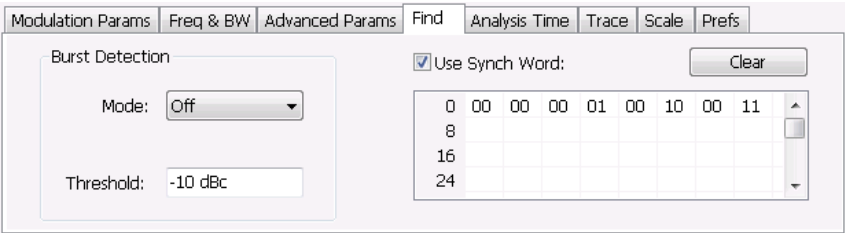
```
## (Resembles the shape of the constellation)
```

```
          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

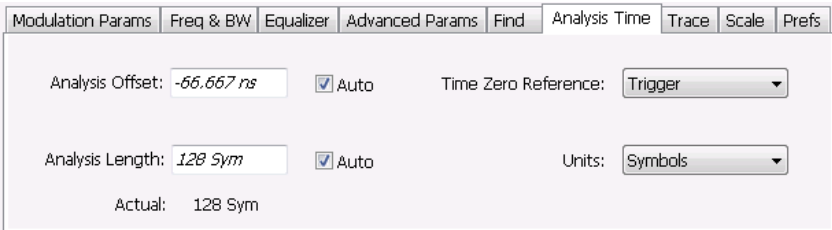
The Find tab is used to set parameters for finding bursts within the data record. This is a post-acquisition operation. Synch Word search controls are also on this tab.



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

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

The screenshot shows the 'Traces' tab in the software interface. The tabs at the top are: Modulation Params, Freq & BW, Equalizer, Advanced Params, Find, Analysis Time, Traces (selected), and Prefs. The main area contains the following settings:

- Trace: Trace 2 (dropdown)
- Show: ☒ (checkbox)
- Freeze: ☒ (checkbox)
- Content: Lines (dropdown)
- Q Offset: Use shared Pref (dropdown)
- All GP Digital Modulation displays (grouped box):
  - Points/symbol: 4 (dropdown)
  - Symbol point location: Center (dropdown)

Example traces tab for constellation display set to SOQPSK modulation type

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

The screenshot shows the 'Traces' tab with the following settings:

- Trace: Trace 1 (dropdown)
- Show: ☒ (checkbox)
- Freeze: ☐ (checkbox)
- Content: Vectors (dropdown)
- Phase multiplier: 1 (dropdown)
- All GP Digital Modulation displays (grouped box):
  - Points/symbol: 4 (dropdown)

Example trace tab for constellation display set to CPM modulation type

The screenshot shows the 'Trace' tab (note the absence of 'Traces') with the following settings:

- Trace: I (dropdown)
- Show: ☒ (checkbox)
- Points/symbol: 8 (dropdown)
- Content: Points (dropdown)
- Symbol point location: Center (dropdown)

Example trace tab for Demod I&Q display



Setting	Description
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.
Freeze	Halts updates to the trace selected by the Trace setting. Present for the Constellation display only.
Content	Selects whether to display the trace as vectors (points connected by lines), points (symbols only without lines), or lines (lines drawn between symbols, but no symbols are displayed). The choices available depend on the display.
Q Offset	For traces with offset modulation (OQPSK and SQPSK), this setting enables the trace to be displayed with Q offset or without Q offset. Choices available are <b>Remove Q offset</b> , <b>Include Q Offset</b> , and <b>Use Shared Pref</b> . Selecting Use Shared Pref causes the analyzer to add or remove Q offset according to the <b>Remove Q Offset</b> setting located on the Prefs tab. Setting the Q Offset on the Traces tab changes the Q offset only for the Constellation display. If other GP Digital Modulation displays are shown, they will use the use the Remove Q Offset setting on the Prefs tab regardless of the Q Offset setting on the traces tab for the Constellation display. The Q Offset setting is available only when the modulation type is set to OQPSK or SQPSK.
Points/symbol	Select how many points to use between symbols when connecting the dots. Values: 1, 2, 4, 8.
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: $\times 1$ (default), $\times 2$ , $\times 4$ , $\times 8$ , $\times 16$ , or $\times 32$ . 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.

### Comparing Two Traces in the Constellation Display

When the Constellation display is the selected display, you can use the Traces tab to enable the display of a second trace. The second trace is a version of the current acquisition. You can choose to freeze a trace in order to display the current live trace to an earlier version of itself, you can display the trace as a second trace with or without Q Offset, or you can choose to display both traces frozen in order to compare the trace to itself at different times.

To display a second trace in the Constellation display:

1. If more than one display is present, select the Constellation display to ensure it is the selected display.
2. Click the settings icon or select **Setup > Settings** from the menu bar.
3. Select the **Traces** tab.
4. Select **Trace 2** from the **Trace** drop-down list.
5. Click the **Show** checkbox so that it is checked.
6. Specify the **Content** as desired. Trace 2 lines appear in blue to aid in distinguishing Trace 2 from Trace 1.



## 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.

The screenshot shows the 'Scale' tab in a software interface. It has two main sections: 'Vertical' and 'Horizontal'. The 'Vertical' section has a 'Scale' input set to '200 mV' and a 'Position' input set to '0.000 V', with an 'Autoscale' button below. The 'Horizontal' section has a 'Scale' input set to '128.00 Sym', a 'Position' input set to '-1.00 Sym', an 'Auto' checkbox which is checked, and an 'Autoscale' button.

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.
Auto	

## 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.



Modulation Params	Freq & BW	Equalizer	Advanced Params	Find	Analysis Time	Trace	Scale	Prefs
<div>Radix: <span>Binary</span></div> <div> <input checked="" type="checkbox"/> Show graticule         <input checked="" type="checkbox"/> Show Marker readout in graph (selected marker)       </div>								

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.
Remove Q offset	The I and Q data traces are 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> . (Which is only present when the modulation type is set to OQPSK or SOQPSK.)
Show EVM and Offset EVM results	Adds EVM results in the display when enabled (Offset EVM is always displayed). Present only in Signal Quality display and with SOQPSK and OQPSK modulation types only

## Symbol Maps

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

QPSK		OQPSK		SOQPSK	
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**

1	0
---	---

**SBPSK**

1	0
---	---

0100-019

**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

0100-010

**32QAM**

Left			Right		
	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	

0100-011



**64QAM**

Left				Right			
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

0109-012

**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		

0109-017



**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
---	---	---	---	---	---	---	---	----	----	----	----	----	----	---	---

0169-016

**C4FM**

Left

Right

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

0169-020

**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 \(see page 475\)](#).

### 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 reference marker. Markers can all be placed on the same trace or they can be placed on different traces. There are three types of Markers: Reference, Delta, and Power Markers. The Marker Reference (labeled MR in the graph) makes absolute measurements and is also used for calculating differences when Delta or Power 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 Power Markers (labeled M1 to M4 in the graph) function the same way as the Delta Markers, except they show power density and integrated power density (dBm/Hz) instead of power level (dBm).

The following two tables show the appearance of the four types of marker readouts.

Marker Reference Readout	Absolute Marker Readout	Power Marker Readout	Delta Marker Readout
<div>Reference Marker label</div> <div>Power level at marker</div> <div>MR: -10.00 dBm</div> <div>1.004 GHz</div> <div>Frequency at marker</div>	<div>Absolute Marker label</div> <div>Power level at marker</div> <div>M1: -40.54 dBm</div> <div>999 MHz</div> <div>Frequency at marker</div>	<div>Power density at Power Marker</div> <div>M1: -64.97 dBm/Hz</div> <div>Delta: 10 MHz</div> <div>IntPowerM1: -9.92 dBm</div> <div>PowerDensity: -79.98 dBm/Hz</div> <div>Difference in frequency between Power Marker and Reference Marker</div> <div>Integrated power value from points between and including Reference Marker to Power Marker</div>	<div>Delta Marker label</div> <div>Difference in power level between Delta Marker and Marker Reference</div> <div>ΔM1: -30.54 dB</div> <div>-5 MHz</div> <div>Difference in frequency between Delta Marker and Marker Reference</div>

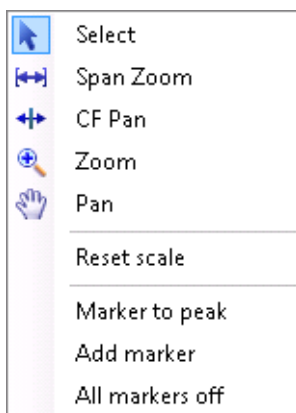
The following table shows the appearance of the marker indicators as they appear on the trace. Whichever marker is active will appear as a solid diamond.

Marker Reference	Absolute, Delta, and Power Marker
<div>MR</div>	<div>M1</div>

## Controlling Markers with the Right-Click Actions Menu

In addition to controlling the marker actions from the menu controls, you can use the right-click actions menu to move markers or add and delete markers. Some items are not available for certain displays.



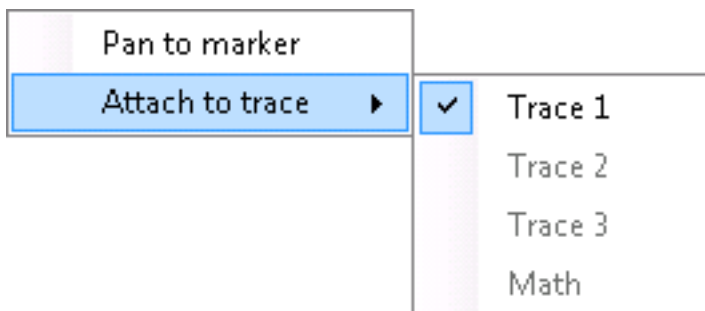


You display the Right-click Action menu by clicking the right mouse button.

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 and pan the trace to place the marker at the measurement frequency.

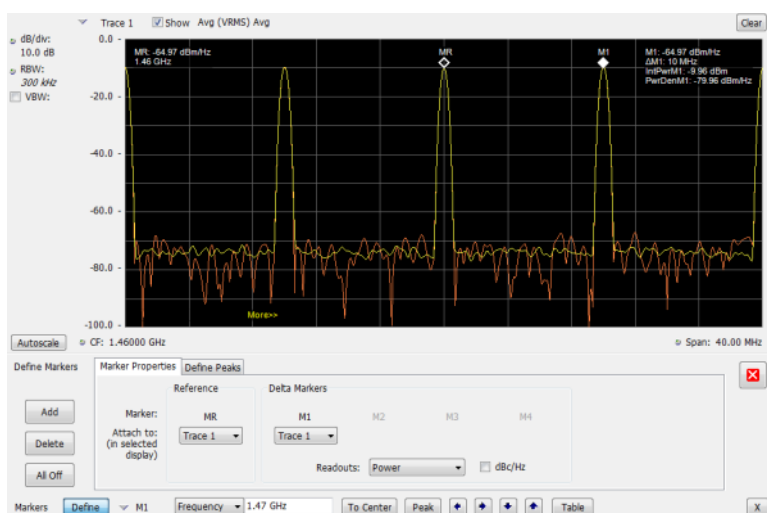




## Measuring Frequency and Power in the Spectrum Display

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 Delta Markers for which readouts can be selected for Delta, Power, or Absolute. 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 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.
10. If Power markers are selected, read the point power density and the integrated power density.



## 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.

## Enabling Markers and Setting Marker Properties

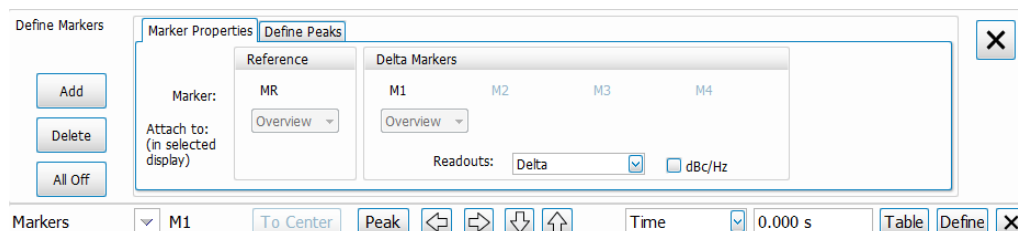
The Define Markers Control Panel is used to enable markers and set their properties. You can set up to five markers including the marker reference. Markers are shown in most displays.

Markers have three types of on-screen readouts: Absolute, Delta, and Power. 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). When **Readouts**



is set to **Power**, each delta marker (M1-M4) readout displays the marker's position on the trace, the difference between its position and the position of the Reference Marker (MR), the point power density, and the integrated power density.

## Defining Markers



1. Click the **Markers** button on the basic control toolbar to view the Markers toolbar.
2. Click the **Define** button on the Markers toolbar to open the Define Markers control panel.
3. In the Marker Properties tab, 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.

---

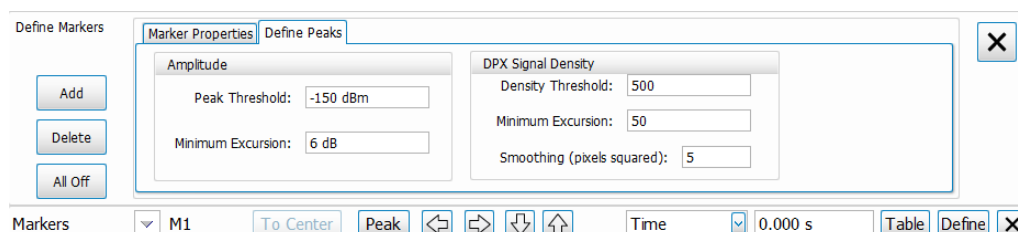
**NOTE.** The first marker defined will always be **MR**. The MR marker is the reference for delta marker readouts.

---

4. Select the trace to which the marker should be attached from the drop-down list.
5. Click **Add** to add additional markers.
6. Click on the **Readouts** drop down menu to select the readout to view. If you select Delta from the drop down menu, you can check the **dBc/Hz** box to measure noise in dBc/Hz and show that for the delta value. Checking this box if other readouts are selected will force the readout to Delta. You can read more about dBc/Hz mode [here \(see page 485\)](#).
7. Click the close button to remove the Define Markers control panel.

## Defining Peaks

You can specify two amplitude values that define peaks. For the DPX display, you can also define peaks based on signal density characteristics.





**NOTE.** The settings shown in the DPX Signal Density section of the Define Peaks tab are not used by SignalVu-PC.

### 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.

### DPX Signal Density

Density Threshold	Density Threshold specifies the signal density (number of hits per displayed pixel) that the DPX bitmap must exceed to be considered a trigger event.
Minimum Excursion	Minimum Excursion specifies how much the signal density must decrease and increase again before another peak can be declared.
Smoothing (pixels squared)	Smoothing specifies the number of pixels around the marker that are averaged together to reduce "noise" in the readout of signal density. The value of this control is the number of pixels on each side of the square area used for averaging. With Smoothing = 1, no averaging is done and the marker z-axis readout is the hit count (density) of a single pixel. Use this control to characterize how wide or narrow a range of pixels should be averaged to determine the signal density.

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: 


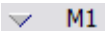
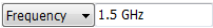








Menu bar: **View > Marker Toolbar**

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.

## Measuring Noise Using Delta Markers in the Spectrum Display

In the Spectrum display, you can set Markers to dBc/Hz to measure noise on the trace. Markers in this 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.

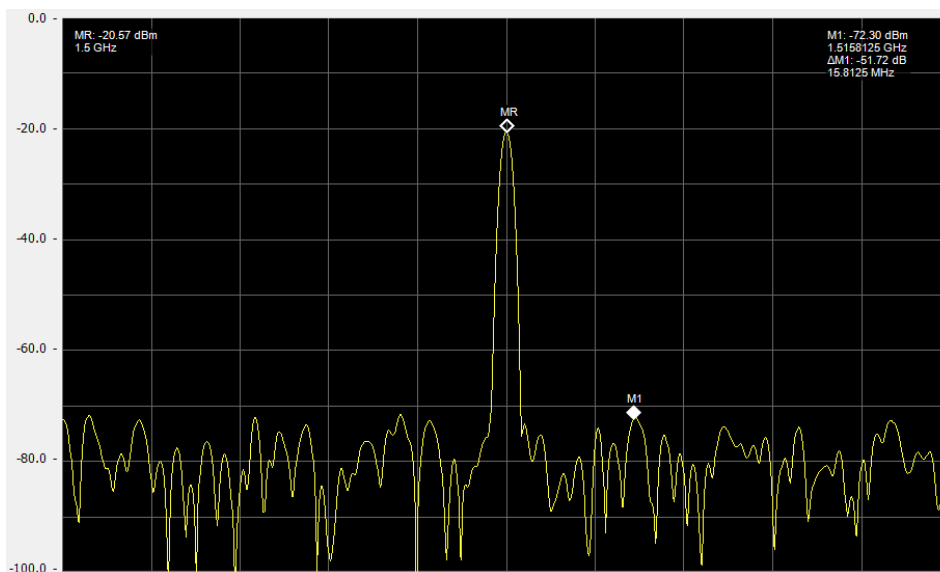
### Measuring Noise

To measure noise on a Spectrum trace:



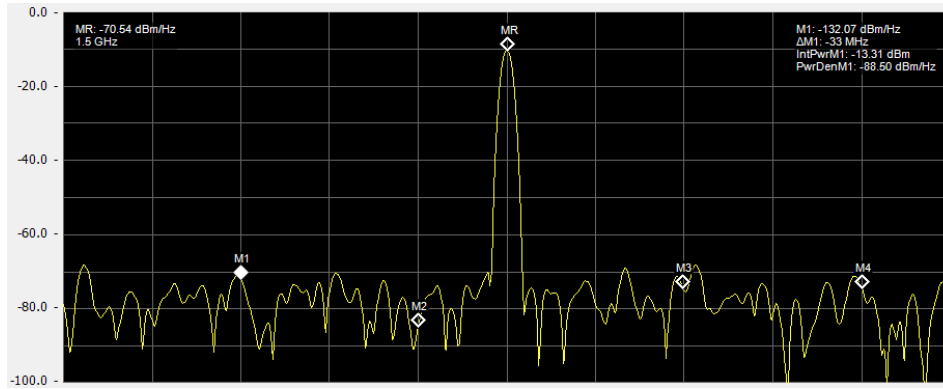
1. Select **Markers > Define** to display the Markers control panel.
2. Click **Add**. The first marker defined is always designated the Marker Reference. Subsequently defined markers are Delta Markers for which readouts can be selected for Delta, Power, or Absolute. You can also select and adjust markers by clicking on an existing marker on a trace.
3. Click **Add** again so that there are at least two markers defined.
4. Check that **Readouts** is set to Delta and check the **dBc/Hz** box.
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. Notice that Detection is set to **Average** for the trace you are using for this measurement.
7. Check that the Amplitude units are set to dBm (that is the default). If they are not, click the  (Analysis) icon, select the **Units** tab, and select **dBm**.
8. Click the Close button to remove the control panel.
9. Move the markers to the desired locations on the trace.
10. 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 following image shows the Spectrum display with a Delta Marker.



The following image shows the Spectrum display with Power Markers.











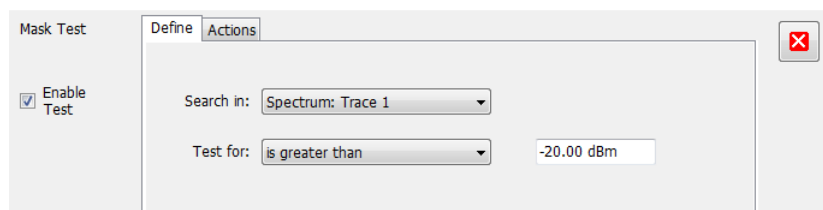
## The Mask Test Tool

You can specify pass/fail and mask parameter conditions for the Spectrum, Spurious, Noise Figure, Gain, Frequency Settling Time and Phase Settling Time displays. When these conditions are met, the instrument can perform actions such as stopping acquisitions or saving data.

## Mask Test Settings

### Menu Bar: Tools > Mask Test

Selecting **Mask Test** displays the Mask Test control panel. These settings define test parameters and specify actions to be performed when the test conditions are met. Checking the **Enable Test** box sets the application to perform the test once the conditions are defined.

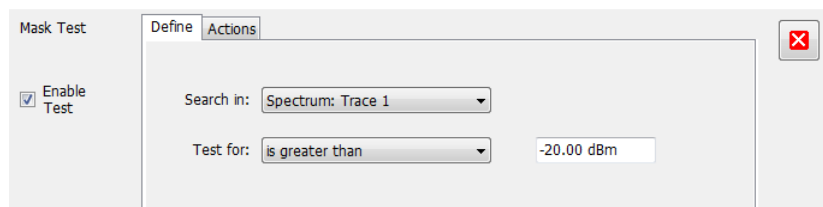


Setting	Description
Enable Test	Select to perform a test, then set the test conditions.
<a href="#">Define (see page 489)</a>	Specifies which result to test and what to test for.
<a href="#">Actions (see page 494)</a>	Specifies the action to take when the test condition is met.

## Define Tab (Mask Test)

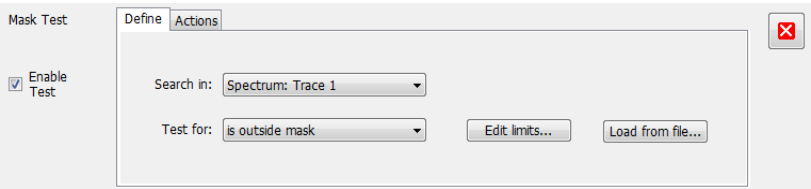
The Define tab sets the parameters for tests. From this tab, you specify which result to test and what kind of violation to test for.

The following image shows the Define tab with *is great than* selected. After you select that test, you will enter the desired signal level. The procedure is the same if you select *is less than*.





The following image shows the Define tab with *is outside mask* selected. After you select that test, you need to click the Edit limits button and set the desired test limits. The procedure is the same if you select *is inside mask*.

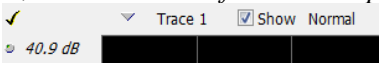


Setting	Description
Search in	Specifies which result to test.
Test for	Specifies what to test for. You can specify a test based on a signal level ("is greater than", "is less than") or a mask ("is outside mask", "is inside mask"). Options for Spurious and Settling Time are Pass and Fail.

Search In

The possible choices for **Search in** include traces from Spectrum, DPX, Noise Figure, Spurious, and Setting Time displays. The available choices are Trace 1, Trace 2, Trace 3, Math , Spectrogram Trace, Spurious, and Settling Time. The available choices include only results from displays that are currently open.

**NOTE.** If you select a result that is not the selected trace or result in the target display, you will not see the results of the test. To see the results, select the trace from the drop-down menu in the target measurement display and check the Show box:



Test For

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

Pass/Fail Tests for Spurious and Settling Time

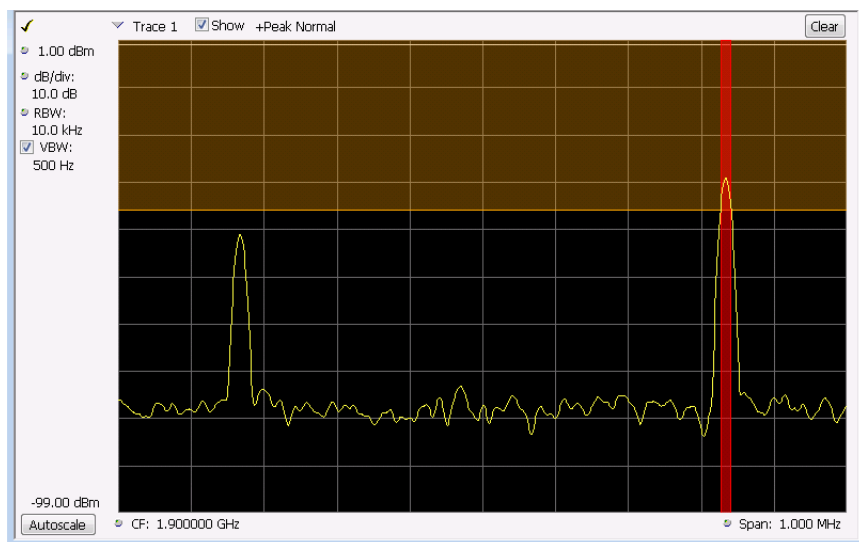
The Frequency Settling Time, Phase Settling Time measurements, and Spurious measurements test functions provide pass/fail results.

Greater Than/Less Than Tests for Spectrum

If you select a greater than/less than test, 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 test for. While not as flexible as mask testing, this type of test is quicker to set up.

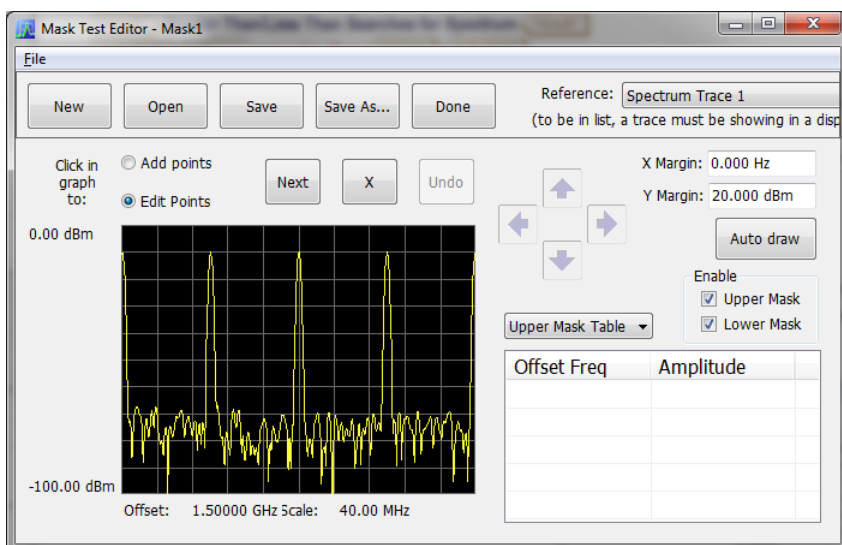
The following figure shows the results of an **is greater than** test. The vertical red bar highlights results that match the test definition.





### Outside/Inside Mask Tests

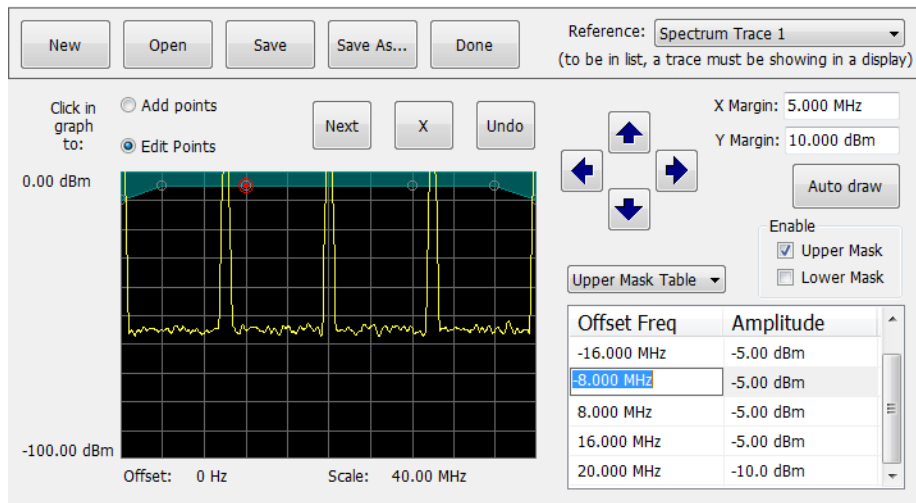
If you specify a mask-based test, then you need to edit the mask to specify the levels that define a violation. When you select **is outside mask** or **is inside mask**, an **Edit limits** button is displayed. Click the **Edit limits** button to display the Mask Test Editor window.



