Keysight 8990B Peak Power Analyzer

KEYSIGHT TECHNOLOGIES

User's Guide

Notices

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	Caution, risk of danger (refer to this manual for specific Warning or Caution information)		Alternating current (AC)
	Frame or chassis (ground) terminal		Protective earth (ground) terminal
	Caution, risk of electric shock		Earth (ground) terminal
	On (mains supply)		Off (mains supply)

Safety Considerations

This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to damage the instrument. Intentional interruption is prohibited.

WARNING

- Do not operate the instrument in an explosive atmosphere or in the presence of flammable gasses or fumes.
- Do not use repaired fuses or short-circuited fuseholders. For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.
- Do not perform procedures involving cover or shield removal unless you are qualified to do so. Operating personnel must not remove the meter covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only.
- Do not service or adjust alone. Under certain conditions, dangerous voltages may exist even with the instrument switched off. To avoid electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- Do not operate damaged instrument. Whenever it is possible that the safety protection features built into this instrument have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the instrument until safe operation can be verified by service-trained personnel. If necessary, return the instrument to Keysight for service and repair to ensure the safety features are maintained.
- Do not substitute parts or modify the instrument. Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to Keysight for service and repair to ensure the safety features are maintained.

Environmental Conditions

This instrument is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition – 5 °C to 40 °C Storage condition – –40 °C to 70 °C
Humidity	Operating condition – Up to 95% RH at 40°C (non-condensing) Storage condition – Up to 90% RH at 65°C (non-condensing)
Altitude	Up to 4600 m
Pollution degree	2

Regulatory Markings

CE ISM 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.		The RCM mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.
SA ® C US	The CSA mark is a registered trademark of the Canadian Standards Association.		This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
KC	This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.		

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/insulationtesters
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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Table of Contents

List of Figures

List of Tables

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1 Introduction

This chapter provides a general overview of the 8990B peak power analyzer.

Overview of the 8990B

The 8990B is a peak power analyzer that consists of two RF input channels (1 and 4) and two video input channels (2 and 3). When used with a compatible wideband power sensor, the 8990B is able to measure the dynamic or time-dependent aspects of RF and microwave power. A combination of the 8990B and the N1923/4A wideband power sensor enables the RF pulse rise/fall time measurement of up to 5 ns. The video inputs of the 8990B allow the simultaneous analysis of time-domain control signals.

The 8990B has a frequency range of 50 MHz to 40 GHz and a dynamic power range of –35 dBm to 20 dBm, depending on the wideband power sensor used. The 8990B is capable of measuring peak power, minimum power, average power, peak-to-average power, pulse repetition interval, pulse repetition rate, rise time, fall time, pulse off time, pulse top, pulse base, pulse width, duty cycle, and overshoot. The 8990B also provides internal and external trigger functions.

Standard Shipped Items

Verify that you have received the following items with your 8990B. If anything is missing or damaged, contact the nearest Keysight Sales Office.

- 8990B peak power analyzer
- Power cord
- Optical mouse
- Mini keyboard
- Stylus pen
- Two units of 50 Ohm BNC cable
- Keysight 8990B Peak Power Analyzer User's Guide, English[1]
- Keysight 8990B Peak Power Analyzer Installation Guide, English[1]
- Keysight 8990B Peak Power Analyzer Product Reference CD-ROM
- Keysight IO Libraries Suite CD-ROM
- Certificate of Calibration

Standard 8990B options

- Standard hard drive installed (Option 800)[2]
- Removable hard drive installed (Option 801)[2]
- 8990B with USB host connectivity (Option U01)[3]
- 8990B without USB host connectivity (Option U02)[3]

[1] Only applicable when the default manual configuration, 8990B-ABA is selected.

[2] Select either Option 800 or Option 801

[3] Select either Option U01 or U02

Optional Items

The following items are available for purchase separately.

- Rack mount kit (Option 1CM, 8U full rack)
- N6921A stacking kit
- N6922A BNC extension cable, male to female
- N6923A BNC adapter, right angle
- N6924A additional hard drive with image
- N6925A storage pouch
- 8990B Programming Guide, English (Option OBF, printed)
- 8990B User's Guide, English and Programming Guide, English (Option OBK, printed)
- 8990B Service Guide, English (Option OBW, printed)
- 8990B User's Guide, Japanese and Programming Guide, English (Option ABJ, printed)
- 8990B User's Guide, English (Option ABA, printed)
- N1923A User's Guide, Japanese (N1923A-ABJ, printed)
- N1923A User's Guide, English (N1923A-OB1, printed)
- N1923A Service Guide, English (N1923A-OBN, printed)
- N1924A User's Guide, Japanese (N1924A-ABJ, printed)
- N1924A User's Guide, English (N1924A-OB1, printed)
- N1924A Service Guide, English (N1924A-OBN, printed)
- Return-to-Keysight Warranty and Service Plan
- Return-to-Keysight Calibration Plan
- ISO 17025 compliant calibration test data (Option 1A7, printed)
- ANSI/NCSL Z540 Certificate of Compliance Calibration (Option A6J, printed)
- Multipulse analysis software, fixed perpetual license (8990B-1FP)
- Multipulse analysis software (N6903A)

Sensor Compatibility

The 8990B is compatible with the Keysight N1923/4A wideband power sensor. A combination of the 8990B and the N1923/4A wideband power sensor enables the RF pulse rise or fall time measurement of up to 5 ns. The following table lists the frequency range and dynamic power range for each of these sensors:

Wideband power sensor model	Frequency range	Rise/fall time	Dynamic power range
N1923A	50 MHz to 18 GHz	*≤5.5 ns*[a]	–35 dBm to +20 dBm
N1924A	50 MHz to 40 GHz	*≤5.5 ns*[a]	–35 dBm to +20 dBm

[a] Applicable for frequency of ≥500 MHz.

The 8990B is also compatible with the Keysight N1921/2A P-Series wideband power sensor. The following table lists the frequency range and dynamic power range for each of these sensors:

P-Series wideband power sensor model	Frequency range	Rise/fall time	Dynamic power range
N1921A	50 MHz to 18 GHz	≤13 ns[a]	– –35 dBm to +20 dBm (≥500 MHz) – –30 dBm to +20 dBm (50 MHz to 500 MHz)
N1922A	50 MHz to 40 GHz	≤13 ns[a]	– –35 dBm to +20 dBm (≥500 MHz) – –30 dBm to +20 dBm (50 MHz to 500 MHz)

[a] Specification applies only when the Off video bandwidth is selected.

NOTE For further information on these sensors, refer to their respective manuals.

Probe Compatibility

The 8990B is compatible with the Keysight N2873A passive probe which has a DC-to-500 MHz frequency range and a 10:1 attenuation factor.

NOTE **The 8990B video input channels are able to support passive probes with analog bandwidth of up to 1 GHz.**

Front Panel Outlook

This topic briefly describes the functions of the front panel keys, knobs, and connectors.

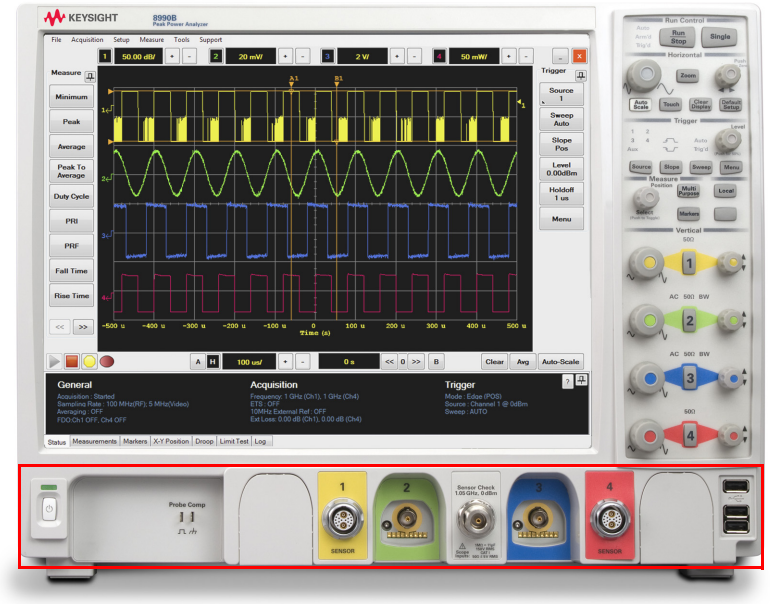

Figure 1-1 Front panel outlook

This section is associated with the power switch, probe compensation output, measurement channels, sensor check source, and USB ports.

Item		Description
	Power on/off	Press this key to turn on or off the 8990B
	RF input channels	Connect to the RF input using the N1921/2/3/4A wideband power sensors

Item		Description
	Video input channels	Connect to the video input using the N2873A oscilloscope probes or N6922A BNC cable
	Probe compensation output	Performs adjustment of the probe capacitor in order to maximize the bandwidth of the probe. NOTE: Probe compensation will only be supported in future releases.
	Sensor check source	Sensor check source for sensor that outputs an RF carrier of 1.05 GHz with a modulating pulse train signal of 1 kHz from a Type-N female connector. The RF level is 0 dBm at the carrier frequency.
	USB Hosts	Connect to external USB devices. You can connect or disconnect the external USB devices without shutting down or restarting the 8990B.

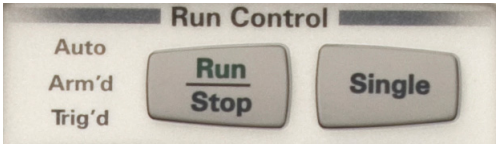

Figure 1-2 Run Control section

This section is categorized as run controls.

Item	Description
	Press this key to start or stop a continuous data acquisition
	Press this key to make a single data acquisition when the next trigger event occurs

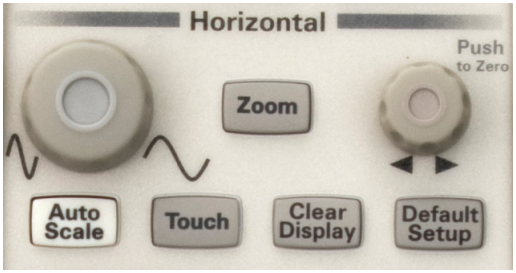

Figure 1-3 Horizontal section

This section is associated with horizontal controls as well as zoom, autoscale, touch screen, clear display, and default setup functions.

Item	Description
	Turn this knob to configure the horizontal scale of the display. NOTE: Vernier function (fine scaling) will only be supported in future releases.
	Press this key to view a magnified section of the waveform
	Turn this knob to configure the horizontal position of the waveform. Push this knob to set the horizontal position to zero.
	Press this key to automatically scale the waveform to the optimized display
	Press this key to enable or disable the touch screen
	Press this key to clear the waveform display. When the 8990B is running in the continuous acquisition mode, this function will clear the current waveform and redraw it. Other than the waveform, this function also clears the data for measurements, markers, droop, and averaging.
	Press this key to return the 8990B to the factory default settings

Figure 1-4 Trigger section

This section is categorized as trigger controls.

Item	Description
	Press this key to set the trigger source to any of the channels or auxiliary. The selected trigger source LED above this key will be illuminated.
	Press this key to trigger on a rising or falling edge. The selected slope LED above this key will be illuminated.
	Press this key to set the trigger sweep mode to either automatic or triggered. The selected sweep mode LED above this key will be illuminated.
	Press this key to access the trigger menu
	Turn this knob to configure the trigger level. Push this knob to set the trigger level to 50%.

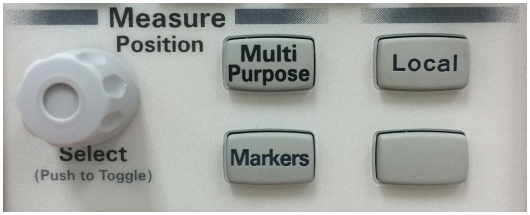

Figure 1-5 Measure section

This section is categorized as measurement and marker controls.

Item	Description
	Turn this knob to change the position of the marker. Push this knob to select a marker or toggle between two markers.
	Press this key to access the marker selection dialog.
	Press this key to toggle between the tabs on the multi-purpose pane.
	Press this key to unlock the controls when in remote access mode.

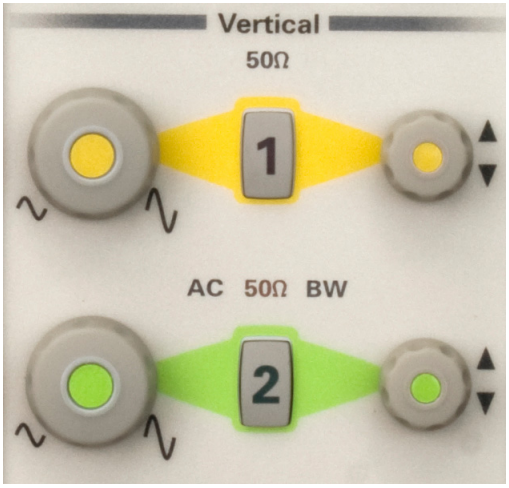

Figure 1-6 Vertical section

This section is categorized as vertical controls.

This section has a set of LEDs per channel that indicate the input impedance, coupling, and whether or not bandwidth limit is enabled for the channel.

Item	Description
	Turn the knob for a particular channel to configure the vertical scale of the display. NOTE: Vernier function (fine scaling) will only be supported in future releases.
	Press this key to turn the display on or off for a particular channel
	Turn the knob for a particular channel to configure the vertical offset of the waveform

Side Panel Outlook

The following connectors and hard drive are available on the side panel. To set up the remote interfaces, refer to the 8990B *Installation Guide*.

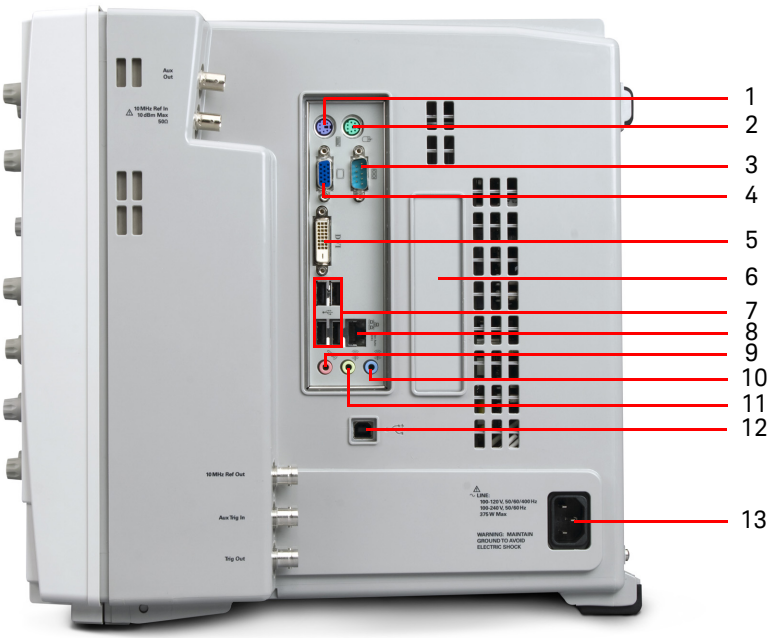

Figure 1-7 Side panel outlook

No.	Item	Description
1	Keyboard PS/2 port	Allows a keyboard to be plugged in to control the 8990B graphical interface. The keyboard must be plugged in prior to turning on the 8990B.
2	Mouse PS/2 port	Allows a mouse to be plugged in to control the 8990B graphical interface. The mouse must be plugged in prior to turning on the 8990B.
3	Serial printer port	Allows a serial printer to be connected to the 8990B
4	XGA video output	Allows an external monitor to be connected to the 8990B
5	DVI video output	Allows an external monitor to be connected to the 8990B

No.	Item	Description
6	Removable hard drive	Allows the 8990B hard drive to be swapped with another hard drive
7	USB ports	Allows external USB devices to be connected to the 8990B. You can connect or disconnect the external USB devices without shutting down or restarting the 8990B.
8	LAN port	Allows the 8990B to be controlled remotely over the LAN interface
9	Microphone port	Allows a microphone to be connected to the 8990B
10	Audio line-in port	Allows an external audio device to be connected to the 8990B
11	Headphone sound output port	Allows a headphone to be connected to the 8990B
12	USB Type-B port	Allows the 8990B to be controlled remotely over the USB interface
13	AC power inlet	Allows the 8990B to be connected to an AC line voltage

Rear Panel Outlook

The following connectors are available on the rear panel.

Figure 1-8 Rear panel outlook

No.	Item	Description
1	Auxiliary trigger out	Used to provide internal 8990B waveforms for calibration and external triggering
2	10 MHz reference in	Used to synchronize the 8990B horizontal timebase system to a reference clock that you provide. The clock that you provide must meet the following specifications: Level: –2 dBm to 10 dBm Impedance: 50 Ω

No.	Item	Description
3	10 MHz reference out	Used to track the external reference input level. The output specifications are as follows: Level: 4 dBm to ±2 dBm Impedance: 50 Ω
4	Auxiliary trigger in	Used as a trigger source for rising edge TTL level triggering only. The input specifications are as follows: Level: ±5 V Impedance: 50 Ω
5	Trigger out	Used to provide TTL compatible logic levels with an output impedance of 50 Ω for external triggering

Display Outlook

The graphical interface provides access to the configuration and measurement features of the 8990B through an easy-to-use system of menus, toolbars, dialog boxes, icons, and buttons. You can control the graphical interface using the touch screen feature, via connected peripherals such as a mouse or a keyboard, or using the front panel interface (where applicable).

The following section provides a general overview of the graphical interface layout.

Figure 1-9 Display outlook

Table 1-1 Display outlook description

No.	Description
1	This is the toolbar which provides access to file management, instrument settings, measurement controls, and help information
2	This is the channel vertical scale control field which allows you to turn on or off the channel, configure the channel settings, and adjust the vertical scale of the display
3	This is the measurement menu which enables you to select and perform the measurements available. The >> and << buttons at the bottom of the menu provide access to the next and previous lists of measurements respectively.
4	This is the acquisition control field which enables you to start or stop a continuous data acquisition or perform a single data acquisition of the waveform. You can also log and save the measurement data.
5	This is the trigger menu which allows you to configure the trigger settings
6	This is the horizontal (time) scale control and marker field which allows you to configure the timebase settings and select the A and B markers to apply on the trace
7	This is the display control field which allows you to clear the display and perform averaging and autoscaling on the waveform
8	This is the multi-purpose pane which enables you to select any of the seven types of views to display: status view, measurement view, marker view, X-Y position view, droop view, limit test view, and log view
9	This button will appear when remote access is in session. The front panel controls are locked when remote access is active. Click the **Remote** button on the screen or press the Local button on the 8990B front panel to unlock the controls.

LCD display layout

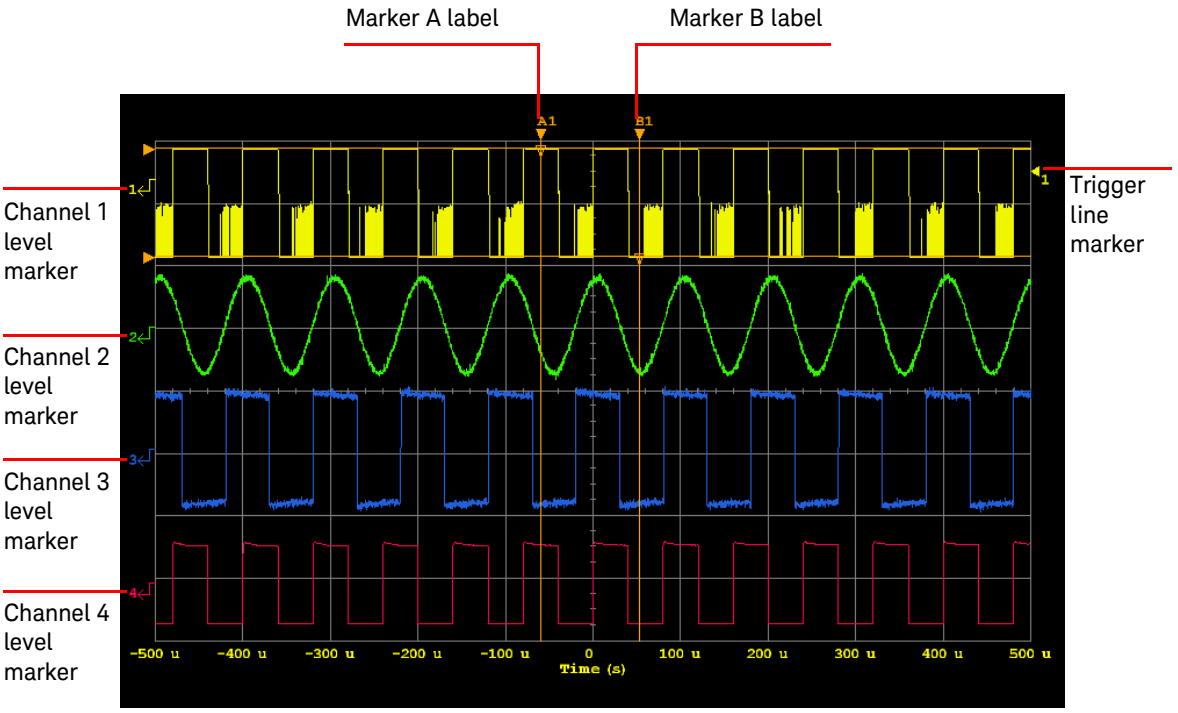

Figure 1-10 LCD display layout

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2 Using the 8990B

This chapter describes the general operation of the 8990B peak power analyzer.

Hiding the Side Menus and Multi-Purpose Pane

The 8990B allows you to hide the measurement menu, trigger menu, and multi-purpose pane.

1 Select the pin button to hide the menus or multi-purpose pane.

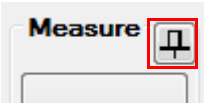


Figure 2-1 Pin button

2 The display outlook with the hidden menus and multi-purpose pane is as shown in Figure 2-2.

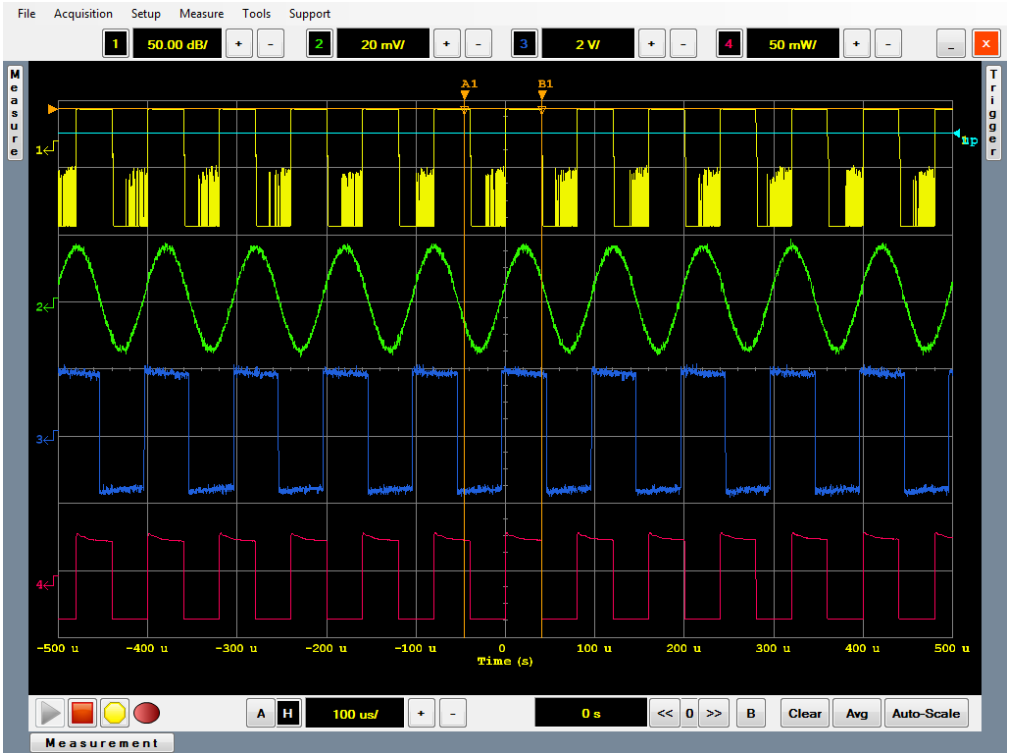


Figure 2-2 Display outlook with hidden menus and multi-purpose pane

Enabling or Disabling the Touch Screen

The 8990B allows you to navigate the graphical interface via touch screen. The touch screen capability is enabled by default.

Use the following procedure to enable or disable the touch screen.

1 To enable or disable the touch screen capability, press Touch in the Horizontal section of the front panel as shown in Figure 2-3.

Figure 2-3 Touch button in the Horizontal section

2 The Touch LED illuminates white when the touch screen capability is enabled.

Accessing the Toolbar Menus

The toolbar is located at the top of the graphical interface as shown in Figure 2-4.

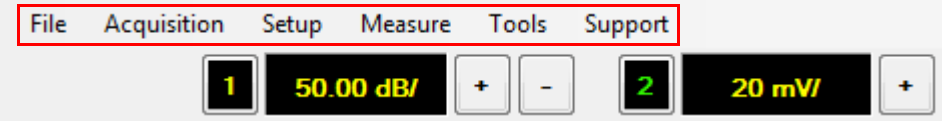


Figure 2-4 Toolbar on the graphical interface

Select the desired toolbar title to display the drop-down menu. Select an item from the drop-down menu to execute its respective function. The description for each drop-down menu on the toolbar is shown in Table 2-1.

Table 2-1 Toolbar menus

Level 1 menu	Level 2 menu	Description
File	Load Waveform...	Load the saved waveform. Refer to "Saving and Loading Waveform Memories" on page 82 for more information.
	Save Waveform...	Save the current waveform data. The waveform data is saved as a CSV file. Refer to "Saving and Loading Waveform Memories" on page 82 for more information.
	Save Screen...	Save the current graphical interface screen. Refer to "Saving the Screen" on page 156 for more information.
	Save Screen (Printer Friendly)	Save the current graphical interface screen in black and white. Refer to "Saving the Screen" on page 156 for more information.
	Restore Saved Setup...	Restore a saved 8990B state. Refer to "Saving and Restoring 8990B States" on page 157 for more information.
	Save Current Setup...	Save the current 8990B state. Refer to "Saving and Restoring 8990B States" on page 157 for more information.
	Restore Default Setup	Reset the 8990B to the factory default settings. Refer to "Restoring the 8990B to Factory Default Settings" on page 165 for more information.
	Save Report...	Generate and save a report. Refer to "Generating and Saving a Report" on page 161 for more information.
	Exit	Exit the 8990B graphical interface

Table 2-1 Toolbar menus (continued)

Level 1 menu	Level 2 menu	Description
Acquisition	Run	Start waveform acquisition. Refer to "Starting and Stopping Waveform Acquisition" on page 63 for more information.
	Stop	Stop waveform acquisition. Refer to "Starting and Stopping Waveform Acquisition" on page 63 for more information.
	Clear Display	Clear the waveform display, measurement data, marker information, droop measurement data, and waveform averaging. Refer to "Clearing the Waveform Display" on page 66 for more information.
	Zoom	Magnify a section of the waveform. Refer to "Magnifying a Section of the Waveform Using Zoom" on page 108 for more information.
	CCDF	Display the Complementary Cumulative Distribution Function (CCDF) information for the RF input channels. Refer to "Displaying the Complementary Cumulative Distribution Function (CCDF) Information" on page 113 for more information.
	Split screen	Split the waveform screen to four separate channel screens. Refer to "Splitting the Waveform Screen" on page 111 for more information.
	MultiPulse	Access the multipulse mode. Refer to "Accessing the Multipulse Mode" on page 120 for more information.
	Display XY	Display the XY Display mode. Refer to "Accessing the Display XY Mode" on page 127 for more information.
	Auto-Scale	Scale the waveforms to the optimized display. Refer to "Enabling Autoscale" on page 73 for more information.
	Undo Autoscale	Undo the autoscaling. Refer to "Enabling Autoscale" on page 73 for more information.
	Save measurement...	Log and save the measurements data. Refer to "Logging and Saving the Measurement Data" on page 159 for more information.
Setup	Channel 1...	Configure the channel 1 settings. Refer to "Accessing the Channel Setup" on page 51 for more information.
	Channel 2...	Configure the channel 2 settings. Refer to "Accessing the Channel Setup" on page 51 for more information.

Table 2-1 Toolbar menus (continued)

Level 1 menu	Level 2 menu	Description
	Channel 3...	Configure the channel 3 settings. Refer to "Accessing the Channel Setup" on page 51 for more information.
	Channel 4...	Configure the channel 4 settings. Refer to "Accessing the Channel Setup" on page 51 for more information.
	Trigger...	Configure the trigger settings. Refer to "Accessing the Trigger Setup" on page 75 for more information.
	Acquisition...	Configure the ETS acquisition setup. Refer to "Equivalent Time Sampling (ETS)" on page 67 for more information.
	Display Setup	Configure the display settings. Refer to "Configuring the Display Settings" on page 168 for more information.
	Measurement Thresholds	Configure the measurement threshold settings. Refer to "Setting the Measurement Threshold" on page 79 for more information.
	Waveform Memory	Load multiple saved waveform files. You can select a saved waveform to enable and adjust the horizontal scale and offset. Refer to "Saving and Loading Waveform Memories" on page 82 for more information.
	Waveform Math	Perform waveform math operations on a pair of RF input or video input channels. Refer to "Performing Waveform Math Operations" on page 86 for more information.
Measure	Measurement functions	Select the desired measurement functions to measure. Refer to "Measurement view" on page 131 for more information.
Tools	Front Panel Test...	Verify the 8990B front panel keys and knobs. Refer to "Front Panel Test" on page 172 for more information.
	Limit Test...	Set the upper limit and lower limit values, and track the values. Refer to "Limit test view" on page 145 for more information.
	Self Test...	Perform instrument self-test on the 8990B. Refer to "Front Panel Test" on page 172 for more information.
	Remote Setup...	Display the 8990B remote setup parameters. Refer to "Remote Setup" on page 170 for more information.
	Auto Cal...	Configure the sensor auto-calibration settings. Refer to "Performing Zeroing and Calibration" on page 151 for more information.
	Check Source	Configure the sensor check source settings. Refer to "Sensor Check Source" on page 154 for more information.

Table 2-1 Toolbar menus (continued)

Level 1 menu	Level 2 menu	Description
	Secure Erase...	Erase the 8990B setup, FDO tables, and reference memory. Refer to "Secure Erase" on page 164 for more information.
	Toggle 10 MHz Input	Enable or disable the 10 MHz reference input for the video input channels. When the 10 MHz reference input is enabled, the 10MHz Input status is displayed in the Status view. Refer to "Status view" on page 130 for more information.
	FDO	Set the Frequency-Dependent Offset (FDO) for different frequency points. Refer to "Setting the Frequency-Dependent Offset (FDO)" on page 105 for more information.
	Marker	Track the X-axis and Y-axis values, and the delta values between the two markers. Refer to "Marker view" on page 135 for more information.
Support	Documentation	Display the 8990B documentation information
	Help	Display the 8990B help information
	Tutorial Video	Display the 8990B tutorial video
	About	Display the 8990B product information
	License	Display the installed licenses in the 8990B

Turning Channels On or Off

Channel 1 to channel 4 in the 8990B are color-coded in yellow, green, blue, and red respectively. Turn off the channels that you are not using to simplify the waveform display and increase the display refresh rate. The 8990B channels can be turned on from the Vertical section on the front panel or the graphical interface.

Use the following procedures to turn on or off the channels.

NOTE **For RF input channel 1 and 4, the channels can only be turned on when a wideband power sensor is connected.**

Front panel

1 Press the desired channel number button in the Vertical section to turn on the channel as shown in Figure 2-5.

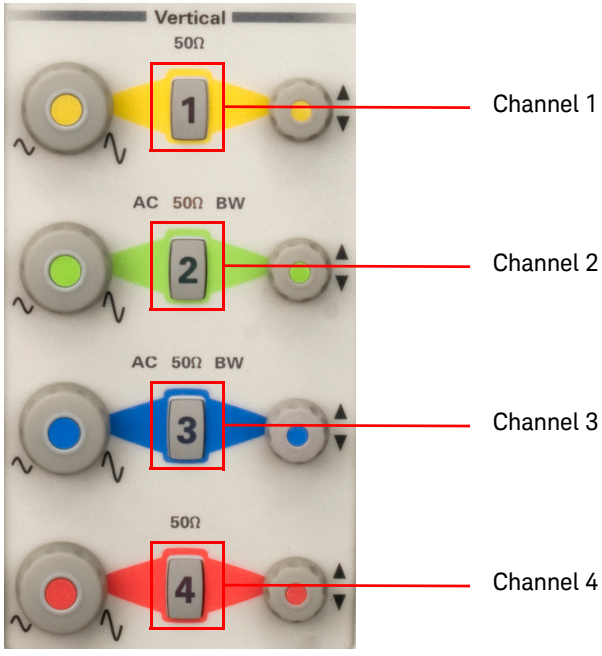


Figure 2-5 Channel number buttons in the Vertical section

2 The channel number button LED illuminates when it is turned on.

3 Press the channel number button again to turn off the channel.

Graphical interface

1 Select the desired channel number button on the graphical interface to turn on the channel as shown in Figure 2-6.

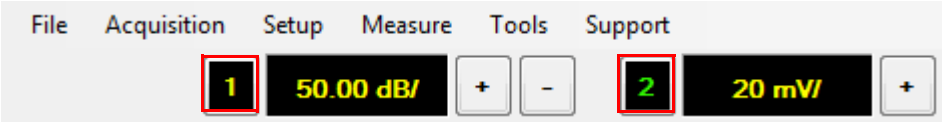


Figure 2-6 Channel number button on the graphical interface

2 The channel number button darkens when it is turned on.

3 Select the channel number button again to turn off the channel.

NOTE The channels can also be turned on or off from the Channel Setup dialog. For more information on the Channel Setup dialog, refer to "Accessing the Channel Setup" on page 51.

Accessing the Channel Setup

The Channel Setup dialog allows you to configure the settings for each channel.

For RF input channels, you can turn on or off the channel, and set the power display type, vertical scale, frequency, reference style, reference level, external loss, bandwidth, and perform zeroing and calibration of the sensor from the Channel Setup dialog.

For video input channels, you can turn on or off the channel, and set the vertical scale and offset, input coupling, input impedance, and probe attenuation ratio.

You can select the channel number button at the top of the Channel Setup dialog to access the setup for the desired channel.

Use the following procedure to access the channel setup.

