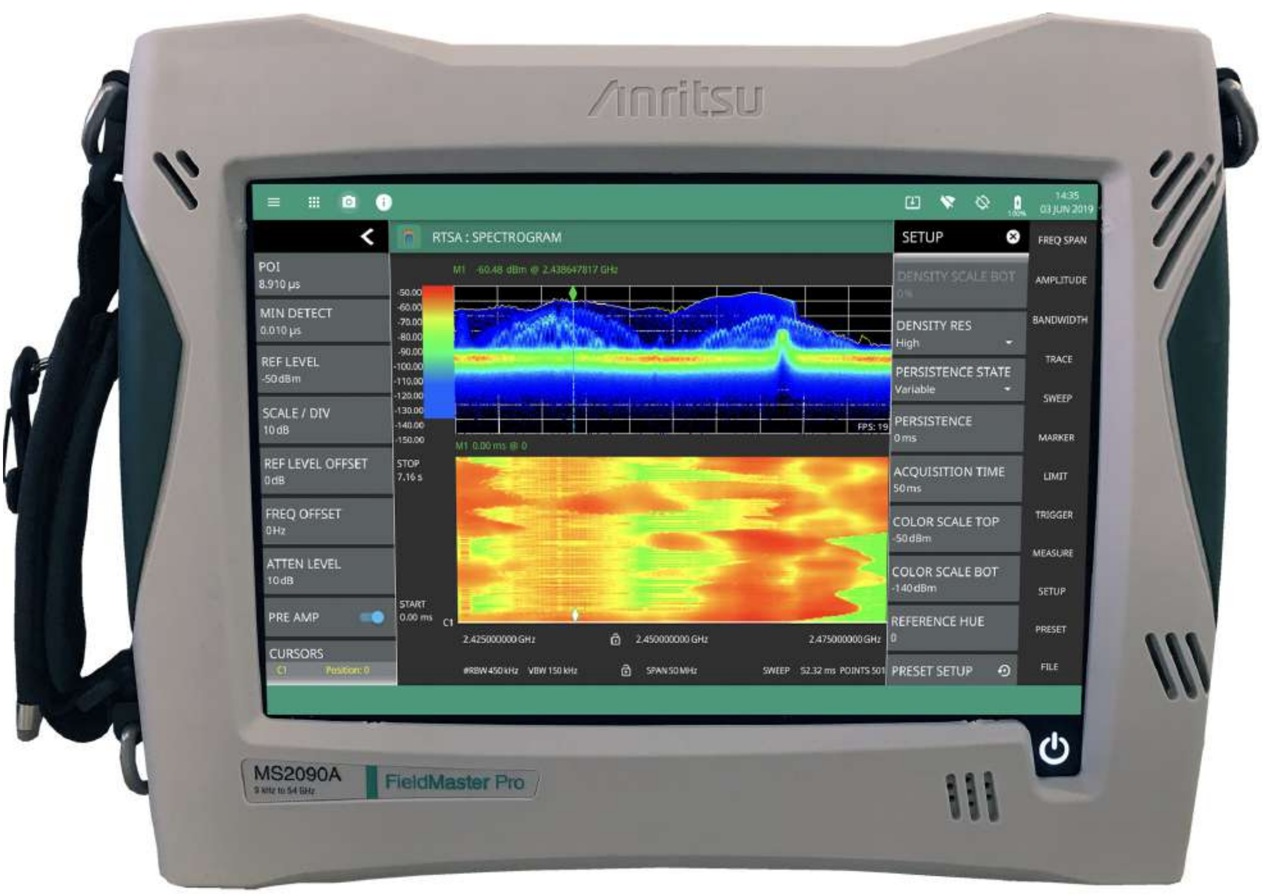
User Guide

Field Master Pro™ MS2090A

Spectrum Analyzer

MS2090A-0709 9 kHz to 9 GHz (Option 709)
MS2090A-0714 9 kHz to 14 GHz (Option 714)
MS2090A-0720 9 kHz to 20 GHz (Option 720)
MS2090A-0726 9 kHz to 26.5 GHz (Option 726)
MS2090A-0732 9 kHz to 32 GHz (Option 732)
MS2090A-0743 9 kHz to 43.5 GHz (Option 743)
MS2090A-0754 9 kHz to 54 GHz (Option 754)



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Chapter 1 — General Information

1-1 Introduction

The MS2090A Field Master Pro User Guide is part of a set of manuals that cover all of the instrument functions and their use. This manual covers the instrument overview, system functions, and other common features, along with a brief guide to basic measurement concepts and setups. Most instrument operations are covered in specific chapters of this manual as listed below. Remote programming is covered in the programming manual. Additionally, the MS2090A Field Master Pro offers a remote PC software that replicates the instrument user interface on your PC screen and allows network connection to an instrument or the ability to recall data and perform on-screen measurement analysis without a connection to an instrument (refer to Appendix C, "MS2090A PC Software").

Before You Begin

- Read the *Field Master Pro MS2090A Information, Compliance, and Safety Guide* (PN: 10100-00069) for important safety, legal, and regulatory notices before operating the equipment.
- Charge the instrument battery using the supplied battery charger until fully charged.

Note	The instrument may reboot when the battery charge level is low and external power is removed.

- Review Section 1-2 "Instrument Description" on page 1-2 and Section 1-3 "Instrument Care and Preventive Maintenance" on page 1-5.
- Chapter 2, "Instrument Overview" provides information about the physical instrument, connectors, and other hardware interfaces.
- Chapter 3, "Spectrum Analyzer Measurements" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the spectrum analyzer.
- Chapter 4, "Real-Time Spectrum Analyzer Measurements" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the real-time spectrum analyzer.
- Chapter 5, "LTE Measurements" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the LTE analyzer.
- Chapter 6, "5GNR Measurements" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the 5GNR analyzer.
- Chapter 7, "IQ Capture/Streaming (Option 124/126 and 125/127)" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the 5GNR analyzer.
- Chapter 8, "EMF Meter Measurements (Option 445)" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the 5GNR analyzer.
- Chapter 9, "Pulse Analyzer Measurements (Option 421)" provides information on the software user interface, such as instrument settings, measurement features, and menu overviews, for the pulse analyzer.

Additional Documentation

Table 1-1. Related Manuals

Document Part Number	Description
10100-00069	Important Product Information, Compliance, and Safety Notices
11410-01000	MS2090A Field Master Pro Technical Data Sheet
10580-00445	Programming Manual

For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:

http://www.anritsu.com/en-US/test-measurement/products/ms2090a

Document Conventions

The following conventions are used throughout the MS2090A documentation set.

Instrument Identification

When identifying a frequency option for the MS2090A, that option number is appended after the model number; example: MS2090A-0709.

User Interface

The MS2090A user interface consists of menus, buttons, toolbars, and dialog boxes.

User Interface Navigation

Elements in navigation paths are separated as follows: MARKER > PEAK SEARCH > NEXT PEAK.

1-2 Instrument Description

The MS2090A Field Master Pro is a synthesizer-based handheld signal analyzer that provides quick and accurate measurement results. The instrument is designed for monitoring, measuring, and analyzing signal environments. Measurements can easily be made by using the main instrument functions: frequency, span, amplitude, and bandwidth. A 10.1" capacitive touchscreen enables fast, easy data entry.

Typical measurements include in-band interference and transmit spectrum analysis, plus cell site and 802.11a/b/g interference testing. Options are available for RF, advanced demodulation, and over-the-air (OTA) measurement. A full range of marker capabilities (such as peak, center, and delta functions) are provided for faster, more comprehensive analysis of displayed signals. Upper and lower multi-segmented limit lines are available to create quick, simple pass/fail measurements.

Time and date stamping of measurement data is automatic. The internal memory provides for the storage and recall of up to 1000 measurement setups and up to 1000 traces. Measurements and setups can be stored internally on the instrument or on a USB flash drive for later recall.

Note	Not all after-market USB drives are compatible with Field Master Pro. The USB drive must contain a single partition using FAT32 format.

Available Models

Table 1-2 lists the frequency options available with the MS2090A Field Master Pro.

Table 1-2. Field Master Pro Frequency Options

Model	Frequency Range
MS2090A-0709	Signal Analyzer, 9 kHz to 9 GHz
MS2090A-0714	Signal Analyzer, 9 kHz to 14 GHz
MS2090A-0720	Signal Analyzer, 9 kHz to 20 GHz
MS2090A-0726	Signal Analyzer, 9 kHz to 26.5 GHz
MS2090A-0732	Signal Analyzer, 9 kHz to 32 GHz
MS2090A-0743	Signal Analyzer, 9 kHz to 43.5 GHz
MS2090A-0754	Signal Analyzer, 9 kHz to 54 GHz

Available Options

Available options for the Field Master Pro are listed in Table 1-3.

Table 1-3. Available Options

Option[a]	Description
MS2090A-0006	Remove Wi-Fi
MS2090A-0024	Interference Finder
MS2090A-0031	GPS Receiver (requires external GPS antenna)
MS2090A-0089	Zero Span IF Output
MS2090A-0090	Gated Sweep
MS2090A-0103	50 MHz Analysis Bandwidth
MS2090A-0104	100 MHz Analysis Bandwidth
MS2090A-0124	IQ Waveform Capture
MS2090A-0125	IQ Waveform Streaming (requires Option 124)
MS2090A-0126	IQ Waveform Capture (non export control)
MS2090A-0127	IQ Waveform Streaming (non export control, requires Option 126)
MS2090A-0128	Vector Signal Analysis Enabled (requires Option 124 or 126; use with MX280005A)
MS2090A-0421	Pulse Analyzer
MS2090A-0444	EMF Measurement (requires a compatible Anritsu isotropic antenna)
MS2090A-0445	EMF Meter Enabled (requires 2000-1985-R isotropic EMF probe)
MS2090A-0199	Real-Time Spectrum Analyzer
MS2090A-0888	5GNR Downlink Measurements (requires GPS option MS2090A-0031)
MS2090A-xxxx-0097	Accredited Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.
MS2090A-xxxx-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate.
MS2090A-xxxx-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.

a. xxxx is the frequency option number of the instrument.

1-3 Instrument Care and Preventive Maintenance

Instrument care and preventive maintenance consist of proper operation in a suitable environment, occasional cleaning of the instrument, and inspecting and cleaning the RF connectors and all accessories before use. Clean the instrument with a soft, lint-free cloth dampened with water or water and a mild cleaning solution.

Caution	To avoid damaging the display or case, do not use solvents or abrasive cleaners.

Ventilation and Cooling

The Field Master Pro provides active cooling of the internal components to prevent damage from overheating. The airflow vents on the edges and bottom of the instrument must be kept clear and unobstructed while the instrument is powered on. When using the Field Master Pro on a desktop or bench, the tilt bail can be used or the instrument can be placed flat on its back to facilitate increased airflow.

Caution	Do not operate or store the Field Master Pro in extreme environments. Refer to the instrument Technical Data Sheet for the specified operating and storage conditions.

Connector Care

Clean the RF connectors and center pins with a cotton swab dampened with denatured alcohol. Visually inspect the connectors. The fingers of the N(f) connectors and the pins of the N(m) connectors should be unbroken and uniform in appearance. If you are unsure whether the connectors are undamaged, gauge the connectors to confirm that the dimensions are correct. Visually inspect the test port cable(s). The test port cable should be uniform in appearance and not stretched, kinked, dented, or broken.

To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the Type-N connectors. The recommended torque is 12 lbf ·in to 15 lbf ·in (1.36 N ·m to 1.70 N ·m). Inadequate torque settings can affect measurement accuracy. Over-tightening connectors can damage the cable, the connector, the instrument, or all of these items.

Visually inspect connectors for general wear, cleanliness, and for damage such as bent pins or connector rings. Repair or replace damaged connectors immediately. Dirty connectors can limit the accuracy of your measurements. Damaged connectors can harm the instrument. Connection of cables carrying an electrostatic potential, excess power, or excess voltage can damage the connector, the instrument, or both.

Connecting Procedure

1. Carefully align the connectors. The male connector center pin must slip concentrically into the contact fingers of the female connector.
2. Align and push connectors straight together. Do not twist or screw them together. A slight resistance can usually be felt as the center conductors mate.
3. To tighten, turn the connector nut, not the connector body. Major damage can occur to the center conductor and to the outer conductor if the connector body is twisted.
4. If you use a torque wrench, initially tighten by hand so that approximately 1/8 turn or 45 degrees of rotation remains for the final tightening with the torque wrench.

   Relieve any side pressure on the connection (such as from long or heavy cables) in order to assure consistent torque. Use an open-end wrench to keep the connector body from turning while tightening with the torque wrench.

   Do not over-torque the connector.

Disconnecting Procedure

1. If a wrench is needed, use an open-end wrench to keep the connector body from turning while loosening with a second wrench.
2. Complete the disconnection by hand, turning only the connector nut.
3. Pull the connectors straight apart without twisting or bending.

ESD Caution

The Field Master Pro, like other high performance instruments, is susceptible to electrostatic discharge (ESD) damage. Coaxial cables and antennas often build up a static charge, which (if allowed to discharge by connecting directly to the instrument without discharging the static charge) may damage the Field Master Pro input circuitry. Instrument operators must be aware of the potential for ESD damage and take all necessary precautions.

Operators should exercise practices outlined within industry standards such as JEDEC-625 (EIA-625), MIL-HDBK-263, and MIL-STD-1686, which pertain to ESD and ESDS devices, equipment, and practices. Because these apply to the Field Master Pro, it is recommended that any static charges that may be present be dissipated before connecting coaxial cables or antennas to the instrument. This may be as simple as temporarily attaching a short or load device to the cable or antenna prior to attaching to the Field Master Pro. It is important to remember that the operator may also carry a static charge that can cause damage. Following the practices outlined in the above standards will ensure a safe environment for both personnel and equipment.

1-4 Calibration and Verification

The Field Master Pro comes fully calibrated from the factory and there are no field-adjustable components. Anritsu recommends annual calibration and performance verification by local Anritsu service centers. Accredited calibration to ISO17025 and ANSI/NCSL Z540-1 are available and can include a calibration certificate, test report, and uncertainty data. Contact Anritsu sales and service centers for more information.

1-5 Contacting Anritsu for Sales and Service

To contact Anritsu, visit the following URL and select the services in your region:

http://www.anritsu.com/contact-us

Chapter 2 — Instrument Overview

2-1 Introduction

This chapter provides an overview of the Anritsu MS2090A Field Master Pro. It describes the instrument hardware features, touch screen display, general system settings and instrument configurations, and the connector panels. For detailed information on the instrument's user interface and functions, refer to the relevant chapter for your measurement:

- Chapter 3, "Spectrum Analyzer Measurements"
- Chapter 4, "Real-Time Spectrum Analyzer Measurements"
- Chapter 5, "LTE Measurements"
- Chapter 6, "5GNR Measurements"
- Chapter 7, "IQ Capture/Streaming (Option 124/126 and 125/127)"
- Chapter 8, "EMF Meter Measurements (Option 445)"
- Chapter 9, "Pulse Analyzer Measurements (Option 421)"

2-2 Instrument Front Panel

The Field Master Pro uses a touch screen for data input. The menus can vary depending on the current measurement configuration, installed options, and selected instrument function.