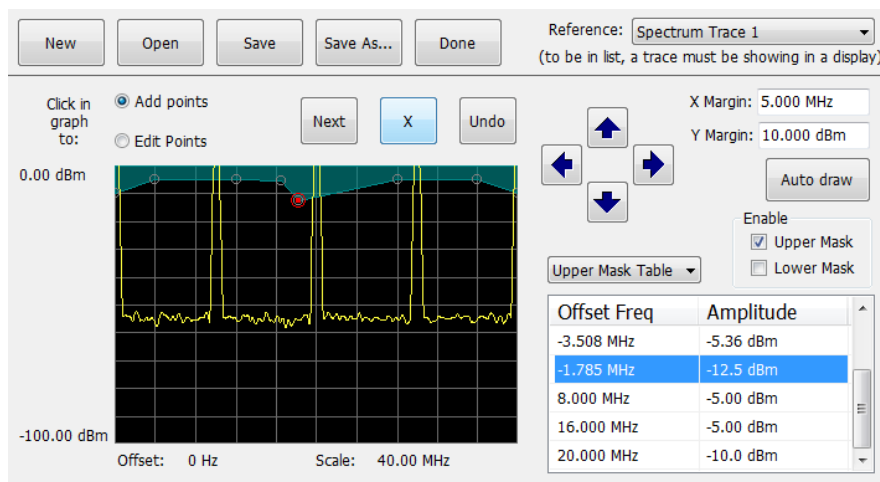
**To set up and save mask test limits for a test.** Perform the following procedure to set up a test using the mask limits.



1. After choosing the desired **Search in** and **Test for** items, click **Edit limits** to display the Mask Test Editor window.
2. Click the **New** button to create a table. This clears the existing points and loads the default table. You can also click **Open** to open an existing table.
3. To edit values, add points, or delete points in a table:
  - a. To edit an existing value, double-click on the cell you want to edit and enter the desired value. The active point shows as a red point on the plot.

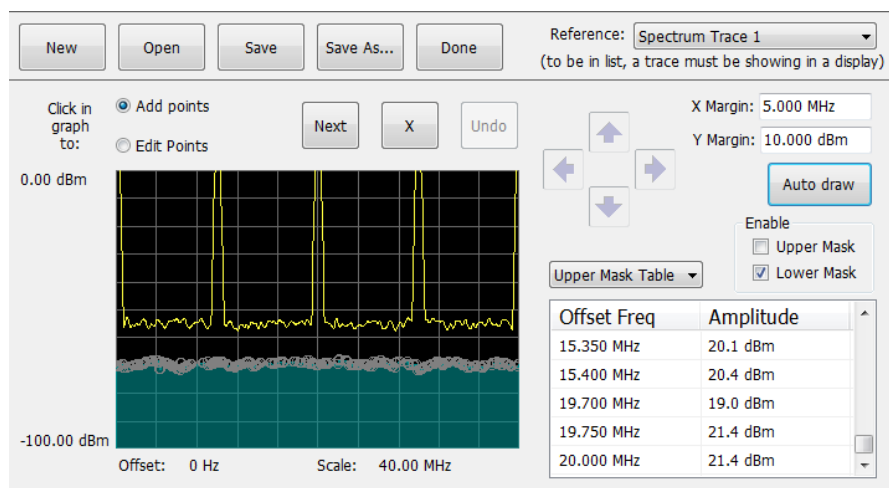


- b. To add a new point, check the box next to the target mask (located below the **Auto draw** button).
- c. Select **Add points** located below the **Open** button.
- d. Select the target mask (Upper Mask Table or Lower Mask Table) from the drop-down menu.
- e. Click in the desired location on the plot to add the point.



- f. To use the auto draw feature to automatically place points on the chosen mask, enable the desired mask from the drop-down menu and then click the **Auto draw** button.






---

**NOTE.** Units may be changed for measurements other than Noise Figure in Setup > Analysis > Units.

---

4. To delete a point from the table, select the point to be removed, and click the **X** button.
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.

---

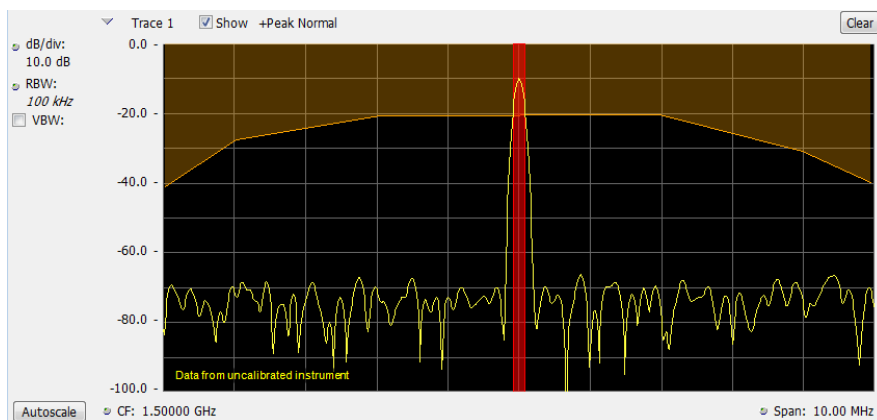
**NOTE.** Masks are saved in XML format with a .msk extension.

---

7. To dismiss the Mask Test Editor window, click **Done**.

### Mask Test Result Example

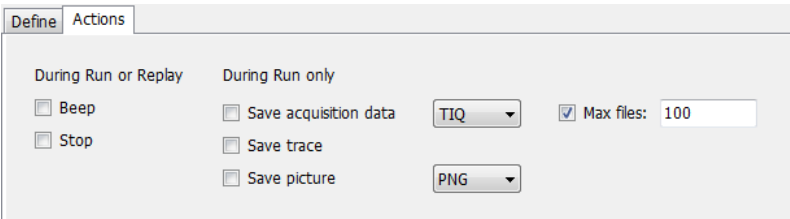
The following figure shows the results of a Spectrum **is outside mask** test with Upper Mask enabled. The vertical red bar highlights results that have exceeded the test limits. The shaded region shows the mask area.





# Actions Tab

The Actions tab allows you to trigger the application when a signal in the frequency domain violates the mask.



Setting	Description
During Run or Replay	Actions specified here will occur in either Run mode or Replay mode. (Run actions not available in SignalVu-PC.)
Beep	The analyzer beeps when the test condition is met.
Stop	The analyzer stops when the test condition is met.
During Run Only	Actions specified here are taken only during Run mode (while acquiring live data).
Save acquisition data	Saves acquisition data to a file when the test condition is met. Use the drop-down list to specify the format of the saved data. The available file formats are: <a href="#">TIQ</a> , <a href="#">CSV</a> , and <a href="#">MAT</a> (see page 555).
Save trace	Saves Trace data to a file when the test condition is met.
Save picture	Saves a screen capture to a file when the test condition is met. Use the drop-down list to specify the format of the saved picture. The available file formats are: <a href="#">PNG</a> , <a href="#">JPG</a> , and <a href="#">BMP</a> (see page 555). Note that no trace will be saved if the tested trace isn't a saveable trace type. For example, a Spurious trace is not saveable.
Max files	Specifies the number of times a test action stores a file. After this limit is reached, no more files are saved. The instrument will continue to run, but no additional files are saved when test conditions are met.  Keep in mind when setting this number that picture files are counted as part of the total number of files. For example, if you set Max files to 100, the instrument will save 100 acquisitions if only acquisitions are saved or only pictures are saved. But, if both acquisitions and pictures are saved, then 50 acquisitions and 50 pictures will be saved.

## 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 *C:\<instrument name>Files\*.

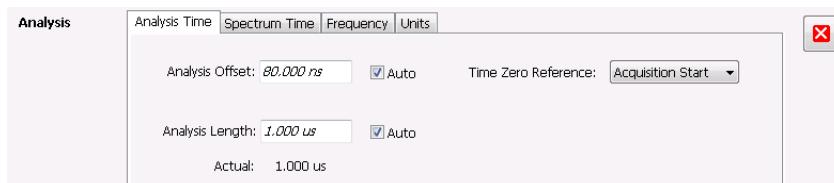


## Analysis Settings

**Menu Bar:** Setup > Analysis

**Application Toolbar:** 

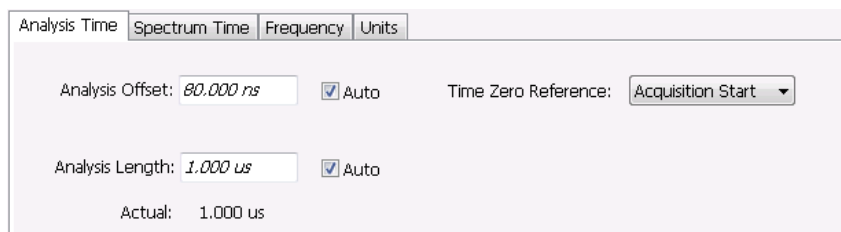
The Analysis control panel provides access to settings that are used by all displays. These settings affect only post processing and they do not control hardware settings.



Setting	Description
<a href="#">Analysis Time (see page 495)</a>	Specifies the length of time to use in measurements.
<a href="#">Spectrum Time (see page 497)</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 497)</a>	Specifies the measurement frequency (center frequency).
<a href="#">Units (see page 500)</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.

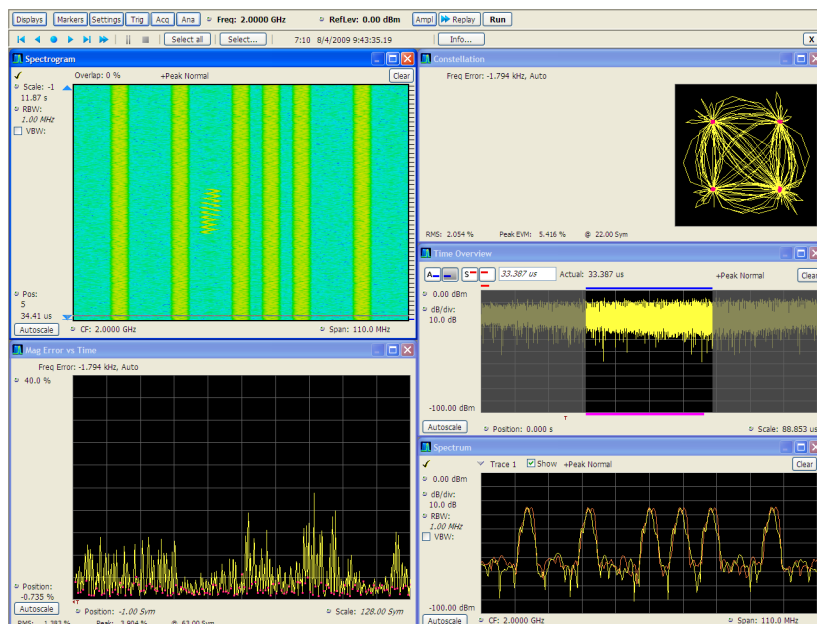
Settings	Description
<b>Spectrum Time Mode</b>	
Independent	Causes the spectrum analysis views to use the settings unique to those displays.
Use Analysis Time settings	Causes the spectrum analysis views to use the settings on the Analysis Time tab.
<b>Spectrum Time (only available when <i>Independent</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.

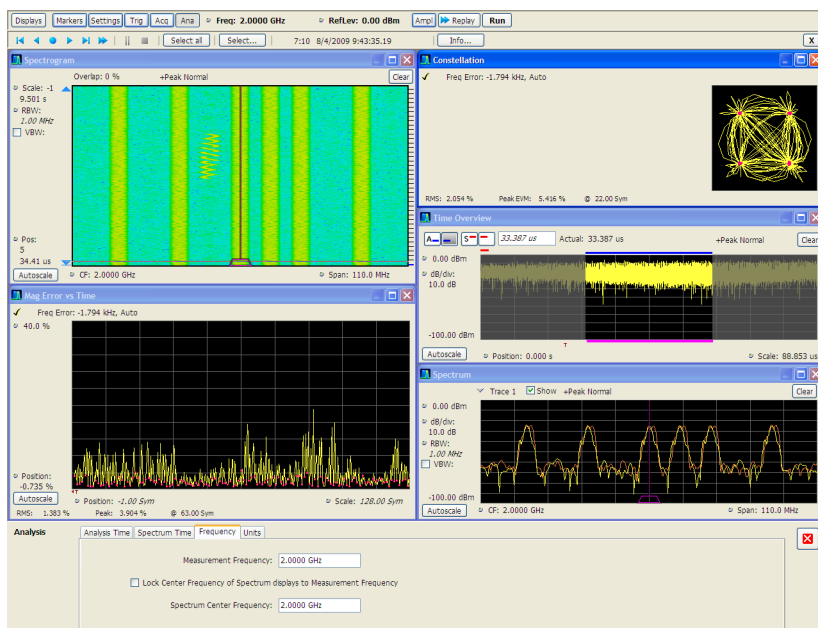


The following screen capture shows a display with both the Measurement Frequency and the Spectrum Center Frequency locked together.

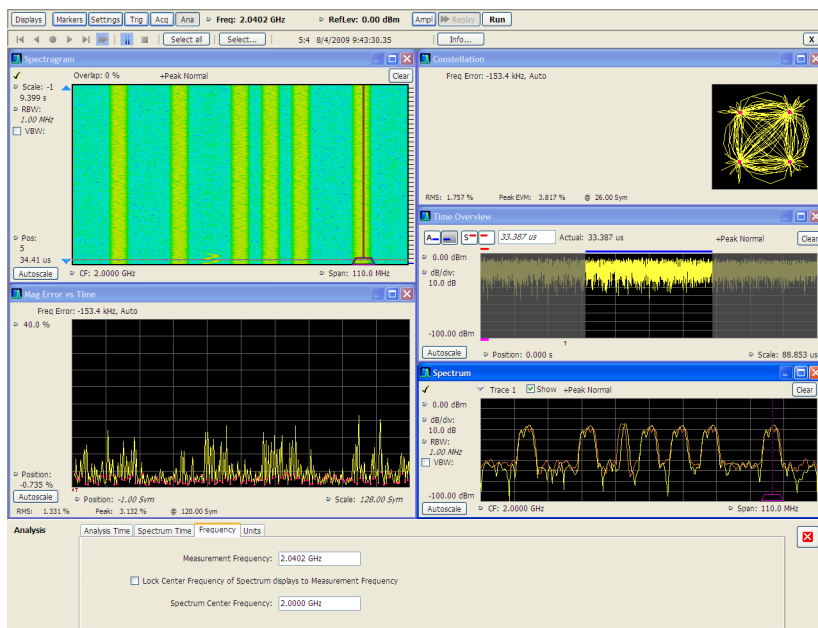


Normally, the Measurement Frequency and the Spectrum Center Frequency are locked together so that both have the same setting. But in some situations, for example, where a signal contains a set of channels, it is useful to unlock the Measurement Frequency from the Spectrum Center Frequency. When the Spectrum 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.

The Measurement Frequency indicator is useful for interpreting system behavior when MeasFreq is unlocked. If a measurement has a wide bandwidth relative to the spectrum span, and the Measurement Frequency is far from spectrum center, the measurement is likely to fail because its required frequency range exceeds the frequency range of the available data. In such a case, the navigation control will show that the measurement bandwidth extends outside the Spectrum's span.

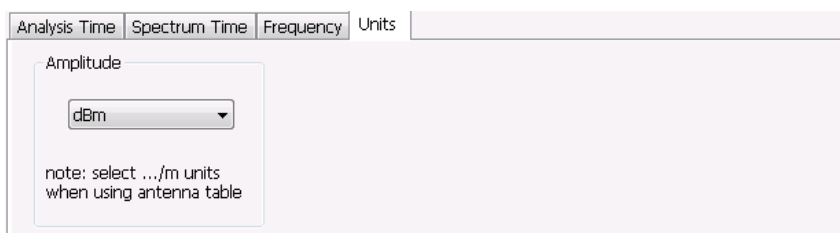
There are interactions between frequency unlocking and RF & IF Optimization (see the [Amplitude control panel \(see page 507\)](#)). When **Best for multiple displays** is the selected optimization, the instrument is allowed to use its full bandwidth to meet the needs of all open displays. This is the most user-friendly optimization because it decreases the number of **Acq BW too small** errors, but it can increase noise and slightly decrease measurement accuracies. For all other optimization types, the instrument optimizes the acquisition bandwidth for the selected display, improving measurement quality somewhat, but reducing concurrent measurement capability.

There are also interactions with trigger settings. When the Spectrum Center Frequency is unlocked from Measurement Frequency, the RF triggers (Trigger Source = RF Input) can tune to either Spectrum Center Frequency or Measurement Frequency. When a spectrum display is selected, the trigger frequency is the same as the Spectrum Center Frequency. When one of the other displays that uses Measurement Frequency is selected, the trigger is tuned to the Measurement Frequency also. This allows you to trigger on the signal you are measuring. But, there is an exception: when the selected RF & IF Optimization is **Best for multiple displays**, the trigger is always tuned to the Spectrum Center Frequency.

The reason the trigger frequency is affected by Measurement Frequency and RF & IF Optimization, is that these functions control how the acquisition is tuned. The optimization **Best for multiple displays** keeps the acquisition centered about the Spectrum Center Frequency at all times. To accommodate off-center Measurement Frequencies, it just widens the acquisition bandwidth. Other optimizations tune the acquisition frequency to match that of whichever display is currently selected. The RF trigger module receives the same acquisition data as all the measurements, tuned to the center of the current acquisition bandwidth.

## Units Tab

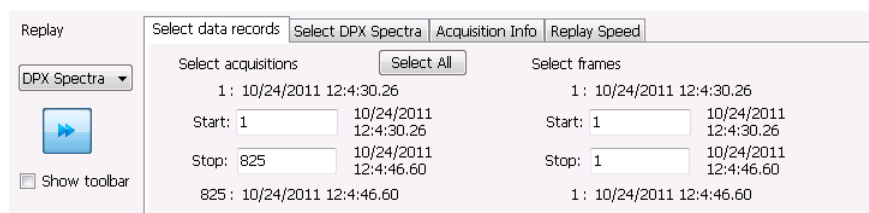
The Units tab specifies the global Amplitude units for all the views in the analysis window.





## 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 was enabled when the waveform file was saved), or any contiguous set of data records from acquisition history.



### Displaying the Replay Control Panel

To display the Replay control panel:

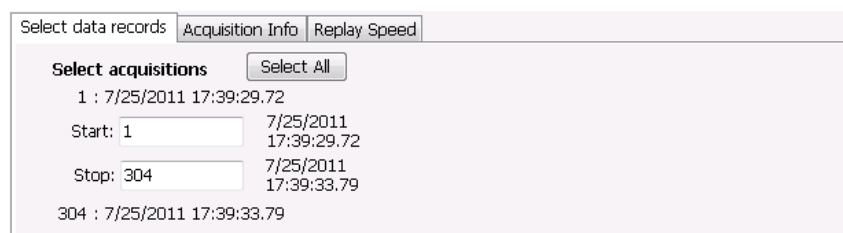
- From the menu bar, select **Replay > Select data records from history**.

### Selecting the Data Type to Replay

You can choose to replay either acquisition data or DPX spectra (providing DPX Spectra were saved in the waveform file). Choose **Acq Data** to replay any acquisitions except DPXogram acquisitions. Choose **DPX Spectra** to replay a DPXogram acquisition.

### Select Data Records Tab

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.



Without FastFrame enabled



Select data records	Acquisition Info	Replay Speed
<div> <div>Select acquisitions</div> <div>Select All</div> </div> <div> <div>Select frames</div> </div>		
<div> <div>1 : 3/10/2010 4:47:40.22</div> <div>Start: 1 3/10/2010 4:47:40.22</div> <div>Stop: 1 3/10/2010 4:47:40.22</div> <div>1 : 3/10/2010 4:47:40.22</div> </div> <div> <div>1 : 3/10/2010 4:47:40.22</div> <div>Start: 1 3/10/2010 4:47:40.22</div> <div>Stop: 10 3/10/2010 4:47:51.74</div> <div>10 : 3/10/2010 4:47:51.74</div> </div>		

With FastFrame enabled

**Date and Time Stamps.** The line that appears above each Start box (one for acquisitions and one for frames when FastFrame is enabled) is a date stamp that displays the date and time the first record in the current acquisition was acquired. The line that appears below each Stop box is a date stamp that displays the date and time the last record in the current acquisition was acquired.

The line that appears to the right of each Start box displays the date and time the selected acquisition or frame was acquired. The line that appears to the right of each Stop box displays the date and time the selected record or frame in the current acquisition was acquired.

**Select All button.** Selecting Select All resets the Start and Stop values. The Start value is reset to the first acquisition or frame of the current acquisition. The Stop value is reset to the last acquisition or frame in the current acquisition.

## Select DPX Spectra Tab

The Select DPX Spectra tab is used to select which DPXogram spectra to replay. A spectra is the smallest DPXogram unit that can be replayed. It is equivalent to one line in the DPXogram display.

Select data records	Select DPX Spectra	Acquisition Info	Replay Speed
<div> <div>Select spectra</div> <div>Select All</div> </div> <div> <div>1 : 9/29/2011 17:36:53.05</div> <div>Start: 1 9/29/2011 17:36:53.05</div> <div>Stop: 602 9/29/2011 17:37:7.82</div> <div>602 : 9/29/2011 17:37:7.82</div> </div>			

**Date and Time Stamps.** The line that appears above the Start box is a date stamp that displays the date and time the first DPX spectra in the current acquisition was acquired. The line that appears below the Stop box is a date stamp that displays the date and time the last DPX Spectra in the current acquisition was acquired.

The line that appears to the right of each Start box displays the date and time the selected DPX Spectra was acquired. The line that appears to the right of each Stop box displays the date and time the selected DPX Spectra in the current acquisition was acquired.

**Select All button.** Selecting Select All resets the Start and Stop values. The Start value is reset to the first DPX Spectra of the current acquisition. The Stop value is reset to the last DPX Spectra in the current acquisition.



## Acquisition Info Tab

Displays information about acquisition settings and sets the number of decimal places used for displaying the time stamp.

The screenshot shows the 'Acquisition Info' tab selected. It contains a 'Timestamp decimal places' field set to '2'. There are two buttons: 'Delete all Acq data' and 'Delete all DPX spectra'. Below these are two columns of acquisition parameters:

Acq Center Freq:	1.90 GHz	Preamp:	Off
Acq Bandwidth:	85.0 MHz	RF Atten:	15.00 dB
Sampling Rate:	150 MHz	Ref Level:	0.00 dBm
Dither:	On	Acq Length:	5.19 us

## Replay Speed Tab

Sets the speed at which data records are replayed.

The screenshot shows the 'Replay Speed' tab selected. It features a horizontal slider control with 'Slow' on the left and 'Fast' on the right. The slider handle is positioned approximately three-quarters of the way towards 'Fast'.

## 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
Acq Data	Select Acq Data to replay acquisitions.
DPX Spectra	Select DPX Spectra to replay a DPXogram display.
Replay all selected records	Replays the sequence of records specified by Start and Stop on the Select data records tab.
Loop overall selected records	Replays the sequence of records specified by Start and Stop on the Select data records tab continuously.
Replay current record	Replays the currently selected acquisition (or frame).
Replay 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.



Menu item	Description
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.

## Acq Data

Selecting **Acq Data** selects acquisition data as the source for replay. Selecting Acq Data does not start replay, it only selects the type of acquisition data that will be replayed.

## DPX Spectra

Selecting **DPX Spectra** selects DPX spectra as the source for replay. Selecting DPX Spectra does not start replay, it only selects the type of acquisition data that will be replayed.

## Replay All Selected Records

Selecting **Replay all selected records** replays 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.

## Replay Current Record

Selecting **Replay current record** 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.



## Replay from Selected

Select **Replay 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



Item	Description
Replay	Selects data type to be replayed. Select DPX Spectra to replay a DPXogram. Select Acq Data for all other types of replay.
	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.
	Replays all records in the selected set continuously until stopped.
	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.
	Clicking <b>Select All</b> selects all records in history for replay. Selecting Select all resets the <b>Start</b> and <b>Stop</b> values on the Select data records tab of the Replay control panel.
	Clicking the <b>Define</b> button displays the Define 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.  You can also view and use the Select data records tab, Select DPX Spectra tab, and Replay Speed tab.
1:10      3/10/2010 4:47:51.74	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.

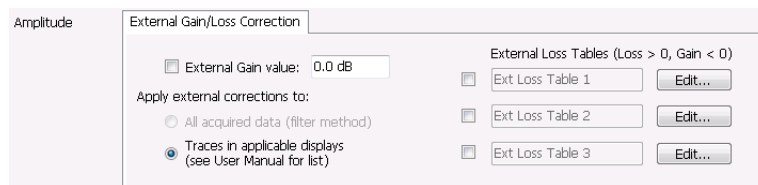


## Amplitude Settings

**Menu Bar:** Setup > Amplitude

**Application Toolbar:** 

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



Setting	Description
<a href="#">External Gain/Loss Correction (see page 507)</a>	Specifies whether a correction is applied to the signal to compensate for the use of external equipment.

## External Gain/Loss Correction Tab

### 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.*

---

### 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.



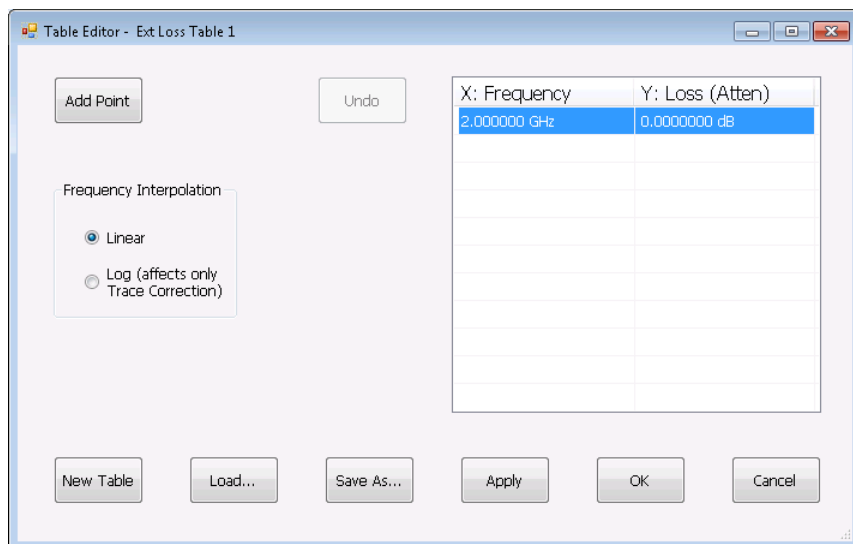
**NOTE.** If you are using an External Loss Table for antenna corrections, be sure to set the Amplitude units (Setup > Analysis > Units) to dBuA/m or dBuV/m.

## 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

---

**NOTE.** *SignalVu-PC must be connected to an instrument to display the Run Menu.*

---

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.

---

**NOTE.** *SignalVu-PC must be connected to an instrument to display the Run Menu.*

---

## 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.

---

**NOTE.** *SignalVu-PC must be connected to an instrument to display the Run Menu.*

---



## 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.

---

**NOTE.** *SignalVu-PC must be connected to an instrument to display the Run Menu.*

---

## Acquire

### Menu Bar: Setup > Acquire

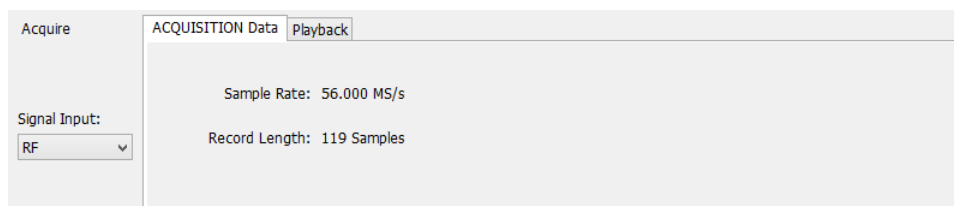
### Application Toolbar:

Selecting **Acquire** displays the Acquire control panel.