1 Select the vertical scale area for the desired channel on the graphical interface as shown in Figure 2-7.

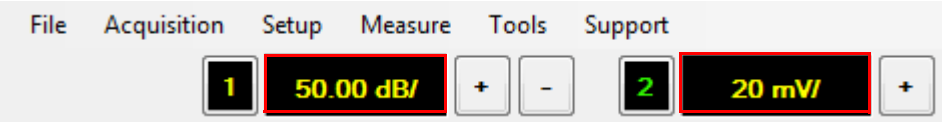


Figure 2-7 Vertical scale area on the graphical interface

2 For the RF input channel, the Channel Setup dialog is displayed as shown in Figure 2-8.

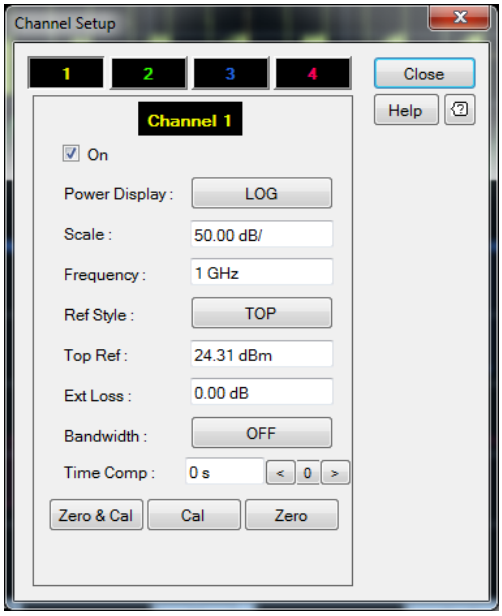


Figure 2-8 RF input Channel Setup dialog

Power Display

Select either Log or Linear as the power display type for the RF input channel signal.

Scale

Set the vertical scale value for the RF input channel. Refer to "Adjusting the Vertical Scale and Offset" on page 56 for more information.

Frequency

Setting the frequency of the RF input channel signal. This will optimize the accuracy and minimize the measurement uncertainty, especially when making comparative measurements between signals.

Ref Style

Select among TOP, CENTER, or BOTTOM as the reference style.

Reference Level

Set the reference level value for the RF input channel. Refer to "Adjusting the Vertical Scale and Offset" on page 56 for more information.

Ext Loss

Set the external loss for the RF input channel signal caused by a coupler, amplifier, or cable.

Bandwidth

Select among OFF, LOW, MEDIUM, or HIGH for the bandwidth. The bandwidth set will minimize the effect of any visible noise in the signal.

Time Comp

Set the time compensation value for the RF input channel. The time compensation set will overcome any timing delay in the cable. The step size for the time compensation increment (>) and decrement (<) buttons is set to a time scale of 1/500.

Zero & Cal, Cal, and Zero

Perform zeroing and calibration on the connected power sensor. Refer to "Performing Zeroing and Calibration" on page 151 for more information.

3 For the video input channel, the Channel Setup dialog is displayed as shown in Figure 2-9.

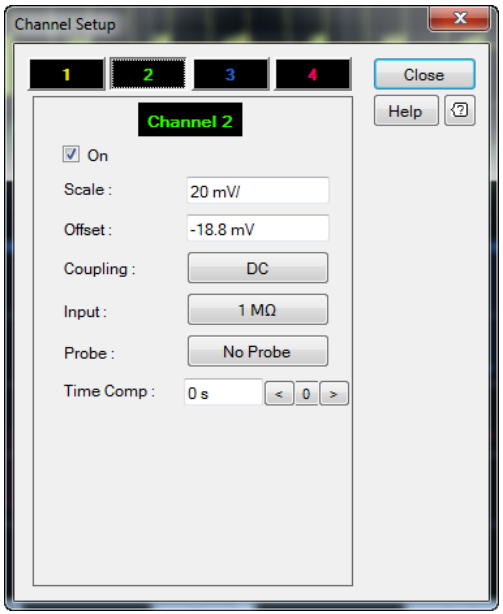


Figure 2-9 Video input Channel Setup dialog

Scale

Set the vertical scale value for the video input channel. Refer to "Adjusting the Vertical Scale and Offset" on page 56 for more information.

Offset

Set the vertical offset value for the video input channel. Refer to "Adjusting the Vertical Scale and Offset" on page 56 for more information.

Coupling

Select either DC or AC coupling for the video input channel signal.

Input

Select either 50 Ω or 1 MΩ as the input impedance for the video input channel signal.

Probe

View the probe information used at the video channel.

Time Comp

Set the time compensation value for the video input channel. The time compensation set will overcome any timing delay in the cable.

4 After you have completed the channel setup, select the close button at top right corner of the dialog or select **Close** to close the Channel Setup dialog.

Adjusting the Vertical Scale and Offset

Adjusting the vertical scale increases or decreases the number of watts per division (W/div) or decibels per division (dB/div) for RF input channels and the number of volts per division (V/div) for video input channels. Adjusting the vertical offset moves the waveform towards the top or bottom of the display. The vertical scale and offset can be adjusted from the Vertical section on the front panel or the graphical interface.

Use the following procedures to adjust the vertical scale and offset.

Front panel

1 To adjust the vertical scale, turn the vertical scale knob of the desired channel in the Vertical section as shown in Figure 2-10.

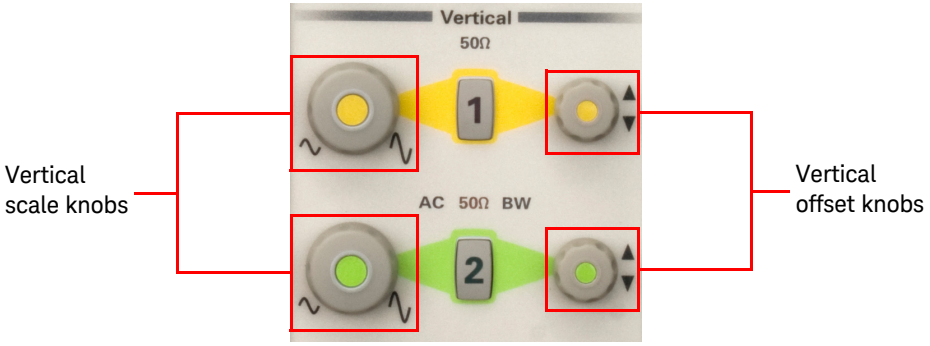


Figure 2-10 Vertical scale and offset knobs in the Vertical section

2 Turn the vertical scale knob clockwise to decrease the vertical scale value or counter-clockwise to increase the vertical scale value.

3 To adjust the vertical offset, turn the vertical offset knob of the desired channel in the Vertical section as shown in Figure 2-10.

4 Turn the vertical offset knob clockwise to move the waveform towards the top of the display or counter-clockwise to move the waveform towards the bottom of the display.

Graphical interface

1 Select the vertical scale area of the desired channel at the top of the graphical interface to access the Channel Setup dialog as shown in Figure 2-7.

2 For RF input channels, select the vertical scale field on the Channel Setup dialog to adjust the vertical scale as shown in Figure 2-11.

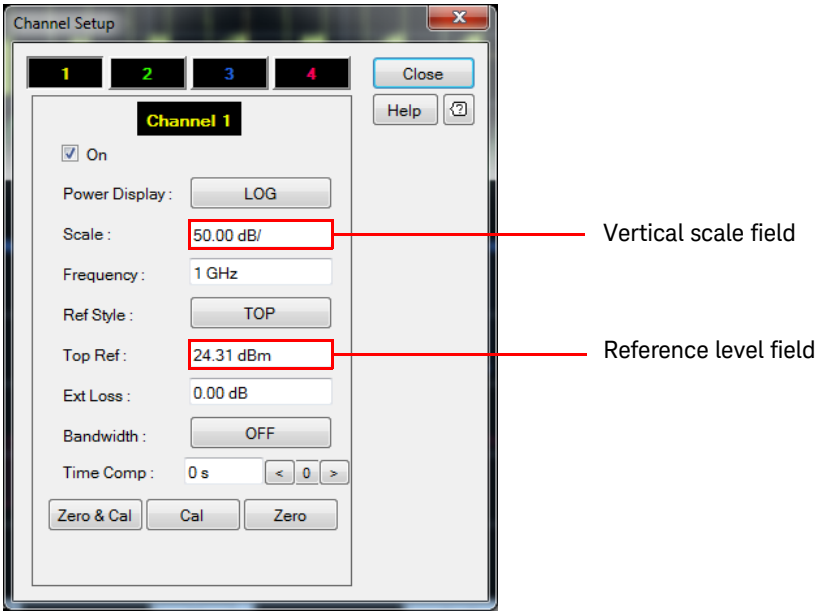


Figure 2-11 Vertical scale and reference level field for the RF input channel

3 The vertical offset in the RF input channel is referred to as top reference level, center reference level, or bottom reference level depending on the desired reference style. Select the reference level field on the Channel Setup dialog to adjust the reference level as shown in Figure 2-11.

4 For video input channels, select the vertical scale field on the Channel Setup dialog to adjust the vertical scale as shown in Figure 2-12.

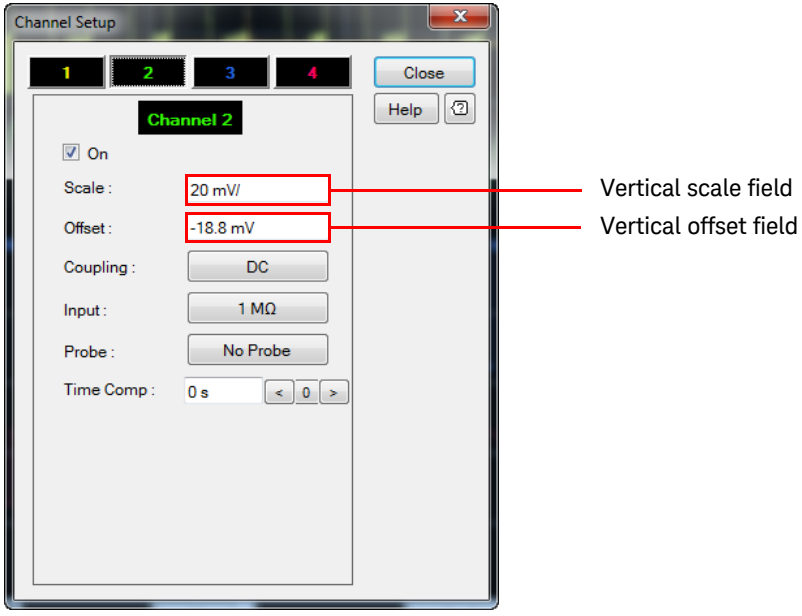


Figure 2-12 Vertical scale and offset field for the video input channel

5 Select the vertical offset field on the Channel Setup dialog to adjust the vertical offset as shown in Figure 2-12.

6 The vertical scale keypad dialogs are displayed as shown in Figure 2-13.

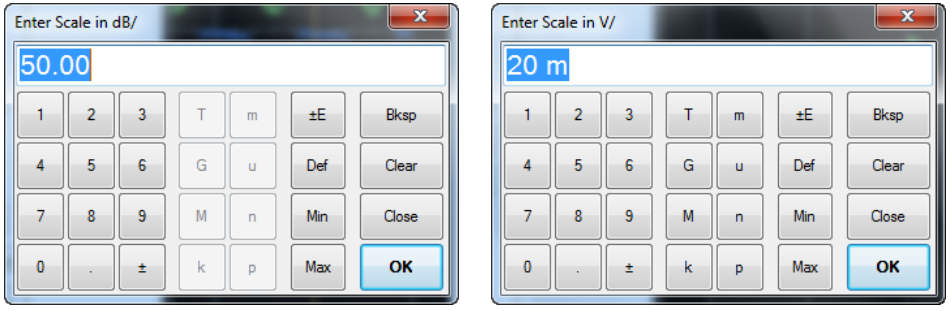


Figure 2-13 Vertical scale keypad dialogs

7 Set the desired value and select **OK** to confirm.

8 You can also adjust the vertical scale using **+** and **–** as shown in Figure 2-14.

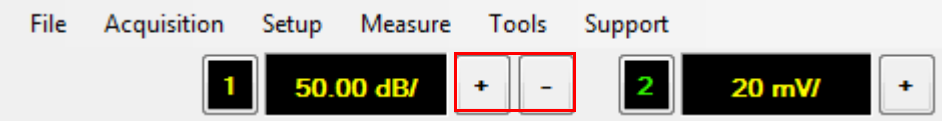


Figure 2-14 Vertical scale adjustment on the graphical interface

9 The reference level keypad dialog for the RF input channel is displayed as shown in Figure 2-15.

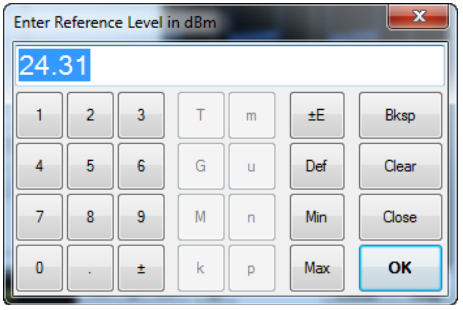


Figure 2-15 Reference level keypad dialog for the RF input channel

10 The vertical offset keypad dialog for the video input channel is displayed as shown in Figure 2-16.

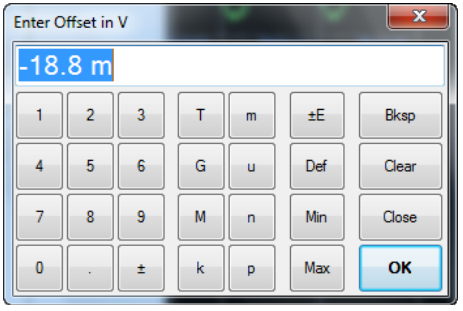


Figure 2-16 Vertical offset keypad dialog for the video input channel

11 Set the desired value and select **OK** to confirm.

Adjusting the Horizontal Scale and Offset

Adjusting the horizontal scale increases or decreases the number of seconds per division (s/div). Adjusting the horizontal offset moves the waveform towards the left or right of the display. The horizontal scale and offset can be adjusted from the Horizontal section on the front panel or the graphical interface.

NOTE **Negative horizontal offset will reduce the sampling rate and cause trace distortion. It is recommended to set the offset relatively close to the horizontal scale for optimum performance.**

Use the following procedures to adjust the horizontal scale and offset.

Front panel

1. To adjust the horizontal scale, turn  in the Horizontal section as shown in Figure 2-17.
2. Turn  clockwise to decrease the horizontal scale value or counter-clockwise to increase the horizontal scale.
3. To adjust the horizontal offset, turn  in the Horizontal section as shown in Figure 2-17.
4. Turn  clockwise to move the waveform towards the right of the display or counter-clockwise to move the waveform towards the left of the display.

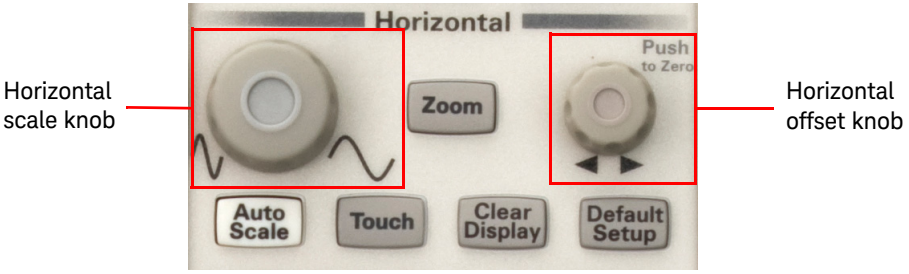


Figure 2-17 Horizontal scale and offset knobs in the Horizontal section

5. To set the offset to zero, push  .

NOTE The horizontal scale knob is adjustable in factors of 1, 2, and 5.

Graphical interface

1 To adjust the horizontal scale, select the horizontal scale area on the graphical interface as shown in Figure 2-18.

Figure 2-18 Horizontal scale on the graphical interface

2 The horizontal scale keypad dialog is displayed as shown in Figure 2-19.

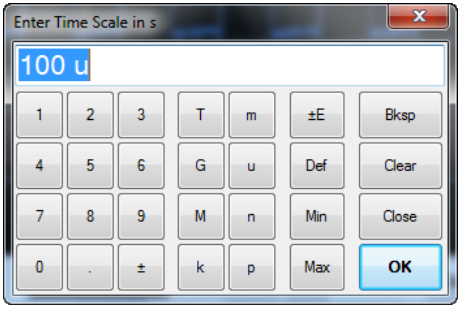


Figure 2-19 Horizontal scale keypad dialog

3 Set the desired value and select **OK** to confirm.

4 You can also adjust the horizontal scale using **+** and **–** as shown in Figure 2-18.

5 To adjust the horizontal offset, select the horizontal offset area on the graphical interface as shown in Figure 2-20.

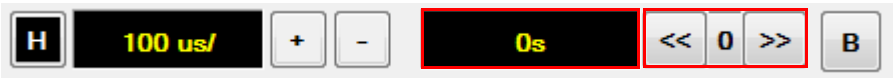


Figure 2-20 Horizontal offset on the graphical interface

6 The horizontal offset keypad dialog is displayed as shown in Figure 2-21.

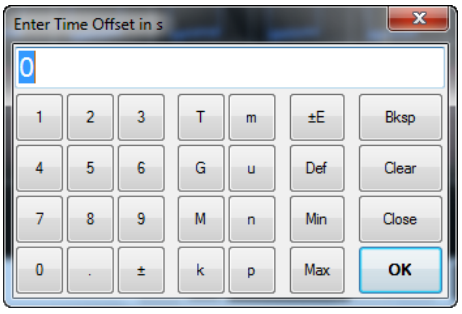


Figure 2-21 Horizontal offset keypad dialog

7 Set the desired value and select **OK** to confirm.

8 You can also adjust the horizontal offset using **<<** and **>>**, or set the offset to zero using **0** as shown in Figure 2-20.

NOTE The step size for the horizontal offset buttons is set to a time scale of 1/50.

Starting and Stopping Waveform Acquisition

The 8990B allows you to perform a continuous or single data acquisition of the waveform from the Run Control section on the front panel or the graphical interface.

Continuous waveform acquisition

Use the following procedures to perform continuous waveform acquisition.

Front panel

1 Press Run Stop in the Run Control section as shown in Figure 2-22 to start a continuous data acquisition of the waveform.

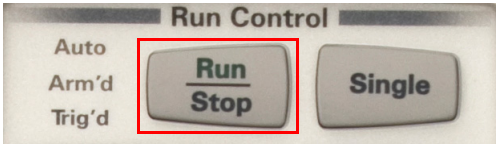


Figure 2-22 Run/Stop button in the Run Control section

2 The Run Stop LED illuminates green when the continuous data acquisition is running.

3 To stop the continuous data acquisition, press Run Stop again in the Run Control section. The Run Stop LED illuminates red when the acquisition is stopped.

Graphical interface

1 Select the start or stop button on the bottom left of the graphical interface to start or stop a continuous data acquisition of the waveform respectively as shown in Figure 2-23.

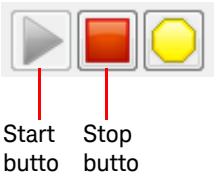


Figure 2-23 Start and stop buttons on the graphical interface

2 The start or stop button is grayed out when you start or stop the continuous waveform acquisition respectively.

Single waveform acquisition

Use the following procedures to perform single waveform acquisition.

Front panel

1 Press Single in the Run Control section as shown in Figure 2-24 to perform a single data acquisition of the waveform.

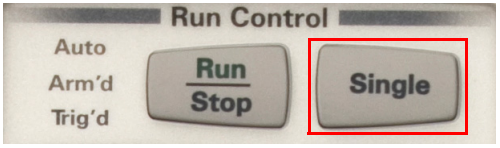


Figure 2-24 Single waveform acquisition button in the Run Control section

2 The Single LED illuminates yellow when the single data acquisition is running.

Graphical interface

Select the Single button on the bottom left of the graphical interface to perform a single data acquisition of the waveform as shown in Figure 2-25.

Figure 2-25 Single waveform acquisition button on the graphical interface

Clearing the Waveform Display

Clearing the waveform display will clear the measurement data, marker information, droop measurement data, and waveform averaging. The 8990B allows you to clear the waveform display from the Horizontal section on the front panel or the graphical interface.

Use the following procedures to clear the waveform display.

NOTE

- When the 8990B is running in a continuous acquisition mode, the Clear Display function clears the current waveform and redraws it.
- Waveform memory will not be cleared when the Clear Display function is used.

Front panel

Press Clear Display in the Horizontal section to clear the waveform display as shown in Figure 2-26.

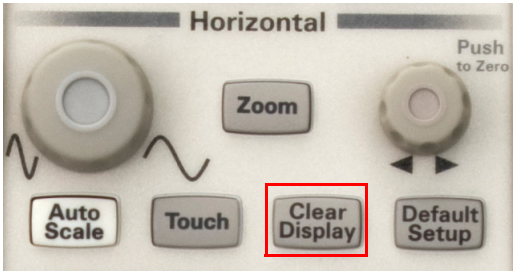


Figure 2-26 Clear Display button in the Horizontal section

Graphical interface

Select **Clear** on the bottom right of the graphical interface to clear the waveform display as shown in Figure 2-27.

Figure 2-27 Clear button on the graphical interface

Equivalent Time Sampling (ETS)

The ETS function in the 8990B is used to increase the effective sampling rate for high bandwidth repetitive signals detection. ETS is implemented by accumulating the samples of the input signals at slightly different starting points and accumulating them over several cycles to construct a complete waveform trace line.

The ETS function auto-ETS is enabled by default. You can enable or disable auto-ETS from the Acquisition Setup dialog. When auto-ETS is enabled, the ETS function is automatically turned on when the horizontal scale is less than the ETS threshold. The ETS threshold can be set to 500 ns, 1 µs, 2 µs, 5 µs, or 10 µs. The default ETS threshold is 500 ns. When auto-ETS is disabled, the ETS function will not be turned on at all.

Use the following procedure to enable the auto-ETS function.

1 Select **Setup > Acquisitions...** on the toolbar as shown in Figure 2-28**.**

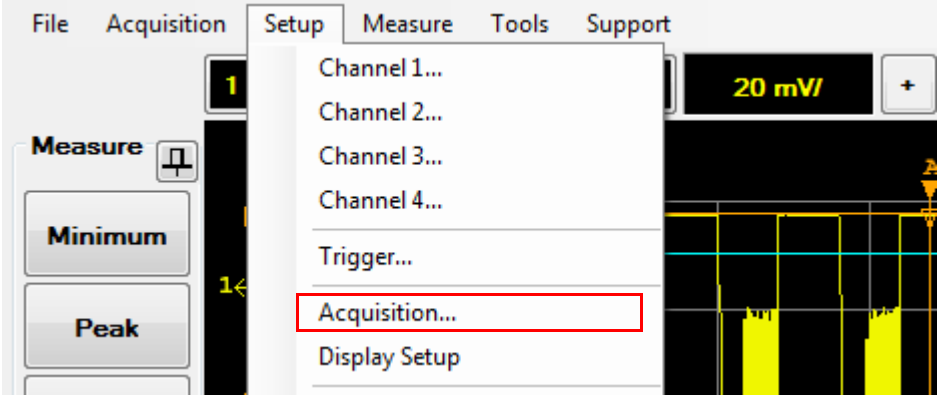


Figure 2-28 Acquisition selection in the Setup menu

2 The Acquisition Setup dialog is displayed as shown in Figure 2-29. Select the **Auto** check box to enable the auto-ETS feature and select the desired ETS threshold. Select the **(Sin x)/x Interpolation** check box to allow 1 GHz analog bandwidth verification.

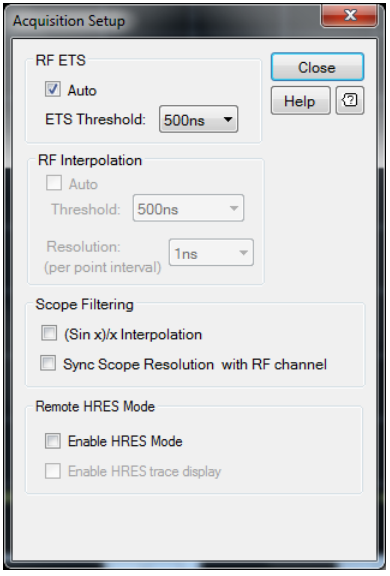


Figure 2-29 Acquisition Setup dialog

3 The ETS status is displayed in the Status view as shown in Figure 2-30. For more information on the Status view, refer to "Status view" on page 130.

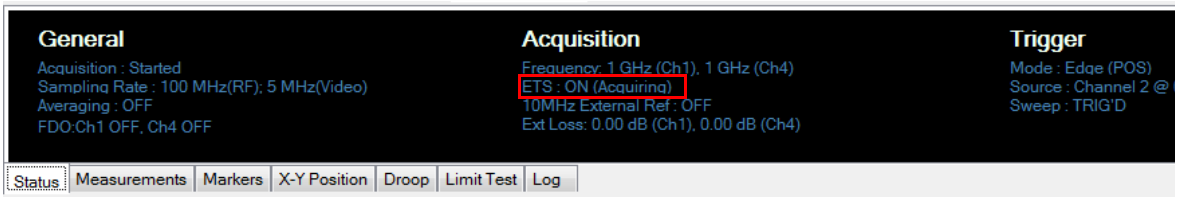


Figure 2-30 ETS status in the status view

For a complete waveform trace, use continuous waveform acquisition. When single waveform acquisition is used, the waveform trace will not be drawn as the

ETS function trace is not completeled. Press Single continuously to allow the ETS function to complete the trace.

For more information on the continuous and single waveform acquisition, refer to "Starting and Stopping Waveform Acquisition" on page 63.

NOTE The ETS function is not supported in Auto trigger mode. Trigger mode will be set to Triggered when ETS is enabled.

NOTE

- When the ETS function is enabled, the allowable horizontal offset settings is limited, depending on the timebase settings. This limitation is to avoid any under-sampling situation that will cause trace distortion.
- In the AUX trigger mode, pressing the **Single** button will ensure that ETS acquisition is completed before returning the trace. You will need to send multiple **Single** commands or press the **Single** button to get the completed ETS trace.

When the ETS function is acquiring data to complete the waveform trace, the ETS status is displayed as shown in Figure 2-31.

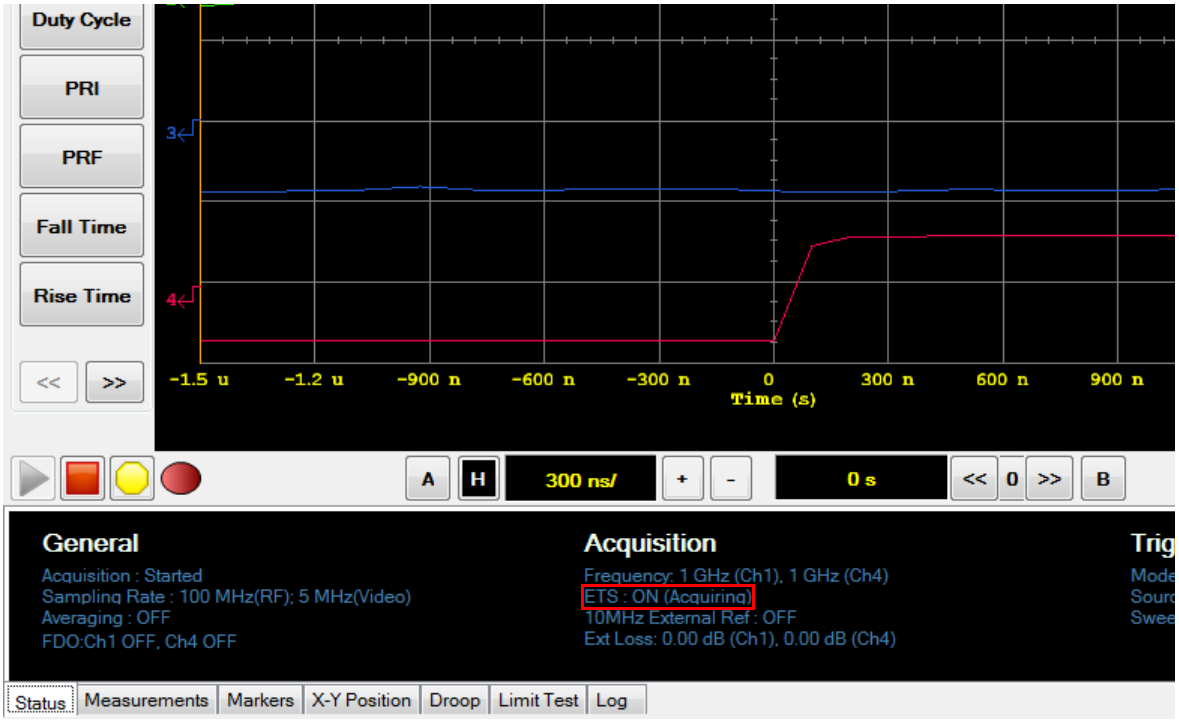


Figure 2-31 ETS acquiring data status in the status view

Setting the Averaging

Averaging uses a digital filter to average repetitions of a triggered signal. The average of a number of acquisitions is calculated to smoothen the displayed trace and reduce apparent noise.

The averaging counts can be in a range of 2 to 2048, in multiples of 2^n. Increasing the value of a measurement average count reduces the noise but increases the time required to make the measurement. The averaging count values are predefined to 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, and 2048.

NOTE **If averaging is turned on in the ETS mode, averaging will only be performed after the ETS operation is completed.**

Use the following procedure to set the averaging.

1 Select **Avg** on the bottom right of the graphical interface to enable the waveform averaging as shown in Figure 2-32.

Figure 2-32 Averaging button on the graphical interface

2 The Averaging dialog is displayed as shown in Figure 2-33.

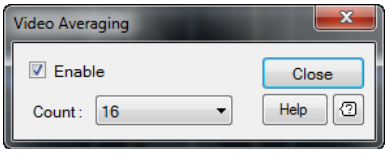


Figure 2-33 Averaging dialog

3 Select the **Enable** check box to turn on the averaging.

4 To change the average count, select the **Count** field on the Averaging dialog to display the count selection as shown in Figure 2-34.

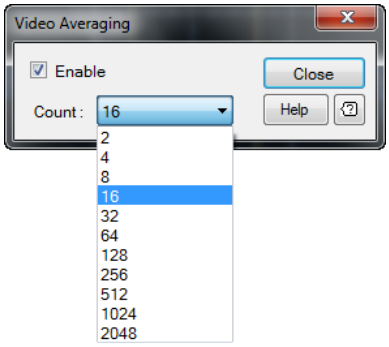


Figure 2-34 Averaging count selection on the Averaging dialog

5 Select the desired averaging count and select **Close**.

6 The waveform averaging status is displayed in the Status view as shown in Figure 2-35.

Figure 2-35 Waveform averaging status in the status view

NOTE For more information on the Status view, refer to "Status view" on page 130.

Enabling Autoscale

Autoscale feature evaluates all input signals and sets the correct conditions to best display the signals. The 8990B will automatically configure the X-axis and Y-axis values. For the X-axis, the horizontal scale is scaled with reference to the higher priority channel in the order of channel 4, 3, 2, and 1 respectively.

A notification dialog is displayed when autoscaling is running. Once autoscaling has completed, the autoscale dialog is displayed. You can undo the autoscaling or close the dialog. Autoscaling can be performed from the front panel or the graphical interface.

Use the following procedures to enable the autoscale.

Front panel

To perform autoscaling, press Auto Scale in the Horizontal section as shown in Figure 2-36.

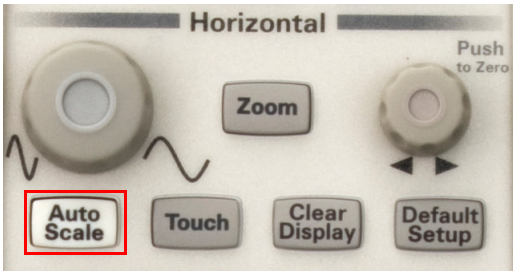


Figure 2-36 Autoscale button in the Horizontal section

Graphical interface

1 Select **Auto-Scale** on the bottom right of the graphical interface as shown in Figure 2-37.

Figure 2-37 Autoscale button on the graphical interface

2 When the autoscale function is running, a notification dialog is displayed as shown in Figure 2-38.

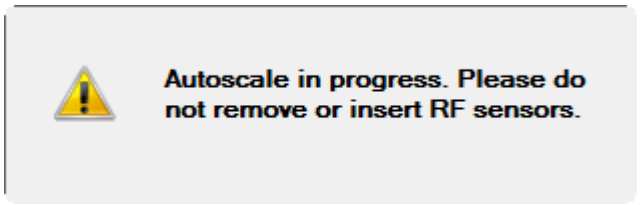


Figure 2-38 Autoscale notification dialog

NOTE Autoscaling may take a few seconds to complete.

3 Once autoscaling has completed, the Undo AutoScale? dialog is displayed as shown in Figure 2-39.

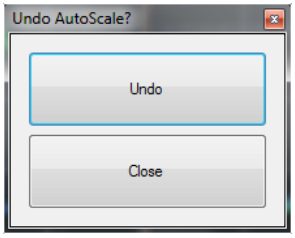


Figure 2-39 Undo AutoScale? dialog

4 Select **Undo** to undo the new settings, or select **Close** to close the Undo AutoScale? dialog. You can also undo autoscale from the **Acquisition** menu on the toolbar.

NOTE The Undo AutoScale? dialog will automatically close after 5 seconds.

Accessing the Trigger Setup

The trigger source can be set to channel 1, 2, 3, or 4, or AUX. For the channel trigger source, you can set the trigger sweep, slope, level, and holdoff. For the AUX trigger source, the trigger level setting is disabled. The 8990B allows you to configure the trigger settings from the Trigger section on the front panel and the Trigger menu on the graphical interface.

Use the following procedures to access the trigger setup.

Front panel

1 To configure the trigger settings, use the individual buttons and knob in the Trigger section, or press Menu to access the Trigger Setup dialog as shown in Figure 2-40.

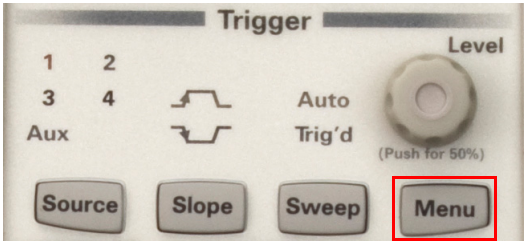


Figure 2-40 Menu button in the Trigger section

2 For more information on the Trigger Setup dialog, refer to Graphical interface.

Graphical interface

1 To configure the trigger settings, select the individual buttons on the Trigger menu to toggle between selections or access the menu dialog as shown in Figure 2-41.

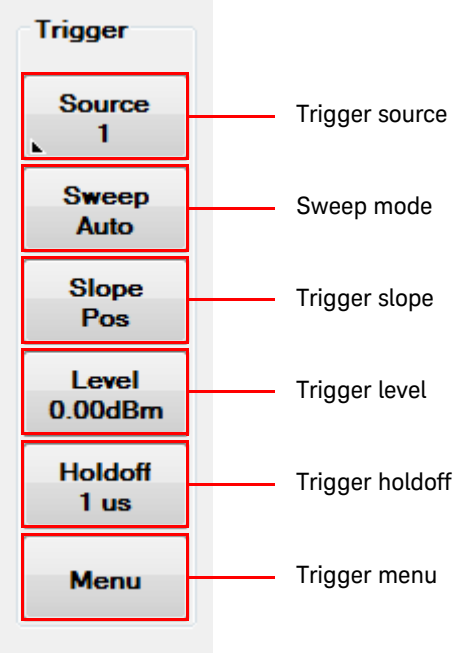


Figure 2-41 Trigger menu on the graphical interface

Source

Select either channel or AUX as the trigger source. The channel selection depends on the connected sensors or probes.