1. Touch Screen Display
2. "Top Connector Panel" on page 2-3
3. Shoulder Strap D-Ring Mount
4. Fan Ventilation Ports
5. "Side Connector Panel" on page 2-5
6. Battery Cover (see "Replacing the Battery" on page 2-9)
7. Power LED/Button and Battery Charge LED (see Section 2-6 "Turning On the MS2090A Field Master Pro")
8. Handle and Stylus

Figure 2-1. Front Panel Overview

2-3 Connector Panels

The MS2090A Field Master Pro uses two connector panels to provide for all physical IO. These panels use a variety of connector types intended for their purpose.

RF Connectors

The main RF input connector can be Type N, Type K, or Type V, depending on the frequency option that is installed. These are ruggedized 50 Ω connectors. Type N connectors are female and Type K and V are male. Additional IO is provided with the SMA and SMB style connectors. The SMA connectors are 50 Ω female and the SMB connectors are 50 Ω jack slip-on connectors.

Caution	To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the connectors. Do not overtighten the connector. The recommended torque for Type K and V is 8 lbf·in (0.9 N·m or 90 N·cm). The recommended torque for Type N is 12 lbf·in (1.35 N·m or 135 N·cm).

Top Connector Panel

Figure 2-2 shows the top connector panel on the MS2090A.

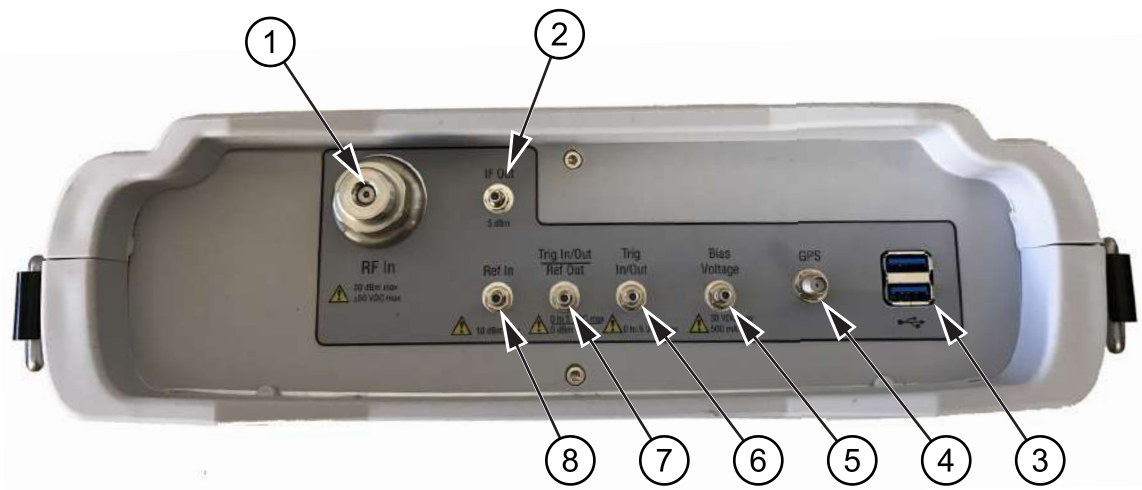


Figure 2-2. Test Panel Connectors

1. RF In Port

This is a 50 Ω ruggedized connector of the following:

- Type N female with options 709, 714, and 720
- Type K male with options 26, 32, and 43
- Type V male with option 754

Maximum Input: ±50 VDC, +23 dBm, +13 dBm with Preamp On

To prevent damage to your instrument, do not try to mate incorrect connector types or use pliers or a plain wrench to tighten the connector. Do not overtighten the connector. The recommended torque for Type K and V is 8 lbf·in (0.9 N·m or 90 N·cm). The recommended torque for Type N is 12 lbf·in (1.35 N·m or 135 N·cm).

2. IF Out

This 50 Ω SMB jack connector provides internal IF output. The nominal frequency range is 325 MHz with FFT capture bandwidth ≤ 32 MHz and 300 MHz with FFT capture bandwidth = 100 MHz. The nominal RF output level is –4 dBm with a 10 MHz, –20 dBm input, and with 0 dB input attenuation and preamp off. The spectrum can be inverted in certain RF input bands. Refer to “Zero Span IF Output (Option 89)” on page 3-10. This is a slip-on connector that should seat with a click.

3. USB Interface – Type A

The Field Master Pro has three Type A USB connectors that accept USB storage devices for saving measurements, setup data, and screen images. Two connectors are located on the top panel and one is located on the side panel. To ensure the device or it’s data does not become corrupted, press the eject icon to eject (unmount) the USB device before it is unplugged from the USB port (see Section 2-8 “Title Bar” on page 2-19).

4. GPS Antenna Connector

The GPS antenna connection on the Field Master Pro is type SMA female. This connector also provides 5.0/3.3 VDC for an active GPS antenna. To prevent damage to your instrument, do not use pliers or a wrench to tighten the connector.

5. Bias Voltage

The power supply is set up to provide 1 V to 34 V with a resolution of 0.1 V. The maximum current is 1 A, but with at total maximum power of 15 W.

6. Trigger In/Out

A TTL signal that is applied to the external trigger 50 Ω SMB jack input connector causes a single sweep to occur. In spectrum analysis, triggering is generally used in zero span, and triggering occurs on the rising edge of the signal. After the sweep is complete, the resultant trace is displayed until the next trigger signal arrives. This is a slip-on connector that should seat with a click.

7. Trigger In/Out / Ref Out (10 MHz)

This port can be configured as a trigger in/out as above or as a reference output. The reference output port is a 50 Ω SMB male connector that provides 10 MHz at approximately –7 dBm to 0 dBm. This is a slip-on connector that should seat with a click.

8. Ref In

The external reference input port is a 50 Ω SMB jack connector that provides for input of an external frequency reference. Refer to your Technical Data Sheet for valid frequencies. This is a slip-on connector that should seat with a click. The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Side Connector Panel

Figure 2-3 shows the MS2090A side connector panel.

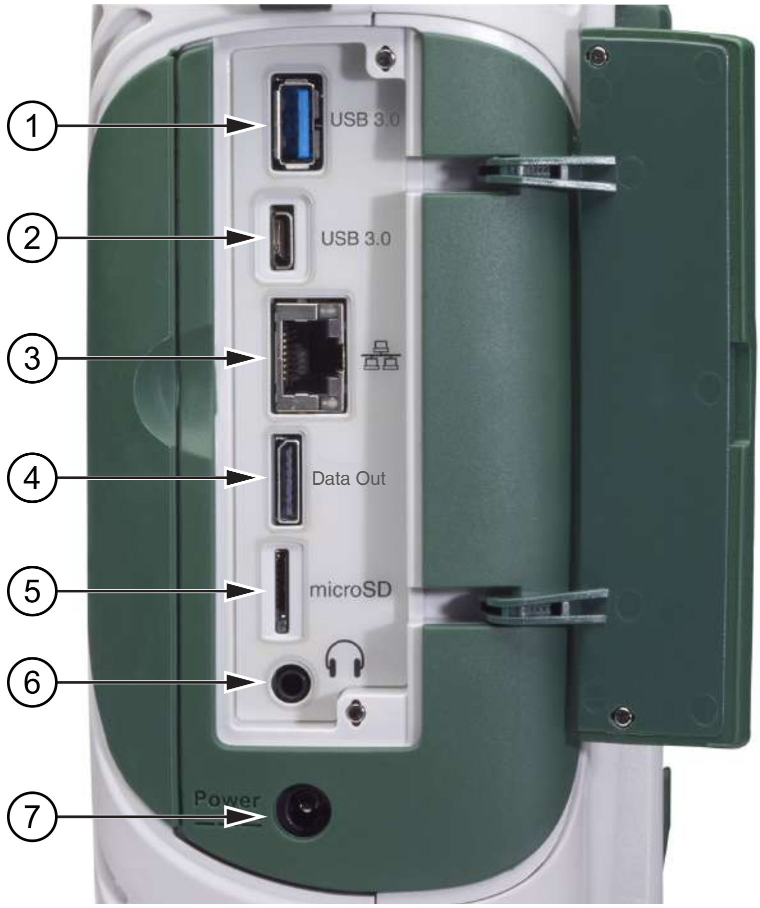


Figure 2-3. Side Panel Connectors

1. USB Interface – Type A

The Field Master Pro has three Type A USB connectors that accept USB storage devices for saving measurements, setup data, and screen images. Two connectors are located on the top panel and one more is located on the side panel. To ensure the device or it's data does not become corrupted, press the eject icon to eject (unmount) the USB device before it is unplugged from the USB port (see Section 2-8 "Title Bar" on page 2-19).

2. USB Interface – Type C

The USB Type-C port is used to connect the Field Master Pro directly to a PC for future capabilities.

3. LAN Connection

The RJ-45 connector is used to connect the Field Master Pro to a local area network or directly to a PC with an Ethernet crossover cable. See "Ethernet Connection" on page 2-26 for more details.

4. Data Out Port

The Data Out port is used for IQ Streaming. Refer to Chapter 7, "IQ Capture/Streaming (Option 124/126 and 125/127)". This is a multi-purpose, hot pluggable input/output (I/O) interface.

5. MicroSD

The Micro Secure Digital slot is a small expansion slot located on the side panel. The slot accepts industry standard MicroSD storage cards and can be used for storing measurements, setup data, and screen images similar to USB storage devices.

Note	The MicroSD slot is not currently active. Functionality will be added via an upcoming software update.

6. Headset Jack

Note	The headset jack is not yet enabled. Functionality will be added via an upcoming software update.

The 3-wire headset jack provides audio output from the built-in sounds generated by the instrument. The jack accepts a 3.5 mm 3-wire miniature phone plug such as those commonly used with cellular telephones.

7. External Power

This is a 2.5 mm by 5.5 mm barrel connector, 15 VDC, 5 A, center positive. The external power connector is used to power the unit and for battery charging. An orange blinking LED power button indicates that the instrument battery is being charged by the external charging unit. The indicator is a steady green when the battery is fully charged.

Warning	When using the AC-DC Adapter, always use a three-wire power cable that is connected to a three-wire power line outlet. If power is supplied without grounding the equipment in this manner, the user is at risk of receiving a severe or fatal electric shock.

Refer to "Turning On the MS2090A Field Master Pro" on page 2-10.

2-4 Tilt Bail Stand

The attached tilt bail can be used for desktop operation. The tilt bail provides a backward tilt for improved stability and air flow. To deploy the tilt bail, pull the bottom of the tilt bail away from the back of the instrument. To store the tilt bail, push the bottom of the bail towards the back of the instrument and snap the bail into the clips on the back of the instrument.

Figure 2-4. Tilt Bail Stand

2-5 Battery Information

The batteries that are supplied with the Field Master Pro may need charging before use. They can be charged using either the provided AC-DC adapter or the DC adapter. Refer to “Battery Status” for a description of the battery status and information panel. The batteries can be charged in the instrument or removed for charging in an optional battery charger. The batteries are installed at the factory and can be replaced by the user. Refer to the next section for information on removing the batteries. Battery status is shown in “Battery Information” on page 2-38.

Note	Use only Anritsu-approved batteries, adapters, and chargers with this instrument. The batteries will charge at a faster rate when the instrument is turned off. To prolong the useful battery life, the internal charging circuit monitors the battery temperature. Normal charging occurs when the battery temperature is between 0 °C and 45 °C. Charging is paused if the internal battery temperature is outside this range.

Caution	When using the automotive cigarette lighter adapter, always verify that the supply is rated for a minimum of 75 Watts @ 15 VDC, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, discontinue use immediately.

Note	Anritsu Company recommends removing the battery for long-term storage of the instrument.

Replacing the Battery

The battery can be replaced without the use of tools. The battery compartment door is located on the lower right side of the instrument (when you are facing the measurement display). To remove the battery:

1. Push in and slide the battery door tab to disengage it.
2. Remove the battery door.
3. Pull straight out on the lanyard to remove the battery pack from the instrument.

Note	When inserting the battery, the battery contacts should face up and slide in first. If the battery door does not close tightly, the battery may be inserted incorrectly.

Figure 2-5. Battery Removal

2-6 Turning On the MS2090A Field Master Pro

The Anritsu MS2090A Field Master Pro is capable of approximately two hours of continuous operation from a fully charged, field-replaceable battery (refer to "Battery Information" on page 2-8). The instrument can also be operated from a 15 VDC source (which will simultaneously charge the battery). This can be achieved with either the Anritsu AC-DC adapter or the automotive power adapter, which can be purchased as an optional accessory. Refer to the instrument Technical Data Sheet for more options and accessories.

Caution	When using the Automotive Power Adapter, always verify that the supply is rated for a minimum of 75 Watts @ 15 VDC, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, discontinue use immediately.

To turn on the Field Master Pro, briefly press the power button on the lower right of the touchscreen (see Figure 2-1 on page 2-2).

The Field Master Pro takes approximately 60 seconds to complete power-up and to load the instrument software. At the completion of this process, the instrument is ready for use.

Note	Keep the fan inlet and exhaust ports clear of obstructions at all times for proper ventilation and cooling of the instrument.

Power/Charge LED Indicators

The power/charge LED is integrated with the power button. The LED has the following indicators:

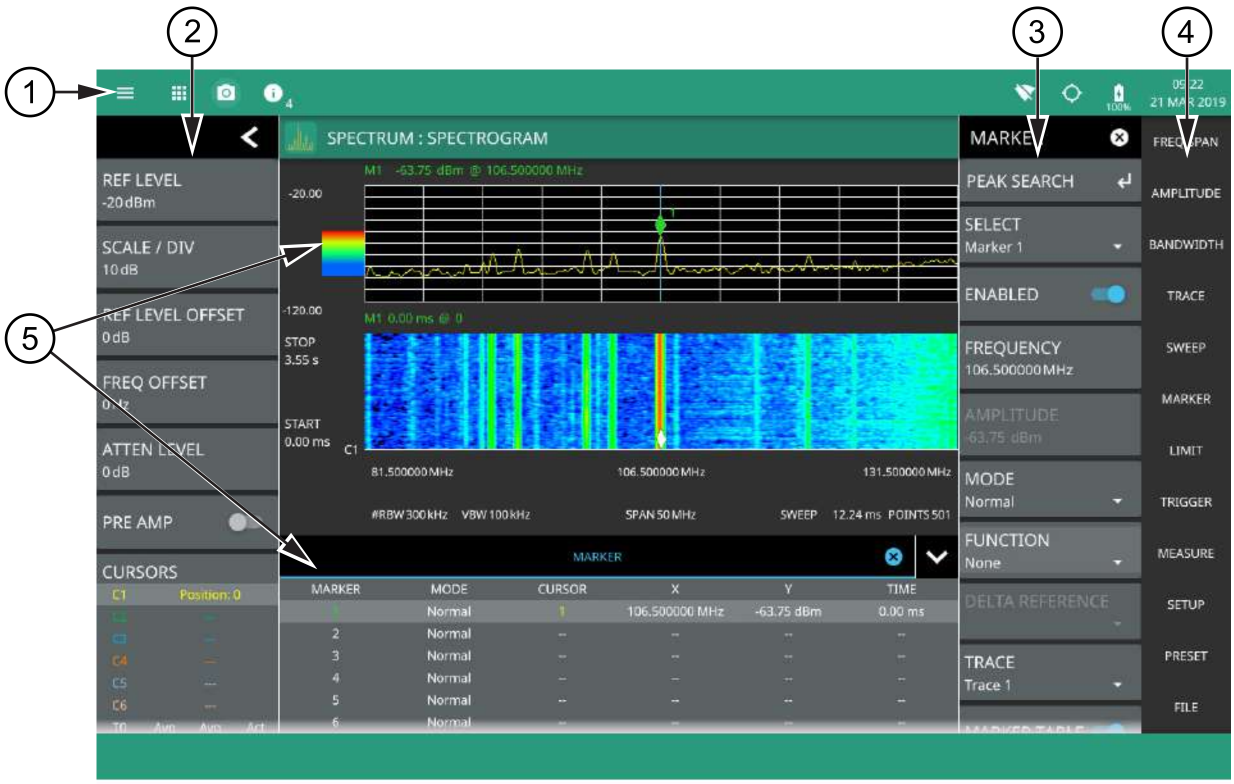
- Solid white when the instrument is on or booting up.
- Slowly blinks orange when the instrument is off and connected to an external power source, and the battery is charging.
- Solid green when the instrument is off and connected to an external power source, and the battery is fully charged.
- Solid red when the instrument is off and connected to an external power source, and the battery is NOT installed or has a fault.