The Acquire control panel changes based on whether you are connected to an RSA306 or not.

### Acquire (RSA306 not connected)

The Acquire control panel contains the Acquisition Data tab and Playback tab.



**Signal Input.** The Signal Input control is not used by SignalVu-PC.

Setting	Description
<a href="#">Acquisition Data (see page 513)</a>	Displays the sample rate and record length reported by the oscilloscope.
<a href="#">Playback (see page 517)</a> (requires option SV56)	Plays saved files that were recorded with the Record feature. Playback only plays .r3f file formats.
<b>NOTE.</b> <i>The Record tab only displays when connected to an RSA306.</i>	

### Acquire (RSA306 connected)

Selecting **Acquire** displays the Acquire control panel. These settings control the hardware acquisition parameters for the RSA306 signal analyzer.



The screenshot shows the 'IQ Sampling Parameters' tab. On the left, under 'Acquire', the 'Run:' dropdown is set to 'Continuous'. The main area has four sub-tabs: 'IQ Sampling Parameters' (active), 'Frequency Reference', and 'Record'. Under 'IQ Sampling Parameters', there are input fields for 'Adjust:' (set to 'All Auto (recommended)'), 'Acq BW:' (40.00 MHz), 'Acq Length:' (1.906 us), and 'Samples:' (107 Samples). To the right of these fields, the following values are displayed: '56.0 MS/s', '17.9 nsec/Sample', 'Capacity: 1 s', '56.6 MSamples', and 'Using: 1.91 us, 107 Samples, 0.0 % of capacity'.

Tab	Description
<a href="#">IQ Sampling Parameters (see page 514)</a>	Sets the controls for real-time acquisition.
<a href="#">Frequency Reference (see page 515)</a>	Specifies the source of the reference frequency.
<a href="#">Record (see page 515)</a>	Records the acquisition data directly to a file.
<a href="#">Playback (see page 517)</a> (requires option SV56)	Plays the saved files recorded with the Record feature. Playback only plays .r3f file formats.

## 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.

## Acquisition Data

The Acquisition Data tab lists the Sample Rate and Record length of the recalled acquisition data file.

The screenshot shows the 'Acquisition Data' tab. It displays two lines of information: 'Sample Rate: 3.125 GS/s' and 'Record Length: 165.177 kSamples'.



## IQ Sampling Parameters

The IQ Sampling Parameters tab enables you to set the controls for real-time acquisition. Normally, the best results are achieved by leaving the Adjust control set to the recommended setting of All Auto. This allows the settings to be automatically adjusted for selected measurements.

Depending on the setting chosen for Adjust, two additional parameters can be set.

IQ Sampling Parameters | Frequency Reference | Record

Adjust: All Auto (recommended) ▼

Acq BW: 40.00 MHz

Acq Length: 1.906 us

Samples: 107 Samples

56.0 MS/s  
17.9 nsec/Sample

Capacity: 1 s  
56.6 MSamples

Using: 1.91 us, 107 Samples, 0.0 % of capacity

Adjust	User Sets	Analyzer Calculates
All Auto	N /A	N /A
Acq BW / Acq Samples	Acq BW	Acq Samples
Acq BW / Acq Length	Acq BW	Acquisition Length

### 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.



## Frequency Reference

Specifies the source of the reference frequency . You can select between an Internal (10 MHz) source and an external source.

### Setting

Internal	Uses the internal 10 MHz clock of the RSA306 as the reference frequency.
External (10 MHz)	Uses a 10 MHz clock signal applied to the Ref In connector of the RSA306 as the reference frequency.

## Record

Record lets you record the acquisition data directly to a file. You can then use the Playback feature to play recorded files. Playback can only play files that were recorded using the Formatted Data Structure.

You can use other applications, such as MATLAB to read files recorded as Formatted data or Raw data.

**NOTE.** *SignalVu-PC does not accept changes while recording is active. Stop the current recording session to change settings.*



**Setting****Record to disk:**

Record now	Data recording starts immediately when the Start button is pressed. Data is continuously recorded until either stopped by the Start (Stop) button or the File Length condition is met. If File Length is disabled, recording continues until the Stop button is pressed (or the specified save location runs out of space).
Record on trigger	Data recording starts when an appropriate trigger signal is received (when Triggering is set to Triggered).
Start	The Start button is enabled when the Record to disk is set to Record now. Pressing Start begins the data recording. The button changes to Stop and recording continues until pressed or the file length condition is met.
File Length:	File Length is enabled by default. This determines how much data (time in milliseconds, seconds, or minutes) is recorded when recording starts. File Length uses the Max saved files per run: setting to determine how many data files are captured per each recording session. Disabling File Length allows the recording to continue until the Stop button is pressed (or the specified save location runs out of space).
Location:	Sets the location for the recorded file(s).
Base file name:	Enter a base name that will be used for all recorded files. This base name is appended with additional information, creating unique file names.
Max saved files per run:	This determines how many times a record is created, of the specified File Length setting. If the File Length is not enabled, this setting is ignored.
Data structure:	Choose the output data file structure. Files created with the Record feature: Raw recordings contain instrument setting and other information in a separate file from the raw ADC samples. Formatted recording files contain all information in a single file. Refer to the RSA306 API programming manual for more detailed information about the data files created with the Record feature.
Formatted	Formatted files are created, ending with a .r3f suffix, and contain a single Configuration info block, followed by a block of data and status information. Each data block is called a frame which is 16384 bytes (16 kB) in size. Formatted files can only contain complete frames.
Raw	Unformatted files are created. Raw recordings contain instrument setting and other information in a separate file from the raw ADC samples. Two files are created for each recording, a header file (.r3h) and the raw data file (.r3a). Raw data files contain only ADC samples. The samples are contiguous, with all transport frame information removed before storage. The header file, if available, contains the Config data which can be used to interpret and scale the ADC data samples for further processing.



## Playback

Playback lets you play back acquisition files that were recorded with SignalVu\_PC's record feature. Recorded files have a .r3f file extension and only these file types can be played with the Playback feature.

---

**NOTE.** *The playback feature is best suited for PCs utilizing a solid-state drive (SSD) to achieve the read/write speeds necessary for best playback performance. Playback performance will be degraded on PCs with slower drives.*

---

SignalVu-PC acquires and analyzes the data of a recorded file as if it were obtaining data from an instrument. Because of this, SignalVu-PC disconnects any instrument currently connected via the Connect feature.

But since playing a recorded file is virtually the same as acquiring live data, the **Connected** indicator square at the bottom of the screen displays green (■). In addition, the Run/Stop toolbar is active which allows you to stop and start the playback of the selected file (like the Stop and Play button in the Playback screen).

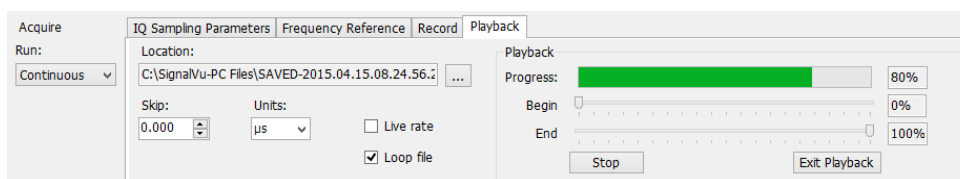
---

**NOTE.** *Most controls in the Playback tab are not active while acquiring live data from a connected instrument. The only control available is the Stop button which will halt the acquisition of data from the connected instrument.*

---

*Once acquisition has stopped, the Playback controls become active.*

---



### Setting

Location:	Navigate to the location of the recorded file(s).
	<b>NOTE.</b> <i>You can also use the File &gt; Recall menu to navigate to recorded files. You must set the file type (to search for) to ADC sample data (R3F).</i>
Skip:	Defines the amount of time skipped between frames of the playback data. For long recordings, this allows you to skip portions of the data, allowing you to perform a coarser analysis, but much quicker. The amount of skip cannot be less than the defined acquisition length. The resolution for setting the skip is one USB frame (73 µs).
Units:	Defines the units of the Skip setting (µsec, msec, seconds).



**Setting**

Live rate	This setting forces SignalVu_PC to attempt to play the file at the same rate as when it was acquired, making the playback operation appear to be identical to having the instrument connected.  This setting is very useful when listening to audio.
Loop file	When selected, the file selected for playback continues to loop until playback is stopped.  If only a portion of the file is selected for playback (with the Begin and End sliders) only that portion is looped.
Playback fields	
Progress	Provides an indication of the current status of the file being played.
Begin	Use the Begin slider to choose a starting point within the recorded file to begin playback.
End	Use the End slider to choose an end point within the recorded file to stop the playback.
Stop/Play	This button toggles between Stop and Play.  <b>NOTE.</b> The Run/Stop toolbar in the SignalVu-PC application also performs the same functions as the Stop/Play button in the Playback screen.
Stop	Stop is displayed while a recorded data file is being played. Pressing Stop halts the playback operation.  Stop is also displayed if SignalVu-PC is currently connected to an instrument. Pressing Stop stops the acquisition of data from the instrument.  No changes can be made to playback while Stop is displayed.
Play	Pressing Play starts playout of the file defined in the Location field.  If SignalVu-PC is connected to an instrument, the instrument is disconnected before the file starts to play.
Exit Playback	Exits the playback mode, disconnecting the recorded file (and the connected status indicates no connection).  After you exit playback, you can replay the currently selected file, choose another file to play, or reestablish a connection to an instrument.

## Triggering

Triggering is available in SignalVu-PC when connected to an RSA306 Spectrum Analyzer. The RSA306 analyzer has two triggering modes: Free Run and Triggered.

### Free Run

In Free Run mode, the RSA306 initiates acquisitions without considering any trigger conditions. It is a fast and easy way to see the signals. Free Run is usually adequate for the Spectrum display unless you need to specify a particular time at which to collect the data record.

### Triggered

In the Triggered mode, the instrument initiates an acquisition when a trigger event is recognized. The conditions that define a trigger event depend on the selected trigger source. If the RF input is the selected



trigger source, Power is the trigger type and you can select the slope and level of the trigger point. If External is selected as the trigger source, you can select the slope as the trigger point.

You can define the following event parameters by selecting the respective tab in the Trigger control panel:

- Event source and event type.
- Advanced parameters define where a trigger occurs within the acquired memory or trigger each segment in the swept acquisition mode.
- Actions set parameters for the Save on trigger function.

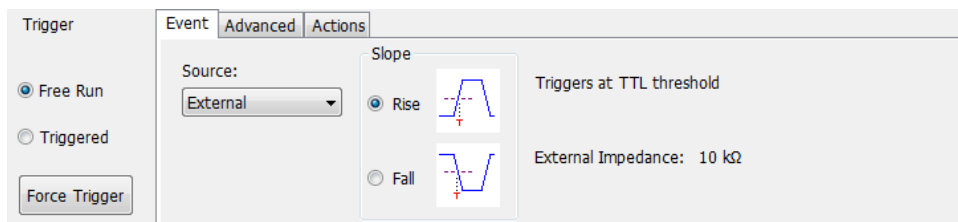
## Save on Trigger

An additional feature of the triggering capability is to save acquisition data when a trigger event occurs. When the analyzer is run in Triggered mode, you can configure the instrument to save acquisition data to a file. You can also set the instrument to save a picture of the screen when the trigger event occurs. See [Action Tab \(Triggering\) \(see page 523\)](#) for details on configuring Save on trigger.

## Setting Up Triggering

To set up triggering, use the Trigger control panel. To display the Trigger control panel:

- Click **Trig** in the Application toolbar or select **Setup > Trigger**.



## Using Free Run

To set Triggering to Free Run:

- Click the **Free Run** option button.

The signal analyzer will acquire a signal without regard to any triggering conditions.

## Using Power Trigger

To trigger acquisitions based on the power of the signal:

1. Click the **Triggered** option button.
2. Select **RF Input** from the Source drop-down list.



3. Select **Power** from the **Type** drop-down list.
4. For further information on setting the power level parameters, see [Event Tab \(Triggering\)](#). (see [page 521](#))

## Trigger Settings

**Menu Bar:** Setup > Trigger

**Application Toolbar:** 

The Trigger control panel allows you to set the parameters that define trigger events and how the instrument responds to them.

### Trigger Modes

There are two trigger modes: Free Run and Triggered.

Mode	Description
Free Run	Acquires and displays the signal without triggering.
Triggered	Acquires a data record after the defined trigger event is recognized.

### Trigger Tabs

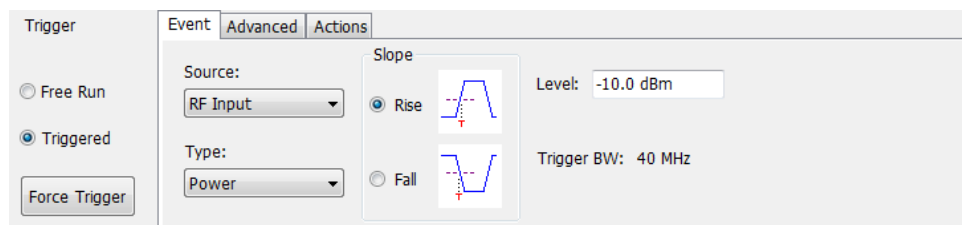
Use the Trigger tabs to access controls for setting the different trigger parameters.

Tab	Description
<a href="#">Event (see page 521)</a>	Sets parameters that control triggering on the selected trigger source.
<a href="#">Advanced (see page 522)</a>	Sets controls for triggering in swept acquisitions.
<a href="#">Actions (see page 523)</a>	Sets parameters for Save on trigger function.



## Event Tab

The Event tab is used to set the parameters that define trigger events. The parameters that appear on the Event tab change depending on the selected Trigger source and type.



### Source

Source specifies the source of the signal to be monitored for a trigger event. The choices available are RF Input and External. The Source drop-down list is always visible on the Event tab.

### Type

Type defines the trigger type. Power is the only selection available. With Power as the trigger type, the trigger event is determined by the transition through an adjustable level. The Type selection is only present when Source is set to RF Input.

For the Power setting, if the RF input signal crosses the specified level (in the direction set by Slope), a trigger event occurs. A trigger event does not occur if the power level of the signal simply exceeds the level setting, there must be a power level transient that crosses the specified level.

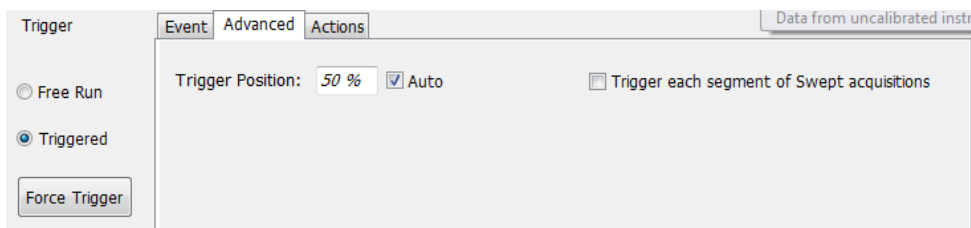


## Advanced Tab (Triggering)

**Menu Bar:** Setup > Trigger > Advanced

**Application Toolbar:** Trig > Advanced

Allows you to set parameters for trigger position and holdoff settings.



Setting	Description
Trigger Position	Sets the point along the acquisition record the trigger event should occur.
Auto	Enables the instrument to set the position of the trigger event. To manually specify the position of the trigger event, unselect Auto.
Trigger each segment of Swept acquisitions	Sets the analyzer to wait for a trigger for each acquisition in a swept spectrum or other measurement requiring multiple acquisitions worth of span.



## Actions Tab (Triggering)

The Actions tab sets parameters for the Save on trigger function. The Save on trigger function allows you to save an acquisition data file and/or a screen capture when a trigger event occurs.

Trigger events are defined on the [Event](#) tab.

The screenshot shows the 'Actions' tab of the software interface. On the left, under the 'Trigger' section, the 'Triggered' radio button is selected. Below it is a 'Force Trigger' button. The main area of the 'Actions' tab contains three settings:
 

- 'Save acq data on Trigger:' with a checkbox, a dropdown menu set to 'TIQ', and a note '(1 complete acquisition, not valid when swept)'.
- 'Save picture on Trigger:' with a checkbox and a dropdown menu set to 'PNG'.
- 'Max total files saved per Run:' with a checkbox and a text input field set to '100'.

### Action tab settings

Setting	Description
Save acq data on Trigger	<p>Enables the Save on Trigger function. The list box to the right of the <b>Save acq data on Trigger</b> check box specifies the format of the saved file. Acquisition data files can be saved in TIQ (native) format, CSV format, and MAT (MATLAB) format. For descriptions of these file formats, see <a href="#">Data, Settings and Picture File Formats (see page 562)</a>.</p> <p>When TIQ is the selected file type, a file is saved after a complete acquisition, which can include multiple frames. When CSV or MAT is the selected file type, a separate file is saved for each frame.</p> <p>Files are saved in the last location a file was saved. The default location is C:\SignalVu-PC Files.</p>
Save picture on Trigger	<p>Enables saving a picture of the display when a trigger event occurs. Files can be saved in PNG, JPG, and BMP format. For descriptions of these file formats, see <a href="#">Data, Settings, and Picture File Formats (see page 562)</a>.</p>
Max total files saved per Run	<p>Specifies the number of times a Save on Trigger action stores a file. After this limit is reached, no more files are saved. The instrument will continue to run, but no additional files are saved when a trigger event occurs.</p> <p>Keep in mind when setting this number that picture files are counted as part of the total number of files. For example, if you set Max total files to 100, the instrument will save 100 acquisitions if only acquisitions are saved or only pictures are saved. But, if both acquisitions and pictures are saved, then 50 acquisitions and 50 pictures will be saved.</p>








## How to set up GNSS

The combined use of the GNSS, Antenna, and Map It features allows you to capture and map location coordinates when using an antenna and a GNSS receiver. The Map It feature requires that the optional MAP application license be installed.

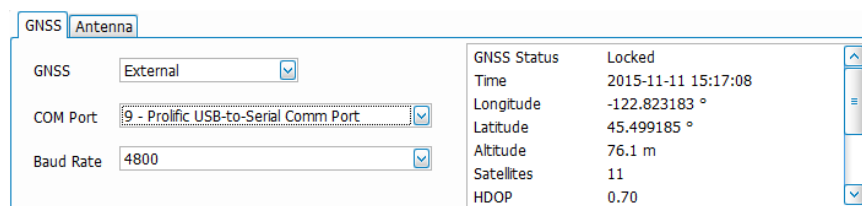
You can use the GNSS and Map It features to connect a Global Navigation Satellite System (GNSS) receiver to a communication (COM) port on your PC to capture the timing and positioning data of the receiver for a measurement from a satellite or constellation of satellites. The receiver must output navigation messages using NMEA 0183 serial data format, and the messages must include at least one of these sentence types: RMC, GGA or GNS.

### How to access the GNSS/Antenna control panel

Click the  icon or select **Setup > GNSS/Antenna** from the Main menu bar to view the GNSS/Antenna control panel.

### GNSS settings

The following image and table show the GNSS tab of the GNSS/Antenna control panel and its contents.




The screenshot shows the GNSS/Antenna control panel with two tabs: 'GNSS' and 'Antenna'. The 'GNSS' tab is active. On the left, there are three settings: 'GNSS' set to 'External', 'COM Port' set to '9 - Prolific USB-to-Serial Comm Port', and 'Baud Rate' set to '4800'. On the right, there is a 'GNSS Status' readout showing: 'Locked', 'Time: 2015-11-11 15:17:08', 'Longitude: -122.823183 °', 'Latitude: 45.499185 °', 'Altitude: 76.1 m', 'Satellites: 11', and 'HDOP: 0.70'.

Setting	Description
GNSS	Select the GNSS source as external or none. An external source may be a receiver in the PC with SignalVu-PC installed, or it may be one you connect through USB or some other method.
COM Port	This list is auto-populated with the COM ports on your PC, as well as a simulation port.
Baud rate	Select a baud rate. Selection of this rate will depend on your GNSS receiver and COM port specifications. Options are 4800, 9600, 19200, and 38400.
GNSS readout	This readout shows the status of the GNSS connection and time, location, and satellite information. Each item is described below.
GNSS Status	GNSS receiver connection status: Off, Comm error, Unlocked, Locked.
Time	Date (yyyy-mm-dd) and time (hh:mm:ss).
Longitude	East-west position (shown in degrees), where the prime meridian is 0°.
Latitude	North-south position between the poles (shown in degrees), where the equator is 0°.
Altitude	Elevation from sea level (shown in meters).



Setting	Description
Satellites	Number of satellites being used in the GNSS array. The array used is determined by your receiver.
HDOP	Horizontal Dilution of Precision (HDOP). This value indicates the quality of the satellite signal using the relative geometry of the satellite to receiver. An ideal value is <1. The lower the value, the better the positional precision.
Speed	Speed of receiver (shown in km/s).
Course	Compass bearing (shown in degrees).

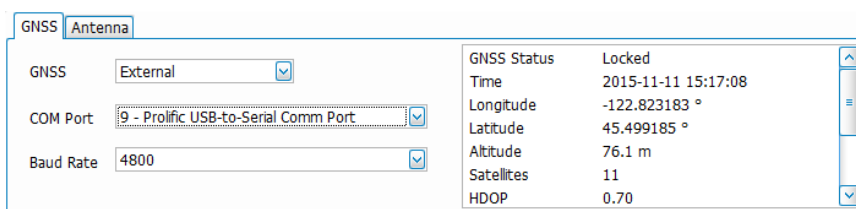
The icon  appears in the right corner of the Status Bar. It is green when GNSS is locked, yellow if unlocked, and red if there is a Comm error.

### How to set up the GNSS feature

1. Install a GNSS receiver to a COM port on your PC.
2. Select **Setup > GNSS/Antenna** from the Main menu bar to view the GNSS/Antenna control panel.
3. Select **External** from the drop-down menu in the GNSS tab.
4. From the COM Port drop-down list, select the COM port to which the GNSS receiver is connected.

**NOTE.** You can select *Simulation Port* to run a simulation when no GNSS receiver is present. Copy the file *GnssSimCom19* from *C:/RSAMap Files/Example Files* and place it in the Windows *C:/Temp* directory, then select *Simulation Port* from the *COM Port* drop down menu.

5. Set the Baud Rate as appropriate for the connected GNSS receiver. The default is 4800, which is a typical rate.



GNSS/Antenna	
GNSS	External
COM Port	9 - Prolific USB-to-Serial Comm Port
Baud Rate	4800
GNSS Status	Locked
Time	2015-11-11 15:17:08
Longitude	-122.823183 °
Latitude	45.499185 °
Altitude	76.1 m
Satellites	11
HDOP	0.70

When the GNSS receiver is communicating with the analyzer, the readouts in the right portion of the GNSS panel (status area) will update to display current location information and GNSS receiver status. Lock times will vary depending on the receiver and receiving conditions.

### See also:

[How to use the Antenna feature](#)



## [How to use Map It](#)


# How to use the Antenna feature

The antenna feature allows you to connect to an Alaris DF-A0047 USB-connected antenna that reports bearing/azimuth data over USB. In conjunction with a GNSS receiver, you can capture location and azimuth data using the [Map It](#) feature. If you do not use an Alaris DF-A0047 antenna, you can use the manual controls to enter an azimuth.

Explore the following topics in this section:

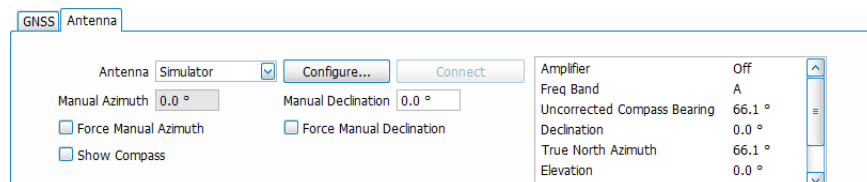
- [Antenna settings.](#)
- [How to set up the Antenna feature with an antenna.](#)
- [How to use the antenna Simulator.](#)

## How to access the Antenna control panel

Click  or select **Setup > GNSS/Antenna** from the Main menu bar to view the GNSS/Antenna control panel. Then click on the **Antenna** tab in the control panel.

## Antenna settings

Following is an image and a description of the Antenna tab of the GNSS/Antenna control panel.



Setting	Description
Antenna	Select the antenna. Choices are None, Alaris DF-A0047, and Simulator. The Simulator simulates an antenna connection and readouts for demonstration purposes.
Manual Azimuth	Enter a value here to force the azimuth (compass direction in degrees) to be a specific value. The azimuth is the angle measured clockwise between the reference meridian (geographic north) and the current antenna direction. It can range from 0 to 360°.
Force Manual Azimuth	Check this box to force the analyzer to read the azimuth at the entered value instead of the antenna generated value.
Show Compass	Check this box to view a visual, qualitative representation of the bearing (a virtual compass). To remove the compass, uncheck the box. To adjust the compass size, click and drag from the bottom right corner.



Setting	Description
Configure...	This button opens the Antenna Setup window. In this window you can enter the antenna serial number and set the following antenna related parameters: baud rate, data bits, stop bits, and parity.
Connect	Click this button to connect to the antenna or to start the antenna simulator.
Manual Declination	Enter a value here to force the declination (angle in degrees between magnetic (true) north and geographic north) to be a specific value.
Force Manual Declination	Check this box to force the analyzer to use the manually entered declination value. Otherwise, the analyzer will assume that geographic north and magnetic north are the same and use 0°.
Antenna readout	This readout field will contain some or all of the following readings, depending on your setup.
Amplifier	Shows Off or On depending on whether or not you have enabled the amplifier on the antenna.
Freq Band	The current operating frequency band of the antenna. For the Alaris DF-A0047, this value can be one of the following: A (0.009 - 20 MHz) B (20 - 50 MHz) C (50 - 8500 MHz)
Uncorrected Compass Bearing	Shows the azimuth reading from geographic north.
Declination	Shows the declination.
True North Azimuth	Shows the azimuth reading after declination is applied.
Elevation	Shows the antenna elevation.
Roll	Shows the antenna roll.

### How to set up the Antenna feature with an antenna

1. Install the Alaris DF-A0047 driver. The driver can be copied from the SignalVu-PC Software and Documentation USB stick supplied with the RSA306. It can also be download from [www.tektronix.com/downloads](http://www.tektronix.com/downloads).