Sweep

Select either auto trigger sweep mode, or normal trigger sweep mode.

Slope

Set the trigger point to the positive slope or negative slope of the signal.

Level

Set the trigger level value to determine the position of the trigger point.

Holdoff

Set the trigger holdoff value to keep the trigger from occuring until after a certain amount of time has passed since the last trigger.

Menu

Display the trigger setup dialog.

2 The Trigger Setup dialog is displayed as shown in Figure 2-42.

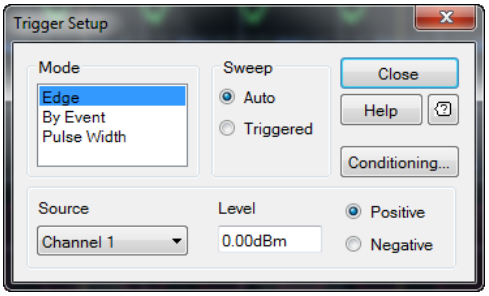


Figure 2-42 Trigger Setup dialog

3 You can set the trigger mode, trigger sweep mode, trigger count, trigger source, trigger level, and trigger slope from the Trigger Setup dialog. Trigger count is only applicable when the trigger mode is By Event. Trigger On, T1, and T2 are only applicable when the trigger mode is Pulse Width.

4 Select **Conditioning...** on the Trigger Setup dialog to display the Trigger Conditioning dialog as shown in Figure 2-43.

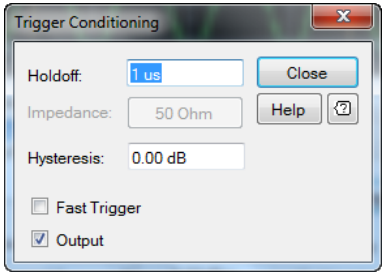


Figure 2-43 Trigger Conditioning dialog

5 You can set the trigger holdoff, impedence, hysteresis, and enable or disable the fast trigger and trigger output.

Fast Trigger

Fast Trigger is essentially a triggering mode where the 8990B sends out a trigger signal whenever the input RF signal crosses the trigger threshold. This is useful for application that requires fast trigger response. When Fast Trigger is disabled, the trigger out is sent only for every capture.

NOTE

Trigger out signal

The behaviors of the trigger out signal with different channel source are listed as follows.

RF input channel 1/4 as the trigger source.

- With fast trigger on, the trigger output pulse train resembles the RF input channel. The trigger output varies according to the RF input pulse with PRF less than 1 MHz.
- Fast Trigger is essentially a triggering mode where the 8990B sends out a trigger signal whenever the RF input signal crosses the trigger threshold. This is useful for application that requires fast trigger response. When Fast Trigger is disabled, the trigger out is sent only for every capture.
- With fast trigger off, the trigger output pulse is 1 µs pulse/capture.

Video input channel 2/3 as the trigger source with a sensor connected.

- The trigger output pulse is 1 µs pulse/capture.

Video input channel 2/3 as the trigger source without any sensor connected.

- The trigger output pulse is 25 ns pulse/capture.

Setting the Measurement Threshold

The measurement thresholds setting customizes the measurement parameters which are amplitude sensitive such as rise time, fall time, and pulse width. The threshold setting enables you to distinguish a valid measurement from a questionable measurement. The default threshold is 0%.

When a threshold is set, the time-related measurement result will be prefixed with a question mark, **?**, if it falls below the threshold value. This is useful to distinguish an invalid measurement as a result of over zooming into a measured pulse top or pulse base.

NOTE

The measurement result will return a question mark if the product of the pulse top and pulse base is lower than the threshold set.

If the vertical scale is in dB/div (log power display), the calculation is as follows.

10Log(Pulse top (W) / |Pulse base (W)|) < Threshold × Vertical scale

If the vertical scale is in W/div (linear power display), the calculation is as follows.

(Pulse top – Pulse base) < Threshold × Vertical scale

For example,

Pulse top: 0 dBm (1 mW)
Pulse base: –69 dBm (0 W)
Vertical scale: 12 dB
Threshold: 50%

10Log (1 mW/0 mW) < 50% × 12 dB
0 dB < 6 dB (invalid measurement)

Use the following procedure to set the measurement threshold.

1 Select **Setup > Measurement Thresholds** on the toolbar as shown in Figure 2-44.

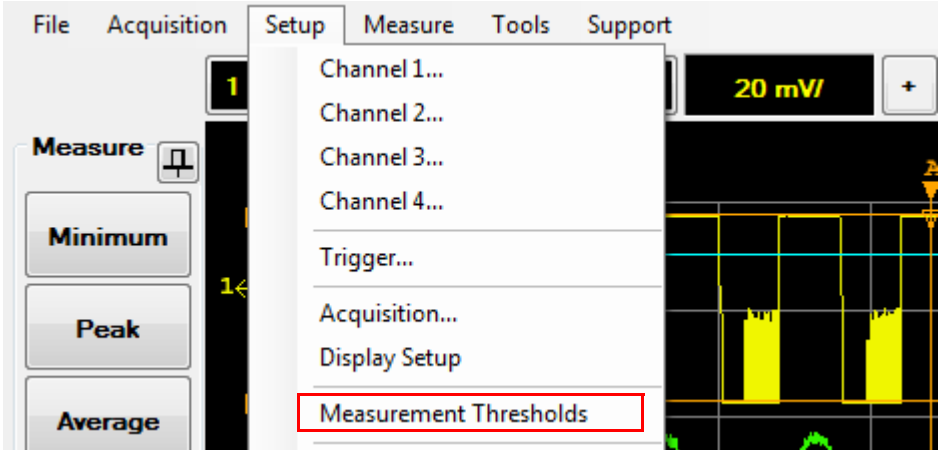


Figure 2-44 Measurement Thresholds selection in the Setup menu

2 The Measurement Thresholds dialog is displayed as shown in Figure 2-45 to allow you to configure the threshold settings for each channel.

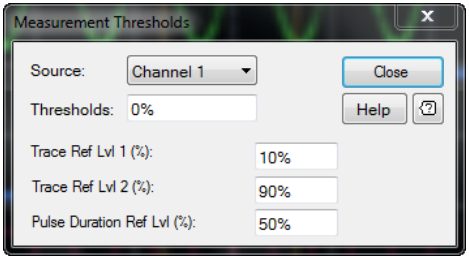


Figure 2-45 Measurement Thresholds dialog

Source

Set the measurement threshold source to channel 1, 2, 3, or 4.

Thresholds

Set the measurement threshold value in percentage.

Trace Ref Lv 1 and 2 (%)

Use in the calculation of transition durations and occurrences.

Pulse Duration Ref Lvl (%)

Allow pulse duration measurements between non-standard reference levels.

Saving and Loading Waveform Memories

The 8990B allows you to save and load the waveform memories.

Use the following procedures to save and load waveform memories.

Saving waveform memories

1 Select **File > Save Waveform...** on the toolbar to save the current 8990B waveform data as a *.csv file as shown in Figure 2-46.

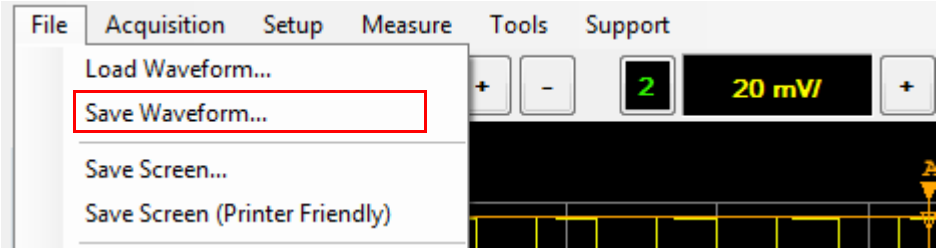


Figure 2-46 Save Waveform... selection in the File menu

2 The Save Waveform dialog is displayed. You can select the input channel to be saved by selecting **Waveform Source** to display the input channel list.

3 Select **Keyboard** on the Save Waveform dialog to display the on-screen keyboard as shown in Figure 2-52. This is useful when there is no keyboard connected to the 8990B.

Loading waveform memories

Select **File > Load Waveform...** on the toolbar to load a *.csv waveform data file as shown in Figure 2-47.

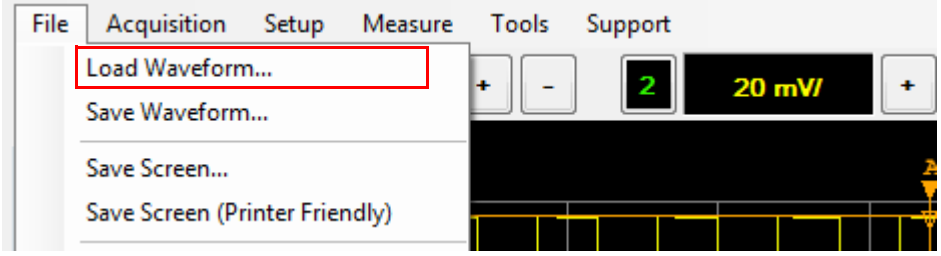


Figure 2-47 Load Waveform... selection in the File menu

You can also set four waveform memories and load the waveform data from the channels, waveform memories, or a CSV file from the Waveform Memory dialog.

Use the following procedure to configure the waveform memories.

1 Select **Setup > Waveform Memory** on the toolbar as shown in Figure 2-48.

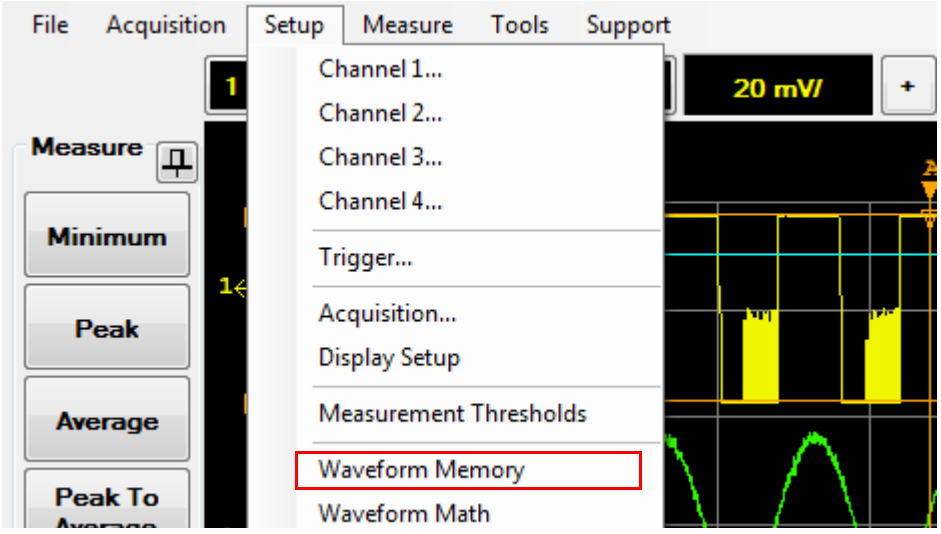


Figure 2-48 Waveform memory selection in the Setup menu

2 The Waveform Memory dialog is displayed as shown in Figure 2-49.

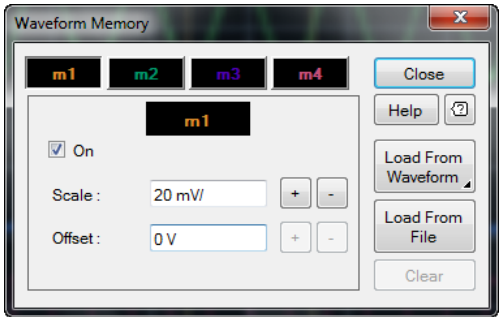


Figure 2-49 Waveform Memory dialog

3 Select the **On** check box to enable the waveform memory. You can set the vertical scale and offset. Select the **m1**, **m2**, **m3**, or **m4** tab to toggle among the four available waveform memories.

4 Select **Load From Waveform** to load the waveform from channel 1 to 4 or waveform memory as shown in Figure 2-50. The waveform memory selection is only available if the waveform memory is enabled.

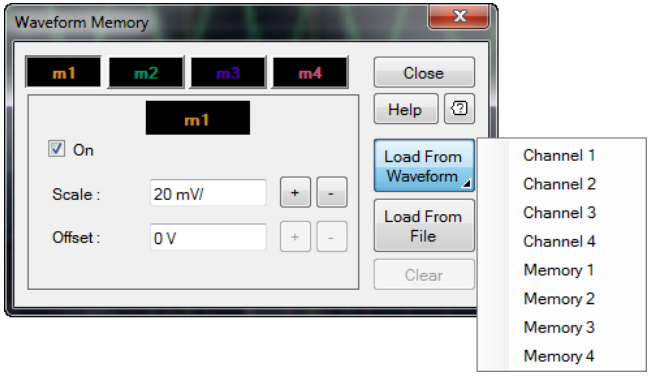


Figure 2-50 Load from waveform selection

5 Select **Load From File** to load the waveform from a CSV file.

6 The Load Waveform dialog is displayed as shown in Figure 2-51. You can select the waveform memory for the waveform data file to load into by selecting the **Load to memory** to display the waveform memory list.

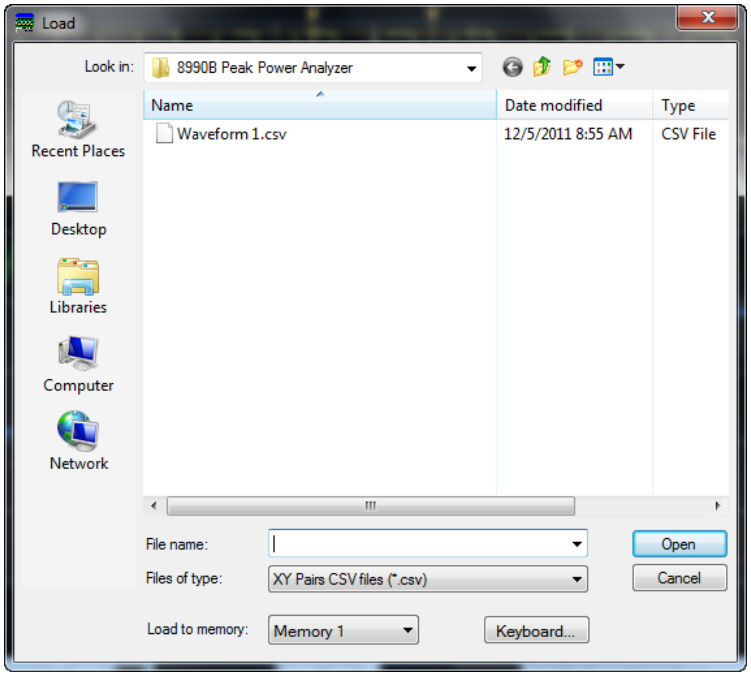


Figure 2-51 Load waveform from file

7 Select **Keyboard** on the Load Waveform dialog to display the on-screen keyboard as shown in Figure 2-52. This is useful when there is no keyboard connected to the 8990B.

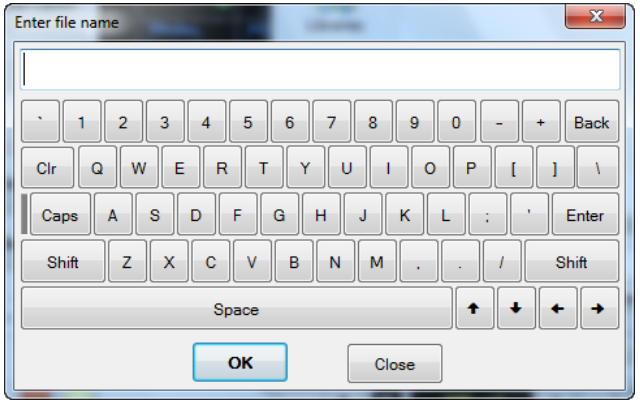


Figure 2-52 On-screen keyboard

Performing Waveform Math Operations

The 8990B allows you to perform math operations on a pair of channels with the same measurement unit.

Use the following procedure to perform waveform math operations.

1 Select **Setup > Waveform Math** on the toolbar as shown in Figure 2-53.

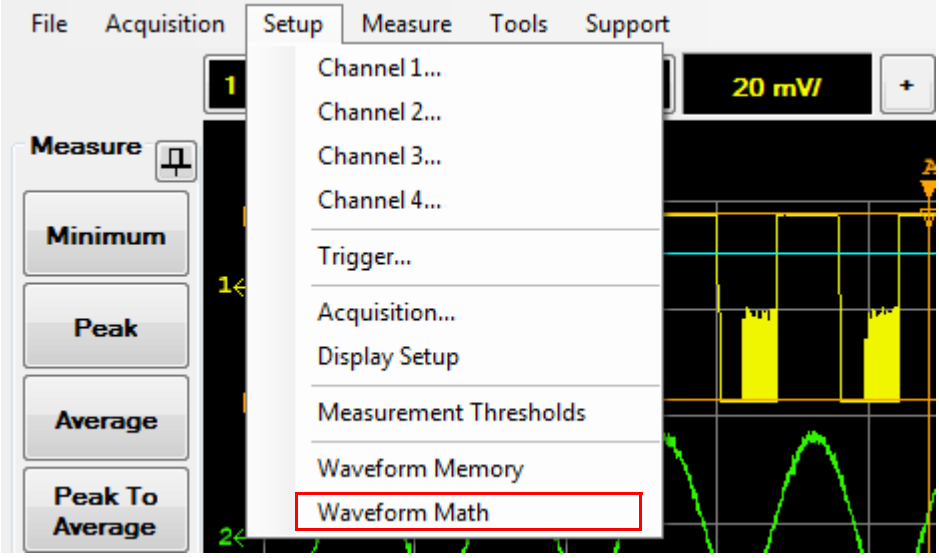


Figure 2-53 Waveform Math selection in the Setup menu

2 The Waveform Math dialog is displayed as shown in Figure 2-54 to allow you to select the channel source and the type of math operation to perform. The available math operations are Add, Averaging, Common mode, Divide, Invert, Magnify, Multiply, Power-added efficiency, Power-added efficiency 2, Subtract, Square, and Square Root.

3 Denominator clipping is only available for math operations that involve division such as Divide, Power-added efficiency, and Power-added efficiency 2. Displaying the trace in percentage settings are only applicable for Power-added efficiency and Power-added efficiency 2 math operations.

4 Select the **On** check box to display the desired math operation result.

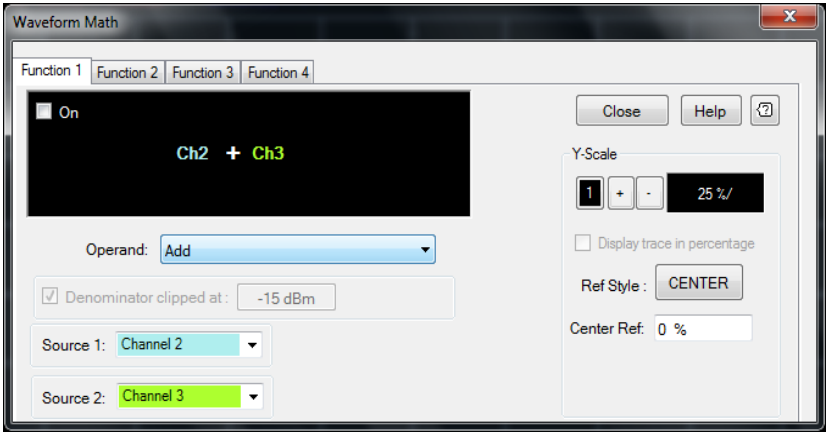


Figure 2-54 Waveform Math dialog

5 You can select the **Function 1**, **Function 2**, **Function 3**, or **Function 4** button to access the math operation setup for the desired math operation function. You may choose to display either one or both of the math operation function.

6 The resultant trace waveform of the math operation is displayed on the display layout in white or green depending on the math operation function used.

7 An example of a resultant trace waveform is displayed as shown in Figure 2-55.

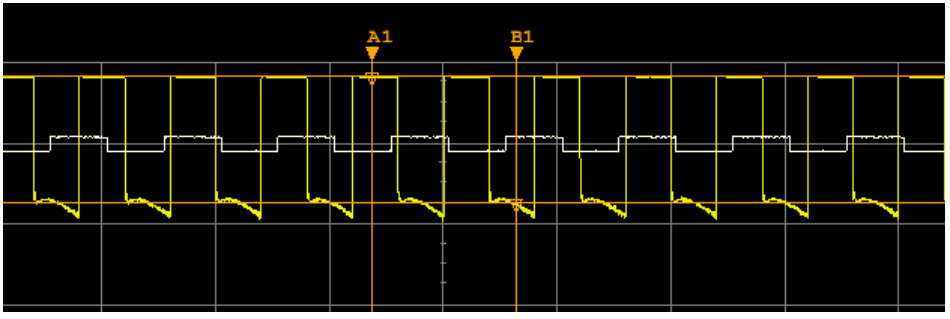


Figure 2-55 Resultant trace waveform of the math operation

Add

The add math operation adds source 1 and source 2 trace values, point by point.

NOTE

- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the add math operation. The resultant trace is then converted back to dBm.
- If the trace length between the channels is not equal, the waveform math operation will find the shortest trace between the sources and shrink other traces to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.

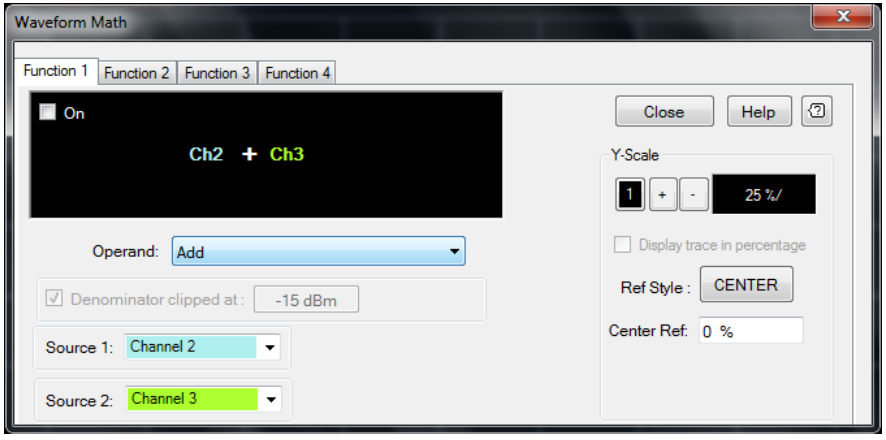


Figure 2-56 Add

Averaging

The 8990B allows you to perform the Averaging math operation that acquires the waveform data from several acquisitions and averages the traces. The higher the average count is, the less impact each new waveform has on the cumulative-averaged waveform. It is different with video averaging as it performs only on a single channel.

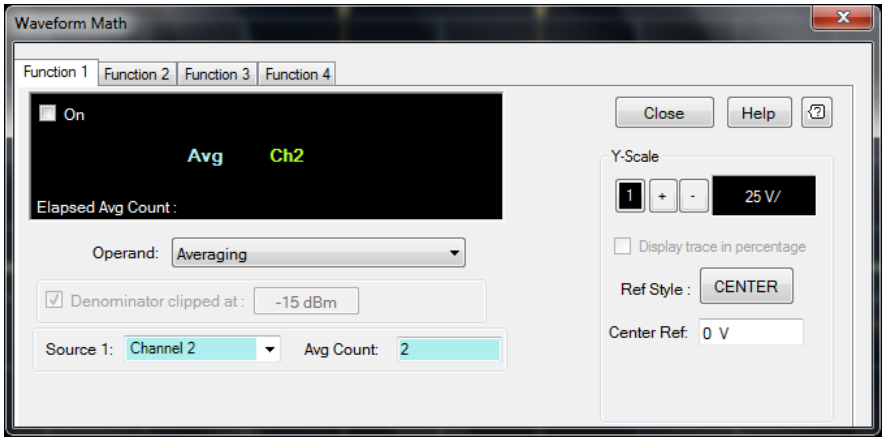


Figure 2-57 Averaging

Setting the averaging math operation

1. Select **Average** at the Waveform Math dialog as shown in Figure 2-57.
2. When the waveform math is enabled, the elapsed average count will start to update, showing the number of waveforms that is acquired.
3. The example in Figure 2-57 acquires 10 traces from channel 1 and averages the traces point by point. It calculates the average of each data point. After the elapsed average count is reached, the previously acquired trace will be removed and replaced with a newly acquired trace.

Common mode

The common mode math operation is used to look for the common mode component of the differential waveforms. This operation will add source 1 and source 2 trace values and divides the value by two, point by point.

NOTE

- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the common mode math operation. The resultant trace is then converted back to dBm.
- If the trace length between the channels is not equal, the waveform math operation will find the shortest trace between the sources and shrink other traces to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.

Figure 2-58 Common Mode

Divide

The divide math operation divides source 1 and source 2 trace values, point by point.

NOTE

- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the divide math operation. The resultant trace is then converted back to dB.
- If the trace length between the channels is not equal, the waveform math operation will find the shortest trace between the sources and shrink the other trace to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.

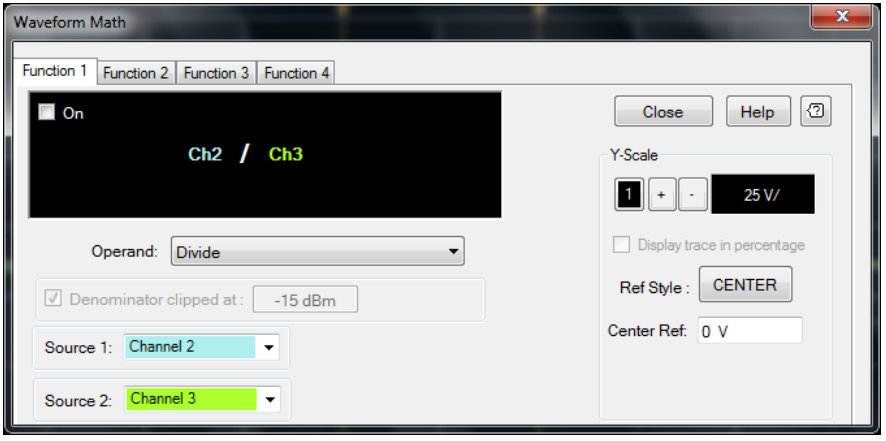


Figure 2-59 Divide

Invert

The invert math operation inverts the sign of the waveform trace values, point by point.

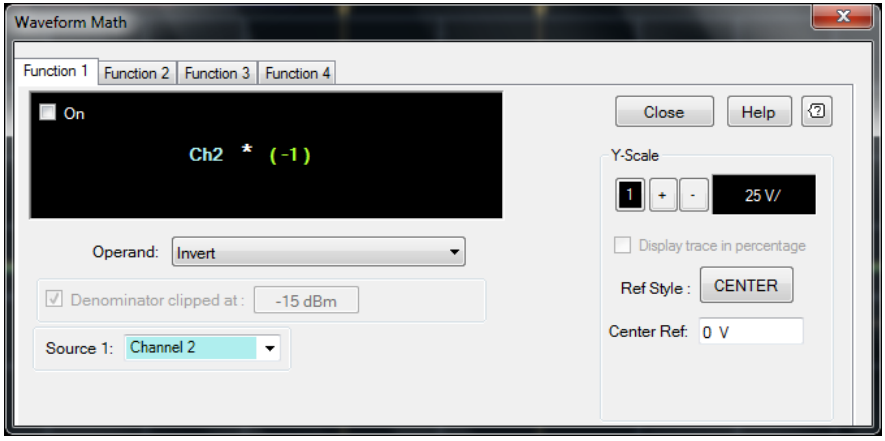


Figure 2-60 Invert

Magnify

The magnify math operation allows you to magnify or reduce the source 1 waveform in vertical directions. This operation is performed on an acquired waveform. Therefore, the resolution is the same as the original acquisition no matter how large the waveform is magnified.

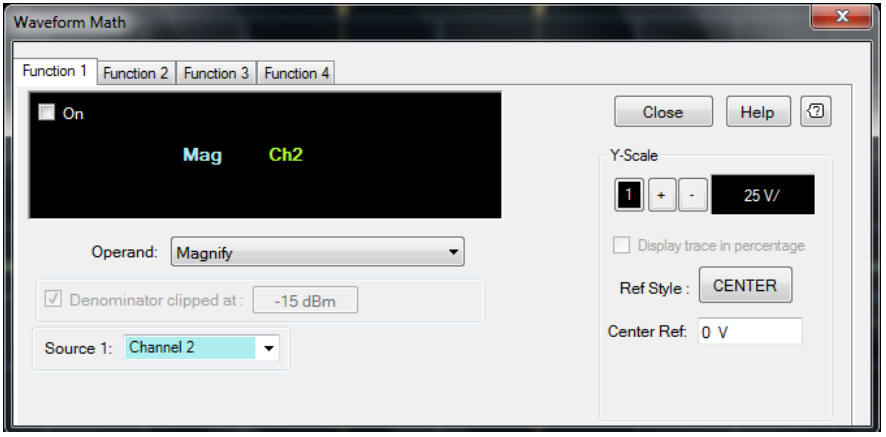


Figure 2-61 Magnify

Multiply

The multiply math operation multiplies source 1 and source 2 trace values, point by point.

NOTE

- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the multiply math operation. The resultant trace will have the undefined (UDF) unit.
- If the trace length between the channels is not equal, the waveform math operation will find the shortest trace between the sources and shrink other traces to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.

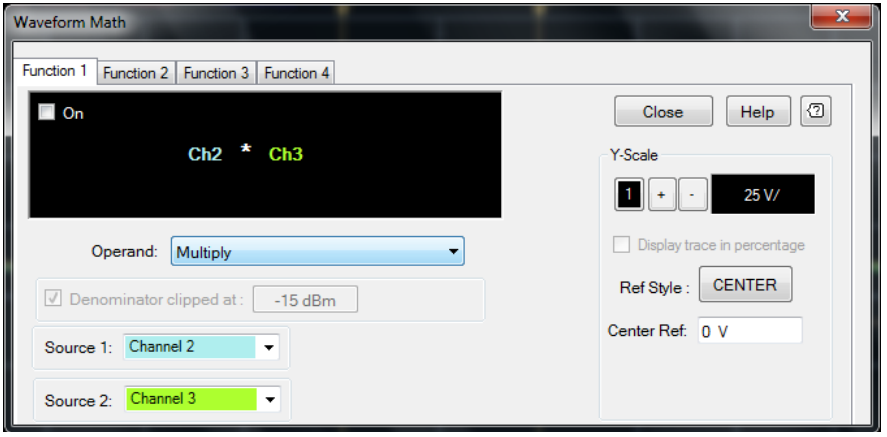


Figure 2-62 Multiply

Power-added efficiency

The 8990B allows you to perform power-added efficiency measurements. Power-added efficiency is the measure of the power conversion efficiency of the power amplifiers. The formula for power-added efficiency is as follows:

$$\text{Power-added efficiency (in \%)} = [(P_{RFout} - P_{RFin})/P_{DC}] \times 100\%$$
$$= [(P_{RFout} - P_{RFin})/(V_{DC} - I_{DC})] \times 100\%$$

P_{RFout} = Power in watts, which can be set to RF input channel 1 or 4

P_{RFin} = Power in watts, which can be set to RF input channel 1 or 4

$P_{DC} = V_{DC} \times I_{DC}$

V_{DC} = Voltage supplied, which can be set to video input channel 2 or 3

I_{DC} = Current supplied, which can be transduce voltage from video input channel 2 or 3

For example, I_{DC} = Voltage across (V)/Resistance (Ω) = (1/R) video input channel 2 or 3

NOTE

- If the amplifier gain is more than 30 dB, the nominator can be set to a single RF input channel.
- The power-added efficiency result is an absolute and non-negative value.
- The denominator P_{DC} must be a real and non-zero value.
- The dBm and power conversion formula is 10 × log (*power/1 mW*)
- If the trace lengths among the channels are not equal, the waveform math operation will find the shortest trace among the sources and shrink the other traces to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.
- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the power-added efficiency measurement.

Setting the power-added efficiency measurement

1 Select **Power-added efficiency** at the Waveform Math dialog as shown in Figure 2-63.

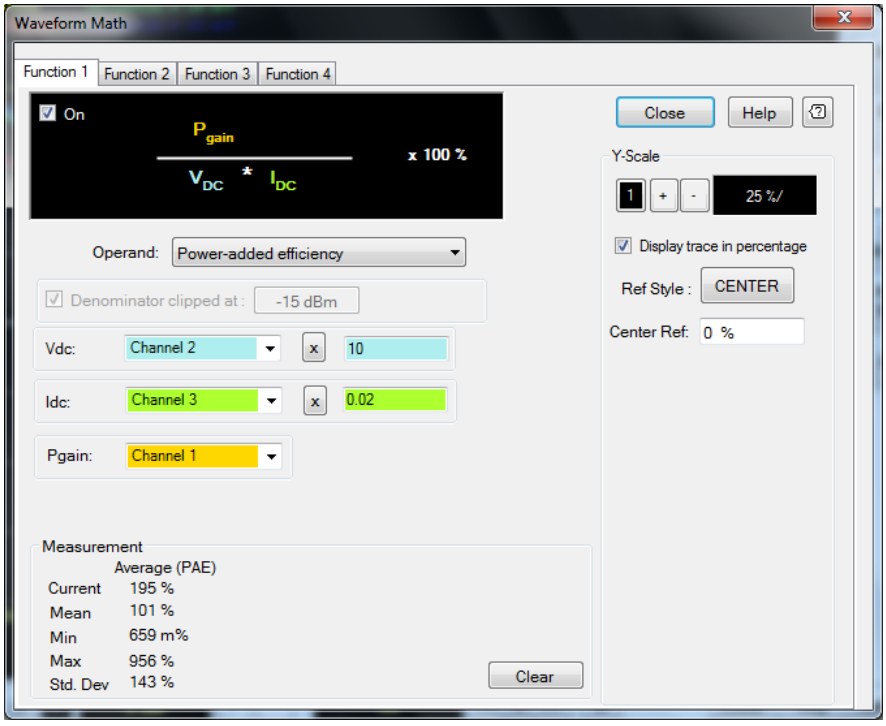


Figure 2-63 Power-added efficiency

2 Select the **On** check box to display the power-added efficiency measurement result.

3 Compare the setting at the Waveform Math dialog with the power-added efficiency formula.

Pgain = Channel 1 = $P_{RFout} - P_{RFin}$

Vdc = 10 × Channel 2

Idc = (1/R) Channel 3 = 0.02 × Channel 3

4 Toggle the **X** button to select between the multiplication symbol (**x**) or division symbol (**/**) as the symbol type. If the multiplication symbol (**x**) is used, the constant value sent through SCPI will be updated in the text box accordingly. If the division symbol (/) is used, the constant value sent through SCPI will be displayed as 1/(constant value) in the text box.