Shutting Down and Restarting

To shut down or restart the instrument, briefly press the power button (a shutdown dialog will be displayed), then select RESTART INSTRUMENT or POWER OFF. The current setup is saved when the instrument is shut down or is restarted. Once the instrument shuts down, it will either power off completely (if running on batteries) or it will go into a low power state (if running on external power).

2-7 GUI Overview

The MS2090A Field Master Pro software controls all instrument functions. The software runs locally on the instrument and primary operation is through the touch screen display. The figure below identifies the main display areas, which are each described in more detail later in this chapter.



1. The title bar provides quick access to the system settings and informational dialogs.
2. The status and trace panel is used to show common settings and controls, and to provide trace and cursor information. The information displayed on this panel depends on the current measurement and view settings. Refer to the appropriate chapter in this guide for information about this panel.
3. Menus are used to configure measurement settings such as frequency, amplitude, and bandwidth, and to enable measurement modes and views such as Spectrogram view, OBW, ACP, and SEM measurements.
4. The main menu provides access to setting menus and other instrument controls.
5. The upper area typically displays graphical data such as spectrum trace and spectrogram plots. The lower area typically displays tabular measurement data such as marker data, demodulation results, or other measurement data depending on the selected measurement.

Figure 2-6. GUI Overview (sample display elements)

Operating the Touch Screen

Field Master Pro uses common touch gestures to achieve a variety of operations. These include interactions on hot areas by pressing, double pressing (or tapping), dragging, and pinching.

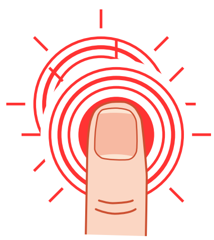
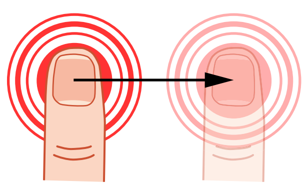
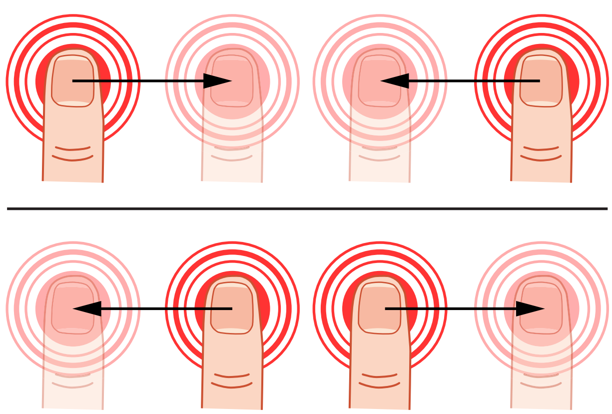
	**Single Press:** Most controls require a single press or tap. Touch the screen briefly and then release.
	**Double Press:** Some controls require a double press or tap. This action is similar to a double mouse click. If a second press is not detected in a certain time period, the action is dismissed or considered a single press.
	**Press and Drag:** Some items can be dragged to a new location. This action is accomplished by pressing and holding the item lightly while dragging it to a new location, then releasing. You can drag items such as markers, limit line nodes, and the center frequency by dragging the trace to the left or right.
	**Pinch:** Some items can be reduced or expanded. This action is accomplished by simultaneously pressing the item with two fingers and holding the item lightly when dragging the fingers in closer together or out farther apart, and then releasing. You can pinch items in or out, such as the frequency span by touching and holding the trace in two positions, and then dragging your fingers closer together to narrow the span or dragging your fingers farther apart to widen the span.

Figure 2-7. Touch Screen Gestures

Common GUI Controls

In addition to the touch gestures described in the previous section, the following lists the most common controls that you will encounter when working with the Field Master Pro.

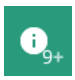
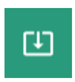
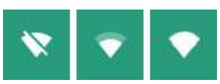
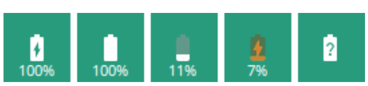
	The 3-line icon provides quick access to system information, settings, file management, and built-in diagnostic tools. Refer to Section 2-10 “System Menu” on page 2-21.
	The 9-dot icon provides access for selecting the analyzers. Refer to Section 2-9 “Selecting the Analyzer” on page 2-20.
	The camera icon will capture a screen image and save it to a file. Refer to “Screenshot Setup” on page 2-30.
	The notification icon provides access to informational and error messages. If displayed, the number indicates the number of notifications. Refer to “Notifications” on page 2-22 and Appendix A, “Instrument Messages and Troubleshooting”.
	The USB eject icon is displayed when the instrument detects one or more USB devices. Pressing this icon ejects the USB device, or presents a dialog to select which USB device to eject when more than one device is detected.
	The software update icon is displayed when the instrument detects a valid software package. Pressing this icon opens an updated dialog to select the software to install. Refer to Section 2-15 “Software Update” on page 2-41.
	The local hose icon is displayed only on the MS2090A PC application when connected to the localhost instead of an instrument. The icon is not functional. Refer to Appendix C, “MS2090A PC Software”.
	The wireless networking icon shows connection status (no connection, weak connection, strong connection) and relative signal strength. Pressing the icon opens the Wi-Fi settings menu. Refer to “Wi-Fi Settings” on page 2-28.
	The GPS icon shows connection status (no connection, no fix, good fix, using last good fix). Pressing the icon opens the GPS/GNSS settings menu. Refer to “GPS/GNSS Settings (Option 31)” on page 2-29.
	The battery icon shows the current battery charge state and indicates that the battery is charging with a lightning bolt. A question mark (?) indicates that the battery is not installed or has a malfunction. Touching the icon opens the battery information dialog. Refer to “Battery Information” on page 2-38.
	The close icon is used to close menus and other dialogs.
	The chevron will expand and collapse the status and table displays. A similar chevron on the virtual keyboard may be for capital letters or to scroll through key sets.
	Toggle icon will enable and disable the feature. When highlighted in blue, the item is enabled.
	The drop-down icon exposes a list of items from which to choose.
	The refresh icon will restart a process, such as a sweep or averaging count.
	The edit icon allows editing of a feature or label.
	The enter icon accepts an entry. A similar icon is found on menu buttons to indicate an additional menu.
	Gesture lock and unlock icons indicate when the drag and pinch gestures have been toggled on or off. Refer to “GESTURES Menu” on page 3-14.

Figure 2-8. Common GUI Controls

Data Entry

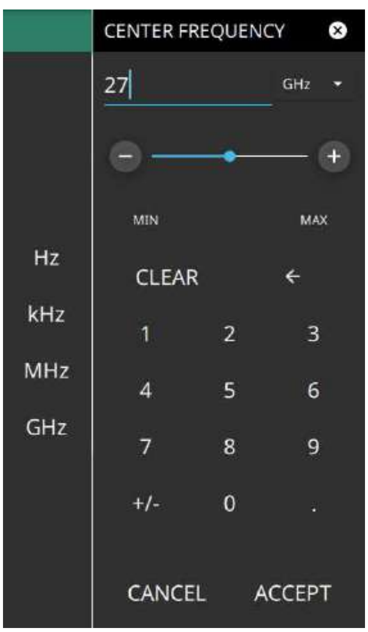
User input can be in the form of numeric values for instrument or measurement settings, selected values from a preset list, or alphanumeric text when entering file names, for example. To view or change a parameter value, access the appropriate menu or control, then enter data using the data entry control or attached physical keyboard. Some items can be accessed directly on the annotated display by touching their value.

Invalid Entries

When setting parameters or entering other types of data, if an entry is out of range or is otherwise invalid, Field Master Pro will shade the background display and may provide a message indicating a valid range. In this case, clear or cancel the entry and enter a valid value or change the units by using either the drop-down selection next to the data entry window, or with the unit terminators to the left of the keypad.

Numeric Values

To modify a numeric parameter setting that is displayed on a menu or annotated field, press the item to make it active and to display the numeric keypad data entry control. Use the touch screen to enter or change the value.



The keypad typically provides controls to:

- Enter new values directly, such as frequency entries in Hz, kHz, MHz, or GHz. There are two places on the keypad to enter unit terminators when applicable, on left side pop-out that occurs as frequency keypad entries are selected, or on the top right corner drop-down of the entry field.
- Drag a parameter value within its settable range using a sliding control.
- Increment the parameter value up or down. At each end of the slider are plus (+) and minus (–) controls that increment the parameter value. Most parameters have a fixed increment, such as bandwidth that follows a 1:3:10 sequence and span that follows a 1:2:5:10 sequence. In the case of frequency, you can set a custom frequency step increment value. Once the entry is complete, press the desired unit or press ACCEPT to complete the entry.
- Set the parameter to the maximum or minimum possible value.
- CLEAR the entire entry.
- Left arrow to backspace and delete the entry
- CANCEL to terminate any entries made for that particular setting. Note that pressing the "X" to close the keypad is the same as pressing cancel. Pressing CANCEL will restore settings back to the state they were in before the keypad opened, even if changes from the +/- controls are already reflected in the data display.
- ACCEPT to operate with the settings displayed on the keypad.

Figure 2-9. Touchscreen Keypads

A physical keyboard connected via USB can also be used to enter values in a similar manner and the keyboard ENTER key used to accept the new value.

Selection Lists

Some parameters and instrument functions are selectable from a list. These list boxes display the available selections and value limits as applicable. Use the touch screen to scroll through the list and select the desired entry.

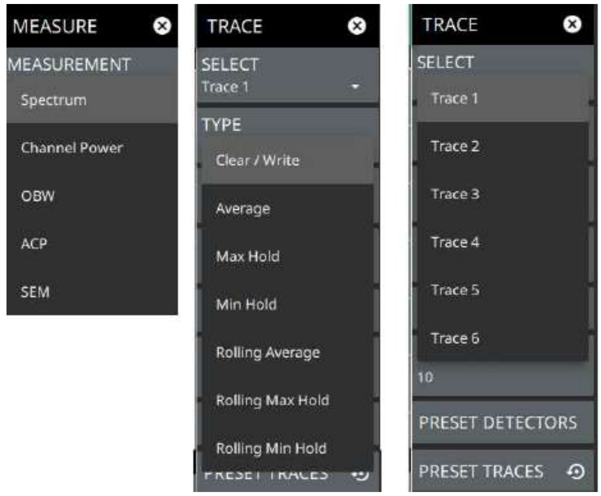
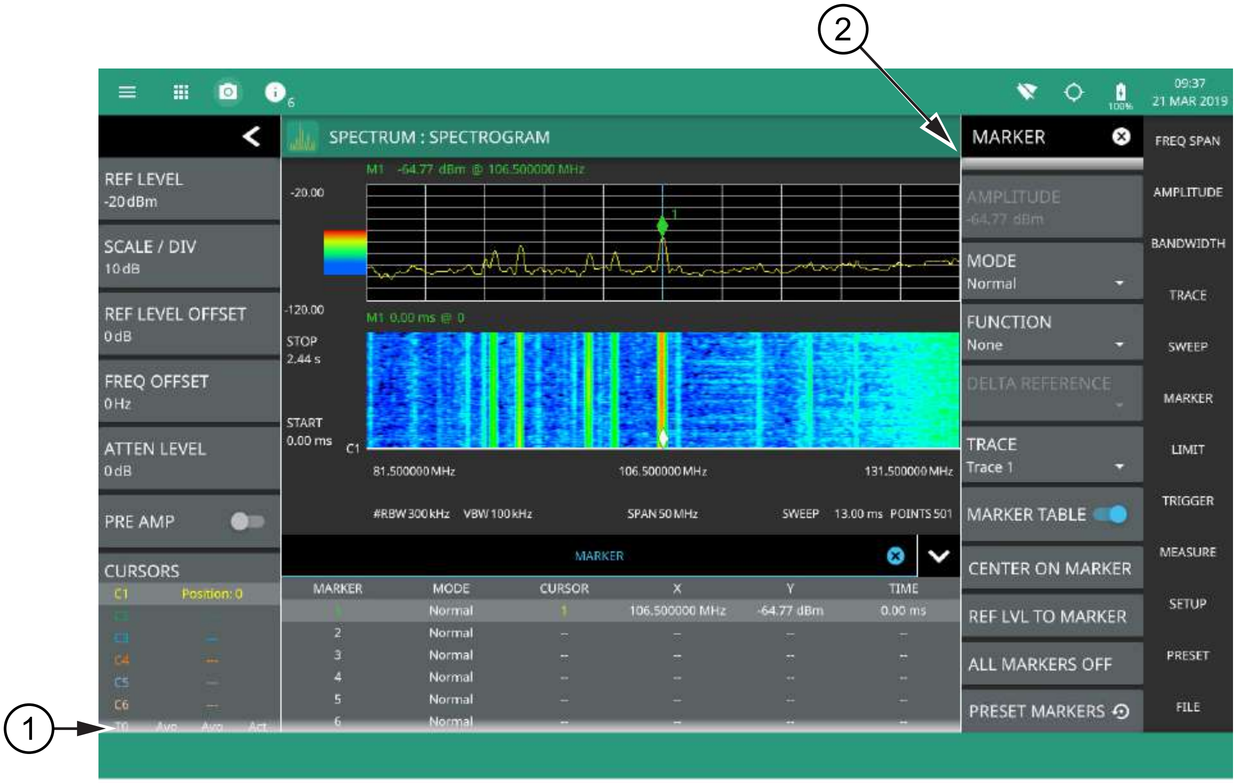


Figure 2-10. Touch Screen Keypads

To cancel the selection, touch somewhere else on the display or close the menu.

Scroll Indication

In some cases, menus, status panels, or other lists contain more information than can be displayed in the available area. In these cases, the top or bottom of the panel will have a fade-to-white appearance as shown below. You can scroll the control to move it up or down and expose the hidden information.



1. The fade-to-white at the bottom of the status panel and marker table here indicates that there is more information below the display area. The panel can be scrolled by dragging it upward to expose more information.
2. The fade-to-white at the top of the menu here indicates that there is more information above the display area. The menu can be scrolled by dragging it downward to expose the information.