2. Connect an Alaris DF-A0047 antenna to the PC.

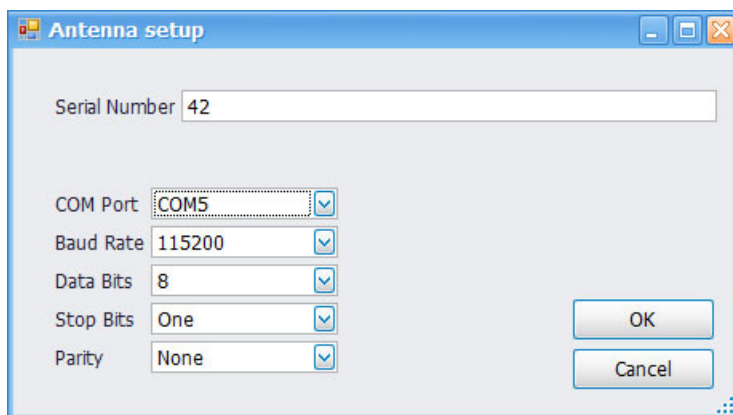
---

**NOTE.** *Connecting an RSA306 is not required, but provides increased functionality of this feature.*

---

3. Select **Setup > GNSS/Antenna** to open the GNSS/Antenna control panel.
4. Select **Alaris DF-A0047** from the Antenna drop-down menu. Selections also include None (default) and Simulator.
5. Click the **Configure...** button to launch the Antenna Setup window.

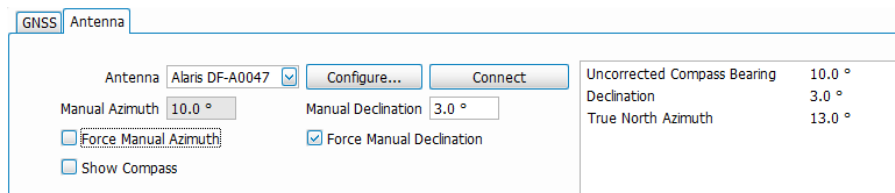




6. Do the following in the Antenna Setup window:
  - a. Enter the serial number of the antenna, if desired.
  - b. Select the COM port to which the antenna is connected. You can see a list of COM ports for your PC in the Microsoft Windows Control Panel.
  - c. You can change the following parameters; however, the default values are set for the Alaris DF-A0047 antenna. If you change these parameters, you may lose communication with the Alaris antenna: baud Rate, data bits, stop bits, and parity.
8. Click **OK** to save the changes and close the Antenna Setup window.
9. You can now choose to manually set the declination, if desired. To do this, check the box next to **Force Manual Declination** in the Antenna tab of the GNSS/Antenna control panel and then enter the desired value. Notice that the value you enter will appear in the antenna readout to the right of the Connect button. The True North Azimuth reading is the sum of the Uncorrected Compass Bearing and the Declination.

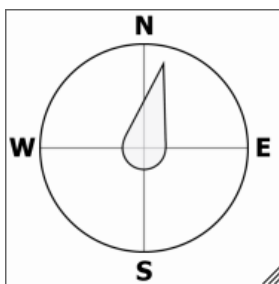
You can also check the box next to **Force Manual Azimuth** and enter a desired value if you want to force the azimuth or are using an antenna that does not report azimuth.

When you select to manually force the declination and/or azimuth, those values will not change in the readout, even if the antenna direction changes.



10. Check the **Show Compass** box to view a visual, qualitative representation of the bearing. As you move the antenna, the compass needle will move.



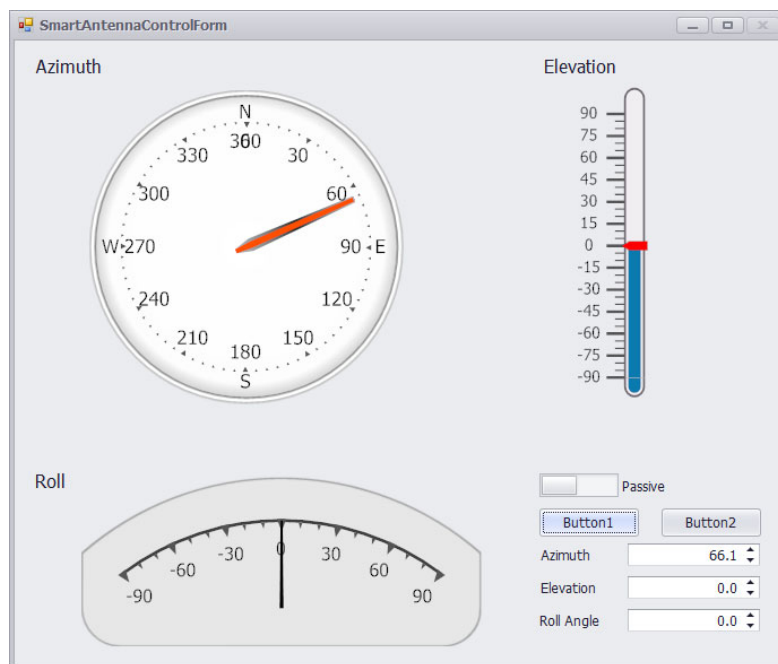


**TIP:** You can adjust the size of the compass by clicking on the right bottom corner and dragging it.

11. Click the **Connect** button to connect to the antenna. Connection may take about 10 seconds. Once connected, the antenna readout will reflect the antenna direction and other readings.

### How to use the antenna Simulator

1. Select **Setup > GNSS/Antenna** to open the GNSS/Antenna control panel.
2. Select **Simulator** from the Antenna drop-down menu. Selections also include None (default) and Alaris DF-A0047.
3. Click the **Connect** button to launch the Smart Antenna Control Form.



4. Click on the various areas of the Smart Antenna window to adjust azimuth, roll, or elevation. You can also enter the values directly in the Azimuth, Elevation, and Roll Angle fields. This Smart Antenna window simulates a physical antenna, except that there is no amplification available (the Passive/Active switch is non-functional).
5. Click the **Button1** button to capture the GNSS information. (See the [How to use Map It](#) topic for more information on capturing data.)

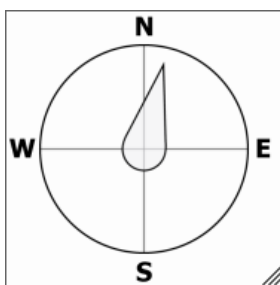


6. You can now choose to manually set the declination, if desired. To do this, check the box next to **Force Manual Declination** in the Antenna tab of the GNSS/Antenna control panel and then enter the desired value. Notice that the value you enter will appear in the antenna readout to the right of the Connect button. The True North Azimuth reading is the sum of the Uncorrected Compass Bearing and the Declination.

You can also check the box next to **Force Manual Azimuth** and enter a desired value if you want to force the azimuth or are using an antenna that does not report azimuth.

When you select to manually force the declination and/or azimuth, those values will not change in the readout, even if the antenna direction changes.

7. Check the **Show Compass** box to view a visual, qualitative representation of the bearing. As you move the antenna, the compass needle will move.



**TIP:** You can adjust the size of the compass by clicking on the right bottom corner and dragging it.

**See also:**

[How to set up GNSS \(see page 525\)](#)

[How to use Map It \(see page 531\)](#)

## How to use Map It

Select **View > Map It Toolbar** from the Main menu bar to open the Map It toolbar.

Once you have set up the GNSS receiver as shown [here](#), perform the following steps to capture the data. A Map It file includes trace data, measurement data, time, and location information for use in the RSA Map program.

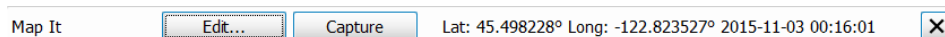
---

**NOTE.** The Map It feature requires that the optional MAP application license be installed.

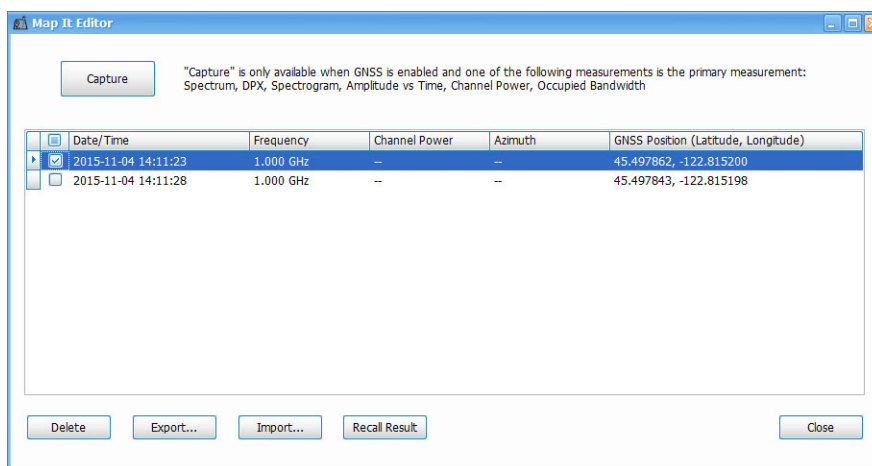
---



1. Check that at least one of the following displays is active in SignalVu-PC: Spectrum, DPX, Spectrogram, Amplitude vs Time, Channel Power, or Occupied Bandwidth.
2. If an RSA306 is not currently connected to the PC, you can connect one now, if desired.
3. Select **View > Map It Toolbar** from the main menu bar to view the Map It toolbar. Notice that the current GNSS location and time information are shown on the toolbar.



4. Click the **Edit...** button to open the Map It Editor window.
5. In the Map It Editor window, click the **Capture** button to capture data. If you prefer, you can click the **Capture** button on the Map It toolbar first, and then click **Edit...** to open the Map It Editor window to view the result.
6. You can now import, export, or recall captured data using the related buttons at the bottom of the Map It Editor window. If you export a file, you can then open it using the RSAMap application (open from the Tools menu).



## Importing and exporting Map It files

The information you capture can be zipped and stored as a single file with multiple captures. Recalling results will recall the trace data and settings stored with Map It. Make sure to uncheck the Show box in the traces menu of the selected display when you have completed examination of the Map It data.

The Map It zip file is structured as follows:



```
\(root)
|
+ Readme.txt = This document.
+ \Data = Contains all exported comma-separated trace data and image captures.
Also contains a measurement summary file.
    + Measurements.csv
    + <Timestamp>_Result.csv
    + <Timestamp>_Picture.png
+ \Mifmid = Contains exported .mif and .mid files.
    + <ArchiveFilename>.mif
    + <ArchiveFilename>.mid
+ \KMZ = Contains the exported .kmz file.
    + <ArchiveFilename>.kmz
+ \RSA = Contains RSA trace files for all measurements.
+ \Tek = Contains files for use by RSA Map.
+ \Map = Contains files and data for the map used with this archive.
|
```

**See also:**

[How to use the Antenna feature](#)

[How to set up GNSS](#)







## How to use the Signal Database

Select **Tools > Signal Database** to open the Signal Database window. Here you can select which signal standards and types are listed (and selectable) in the Channel Navigation toolbar and/or the Define Survey control panel.

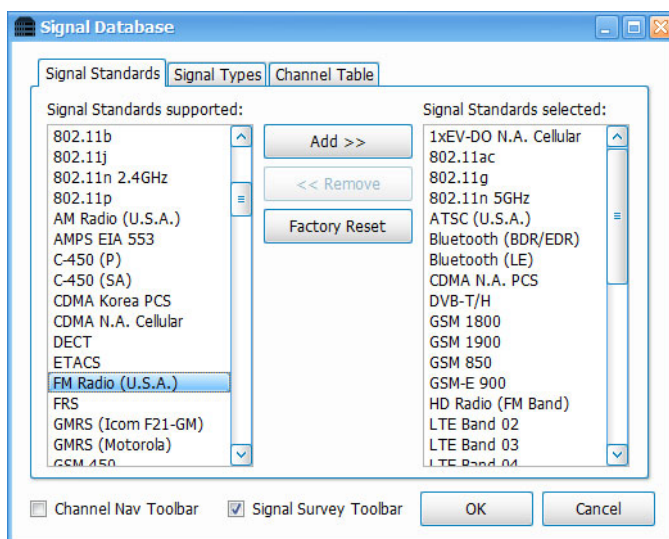
### Signal standards and signal types defined

The analyzer uses the following definitions of signal standards and signal types to populate the Signal Database.

- **Signal standard:** A group of channels that adheres to the parameters and characteristics of a given signal type. These channels could include both uplink and downlink frequencies.
- **Signal type:** Parameters and characteristics (bandwidth, spectral shape) common to a given signal. A signal type can be shared by multiple signal standards.

### How to select signal standards in the database window

The following image is of the Signal Database window with the Signal Standards tab selected. The table describes the fields and buttons of the tab. The standards selected here show in the Define Survey control panel and the [Channel Navigation](#) toolbar.



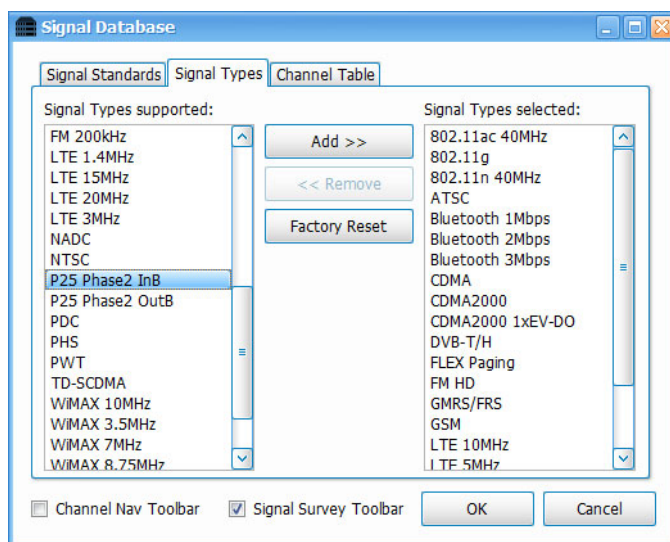
Setting	Description
Signal Standards Supported	List of all available signal standards. Click a standard to select it or click and drag to select a contiguous range of standards.
Add >>	Adds (moves) selected items from the <b>Signal Standards Supported</b> list to the <b>Signal Standards selected</b> list.



Setting	Description
< < Delete	Deletes (moves) selected items from the <b>Signal Standards selected</b> list to the <b>Signal Standards Supported</b> list.
Signal Standards selected	List of selected signal standards that will be made available in the Channel Navigation toolbar and the Region tab of Define Survey control panel. To delete items, select one or more signal standards and click the <b>Delete</b> button.
Factory Reset	Sets the supported and selected fields to the factory-specified signal standards.
Channel Nav Toolbar check box	Check box to open the Channel Navigation toolbar. The Signal Database window stays open. You can read more about the Channel Navigation toolbar <a href="#">here</a> .
Signal Survey Toolbar check box	Check box to open the Signal Survey toolbar. The Signal Database window stays open. You can read more about the Signal Survey toolbar <a href="#">here</a> .

### How to select signal types in the database window

The following image is of the Signal Database window with the Signal Types tab selected. The table describes the fields and buttons of the tab. The types selected here show in the Define Survey control panel.



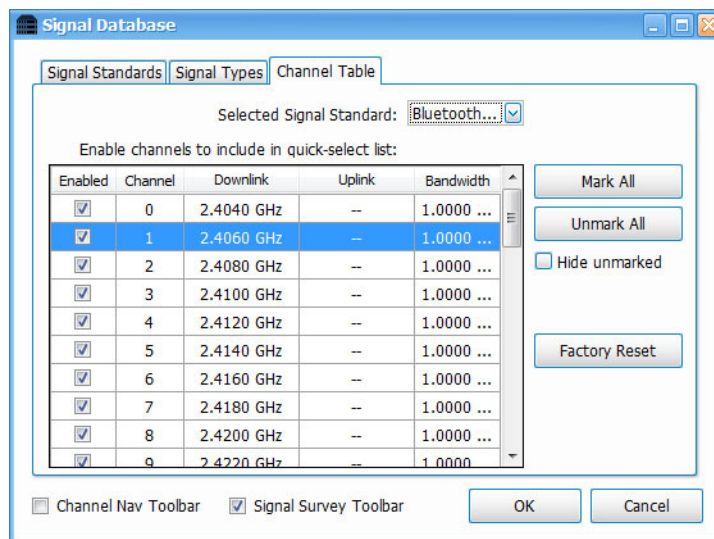
Item	Description
Signal Types supported	List of all available signal types. Click a type to select it or click and drag to select a contiguous range of types.
Add > >	Adds (moves) selected items from the <b>Signal Types Supported</b> list to the <b>Signal Types selected</b> list.
< < Delete	Deletes (moves) selected items from the <b>Signal Types selected</b> list to the <b>Signal Types Supported</b> list.
Signal Types selected	List of selected signal types made available in the Region tab of the Define Survey control panel. To delete items, select one or more signal types and tap the Delete button.
Factory Reset	Sets the supported and selected fields to the factory-specified signal types.



Item	Description
Channel Nav Toolbar check box	Check box to open the Channel Navigation toolbar. The Signal Database window stays open. You can read more about the Channel Navigation toolbar <a href="#">here</a> .
Signal SurveyToolbar check box	Check box to open the Signal Survey toolbar. The Signal Database window stays open. You can read more about the Signal Survey toolbar <a href="#">here</a> .

## How to select channels in the database window

The following image is of the Signal Database window with the Channel Table tab selected. The table describes the fields and buttons of the tab. The channels selected here are included in the Signal Channel Selection window. (See the [Channel Navigation toolbar](#) section for information about channel selection.)



Item	Description
Selected Signal Standard	Drop down list allows you to select the signal standard, the channels of which will populate the channel table. This list is taken from the enabled standards in the Signal Standards tab.
Enabled column checkboxes	Enables/disables the channel in the row.
Mark All	Selects all channels in the table to enable them.
Unmark All	Deselects all channels in the table to disable them.
Hide unmarked checkbox	Hides any deselected channels so that you can view only the enabled channels in the table.
Factory Reset	Sets each channel to the factory-specified enabled/disabled state.



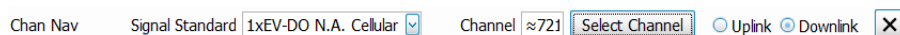
Item	Description
Channel Nav Toolbar checkbox	Check box to open the Channel Navigation toolbar. The Signal Database window stays open. You can read more about the Channel Navigation toolbar <a href="#">here</a> .
Signal Survey Toolbar checkbox	Check box to open the Signal Survey toolbar. The Signal Database window stays open. You can read more about the Signal Survey toolbar <a href="#">here</a> .

## Channel Navigation toolbar

Select **View > Chan Nav Toolbar** to view the Channel Navigation toolbar. This toolbar allows you to navigate easily from channel to channel in any measurement display. It provides the following capabilities:

- Select a channel for enabled standards (only standards selected in the Signal Database).
- Select the channel direction, if applicable (uplink or downlink).
- Access the Signal Channel Selection window, which allows you to select from a list of enabled channels.

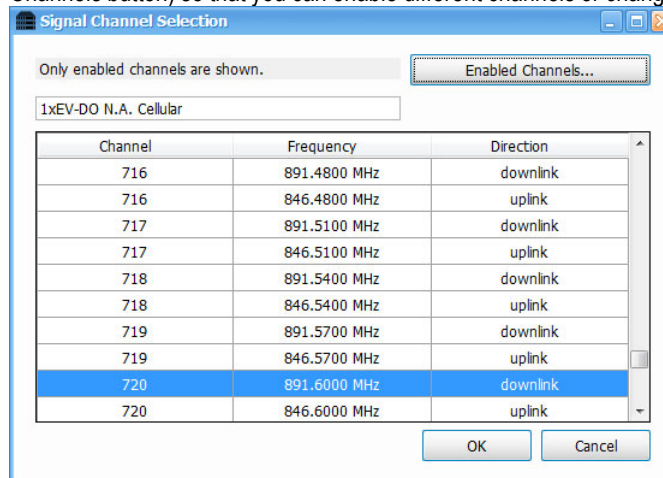
The following image shows the toolbar and the following table describes how it functions.



Item	Description
Signal Standard	Drop down list allows you to select the signal standard, the channels of which will populate the Channel field to the right. This list is taken from the enabled standards in the Signal Standards tab of the Signal Database.
Channel	<p>This field shows the channel number of the currently selected signal standard that the instrument is currently tuned to. An entry of "--" indicates that the current instrument frequency does not match that of any of the currently enabled channels.</p> <p>Clicking in this field allows for direct channel number entry. To select the next or previous channel, you can use the up and down arrow keys on your keyboard or the arrows in the Numeric Keypad (in the View menu, check the Numeric Keypad box). Note that this applies to enabled channels only.</p> <p>If you see a <math>\approx</math> in front of the channel number, it means that the current instrument frequency is close to, but not exactly equal to, the currently selected channel. It means that the current instrument frequency does not exactly match the currently selected channel frequency, but that it is within the current channel bandwidth.</p> <p>You cannot directly enter or use the arrow keys to select non-numeric channel names for signal standards. You must use the <b>Select Channel</b> button.</p>



Item	Description
Select Channel	Opens the Signal Channel Selection window. This window shows a table of enabled channels for the selected standard. Click on the channel you want to view in the plot and then click the OK button. This window also allows you to access the Signal Database window (using the Enabled Channels button) so that you can enable different channels or change standards or types, if desired.



Uplink	Click to select the uplink channels for the currently selected signal standard.
Downlink	Click to select the downlink channels for the currently selected signal standard.

**See also:**

[How to use the Signal Database. \(see page 535\)](#)







## Signal Classification

With the SV54 optional application license for SignalVu-PC installed, you can use the signal classification toolset to help you classify signals. You will first define areas of interest as regions anywhere on a Spectrum or DPX waveform. You can then use our Signal Database tool to compare the spectral shape of the selected signal area to known signal types, and the center frequency of the selected signal area to known signal standard channels. Finally, you can assign classification labels to regions, record related notes, and save all defined regions to a region survey file. This toolset also allows you to import and export survey files. The following information and procedures are available to help you find, navigate through, and use the signal classification tools to classify a signal.

- [Step by step procedures for classifying a signal.](#) These procedures walk you through the classification process from start to finish using the SignalVu-PC signal classification tools. Examples are included.
- [How to use the Signal Survey toolbar. \(see page 549\)](#) Once launched, this toolbar allows you to access the Create/Edit, Define, and Classify tools. These tools allow you to create a new survey/region, import and export surveys, define region signal standards and types, navigate quickly through regions in a survey, and classify a signal in a region.
- [How to use the Signal Survey Editor window. \(see page 550\)](#) This window is accessed through a Signal Survey toolbar button. It allows you to create and edit regions or import or export a survey.
- [How to use the Define Survey control panel. \(see page 551\)](#) This panel is accessed through a Signal Survey toolbar button. It allows you to select signal standards and types from the Standards Database; see bandwidth, frequency, and channel information; view all regions and related information in a survey in a table; and select and view a spectral profile (most signal types have an available profile).

### How to classify a signal

The following procedure shows you how to use the signal classification tools to classify a signal. It is divided into four main tasks.

---

**NOTE.** Before you proceed, you will need to select a list of enabled signal standards, signal types, and channels in the [Signal Database](#). You do not need to perform this setup each time you classify a signal. Once set up, this list does not change unless you reset to default or change the selections.

---

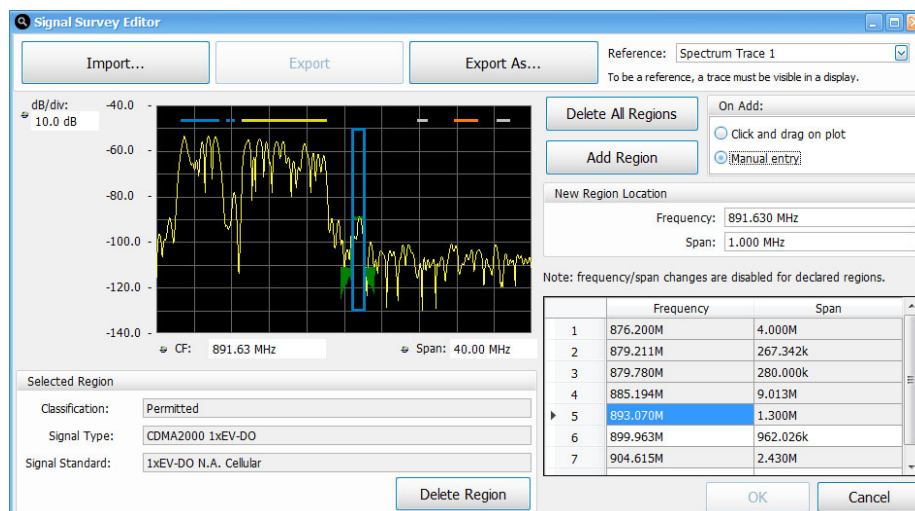
1. [Create](#) areas of interest as regions (center frequency and frequency span) anywhere on the signal.
2. [Define](#) a survey (a region or collection of regions) by comparing the bandwidth of the unknown signal to that of known signal types, and the center frequency of the unknown signal to that of known signal standard channel frequencies.
3. [Classify](#) the signal by assigning classification labels and notes to a defined region.
4. [Export or import](#) a region survey file.




## Create a region

The first step in classifying a signal is to create a region that defines the portion of the signal you want to use.

1. Open a Spectrum or DPX display to view the signal you want to classify.
2. Select **View** from the SignalVu-PC menu bar and select (check) **Signal Survey Toolbar**. The toolbar will appear near the bottom of the screen.
3. Click the **Create/Edit...** button in the Signal Survey tool bar to open the Signal Survey Editor window.




4. Check that the selected reference trace is correct in the Reference dropdown list which is located to the right of the **Export As...** button. Note that for a trace to be in the list, it must be enabled in the Spectrum or DPX display.
5. Click the **Add Region** button.
6. By default, **Click and drag on plot** is selected for the add region method. Click and drag on the plot around the signal area of interest to define the width (span) of the region. The analyzer will draw a box on the plot that is outlined in gray, indicating that the region is as yet undefined. Click on the  icon at the bottom of the region to change the CF. You can also click and drag on the left or right edge of the region rectangle to change its span. The amplitude of the signal does not need to be totally enclosed in the region box.
7. If you want to manually enter the center frequency and span parameters to create a region, select **Manual entry**, enter the values in the New Region Location fields, and then click the **Add Region** button.
8. Create more than one region, if needed.

---

**NOTE.** A maximum of two regions can overlap at any given frequency. If you try to create a new region that contains any frequency point that is already shared by two other regions, an error message is displayed stating that too many regions overlap.

---



9. If you want to edit a region, then you can use the same tools as when you first created the region (click, drag, ). If you want to delete a region, select the desired region and then click the **Delete Region** button. You can also click **Delete All Regions** to delete all regions in the display.

When Manual entry is selected in the On Add area, you can manually edit the Frequency and Span.

10. Click the **OK** button when you are finished creating and editing regions. Clicking the **Cancel** button will result in all additions/changes made during the current edit session (as long as the Signal Survey Editor dialog has been open) being discarded.

#### See also:

[How to use the Signal Survey Editor window.](#)

[How to use the Signal Survey toolbar.](#)

[How to use the Define Survey control panel.](#)

[What region color codes mean.](#)

[Using the Signal Database.](#)

#### Define a region using known standards

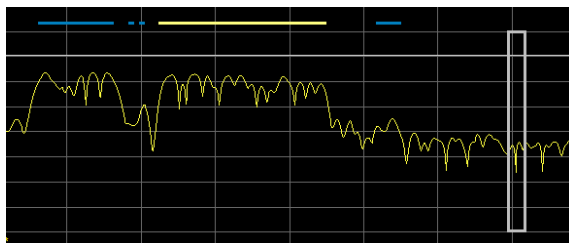
The next step after creating a region is to define it by comparing the unknown signal's bandwidth and frequency to the known signal standards and signal types. Doing this allows you to potentially find a match and classify the unknown signal. You can also use known signal standard channel frequencies to match against a region's center frequency.

---

**NOTE.** You can also define a region using a known signal standard channel frequency and match it against the center frequency of a region.

---

1. Click the **Define** button to open the Define Survey panel.
2. Do one of the following to select a region:
  - Click on a region (shown as a horizontal bar along the top edge of the plot) in the Spectrum or DPX display. When selected, the region will expand to a rectangular box around the signal.



- Click on a row in the Survey Summary tab table of the Define Survey panel. This table is scrollable and contains summary information about all of the regions in the current display (called



a survey). Clicking on a row in the table selects the region in the display. Information in the rows is not editable.