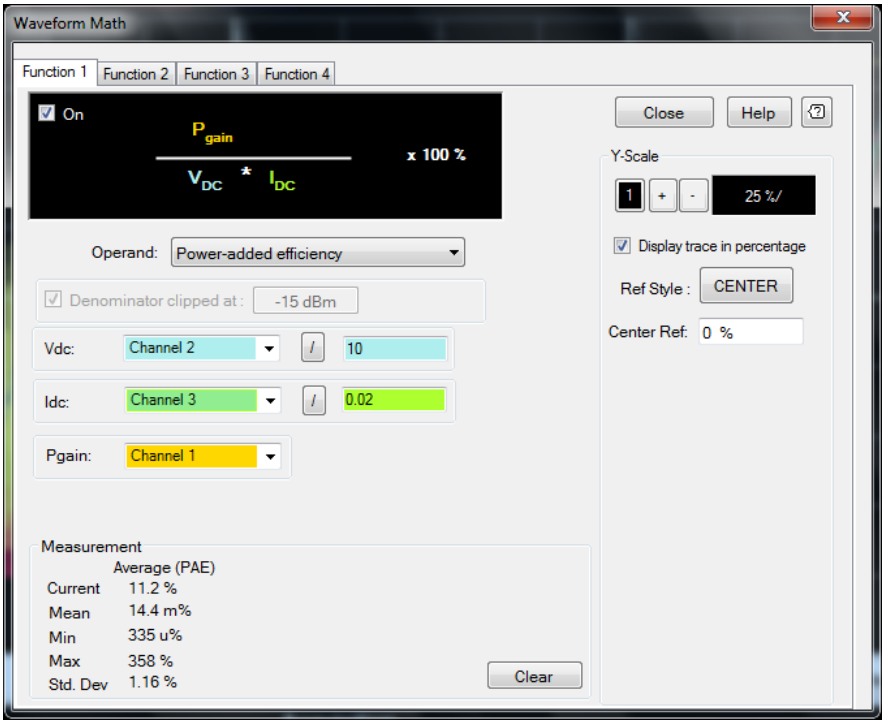


Figure 2-64 Power-added efficiency with division symbol (/)

5 The calculated power-added efficiency measurement result is in %.

6 Unselect the **Display trace in percentage** check box to display the result in ratio.

Setting the power-added efficiency 2 measurement

1 Select **Power-added efficiency 2** at the Waveform Math dialog as shown in Figure 2-65.

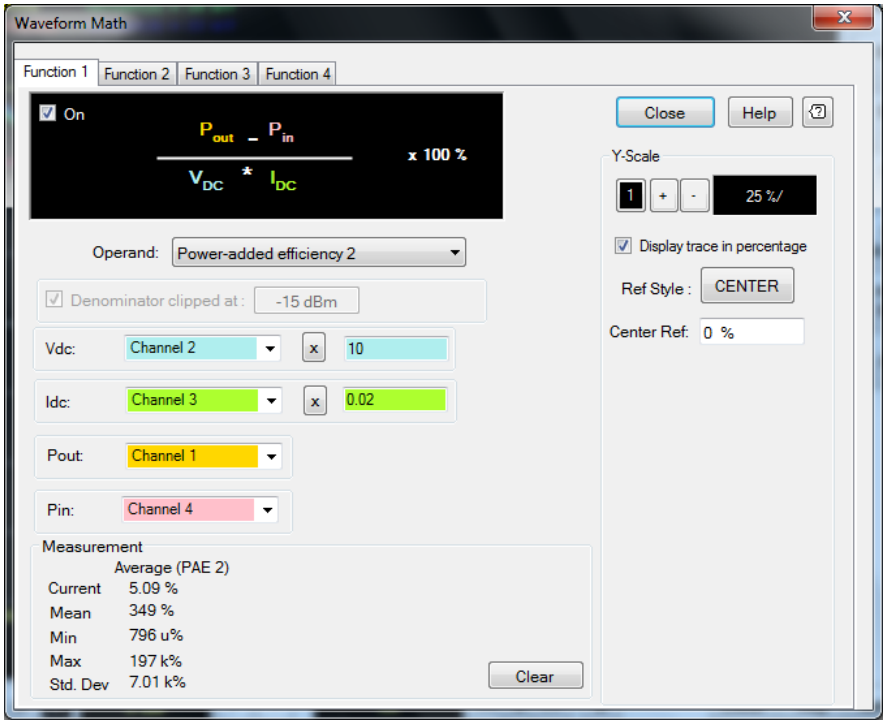


Figure 2-65 Power-added efficiency 2 with multiplication symbol (x)

2 Select the **On** check box to display the power-added efficiency measurement result.

3 Compare the setting at the Waveform Math dialog with the power-added efficiency formula.

Pout = Channel 1 = P_{RFout}

Pin = Channel 4 = P_{RFin}

Vdc = 10 × Channel 2

Idc = (1/R) Channel 3 = 0.02 × Channel 3

4 Toggle the **X** button to select between the multiplication symbol (**x**) or division symbol (**/**) as the symbol type. If the multiplication symbol (**x**) is used, the constant value sent through SCPI will be updated in the text box accordingly. If the division symbol (/) is used, the constant value sent through SCPI will be displayed as 1/(constant value) in the text box.

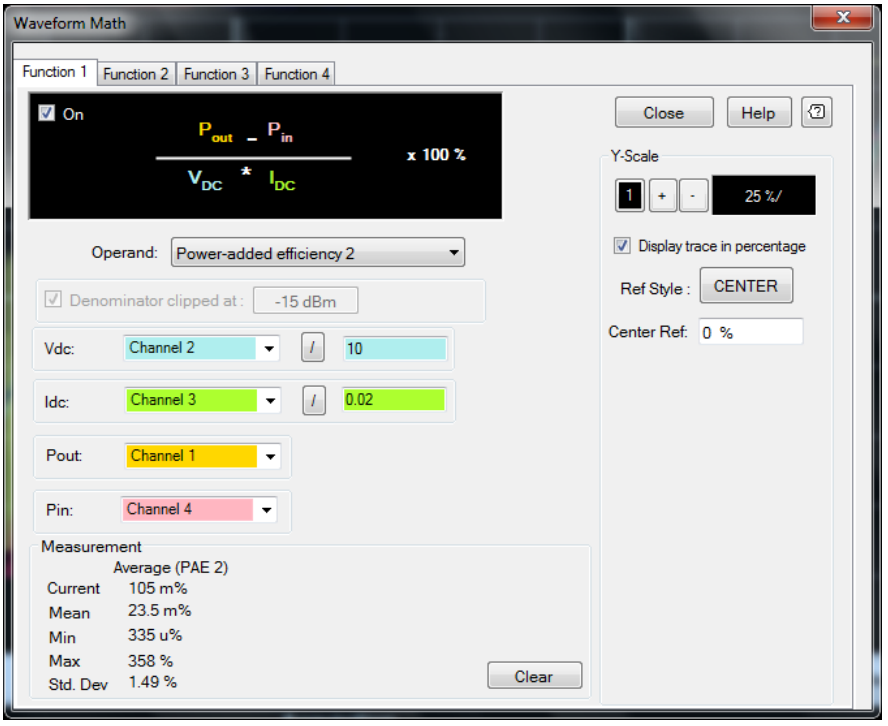


Figure 2-66 Power-added efficiency 2 with division symbol (/)

5 The calculated power-added efficiency measurement result is in %.

6 Unselect the **Display trace in percentage** check box to display the result in ratio.

Setting the power-added efficiency 3 measurement

1 Select **Power-added efficiency 3** at the Waveform Math dialog as shown in Figure 2-67.

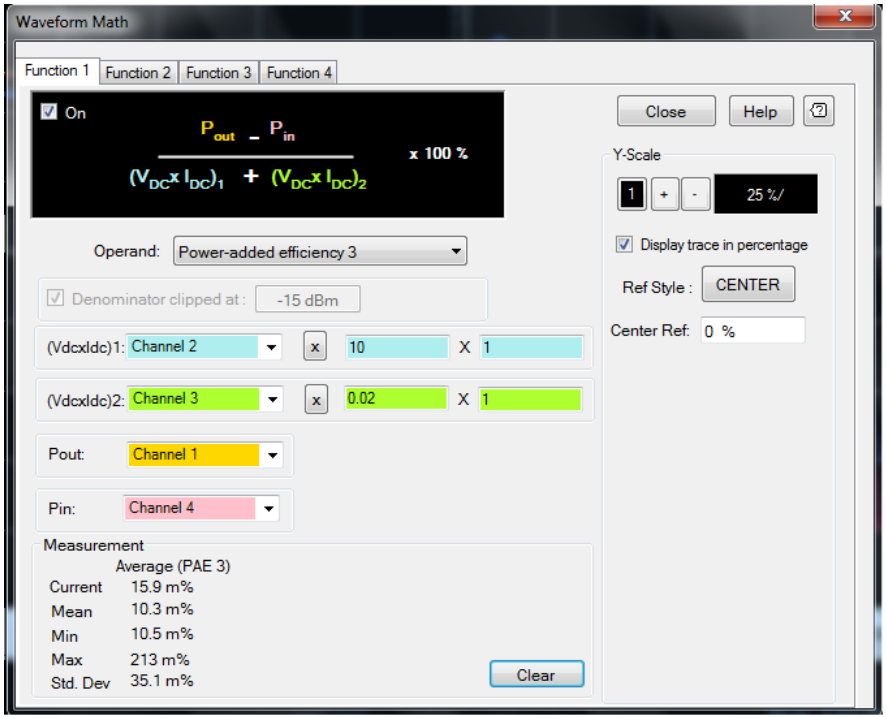


Figure 2-67 Power-added efficiency 3 with multiplication symbol (x)

2 Select the **On** check box to display the power-added efficiency measurement result.

3 Compare the setting at the Waveform Math dialog with the power-added efficiency formula.

Pout = Channel 1 = P_{RFout}

Pin = Channel 4 = P_{RFin}

$(Vdc \times Idc)_1$ = Channel $2 \times 10 \times 1$

$(Vdc \times Idc)_2$ = Channel $3 \times 0.02 \times 1$

4 Toggle the **X** button to select between the multiplication symbol (**x**) or division symbol (**/**) as the symbol type. If the multiplication symbol (**x**) is used, the constant value sent through SCPI will be updated in the text box accordingly. If the division symbol (/) is used, the constant value sent through SCPI will be displayed as 1/(constant value) in the text box.

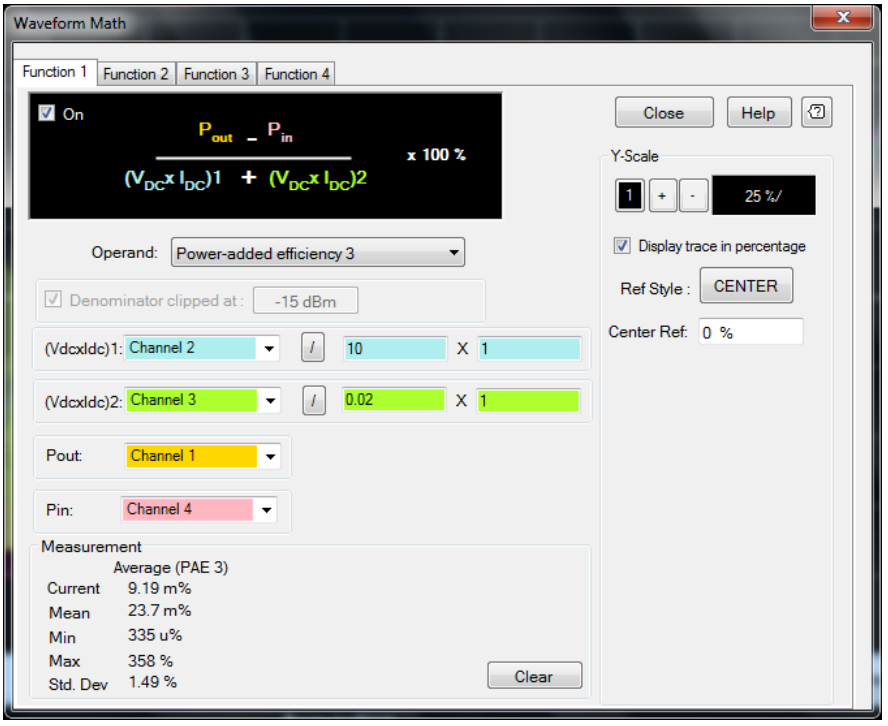


Figure 2-68 Power-added efficiency 3 the division symbol (/)

5 The calculated power-added efficiency measurement result is in %.

6 Unselect the **Display trace in percentage** check box to display the result in ratio.

Subtract

The subtract math operation subtracts source 1 and source 2 trace values, point by point.

NOTE

- If the source(s) input is in the log scale, it will be converted to the linear scale to perform the subtract math operation. The resultant trace is then converted back to dBm.
- If the trace length between the channels is not equal, the waveform math operation will find the shortest trace between the sources and shrink other traces to an equal length.
- If the number of trace points is not equal, the waveform math operation will add trace points by using the PCHIP method.

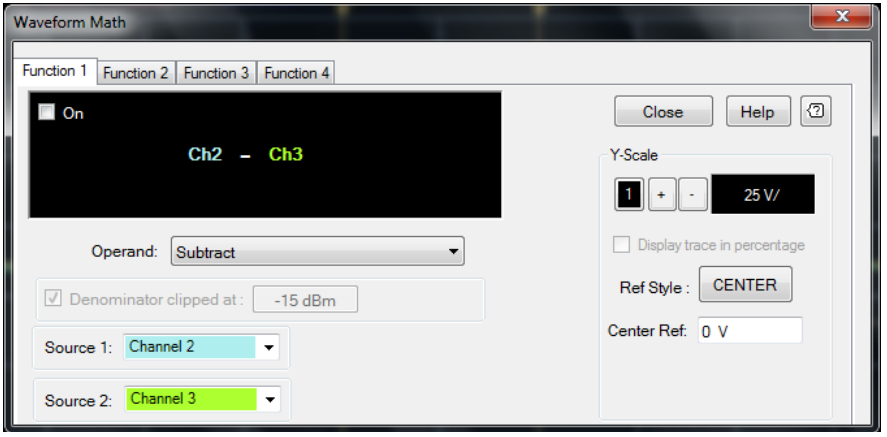


Figure 2-69 Subtract

Square

The square math operation squares the channel waveform, point by point.

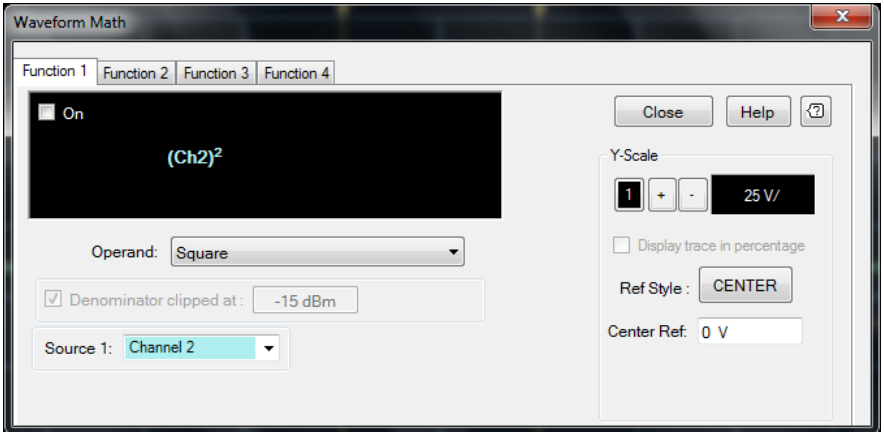


Figure 2-70 Square

Square root

The square root math operation calculates the squsre root of source 1, point by point.

NOTE If any of the source 1 trace points is less than zero, it will be clipped to zero as the square root operation is not able to calculate negative values.

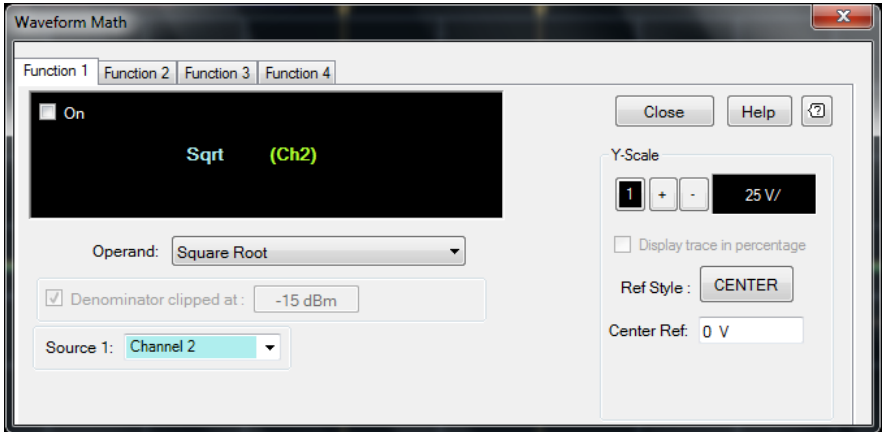


Figure 2-71 Square root

Setting the Frequency-Dependent Offset (FDO)

FDO tables provide a quick and convenient method of compensating for frequency-related changes. When selected, frequency-dependent offset corrections are applied in addition to any correction for RF input channels frequency response. The 8990B is capable of storing 10 frequency-dependent offset tables with a maximum of 80 frequency points each.

Use the following procedure to set the FDO tables.

1 Select **Tools > FDO** on the toolbar as shown in Figure 2-72.

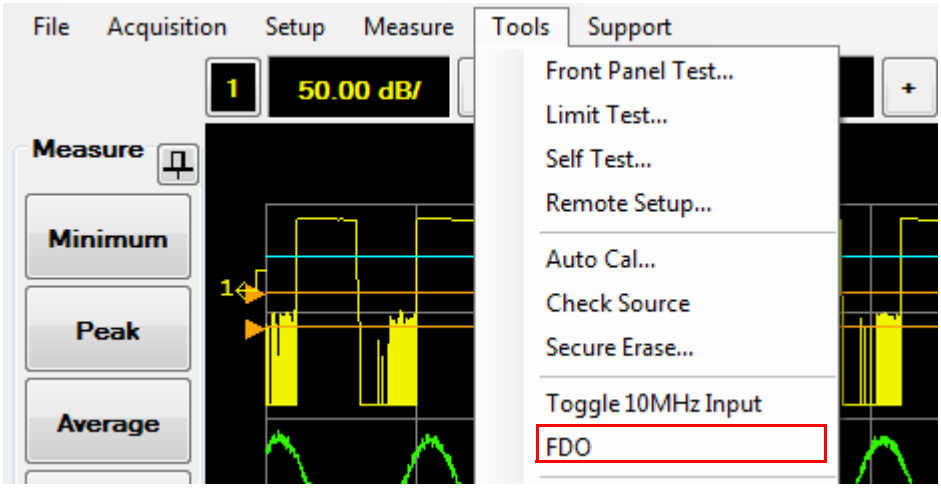


Figure 2-72 FDO selection in the Tools menu

2 The FDO Table dialog is displayed as shown in Figure 2-73 to allow you to select and configure the FDO table.

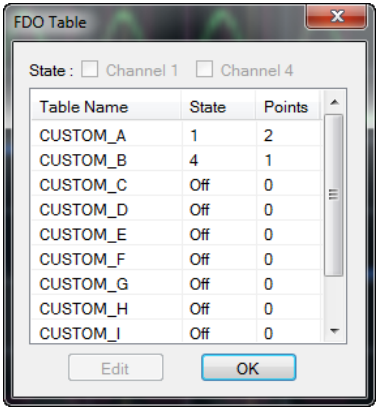


Figure 2-73 FDO Table dialog

3 Select the desired custom FDO table name, and select either the **A Table** or **B Table** check box, or both to set the custom FDO table state to apply on RF input channel 1 or 4, or both channels.

4 To display the custom FDO table data dialog, select the desired custom FDO table name, and select **Edit** as shown in Figure 2-74, or double-click or double-touch the desired custom FDO table name.

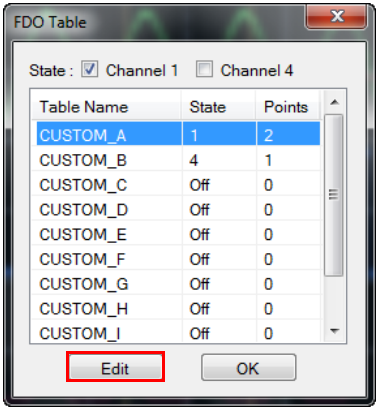


Figure 2-74 Edit button

5 The selected custom FDO table data dialog is displayed as shown in Figure 2-75.

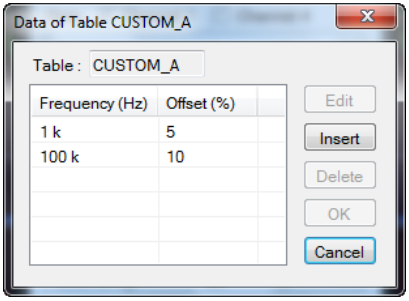


Figure 2-75 Custom FDO table data dialog

6 Select **Insert** to add a new frequency point. Insert the desired frequency point and offset in the New Data dialog as shown in Figure 2-76.

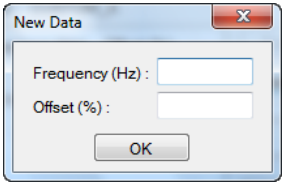


Figure 2-76 New Data dialog

7 The FDO status is displayed in the Status view as shown in Figure 2-77. For more information on the Status view, refer to "Status view" on page 130.

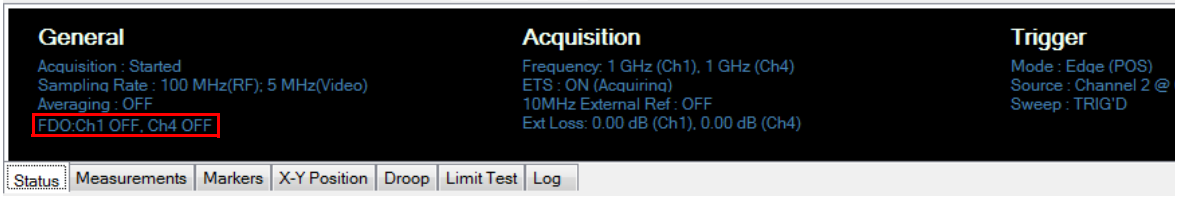


Figure 2-77 FDO status in status view

Magnifying a Section of the Waveform Using Zoom

The Zoom function allows you to magnify a section of the waveform up to 30 times of the current horizontal scale.

Use the following procedures to magnify a section of the waveform.

Front panel

1 To perform the zoom function, press Zoom in the Horizontal section as shown in Figure 2-78.

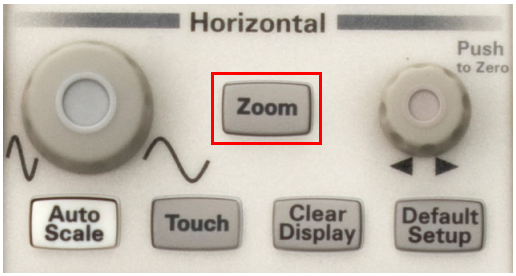


Figure 2-78 Zoom button in the Horizontal section

2 Press Zoom in the Horizontal section to close the zoom function.

Graphical interface

1 Select **Acquisition** > **Zoom** on the toolbar as shown in Figure 2-79.

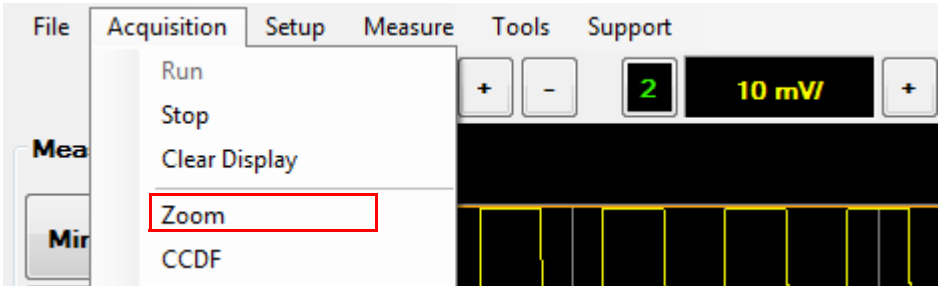


Figure 2-79 Zoom selection in the Acquisition menu

2 A rectangle frame is displayed at the main graph window to indicate the area that is magnified as shown in Figure 2-81. The magnified section of the waveform is displayed below the main graph.

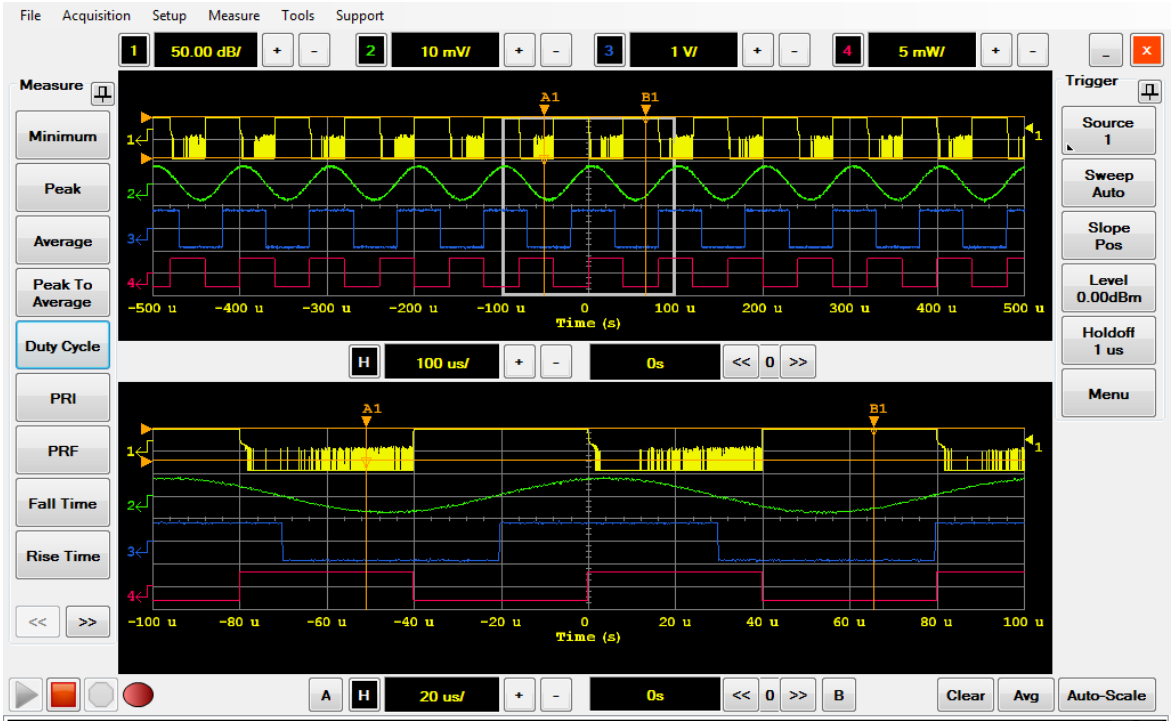


Figure 2-80 Rectangle frame at the main graph window in zoom display layout

3 Adjust the horizontal scale to increase or decrease the magnified area, or adjust the horizontal offset to shift the rectangle at the main graph window.

NOTE You can also use the horizontal scale and offset knobs at the horizontal section in the front panel to adjust the scaling. The horizontal scale knob is adjustable in factors of 1, 2, and 5.

4 The Measurement view on the multi-purpose pane will display the measurement results of the magnified section of the waveform as shown in Figure 2-81.

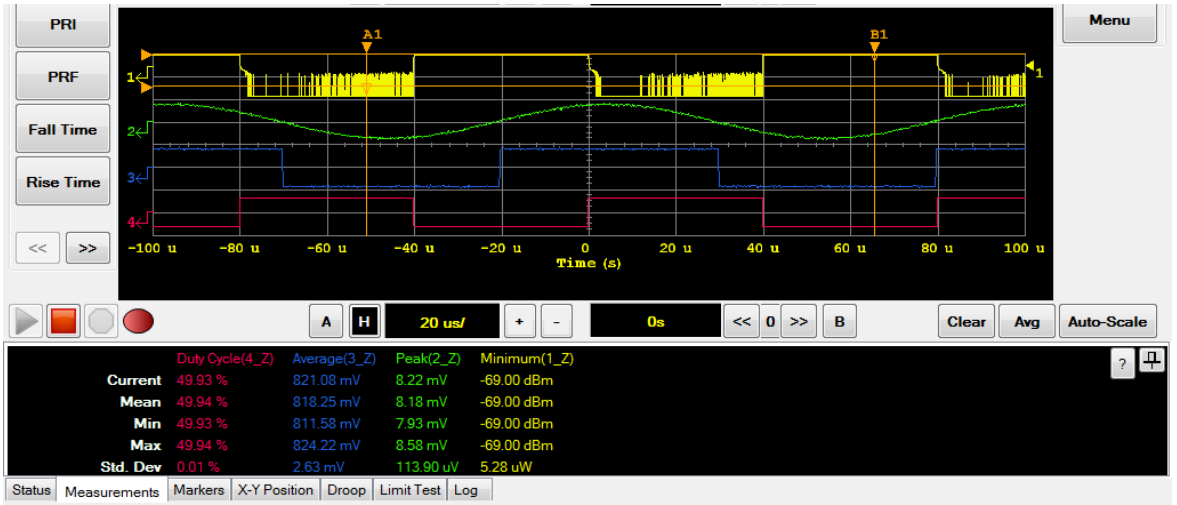


Figure 2-81 Measurement view in zoom display layout

5 Select **Acquisition > Zoom** on the toolbar to close the Zoom function.

Splitting the Waveform Screen

The 8990B allows you to separate the waveform display to four split screens according to the channels.

1 Select **Acquisition > Split Screen** on the toolbar as shown in Figure 2-82.

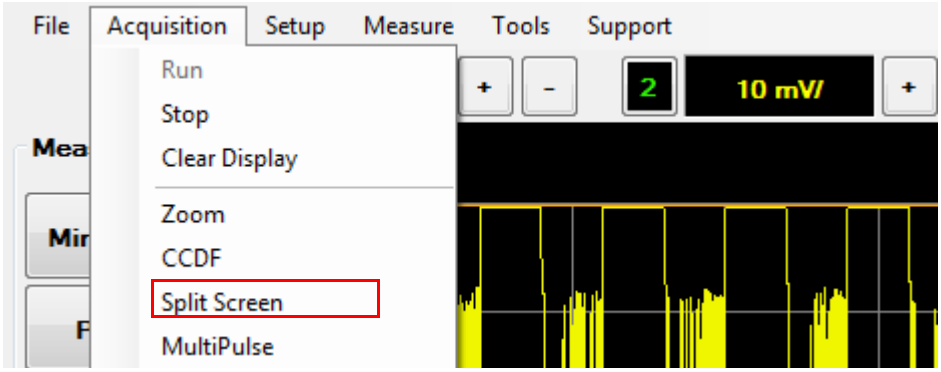


Figure 2-82 Split Screen selection in the Acquisition menu

2 An example of the split screen is as shown in Figure 2-83.

Figure 2-83 Split screens

Displaying the Complementary Cumulative Distribution Function (CCDF) Information

NOTE **CCDF information is only available for RF input channels. When the CCDF feature is used, the video input channels will be disabled.**

A CCDF curve is defined by how much time the waveform spends at or above a given power level. This is expressed in dB relative to the average power. A CCDF curve is a plot of relative power levels versus probability where the X-axis represents the dB above the average signal power, while the Y-axis represents the percent of time the signal spends at or above the power level specified by the X-axis.

The CCDF feature will display the CCDF curve on a separate graph. When the CCDF feature is used, you can toggle among four types of views to display on the multi-purpose pane: status view, table view, marker view, and log view.

Use the following procedure to display the CCDF information.

1 Select **Acquisition > CCDF** on the toolbar as shown in Figure 2-84.

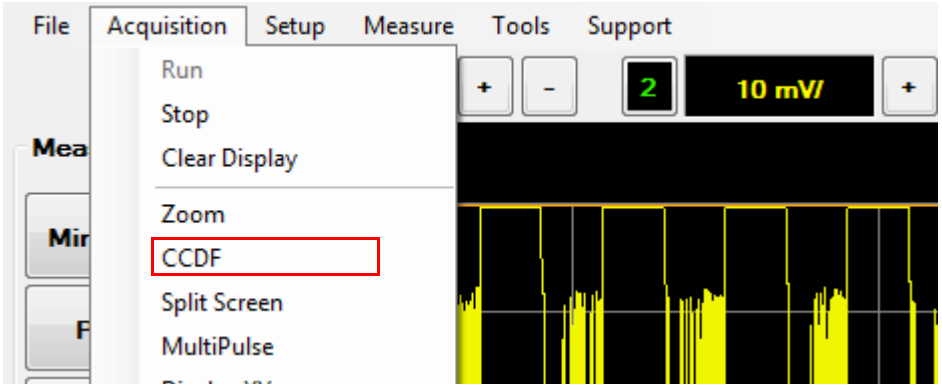


Figure 2-84 CCDF selection in the Acquisition menu

2 The CCDF graph is displayed as shown in Figure 2-85.

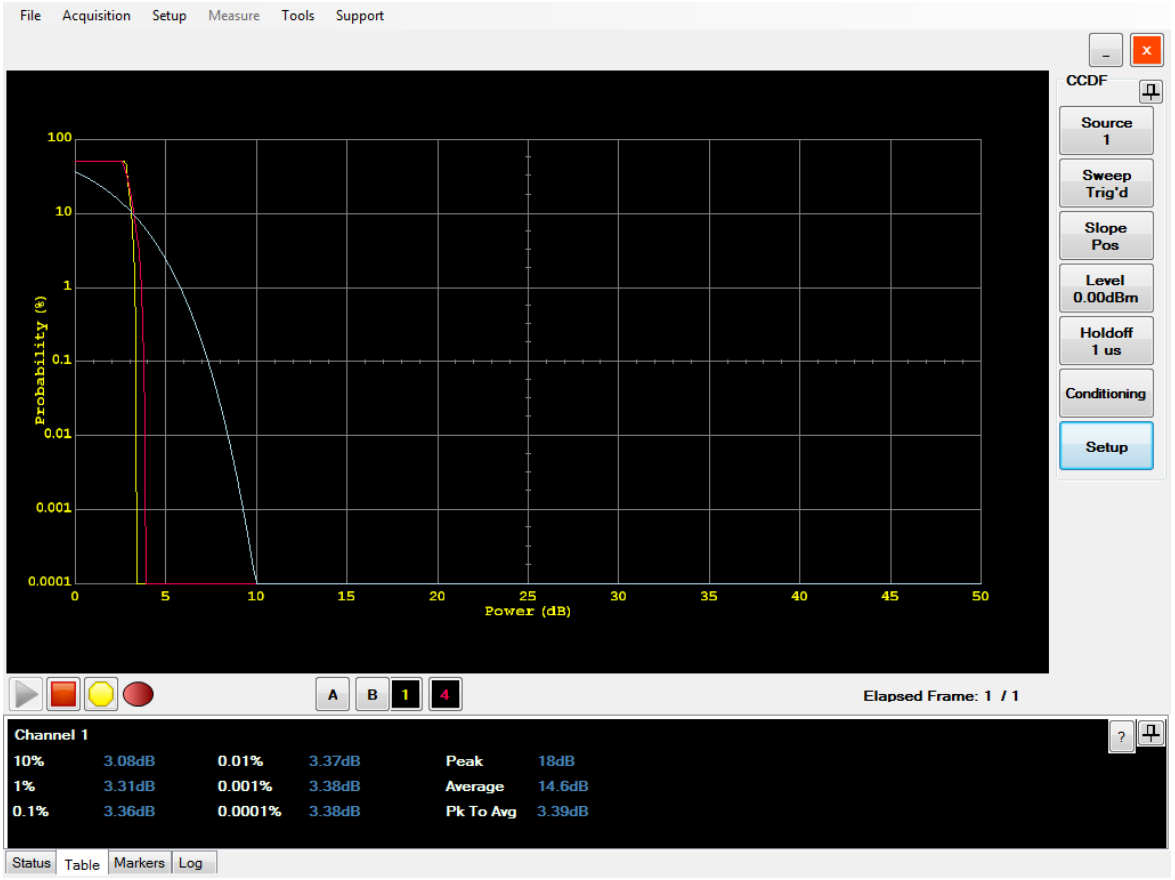


Figure 2-85 CCDF graph display in table view

3 The Table view on the multi-purpose pane will display the CCDF statistical information, peak, average, and peak to average measurement results as shown in Figure 2-85.