Figure 2-11. Scroll Indication

Note	If the display is set to another color theme, the fade effect remains the same but the color may fade to a dark shade.

Text Entry and EZ Keyboard

When an instrument function requires you to enter text, such as entering an Ethernet hostname, a touch screen alphabetic keyboard is displayed. See Figure 2-12. Press the “?123” key to switch to the digits and symbols keyboard. Use the left arrow key (backspace) to delete the character to the left of the insertion point. The insertion point can be moved to a touched position in the data entry field. You can enable caps lock by double tapping the shift key.

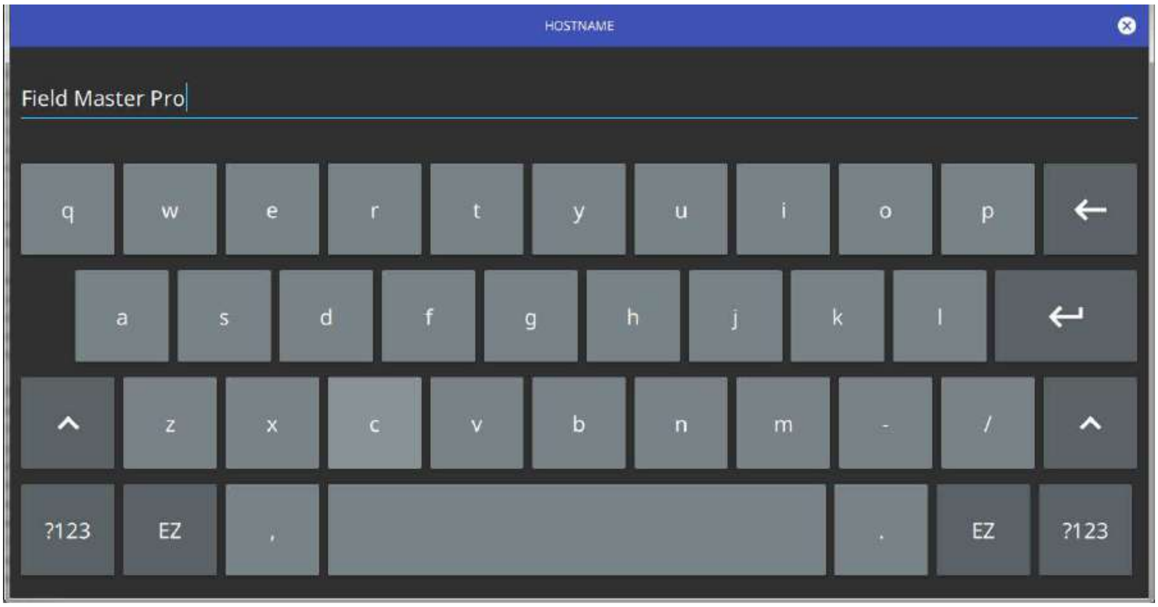


Figure 2-12. Touch Screen Keyboard

The EZ key switches to a configurable EZ keyboard, illustrated below.

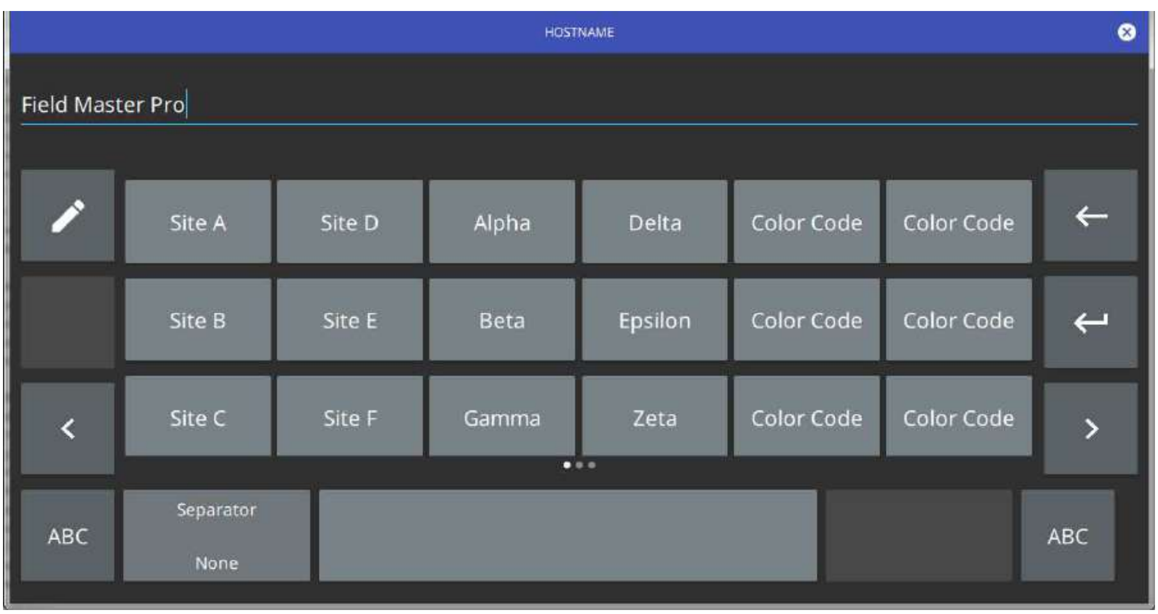


Figure 2-13. Touch Screen EZ Keyboard

Use the EZ keyboard to enter frequently used text strings with a single screen tap. The EZ keyboard is initially populated with default values. Each key enters the entire string as shown on the key. For convenience, you can set an automatic Separator character to be placed between each EZ key string.

To change a key's value:

1. Press the pencil (edit) key. The EZ keys will become highlighted.

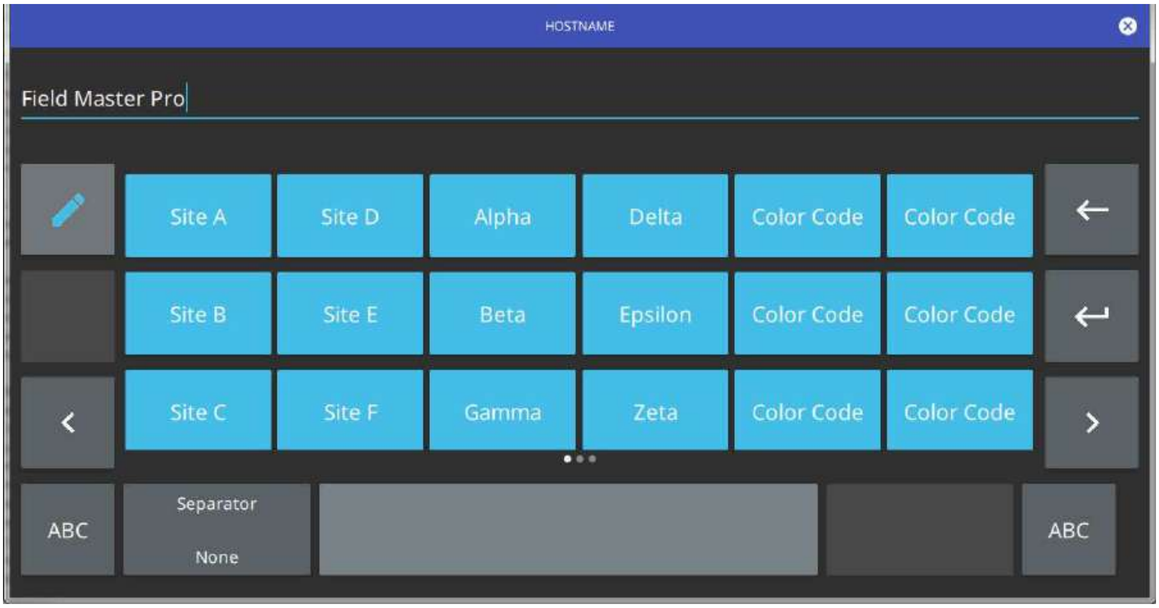


Figure 2-14. Touch Screen EZ Keyboard

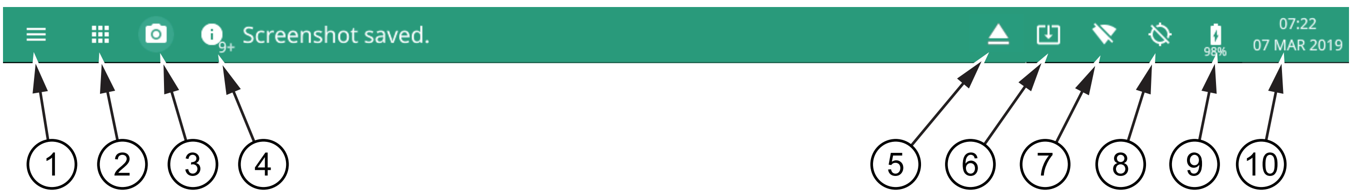
2. Press the key to be edited. This will display the standard keyboard for entering a new EZ key value.

Figure 2-15. Touch Screen EZ Keyboard

3. Enter the new value, then press ACCEPT to assign the new value to the EZ key, or press CANCEL.

2-8 Title Bar

The title bar is located at the top of the interface screen. It displays icons that provide access to information and user actions as described below. All of the icons are active and will open the appropriate menu or item when touched.



1. Press the 3-line icon to display the System Menu. The instrument model with frequency option and its serial number are also displayed.
2. The 9-dots icon is used for Selecting the Analyzer.
3. Press the camera icon to capture a screen shot of the current display. The image file is saved in PNG format with the following naming scheme: screenshot_yymmdd_hhmmss.png (year, month, day, hour, minute, second). Using the Screenshot Setup, you can set the screen capture region, color theme, annotations, and destination directory.
4. Notifications are generated when an error is detected or an activity such as a screen shot has taken place. The number of unread notifications appears next to the icon. Press the icon to display the Notifications list.
5. Displayed when a USB device is attached. To ensure the device or it's data does not become corrupted, press this icon to eject (unmount) the USB device before it is unplugged from the USB port. A similar icon can be accessed via Section 2-12 "File Management" on page 2-36.
6. Displayed when a USB device contains an installable software package. Pressing the icon launches the "Software Update" on page 2-41.
7. Press the wireless networking icon to display the Wi-Fi Settings.
8. Press the GPS icon to view the GPS/GNSS Settings (Option 31).
9. Press the battery icon to open the Battery Information and view battery charge state and capacity.
10. The right side of the instrument title bar displays the system date and time. Pressing this field opens the Date Time Settings.

Figure 2-16. Title Bar

2-9 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon. To select an analyzer, press the 9-dot icon in the title bar to display the available analyzers, illustrated in Figure 2-17. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

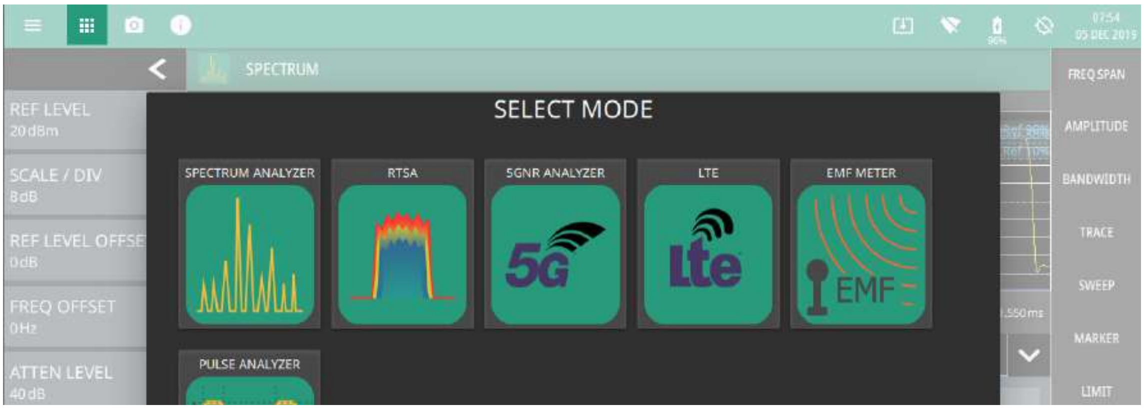
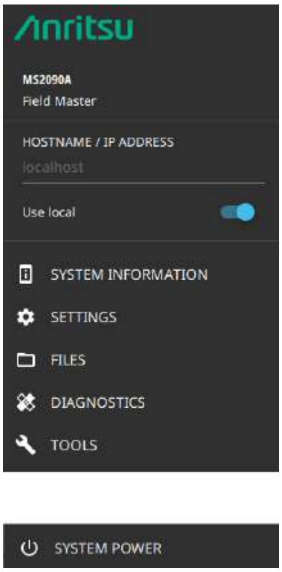


Figure 2-17. Example Analyzers

2-10 System Menu



The System menu identifies the instrument model and serial number.

HOSTNAME/IP ADDRESS: Displayed only on the MS2090A PC application. This field is used to specify the IP address or hostname of an instrument that is connected to the network. When **Use local** (localhost) is toggled on, the software will connect locally to provide some UI functionality. Refer to Appendix C, "MS2090A PC Software" for details.

SYSTEM INFORMATION: Opens the System Information panel showing instrument, software, and network connection details.

SETTINGS: Opens the "Settings Menu" on page 2-23, providing access to all system level settings and controls.

FILES: Opens "File Management" on page 2-36. Note that the file management menus are different from the right-side FILE menu. Use file management to organize, copy, and rename files. Use the right side FILE menu to save and recall measurement data, instrument setup files, or to save a screenshot.

DIAGNOSTICS: Opens "Diagnostics" on page 2-38.

TOOLS: Opens "Tools Menu" on page 2-40.

SYSTEM POWER: Opens a dialog to RESTART or POWER OFF the instrument.

Figure 2-18. System Menu

System Information

The System Information panel shows all information about the instrument hardware, software, and connectivity. From here, you can also toggle software update checking when connected to the Internet and start a software update when one is available. If web updates are toggled on, the instrument will automatically check for updates once every 24 hours or when the user presses the "CHECK" button.