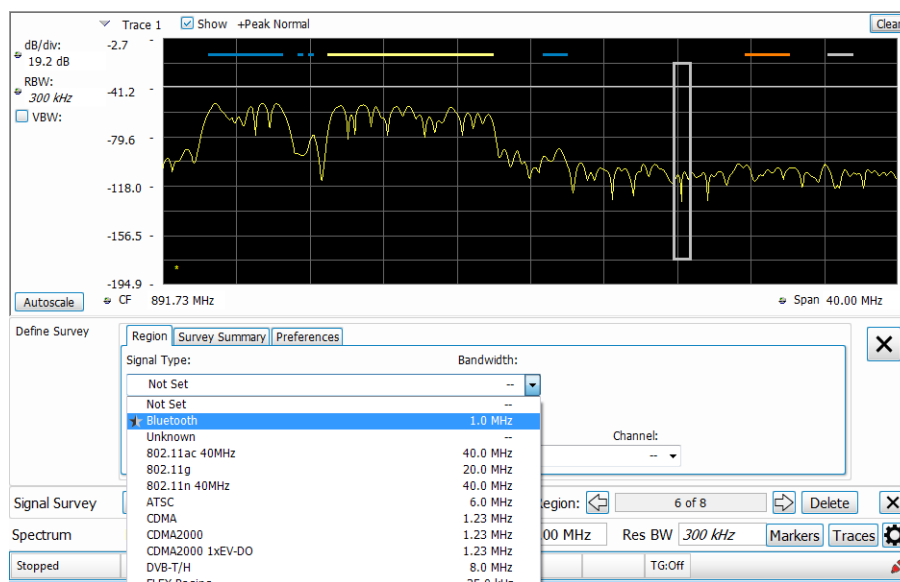
Region	Survey Summary	Preferences			
	Frequency	Span	Classification	Type	Standard
▶ 5	893.07038 MHz	1.3 MHz	None	CDMA2000 1xEV-DO	1xEV-DO N.A. Cellular
6	899.963038 MHz	962.026 kHz	None	Bluetooth 1Mbps	Bluetooth (LE)
7	904.614684 MHz	2.43038 MHz	Unauthorized	Not Set	Not Set
8	908.583544 MHz	1.392404 MHz	None	Not Set	Not Set

- Use the left or right arrows on the Signal Survey toolbar to navigate to the desired region. Notice that this will highlight the row number in the Survey Summary tab table of the associated region, and thus select the region in the display.

Signal Survey    Selected Region:  9 of 10

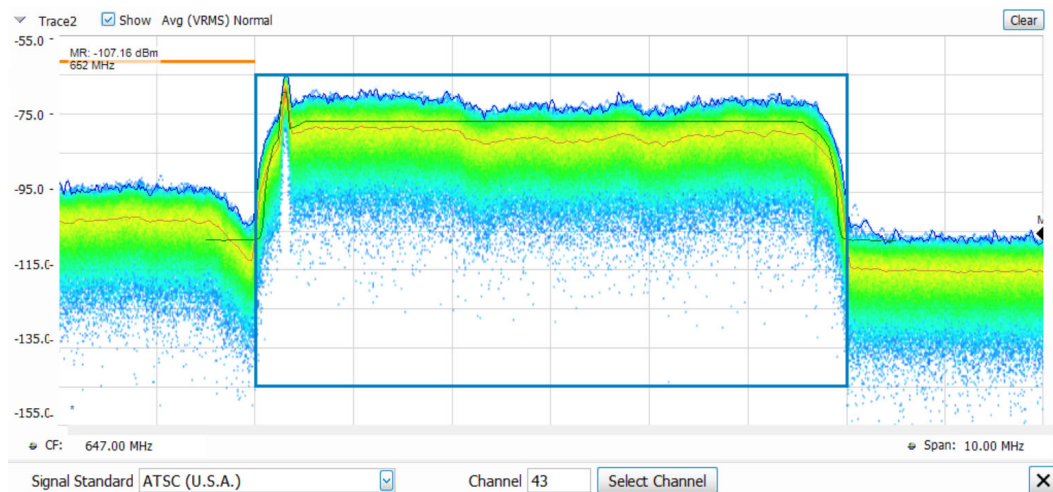
**NOTE.** Only one region can be active at a time. Inactive regions are shown as horizontal bars along the top edge of the signal. An active region is shown as a box drawn around the signal.

- In the Define Signal panel, select the Region tab and click to view the drop-down list under the Signal Type Bandwidth. In the below image, you can see that in the list, the Bluetooth signal type has a star next to it. The degree and darkness of the shading of a star indicates how close of a bandwidth match the given signal type is to the unknown signal. (You can read about how the star indicator works in [The Define Survey control panel \(see page 551\)](#) topic.)



- You now want to select from this list of known signal types and associated bandwidths. Once selected, a spectral profile (shown as a green waveform in the example image) will be overlaid on the portion of the signal in the region. The spectral profile is used to compare against the signal in the region. If the profile and the signal match, then there is a good chance the signal is that given signal type.






---

**NOTE.** Most, but not all, signal database signal types have spectral profiles.

---

5. Click on the Prefs tab in the Define Survey panel to set the spectral profile to do one of the following:
  - **Snap to Channel Frequency:** Use this option if you want to verify the frequency of the signal is aligned with the selected signal standard channel frequency. If the selected signal standard channel frequency is within the selected region, then the spectral profile will center on that channel frequency. If the channel frequency is outside of the selected region, then the spectral profile will revert to being centered within the region.
  - **Snap to Center of Region:** Use this option if you know that the frequency you are viewing has no defined signal standard channels in the database.
  - **Off:** Use this option if you want to view the signal in the region without the spectral profile overlaid on the signal.

#### See also:

[How to use the Signal Survey Editor window](#)

[How to use the Signal Survey toolbar](#)

[How to use the Define Survey control panel.](#)

[What region color codes mean](#)

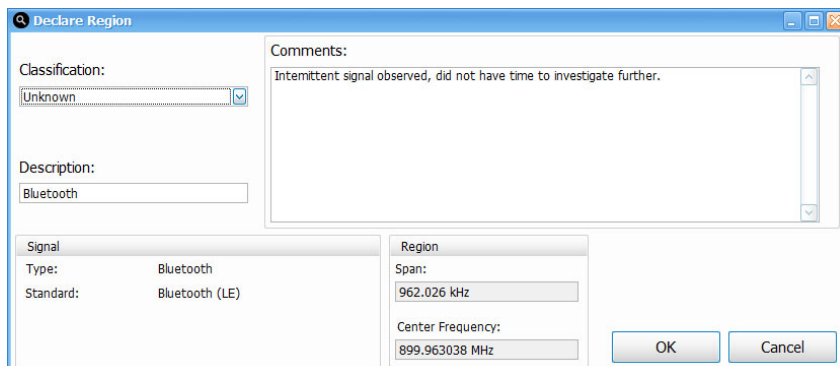
[Signal Database](#)

#### Classify a region

After you have created a region, you can classify it by assigning classification labels and notes to it.



1. Select a region.
2. Click the **Classify** button in the Signal Survey toolbar to view the Declare Region window.



The 'Declare Region' dialog box is shown. It has a 'Classification' dropdown menu set to 'Unknown'. Below it is a 'Description' text box containing 'Bluetooth'. To the right is a 'Comments' text area with the text 'Intermittent signal observed, did not have time to investigate further.' At the bottom, there are two sections: 'Signal' and 'Region'. The 'Signal' section has 'Type: Bluetooth' and 'Standard: Bluetooth (LE)'. The 'Region' section has 'Span: 962.026 kHz' and 'Center Frequency: 899.963038 MHz'. At the bottom right are 'OK' and 'Cancel' buttons.

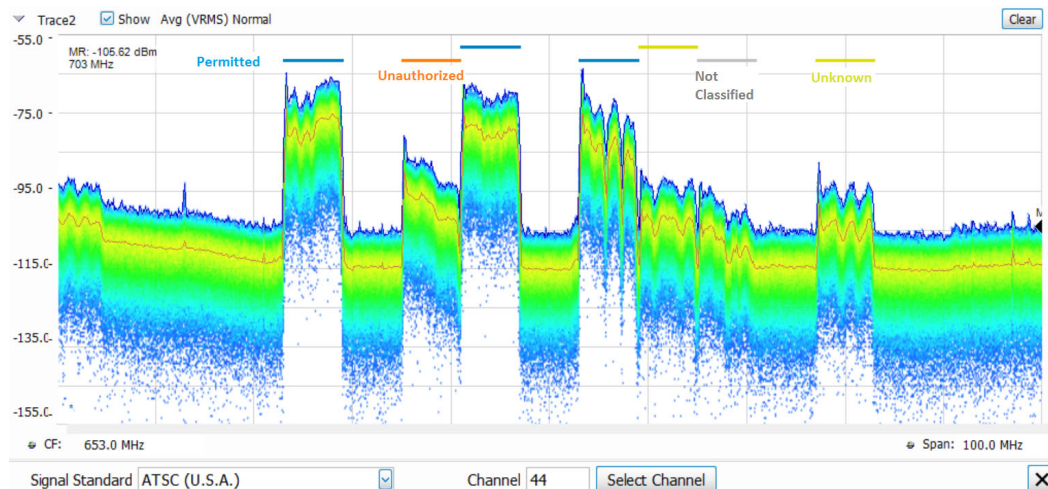
3. Select a Classification state from the drop-down list and enter a Description and Comments for the region.

**Classification state and region color coding.** Each region's outline is colored according to its classification state:

- Gray = None
- Yellow = Unknown
- Orange = Unauthorized
- Blue = Permitted

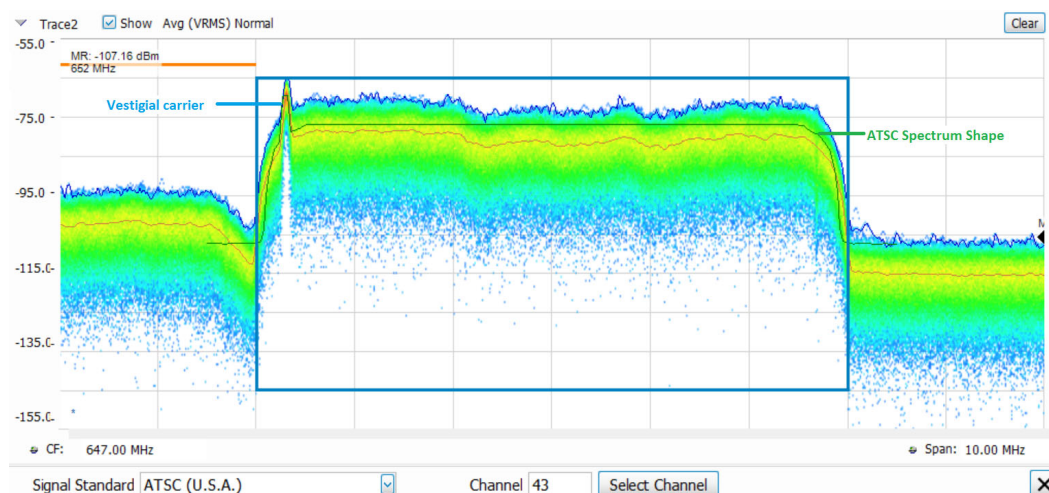
4. Click **OK** to save the classification information as a survey and close the window. Once a region has been classified, the signal type and signal standard used for classification are locked. To apply different signal types and standards to the region, set the classification to **None**.

The following example survey is of a portion of the TV broadcast band. Seven regions have been declared as either Permitted, Unknown, or Unauthorized, as indicated by the color bars for each region.





The illustration below shows a detailed portion of one of the declared regions. Since we have declared this to be an ATSC video signal, the spectral profile for the ATSC signal is shown overlaid in the region. The signal is a close match to the spectral profile, including the vestigial carrier at the lower side of the signal, characteristic of ATSC broadcasts.



### See also:

[How to use the Signal Survey Editor window](#)

[How to use the Signal Survey toolbar](#)

[How to use the Define Survey control panel.](#)

[How to use the Declare Region window](#)

[Signal Database](#)

### Export or import a survey file

The application does not enforce a hard limit on the total number of regions you can create. However, as the number of regions increase, system performance decreases. A good rule of thumb is to keep the total number of regions under 500. If more than that are required, create and save separate surveys, each with no more than 500 regions.

**Export a file.** To export a region or set of regions in a file, do the following:

1. Click the **Create/Edit...** button in the Signal Survey toolbar to open the Signal Survey Editor window.
2. Click the **Export As...** button in the Signal Survey Editor window.
3. Navigate to the location you want to save the file.



4. From the Save as type drop down list in the Save As window, select one of the following:
  - \*.Survey – survey in an internal format
  - \*.txt – survey in a tab separated format
  - \*.csv – survey in a comma separated format
5. Enter the file name and click **Save** to save the file.

#### Survey Import/Export file format notes.

- All lines starting with a "#" character are treated as a comment line.
- All blank lines are ignored.
- Lines starting with "Signal Classification: Number of Regions" are ignored (in order to be compatible with H500/SA2500 survey import/export files).
- The only required fields are the region center frequency and region bandwidth all other fields can be left blank.

**Survey file field definitions.** You can create your own .txt and .csv Survey files using software applications such as Excel or Notepad, and then import them. The following information will help you do this. You can also refer to the *SurveyImportFileExample.txt* sample import/export file installed with SignalVu-PC in the *C:\SignalVu-PC Files\Example Files\SignalClassification* directory.

- **#** - Region number. Note that the value specified is not used during import (regions are renumbered as necessary)
- **Freq (Hz)** - Center frequency of the region
- **Span (Hz)** - Bandwidth of the region
- **Description** - Short description of the region
- **Classification** - Declared region classification (None, Unknown, Permitted, or Unauthorized)
- **Type** - Declared region signal type ("Not Set", "Unknown" or any currently defined signal type name)
- **Standard** - Declared region signal standard ("Not Set", "Unknown" or any currently defined signal standard name)
- **Channel** - Declared region channel number (channel number from the specified signal standard; "----" can be used to denote no channel number specified)
- **Ch Freq (Hz)** - Declared region channel frequency (for the specified channel number; "----" can be used to denote no channel frequency specified)
- **Comments** - Declared region comments



**Import a file.** To import a region or survey file, do the following:

---

**NOTE.** *If a problem is found with the format of the file being imported, a dialog will be displayed indicating the file line number where the problem was found and a short description of the problem. For example, "Survey Import failed: Syntax Error near line 10: Invalid span value".*

---

2. Click the **Create/Edit...** button in the Signal Survey toolbar to open the Signal Survey Editor window.
3. Click the **Import...** button in the Signal Survey Editor window.
4. Navigate to the location of the saved file and select to import one of the following file types:
  - \*.Survey – survey in an internal format
  - \*.txt – survey in a tab separated format
  - \*.csv – survey in a comma separated format
5. Click **Open** to open the selected file.

**Importing guidelines.** If you try to import a survey when regions are already defined, an Import Regions dialog will appear and prompt you to select one of the following import options:

1. Delete all existing regions prior to import.
2. Attempt to merge the imported regions with the existing regions.
3. Cancel the import.

If an import and merge action does not successfully merge all regions, the "Warning: not all regions were successfully merged" message will be displayed in the informational area of the Signal Survey Editor dialog.

## Signal Survey toolbar

Select **View > Signal Survey Toolbar** to view the Signal Survey toolbar. It allows you to create, edit, define, and classify a signal. It also allows you to navigate from one region to another in the DPX or Spectrum display and to delete the selected region. This topic describes the toolbar and all of its related windows and functions.



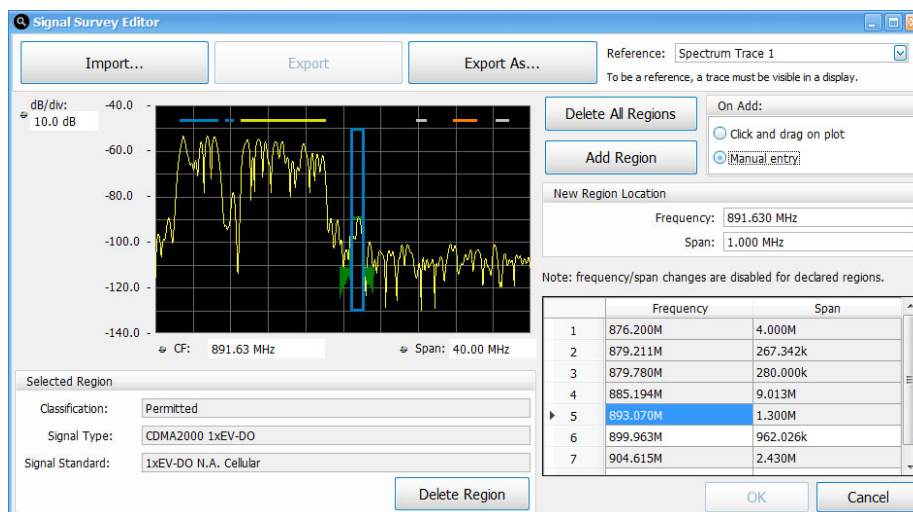
Item	Description
Create/Edit...	Opens the <a href="#">Signal Survey Editor window</a> that allows you to create and edit regions and import and export region survey files.
Define	Opens the <a href="#">Define Survey</a> control panel. This panel allows you to view a survey summary, select how to view spectral profiles, and to specify a signal type and signal standard channel for each region.
Classify	Opens the <a href="#">The Declare Region window (classify)</a> (see page 553) that allows you to classify a region.



Item	Description
Selected Region	Click the arrows to navigate from region to region.
Delete	Click to delete a selected region.

## The Signal Survey Editor

Click the **Create/Edit...** button on the Signal Survey toolbar to access the Signal Survey Editor window. Following is an image of the window and a table describing it.



**NOTE.** If you change which waveforms are enabled in the DPX or Spectrum display after the Signal Survey Editor window is open, the Reference list in the Editor will no longer be accurate. You must close and then reopen the Editor to refresh the list.

Item	Description
Import	Click this button to import a survey from a file.
Export	Click this button to save changes made to a previously saved survey file. This button is only available for previously saved surveys. This function is like the common Save function.
Export As...	Click this button to export all of the region information to a survey file. This function is like the common Save As function.
Reference	This drop down list shows all active traces from the currently displayed Spectrum and/or DPX measurement displays. When you first open the Editor, the displayed reference trace will be the trace in the currently selected Spectrum or DPX measurement display.
Delete All Regions	Click this button to delete all regions on the plot.
Add Region	Click the Add Region button to enable the plot to allow you to add a region by clicking and dragging or entering the values manually, depending on the selected On Add setting.
On Add:	Select to add a region manually or by clicking and dragging on the plot.



Item	Description
New Region Location	When Manual entry is selected in the On Add area, the New Region Location area appears. Here you can manually enter the Frequency and Span.
Status message area	Shows informational and error messages.
Region table	Shows regions and the related frequency and span. These are editable in the table for regions that have not yet been classified.
Measurement display	Interactive view of the active measurement plot (DPX or Spectrum). You can click and drag on the plot to create a region and left-click in the display area to select the current click/drag mode. Allowable modes are Select, Span Zoom, and CF Pan. You can also adjust the area of the signal within the region using the following:
dB/div	Shows the dB per division on the y-axis of the plot.
CF	Shows the current region center frequency. Click on the field to enter a new value.
Span	Shows the current region span. Click on the field to enter a new value.
Classification	Shows the classification label of the selected region: Unknown, Unauthorized, or Permitted. If it has not been classified, this field reads None.
Signal Type	Shows the signal type of the selected region, if the signal in the region has been classified. If it has not been classified, this field reads Not Set.
Signal Standard	Shows the signal standard of the selected region, if the signal in the region has been classified. If it has not been classified, this field reads Not Set.
Delete Region	Click this button to delete the selected region.

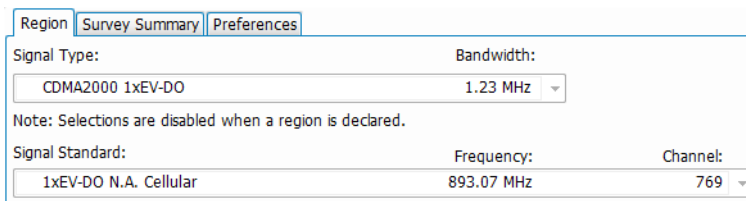
### See also:

The [Create a region \(see page 542\)](#) topic to see how the Signal Survey Editor works when creating/editing a region.

## The Define Survey control panel

Click the **Define** button on the Signal Survey toolbar to access the Define Survey control panel. The following images and tables describe the Define Survey control panel and its tabs.

### Region tab



Region | Survey Summary | Preferences

Signal Type: CDMA2000 1xEV-DO Bandwidth: 1.23 MHz

Note: Selections are disabled when a region is declared.

Signal Standard: 1xEV-DO N.A. Cellular Frequency: 893.07 MHz Channel: 769



Item	Description
Signal Type	For classified regions, this field is not editable. For unclassified regions, this field is a drop-down list of all enabled signal types (set in the Signal Database). The types that best match the signal are starred in this list. See <a href="#">here</a> for star rating definitions.
Bandwidth	Shows the bandwidth of the selected signal type.
Notification area	Notes may appear between the Signal Type and Signal Standard fields.
Signal Standard	For classified regions, this field is not editable. For unclassified regions, this field is a drop-down list of all enabled signal standards (set in the Signal Database) and standards for which channels are enabled. The standards and their channels that best match the center frequency of the region are starred in this list. See <a href="#">here</a> for star rating definitions.
Frequency	Shows the channel frequency of the selected signal standard.
Channel	Shows the channel number for the selected signal standard. .

### Criteria for signal standard and type star ratings.

Criteria		
Star	Signal standards	Signal types
★	The region center frequency matches the selected signal standard channel frequency and the selected signal standards database signal type matches that of the selected signal type.	The region bandwidth exactly matches the selected signal type bandwidth.
★	The region center frequency matches the selected signal standard channel frequency.	The region bandwidth is within $\pm 5\%$ of the selected signal type bandwidth and does not exceed the defined min/max matching bandwidth range of the selected signal type.
★	A large portion of the region start/stop frequency overlaps the selected signal standard channel frequency.	The region bandwidth is within the defined min/max matching bandwidth range of the selected signal type.
★	A small portion of the region start/stop frequency overlaps the selected signal standard channel frequency.	Not applicable.
No star	No portion of the region start/stop frequency overlaps the selected signal standard channel frequency.	The region bandwidth is outside the defined min/max matching bandwidth range of the selected signal type.

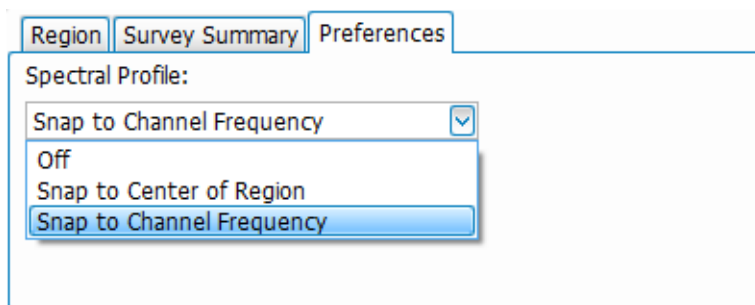
### Survey Summary tab

Region	Survey Summary	Preferences			
	Frequency	Span	Classification	Type	Standard
▶ 1	876.2 MHz	4.0 MHz	Permitted	WCDMA	WCDMA 850
2	879.210653 MHz	267.342 kHz	Permitted	GSM	GSM 850
3	879.78 MHz	280.0 kHz	Permitted	GSM	GSM 850
4	885.19443 MHz	9.012658 MHz	Unknown	Not Set	Not Set
5	893.07038 MHz	1.3 MHz	Permitted	CDMA2000 1xEV-DO	1xEV-DO N.A. Cellular



Item	Description
Summary table of all of the regions in the active plot	Each region is identified by a number.
	The center frequency of the region.
	The span of the region.
	The classification of the signal in the region.
	The signal type of the signal in the region, if it has been set. Otherwise, this field reads Not Set.
	The signal standard and channel of the signal in the signal in the region, if it has been set. Otherwise, this field reads Not Set.

### Preferences tab



Item	Description
Spectral Profile	<b>Off</b> turns the spectral profile off so that it does not appear on the plot. Use this option if you want to view the signal in the region without the spectral profile overlayed on the signal.
	<b>Snap to Center of Region</b> aligns the spectral profile to the center of the region. Use this option if you know that the frequency you are viewing has no defined signal standard channels in the database.
	<b>Snap to Channel Frequency</b> aligns the spectral profile with the specified signal standard channel frequency of the signal. Use this option if you want to check that the channel frequency of the spectral profile matches the signal frequency you are looking at. If the selected signal standard channel frequency is within the selected region, then the spectral profile will center on that channel frequency. If the channel frequency is outside of the selected region, then the spectral profile will snap to the center of the region.

### See also:

[Define a region using known standards.](#)

## The Declare Region window (classify)

Click the **Classify...** button on the Signal Survey toolbar to access the Declare Region window. Once a region is classified, you can no longer change the signal type or signal standard in the Region tab of the [Define Survey control panel](#). The following image and table describe the Declare Region window.



**Declare Region**

Classification: Permitted

Description: Probably permitted

Comments: Not 100% sure this GSM-850 channel 181

Signal  
Type: GSM  
Standard: GSM 850

Region  
Frequency: 879.78 MHz  
Span: 280.0 kHz

OK Cancel

Item	Description
Classification	Lists classification types to assign to the current region. Each classification has a unique color that is assigned to the region box: None: Gray Unknown: Yellow Unauthorized: Orange Permitted: Blue
Description	Enter a brief description to identify the region.
Comment/Notes	Enter additional comments to provide needed information regarding the region.
Signal	Lists the selected signal type and signal standard of the selected region.
Region	Lists the span and center frequency of the selected region.

---

**NOTE.** If a region is classified, you need to change the classification to "None" before you can make any changes to that region.

---



## 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 (.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 (.BMP, .PNG, .JPG)
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 (various)
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 (various)
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 (TIQ); 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-PC Files\User 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 Waveforms with SignalVu-PC

SignalVu-PC can recall waveform files saved by Tektronix oscilloscopes and spectrum analyzers. It can also read files saved in MATLAB Level 5 format. Waveform files can be recalled two ways: as Data and setup, and as Data only. When recalled as Data and setup, only the .tiq file format opens with all settings and measurements recalled. Because only the .tiq file is recalled with all settings and measurements, you should save any non-tiq file as a .tiq file once you have recalled the file with SignalVu-PC.

The following tables lists the supported file formats and includes notes about using the files.