4 The Marker view displays the X-axis and Y-axis values for the markers, and the delta values between the two markers that you enabled on the trace as shown in Figure 2-86.

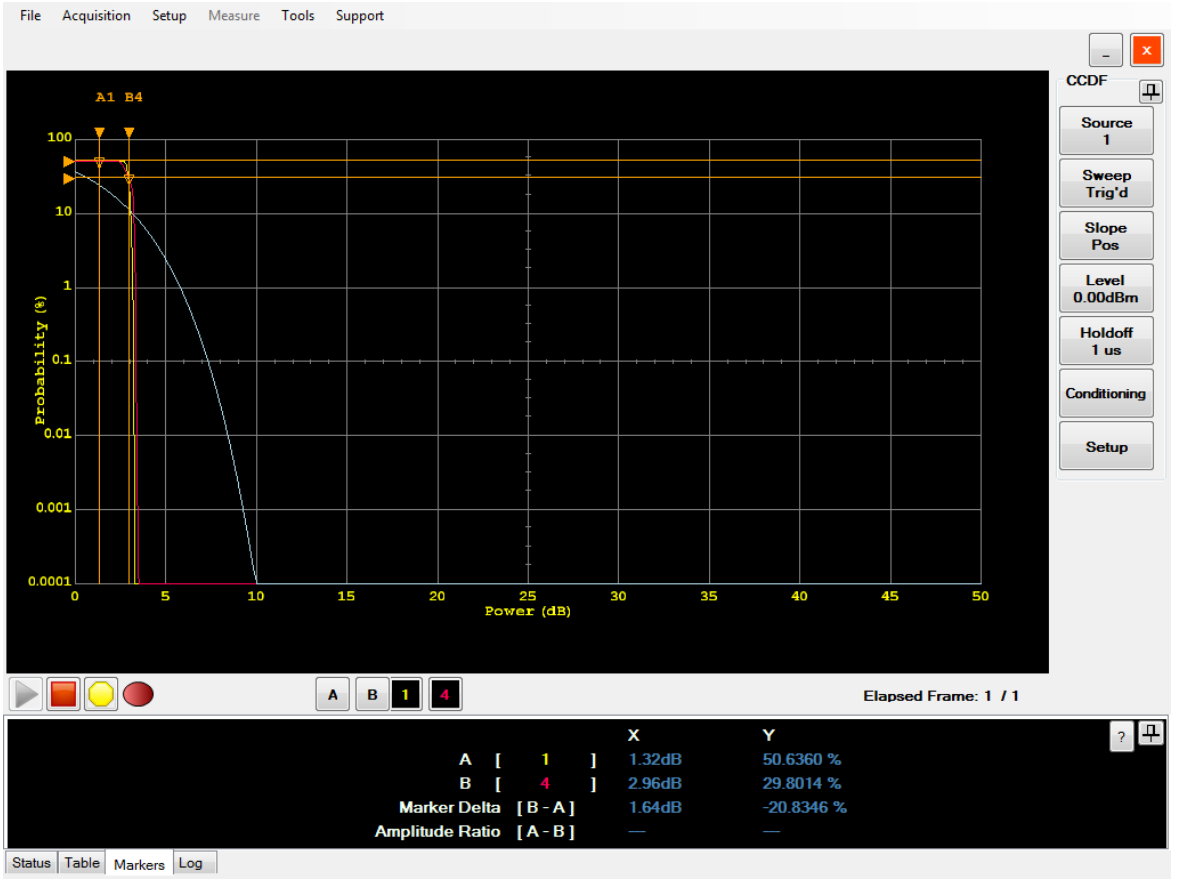


Figure 2-86 Marker view in CCDF

5 To configure the CCDF settings, select the individual buttons on the CCDF menu to toggle between selections or access the menu dialog as shown in Figure 2-87.

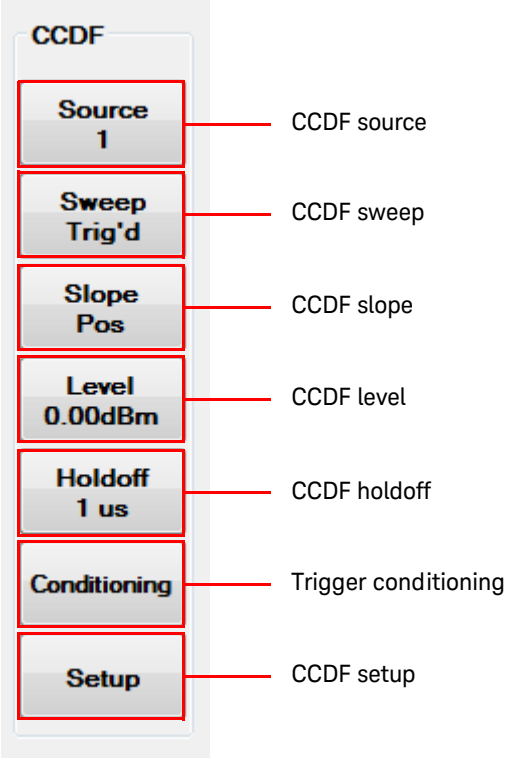


Figure 2-87 CCDF menu on the graphical interface

Source

Toggle between channel 1 or channel 4 as the CCDF source.

Sweep

Toggle between Free or Triggered as the CCDF sweep mode.

Slope

Toggle between positive and negative slope. This setting is only applicable when the CCDF sweep mode is Triggered.

Level

Set the CCDF level value. This setting is only applicable when the CCDF sweep mode is Triggered.

Holdoff

Set the CCDF holdoff value. This setting is only applicable when the CCDF sweep mode is Triggered.

Conditioning

Display the Trigger Conditioning dialog. This setting is only applicable when the CCDF sweep mode is Triggered.

Setup

Display the CCDF Setup dialog.

6 The Trigger Conditioning dialog is displayed as shown in Figure 2-88.

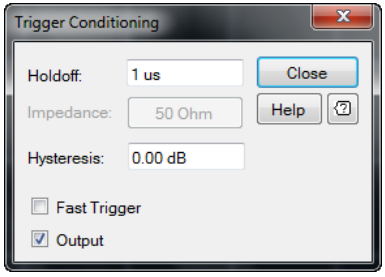


Figure 2-88 Trigger Conditioning dialog

7 You can set the trigger holdoff, impedance, hysteresis, and enable or disable the fast trigger and output. For more information on the trigger conditioning dialog, refer to "Accessing the Trigger Setup" on page 75.

8 The CCDF Setup dialog is displayed as shown in Figure 2-89.

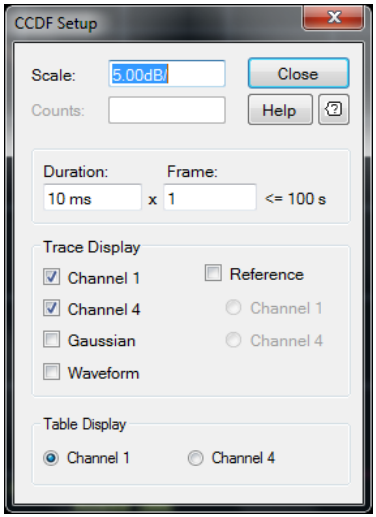


Figure 2-89 CCDF Setup dialog

Scale

Set the CCDF vertical scale.

Counts

Set the CCDF count value. This setting is only applicable when the CCDF sweep mode is Free.

Duration × Frame

Set the CCDF duration and frame. The product of the CCDF duration and frame cannot be more than 100 s. This setting is only applicable when the CCDF sweep mode is Triggered.

Trace Display

Select among **Channel 1**, **Channel 4**, **Gaussian**, **Waveform**, and **Reference** channel to be displayed on the CCDF trace. The CCDF trace can be referenced to **Channel 1** or **Channel 4**. When **Waveform** is selected, the CCDF-saved waveform is recalled from memory.

Table Display

Select between Channel 1 or Channel 4 as the channel for the CCDF information to be displayed at the Table view.

9 Select **Acquisition > CCDF** on the toolbar to close the CCDF function.

Accessing the Multipulse Mode

Multipulse is only available in the RF channels with a maximum of 512 frames. It can be used to analyze the power amplifier or transmitter output stability by measuring the amplitude droop, pulse to pulse stability, and abnormal pulse. Multipulse is also able to capture and analyze continuous pulses, compare the pulses characteristics, and capture long PRI pulses or any multiple pulse trains or burst. The histogram in the multipulse mode is useful to analyze the jitter in rise time, fall time, and pulse width measurements of the pulse trains.

Use the following procedure to display the multipulse mode.

1 Select **Acquisition > MultiPulse** on the toolbar as shown in Figure 2-90.

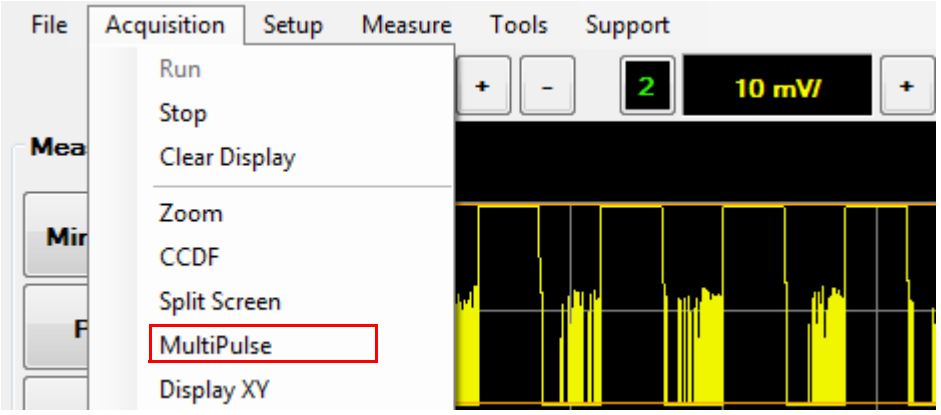


Figure 2-90 MultiPulse selection in the Acquisition menu

2 The MultiPulse Setup dialog is displayed as shown in Figure 2-91 to allow you to configure the multipulse display.

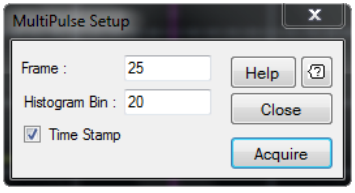


Figure 2-91 MultiPulse Setup dialog

3 Insert the desired number of frames and histogram bin, and select the **Time Stamp** check box to display the time stamp on the multipulse display.

4 The multipulse status is displayed on the multi-purpose pane as shown in Figure 2-92.

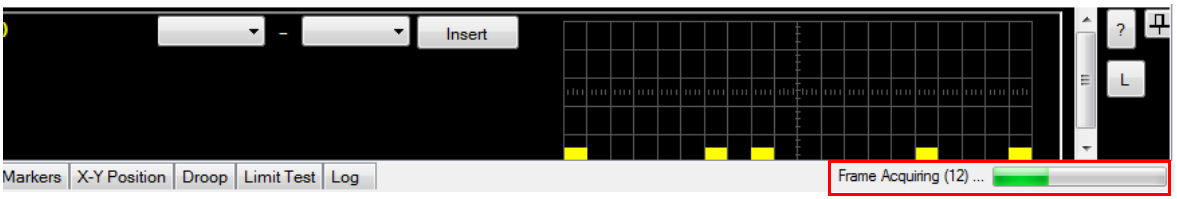


Figure 2-92 Multipulse status on the multi-purpose pane

5 An example of the multipulse display is as shown in Figure 2-93.

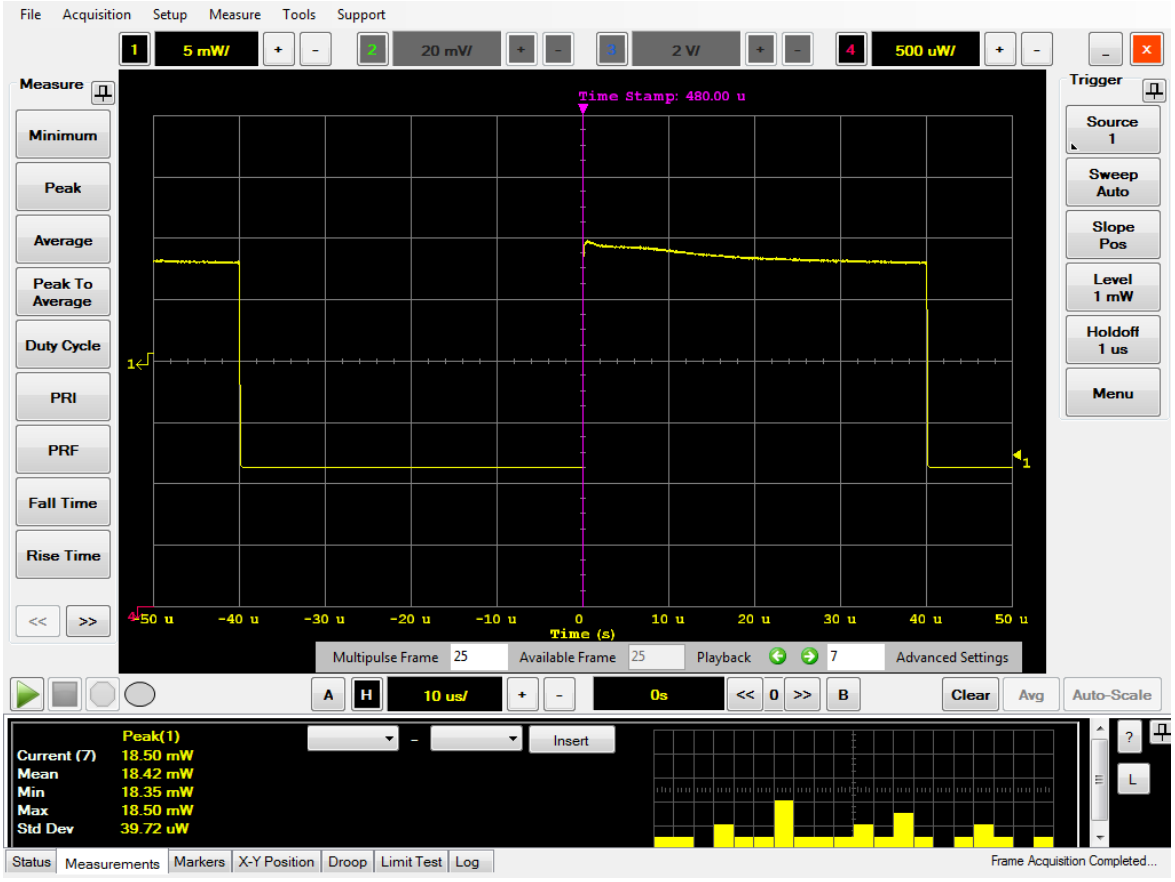


Figure 2-93 Multipulse display

6 Select the arrows on the display to display the desired frames.

7 You can also display the MultiPulse Display dialog by selecting **Advanced Settings** from the Multipulse display.

Multipulse measurement

1 The Measurement view on the multi-purpose pane will display the desired measurement results of the multipulse and the histogram data as shown in Figure 2-94.

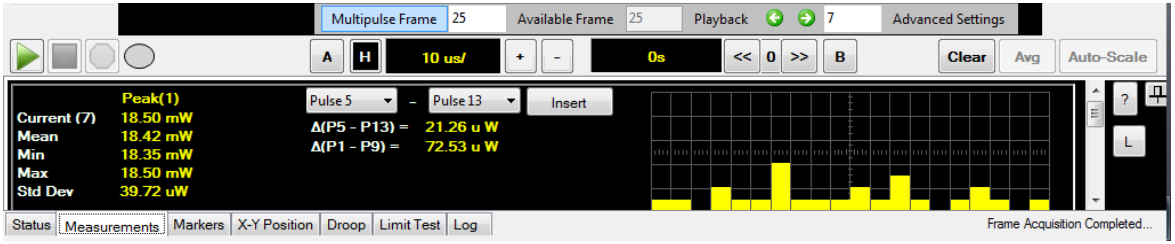


Figure 2-94 Measurement view in multipulse display

2 You can also select the measurement functions from the **Measure** menu on the toolbar.

3 The delta value between two pulses can also be displayed from the measurement view as shown in Figure 2-94. Select **Insert** after selecting your desired pulses to display the delta value.

4 To remove the measurement functions results from the Measurement view, select the Measurement view area to display the delete measurement menu and select **Delete > All Measurements.** To remove only specific measurement function results, select the specific measurement fucntion or delta to be deleted as shown in Figure 2-95.

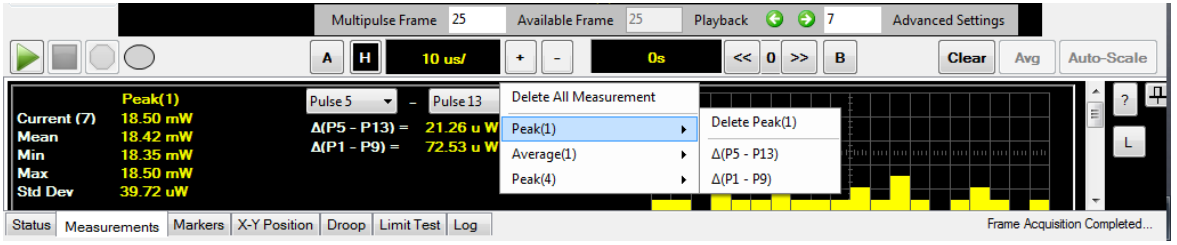


Figure 2-95 To delete multipulse measurement results on the multi-purpose pane

5 Select the **L** button to display the measurement view in a separate dialog as shown in Figure 2-96.

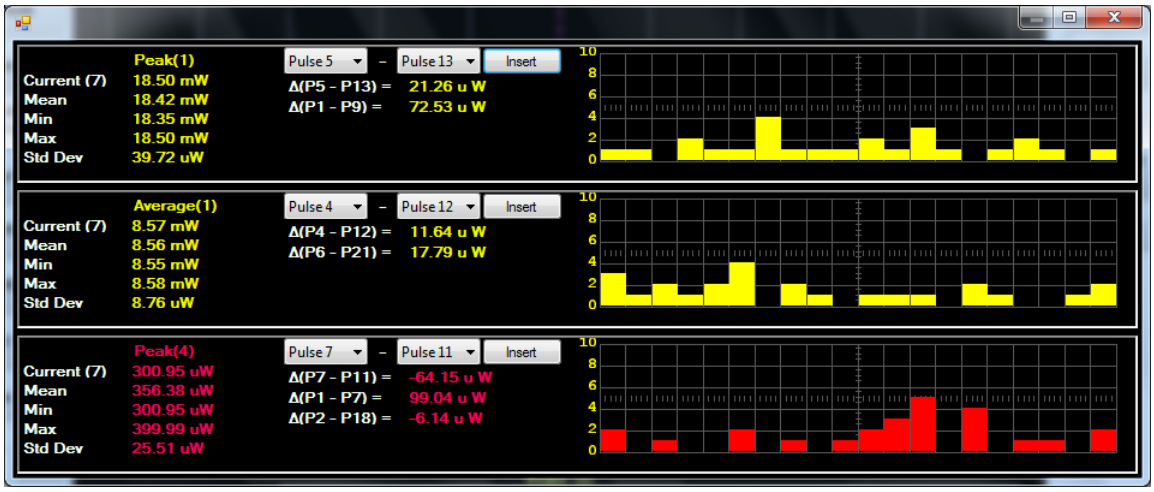


Figure 2-96 Multipulse measurement view dialog

6 Select **Acquisition > Multipulse** on the toolbar to close the multipulse function.

Save the multipulse measurement

The 8990B allows you to save the multipulse measurement of the acquired waveform.

1 Select **Acquisition > Save measurement > Multipulse** on the toolbar to save the multipulse measurement data as a *.csv file as shown in Figure 2-97.

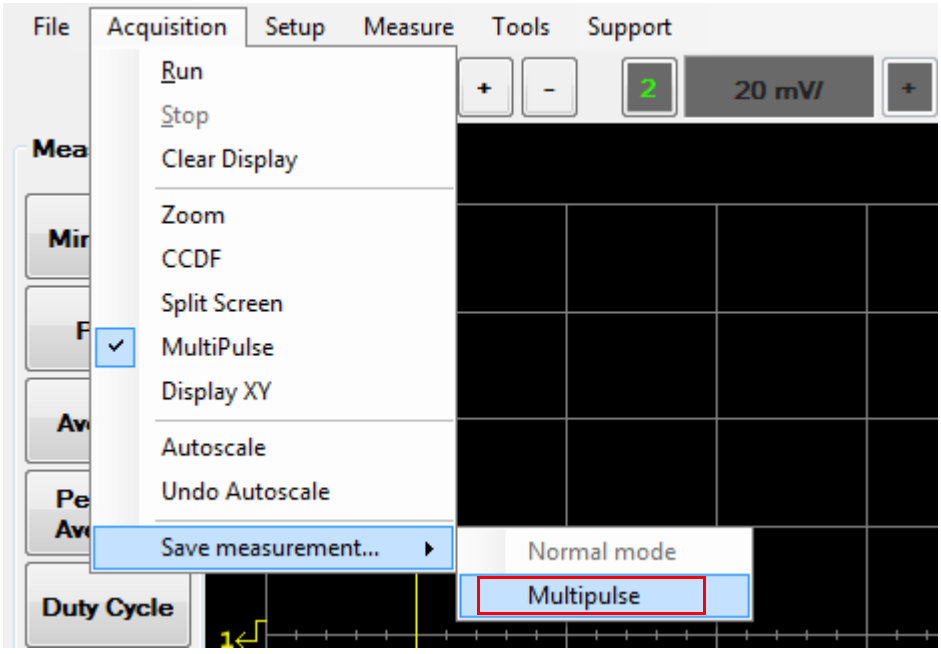


Figure 2-97 Save measurement... > Multipulse selection in the Acquisition menu

2 The Save dialog is displayed as shown in Figure 2-98. You can select the input channel to be saved by selecting **Waveform Source** to display the input channel list.

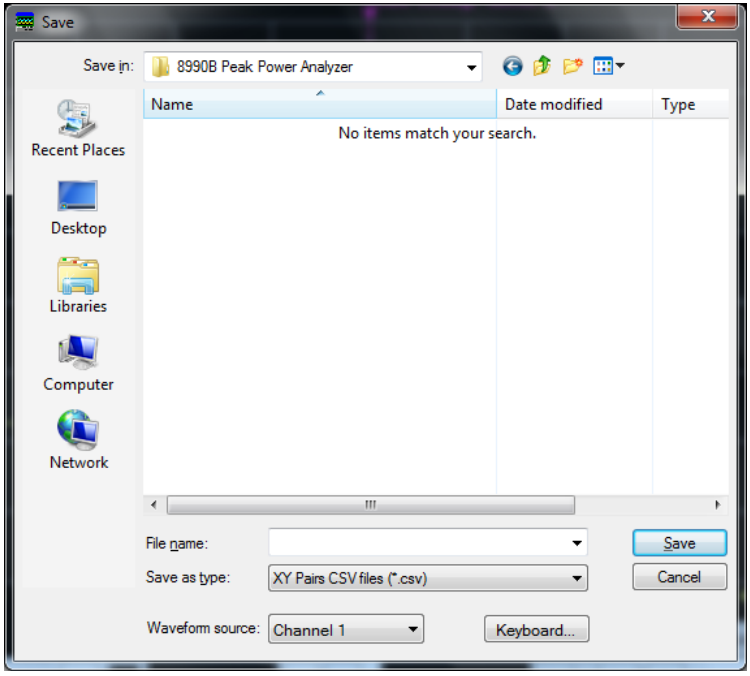


Figure 2-98 Save multipulse dialog

Accessing the Display XY Mode

The 8990B allows you to have a new visualization of trace instead of the timebase X-axis. You can use the Display XY mode to select the X-axis source and Y-axis source. Based on the selected sources, the Display XY mode will draw a scatter trace on a separate graph.

Display XY is useful to view two functional characters or measurement results. For example, in a power amplifier test, you can display the plot of Gain versus Power-IN. In a PAE test, plotting the PAE function versus power out or power in will be useful to understand the PAE characteristics of the power amplifier under test.

NOTE **If the X-axis source is in the linear scale, the origin will always start from a non-negative value.**

Use the following procedure to display the Display XY mode.

1 Select **Acquisition > Display XY** on the toolbar as shown in Figure 2-99.

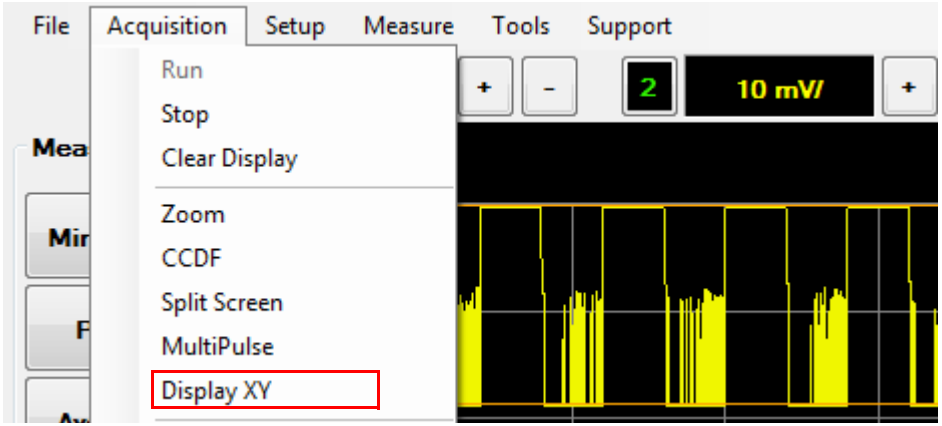


Figure 2-99 Display XY selection in the Acquisition menu

2 An example of the Display XY mode is as shown in Figure 2-100.

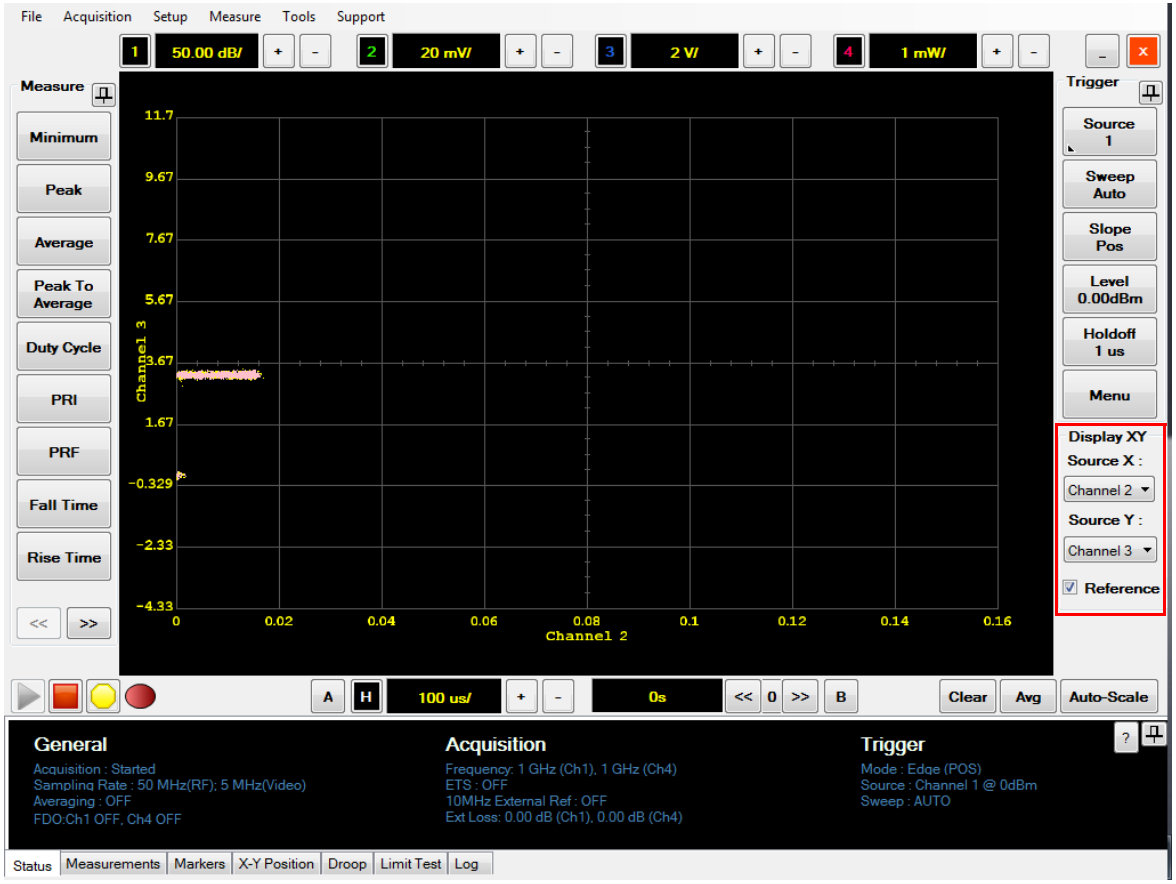


Figure 2-100 Display XY mode

3 The resultant trace is displayed in yellow. You can change the X-axis and Y-axis source below the Trigger menu.

4 Select the **Reference** check box to set the current displayed trace as the reference trace. The reference trace will be displayed in pink.

5 The DisplayXY Reference Trace dialog will be displayed as shown in Figure 2-101 when you change the Display XY mode sources with the reference trace enabled.

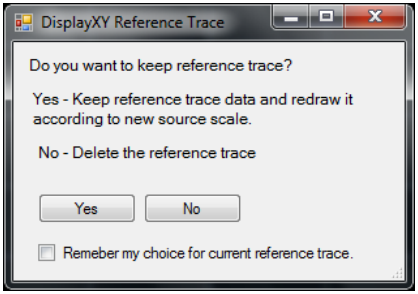


Figure 2-101 DisplayXY Reference Trace dialog

6 Select **Yes** or **No** to keep the current reference trace and redraw the trace according to the new sources scale or disable the reference trace.

7 Select **Acquisition > Display XY** on the toolbar to close the Display XY mode.

NOTE For the DisplayXY mode, the marker tracking style is set to Free Float.

Accessing the Multi-Purpose Pane

The multi-purpose pane allows you to toggle among seven types of views to display – status view, measurement view, marker view, X-Y position view, droop measurement view, limit test view, and log view. The multi-purpose pane is located at the bottom of the graphical interface as shown in Figure 2-102.

Use the following procedure to access the multi-purpose pane.

1 Select the **Status**, **Measurements**, **Markers**, **X-Y Position**, **Droop**, **Limit Test**, or **Log** tab to access the respective views.

Figure 2-102 Multi-purpose pane on the graphical interface

Status view

The Status view displays the general 8990B operating information, measurement acquisition functions status, and trigger settings information. The Status view displays all these information as shown in Figure 2-103.

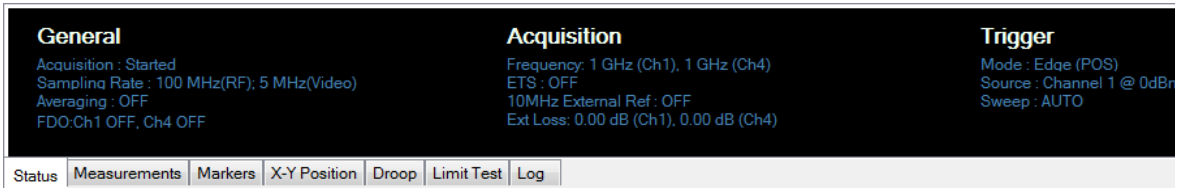


Figure 2-103 Status view on the multi-purpose pane

Measurement view

The Measurement view displays the measurement results for different measurement functions. You can select the desired measurement functions to measure from the Measure menu in the graphical interface as shown in Figure 2-104. You can also select the measurement functions from the **Measure** menu on the toolbar.

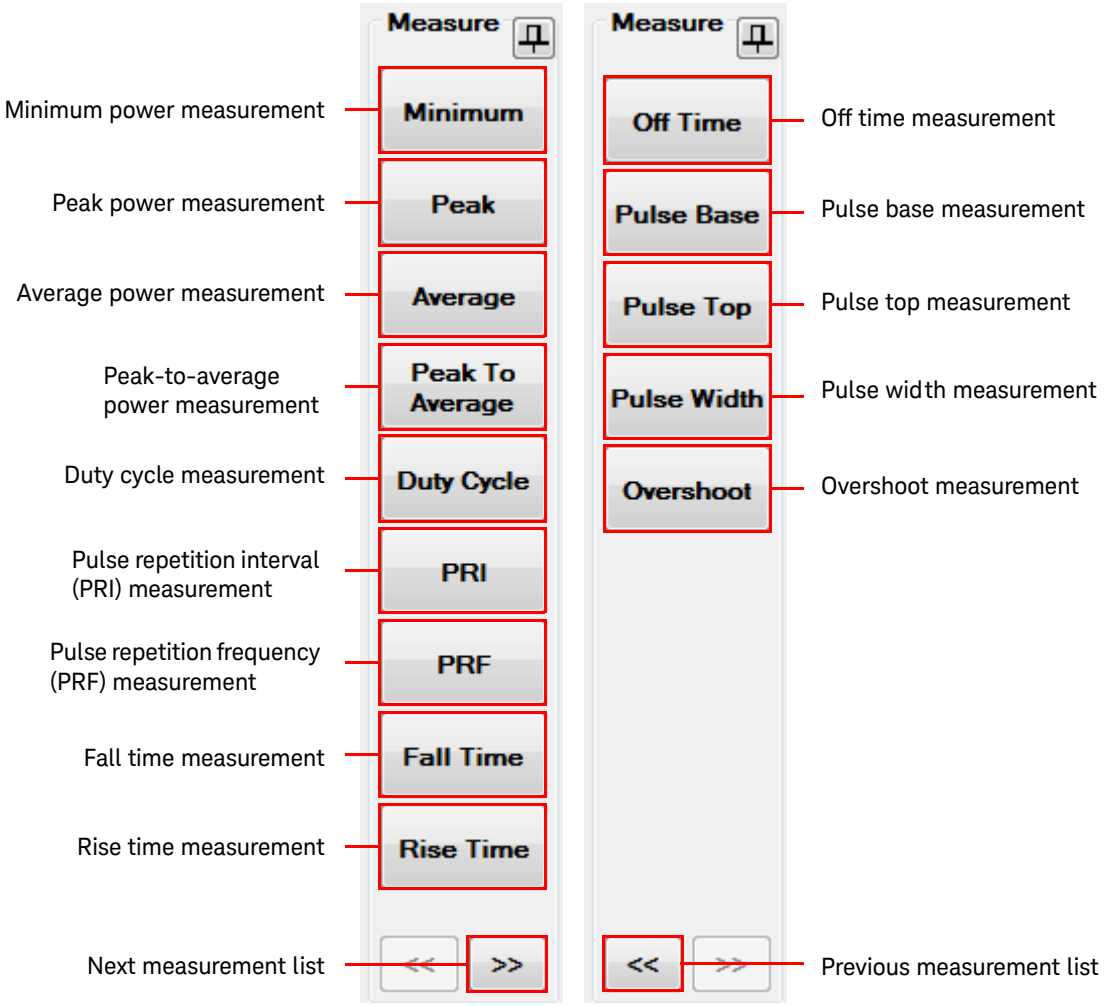


Figure 2-104 Measure functions menu on the graphical interface

The measurement functions available are minimum power, peak power, average power, peak-to-average power, duty cycle, PRI, PRF, fall time, rise time, off time, pulse base, pulse top, pulse width, and overshoot. You can also select the normal or zoom mode for the selected measurement to be displayed as shown in Figure 2-105.