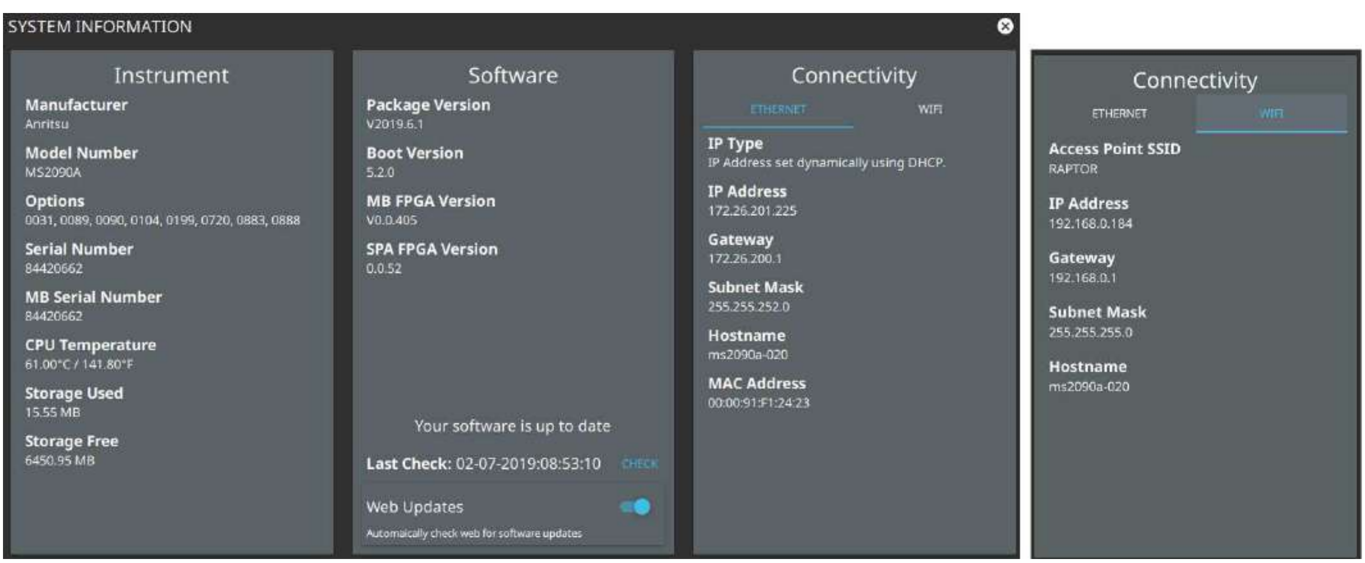


Figure 2-19. System Information

Notifications

The notification area is where all dynamic notifications are presented. These notifications are generally information messages to the user and not hardware failure messages. Refer to "Self Test" on page 2-39 and Appendix A, "Instrument Messages and Troubleshooting" for more diagnostic information.

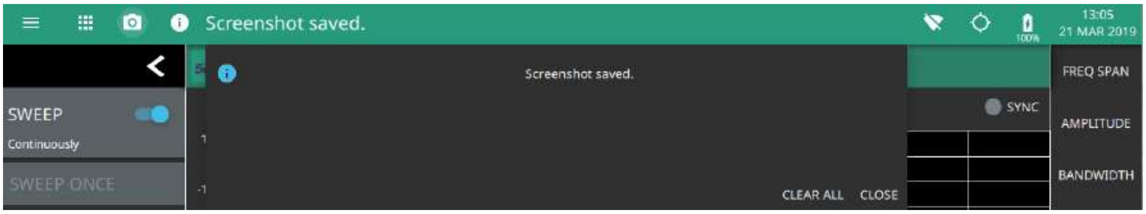
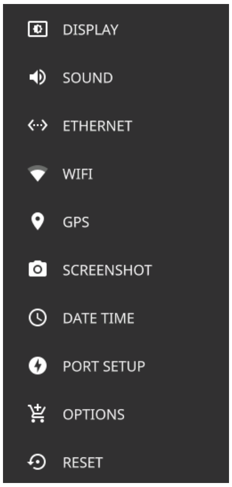


Figure 2-20. Notifications

2-11 Settings Menu

The system settings menu provides access to all instrument system-level settings such as network, GPS/GNSS, date and time, and display.



DISPLAY: Opens the Display Settings.

SOUND: Opens the Sound Settings.

ETHERNET: Opens the Network Settings.

WIFI: Opens the Wi-Fi Settings.

GPS: Opens the GPS/GNSS Settings (Option 31).

SCREENSHOT: Opens the Screenshot Setup.

DATE TIME: Opens the Date Time Settings.

PORT SETUP: Opens Port Setup.

OPTIONS: Opens the Options Settings.

RESET: Opens the Reset Settings.

Figure 2-21. Settings Menu

Display Settings

The DISPLAY settings allow you to adjust the display brightness and to set the amount of idle time before the screen automatically dims to conserve battery life. The DIM DISPLAY AFTER button provides up to 15 minute idle time settings. Or you can select Never so the display will remain illuminated for as long as the instrument remains powered on.

You can also set the display to a Default or Light color scheme, the latter of which may be more suitable for viewing in bright ambient conditions.

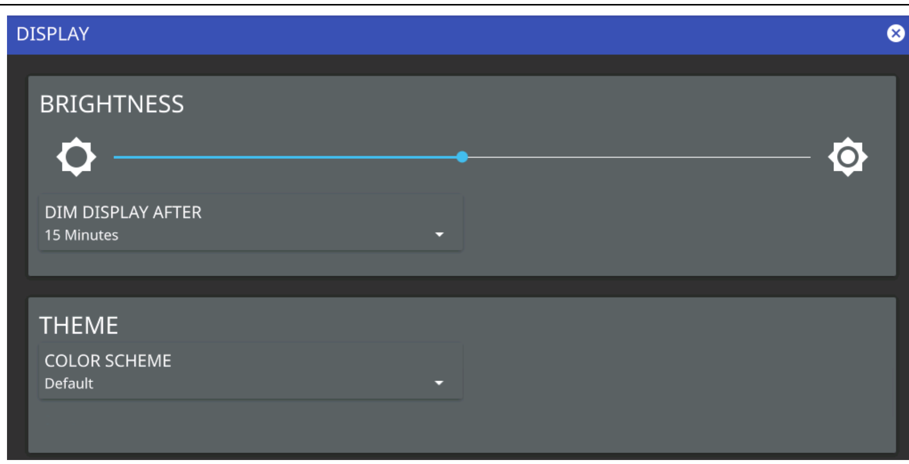


Figure 2-22. Display Settings

Sound Settings

The SOUND settings allow you to adjust the MASTER VOLUME or MUTE ALL of the instrument sounds. The master volume may affect other volume settings found in various setup menus.

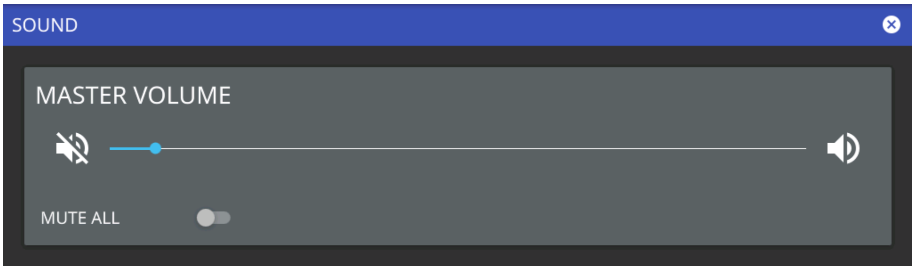


Figure 2-23. Sound Settings

Network Settings

The MS2090A uses Ethernet or WLAN (Wi-Fi) to communicate remotely with a controller. Most instrument functions (except power on/off) can be controlled via a network connection to a PC connected directly (with an Ethernet cross-over cable or Wi-Fi peer-to-peer) or through a network. The instrument software supports the TCP/IP raw socket network protocol.

Ethernet networking uses a bus or star topology in which all of the interfacing devices are connected to a central cable called the bus, or are connected to a hub. Ethernet uses *Carrier Sense Multiple Access/Collision Detection* (CSMA/CD) access method to handle simultaneous transmissions over the bus. This standard enables network devices to detect simultaneous data channel usage, called a *collision*, and provides for a contention protocol. When a network device detects a collision, the CSMA/CD standard dictates that the data is retransmitted after waiting a random amount of time. If a second collision is detected, the data is again retransmitted after waiting twice as long. This is known as exponential back off.

Wi-Fi uses a similar star topology in which all of the interfacing devices are connected to an access point. Wi-Fi uses *Carrier Sense Multiple Access/Collision Avoidance* (CSMA/CA) access method to handle simultaneous transmissions. CSMA/CA doesn't detect collisions but rather avoids them through the use of a control message. If the control message collides with another control message from another node, it means that the medium is not available for transmission and the back-off algorithm is applied before attempting another transmission.

The TCP/IP setup requires the following:

- IP Address: Every computer and electronic device in a TCP/IP network requires an IP address. An IPv4 address has four numbers (each between 0 and 255) separated by periods. For example: 128.111.122.42 is a valid IP address.
- Subnet Mask: The subnet mask distinguishes the portion of the IP address that is the network ID from the portion that is the station ID. The subnet mask 255.255.0.0, when applied to the IP address given above, would identify the network ID as 128.111 and the station ID as 122.42. All stations in the same local area network should have the same network ID, but different station IDs.
- Default Gateway: A TCP/IP network can have a gateway to communicate beyond the LAN identified by the network ID. A gateway is a computer or electronic device that is connected to two different networks and can move TCP/IP data from one network to the other. A single LAN that is not connected to another LAN requires a default gateway setting of 0.0.0.0. If you have a gateway, then the default gateway would be set to the appropriate value of your gateway.
- Ethernet Address: An Ethernet address, or *Media Access Control* (MAC) address, is a unique 48-bit value that identifies a network interface card to the rest of the network. Every network card has a unique Ethernet address permanently stored in its memory.
- Remote programming and operation between the instrument and remote program is accomplished via a TCP/IP raw socket connection to port 9001. The remote program must establish a TCP/IP raw socket connection at port 9001 to the MS2090A.
- The remote program may connect to the instrument IP address or to its `HOSTNAME` (Ethernet only). If using DHCP instead of a static IP, using the `HOSTNAME` may be more reliable for finding an instrument on a network.
- You may need to contact your network administrator to ensure network security policies, anti-virus, and firewall settings do not block access to the controlling computer and its ports.

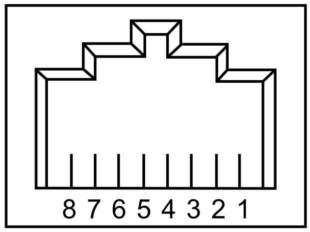
The MS2090A can be configured for *Dynamic Host Configuration Protocol* (DHCP), an Internet protocol that automates the process of setting IP addresses for devices that use TCP/IP, and is the most common method of configuring a device for network use.

To determine if a network is set up for DHCP, connect the instrument to the network and select DHCP protocol. Power cycle the instrument. If the network is set up for DHCP, the assigned IP address should be displayed in the network settings.

Ethernet Connection

Interface between the instrument and other devices on the network is via a category five (CAT-5) interface cable connected to a network. This cable uses four twisted pairs of insulated copper wires terminated into an RJ45 connector. CAT-5 cabling is capable of supporting frequencies up to 100 MHz and data transfer speeds up to 1 Gbps, which accommodates 1000Base-T, 100Base-T, and 10Base-T networks. CAT-5 cables are based on the EIA/TIA 568 Commercial Building Telecommunications Wiring Standard developed by the Electronics Industries Association. A pinout diagram is shown in Table 2-1.

Table 2-1. 8-pin Ethernet RJ45 Connector Pinout Diagram



Pin	Name	Description	Wire Color
1	TX+	Transmit data (> +3 volts)	White/Orange
2	TX–	Transmit data (< –3 volts)	Orange
3	RX+	Receive data (> +3 volts)	White/Green
4	–	Not used (common termination)	Blue
5	–	Not used (common termination)	White/Blue
6	RX–	Receive data (< –3 volts)	Green
7	–	Not used (common termination)	White/Brown
8	–	Not used (common termination)	Brown

Integrated into the RJ45 connector are two LEDs that illuminate as follows:

- LED 1 Off: 10 Mbit/s LAN connection
- LED 1 Orange: 100 Mbit/s LAN connection
- LED 1 Green: 1000 Mbit/s LAN connection
- LED 2 Amber/Yellow: On or blinking indicates LAN traffic

The instrument IP address and its `HOSTNAME` are set via the System menu (upper left corner) and accessing the ETHERNET or WIFI settings menu.

Note	Wi-Fi does not support connections using HOSTNAME; use IP addressing to establish a wireless network connection.

TCP/IP connectivity requires setting up the parameters described at the beginning of this section. The following is a brief overview of how to set up a general LAN connection on the MS2090A.

Note	You may need to consult your network documentation or network administrator for assistance in configuring your network setup.

Ethernet Settings

Refer to “Network Settings” on page 2-25 for general network setup and information.

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select ETHERNET to view the current network settings (IP address, HOSTNAME, etc.).

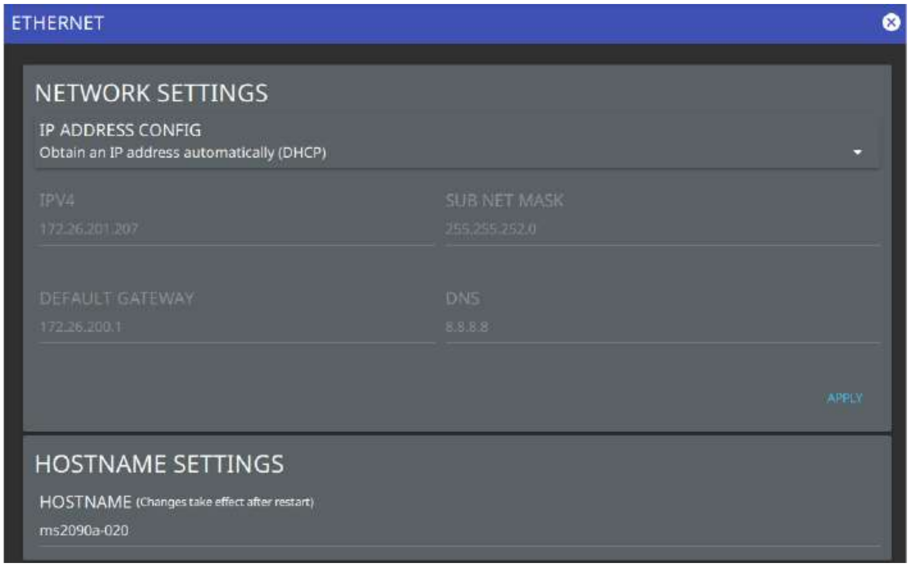


Figure 2-24. Ethernet Settings

The instrument IP address can be set automatically using DHCP or manually by entering the desired IP address, gateway address, and subnet mask.

Note	If an active Ethernet cable is connected to the instrument while it is turned on, a reboot may be required to establish a DHCP connection. If the port becomes inactive, verify that an active Ethernet cable is attached to the instrument, then cycle the instrument power off and on.

Wi-Fi Settings

Refer to "Network Settings" on page 2-25 for general network setup and information.

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select WIFI to display the current network settings (IP address, HOSTNAME, etc.).

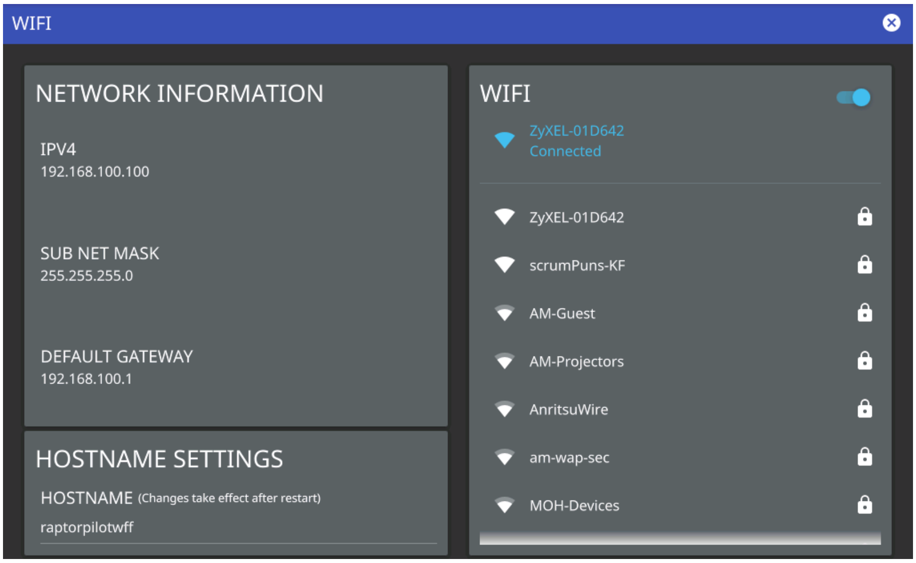


Figure 2-25. Wi-Fi Settings

The instrument IP, subnet mask, and gateway address are managed by the access point or wireless router.