**Table 10: RSA5000/RSA6000/SPECMON file formats supported by SignalVu-PC**

Generated by			RSA5000/RSA6000/SPECMON	
File type			.tiq	.mat
File description			Contains corrected I and Q time-domain data, all settings and measurement setup	Contains I and Q time-domain data, center frequency, sample rate
What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled	✓	
		Automatically Sets Span, Center Frequency		✓
	Open as data only	Uses settings from SignalVu-PC when opened	✓	✓
Notes			This is the native format for SignalVu-PC. It contains all information needed to open and analyze all displays available	Recommend saving as .tiq file after opening



**Table 11: RSA3000 and WCA200 file formats supported by SignalVu-PC**

<b>Generated by</b>		RSA3000, WCA200	
<b>File type</b>		.iq	.mat
<b>File description</b>		Contains I and Q time-domain data, center frequency, sample rate, amplitude and phase corrections	Contains I and Q time-domain data, center frequency, sample rate
<b>What SignalVu-PC can do with this format</b>	<b>Open with settings</b>	<b>All Settings and Measurements are Recalled</b>	
		<b>Automatically Sets Span, Center Frequency</b>	✓
	<b>Open as data only</b>	<b>Uses settings from SignalVu-PC when opened</b>	✓
<b>Notes</b>		Recommend saving as .tiq file after opening	Recommend saving as .tiq file after opening

**Table 12: WCA300 file formats supported by SignalVu-PC**

<b>Generated by</b>		WCA300	
<b>File type</b>		.iq	
<b>File description</b>		Contains I and Q time-domain data, center frequency, sample rate, amplitude and phase corrections	
<b>What SignalVu-PC can do with this format</b>	<b>Open with settings</b>	<b>All Settings and Measurements are Recalled</b>	
		<b>Automatically Sets Span, Center Frequency</b>	✓
	<b>Open as data only</b>	<b>Uses settings from SignalVu-PC when opened</b>	✓
<b>Notes</b>		Recommend saving as .tiq file after opening	

**Table 13: SignalVu on oscilloscopes file formats supported by SignalVu-PC**

<b>Generated by</b>		SignalVu on oscilloscopes	
<b>File type</b>		.tiq	.mat
<b>File description</b>		.tiq format as used by SignalVu, all versions, includes I and Q time domain data, all settings and measurement setup	Contains I and Q time-domain data, center frequency, sample rate



**Table 13: SignalVu on oscilloscopes file formats supported by SignalVu-PC (cont.)**

What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled	✓	
		Automatically Sets Span, Center Frequency		✓
	Open as data only	Uses settings from SignalVu-PC when opened	✓	✓
Notes			This is the native format for SignalVu-PC. It contains all information needed to open and analyze all displays available	Recommend saving as .tiq file after opening

**Table 14: Performance Oscilloscope (without SignalVu) file formats supported by SignalVu-PC**

Generated by		MSO/DPO/DSA5000/7000/70000		
File type		.wfm		
File description		Amplitude vs. Time, includes sample rate information		
What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled		
		Automatically Sets Span, Center Frequency		
	Open as data only	Uses settings from SignalVu-PC when opened	✓	
Notes			Prior to opening: Preset SignalVu-PC. Set span and center frequency. After opening, save as .tiq file. Reopen the .tiq file for further changes to the measurement settings and opening additional displays	

**Table 15: Bench Oscilloscope file formats supported by SignalVu-PC**

Generated by		MSO/DPO 2000, 3000, 4000		
File type		.isf		
File description		Amplitude vs. Time, includes sample rate information		



**Table 15: Bench Oscilloscope file formats supported by SignalVu-PC (cont.)**

What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled	
		Automatically Sets Span, Center Frequency	
	Open as data only	Uses settings from SignalVu-PC when opened	✓
<b>Notes</b>			Prior to opening: Preset SignalVu-PC. Set span and center frequency. After opening, save as .tiq file. Reopen the .tiq file for further changes to the measurement settings and opening additional displays

**Table 16: MDO4000 mixed domain oscilloscope file formats supported by SignalVu-PC**

<b>Generated by</b>		MDO4000, RF channel	
<b>File type</b>		.tiq	
<b>File description</b>		Contains I and Q time domain data. Opens with spectrum analyzer and time overview.	
What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled	
		Automatically Sets Span, Center Frequency	
	Open as data only	Uses settings from SignalVu-PC when opened	✓
<b>Notes</b>			Native format for SignalVu-PC. Opens with Time Overview and Spectrum Display active

**Table 17: RF Hawk file formats supported by SignalVu-PC**

<b>Generated by</b>		RF Hawk	
<b>File type</b>		.iqt	.mat
<b>File description</b>		Contains I and Q time-domain data, center frequency, sample rate	Contains I and Q time-domain data, center frequency, sample rate



Table 17: RF Hawk file formats supported by SignalVu-PC (cont.)

What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled		
		Automatically Sets Span, Center Frequency	✓	✓
	Open as data only	Uses settings from SignalVu-PC when opened	✓	✓
Notes			Recommend saving as .tiq file after opening	Recommend saving as .tiq file after opening

Table 18: User generated (including Agilent 89601 software) file formats supported by SignalVu-PC

Generated by		User generated (including Agilent 89601 software)		
File type		.mat		
File description		MATLAB Level 5 format, must contain at least InputCenter, InputZoom, Xdelta, and Y		
What SignalVu-PC can do with this format	Open with settings	All Settings and Measurements are Recalled		
		Automatically Sets Span, Center Frequency	✓	
	Open as data only	Uses settings from SignalVu-PC when opened	✓	
Notes			Recommend saving as .tiq file after opening	

To recall a acquisition data file, see [Recalling Files \(see page 556\)](#) above.

**Opening .iqt files saved by RSA3000 and WCA300 analyzers.** To open a .iqt file:

1. Select **File > Preset (Main)**.
2. Select **File> Recall** and select **Acq Data with Settings (IQT) (\*.iqt)** in the Open dialog. Select the desired file and click **OK** to open the file.
3. Save the file by selecting **File > Save As** and set the file type to **Acq data with setup (TIQ) (\*.tiq)**. Save the file by clicking OK.

Saving the file in .tiq format preserves all of the settings in the analyzer and associates them with the data set. After saving the file in .tiq format, recall the saved .tiq file and add measurements and change settings.

The .iqt file format contains I and Q waveforms plus instrument amplitude/phase correction data, analysis bandwidth and center frequency. When SignalVu-PC opens an .iqt file, the amplitude and phase



corrections are applied to the IQ data to produce a corrected data set. The span and center frequency information present in the .iqt file are used to set the SignalVu-PC span and center frequency. However, no information about analysis length, offset or type is preserved in the .iqt file.

**Opening .mat files saved by RSA5000/6000/SPECMON series and third party waveforms.** To open a .mat file from these instruments:

1. Select **File > Preset (Main)**.
2. Select **File> Recall** and select **Acq Data with Setup (MAT) (\*.mat)** in the Open dialog. Select the desired file and click **OK** to open the file
3. Save the file by selecting **File > Save As** and set the file type to **Acq data with setup (TIQ) (\*.tiq)** and click **OK**. Saving the file in .tiq format preserves all of the settings in the analyzer and associates them with the data set.
4. Recall the saved .tiq file and add measurements and change settings.

If you choose to save the file in .mat format, SignalVu-PC automatically adds all of the SignalVu-PC settings needed for your analysis into the stored .mat file.

**Opening files saved with oscilloscopes.** Oscilloscopes acquire and store data in an amplitude vs. time format that must be converted by SignalVu-PC into an IQ format for further processing. Sample-rate and amplitude information is available in these files, but no other information is available to SignalVu-PC.

To open files stored in either .ISF or .WFM format saved by Tektronix oscilloscopes, use the following procedure:

1. Preset SignalVu-PC. This resets the analysis so that only the spectrum analyzer display is present, with a center frequency of 250 MHz and a span of 200 MHz.
2. Set the Span of SignalVu-PC to  $0.2 \times \text{Sample Rate}$  of the acquisition.

How to determine the maximum available span for your .ISF or .WFM file: The maximum span is calculated to be  $0.4 \times \text{Sample Rate}$ . For example, a waveform sampled at 1 GSample/second will have a maximum span of  $0.4 \times (109) = 400$  MHz. This represents the Nyquist bandwidth of the sampling system plus an allowance for filter bandwidth. Note that this span may exceed the bandwidth of the oscilloscope used, and results at frequencies higher than the oscilloscope bandwidth will be attenuated.

When processing the waveform, SignalVu-PC automatically sets the bandwidth to twice the entered span to allow for increasing the span in later analysis. Set the span of the spectrum analyzer to  $\frac{1}{2}$  the calculated maximum span. In the case of the example of above, this is  $\frac{1}{2} \times 400$  MHz, or 200 MHz.

3. Set the center frequency to  $\frac{1}{2}$  of the span. This puts the analysis frequency within the first Nyquist zone to prevent aliasing of the signal.
4. Open the .ISF or .WFM file with the settings above.
5. Set the span to the calculated maximum (in the example above,  $0.4 \times \text{Sample Rate} = 400$  MHz) and reanalyze.
6. Save the results as a .TIQ file. This preserves all of the settings in the analyzer and associates them with the data set.



## 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. The setup is saved as part of the acquisition data file so you can choose when recalling data whether or not to also recall the associated acquisition and analysis parameters.

## 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-PC application window. They are useful for documenting results in test reports.



File type	File extension	Description
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-PC 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.
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.
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.
Recorded file	.r3f	These files contain acquisition data that was recorded directly to a file from an RSA306 spectrum analyzer.  These files can be played back using the Playback feature located in the Acquisition control panel.

### 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 - The acquisition bandwidth in Hertz.

The MATLAB format used to save acquisition data has the following properties and limitations:

- Files are stored in MATLAB Level 5 format.
- MATLAB Level 5 file size is limited to 2 GB.
- The instrument acquisition memory limit is 1 GB (1.024 Gigabytes). Because of the way acquisition data is processed, 1 GB of acquisition memory requires 2 GB of memory to store. When header information (instrument settings) is added to the acquisition data, the resulting file size is >2 GB.
- If acquisition memory is filled (1 GB), exporting the data to MATLAB format will result in a file that exceeds 2 GB in MATLAB level 5 format. A PC with sufficient memory is required to open the file. If memory is not sufficient, MATLAB will warn the user. To check how much acquisition memory is filled, select Setup > Acquire > Sampling Parameters. When the instrument is stopped, or you are analyzing a recalled data file, you can find the acquisition length under File > Acquisition Data Info.



## Printing Screen Shots

You can print screen 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 \(see page 562\)](#). For details on saving a picture to a file, see [Saving and Recalling Data, Settings, and Pictures \(see page 555\)](#).

To print a screen shot:

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.



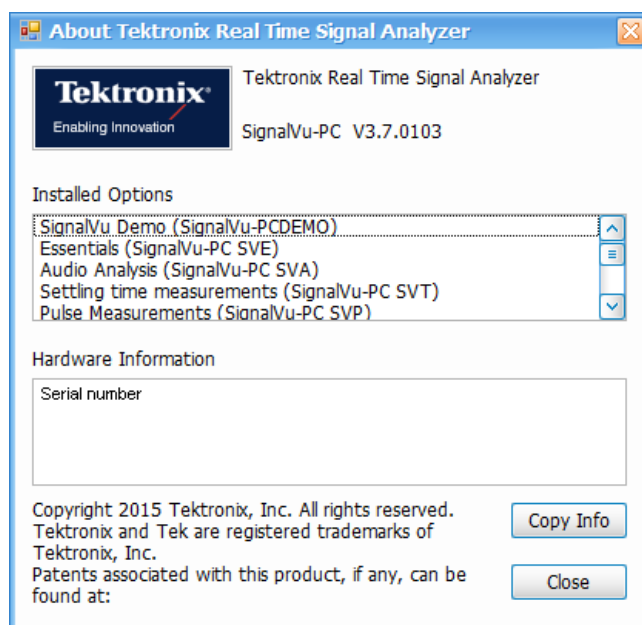
## Application Help

### Menu Bar: Help > User Manual

This menu item displays this Help. It is a standard Windows help system. The Help menu item is the only method available to display the help; there are no other links to the help within the software.

## About the Vector Signal Analysis Software

This window displays information about the SignalVu-PC software.



### Version

At the top of the window is a line that displays the version of the SignalVu-PC software.

### Installed Options

This text box lists the software options installed.

### Hardware Information

This text box lists the serial number of the software and information about connected instruments.



## Copy Info

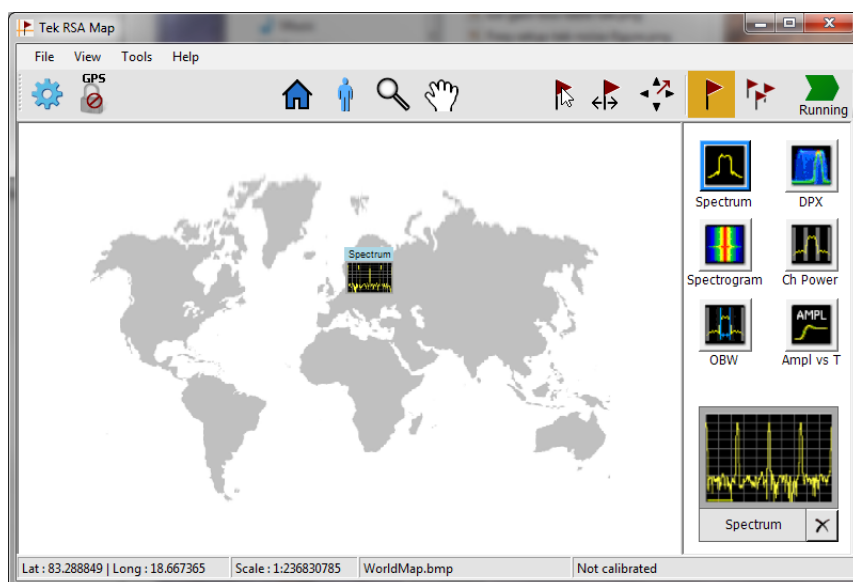
The Copy Info button copies the information to the Windows clipboard, which you can then paste into a document. This information may be useful if you need to contact Tektronix about the software.

## Mapping Measurements

The RSA Map software lets you record measurements on a geo-referenced map or a bitmap map for documentation purposes. If an external GPS receiver is connected to the analyzer, measurements can be mapped at the GPS coordinates where the measurement was taken. Using an external GPS receiver, RSA Map can perform repeat measurements using either time or distance to initiate measurements. RSA Map software can also save results for future reference or analysis.

To map measurements:

- Select Tools > RSA Map. This launches the RSAMap software in a separate window.


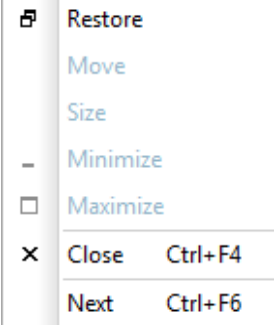



Full documentation on how to use RSA Map is provided in the RSA Map Help. In RSA Map, select **Help > User Manual**.

## Main menu overview

The main menus are:



Menu	Description
	<p>The display icon indicates which display is currently active in the application. Right click on this icon to view the following drop-down menu. These options allow you to control the individual measurement window view.</p> 
Favorites bar toggle 	This icon allows you to toggle to hide or show the <a href="#">Favorites bar</a> . The Favorites bar is located just below the Main Menu bar, is editable, and provides icons for quick and easy access to functions and menus.
<a href="#">File (see page 570)</a>	Select measurements, open and save files, print documents, and preset.
<a href="#">View (see page 574)</a>	Change display size, display the Marker toolbar and Status bar.
<a href="#">Run (see page 577)</a>	Start, stop and abort acquisitions, select single or continuous acquisition mode. Only available when connected to an RSA306 spectrum analyzer or an MSO4000B/C oscilloscopes.
<a href="#">Replay (see page 503)</a>	Replay measurements; select which record(s) to play, Replay/Stop/Pause, or enable continuous loop.
<a href="#">Markers (see page 578)</a>	Define markers and search for signal peaks.
<a href="#">Setup (see page 578)</a>	Change settings for acquisition, analysis, and measurements.
<a href="#">Presets (see page 21)</a>	Load and configure presets.
<a href="#">Tools (see page 579)</a>	Perform searches and configure user preferences.



Menu	Description
<a href="#">Connect (see page 580)</a>	Connect and disconnect from instruments.
<a href="#">Window (see page 581)</a>	Controls the size and layout of displays within the SignalVu-PC application.

## File Menu

Command	Description
<a href="#">Recall (see page 570)</a>	The Recall dialog enables you to recall saved data, setups and traces.
<a href="#">Save (see page 571)</a>	Saves a file without asking for a file parameters (based on most recent settings).
<a href="#">Save As (see page 571)</a>	Displays the Save dialog enabling you to specify the parameters of the save operation.
<a href="#">Save on trigger (see page 523)</a>	Displays the Actions tab of the Trigger control panel which allows you to configure the Save on Trigger function. This is only available when connected to an RSA306 or MDO4000B/C.
<a href="#">Acquisition save options (see page 30)</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.
<a href="#">Acquisition data info (see page 503)</a>	Displays the <a href="#">Acquisition Info tab (see page 503)</a> 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 573)</a>	Displays the characteristics of the most recently analyzed record in the display.
<a href="#">Print (see page 574)</a>	Prints the selected display.
<a href="#">Print Preview (see page 574)</a>	Displays a preview of the print output.
Exit	Closes the SignalVu-PC application.

## Recall

**Menu Bar:** File > Recall

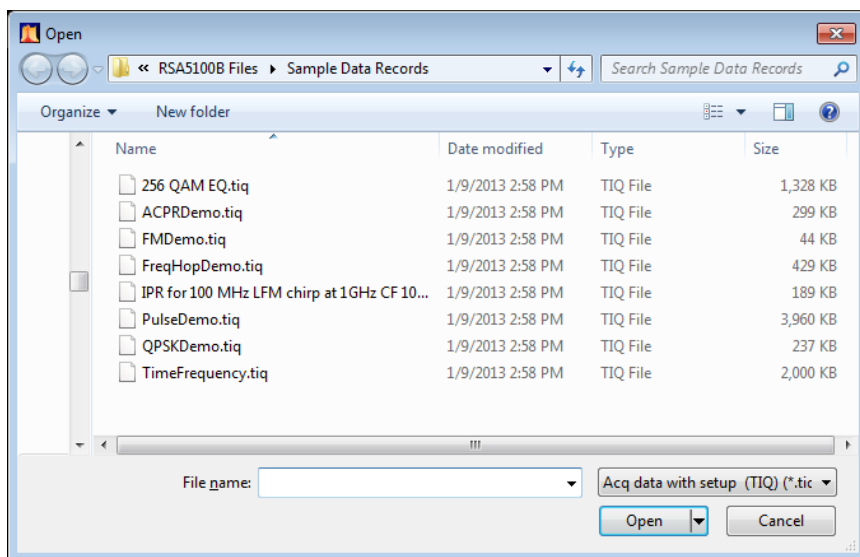
**Application Toolbar:** 

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](#) 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	Acquisition data previously recalled can be exported with different settings. Data is saved in a format readable only by SignalVu-PC, oscilloscopes running SignalVu software, or RSA6100/RSA5100/SPECMON Series instruments.
Setup	Configuration information detailing instrument settings. Data can be saved in a format readable only by SignalVu-PC, oscilloscopes running SignalVu software, or RSA6100/RSA5100/SPECMON Series instruments.
Selected Trace	Saves the selected trace for later analysis by the analyzer. Data is saved in a format readable only by SignalVu-PC, oscilloscopes running SignalVu software, or RSA6100/RSA5100/SPECMON Series instruments.
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 \(see page 562\).](#)

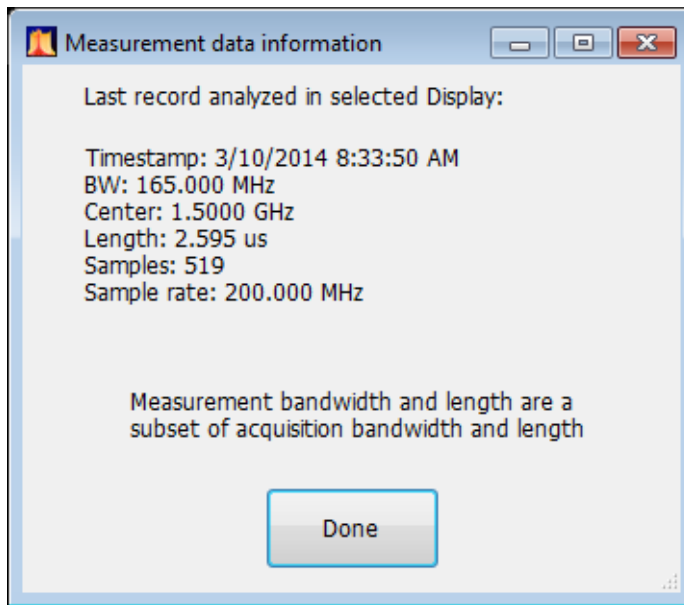
## Options for Saving Pictures of the Display

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.



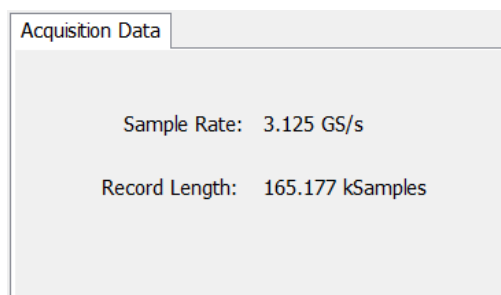
## Measurement Data Info

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.



## Acquisition Data

The Acquisition 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](#) .

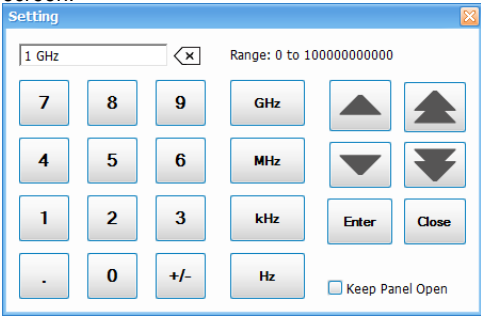
# Print Preview

## Menu Bar: File > Print Preview



Print Preview shows how a print out will appear when it is printed.

# View Menu

The View menu enables you to control the display of views and toolbars in the application window.

Command	Description
<a href="#">Full Screen (see page 575)</a>	Toggles all views between full-screen size and user-selected size.
<a href="#">Navigator View (see page 62)</a>	Selecting Navigator View adds the Time Overview display to the existing measurement displays to provide a better perspective of the signal.  When the Navigator View is enabled, the Time Overview display is always located above any other measurement displays and uses the maximum horizontal resolution of the display area, regardless of the Window Tile setting.
Numeric Keypad	When selected, any time you place the cursor within a control or setting that takes a numeric value, you are presented with a dialog box to easily enter a value.  For instance, placing the cursor in the Frequency setting, displays the following dialog screen. <div data-bbox="561 1352 1039 1665"></div>
	Use the arrow buttons to change the value.  Press the calculator icon to display a keypad that allows you to enter values and suffixes.
<a href="#">Chan Nav Toolbar (see page 538)</a>	Check to view the Channel Navigation toolbar. Uncheck to hide it. Detailed information about this toolbar is available in the Channel Navigation toolbar topic.



Command	Description
<a href="#">Signal Survey Toolbar (see page 549)</a>	Check to view the Signal Survey toolbar. Uncheck to hide it. Detailed information about this toolbar is available in the Signal Survey toolbar topic.
<a href="#">Map It Toolbar (see page 531)</a> (Only available with optional MAP application license.)	Check to view the Signal Survey toolbar. Uncheck to hide it. Detailed information about this toolbar is available in the How to use Map It topic.
<a href="#">Replay Toolbar (see page 505)</a>	Check to view the Replay toolbar. Uncheck to hide it.
Traces Toolbar	Check to view the Traces toolbar. Uncheck to hide it. This toolbar can also be accessed from the Basic Controls Toolbar. It allows quick access to the trace controls of the selected measurement display. This example is the Spectrum trace toolbar. 
<a href="#">Markers Toolbar (see page 484)</a>	Check to view the Markers toolbar. Uncheck to hide it. This toolbar can also be accessed from the Basic Controls Toolbar. It enables you to define Markers and perform Peak searches. Click the Define button on the toolbar to define markers. See the <a href="#">Define Markers menu</a> topic for detailed information.
Basic Controls Toobar	The Basic Controls toolbar is defaulted to on and is located just above the Status Bar. It allows quick access to controls and settings of the selected measurement display. This example is the Spectrum Basic Controls toolbar.  It contains the following: <ul style="list-style-type: none"> <li>■ Name of selected measurement window</li> <li>■ Frequency: The center frequency in the active display. To change the value, click the text and enter a value with a keyboard or the numeric keypad. For fine adjustments, you can use the mouse wheel.</li> <li>■ Reference: Reference level in the active display. To change the value, click the text and enter a value with a keyboard or the numeric keypad.</li> <li>■ Span: The span in the active display. To change the value, click the text and enter a value with a keyboard or the numeric keypad. For fine adjustments, you can use the mouse wheel.</li> <li>■ Res BW: The resolution bandwidth (RBW) in the active display. To change the value, click the text and enter a value with a keyboard or the numeric keypad. For fine adjustments, you can use the mouse wheel.</li> <li>■ Show or hide the Markers toolbar</li> <li>■ Show or hide the Traces toolbar</li> <li>■ Show or hide the Settings Control Panel</li> </ul>
<a href="#">Status Bar (see page 577)</a>	The Status bar is defaulted to on and is located at the bottom of the application window.

## Full Screen

**Menu Bar: View > Full Screen**



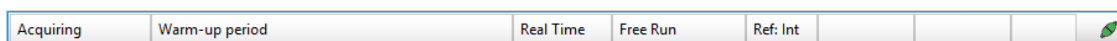
When unchecked, clicking **Full Screen** resizes the application window to fill the screen. Full Screen mode maximizes the application window, and turns off the application title bar.

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 not be hidden.



### Elements of the Status Bar

Area within Bar	Description
Run Status	Displays the running state. For example, some run states are Arm, Ready, Triggered, Analyzing, or Stopped.
Status message area	Displays status messages (for example, ADC Overrange). When there no status messages to report, displays current acquisition parameters (for example, Acq Length: 22.320 us).
Acquisition mode	Displays either Real Time or Swept. Indicates how the next acquisition will be acquired.
Trigger Settings	Displays Trigger settings. For example, you will see Free Run, Power, Trig In (front), Frequency Mask and others.
Frequency Reference Setting	Indicates whether the internal or external reference source is selected. Displays Ref: Int or Ref: Ext.
Connection status	 indicates a GNSS connection status (a green, yellow, or red icon indicates locked, unlocked, or COM error, respectively).  indicates the application is connected to an instrument;  indicates the application is not connected to an instrument.

### Run Status Indicators

Indicator	Description
Acquiring	SignalVu-PC is capturing the signal from a connected MDO4000B/C series oscilloscope or RSA306 spectrum analyzer.
Analyzing	SignalVu-PC is processing the signal record from a connected MDO4000B/C series oscilloscope or an RSA306 spectrum analyzer.
Replaying	SignalVu-PC is analyzing recalled waveform or acquisition records.
Stopped	If Stopped is displayed, no analysis being performed. This can occur because the Stop button has been pressed (when Replay is set to Loop) or because the software has just been launched and no analysis has been performed yet.

## Run Menu

(The Run menu is available only when connected to an RSA306 Spectrum Analyzer or an MDO4000B/C instrument.)



The Run menu provides access to commands that control the signal acquisition.

Command	Description
Run Single	Sets the acquisition mode to Single and runs one measurement/acquisition cycle. If acquisition mode is already Single, selecting Run Single begins a new measurement/acquisition cycle. If acquisition mode is Continuous, selecting Run Single halts the current measurement/acquisition cycle after it completes.
Run Continuous	Sets the acquisition mode to Continuous and starts the measurement/acquisition cycle. If acquisition mode is already Continuous, selecting Run Continuous toggles the measurement/acquisition cycle between Run and Stop.
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 512)</a>	Immediately halts the current measurement/acquisition cycle.

## Replay Menu

The [Replay Menu \(see page 503\)](#) allows you to run measurements using the data in a recalled acquisition data file. You can use this to compute new results for old data after you change settings or measurements.

## Markers Menu

The Markers menu provides to settings that define and control the location of markers.

Setting	Description
<a href="#">Peak (see page 482)</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 482)</a>	Displays the Define Marker control panel.

## Setup Menu

The Setup menu provides access to control panels that specify parameters for numerous signal analyzer functions.



Command	Description
<a href="#">Displays (see page 37)</a>	Displays the Displays control panel.
<a href="#">Settings (see page 590)</a>	Displays the Settings control panel for the selected display.
<a href="#">Trigger (see page 520)</a> (Available when connected to an RSA306)	Displays the Trigger control panel.