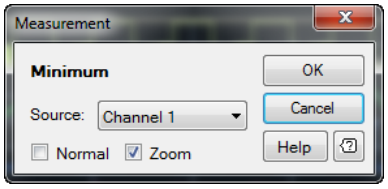


Figure 2-105 Measurement dialog

NOTE The Normal/Zoom mode selection is only available in the zoom function.

The Measurement view will display the current, mean, minimum, maximum, and standard deviation values for the selected measurement functions as shown in Figure 2-106.

NOTE

- The minimum and maximum values are retained if there are no changes in the settings which will invalidate the measurements.
- The minimum and maximum value is reset when there are changes to the trigger parameters or horizontal scale. Clearing the waveform display will also reset the minimum and maximum value.

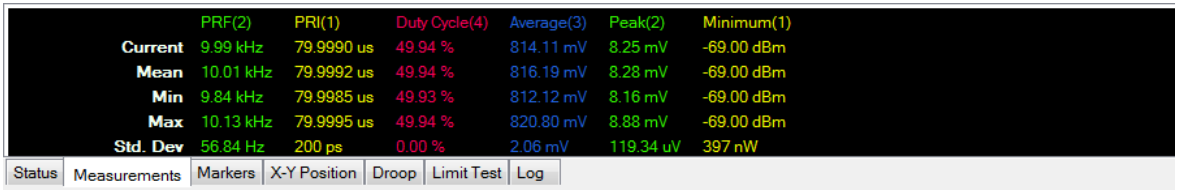


Figure 2-106 Measurement view on the multi-purpose pane

1 To display the measurement results, select the measurement functions from the Measure menu on the graphical interface to measure as shown in Figure 2-104.

NOTE The Measurement view is able to display results of up to six measurement functions.

2 To remove all measurement functions results from the Measurement view, select the Measurement view area to display the delete measurement menu and select **Delete > All Measurements.** To remove only specific measurement function results, select **Delete > [*measurement function*]** as shown in Figure 2-107.

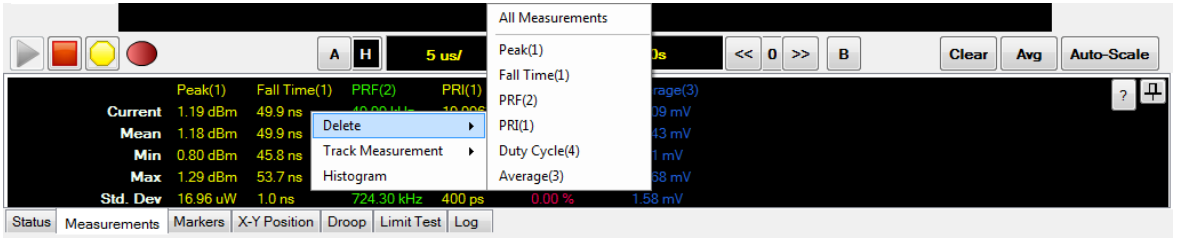


Figure 2-107 To delete measurement results on the multi-purpose pane

3 To track a specific measurement, select the Measurement view area to display the **Track Measurement** menu and select **[*measurement function*]** to track it as shown in Figure 2-108.

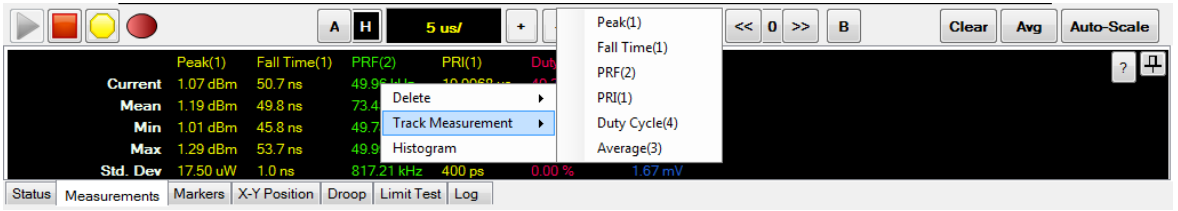


Figure 2-108 To track the measurement results on the multi-purpose pane

4 To view a histogram detailing the measurements, select the Measurement view area to display the **Histogram** button and click it as shown in Figure 2-109. The histogram window is shown in Figure 2-110.

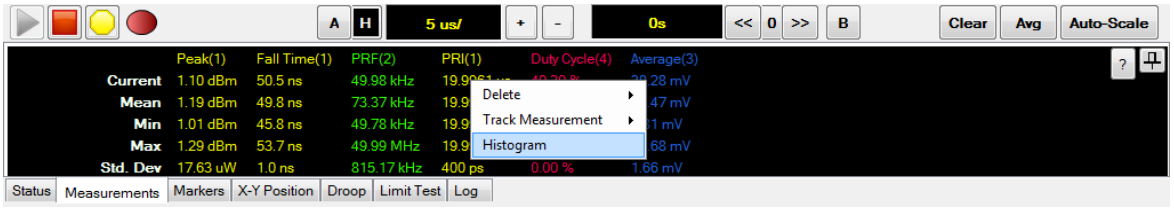


Figure 2-109 To view a histogram based on the results on the multi-purpose pane

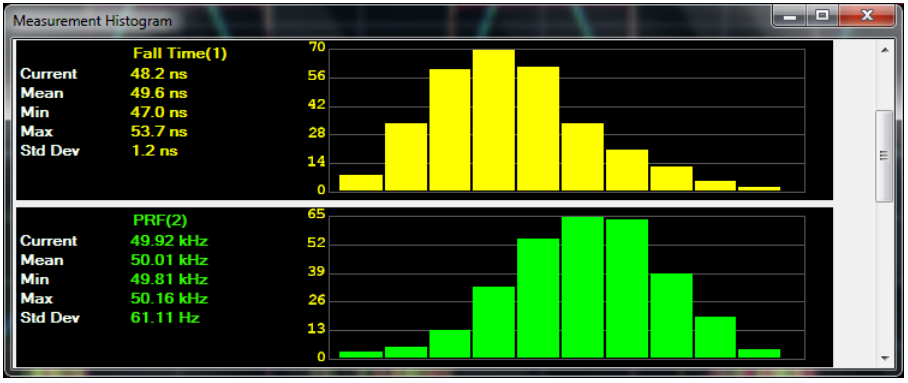


Figure 2-110 Histogram window

Marker view

The Marker view allows you to automatically track the X-axis and Y-axis values for the markers, and the delta amplitude and amplitude ratio values between the two markers that you enabled on the trace, as shown in Figure 2-111. You can also measure delay and spacing measurements using the markers. The 8990B allows you to enable two markers, A and B.

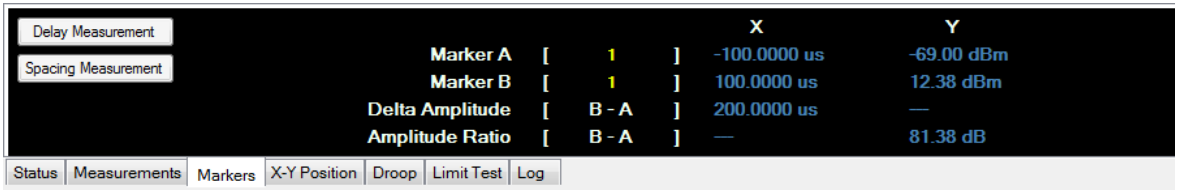


Figure 2-111 Marker view on the multi-purpose pane

Assign or change the channel for the markers

Use the following procedure to assign or change the channel for the markers.

1 To assign or change the channel for each marker, select the marker button at the bottom of the graphical interface as shown in Figure 2-112.

Figure 2-112 Marker buttons on the graphical interface

2 You can also press Markers in the Measure section on the front panel as shown in Figure 2-113 or select **Tools > Marker** on the toolbar.

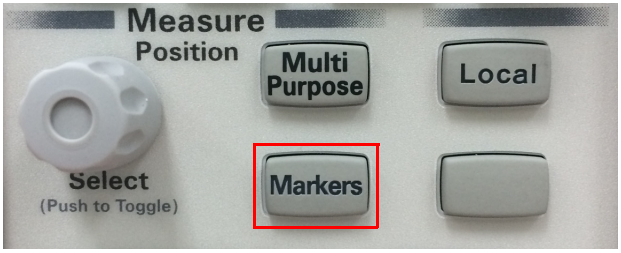


Figure 2-113 Markers button in the Measure section

3 The Markers dialog is displayed on the graphical interface as shown in Figure 2-114.

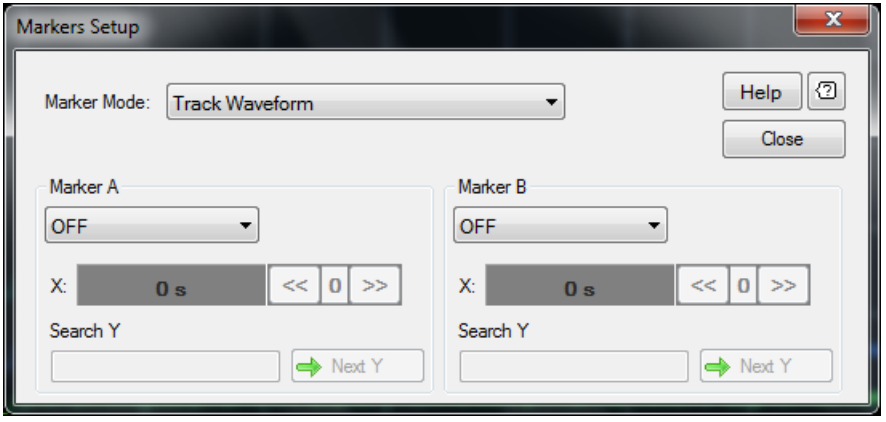


Figure 2-114 Markers dialog

4 Select the **Track Waveform/Free Float/Track Measurement** button to toggle between the Track Waveform mode, Free Float mode, and Track Measurement mode. The track waveform mode sets the marker vertices to always stay close in line with the waveform power level. The free float mode allows the markers to move freely on the graph area. The track measurement mode allows the markers to automatically track the measurements in real time.

5 Under **Marker A** and **Marker B**, select the respective fields to display the source selection. It will reflect all active sources on the front panel at that point.

6 The field box next to **X:** will reflect the X-axis value of the selected source. You may use the **<<**, **0**, or **>>** button to change the values.

7 In the field box under **Search Y**, set the Y value to search for a specific Y-axis value.

Select and move the markers

Use the following procedure to select and move the markers.

1 Push  in the Measure section on the front panel to select or toggle between markers A and B as shown in Figure 2-115.

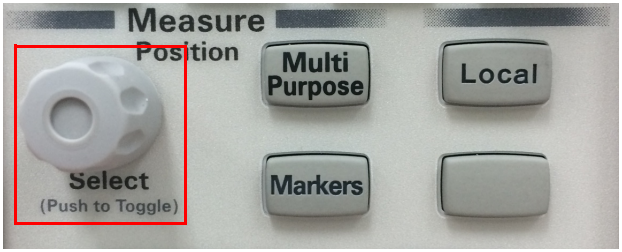


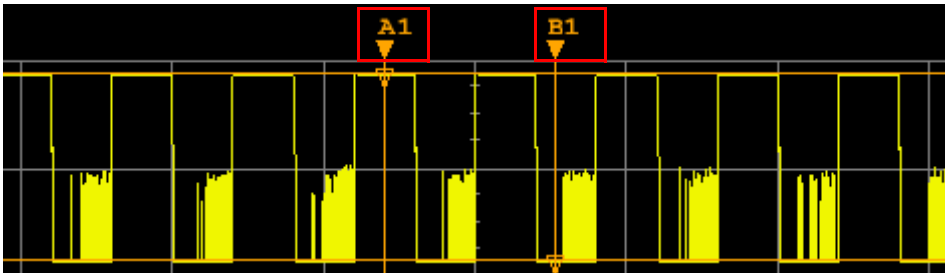
Figure 2-115 Select knob in the Measure section

2 When selecting or toggling between markers, the marker indicator is displayed on the graphical interface as shown in Figure 2-116.

Figure 2-116 Marker indicator on the graphical interface

3 To change the position of the marker, turn  , or select the marker label on the graphical interface and drag the marker to the desired position as shown in Figure 2-117.

Figure 2-117 Marker labels on the graphical interface



Delay measurement

The delay measurement function is useful when measuring time separation between two different channels. When this function is turned on, the markers are automatically positioned on the rising edge or falling edge of the measured channels, depending on the slope type set.

Use the following procedure to set the delay measurement.

1 Select **Delay Measurement** in the Marker view as shown in Figure 2-118.

Figure 2-118 Delay Measurement button in the Marker view

2 The Delay Measurement Setup dialog is displayed as shown in Figure 2-119.

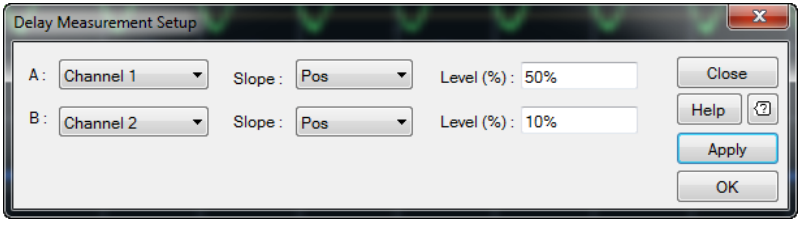


Figure 2-119 Delay Measurement Setup dialog

3 Select the desired marker channels, slope position, and set the trace reference level to set the delay measurement. The marker will be automatically placed at the specified reference level.

4 Select **Apply** or **OK** to turn on the delay measurement function.

5 The delay measurement results will be displayed on the Delta row in the Marker view and the **Delay Measurement** button is highlighted when it is turned on as shown in Figure 2-120.

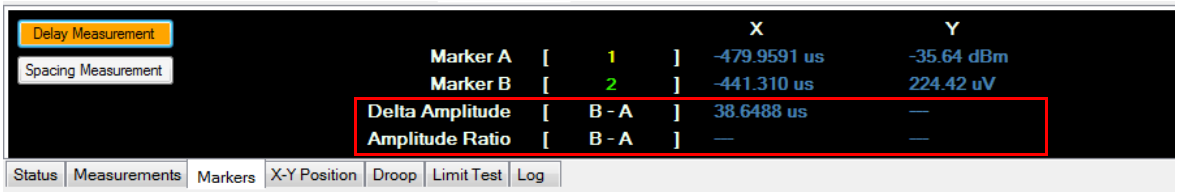


Figure 2-120 Delay measurement in the Marker view

NOTE If the position of the marker is changed manually, the delay measurement is turned off and reverted to the manual marker mode.

Spacing measurement

The spacing measurement function measures the delay in between pulses. When this function is turned on, the markers are automatically positioned on the rising edge or falling edge of the specified pulse.

Use the following procedure to set the spacing measurement.

1 Select **Spacing Measurement** in the Marker view as shown in Figure 2-121.

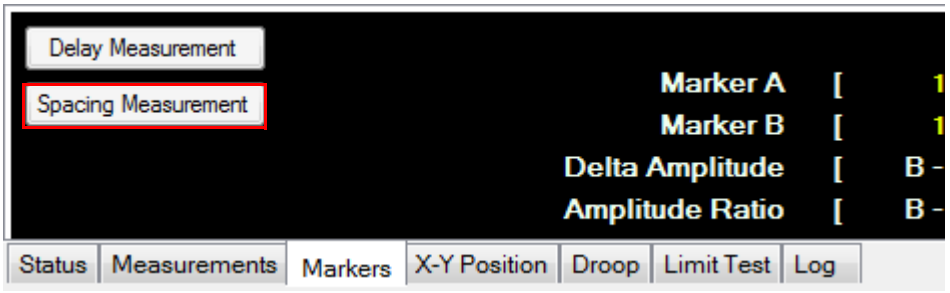


Figure 2-121 Spacing Measurement button in the Marker view

2 The Spacing Measurement Setup dialog is displayed as shown in Figure 2-122.

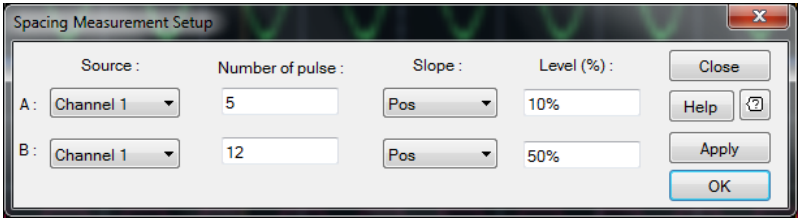


Figure 2-122 Spacing Measurement Setup dialog

3 Select the desired trace channel and slope position, and set the pulse number and trace reference level for the spacing measurement.

4 Select **Apply** or **OK** to turn on the spacing measurement function.

5 The spacing measurement results will be displayed on the Delta row in the Marker view and the **Spacing Measurement** button is highlighted when it is turned on as shown in Figure 2-123.

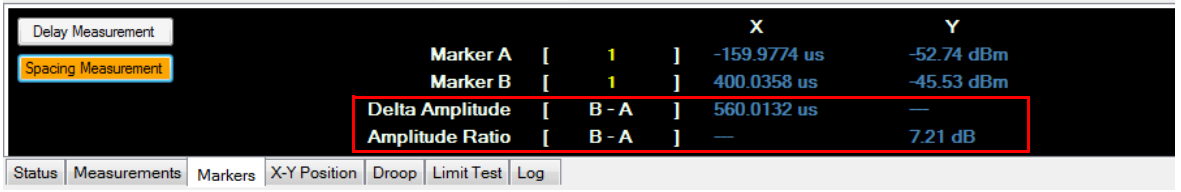


Figure 2-123 Spacing measurement in the Marker view

NOTE

- If the position of the marker is changed manually, the spacing measurement is turned off and reverted to the manual marker mode.
- When in zoom mode, the spacing measurement pulse number is referenced to the zoom trace.

X-Y position view

The X-Y position view allows you to search for a specific Y-axis value using the markers.

Figure 2-124 X-Y Position view

1 Select **Markers Search** in the X-Y Position view or press **Markers** in the Measure section on the front panel.

2 The Markers dialog is displayed as shown in Figure 2-125.

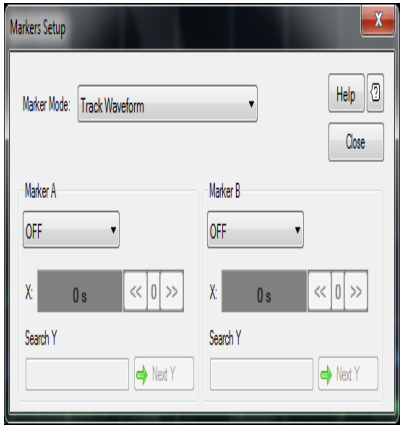


Figure 2-125 Markers dialog

3 Select the **Track Waveform/Free Float/Track Measurement** button to toggle between the Track Waveform mode, Free Float mode, and Track Measurement mode. The track waveform mode sets the marker vertices to always stay close in line with the waveform power level. The free float mode allows the markers to move freely on the graph area. The track measurement mode allows the markers to automatically track the measurements in real time.

4 Select **Search A** or **Search B** and set the Y value to search for a specific Y-axis value.

5 Select **Refresh** to refresh the marker position based on the X value.

6 Select **Reset** to reset the markers.

7 Select **Clear A** or **Clear B** in the X-Y Position view to reset the respective markers Y value search results.

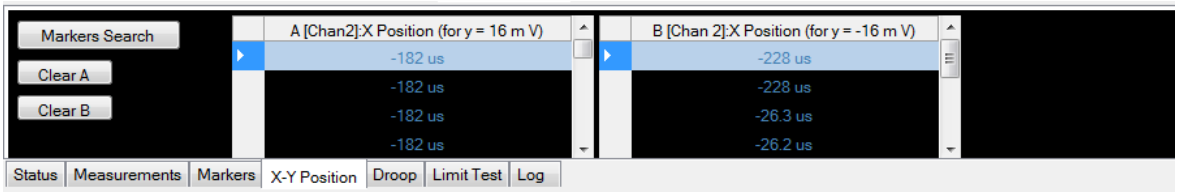


Figure 2-126 X-Y position search results

Droop measurement view

The Droop measurement view is used to measure the amount of droop, A_D of the input signal as shown in Figure 2-127. This function is only applicable for RF input channels.

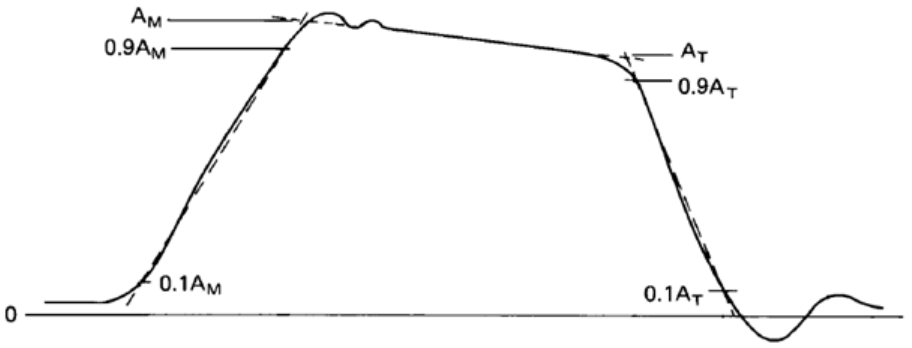


Figure 2-127 Droop measurement graph

Pulse amplitude, A_M

The pulse amplitude quantity is determined by the intersection of a line passing through the points on the leading edge, where the instantaneous value reaches 10% and 90% of A_M and a straight line that is the best least-squares fit to the pulse in the pulse-top region (usually this is fitted visually rather than numerically). For pulses deviating greatly from the ideal trapezoidal pulse shape, a number of successive approximations may be necessary to determine A_M.

Trailing edge (last transition) amplitude, A_T

The trailing edge amplitude quantity is determined by the intersection of a line passing through the points on the trailing edge where the instantaneous value reaches 90% and 10% of A_T, and the straight-line segment fitted to the top of the pulse in determining A_M.

Droop, A_D

Droop is the difference between A_M and A_T. It is expressed in percentage of A_M.

Use the following procedure to set the droop measurement.

1 Select **Droop Measurement** in the Droop view as shown in Figure 2-128.

Figure 2-128 Droop Measurement button in the Droop measurement view

2 The Droop Measurement Setup dialog is displayed as shown in Figure 2-129.

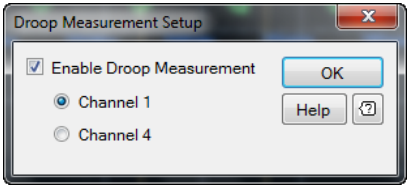


Figure 2-129 Droop measurement Setup dialog

3 Enable the droop measurement function and select the desired RF input channel.

4 The droop measurement results will be displayed in the Droop Measurement view as shown in Figure 2-130.

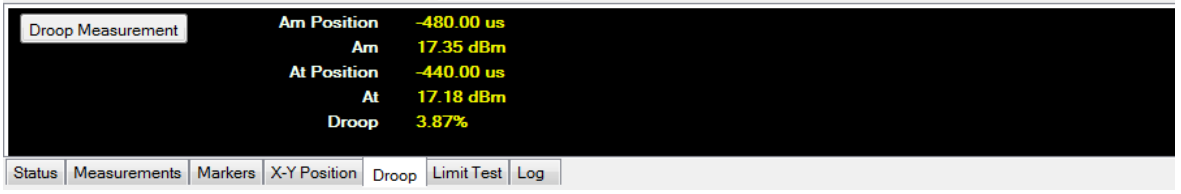


Figure 2-130 Droop measurement view on the multi-purpose pane

Limit test view

The limit test is a feature that is used to test power waveform stability and compliance. The waveform that is to be tested must remain inside a mask-defined region. Any waveform points that fall in the failure region will be indicated in red. There are two types of masks — linear mask and automask.

1 Select **Tools > Limit Test...** on the toolbar as shown in Figure 2-131.

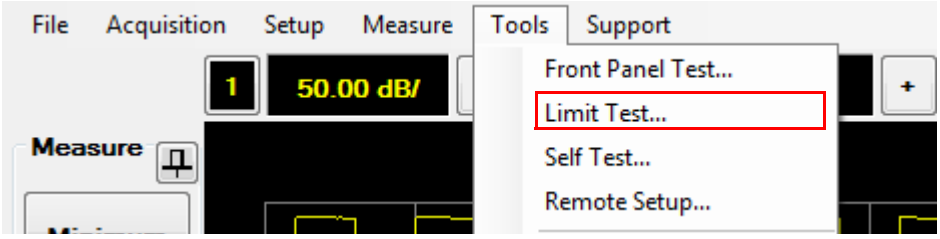


Figure 2-131 Limit test... selection in the Tools menu

2 The Limit Test dialog is displayed as shown in Figure 2-132.

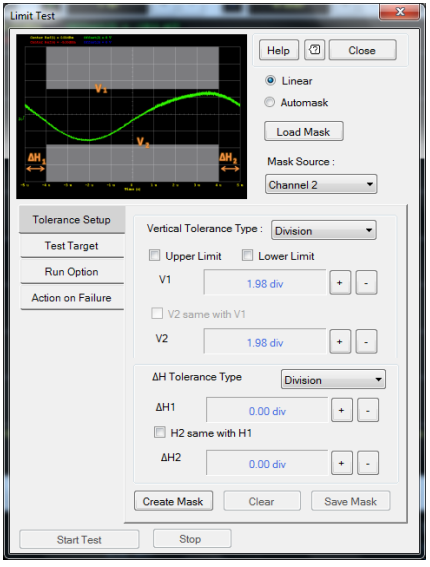


Figure 2-132 Limit Test dialog

3 Click on **Linear** or **Automask** to select the desired shading pattern. The picture display to the left of the check boxes show the shading patterns by using a video channel as the source.

4 You may also click **Load Mask** to load a pre-existing .mst file as the shading mask.

5 You may select one of the four main channels (**Channel 1**, **Channel 2**, **Channel 3**, or **Channel 4**), **Waveform memory**, or **Waveform math** as your **Mask Source**.

Tolerance Setup

– From the **Vertical Tolerance Type** drop-down menu, you may select either **Division**, **Source Unit**, or **Percentage**.

NOTE Only **Source Unit** is allowed for the **Linear** mask.

– Select the **Upper Limit** or **Lower Limit** check box to enable the upper limit or lower limit feature respectively.

– Set the vertical tolerance to your desired values.

– From the **ΔH Tolerance Type** drop-down menu, you may select either **Division** or **Source Unit**.

– Set the horizontal tolerance to your desired values.

– Click **Create Mask** to generate the shading on the graph. You should now see a shaded area in the picture display which corresponds to your input values.

– Click **Clear** to delete the mask shading on the graph, or **Save Mask** to save the shading into a .mst file.

Test Target

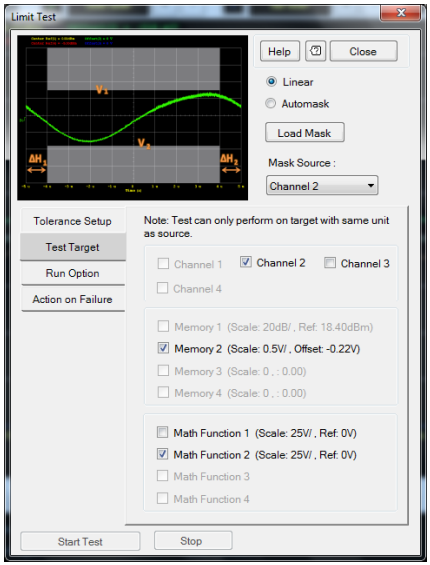


Figure 2-133 Limit Test dialog – Test Target tab

– This tab allows you to select the specific incoming signal source that the limit test is to be run on.

NOTE Only an input signal with the same unit as the source can be selected as a test target.

Run Option

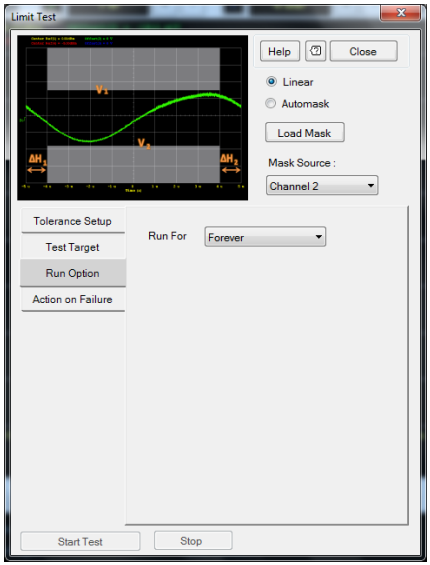


Figure 2-134 Limit Test dialog – Run Option tab

- From the drop-down menu, you may select either **Forever**, **Number of waveforms**, or **Duration**.
  - If you select **Forever**, the test will run continuously.
  - If you select **Number of waveforms**, the test will run for a user-defined number of waveforms.
  - If you select **Duration**, the test will run for a user-defined duration.

Action on Failure

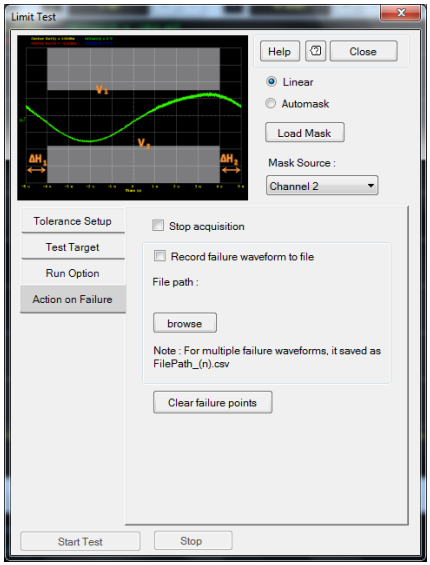


Figure 2-135 Limit Test dialog – Action on Failure tab

- Select **Stop acquisition** to change the acquiring mode to Stop.
- Select **Record waveform to file** to write the entire failure trace into a .csv file. Click **Browse** to select the desired file path.
- Click **Clear failure points** to clear all the failure points shown on the graph.

6 Once all the above settings have been configured, click **Start Test** to run the limit test.

7 Click **Stop** to stop the limit test.

8 The limit test results are displayed in the Limit Test view as shown in Figure 2-136.

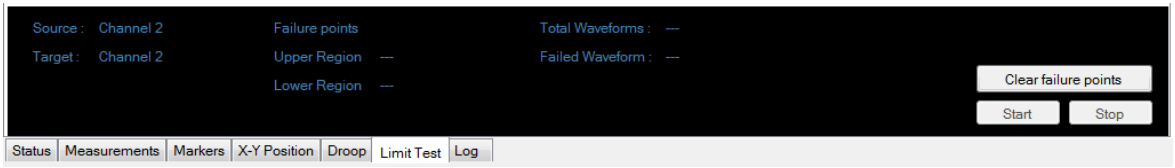


Figure 2-136 Limit test results

Log view

The log view displays the 8990B error status information as shown in Figure 2-137.

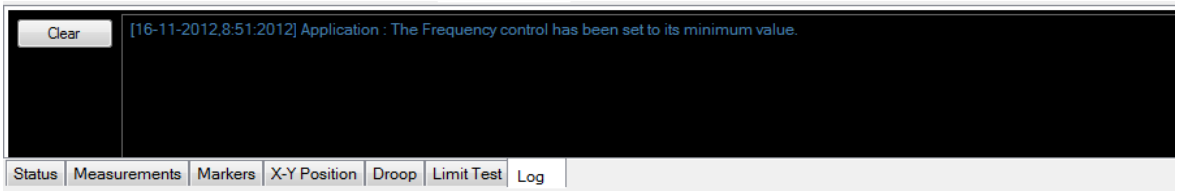


Figure 2-137 Log view on the multi-purpose pane

Use the following procedure to view more information on the log messages.

1. If the 8990B encounters any operation faults while performing acquisitions and measurements, error messages will be displayed.
2. Select **Clear** in the Log view to clear the status information.
3. Double-click or double-touch on a log status message to view more information.
4. The Log dialog is displayed as shown in Figure 2-138.

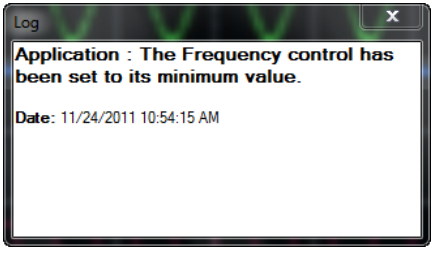


Figure 2-138 Log dialog

Performing Zeroing and Calibration

The 8990B performs internal zeroing and calibration routines on the wideband power sensor. The internal zeroing and calibration processes are used to combine the wideband power sensor and the 8990B to make accurate power measurements.

Zeroing

Zeroing adjusts the 8990B for a zero power reading on each RF input channel and wideband power sensor combination. When the wideband power sensor is plugged into the 8990B, zeroing will start automatically. This can be achieved without removing the sensor from the power source. The 8990B is automatically set to zero-on-the-fly while you are using it. The 8990B also allows you to manually perform zeroing of the sensor from the Channel Setup dialog as shown in Figure 2-139.

Refer to "Accessing the Channel Setup" on page 51 for more information on the Channel Setup dialog.