Note	An active Wi-Fi connection to an access point must be established in order to enable DHCP. If Wi-Fi becomes inactive, cycle the instrument power off and on, then verify that the Wi-Fi device is connected to an access point. Field Master Pro is not able to connect to networks that require sign-in through web servers.

3. Enable the Wi-Fi radio by toggling it on from the right-side panel, then select an access point from the list.
4. When an access point is selected, the keyboard will display for you to enter the access point key (or password).
5. The access point will display below the toggle as the active connection.

GPS/GNSS Settings (Option 31)

The MS2090A Field Master Pro is available with a built-in global positioning receiver feature (Option 31) that can provide latitude, longitude, altitude, and UTC timing information. This option also enhances frequency reference oscillator accuracy. When the global positioning receiver is actively locked to satellites, this information is saved with all saved measurements.

Note	The MS2090A Field Master Pro Data Sheet provides a list of the options and measurements that require GPS (Option 31). In addition to having Option 31 installed, a GPS antenna is required. Refer to the instrument Technical Data Sheet for compatible GPS antennas.

The MS2090A supports the following global positioning satellite systems:

- **GPS:** The United States Global Positioning System (GPS). GPS is currently the world's most utilized satellite navigation system.
- **GNSS:** Global Navigation Satellite System, a term used worldwide. This term includes GPS, GLONASS, and Galileo. Accessing multiple satellites provides increased accuracy, redundancy, and availability at all times.

Activating the GPS Feature

Attach the GPS antenna to the GPS connector on the top of the instrument.

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select GPS to open the GPS settings and info window.

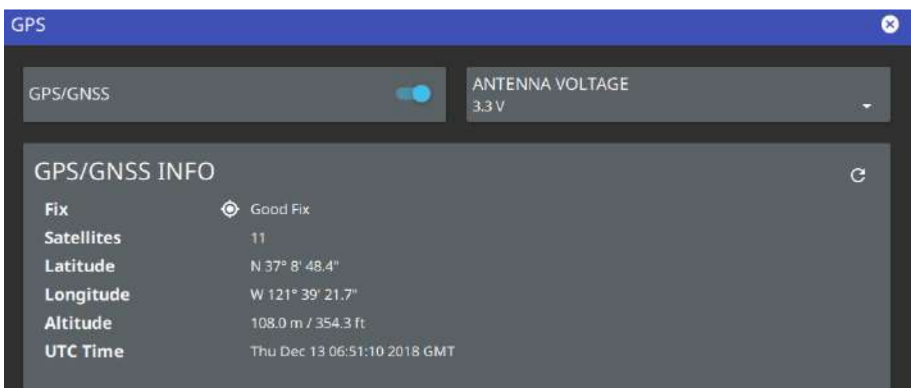


Figure 2-26. GPS Settings

3. Activate the GPS by sliding the GPS/GNSS toggle switch to on.
4. Set ANTENNA VOLTAGE to 3.3 or 5.0V.
5. When the GPS receiver has established a “good fix”, the GPS icon is displayed with a center dot and the following information is kept updated:
   - Fix status
   - Tracked satellites
   - Latitude
   - Longitude
   - Altitude
   - UTC timing information

After GPS location fix is attained, the internal reference oscillator begins to correct its frequency to match the GPS standard. After the internal frequency is adjusted to match the GPS standard, the status is indicated by "GPS High Accuracy" showing in the Status menu, which is displayed on the left side of the measurement display. When the GPS feature is not enabled, the reference source displays either "Internal Standard Accuracy" or a user-selected external reference frequency in the Status menu.

Within three minutes of satellite acquisition, the reference oscillator will have an accuracy of better than 25 ppb (parts per billion). The OCXO internal standard accuracy is ±0.3 PPM. The correction factor applied to the internal OCXO allows the instrument to maintain GPS frequency accuracy for three days at better than 50 ppb, even when the instrument is obstructed from receiving signals from the GPS satellites.

In order to acquire data from the GPS satellites, you must have line-of-sight to the satellites, or the antenna must be placed outside with no obstructions.

If no GPS is connected for at least three days, the Frequency Reference annotation reads Int Std Accy.

Screenshot Setup

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select SCREENSHOT to open the screenshot setup menu.

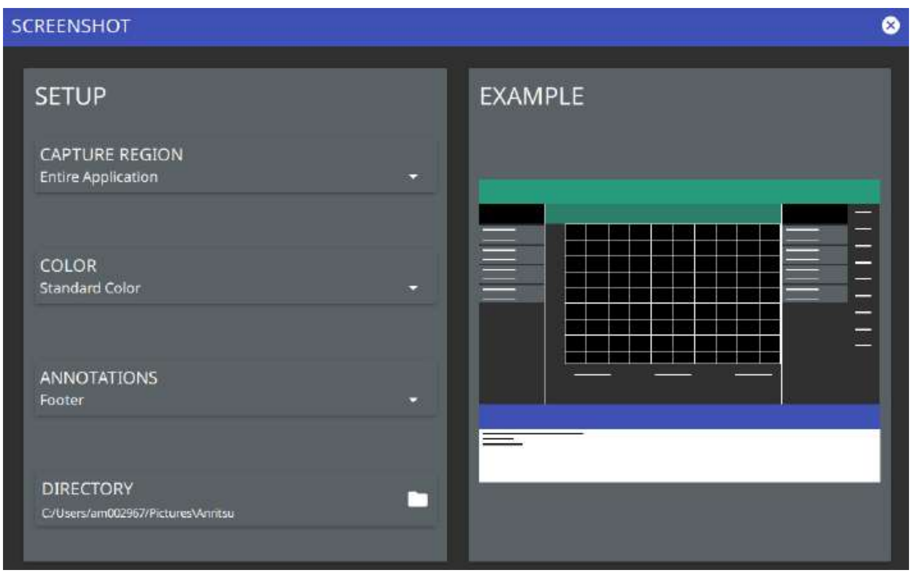


Figure 2-27. Screenshot Setup

Screenshot setup lets you configure the following:

- Capture region: entire window or graph area only
- Color: standard or printer-friendly
- Annotations: may be placed at top (header) or bottom (footer) of captured image
- Directory: directory path to destination folder where the file is to be saved

Note	Screenshots can be previewed on the instrument display from "File Management" on page 2-36.

Date Time Settings

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select DATE TIME to display the current date and time settings.

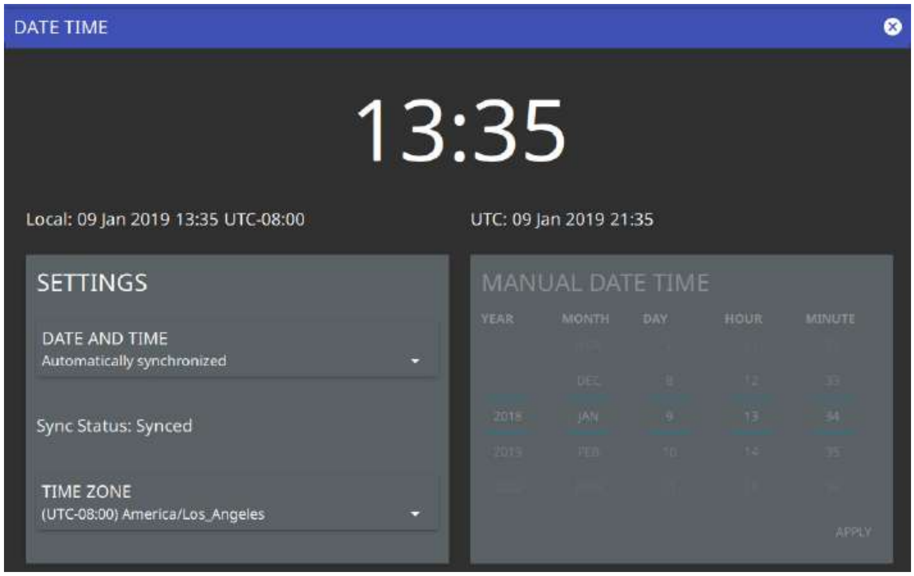


Figure 2-28. Date Time Settings

The Date Time setup lets you set the current date and time and the time zone.

- Date and Time: Manually set or automatically synchronized. When synchronized (Sync Status: Synced), the system uses the network time; if the instrument also has a GPS location fix, the system will determine and use the more accurate of the two, between network and GPS time. Select Manually set to activate the MANUAL DATE TIME window. Here you can scroll to a selectable year, month, day, hour, and minute.
- Time Zone: Lists the selectable time zones.

Port Setup

The Port Setup menu allows you to configure the external ports.

Bias Voltage

Bias Voltage setup provides controls to set the voltage level and to monitor the precise voltage and current, and trip state.

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select PORT SETUP to display the top panel bias voltage output settings.

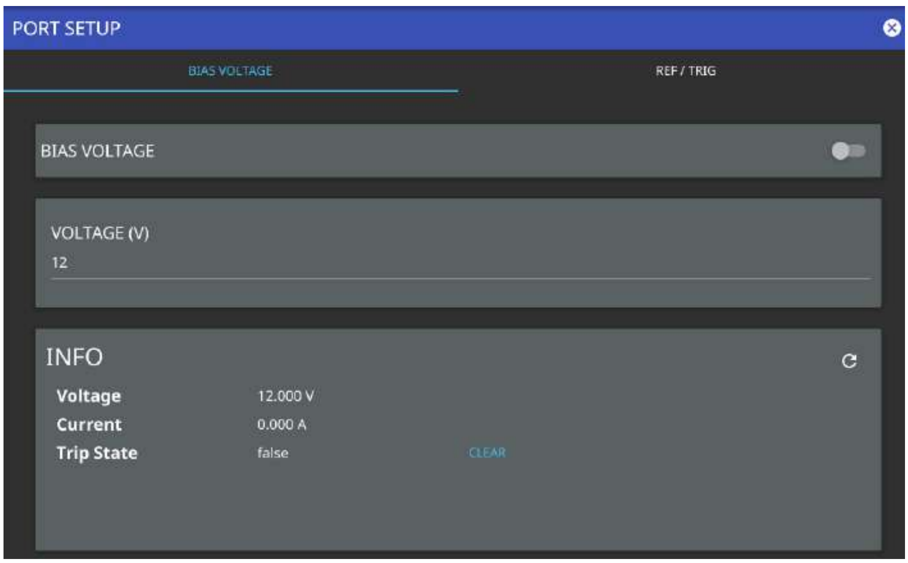


Figure 2-29. Bias Voltage Port Settings

3. Manually set the voltage in the range of 0 V to 34 V.
4. Toggle the bias voltage on or off.

Reference and Trigger

The reference and trigger setup provides controls to set the functionality of the configurable top panel reference and trigger ports.

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu, then select PORT SETUP > REF / TRIG to display the top panel reference and trigger port settings.

Figure 2-30. Reference/Trigger Port Settings

Note	PORT 0 is always a reference in port.

3. To set PORT 1 as a reference output, toggle 10 MHz REFERENCE OUT on. Otherwise, PORT 1 can be selected as a trigger input or trigger output by using the drop-down selection.
4. Use the drop-down selections to select PORT 2 as a trigger input or trigger output.

Options Settings

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu.
3. Select OPTIONS to display the lists of currently installed software options on the left pane and those that are available for installation on the right pane.

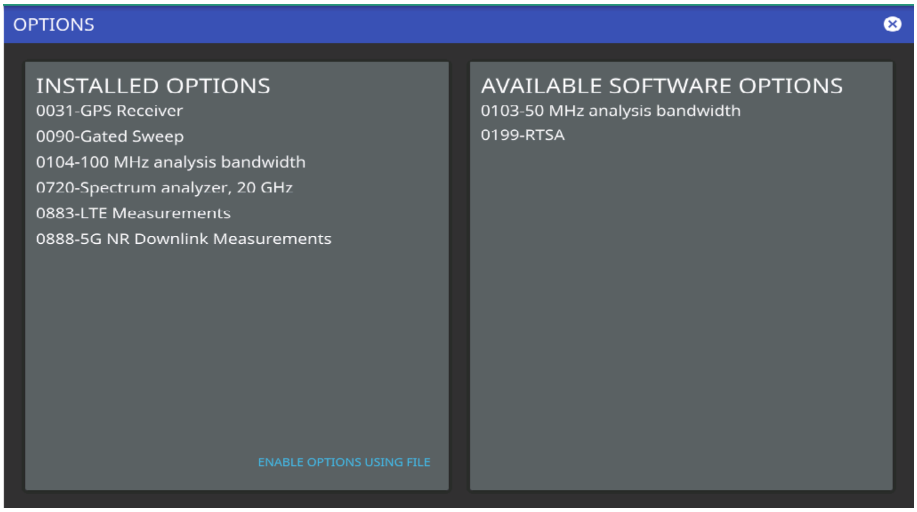


Figure 2-31. Options Settings

Some options can be installed using only a software file. Others may require additional hardware. Contact your local sales or service representative for information on installing new options.

Reset Settings

1. Access the System menu (3-line icon in the upper left corner).
2. Press SETTINGS to access the instrument settings menu.
3. Select RESET to open the Reset menu.

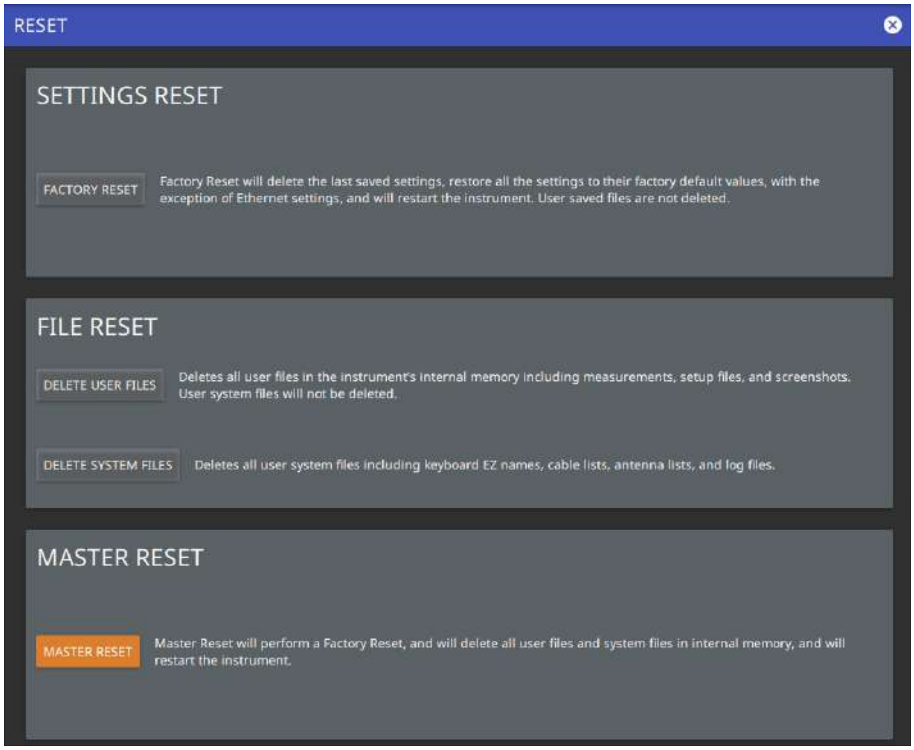


Figure 2-32. Reset Settings

The following reset options are available:

SETTINGS RESET

- FACTORY RESET: Restores the instrument to the factory default settings for all measurement modes and system settings, including language and the display and audio settings. Ethernet settings and user files are not affected. The instrument will automatically restart.