<a href="#">Acquire (see page 512)</a>	Displays the Acquire control panel.
<a href="#">Analysis (see page 495)</a>	Displays the Analysis control panel.
<a href="#">Amplitude (see page 507)</a>	Displays the Amplitude control panel.
<a href="#">Audio (see page 409)</a> (Available when connected to an RSA306)	Displays the Audio demodulation panel.

## Presets Menu

The Presets menu provides you access to instrument presets and preset options.

Command	Description
<a href="#">Main (see page 21)</a>	Resets the instrument to factory defaults. Acquisition data and settings that have not been saved will be lost.
DPX	Recalls the DPX presets.
<a href="#">Standards Presets</a>	Recalls the Standards presets.
<a href="#">Application (see page 25)</a>	Recalls the Application presets.
<a href="#">User (see page 23)</a>	Recalls the User presets.
<a href="#">Preset Options (see page 21)</a>	Displays a control panel where you can configure options for Presets.

## Tools Menu

Provides access to several utilities for controlling instrument functions.



Command	Description
<a href="#">Mask Test (see page 489)</a>	Enables you to locate and highlight specified signal levels in specified displays.
<a href="#">Licenses (see page 7)</a>	Used to activate SignalVu-PC optional application licenses (options).
Licenses > Legacy > Manage...	Used to activate a demo license or deactivate a license (used to move the license between PCs).
<a href="#">Options</a>	Displays the Options control panel.
<a href="#">Signal Database (see page 535)</a>	Allows you to select which signal standards and types are listed (and selectable) in the Channel Navigation toolbar and/or the Define Survey control panel.
RSAMap	Launches the optional MAP application.

## Connect menu

Connect allows you to connect your PC (with SignalVu-PC installed) to the following instruments:

- MDO4000B/C Series instruments using USB, wireless, or LAN (SignalVu-PC with option CON required)
- RSA306 using USB

By connecting to one of these instruments, you are able to view and analyze waveforms in real time using the SignalVu-PC software.

You can find instructions for connecting to an instrument [here \(see page 30\)](#).



## Elements of the Connect Menu

Menu item	Description
Search for instruments	<p>An RSA306 connected via USB is automatically recognized by the software and automatically establishes a connection, so you do not need to search for the instrument.</p> <p>When connecting to an MDO4000B/C series instrument, use this menu to activate TekVISA to search for MDO4000B/C instruments that are connected by USB or through a LAN network.</p> <p>This menu is disabled if a connection to an instrument has been established.</p>
Connect to instrument	<p>Select to view a list of currently connected instruments or to manually look for an instrument.</p> <p>This menu is disabled if a connection to an instrument has been established.</p>
Manually look for LAN instrument	(Available with option CON.) Select to open a dialog window that allows you to enter the IP address of an instrument to connect to.
Disconnect from instrument	Select to disconnect from the currently connected instrument. This is only available when you are connected to an instrument.

## Window Menu

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 windows in a horizontal orientation (top to bottom).
Tile Vertically	Positions windows 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.

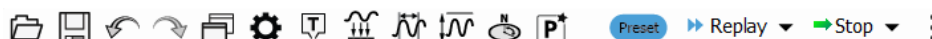
## Help Menu

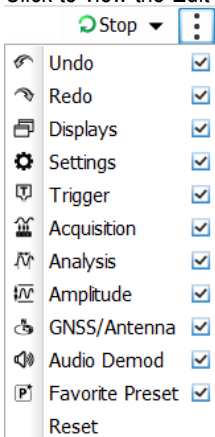
The Help menu provides access to the help and version information about SignalVu-PC.



Command	Description
User Manual On-line	Displays the help.
User Manual (PDF)	Displays a PDF version of the help.
Application Reference (PDF)	Displays a PDF version of the RSA Application Manual.
Quick Start Manual (PDF)	Displays a PDF version of the SignalVu-PC Quick Start User Manual.
About Tektronix Real Time Signal Analyzer Software	Displays information about the SignalVu-PC software and installed options.

## Favorites bar menus



Menu	Description
Icons	The icons on the Favorites bar are detailed in the <a href="#">Specific areas of the application window (see page 17)</a> topic.
Preset	Recalls the <a href="#">Main</a> preset.
<a href="#">Replay (see page 503)</a>	Replay measurements; select which record(s) to play, Replay/Stop/Pause, or enable continuous loop.
<a href="#">Run (see page 577)</a>	Start, stop and abort acquisitions, select single or continuous acquisition mode. Only available when connected to an RSA306 spectrum analyzer or an MSO4000B/C oscilloscope.
⋮	Click to view the Edit Favorites menu: 

## 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.

**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.

**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.

If this data is from a saved file, the error cannot be cleared.

If this data is from a saved file, this error cannot be cleared.

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.

**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.

**Frequency exceeds preamp range**

This is a warning that signals below the minimum preamp operating frequency are likely to be severely attenuated (this is 100 kHz for option 51, 1 MHz for option 50).

**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 \(see page 464\)](#) 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.

#### **Not enough samples – try increasing MeasBW**

The measurement was not able to run because there are not enough samples available for the measurement to analyze. The Settling Time measurement requires at least 256 samples. 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 \(see page 266\)](#)), 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 \(see page 495\)](#) 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 \(see page 266\)](#) 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 \(see page 266\)](#).
- The pulse interval is too long for the current settings. Try decreasing the [filter bandwidth \(see page 266\)](#), 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 \(see page 268\)](#) 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.

- Relaunch the SignalVu-PC application.

**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.



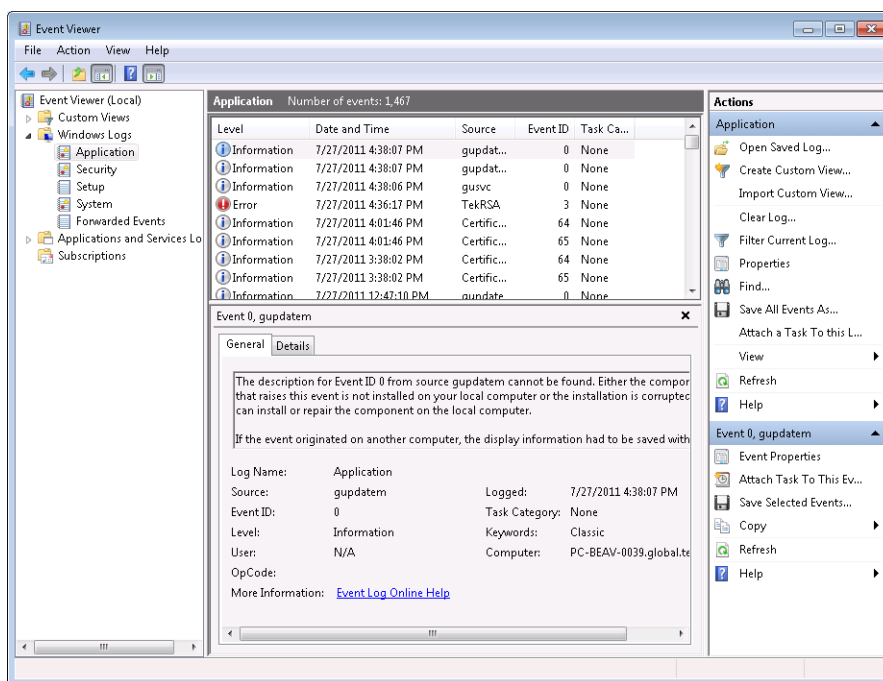
To clear this problem, set the Spectrum Length to Auto or manually increase the Spectrum Length (see Setup > Analysis > Spectrum Time tab). If Spectrum Length is coupled to Analysis Length, set Analysis Length to Auto or manually increase it (see Setup > Analysis > Analysis Time tab).

## 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 Panel.
2. Select Administrative Tools. (If your instrument displays control panels in Category View, select System and Security, and then select Administrative Tools.)
3. Double-click **Event Viewer**.
4. From the Event Viewer window, select **Windows Logs**, then 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 Software Upgrades are Available

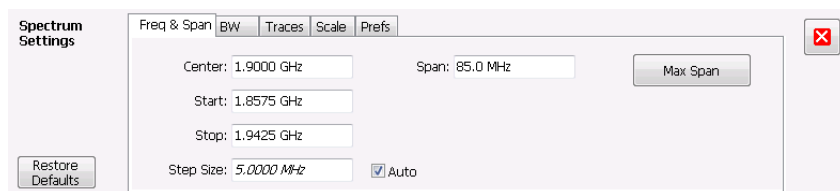
Software upgrades might be available can be downloaded from the Tektronix Web site. To see if a software upgrade is available for your product, use your browser to go to [www.tektronix.com/software](http://www.tektronix.com/software). Search by the product model number.

To add additional software options or features, you will need an option key from Tektronix. In some instances, you may need to upgrade the product software before adding the new option key. Follow the installation instructions provided with your software option.

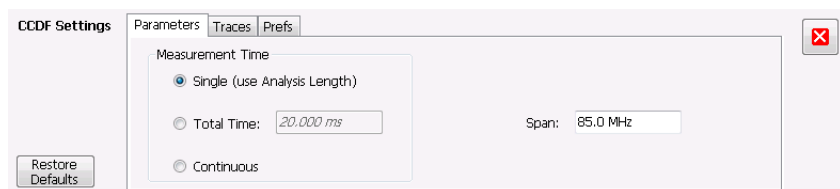
## Settings

### 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 \(see page 120\)](#)

[Acquire \(see page 512\)](#)

[AM Settings \(see page 94\)](#)

[Amplitude vs Time Settings \(see page 76\)](#)



[Analysis Settings \(see page 495\)](#)

[Audio Spectrum Settings \(see page 411\)](#)

[Audio Summary Settings \(see page 413\)](#)

[Bluetooth 20dB BW settings \(see page 392\)](#)

[Bluetooth CF Offset and Drift Settings \(see page 377\)](#)

[Bluetooth Constellation Settings \(see page 371\)](#)

[Bluetooth Eye Diagram Settings \(see page 374\)](#)

[Bluetooth Frequency Dev Vs Time Settings \(see page 390\)](#)

[Bluetooth Summary Settings \(see page 382\)](#)

[Bluetooth Symbol Table Settings \(see page 385\)](#)

[CCDF Settings \(see page 156\)](#)

[Channel Power and ACPR Settings \(see page 120\)](#)

[Constellation Settings \(see page 427\)](#)

[DPX Spectrum Settings \(see page 54\)](#)

[EVM vs Time Settings \(see page 431\)](#)

[Eye Diagram Settings \(see page 434\)](#)

[FM Settings \(see page 101\)](#)

[Frequency Deviation vs Time Settings \(see page 436\)](#)

[Frequency vs Time Settings \(see page 78\)](#)

[LTE ACLR Settings \(see page 334\)](#)

[LTE Channel Spectrum Settings \(see page 337\)](#)

[LTE Constellation Settings \(see page 339\)](#)

[LTE Power vs Time Settings \(see page 341\)](#)

[Magnitude Error Settings \(see page 438\)](#)

[MCPR Settings \(see page 134\)](#)

[Occupied Bandwidth Settings \(see page 143\)](#)

[OFDM Channel Response Settings \(OFDM \(see page 235\)\) \(WLAN \(see page 134\)\)](#)

[OFDM Constellation Settings \(see page 237\)](#)

[OFDM EVM Settings \(see page 238\)](#)

[OFDM Magnitude Error Settings \(see page 240\)](#)

[OFDM Phase Error Settings \(see page 244\)](#)



[OFDM Power Settings \(see page 246\)](#)

[OFDM Summary Settings \(see page 248\)](#)

[OFDM Symbol Table Settings \(see page 250\)](#)

[Phase Error vs Time Settings \(see page 440\)](#)

[Phase vs Time Settings \(see page 80\)](#)

[PM Settings \(see page 109\)](#)

[Pulse Statistics Settings \(see page 265\)](#)

[Pulse Table Settings \(see page 260\)](#)

[Pulse Trace Settings \(see page 263\)](#)

[RF I Q vs Time Settings \(see page 82\)](#)

[Mask Test Limits Settings \(see page 489\)](#)

[Settling Time Settings \(see page 170\)](#)

[Signal Quality Settings \(see page 446\)](#)

[Spectrogram Settings \(see page 71\)](#)

[Spectrum Settings \(see page 67\)](#)

[Symbol Table Settings \(see page 448\)](#)

[Time Overview Settings \(see page 60\)](#)

[Trellis Diagram Settings \(see page 451\)](#)



## 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.

When *Best for multiple windows* is selected in the Amplitude control panel's RF & IF Optimization control, none of the measurement displays shows a checkmark, as there is not a single optimized measurement.

## 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 \(see page 606\)](#).

## 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.



## Detection

The process by which a long waveform is decimated (reduced) down to the desired number of trace points, by dividing the waveform into intervals and choosing a single value to represent each interval in the trace.

## 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 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.

## Frequency Settling Time

The time measured from a reference point to when the signal of interest settles to within user-defined tolerance.

## 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).

## Phase Settling Time

The time measured from a reference point to when the signal of interest settles to within user-defined tolerance.



## 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 Signal 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.)

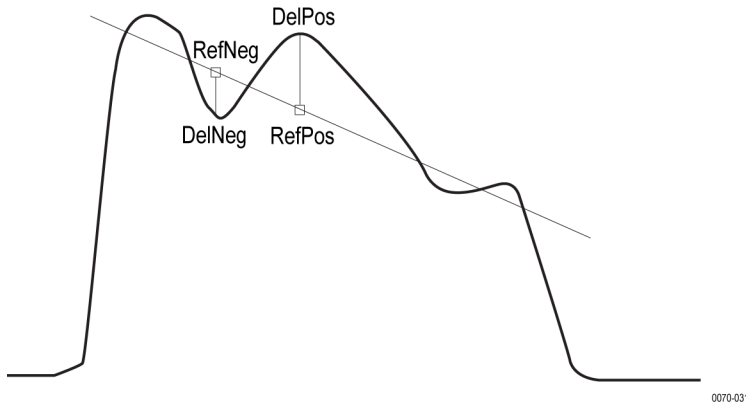
## RBW

The RBW determines how well the analyzer can resolve or separate two or more closely spaced signal components.

## Ripple

The Ripple measurement result is displayed in either Watts or Volts. The amplitude units selected on the Setup > Analysis > Units tab determine whether the measurement is presented in Watts or Volts. Volts are shown for linear units (for example, volts or amps); Watts are shown for non-linear units (for example, watts or dBm).





The Ripple measurement, in Watts, is calculated as follows:

$$\%Ripple (Watts) = 100 \times (RatioPos + RatioNeg)$$

Where:

$$RatioNeg = \left( \left( \left( \frac{DelNeg}{RefNeg} \right) + 1 \right)^2 \right) - 1$$

$$RatioPos = \left( \left( \left( \frac{DelPos}{RefPos} \right) + 1 \right)^2 \right) - 1$$

- DelPos = Delta Positive in Volts
- RefPos = Reference Positive in Volts
- DelNeg = Delta Negative in Volts (this is a positive value)
- RefNeg = Reference Negative in Volts

The Ripple measurement, in Volts, is calculated as follows:

$$\%Ripple (Volts) = 100 \times (RatioPosV + RatioNegV)$$

Where:

- RatioPosV = DelPos/RefPos
- RatioNegV = DelNeg/RefNeg

## 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 \(see page 596\)](#)).

## 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 help, the signal refers to the input signal before it is processed. The signal is an input.

## Signal Strength

Signal Strength locates the direction of a signal using a directional antenna and an audio tone and a visual display.

## 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 others 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 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, 88
- 20 dB bandwidth
  - Bluetooth, 46
- 20dB Bandwidth display
  - Bluetooth, 390
- 3-D Spectrogram display, 68
- 3-D Waterfall
  - Spectrogram/DPXogram, 73
  - Spectrogram/DPXogram display, 57

## A

- Abort acquisition, 512
- About the Software, 567
- Abs
  - Ranges and Limits table, 153
- Abs & Rel
  - Ranges and Limits table, 153
- Abs OR Rel
  - Ranges and Limits table, 153
- Abs Same
  - Ranges and Limits table, 153
- Abs Start (dBm)
  - Ranges and Limits table, 153
- Abs Stop (dBm)
  - Ranges and Limits table, 153
- accuracy, 593
- ACLR, 593
  - LTE, 46
- ACLR measurement, 120
- ACPR measurement, 593
- Acq Data
  - Replay menu, 503
- Acq Data/DPX Spectra, 501
- Acquire control panel, 512
  - Playback, 517
  - Record, 515
- acquisition, 593
- acquisition data
  - saving, 555
- Acquisition data files, 30

- Acquisition Data tab, 513
- Acquisition Info tab, 502
- Acquisition memory usage, 514
- Actions tab
  - Search, 494
  - Triggering, 523
- Activate
  - option key, 7
  - optional legacy application licenses, 7
- adaptive equalizer, 458
- Adjacent Channel Power measurement, 120
- Adjacent Channel Power Ratio, 39
- Advanced Params tab
  - OFDM Analysis displays, 252
- Advanced Params Tab
  - GP Digital Modulation displays, 460
- Advanced tab
  - Triggering, 522
- +AM, 44
  - AM display, 44
- AM
  - AM display, 44
- AM display, 93
- AM measurements, 44
- Ampl Scale tab
  - DPXOgram display, 57
- Amplitude control panel, 507
- Amplitude vs. Time display, 75
- Amplitude vs. Time display
  - Settings, 76
- Analysis control panel, 495
- analysis length, 593
- Analysis Params tab
  - Bluetooth, 398
  - LTE, 355
  - P25 Analysis displays, 311
  - WLAN Analysis displays, 224
- analysis time, 593
- Analysis Time tab
  - Bluetooth, 399
  - GP Digital Modulation displays, 464
  - LTE, 356
  - OFDM Analysis displays, 253
  - Options control panel, 29
  - P25 Analysis displays, 311
  - WLAN Analysis displays, 227
- Analysis Time tab (Analysis control panel), 495
- Antenna, 527
  - control panel, 527
  - how to set up, 528
  - settings, 527
- APCO P25 measurements, 45
- Application
  - moving a license, 6
- Application Help, 567
- Application preset
  - modulation analysis, 25
  - pulse analysis, 26
  - spectrum analysis, 27
  - Time-Frequency analysis, 27
- application presets
  - saving, 555
- Application presets, 21
- Applications
  - how to purchase, 3
  - install, 4
  - list of available options, 10
  - uninstall, 5
- Apply ampl corrections, 269
- APSK parameters, 462
- arranging windows, 581
- ASK, 594
- Audio BW, 415
  - setting, 415
- Audio Demod tab, 409
- audio filters
  - custom, 419



- Audio Filters tab
  - Audio Analysis displays, 417
- Audio Freq
  - Audio Summary display, 412
- Audio Spectrum display, 410
- Audio Spectrum settings, 411
- Audio Summary settings, 413
- Auto
  - Ranges and Limits table, 153
- Auto trigger position, 522
- automatically generate
  - filenames, 29
- Automatically increment
  - filename/number, 30
- Average Channel Power
  - measurement, 120
- Average ON Power, 46
- Average Transmitted Power, 47
- Averaging
  - Audio Analysis displays, 417
  - Params2 tab, 417

## B

- Base software, 3
- Basic Controls Toolbar, 575
- black text
  - settling time
    - measurements, 165
- Blackman-Harris 4B Filter Shape
  - Spectrum display BW tab, 88
- Blizzard color scheme, 30
- block, 594
- Blue background (cells), 144
- Bluetooth
  - Analysis Params tab, 398
  - Analysis Time tab, 399
  - BT 20dB Bandwidth
    - display, 390
  - BT InBand Emission, 393
  - Freq & RBW tab, 407
  - Frequency Dev vs Time (BT)
    - display, 386
  - Limits tab, 400
  - Measurement Params
    - tab, 408
  - Parameters tab, 405
  - Power class, 397
  - Prefs tab, 404

- Scale tab, 401
- Trace tab, 402
- Bluetooth measurements, 45
- BT 20dB BW Settings, 392
- BT CF Offset and Drift
  - display, 375
  - settings, 339
- BT Constellation
  - display, 369
  - settings, 371
- BT Eye Diagram
  - display, 372
  - settings, 374
- BT limits, 377
- BT Summary
  - display, 377
  - settings, 382
- BT Symbol Table
  - display, 382
  - settings, 385
- Burst detect threshold, 110
- BW (Hz)
  - Ranges and Limits table, 153
- BW Tab
  - Amplitude vs. Time
    - display, 77
  - DPXOgram display, 88
  - Spectrum display, 88

## C

- C4FM modulation type
  - measurements, 44
- C4FM signal quality
  - measurements, 446
- calibrator, 594
- Carr Freq Err
  - Audio Summary display, 412
- carrier, 594
- carrier frequency, 594
- Carrier frequency detection, 103
- Carrier Frequency Error, 44
- Carrier frequency offset and drift
  - Bluetooth, 45
- Carrier Power
  - Audio Summary display, 412
- carrier signal, 594
- carrier-to-noise ratio (C/N), 594
- CCDF, 39
- CCDF - Complimentary
  - Cumulative Distribution
    - Function, 595
- CCDF display, 155
- CDMA, 595
- Cell ID detection
  - LTE, 46
- center frequency, 595
- Channel direction, 539
- Channel Navigation toolbar, 538
- Channel Power, 39
  - LTE, 46
- Channel Power and ACPR
  - (Adjacent Channel Power
    - Ratio) display, 117
- Channel Power and ACPR
  - Settings control panel, 120
- Channel Power measure-
  - ment, 120
- Channel Response
  - OFDM, 40
  - WLAN, 41
- Channels
  - how to enable, 539
  - in signal database, 537
  - tune to, 538
- Channels tab
  - Channel Power & ACPR
    - display, 121
  - LTE Analysis displays, 342
  - Signal Strength display, 128
- Channels tab (MCPR), 138
- check mark indicator, 595
- Check mark indicator, 17
- CISPR, 595
- CISPR Filter shape
  - Spectrum display BW tab, 88
- Classic color scheme, 30
- Classify a signal, 553
- Color (DPXogram)
  - DPXogram display, 57
- Connect, 580
- Connect to instruments
  - LAN, USB, 580
- Connect to MDO
  - Connect, 580
- Connect to RSA306
  - Connect, 580



- Connection
  - to an MDO4000B/C, 31
  - to an RSA306, 31
- Connectivity, 30
  - Connect, 580
- Constellation
  - OFDM, 40
  - WLAN, 41
- Constellation display, 426
  - displaying a second trace, 467
- Constellation display
  - settings, 427
- Convergence
  - Equalizer tab, 459
- correction tables, 507
- Create a region (Signal Classification), 542
- Creating presets, 21
- CW, 595
- CW signal, 596

## D

- DANL, 596
- Data file formats, 562
- Data properties
  - File menu, 573
- Data Range tab
  - OFDM Analysis
    - displays, 253
  - WLAN Analysis
    - displays, 226
- Database
  - how to select channels, 537
  - how to set up signal
    - types, 536
  - how to set up standards, 535
  - of signal standards, 535
- dBfs, 596
- dBm, 596
- dBmV, 596
- dBuV, 596
- De-emphasis
  - Audio Filters tab, 419
- deactivating options, 10
- decibel, 596
- Declare a signal, 553
- Default
  - BT limits table, 377
  - P25 limits table, 298
- default settings, restore, 21
- Define a region (Signal Classification), 542
- Define Markers, 482
- Define Peaks tab, 483
- Define tab, 489
  - Pulsed RF displays, 268
  - Settling Time displays, 171
- Delta Frequency, 48
- Delta Markers, 482
- Demod I&Q vs Time display
  - settings, 430
- Demodulation
  - audio, 409
- detect
  - AM display, 97
  - FM display, 104
  - General Signal Viewing
    - displays, 85
  - Time Overview, 63
- Detect
  - PM display, 112
- detection, 597
  - AM display, 97
  - FM display, 104
  - General Signal Viewing
    - displays, 85
  - Time Overview, 63
- Detection
  - DPX display, 55
  - PM display, 112
- detector
  - AM display, 97
  - FM display, 104
  - General Signal Viewing
    - displays, 85
  - Time Overview, 63
- Detector
  - PM display, 112
  - Ranges and Limits table, 153
- Deviation, 44
- Diff
  - Audio Summary display, 413
- Digital Phosphor Spectrum, 49
- Disconnect from instruments
  - Connect, 580
- display reference level, 597
- Displays
  - arranging, 37
  - BT CF Offset and Drift, 375
  - BT Constellation, 369
  - BT Eye Diagram, 372
  - BT Summary, 377
  - BT Symbol Table, 382
  - Frequency Settling Time, 162
  - interactions between, 37
  - LTE ACLR, 332
  - LTE Channel Spectrum, 335
  - LTE Constellation, 339
  - OFDM Channel
    - Response, 233
  - OFDM Constellation, 236
  - OFDM EVM, 237
  - OFDM Mag Error, 241
  - OFDM Phase Error, 244
  - OFDM Power, 245
  - OFDM Spectral Flatness, 239
  - OFDM Summary, 247
  - OFDM Symbol Table, 249
  - P25 Constellation, 291
  - P25 Eye Diagram, 293
  - P25 Power, 296
  - P25 Summary, 298
  - P25 Symbol Table, 301
  - Phase Settling Time, 162
  - selecting, 37
  - SEM (Spectrum Emission Mask), 178
  - WLAN Channel
    - Response, 199
  - WLAN Constellation, 202
  - WLAN EVM, 204
  - WLAN Mag Error, 206
  - WLAN Phase Error, 208
  - WLAN Power, 210
  - WLAN Spectral Flatness, 213
  - WLAN Summary, 215
  - WLAN Symbol Table, 220
- distortion, 597
- Documentation, 12
- Done
  - Ranges and Limits table, 153
- Downlink, 539
- DPX display
  - DPXogram, 49



- Frequency, 49
- Phase, 49
- Spectrum, 49
- Zero Span, 49
- DPX Spectra
  - Replay menu, 503
- DPX Spectra/Acq Data, 501
- DPX Spectrum settings, 54
- DPXogram
  - DPX display, 49
- Droop, 47
- Droop dB, 47
- Duty Factor (%) measurement, 47
- Duty Factor (Ratio)
  - measurement, 47
- dynamic range, 597

**E**

- Elements of the display, 17
- Enable EQ Export
  - Equalizer tab, 459
- Enable Equalization
  - Equalizer tab, 459
- Equalizer tab
  - GP Digital Modulation displays, 458
- error message
  - Windows Event Viewer, 589
- Error messages, 582
- Evaluation mode
  - for options, 9
- Event tab (Triggering), 521
- Event Viewer, 589
- EVM, 219
  - OFDM, 40
  - WLAN, 41
- EVM tab
  - WLAN Analysis displays, 231
- EVM vs. Time display, 430
- EVM vs. Time Settings, 431
- Excrrsn (dB)
  - Ranges and Limits table, 153
- Expand
  - Ranges and Limits Tab, 152
- export, 597
- External Gain value, 507

- External Gain/Loss Correction
  - tab, 507
- External Loss Tables, 507
- Eye Diagram display settings, 434

**F**

- Fall Time, 47
- FastFrame, 597
- FFT, 598
- File formats, 562
- file formats supported
  - waveform, 556
- File Menu, 570
- File types, 562
- filter, 598
- Filter Parameter
  - GP Digital Modulation displays, 453
- Filter Shape
  - Ranges and Limits table, 153
  - Spectrum display BW tab, 88
- Find tab
  - GP Digital Modulation displays, 464
- finding bursts in data
  - GP Digital Modulation displays, 464
- Flatness
  - OFDM, 40
  - WLAN, 41
- FlatTop (CW ampl) Filter Shape
  - Spectrum display BW tab, 88
- FM, 598
- FM display, 99
- FM measurements, 44
- Formatted data structure, 515
- frame, 598
- Free trial
  - for options, 9
- Freq & BW tab
  - RF I & Q vs Time display, 83
- Freq & BW Tab