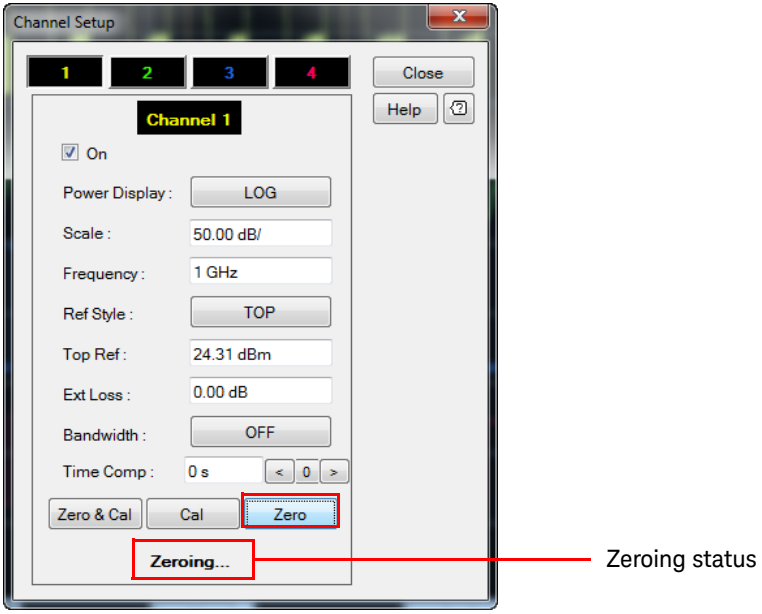


Figure 2-139 Zero button on the Channel Setup dialog

Calibration

Calibration sets the gain of each RF input channel and wideband power sensor combination. This can be achieved without connecting the sensor to the 1 mW power reference. The 8990B is automatically set to calibrate-on-the-fly while you are using it. The 8990B auto-calibration is enabled by default. You can enable or disable the auto-calibration process and notification, and set the auto-calibration interval from the Auto Cal dialog.

Use the following procedure to enable the auto-calibration.

1 Select **Tools > Auto Cal...** on the toolbar as shown in Figure 2-140.

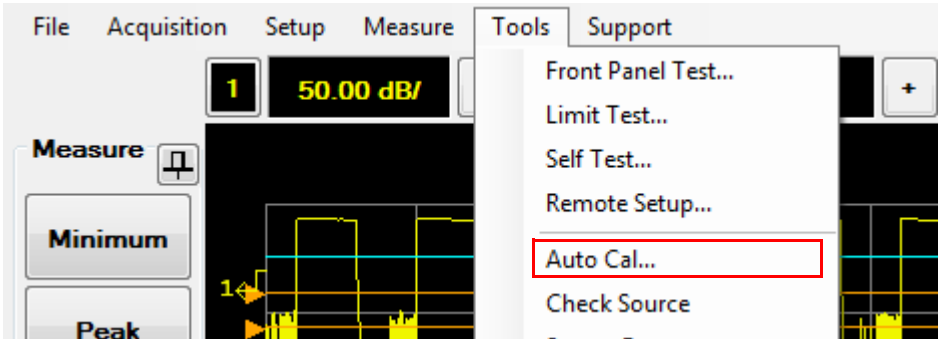


Figure 2-140 Auto Cal... selection in the Tools menu

2 The Auto Cal dialog is displayed as shown in Figure 2-141.

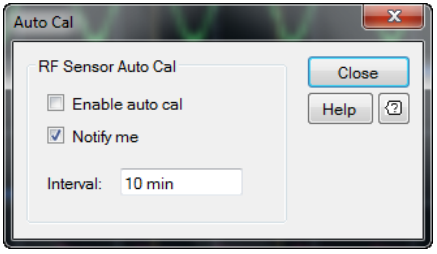


Figure 2-141 Auto Cal dialog

3 You can enable or disable the auto-calibration process and notification, and set the auto-calibration interval. The minimum interval is 1 minute and maximum interval is 60 minutes.

4 The 8990B also allows you to manually perform calibration of the sensor from the Channel Setup dialog as shown in Figure 2-142.

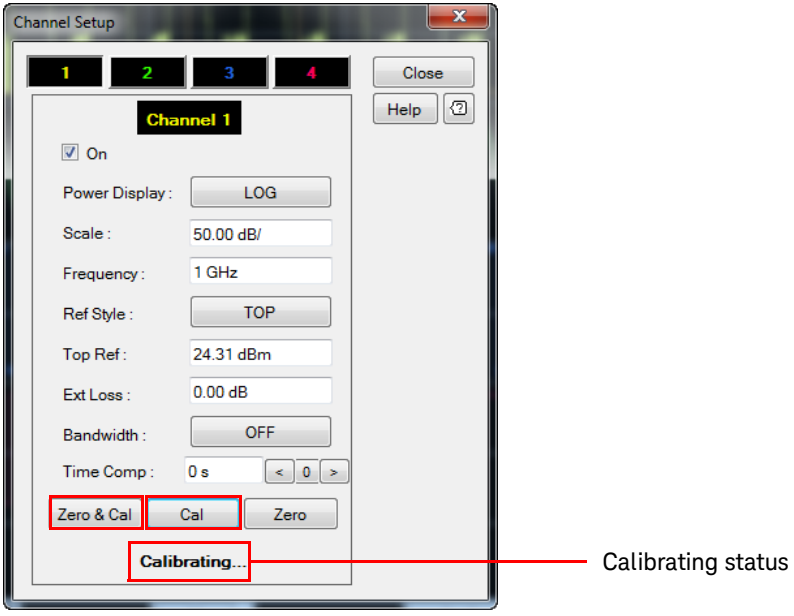


Figure 2-142 Cal and Zero & Cal buttons on the Channel Setup dialog

5 You can also perform zeroing and calibration of the sensor with the **Zero & Cal** button as shown in Figure 2-142. Refer to "Accessing the Channel Setup" on page 51 for more information on the Channel Setup dialog.

Sensor Check Source

The sensor check source is used during delay calibration for RF input channel 1 and 4, and to verify that the wideband power sensor is operational. The sensor check source outputs an RF carrier of 1.05 GHz with a modulating pulse train signal of 1 kHz from a Type-N female connector. The RF level is 0 dBm at the carrier frequency. The sensor check source reference frequency can be set to Off, 1 kHz pulse, 50 MHz CW, or 1.05 GHz CW.

Use the following procedure to set sensor check source.

1 Select **Tools > Check Source** on the toolbar as shown in Figure 2-143.

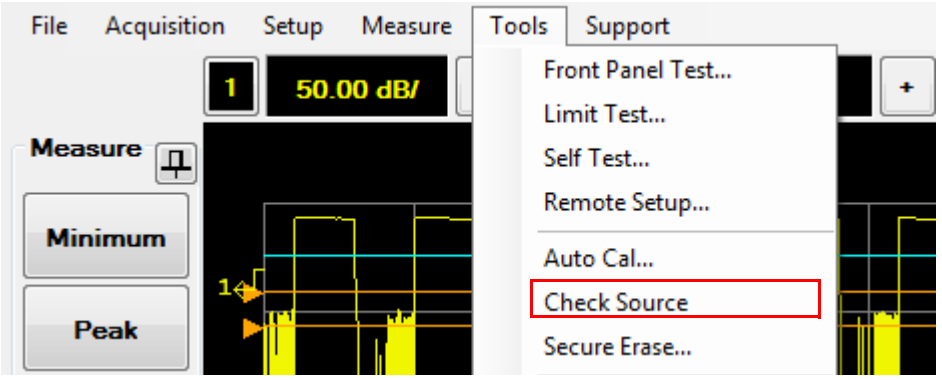


Figure 2-143 Check Source selection in the Tools menu

2 The Check Source dialog is displayed as shown in Figure 2-144 to allow you to configure the check source settings.

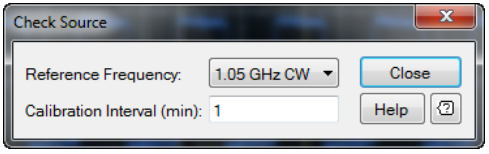


Figure 2-144 Check Source dialog

3 You can set the reference frequency and the number of calibration intervals for the sensor check source.

Reference Frequency

The reference frequency can be set to Off, 1 kHz pulse, 50 MHz CW, or 1.05 GHz CW.

Calibration Interval

The calibration interval can be set to a range of 1 to 60 minutes.

Saving the Screen

The 8990B allows you to save the graphical interface screen to an image file.

Use the following procedure to save the screen.

1 Select **File > Save Screen...** on the toolbar to save the screen image as shown in Figure 2-145.

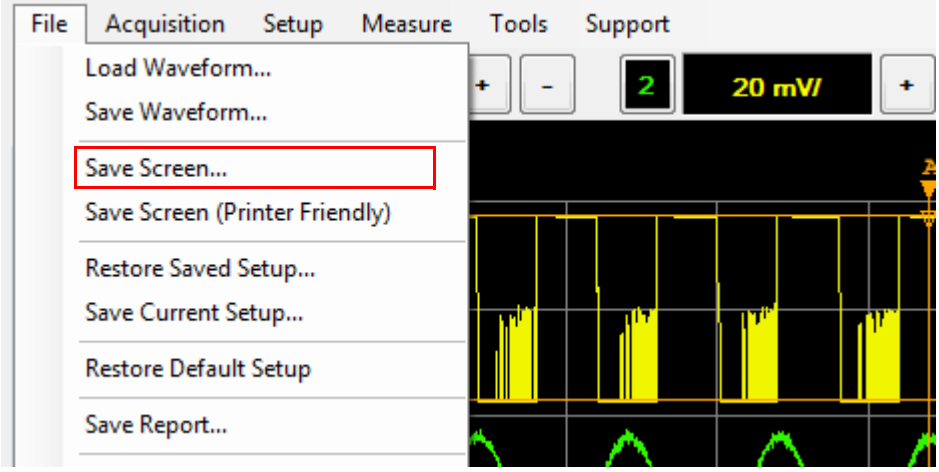


Figure 2-145 Save Screen... selection in the File menu

2 Save the screen image to your desired directory.

3 Select **File > Save Screen (Printer Friendly)** on the toolbar to save the screen image in black and white.

Saving and Restoring 8990B States

The 8990B allows you to save and restore the 8990B states. Saving the current state will help to reduce repeated setup sequences.

Use the following procedures to set the save and restore the 8990B states.

NOTE **The 8990B automatically retains the current state upon power cycle or in the event of interrupted power.**

Saving 8990B states

1 Select **File > Save Current Setup...** on the toolbar to save the current 8990B state to your desired directory in an XML file as shown in Figure 2-146.

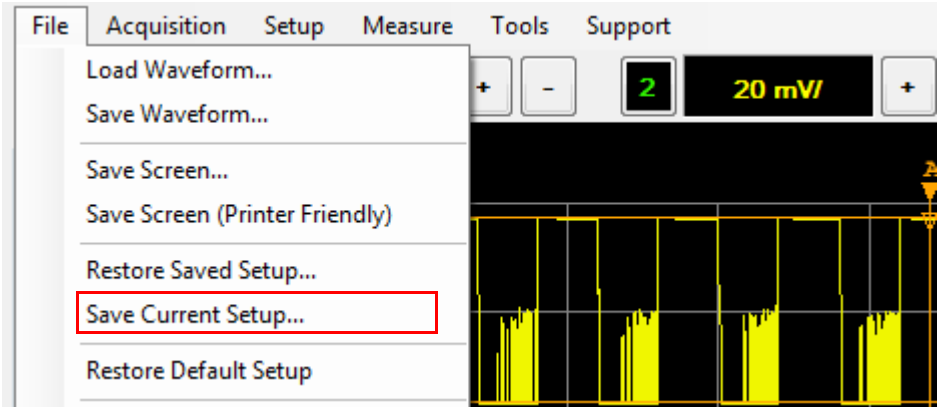


Figure 2-146 Save Current Setup... selection in the File menu

2 Select **Keyboard** on the Save Current Setup dialog to display the on-screen keyboard as shown in Figure 2-52. This is useful when there is no keyboard connected to the 8990B.

Restoring 8990B states

1 Select **File > Restore Saved Setup...** on the toolbar to load a saved 8990B state from an XML file as shown in Figure 2-147.

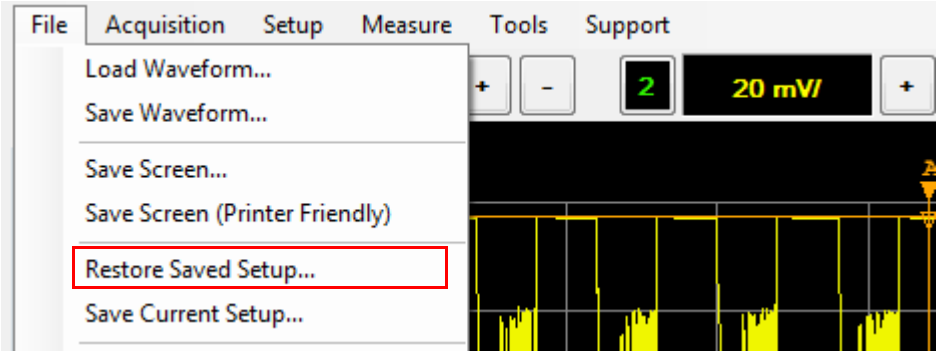


Figure 2-147 Restore Saved Setup... selection in the File menu

2 Select **Keyboard** on the Restore Saved Setup dialog to display the on-screen keyboard as shown in Figure 2-52. This is useful when there is no keyboard connected to the 8990B.

Logging and Saving the Measurement Data

The 8990B allows you to log and save the measurement results.

1 Select **Acquisition > Save measurement... > Normal mode** on the toolbar as shown in Figure 2-148.

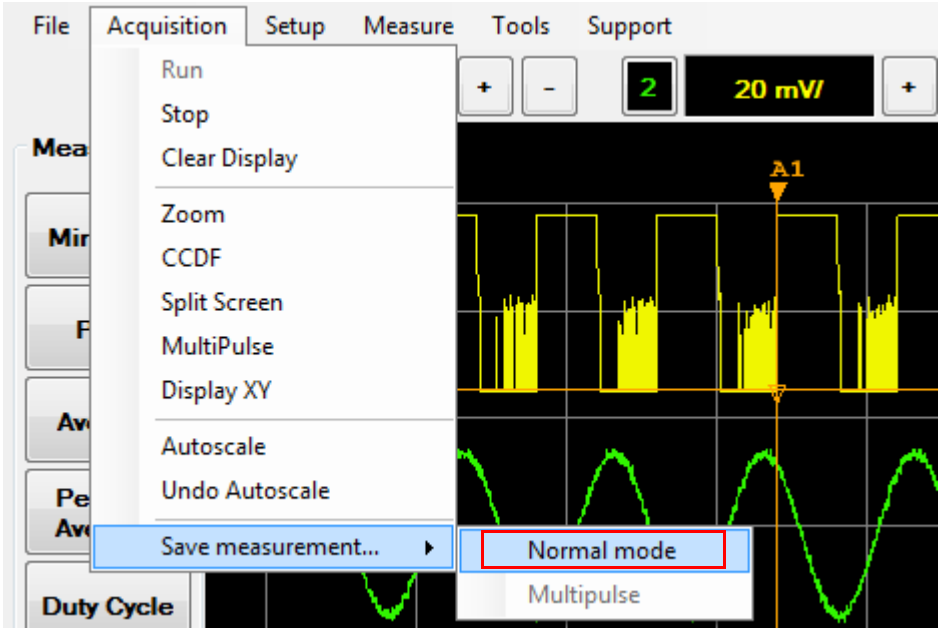


Figure 2-148 Save measurement > Normal mode selection in the Acquisition menu

2 Alternatively, you can also select the Measurement Logging button on the bottom left of the graphical interface as shown in Figure 2-149. The Measurement Logging button is only applicable in the normal mode.

Figure 2-149 Measurement logging buttons on the graphical interface

3 The Measurement Logging dialog is displayed as shown in Figure 2-150.

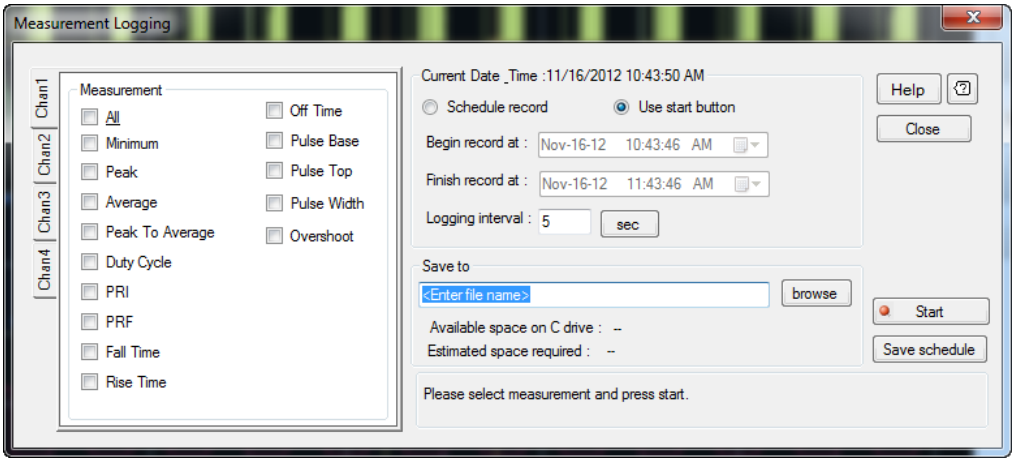


Figure 2-150 Measurement Logging dialog

4 Select the desired measurement function check boxes to be included in the measurement logging.

5 You can schedule a time to record the data or start recording by selecting **Start**.

6 The 8990B also allows you to save a schedule to start logging the measurement data.

Generating and Saving a Report

The 8990B allows you to generate and save a report.

1 Select **File > Save Report...** on the toolbar as shown in Figure 2-151.

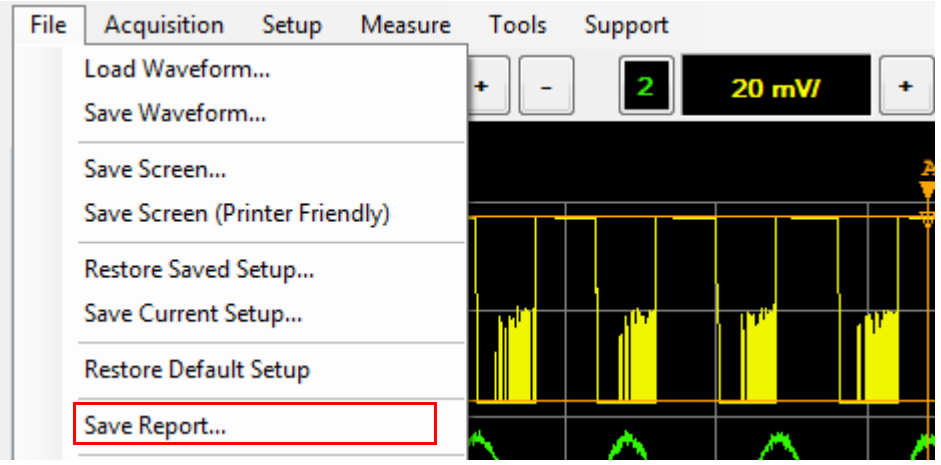


Figure 2-151 Save Report... selection in the File menu

2 The Report dialog is displayed as shown in Figure 2-152.

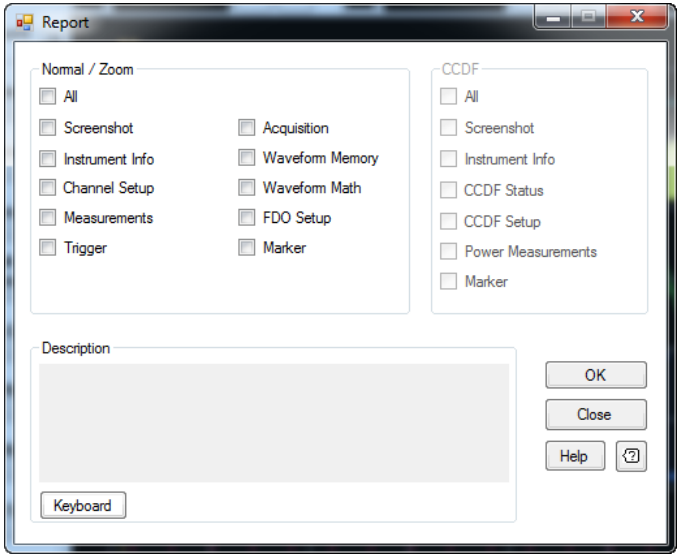


Figure 2-152 Report dialog

3 Select the desired information check boxes to be included in the report. You can also add your description to the report.

4 Select **Keyboard** on the Report dialog to display the on-screen keyboard. This is useful when there is no keyboard connected to the 8990B.

5 Select **OK** to generate the report with the desired information.

6 An example of the generated report is as shown in Figure 2-153.

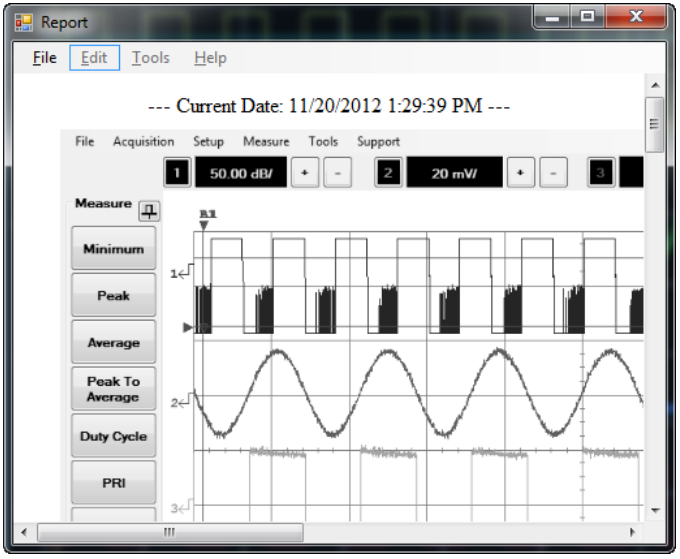


Figure 2-153 Generated report

7 Select **File** > **Save As** to save the report.

Secure Erase

The secure erase feature will erase the battery backed SRAM, the flash file system, and the secure blank password stored in the EEPROM. The flash file system includes the 8990B states, calibration factor tables, and frequency-dependent offset tables. Upon completion, the 8990B will be initialized to the default settings.

Use the following procedure to perform secure erase.

1 Select **Tools > Secure Erase...** on the toolbar as shown in Figure 2-154.

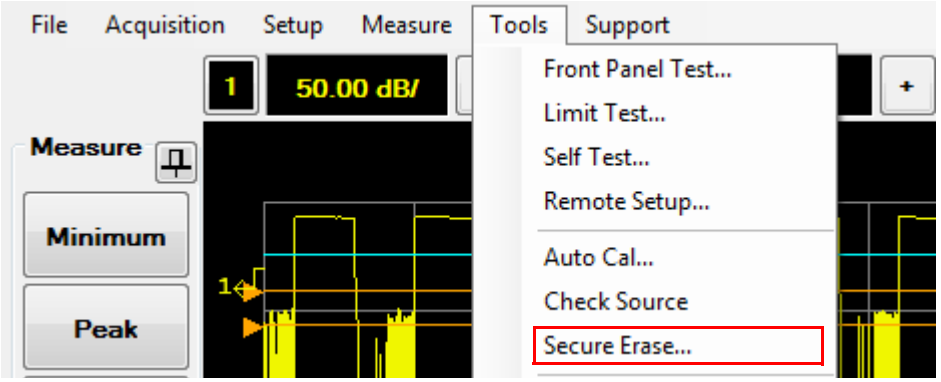


Figure 2-154 Secure Erase... selection in the Tools menu

2 The Secure Erase confirmation dialog is displayed as shown in Figure 2-155. Select **OK** to perform the secure erase operation.

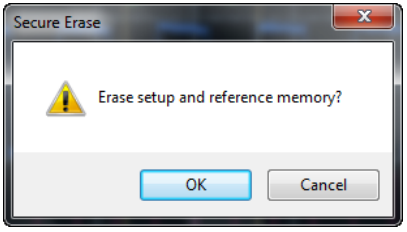


Figure 2-155 Secure Erase dialog

NOTE Secure erase may take a few minutes to complete.

Restoring the 8990B to Factory Default Settings

You can restore the 8990B to its factory default settings from the front panel or the graphical interface.

Use the following procedures to restore the 8990B to the factory default settings.

Front panel

Press Default Setup in the Horizontal section as shown in Figure 2-156.

Figure 2-156 Default Setup button in the Horizontal section

Graphical interface

1 Select **File > Restore Default Setup** on the toolbar to restore the 8990B to its factory default settings as shown in Figure 2-157.

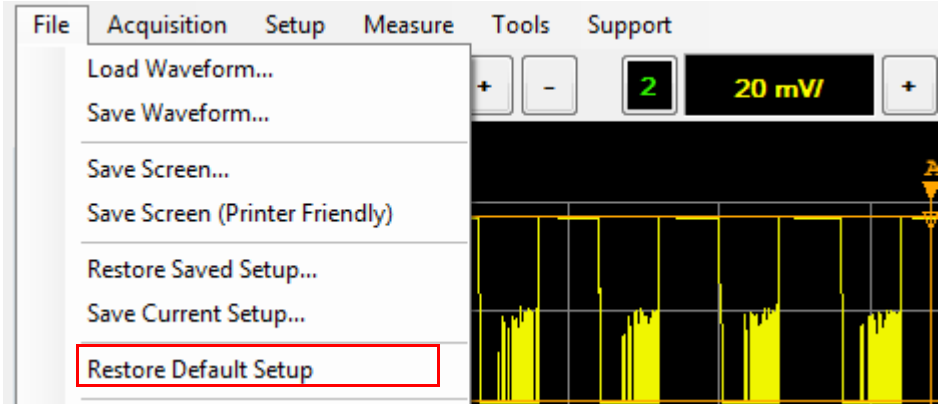


Figure 2-157 Restore Default Setup selection in the File menu

2 When restoring the 8990B to its factory default settings, a notification dialog is displayed as shown in Figure 2-158.

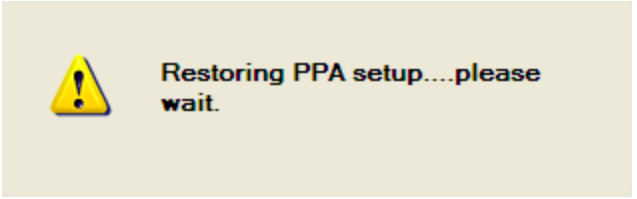


Figure 2-158 Restoring PPA setup notification dialog

Table 2-2 8990B factory default settings

Feature	Default setting
Averaging	Disabled
Auto-ETS	Enabled
Trigger	
Source	Source 1
Sweep	Auto
Slope	Pos
Level	0 dBm
Holdoff	1 µs
Mode	Edge
Output	Enabled
Fast Trigger	Disabled
Hyteresis	0 dB (Channel 1, 4) NORMAL (Channel 2 , 3)
Impedance	50 Ohm
Calibration	
Auto-cal	Enabled
Notify	Enabled
Interval	10 min

Table 2-2 8990B factory default settings (continued)

Feature	Default setting
CCDF	
Scale	5 dB
Sweep	Free
Source	Source 1
Count	100 M
Duration	10 ms
Frame	1
Trace display	
Channel (1,4)	Enabled
Gaussian	Enabled
Reference	Disabled
Store Reference	Channel 1
Check Source	
Reference Frequency	Off
Calibration Interval	1 min

Configuring the Display Settings

Use the following procedure to configure the display settings.

1 Select **Setup > Display Setup** on the toolbar as shown in Figure 2-159.

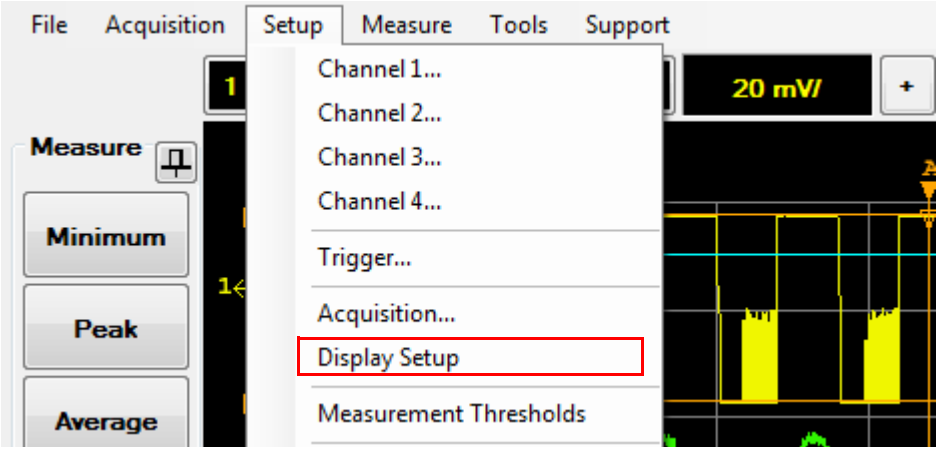


Figure 2-159 Display Setup selection in the Setup menu

2 The Display Setup dialog is displayed as shown in Figure 2-160.

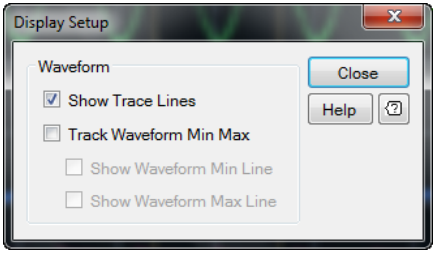


Figure 2-160 Display Setup dialog

3 Select each respective check box to display the trace lines, track the waveform minimum and maximum, or show the waveform minimum and maximum line. The waveform minimum and maximum tracking feature will shade the area between the minimum and maximum traces.

4 An example of the waveform display with the waveform minimum and maximum tracking feature enabled is as shown in Figure 2-161.

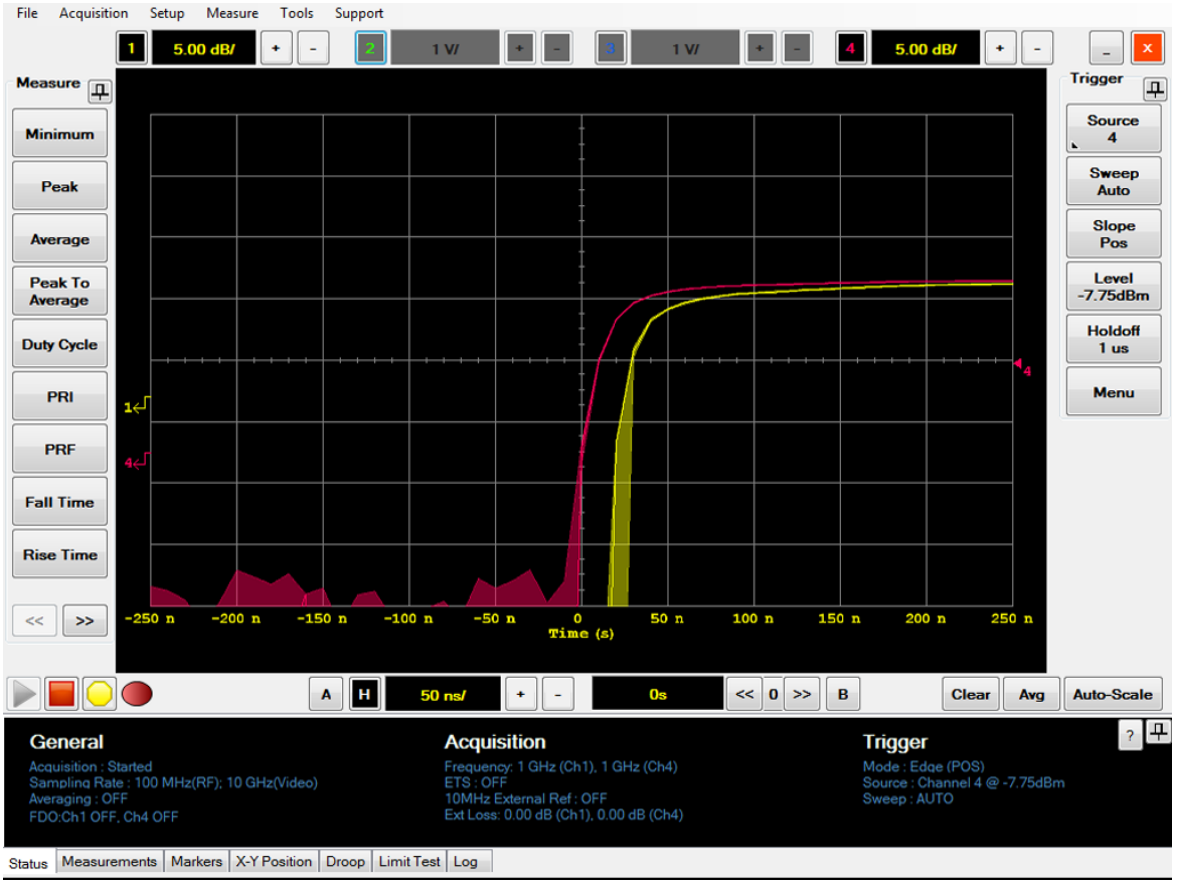


Figure 2-161 Example of the waveform display with the waveform minimum and maximum tracking feature enabled

Remote Setup

Use the following procedure to view the remote setup parameters.

1 Select **Tools > Remote Setup...** on the toolbar as shown in Figure 2-162.

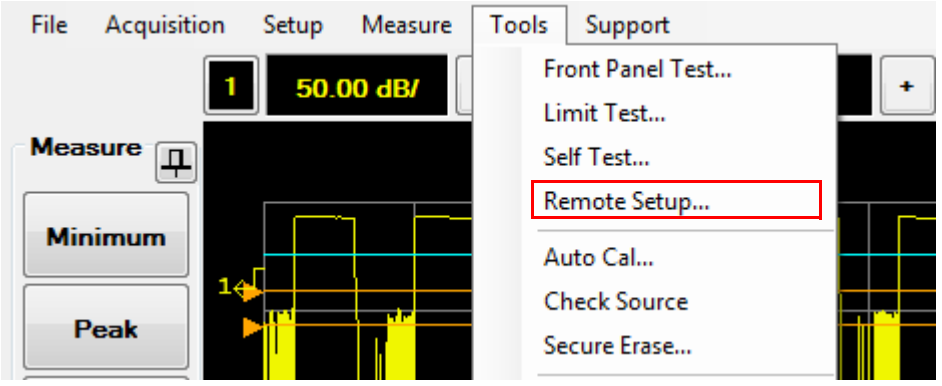


Figure 2-162 Remote Setup... selection in the Tools menu

2 The Remote Setup dialog is displayed as shown in Figure 2-163. The remote setup parameters are listed in the Remote Setup dialog.