FILE RESET

- DELETE USER FILES: Deletes all user files from the instrument’s internal memory, including measurement, setup, and screenshot files. System files are not affected.
- DELETE SYSTEM FILES: Deletes all user system files from the instrument’s internal memory, including keyboard EZ names, cable and antenna lists, and log files. Other user files are not affected.

MASTER RESET

- MASTER RESET: Performs a Factory Reset as described above and deletes all user files and system files from the instrument’s internal memory. The instrument will automatically restart.

2-12 File Management

1. Access the System menu (3-line icon in the upper left corner).
2. Press FILES to access the instrument file management menu.

Figure 2-33. File Management Menu

File Locations

Displays the available memory locations. Touch the location that you want to access and the available files will be displayed on the right side. You can touch the column headers to change the sort order.

File Management Operations

All file operations are selected via the following icons:

3-Dots	Use the 3-dots menu to refresh the displayed folder contents or to close the file management menus.
New Folder	Use the New Folder icon to create a new directory in the current memory location. When pressed, the virtual keyboard is displayed, allowing you to enter a new directory name.
Select	The Select icon enables checkboxes next to your folder and file names. You can then select multiple files to move, copy, or delete.
Clipboard	The Clipboard icon displays the number of items that you have selected and copied to the clipboard. Use this icon to paste the copied items to the destination folder.
Edit	Use the Edit icon to change file or folder names. Select the item you wish to edit, then press Edit to display the virtual keyboard and edit the item's name.
Delete	Use the Delete icon to remove files or folders from memory. Select the item you wish to delete, then press Delete to remove the item. **Caution:** The item will be permanently deleted and cannot be recovered.
Cut	Use the Cut icon to move files or folders. Select the items you wish to move, then press Cut to store the items on the clipboard. Navigate to the new location and press the Clipboard icon to paste the items. The moved items are deleted from the source location.
Copy	Use the Copy icon to select files and folders to copy to a new location. Select the items you wish to copy, then press Copy to store the items on the clipboard. Navigate to the new location and press the Clipboard icon to paste the items. Copies of the items remain in the source location.
USB Eject USB0	Use the USB Eject icon to properly dismount the USB memory device before removing it from the instrument port. Failing to properly eject the device could cause data corruption.

Figure 2-34. File Management Icons

Previewing Screenshots

While in File Manager, you can preview screenshots on the instrument display simply by touching the screenshot file name. While the preview is displayed, you can use the controls to:

- Cycle forward and backward through each screenshot in the directory.
- Rename the file by selecting RENAME, then use the keypad to enter a new filename.
- Delete the file by selecting DELETE and then confirming your choice.
- Copy the file, then close the preview dialog and navigate to the desired location, then touch the Paste icon at the top of the File Manager.

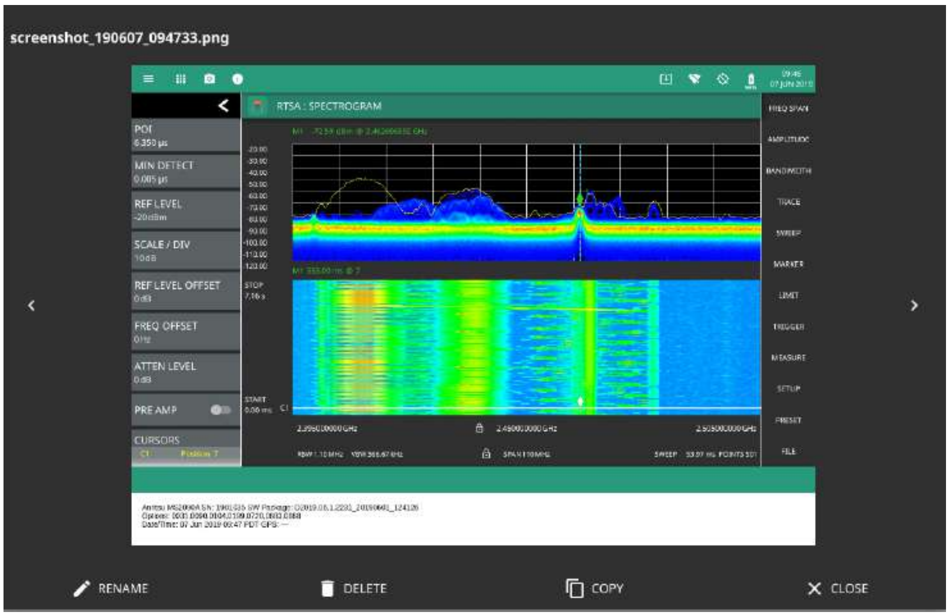
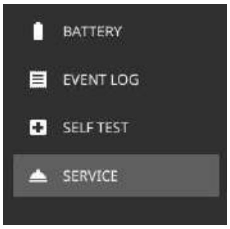


Figure 2-35. Screenshot Preview

2-13 Diagnostics

1. Access the System menu (3-line icon in the upper left corner).
2. Press DIAGNOSTICS to access the instrument diagnostics menu, then select the diagnostic menu that you wish to open.



Battery: Opens Battery Information.

Event Log: Opens the Event Log.

Self Test: Opens the Self Test.

Service: Opens the Service Mode.

Figure 2-36. Diagnostics Menu

Battery Information

The battery information menu shows the available battery information. The relative charge indicates the charge level that the battery is capable of storing. The maximum charge shows the relative capacity of the battery compared to the design capacity. Advanced information can be expanded by touching Advanced.

Figure 2-37. Battery Information

Event Log

The event log allows you to save the event log as a file. This log file is a binary file that may be used by customer service.

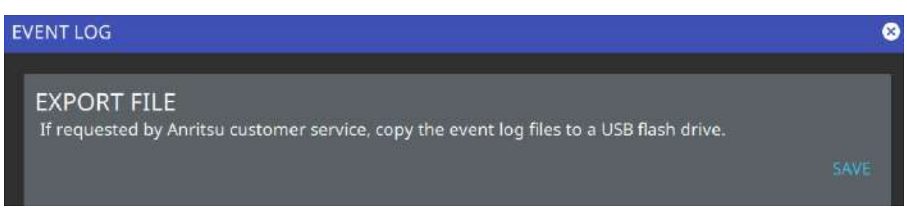


Figure 2-38. Event Log

Self Test

Self test is run when the self test feature is accessed. Basic system results are shown initially. The individual test result can be displayed with test data and a pass/fail status by touching the desired system or application. The self test results can be saved to a file for future reference. Refer to Appendix A, "Instrument Messages and Troubleshooting" for more information.

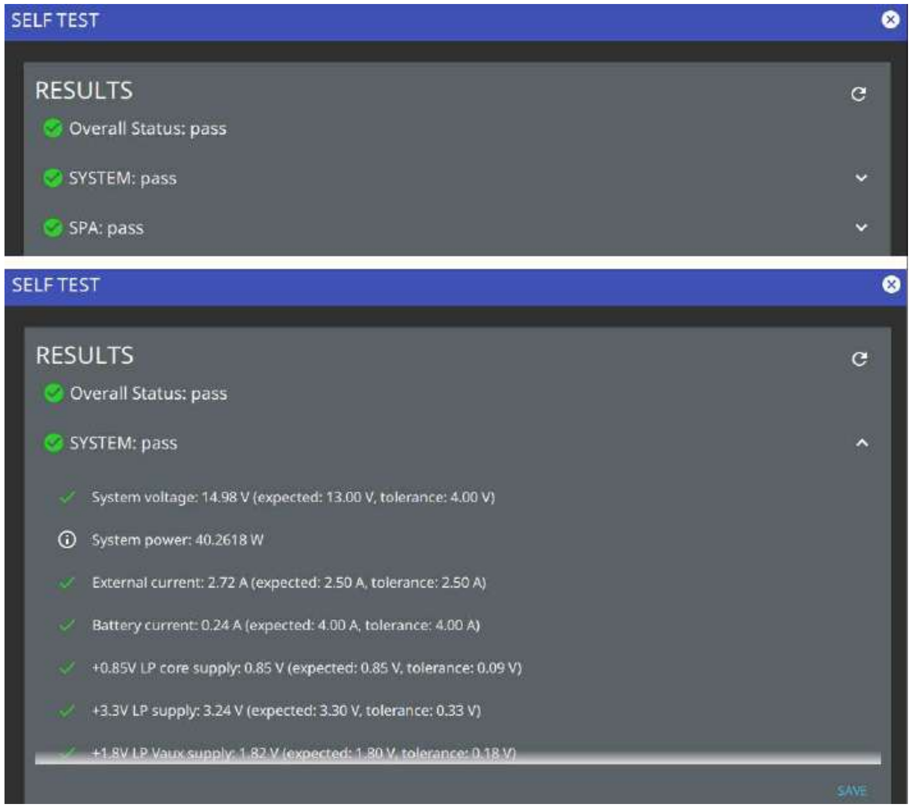


Figure 2-39. Self Test

Service Mode

The service mode is for Anritsu customer service use only.

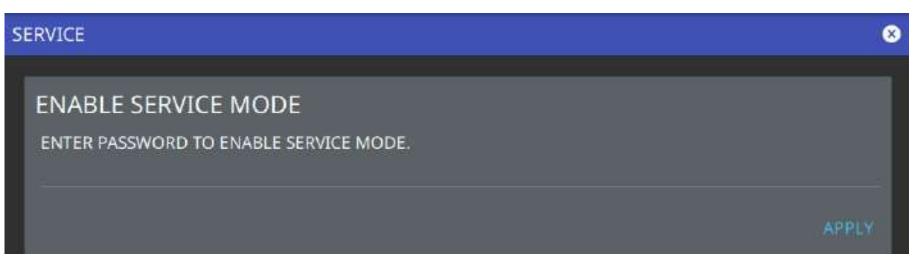


Figure 2-40. Service Mode

2-14 Tools Menu

1. Access the System menu (3-line icon in the upper left corner).
2. Select TOOLS to access the instrument tools menu, then select the tool menu that you wish to open.

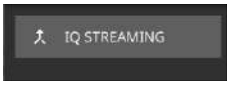
	**IQ STREAMING:** Opens IQ Streaming Tools.

Figure 2-41. Tools Menu

IQ Streaming Tools

The IQ STREAMING menu allows you to concatenate an existing IQ metadata file (.dgzm) with a session of IQ data files (.dgz) that were streamed to a USB device after the stream operation is complete. The data files must all come from the same stream session.

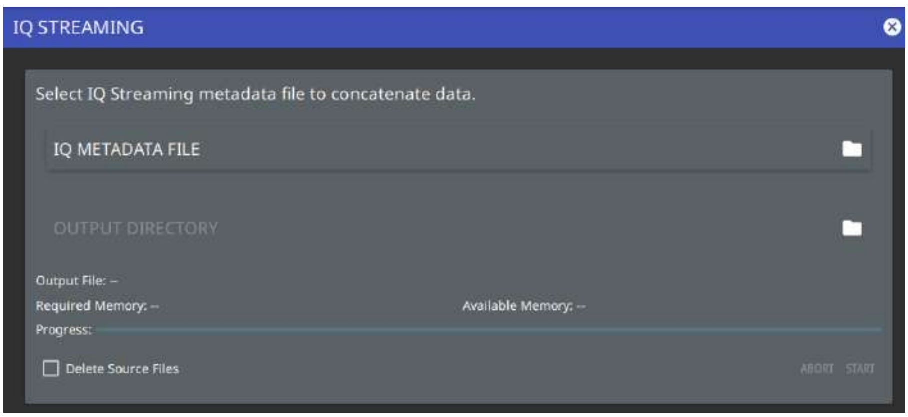


Figure 2-42. IQ Streaming

1. Touch IQ METADATA FILE and then select the file that you wish to concatenate with IQ data streams. All of the data stream files in the selected directory will be concatenated with the metadata file.
2. Touch the OUTPUT DIRECTORY and select the destination for the concatenated files. If desired, select Delete Source Files.
3. Press Start to begin the concatenation. The progress bar will indicate relative progress.

Note	Concatenating files can be time consuming depending on the streaming parameters and time. The process can be much faster if performed on a PC using the MS2090A PC application. Refer to Appendix C, “MS2090A PC Software” for details on using this application.

2-15 Software Update

To update your Anritsu instrument software, use a high quality USB memory device with at least 1 GB of free space and FAT32 file system format.

1. Insert the USB memory device into your PC or laptop.
2. From a browser, go to the following Anritsu products page:

   http://www.anritsu.com/en-US/test-measurement/products/ms2090a

3. On the product page, click Downloads and select Drivers/Firmware/Software.
4. Select the software update for your product and download it to the USB memory device.
5. Insert the USB memory device into the one of the MS2090A USB ports.

Installing the Software

1. Start the software update via one of the two ways below (see Figure 2-43):
   - Access the upper left System Menu (3-line icon), then press SYSTEM INFORMATION > SOFTWARE UPDATE.
   - Press the software update icon from the Title Bar.
2. Select the latest available update from the drop-down selections and press Install.
   - A dialog will appear stating Software Update in Progress.
3. When the installation is complete, see "Verify the Software Update".