  - GP Digital Modulation displays, 457
- Freq & RBW tab
  - Bluetooth, 407

- Freq & Span tab
  - General Signal Viewing displays, 84
- Freq and RBW tab
  - LTE, 353
- Freq Deviation, 48
- Freq Diff, Phase Diff setting, 270
- Freq Error, 44
- Freq Estimation tab
  - Pulsed RF displays, 273
- Freq, Span & RBW tab
  - Channel Power & ACPR display, MCPR display, 136
  - RF Measurements displays, 191
  - Signal Strength display, 126
- Freq-domain Linearity
  - setting, 268
- frequency, 598
- Frequency
  - DPX display, 49
- frequency band, 598
- Frequency Dev vs Time (BT)
  - display
    - Bluetooth, 386
- Frequency Dev vs Time (P25)
  - display, 304
- Frequency Dev vs. Time (BT)
  - Settings, 390
- Frequency Dev vs. Time (P25)
  - Settings, 306
- Frequency deviation
  - P25, 45
- Frequency Deviation vs. Time
  - settings, 436
- frequency domain view, 598
- frequency drift, 599
- Frequency Error, 444
  - GP Digital Modulation displays, 457
- Frequency Offset
  - GP Digital Modulation displays, 457
- frequency range, 599
- Frequency range
  - Bluetooth, 46
- Frequency Reference, 515



frequency settling time, 599  
     measuring, 167  
 Frequency Settling Time  
     display, 162  
 Frequency Settling Time  
     settings, 170  
 frequency span, 599  
 Frequency tab, 497  
 Frequency vs. Time display, 77  
 Frequency vs. Time Settings, 78  
 Full Screen, 575

## G

Gain Imbalance, 42  
 GNSS, 525  
     control panel, 525  
     how to set up, 526  
     Simulation, 526  
 GPIB, 599  
 graticule, 599  
 Graticule On/Off  
     RF Measurements  
         displays, 196  
     Signal Strength display, 130  
 grayed out, 599

## H

Hanning Filter Shape  
     Spectrum display BW tab, 88  
 HCPM transmitter logical channel  
     time alignment  
         P25, 45  
 Help Menu, 581  
 Hide sensitive readouts, 29  
 Hide Sensitive readouts, 29  
 Histogram readout  
     Pulsed RF displays, 276  
 HPF  
     Audio Filters tab, 418  
 Hum & Noise  
     Audio Summary display, 422

## I

I/Q, 600  
 IF, 600  
 Ignore Region  
     Params2 tab, 417

import, 600  
 Impulse Response Amplitude, 48  
 Impulse Response setting, 269  
 Impulse Response Time, 48  
 In-band emission / ACPR  
     Bluetooth, 46  
 InBand Emission  
     Bluetooth, 393  
 Information messages, 582  
 input impedance, 600  
 Internal attenuator (Internal  
     Settings tab), 507  
 IQ Origin Offset, 42  
 IQ Sampling Parameters tab, 514  
 IQ vs. time view, 81  
 is greater than (Test), 490  
 is greater than mask, 489  
 is inside mask, 489  
 is inside mask (Test), 491  
 is less than (Test), 490  
 is less than mask, 489  
 is outside mask, 489  
 is outside mask (Test), 491

## K

Kaiser (RBW) Filter Shape  
     Spectrum display BW tab, 88  
 Keep-out time, 269  
 Keypad, 574

## L

LAN connection  
     Connect, 580  
 Length, 44  
     Equalizer tab, 459  
 Levels tab  
     Pulsed RF displays, 273  
 license  
     deactivating, 10  
 License  
     activating legacy, 7  
     install, 4  
     moving an application, 6  
     return, 5  
     trial, 4  
     uninstall, 5  
 Licensed software, 3

Licenses, 3  
     available application  
         options, 10  
     how to view, 4  
 Limit lines, 489  
 Limits  
     BT default, 377  
     P25 default, 298  
     Spurious display, 154  
 Limits tab  
     Bluetooth, 400  
     P25 Analysis displays, 318  
 Link to Span, 83  
 LISN, 600  
 Load  
     Ranges and Limits Tab, 152  
     Ranges and Limits table, 153  
 local oscillator (LO), 600  
 Lock Center Frequency of  
     Spectrum displays, 497  
 Lock Center Frequency of  
     Spectrum displays to  
     Measurement Frequency  
     Frequency tab, 498  
 Log  
     Audio Spectrum display, 421  
 Log (Horizontal)  
     Spectrum display, 68  
 Loop over all selected records  
     Replay menu, 503  
 LPF  
     Audio Filters tab, 418  
 LTE  
     Analysis Params tab, 355  
     Analysis Time tab, 356  
     Channels tab, 342  
     Freq and RBW tab, 353  
     Measurement Params  
         tab, 354  
     Modulation Params tab, 355  
     Offsets and Limits Table  
         tab, 347  
     Parameters tab, 344  
     Prefs tab, 350  
     Processing tab, 346  
     Scale tab, 348  
     Trace tab, 357  
     VBW (Channels tab), 343



- VBW (Freq & RBW tab), 353
- LTE ACLR
  - display, 332
  - settings, 335
- LTE Channel Spectrum
  - display, 335
  - settings, 337
- LTE Constellation
  - display, 337
- LTE measurements, 46

## M

- Mag Error, 445
  - OFDM, 40
  - WLAN, 41
- Magnitude Error vs. Time
  - display, 437
- Magnitude Error vs. Time
  - settings, 438
- Main
  - presets, 21
- Manuals, 12
- Map It, 525
  - how to use, 531
  - toolbar, 531
- marker, 601
- Marker Noise mode, 485
- Marker Properties tab, 482
- Marker to Center Frequency, 482
- Markers, 484
  - in the BT Symbol Table, 385
  - Marker Toolbar, 484
  - Using Markers, 479
  - Using Markers in Noise
    - Mode, 485
- Markers menu, 578
- Markers Toolbar, 575
- Mask
  - Ranges and Limits table, 153
- Mask Editor, 489
- Mask tab
  - Settling Time displays, 174
- Mask Test, 489
  - is greater than mask, 489
  - is inside mask, 489
  - is less than mask, 489
  - is outside mask, 489
- mask testing
  - settling time
    - measurement, 158
- MATLAB file format, 562
- Max Freq Error, 47
- max hold, 601
- Max number of pulses
  - Pulse Table display, 266
- Max Number of Pulses
  - Params tab, 267
- Max Phase Error, 48
- Max total files saved per Run, 523
- Max trace points, 77
  - Settling Time displays, 178
- MCPR (multiple carrier power ratio), 601
- MCPR display, 130
- MCPR settings, 134
- Meas BW
  - Frequency Settling Time, 171
- Meas Frequency
  - Frequency Settling Time, 171
- Measurement BW, no filter, 83
- Measurement Filter
  - GP Digital Modulation
    - displays, 453
  - Params tab, 267
- Measurement Frequency, 497
  - Frequency tab, 498
- Measurement Length
  - Time Params tab, 173
- Measurement Params tab
  - Bluetooth, 408
  - Channel Power & ACPR
    - display, MCPR
    - display, 136
  - LTE, 354
  - Signal Strength display, 127
- Measurement point, 270
- Measurement settings export, 555
- Measurements, 39
  - APCO P25, 45
  - Bluetooth, 45
  - LTE, 46
- Measurements tab, 261
- measuring settling time, 167
- Menus, 568
- MER (RMS), 42
- min hold, 601
- Min Settled Duration
  - Time Params tab, 173
- Mod Distor
  - Audio Summary display, 413
- Mode
  - Equalizer tab, 459
- modulate, 601
- modulating signal, 601
- modulation, 602
- Modulation analysis
  - application presets, 25
- Modulation characteristics
  - Bluetooth, 45
- Modulation fidelity
  - P25, 45
- modulation measurements, 425
- Modulation measurements, 42
- Modulation Params tab
  - GP Digital Modulation
    - displays, 453
  - LTE, 355
  - OFDM Analysis
    - displays, 251
  - P25 Analysis displays, 308
  - WLAN Analysis
    - displays, 223
- Modulation types supported, 453
- moving windows, 581
- Multi-Carrier Power Ratio, 39
- Multiple Carrier Power Ratio, 134

## N

- Navigator View, 574
- nFSK modulation type
  - measurements, 44
- nFSK signal quality
  - measurements, 445
- No. of Harmonics
  - Params2 tab, 417
- No. of Non-Harmonics
  - Params2 tab, 417
- noise, 602
- noise bandwidth (NBW), 602
- noise floor, 602
- Noise markers, 485
- Non-Harmonic Excursion
  - Params2 tab, 417



Non-Harmonic Threshold  
 Params2 tab, 417  
 Numeric keypad, 574

## O

OBW Level Left/Right, 140  
 OBW Ref Power, 140  
 Occupied bandwidth  
 LTE, 46  
 Occupied Bandwidth, 143  
 Occupied Bandwidth  
 settings, 143  
 Occupied BW display, 140  
 OFDM Channel Response  
 display, 233  
 settings, 235  
 OFDM Constellation  
 display, 236  
 settings, 237  
 OFDM EVM  
 display, 237  
 settings, 238  
 OFDM Mag Error  
 display, 241  
 settings, 242  
 OFDM Phase Error  
 display, 244  
 OFDM Power  
 display, 245  
 settings, 246  
 OFDM Spectral Flatness  
 display, 239  
 settings, 240  
 OFDM Summary  
 display, 247  
 settings, 248  
 OFDM Symbol Table  
 display, 249  
 settings, 250  
 Off  
 Ranges and Limits table, 153  
 Offset & Limits Table tab  
 SEM display, 186  
 Offset EVM, 445  
 Offsets and Limits Table tab  
 LTE, 347  
 On  
 Ranges and Limits table, 153

open (recall), 602  
 Operating band unwanted  
 emission  
 LTE, 46  
 Operating frequency accuracy  
 P25, 45  
 Optimization  
 Channel Power & ACPR  
 display, MCPR  
 display, 136  
 Signal Strength display, 127  
 option  
 activate with Internet, 7  
 activate without Internet, 7  
 Option key  
 activate, 7  
 Optional software, 3  
 options  
 deactivating, 10  
 deactivating legacy, 10  
 moving to another PC, 10  
 Options  
 how to purchase, 3  
 list of available, 10  
 transferring an application  
 license, 6  
 Options control panel, 29  
 OQPSK, 602  
 OQPSK and SOQPSK modulation  
 type measurements, 43  
 Out-of-band spurious emission  
 Bluetooth, 46  
 Output power  
 Bluetooth, 46  
 Overlap, 71  
 Overshoot, 47  
 Overshoot dB, 47  
 Overshoot settings, 271

## P

P25  
 presets, 25  
 P25 Constellation  
 display, 291  
 settings, 293  
 P25 Eye Diagram  
 display, 293  
 settings, 295  
 P25 limits, 298  
 P25 measurements, 45  
 P25 Power vs Time  
 display, 296  
 settings, 297  
 P25 Summary  
 display, 298  
 settings, 301  
 P25 Symbol Table  
 display, 301  
 settings, 303  
 Parameters tab  
 AM display, 95  
 Bluetooth, 405  
 CCDF display, 157  
 FM display, 103  
 LTE, 344  
 Occupied BW display, 144  
 PM display, 110  
 SEM display, 182  
 Spurious display, 149  
 Params tab  
 Pulsed RF displays, 266  
 Params1 tab  
 Audio Analysis displays, 414  
 Params2 tab  
 Audio Analysis displays, 417  
 Pass/Fail readout  
 SEM display, 180  
 Pass/Fail Limit Testing  
 Spurious display, 154  
 Pass/Fail tests, 490  
 Pause  
 Replay menu, 504  
 +Peak  
 Audio Summary display, 413  
 -Peak  
 Audio Summary display, 413  
 Peak Excursion, 482  
 Peak FSK err, 44  
 Peak Mag Err, 44  
 Peak Power, 46  
 Peak Threshold, 482  
 Peak/Avg Ratio, 39  
 Peak-Peak/2  
 Audio Summary display, 413  
 Phase  
 DPX display, 49



- Phase Deviation, 48
- Phase Error, 42
  - OFDM, 40
  - WLAN, 41
- Phase Error vs. Time display, 439
- Phase Error vs. Time settings, 440
- phase settling time, 602
  - measuring, 167
- Phase Settling Time display, 162
- Phase Settling Time settings, 166
- Phase vs. Time display, 79
- Phase vs. Time settings, 80
- pictures
  - saving, 555
- +Pk
  - FM display, 44
  - PM display, 45
- Pk
  - FM display, 44
  - PM display, 45
- Pk-Pk
  - FM display, 44
  - PM display, 45
- Pk-Pk/2
  - FM display, 44
- Playback, 517
  - Define skip, 517
  - Exit playback, 518
  - Live rate, 518
  - Location, 517
  - Loop file, 518
  - Progress bar, 518
- PM, 603
- PM measurements, 45
- Power
  - OFDM, 40
- Power class
  - Bluetooth, 397
- Power density
  - Bluetooth, 46
- Power Markers, 482
- power measurements, 117
- Power measurements, 39
- Power Threshold to Detect Pulses
  - Params tab, 267
- Power vs Time
  - WLAN, 41

- Pre-defined Filters
  - Audio Filters tab, 418
- Prefs tab
  - AM display, 99
  - Bluetooth, 404
  - FM display, 107
  - General Signal Viewing
    - Displays, 91
  - GP Digital Modulation
    - displays, 468
  - LTE, 350
  - OFDM Analysis
    - displays, 257
  - Options control panel, 30
  - P25 Analysis displays, 317
  - PM display, 115
  - Pulsed RF displays, 276
  - RF Measurements
    - displays, 196
  - Settling Time displays, 178
  - Signal Strength display, 130
  - WLAN Analysis
    - displays, 232
- Presets, 21
  - Application, 21
  - Main, 21
  - P25, 25
  - recalling, 23
  - Standards, 21
  - User, 21
  - WLAN, 25
- Presets tab
  - Options control panel, 29
- primary marker, 603
- Print, 574
- Print Preview, 574
- Processing tab
  - LTE, 346
  - SEM display, 185
- Product documentation, 12
- PSK, 603
- Pulse analysis
  - application presets, 26
- Pulse measurements, 259
- Pulse Statistics display, 263
- Pulse Statistics display
  - settings, 265
- Pulse Table display, 259

- Pulse Table settings, 260
- Pulse Trace display, 261
- Pulse Trace display settings, 263
- Pulse Width, 47
- Pulse-Pulse Freq Difference, 47
- Pulse-Pulse Phase Difference, 47
- pulses
  - how many can be analyzed, 267

## Q

- QAM, 603
- Quadrature Error, 42

## R

- Range file, 562
- Ranges and Limits Tab
  - Spurious display, 151
- Raw data structure, 515
- RBW, 604
  - Channel Power & ACPR
    - display, MCPR
    - display, 136
  - Signal Strength display, 126
- real-time analysis, 603
- real-time bandwidth, 603
- real-time seamless capture, 604
- recalling Presets, 23
- Record
  - formatted data structure, 515
  - raw data structure, 515
- Record to disk, 516
- Red background (cells), 144
- red text
  - settling time
    - measurements, 165
- Ref
  - Audio Summary display, 413
- Ref Channel tab
  - SEM display, 186
- Ref level (Internal Settings tab), 507
- Reference Filter
  - GP Digital Modulation
    - displays, 453
- reference level, 604



- Reference tab
  - Spurious display, 149
- Rel
  - Ranges and Limits table, 153
- Rel Same
  - Ranges and Limits table, 153
- Rel Start (dB)
  - Ranges and Limits table, 153
- Rel Stop (dB)
  - Ranges and Limits table, 153
- Relative power
  - Bluetooth, 46
- Repeat, 511
- Repetition Interval, 47
- Repetition Rate, 47
- Replay all selected records
  - Replay menu, 503
- Replay control panel, 501
- Replay current record
  - Replay menu, 503
- Replay from selected
  - Replay menu, 503
- Replay menu, 503
- Replay Speed tab, 503
- Replay toolbar, 505
  - Replay menu, 504
- Reset Equalization
  - Equalizer tab, 459
- Reset layout
  - Ranges and Limits Tab, 152
- residual FM (incidental FM), 604
- residual response, 604
- results
  - saving, 555
- Resume, 511
- RF Channel Power
  - measurement, 119
- RF I & Q vs. Time display, 81
- RF I & Q vs. Time settings, 82
- RF output power
  - P25, 45
- Rho, 444
- Ripple, 47
- Ripple dB, 47
- ripple measurement
  - calculation, 604
- Ripple settings, 271
- Rise Time, 47
- RMS
  - Audio Summary display, 413
  - FM display, 44
  - PM display, 45
- RMS Error Magnitude, 44
- RMS FSK Err, 44
- RMS Mag Err, 44
- RMS Phase Error, 47
- Run, 511
- Run menu, 577
- S**
- S/N
  - Audio Summary display, 413
- Save
  - Ranges and Limits Tab, 152
- Save acq data on Trigger, 523
- Save and Export tab, 29
  - Options control panel, 30
- Save As
  - Ranges and Limits table, 153
- Save on trigger, 523
- Save picture on Trigger, 523
- saved file types, 555
- saving
  - acquisition data, 555
  - pictures, 555
  - results, 555
  - setups, 555
- Saving
  - presets, 21
- Saving and Recalling Data, 555
- Scale tab
  - AM display, 98
  - Audio Analysis displays, 420
  - Bluetooth, 401
  - FM display, 106
  - General Signal Viewing displays, 90
  - GP Digital Modulation displays, 468
  - LTE, 348
  - OFDM Analysis displays, 255
  - P25 Analysis displays, 314
  - PM display, 114
  - Pulsed RF displays, 275
- RF Measurements
  - displays, 195
- SEM display, 189
- Settling Time displays, 177
- Signal Strength display, 129
- Spectrogram display, 73
- Spectrum display, 68
- WLAN Analysis
  - displays, 229
- Search control panel, 494
- Search for instruments
  - Connect, 580
- Search In, 490
- secondary marker, 605
- Security tab, 29
  - Options control panel, 30
- Select all
  - Replay menu, 504
- Select data records tab, 501
- Select records from history
  - Replay menu, 504
- SEM display, 178
- sensitivity, 606
- Set to max BW, 83
- Settings, 590
  - AM display, 94
  - Audio Spectrum display, 411
  - Audio Summary display, 413
  - BT 20dB BW, 392
  - BT CF Offset and Drift, 377
  - BT Constellation, 371
  - BT Eye Diagram, 374
  - BT Frequency Dev vs. Time, 390
  - BT Summary, 382
  - BT Symbol Table, 385
  - CCDF display, 156
  - Constellation display, 427
  - Demod I&Q vs Time display, 430
  - DPX Spectrum, 54
  - EVM vs. Time display, 431
  - Eye Diagram display, 434
  - FM display, 101
  - Frequency Deviation vs. Time, 436
  - Frequency Settling Time, 170
  - Frequency vs. Time, 78



- LTE ACLR, 335
- LTE Channel Spectrum, 337
- Magnitude Error vs. Time, 438
- MCPR, 134
- Occupied Bandwidth, 143
- OFDM Channel
  - Response, 233
- OFDM Constellation, 237
- OFDM EVM, 238
- OFDM Flatness, 240
- OFDM Mag Error, 242
- OFDM Phase Error, 244
- OFDM Power, 246
- OFDM Summary, 248
- OFDM Symbol Table, 250
- Options control panel, 29
- P25 Constellation, 293
- P25 Eye Diagram, 295
- P25 Frequency Dev vs. Time, 306
- P25 Power vs Time, 297
- P25 Summary, 301
- P25 Symbol Table, 303
- Phase Error vs. Time, 440
- Phase Settling Time, 166
- Phase vs. Time, 80
- Pulse Statistics display, 265
- Pulse Table display, 260
- Pulse Trace display, 263
- restoring defaults, 21
- RF I & Q vs. Time, 82
- Signal Quality, 446
- Spectrogram display, 71
- Spectrum display, 67
- Spectrum Emission
  - Mask, 182
- Spurious display, 148
- Symbol Table display, 448
- Time Overview display, 60
- Trellis Diagram display, 451
- Trigger, 520
- WLAN Channel
  - Response, 199
- WLAN Constellation, 203
- WLAN EVM, 205
- WLAN Mag Error, 207
- WLAN Phase Error, 209
- WLAN Power vs Time, 212
- WLAN Spectral Flatness, 214
- WLAN Summary, 219
- WLAN Symbol Table, 222
- Settled Frequency
  - definition, 158
- Settled Phase
  - definition, 158
- settling time
  - measuring, 167
- Settling Time, 158
  - definition, 158
- Settling Time decimal places
  - Settling Time displays, 178
- settling time measurement
  - text color, 165
- Setup Menu, 578
- setups
  - saving, 555
- shape factor (skirt selectivity), 606
- Show graticule
  - General Signal Viewing
    - Displays, 91
  - Pulsed RF displays, 276
  - Settling Time displays, 178
- Show Marker Readout in Graph
  - General Signal Viewing
    - Displays, 91
  - Pulsed RF displays, 276
  - RF Measurements
    - displays, 196
  - Settling Time displays, 178
  - Signal Strength display, 130
- Show recalled trace, 85
  - AM display, 96
  - FM display, 104
  - PM display, 111
  - Time Overview display, 63
- signal, 606
- Signal Classification
  - create a region, 542
  - define a region, 542
- Signal database, 535
- Signal Power
  - Audio Summary display, 412
- Signal Quality display, 441
- Signal quality measurements, 444
- Signal Quality settings, 446
- Signal standards, 535
- signal strength, 606
- Signal Strength display, 123
- Signal Strength Settings control panel, 124
- Signal types, 535
- Simulation
  - GNSS, 526
- SINAD
  - Audio Summary display, 413
- span, 606
- span per division, 606
- Span/RBW Ratio
  - Spectrum display BW tab, 88
- spectrogram, 607
- Spectrogram display, 68
- Spectrogram display settings, 71
- spectrum, 607
- Spectrum
  - DPX display, 49
  - spectrum analysis, 607
  - Spectrum analysis
    - application presets, 27
  - spectrum analyzer, 607
  - Spectrum Center Frequency, 497
    - Frequency tab, 498
  - Spectrum display, 65
  - Spectrum display settings, 67
  - Spectrum Emission Mask
    - display, 178
    - settings, 182
  - Spectrum Monitor
    - Spectrogram, 74
  - spectrum time, 607
  - Spectrum Time tab, 497
  - Spectrums/line, 71
- Split
  - DPX display, 49
- spur, 607
- Spur
  - defining, 154
- Spurious, 144
- Spurious display settings, 148
- spurious response, 607
- Standard
  - Audio Filters tab, 418
- Standard Settings button, 452



Standard software, 3  
Standards  
    database, 535  
    how to set up database, 535  
    presets, 21  
Standards presets  
    P25, 25  
    WLAN, 25  
Start (Hz)  
    Ranges and Limits table, 153  
Status bar, 575  
Status Bar, 577  
Stop  
    Replay menu, 504  
Stop (Hz)  
    Ranges and Limits table, 153  
Summary  
    WLAN, 41  
supported file formats  
    waveform, 556  
symbol maps, 469  
Symbol Rate, 44  
Symbol rate accuracy  
    P25, 45  
Symbol Rate Error, 44  
Symbol Table  
    WLAN, 41  
Symbol Table display, 447  
Symbol Table display  
    settings, 448

**T**

Taps  
    Equalizer tab, 459  
Taps/Symbol  
    Equalizer tab, 459  
Target Reference  
    Frequency Settling Time, 172  
Test For, 490  
Test Patterns tab  
    P25 Analysis displays, 313  
Test using a mask, 491  
THD  
    Audio Summary display, 413  
Thrshld (dBm)  
    Ranges and Limits table, 153  
Thunderstorm color scheme, 30  
Time, 48

Time & Freq Scale tab  
    Spectrogram display, 73  
time measurement, 608  
Time Overview, 59  
Time Overview display  
    settings, 60  
Time Params tab  
    Settling Time displays, 173  
time reference, 608  
time scale status readout, 71  
Time-Frequency analysis  
    application presets, 27  
TIQ acquisition data files, 30  
TIQ acquisition data files  
    parameters, 29  
TNHD  
    Audio Summary display, 413  
TOFF  
    LTE, 46  
Tolerance (+/-)  
    Frequency Settling Time, 172  
Tools Menu, 579  
Total AM  
    AM display, 44  
Touch-screen Actions, 15  
trace, 608  
Trace 2  
    Constellation display, 467  
Trace tab  
    AM display, 96  
    Bluetooth, 402  
    FM display, 104  
    GP Digital Modulation  
        displays, 466  
    LTE, 357  
    OFDM Analysis  
        displays, 255  
    P25 Analysis, 314  
    PM display, 111  
    Settling Time displays, 174  
    Time Overview display, 63  
    WLAN Analysis  
        displays, 228  
Traces tab  
    DPX display, 54  
    General Signal Viewing  
        displays, 85

RF Measurements  
    display, 192  
Spectrogram display, 72  
WLAN Channel Response  
    display, 228  
Traces tab - Math Trace  
    General Signal Viewing  
        displays, 88  
Traces Toolbar, 575  
Transform Window  
    Spectrum display BW tab, 88  
Transmitter frequency behavior  
    P25, 45  
Transmitter power and encoder  
    attack time  
        P25, 45  
Transmitter power and encoder  
    attack time with busy/idle  
        P25, 45  
Transmitter throughput delay  
    P25, 45  
Trellis Diagram display  
    settings, 451  
Trial license, 580  
Trig Meas tab  
    P25 Analysis displays, 316  
Trigger position, 522  
    auto, 522  
Trigger settings, 520  
    Advanced tab, 522  
    Event tab, 521  
Triggering, 518  
Tune to a channel, 538  
Tutorials  
    YouTube videos, 12  
Types  
    how to set up signal  
        database, 536

**U**

Uniform (None) Filter Shape  
    Spectrum display BW tab, 88  
Units tab, 500  
Unwanted emissions (ACPR)  
    P25, 45  
Uplink, 539  
USB connection  
    Connect, 580



## User Filters

file format, 475

loading, 474

## User presets, 21

## User Symbol Map, 462

**V**

## VBW, 140

LTE, 353

RF Measurements

displays, 191

Spectrum display BW tab, 88

## VBW (Hz)

Ranges and Limits table, 153

## VBW On

Ranges and Limits table, 153

vector signal analyzer, 608

vertical scale factor, vertical

display factor, 608

Video tutorials, 12

## View

Basic Controls Toolbar, 575

Full Screen, 574

Markers Toolbar, 575

Navigator View, 574

Numeric keypad, 574

Replay Toolbar, 575

Status Bar, 575

Traces Toolbar, 575

View Menu, 574

violation, 608

**W**

## Waterfall

Spectrogram/DPXogram, 73

Spectrogram/DPXogram

display, 57

waveform file formats

supported, 556

Window menu, 581

Windows Event Viewer, 589

## WLAN

presets, 21

video tutorials, 12

## WLAN Channel Response

display, 199

settings, 201

## WLAN Constellation

display, 202

settings, 203

## WLAN EVM

display, 204

settings, 205

## WLAN Mag Error

display, 206

settings, 207

## WLAN Phase Error

display, 208

## WLAN Power vs Time

display, 210

settings, 212

## WLAN Spectral Flatness

display, 213

settings, 214

## WLAN Summary

display, 215

settings, 219

## WLAN Symbol Table

display, 220

settings, 222

**X**

x dB BW Ref Power, 140

x dB Level, 144

**Y**

## YouTube

Tektronix channel, 12

**Z**

## Zero Span

DPX display, 49