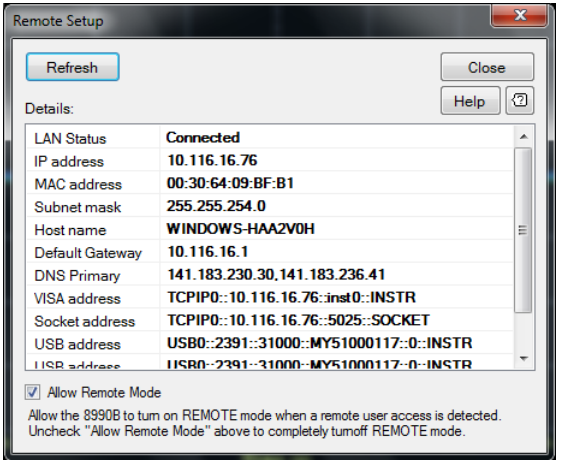


Figure 2-163 Remote Setup dialog

3 Maintenance

This chapter describes the built-in self-tests, error messages, and general maintenance of the 8990B peak power analyzer.

Front Panel Test

The 8990B allows you to verify the 8990B front panel keys and knobs.

NOTE **Remove all the input and output connections from the 8990B before performing the front panel test.**

1 Select **Tools > Front Panel Test...** on the toolbar as shown in Figure 3-1.

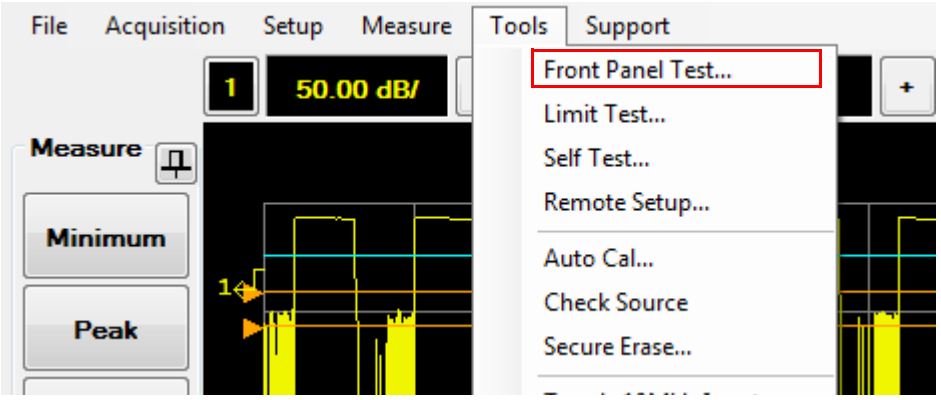


Figure 3-1 Front Panel test... selection in the Tools menu

2 The Front Panel Test dialog is displayed as shown in Figure 3-2.

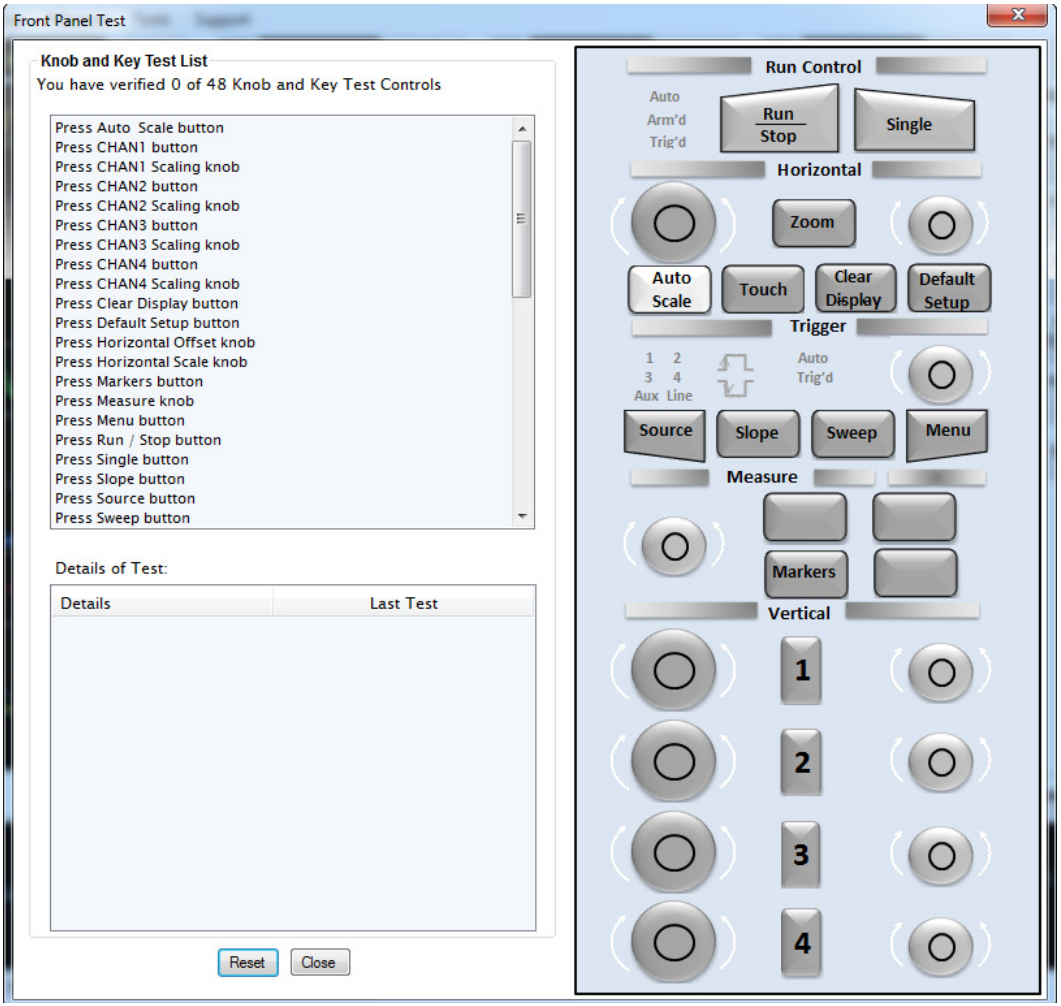


Figure 3-2 Front Panel Test dialog

3 Press the front panel keys and knobs, and turn the knobs to verify that they are functioning.

4 The corresponding keys and knobs on the Front Panel Test dialog illuminate green when they are verified.

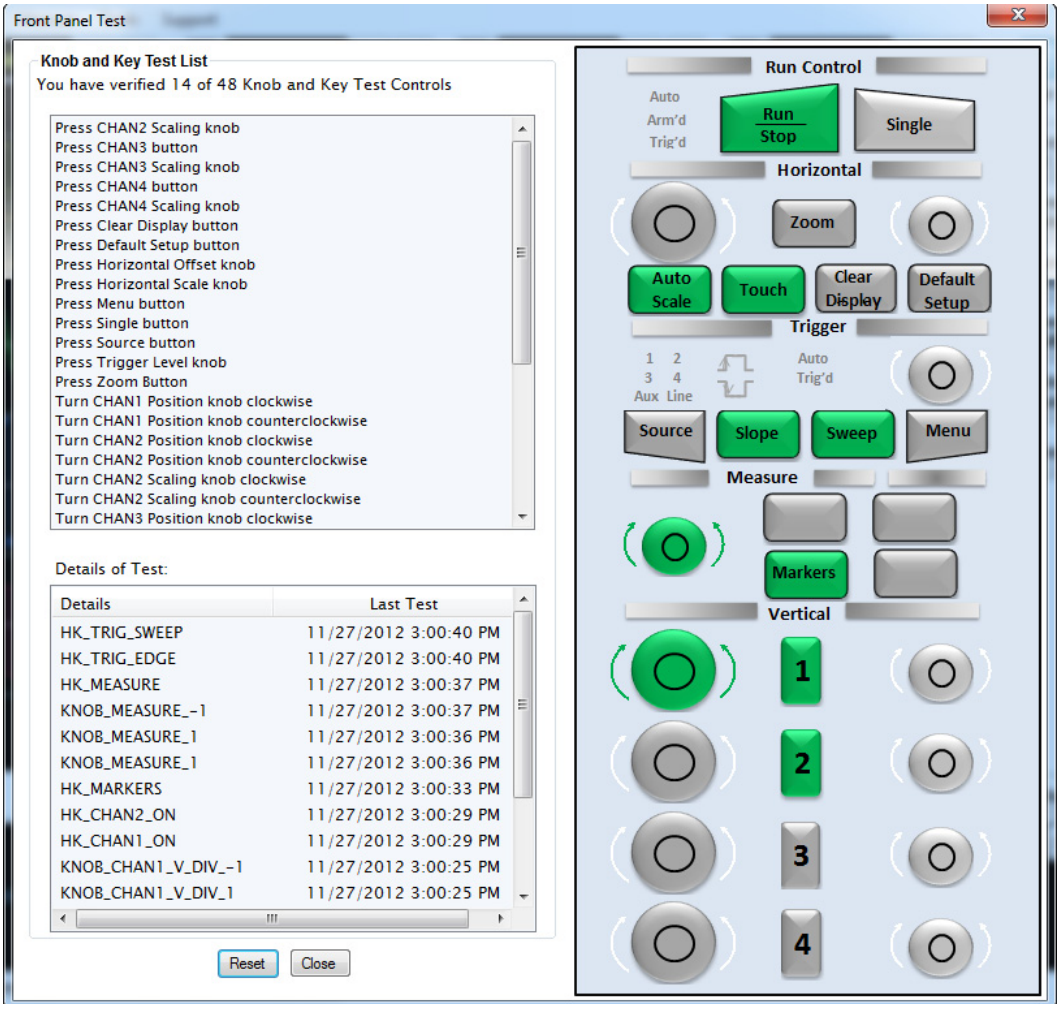


Figure 3-3 Front panel test results

5 Select **Reset** to reset the front panel test.

Self-Test

The 8990B is designed to perform internal diagnostics. The self-test will run diagnostics on the test point voltages, fan, battery, PLL, channel peak paths, channel data acquisition points, and video. The 8990B self test can also be performed remotely.

NOTE **Remove all the input and output connections from the 8990B before performing the self-test.**

Instrument self-test

Use the following procedure to perform instrument self-test.

1 Select **Tools > Self Test...** on the toolbar as shown in Figure 3-4.

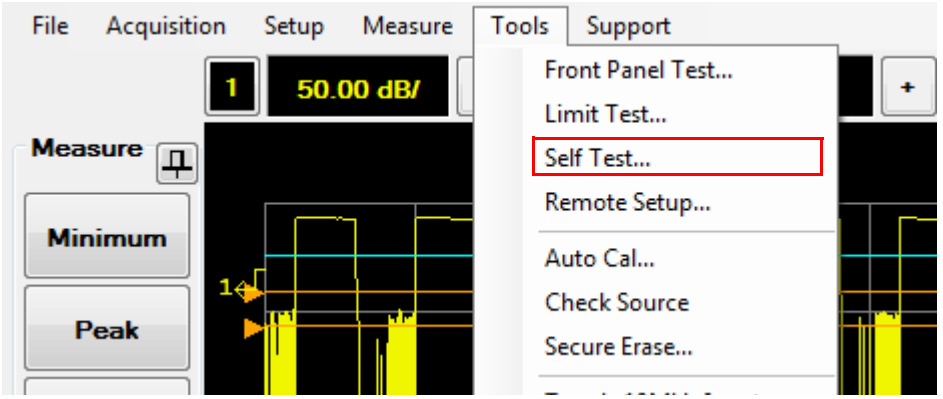


Figure 3-4 Self Test... selection in the Tools menu

2 The Self Test dialog is displayed as shown in Figure 3-5.

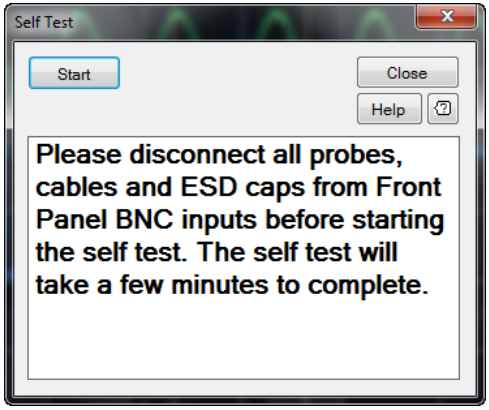


Figure 3-5 Self Test dialog

3 Select **Start** to start the self-test.

4 The self-test result is displayed in the Self Test dialog as shown in Figure 3-6.

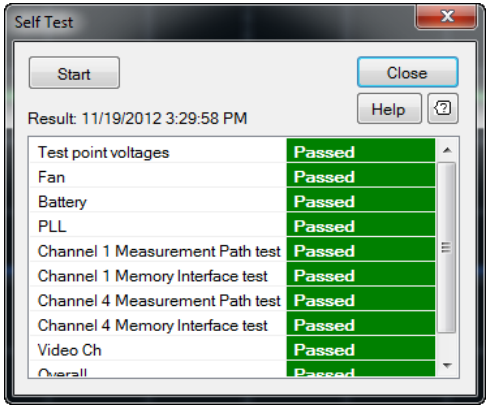


Figure 3-6 Self-test result in the Self Test dialog

Remote self-test

To invoke the remote self-test, the IEEE 488.1 compliant standard command, **`*TST?`** is used. This command runs a full self-test and returns one of the following codes:

- 0 — no tests failed
- 1 — one or more tests failed

When the **`*TST?`** command is executed, the screen is cleared. As each test takes place, the name of the test is listed on the screen. While a test is running, the message **Testing...** appears beside the name of the test. As each stage of the test is completed, the message **Testing...** is replaced by either the message **Passed** or **Failed**.

Test descriptions

Test point voltages

This test verifies the voltage rails.

Fan

This test confirms that the internal side cooling fan is operating.

Battery

This test checks the battery level.

PLL

This test verifies the phase lock loop status.

Channel 1/4 Measurement Path test

This test confirms that the RF input channel measurement path is functioning.

Channel 1/4 Memory Interface test

This test confirms that the RF input channel memory interface is operating.

Video Ch

This test confirms that the video input channels are functioning.

Overall

This status indicates the overall self-test status.

Error Messages

Introduction

This section contains information on error messages. It explains how to read the 8990B error queue and lists all the error messages and their probable causes.

When there is a hardware-related problem (for example, a sensor overload), the error is indicated in the Log view of the multi-purpose pane at the bottom of the display. In addition, errors are also written to the error queue. Any error in the error queue is displayed in the Log view as shown in Figure 3-7.

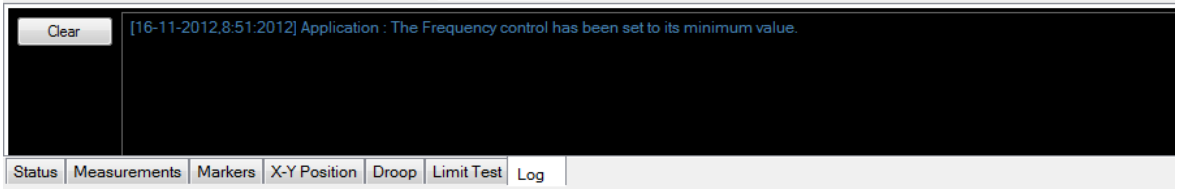


Figure 3-7 Error log

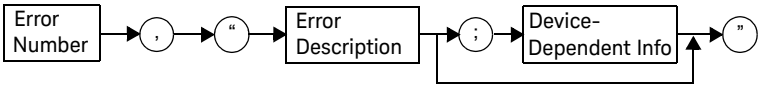
To read the error queue from the front panel:

– select the **Log** tab at the bottom of the display.

To read the error queue from the remote interface:

– use the `SYSTem:ERRor?` query.

Error queue messages have the following format:



Error queue message

For example, –113,"Undefined header;*T<Err> ST?".

Errors are retrieved in a first-in, first-out (FIFO) order. If more than 30 errors occur, the error queue overflows and the last error in the queue is replaced with error –350,“Queue overflow”. Any time the queue overflows, the most recent errors are discarded.

When the errors are read, they are removed from the error queue. This opens a position at the end of the queue for a new error message, if one is subsequently detected. When all errors have been read from the queue, further error queries return 0,“No error”.

To delete all the errors in the queue from the front panel:

– select **Clear** in the Log view.

To delete all the errors in the queue remotely:

– use the `*CLS` (clear status) command.

The error queue is also cleared when the 8990B power has been switched off.

Error list

0	No error The error queue is completely empty. Every error or event in the queue has been read or the queue has been purposely cleared by power-on, *CLS, and so forth.
–100	Command error Generic syntax error
–101	Invalid character An invalid character was found in the command string. You may have inserted a character such as #, $, or % in the command header or within a parameter. Example: MARK:AXP 30#
–102	Syntax error An invalid syntax was found in the command string Example: AUTO
–103	Invalid separator An invalid separator was found in the command string. You may have used a comma instead of a colon, semicolon, or blank space; or you may have used a blank space instead of a comma. Example: ACQ:AVER:COUN,128
–105	GET not allowed A Group Execute Trigger (GET) is not allowed within a command string
–109	Missing parameter Fewer parameters were received than expected for the command. You may have omitted one or more parameters that are required for this command. Example: CHAN1:BWID
–110	Command header error An error was detected in the header
–111	Header separator error A character that was not a valid header separator was found in the command string
–112	Program mnemonic too long A command header was received which contained more than the maximum 12 characters allowed Example: SYSTemCOMMunicateLANDGATeway "10.0.0.2"

–113	Undefined header A command was received that is not valid for the 8990B. You may have misspelled the command, it may not be a valid command, or you may have selected the wrong interface. If you are using the short form of the command, remember that it may contain up to four letters. Example: CHAN2:OFF 50
–114	Header suffix out of range The value of the numeric suffix is invalid
–120	Numeric data error Generic numeric data error
–121	Invalid character in number An invalid character was found in the number specified for a parameter value Example: MARK:BXP 20$
–123	Exponent too large A numeric parameter was found whose exponent was larger than 32000 Example: CHAN1:FREQ 1E34000
–124	Too many digits A numeric parameter was found whose mantissa contained more than 255 digits, excluding leading zeros
–128	Numeric data not allowed A numeric value was received within a command which does not accept a numeric value Example: CHAN1:REF 50
–130	Suffix error Generic suffix error
–131	Invalid suffix A suffix was incorrectly specified for a numeric parameter. You may have misspelled the suffix. Example: CHAN2:INP LFRJ1
–134	Suffix too long A suffix used contained more than 12 characters Example: CHAN2:INP LFR20000000000000
–138	Suffix not allowed A suffix was received following a numeric parameter which does not accept a suffix Example: CHAN2:OFFS 50Hz
–140	Character data error Generic character data error

–141	Invalid character data Either the character data element contains an invalid character, or the element is not valid
–144	Character data too long The character data element contains more than 12 characters
–148	Character data not allowed A discrete parameter was received but a character string or a numeric parameter was expected. Check the list of parameters to verify that you have used a valid parameter type. Example: MARK:MODE OFF_0
–150	String data error Generic string data error
–151	Invalid string data An invalid string was received. Check to see if you have enclosed the character string in single or double quotes. Example; SYST:COMM:LAN:ADDR "10.0.0.2
–158	String data not allowed A character string was received but is not allowed for the command. Check the list of parameters to verify that you have used a valid parameter type. Example: SYST:LOCK 'ON'
–160	Block data error Generic block data error
–161	Invalid block data A block data element was expected but was invalid for some reason
–168	Block data not allowed A legal block data element was encountered but not allowed by the 8990B at this point
–170	Expression error Generic expression error
–171	Invalid expression data The expression data element was invalid
–178	Expression data not allowed A legal expression data was encountered but not allowed by the 8990B at this point Example: MARK:LEV (5+5)
–200	Execution error Generic syntax error

–210	Trigger error An error occurred during triggering
–211	Trigger ignored A triggering signal was received but the trigger was ignored
–220	Parameter error A data element related error occurred
–221	Settings conflict;Requires channel # to be enabled The channel selected is not enabled
–221	Settings conflict;Requires averaging to be enabled The averaging mode is not enabled
–221	Settings conflict;Requires CCDF mode to be enabled The data acquisition mode is not set to CCDF
–221	Settings conflict;Requires zoom mode to be enabled The data acquisition mode is not set to zoom
–221	Settings conflict;Requires droop measurement to be enabled The droop measurement is not enabled
–221	Settings conflict;Requires to switch to manual marker mode The marker measurement mode is not set to manual
–221	Settings conflict;Requires to switch to pulse spacing marker measurement The marker measurement mode is not set to pulse spacing
–221	Settings conflict;Requires CCDF sweep to be in free run mode The CCDF sweep mode is not set to free run
–221	Settings conflict;Requires CCDF sweep to be in triggered mode The CCDF sweep mode is not set to triggered
–221	Settings conflict;Requires CCDF trace # to be enabled The CCDF trace from the channel selected is not enabled
–221	Settings conflict;Requires CCDF Gaussian trace to be enabled The CCDF Gaussian trace is not enabled
–221	Settings conflict;Requires CCDF reference trace to be enabled The CCDF reference trace is not enabled
–221	Settings conflict;CCDF marker # source not set The source of CCDF marker A or B is not set

–221	Settings conflict;CCDF source not set The CCDF source is not set
–221	Settings conflict;Settings conflict;Fast trigger is only applicable to trigger source for channel 1 and 4. Fast trigger has been disabled The fast trigger is enabled when the trigger source is set to channel 2, 3, or auxiliary
–221	Settings conflict;Unable to turn on video bandwidth while ETS mode is on The video bandwidth is being turned on when the ETS mode is enabled
–221	Settings conflict;Unable to set video bandwidth to MEDIUM or HIGH. Frequency must be higher than 500 MHz The video bandwidth is being set to medium or high when the frequency is less than 500 MHz
–221	Settings conflict;Video bandwidth must be off when ETS is on. Video bandwidth is turned off ETS is being turned on when the video bandwidth is enabled
–221	Settings conflict;Frequency less than 500 MHz. Video bandwidth has been set to LOW The frequency is set to less than 500 MHz when the video bandwidth is set to medium or high
–221	Settings conflict;Unable to turn on Trigger on Event while ETS mode is on The 8990B is set to trigger on event when the ETS mode is enabled
–221	Settings conflict;Trigger sweep must be in triggered mode while ETS is on. Trigger sweep is set to triggered mode The trigger sweep mode is set to auto when the ETS mode is enabled
–221	Settings conflict;Unable to set trigger sweep to auto mode, time scale must be at least {0} or higher The trigger sweep mode is set to auto when the time scale is too low
–221	Settings conflict;No FDO data entry available There is no data in the selected FDO table
–221	Settings conflict;No FDO table selected There was no FDO table selected when sending an FDO table-related command
–221	Settings conflict;Duplicated frequency input The frequency value specified for the FDO table is a duplicate of an existing frequency value
–221	Settings conflict;No data in waveform memory slot There is no waveform data in the selected 8990B memory slot
–221	Settings conflict;Unable to set the trigger source. Command ignored An error occurred when setting the trigger source

–222	Data out of range A numeric parameter value is outside the valid range for the command Example: CHAN1:EXT 500
–222	Data out of range;Value clipped to minimum (#) A numeric parameter value is lower than the minimum value allowed
–222	Data out of range;Value clipped to maximum (#) A numeric parameter value is higher than the maximum value allowed
–223	Too much data A data element was received that contains more data than the 8990B can handle
–224	Illegal parameter value A discrete parameter was received which was not a valid choice for the command. You may have used an invalid parameter choice. Example: CHAN1:REF MIDD
–225	Out of memory The 8990B has insufficient memory to perform the requested operation
–231	Data questionable;Calibration error 8990B calibration and zeroing has failed
–231	Data questionable;Voltage overloaded The voltage input to the channel exceeds the maximum range of the probe
–231	Data questionable;Calibration error in channel 1 An error has occured during calibration for channel 1
–231	Data questionable;Calibration error in channel 4 An error has occured during calibration for channel 4
–232	Invalid format The data format or structure is inappropriate
–233	Invalid version The version of the data format is incorrect
–240	Hardware error The command could not be executed due to a hardware problem
–241	Hardware missing;Sensor not found in channel # The 8990B is unable to execute the command because no sensor is connected to the respective channel

–250	Mass storage error Generic error relating to mass storage
–251	Missing mass storage The mass storage is not available
–255	Directory full The specified directory is full
–256	File name not found The selected file was not found
–257	File name error The file name is invalid
–260	Expression execution error An expression program data element related error occurred
–291	Out of memory error The memory is not sufficient to implement the command
–300	Device specific error This is the generic device-dependent error for devices that cannot detect more specific errors. This code indicates that only a Device-Dependent Error as defined in the IEEE-488.2, 11.5.1.1.6 has occurred.
–310	System error The 8990B operation has not completed properly, possibly due to an abnormal hardware or firmware condition
–311	Memory error An error was detected in the 8990B memory
–330	Self-test failed The 8990B self-test has failed
–340	Calibration failed The 8990B calibration has failed
–350	Error queue overflow The error queue is full and another error has occurred which could not be recorded
–400	Query error Generic error query
–410	Query interrupted A condition causing an interrupted query error occurred

–420	Query unterminated A condition causing an unterminated query error occurred
–430	Query deadlocked A condition causing a deadlocked query error occurred
–440	Query unterminated after indefinite response A query was received in the same program message after a query indicating an indefinite response was executed
700	Applicable to channel 1 and 4 only A channel other than channel 1 or 4 has been specified for a command applicable for channels 1 and 4 only; or a command applicable for channels 1 and 4 only has been sent for a channel other than channel 1 or 4
701	Applicable to channel 2 and 3 only A channel other than channel 2 or 3 has been specified for a command applicable for channels 2 and 3 only; or a command applicable for channels 2 and 3 only has been sent for a channel other than channel 2 or 3
702	Applicable to trigger source for channel 1, 4 and auxiliary only A command applicable for the channel 1, 4, or auxiliary trigger source only has been sent when the trigger source was not set to any of these sources
703	Applicable in pair of channel 1 and 4 or 2 and 3 An incorrect channel pair has been specified
704	Applicable to trigger source for auxiliary only A command applicable for the auxiliary trigger source only has been sent when the trigger source was not set to auxiliary
705	Applicable to trigger source for channel 1 and 4 only A command applicable for the channel 1 or 4 trigger source only has been sent when the trigger source was not set to any of these sources
706	Applicable to trigger source for channel 2 and 3 only A command applicable for the channel 2 or 3 trigger source only has been sent when the trigger source was not set to any of these sources
720	No reference signal detected on the 10 MHz REF IN BNC input There is no reference signal at the 10 MHz REF IN BNC input
780	System is busy, command unterminated The system is busy processing the command
939	10 MHz setting is only applicable when ETS is off. 10 MHz setting is turned off The ETS mode is set when the 10 MHz reference signal input is enabled

940	Unable to turn on 10 MHz setting when ETS is on The 10 MHz reference signal input is being turned on when the ETS mode is enabled
943	Markers A and B are positioned on the same waveform Markers A and B have to be placed on two separate waveforms to measure the time difference between them
946	Selected FDO table has reached the limit of 80 frequency points Select another FDO table or delete some frequency points
977	Detected channel 1 frequency changed. Power level is questionable. Please zero and cal channel 1.
978	Detected channel 4 frequency changed. Power level is questionable. Please zero and cal channel 4.

Recovering the 8990B Hard Drive

The 8990B hard drive recovery system is contained in a hidden partition on the 8990B hard drive. Using the 8990B hard drive recovery system will return the 8990B hard drive to the condition it was in when it left the factory.

Before recovering the 8990B hard drive, use the following procedure to return the 8990B to normal operation:

1. Turn off the 8990B.
2. Turn on the 8990B. If the 8990B does not successfully restart, then try recycling the power.
3. If the 8990B still does not successfully restart, follow the instructions below for recovering the hard drive.

8990B hard drive recovery

Use the following procedure to recover the 8990B hard drive:

1. Turn off the 8990B.
2. Connect the keyboard to the keyboard connector on the side panel of the 8990B.
3. Connect the mouse to the mouse connector on the side panel of the 8990B.
4. Turn on the 8990B.
5. When you see the initial boot menu, select **Keysight Recovery System** and press Enter. Follow the on-screen instructions to complete the 8990B hard drive recovery process.

Removing the 8990B Hard Drive (Option 801)

This section explains how to remove the removable hard drive from the 8990B Option 801. The hard drive is not required to be removed before sending the 8990B for calibration or service.

Use the following procedure to remove the 8990B removable hard drive.

1 Turn off the 8990B.

Figure 3-8 Turn off the 8990B

2 Unscrew the hard drive from the 8990B using a slotted screw driver as shown in Figure 3-9.

Figure 3-9 Unscrew the hard drive

3 Slowly pull and remove the hard drive from the slot in the 8990B.

Figure 3-10 Pull and remove the hard drive from the slot

NOTE It is recommended to store the hard drive in an anti-static bag to prevent any damage to the hard drive.

4 To reinstall the hard drive, put the hard drive back into the slot and screw it onto the 8990B.

CAUTION Ensure that you turn off the 8990B before removing or reinstalling the hard drive.

Cleaning the 8990B

To clean the 8990B, disconnect its AC power cord and wipe the outer panels with a soft, lint-free, slightly water-dampened cloth. Do not use detergent.

Disassembly is not required or recommended for cleaning.

CAUTION Do not use too much liquid when cleaning the 8990B. Water can enter the front panel, damaging sensitive electronic components.

Contacting Keysight

This section provides the information on what to do if you encounter problems with your 8990B.

First, refer to the section Prior to contacting Keysight. This section contains a checklist that helps identify some of the most common problems.

If you wish to contact Keysight to enquire about the 8990B, from service problems to ordering information, refer to "Keysight Sales and Service Offices" on page 199.

If you wish to return the 8990B to Keysight, refer to "Returning the 8990B for Service" on page 197.

Prior to contacting Keysight

Before calling Keysight or returning the 8990B for service, perform the inspection based on the list in "Check the basics" on page 195. If you still encounter problems, read the warranty printed at the front of this guide. If your 8990B is covered by a separate maintenance agreement, familiarize yourself with the terms.

Keysight offers several maintenance plans to service your 8990B after warranty expiration. Call your Keysight Sales and Service Center for full details.

Check the basics

Problems can be solved by repeating what was being performed when the problem occured. A few minutes spent in performing these simple inspections may eliminate time spent waiting for instrument repair. Before calling Keysight or returning the 8990B for service, make the following inspections:

- Check that the line socket has power.
- Check that the 8990B is plugged into a proper AC power source.
- Check that the 8990B is switched on.
- Check that other equipment, cables, and connectors are connected properly and operating correctly.
- Check the equipment settings in the procedure that was being used when the problem occurred.
- Check that the test being performed and the expected results are within the specifications and capabilities of the 8990B.
- Check the 8990B display for error indicators.
- Check the 8990B operation by performing the built-in self-test.
- Check using a different wideband power sensor.

Instrument serial numbers

Keysight makes frequent improvements to its products to enhance their performance, usability, and reliability. Keysight service personnel have access to complete records of design changes for each instrument. The information is based on the serial number and option designation of each 8990B.

Whenever you contact Keysight about your 8990B, have the complete serial number available. This ensures you obtain the most complete and accurate service information. The serial number can be obtained via the following methods:

- querying the 8990B over the remote interface using the `*IDN?` command.
- from the serial number label.

The serial number label is attached to the rear panel of each Keysight instrument. This label has two instrument identification entries. The first provides the instrument serial number, and the second provides the identification number for each option built into the instrument.

The serial number is divided into two parts: the prefix (two letters and the first four numbers) and the suffix (the last four numbers).

- The prefix letters indicate the country of manufacture. This code is based on the ISO international country code standard, and is used to designate the specific country of manufacture for the individual product. The same product number could be manufactured in two different countries. In this case, the individual product serial numbers would reflect different country of manufacture codes. The prefix also consists of four numbers. This is a code identifying the date of the last major design change.
- The suffix indicates an alphanumeric code which is used to ensure unique identification of each product throughout Keysight.

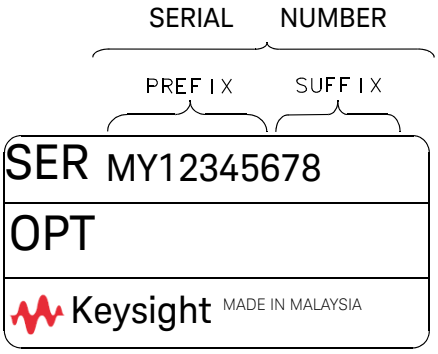


Figure 3-11 Serial number

Recommended calibration interval

Keysight recommends a one-year calibration cycle for the 8990B.

Returning the 8990B for Service

Use the information in this section if you need to return your 8990B to Keysight.

Packaging the 8990B for shipment

Use the following procedure to package the 8990B for shipment to Keysight for servicing:

- Be as specific as possible about the nature of the problem. Send a copy of any or all of the following information:
  - Any error messages that appeared on the 8990B display.
  - Any information on the performance of the 8990B.

CAUTION **Damage to the instrument can result from using packaging material other than those specified. Never use styrene pellets of any shape as packaging material. They do not adequately cushion the instrument or prevent it from shifting in the carton. Styrene pellets cause instrument damage by generating static electricity and by lodging in the rear panel.**

- Use the original packaging material or a strong shipping container made of double-walled, corrugated cardboard with 91 kg (200 lb) bursting strength. The carton must be large and strong enough to accommodate the 8990B and allow at least 3 to 4 inches on all sides of the 8990B for packing material.
- Surround the 8990B with at least 3 to 4 inches of packing material, or enough to prevent the 8990B from moving in the carton. If packing foam is not available, the best alternative is the SD-240 Air Cap™ from Sealed Air Corporation (Commerce, CA 90001). The Air Cap looks like a plastic sheet covered with 1-1/4-inch air-filled bubbles. Use the pink Air Cap to reduce static electricity. Wrap the 8990B several times in the material as protection and to prevent it from moving in the carton.
- Seal the shipping container securely with strong nylon adhesive tape.
- Mark the shipping container as “FRAGILE, HANDLE WITH CARE” to ensure careful handling.
- Retain copies of all shipping papers.

Keysight Sales and Service Offices

In any correspondence or telephone conversations, refer to the 8990B by its model number and full serial number. With this information, the Keysight representative can quickly determine whether your unit is still within its warranty period.

UNITED STATES	Keysight Technologies (tel) (800) 829 4444
CANADA	Keysight Technologies Canada Test & Measurement (tel) (877) 894 4414
EUROPE	Keysight Technologies Test & Measurement European Marketing Organization (tel) 31 20 547 2111
JAPAN	Keysight Technologies Japan Ltd. (tel) 0120 (421) 345 (fax) 0120 421 678
LATIN AMERICA	Keysight Technologies Latin America Region Headquarters, USA (tel) 305 269 7500
AUSTRALIA and NEW ZEALAND	Keysight Technologies Australia Pty Ltd. (tel) 61 3 9210 5555 (Australia) (fax) 61 3 9210 5899 (Australia) (tel) (408) 345 8886 (New Zealand) (fax) (408) 345 8474 (New Zealand)
ASIA PACIFIC	Keysight Technologies, Hong Kong (tel) (852) 3197 7777 (fax) (852) 2506 9292

Or visit Keysight's website at www.keysight.com/find/assist.

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4 Characteristics and Specifications

For the characteristics and specifications of the 8990B Peak Power Analyzer, refer to the datasheet at
http://literature.cdn.keysight.com/litweb/pdf/5990-8126EN.pdf.

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