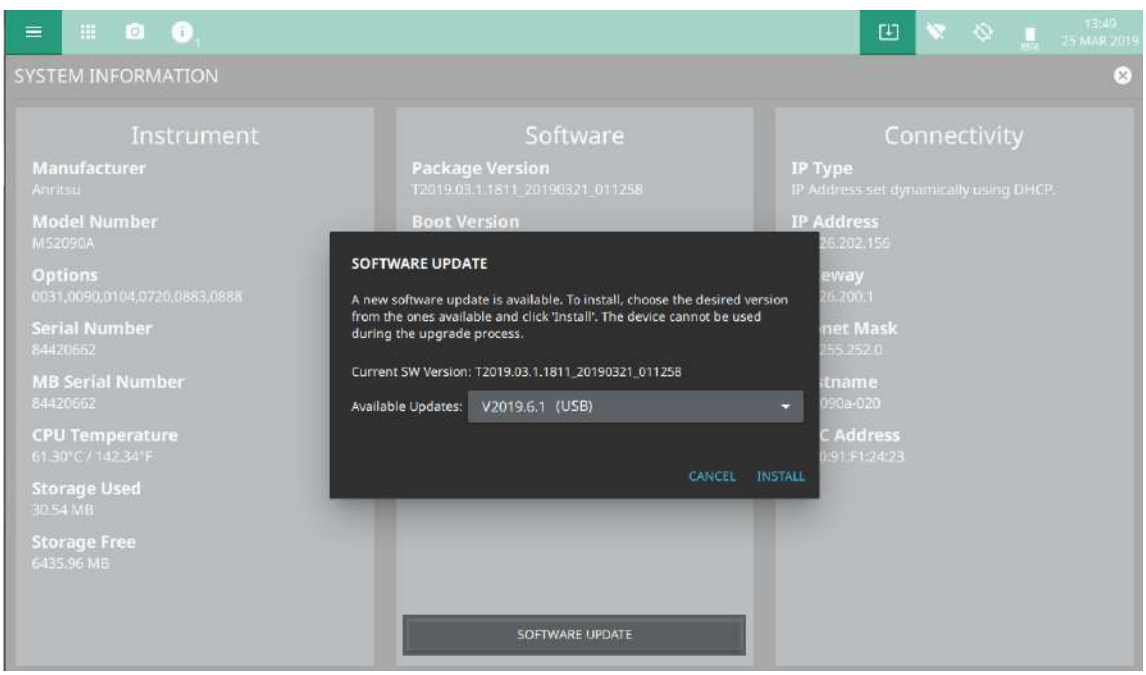


Figure 2-43. Updating the Software

Verify the Software Update

1. Once the software update is complete, power off the MS2090A.
2. Power on the MS2090A
3. Press the System menu icon (3-line icon) from the MS2090A to display the System Menu.
4. Select the System Information menu (see Figure 2-44).

5. Verify the Software Package Version displayed is the most current version installed.

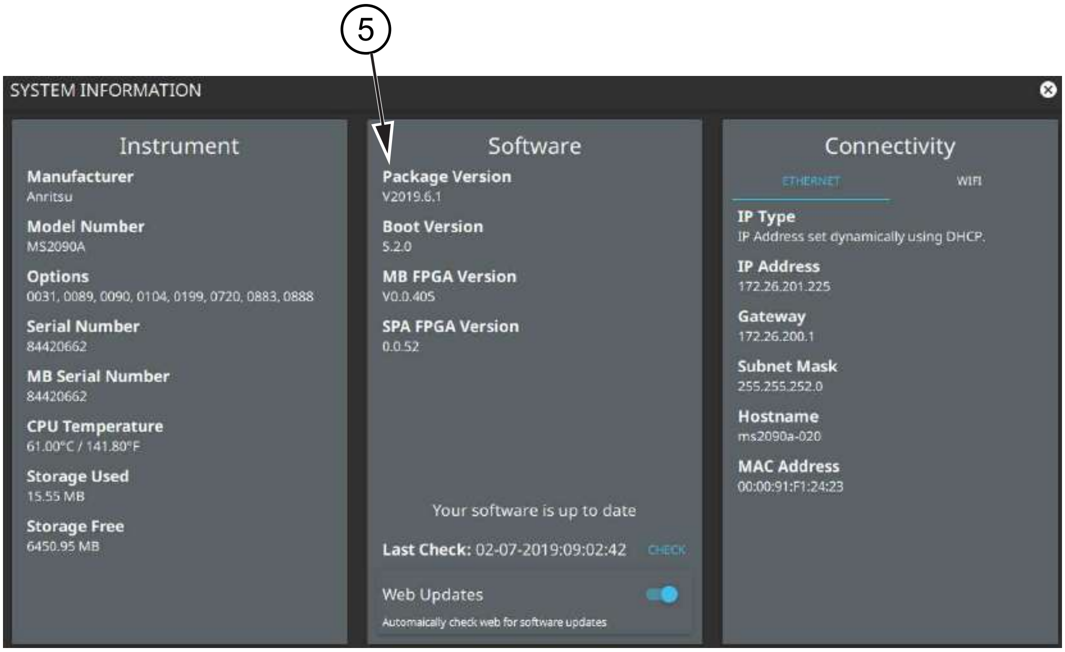


Figure 2-44. System Information

Chapter 3 — Spectrum Analyzer Measurements

3-1 Introduction

This chapter gives a brief overview of the Anritsu Field Master Pro spectrum analyzer and is intended to assist you in your first use of the instrument. The purpose of this chapter is to provide a starting point for making basic measurement setups. This chapter describes general instrument setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, limit lines, and markers. After measurements are taken, refer to Section 2-12 "File Management" and Section 3-25 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

This spectrum analyzer measurements chapter includes sections that describe resolution bandwidth, video bandwidth, sweep, and attenuator functions. For example, in the Field Master Pro, resolution bandwidth is determined by the intermediate frequency (IF) filter bandwidth. The spectrum analyzer traces the shape of the IF filter as it tunes past a signal. If more than one IF filter is used in a spectrum analyzer, then the narrowest one dominates and is considered the resolution bandwidth.

Spectrum analyzer measurements include the use of additional functions beyond frequency, span, amplitude, and marker functions. Section 3-16 through Section 3-20 cover field measurements including brief examples demonstrating channel power, occupied bandwidth, adjacent channel power, and spectral emissions mask testing.

3-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 3-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

Figure 3-1. Example Analyzers

3-3 Spectrum Analyzer GUI Overview

This section illustrates the main graphical displays and menus presented for the spectrum analyzer.

Normal Spectrum View

Normal Spectrum view is the default view and is suitable for viewing signals in the frequency domain where signal amplitude, bandwidth, and harmonic qualities can be studied. Select spectrum view from MEASURE > VIEW > Normal. The sample display below is set up with a single trace enabled and with a marker and the upper limit line envelope set.

Figure 3-2. Normal Spectrum View (1 of 2)

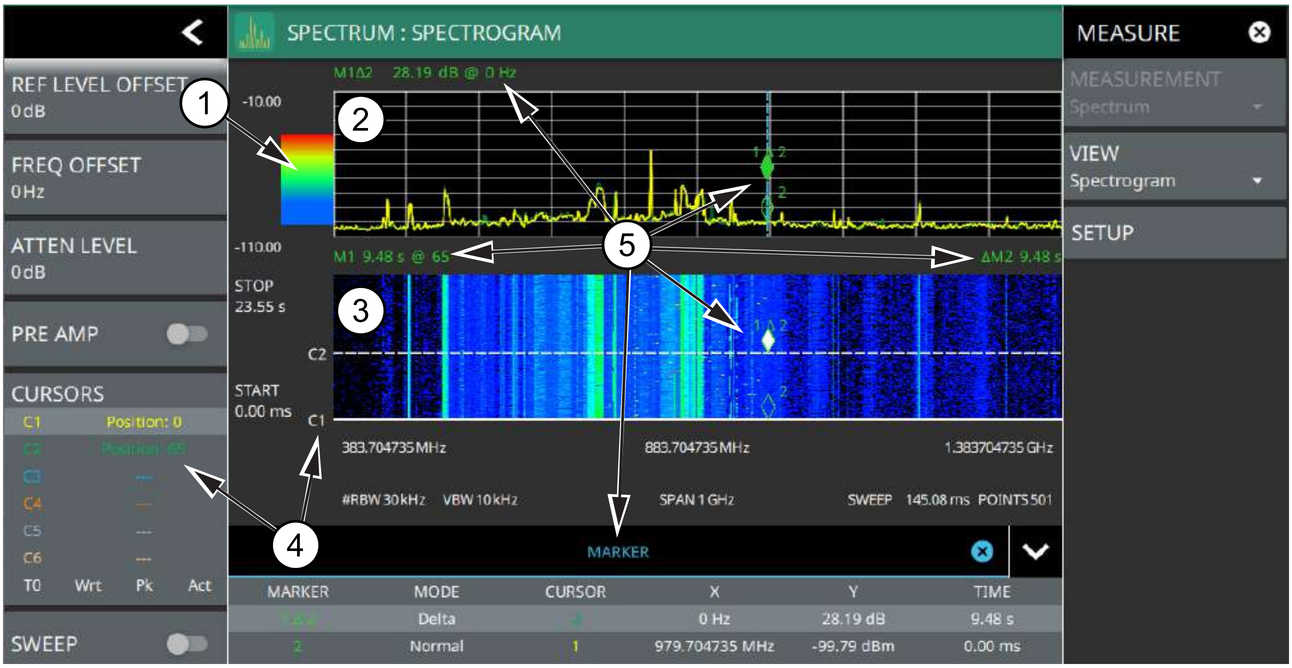
1. **Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings.
2. **Markers:** Markers are displayed as green diamonds on the trace to which they are assigned. The active marker is shown as a solid green diamond with a dashed vertical line. The marker amplitude and frequency will be displayed in green text on the top left edge of the display. In this example, a marker is shown at the signal peak with the marker table enabled. Double tap the marker to open a quick access peak search menu.
3. **Limit Lines:** Limit lines are shown as red (failing) or green (passing) lines with gray circles for each limit line point. Limit lines can be set up point-by-point or by using the envelope feature to quickly set a sloped or square envelope. The currently selected limit line point is shaded in gray. When limit lines are enabled, a pass/fail status is shown in the upper right of the window. If the trace crosses the limit, the trace color will turn red and the limit will indicate a failure. The limit is only applied to the active trace (see Section 3-10 “Setting Trace and Cursor Parameters”), which is indicated next to the pass/fail.
4. **Measurement Settings:** The x-axis shows the start, center, and stop frequencies. The y-axis displays the amplitude of the graticule lines. RBW/VBW, span, sweep time, and number of trace point settings are shown along the bottom of the spectrum display. If either resolution bandwidth or video bandwidth is set to manual, the “#” symbol will precede its label. If an offset frequency is entered, the offset value is displayed in the left side status panel. Pressing any of the editable parameters opens the keypad to edit the value directly. Information-only displays cannot be changed.
5. **Multiple Trace Display:** Each trace has a unique color and each can be set to Clear/Write, Average, Min or Max Hold, Rolling Average, or Rolling Min or Max Hold. Each trace can have Peak, RMS/Average, or Negative detectors. Traces can be set to Active, Hold/View, or Blank.

Figure 3-2. Normal Spectrum View (2 of 2)

Spectrogram View

Spectrogram view is useful for identifying intermittent signals and for providing historical signal data in a comprehensive view. It provides a multi-dimensional “waterfall” display representing frequency, time, and amplitude. Frequency and time are shown on a typical two-dimensional scale while amplitude is displayed in the color dimension. The color is set by adjusting the color range of the color bar.

Select Spectrogram view from MEASURE > VIEW > Spectrogram. Once Spectrogram view is selected, the color bar can be configured from the SETUP menu. Refer to Section 3-15 “Measurement Setup” on page 3-48 for more information on setting up the Spectrogram view.



1. **Color Bar:** The color bar is used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, then black is displayed. The color bar top and bottom setting, and the overall hue to the color range is set via the “SETUP Menu (Spectrogram View)” on page 3-48, which can be opened by pressing the color bar.
2. **Spectrum Window:** The upper display area shows spectrum trace data in the frequency domain. Up to six traces can display data from different times depending on how the corresponding cursors are set in the spectrogram display below. Note that the spectrum display shows trace amplitude (vertical axis) data in the time (horizontal axis) domain.
3. **Spectrogram Window:** The lower display area shows spectrogram trace data in the time (vertical axis), frequency (horizontal axis), and amplitude (color) domains. The bottom of the spectrogram displays the current sweep at the current time (0 ms) or position 0. When a sweep completes, the entire display is shifted up and the new trace is added to the bottom of the spectrogram. The spectrogram holds 142 sweeps (cursor positions) and the stop time reflects the time taken to complete all of the sweeps.
4. **Cursors (C1 to C6):** Cursor information for the currently set cursor type (time or position) is shown in the status panel. Cursors are shown on the spectrogram as white lines at the currently set cursor time or position. Refer to “Cursors in Spectrogram View” on page 3-25.
5. **Markers:** Marker and marker data are shown in a variety of locations. Markers can be placed on different cursors to help you compare measurements at different points in time as well as frequency. Refer to “Spectrogram with Cursors and Markers” on page 3-38.

Figure 3-3. Spectrogram View

3-4 Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 3-7 “Setting Frequency Parameters”.

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 3-8 “Setting Amplitude Parameters”.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 3-9 “Setting Bandwidth Parameters”.

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 3-10 “Setting Trace and Cursor Parameters”.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90). Refer to Section 3-11 “Setting Sweep Parameters”.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 3-12 “Setting Up Markers”.

LIMIT: Provides controls for setting up limit lines and limit alarms. Refer to Section 3-13 “Setting Up Limit Lines”.

TRIGGER: Controls the trigger source, delay and holdoff, and trigger slope settings. Refer to Section 3-14 “Setting Up Triggering”.

MEASURE: Used to select measurements such as spectrum, channel power, occupied bandwidth, adjacent channel power, spectral emissions mask, and opens the spectrogram. Refer to Section 3-15 “Measurement Setup”.

SETUP: Measurement controls for setting up advanced measurements. This menu always displays setting options for the current active measurement (refer to Section 3-16 “Setting Up Advanced Measurements”). When in Spectrogram view, provides access to the spectrogram color SETUP menu (refer to “SETUP Menu (Spectrogram View)” on page 3-48).

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 3-24 “Presetting the Analyzer”.

FILE: Used to save and recall instrument setups and measurements, limit lines, and screen images. Also provides access to save on event controls. Refer to “FILE Menu” on page 3-71 and Section 2-12 “File Management”.

Figure 3-4. Main Menu

Using Menus

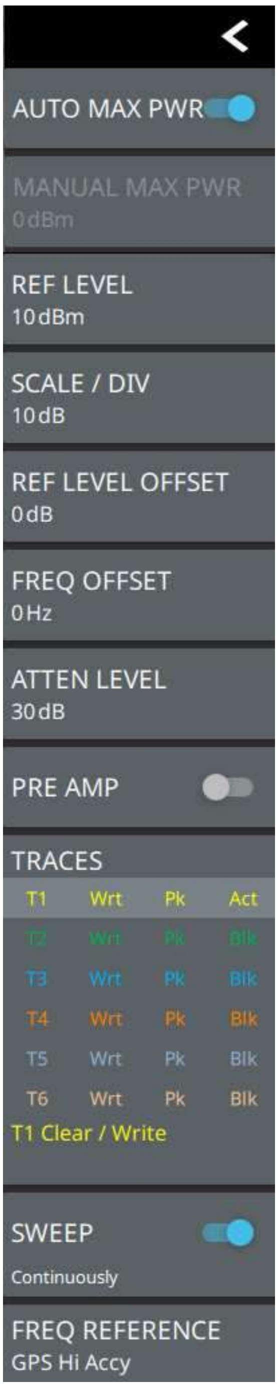
Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.

- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

3-5 Status Panel

The status panels and features illustrated in this section are unique to the spectrum analyzer and to the particular measurement and view that is selected. Below is the spectrum analyzer status panel that covers basic spectrum, spectrogram, channel power, occupied bandwidth, adjacent channel power, and spectral emissions mask measurements (selected via MEASURE > MEASUREMENTS menu).



Pressing any of these parameters opens the associated menu with a keypad that allows you to conveniently change the parameter value. These are the same settings found in the right side menus.

AUTO MAX PWR: Displays in SEM measurements only. Enabling this automatically calculates the reference channel power.

MANUAL MAX PWR: Displays in SEM measurements only. Used to manually enter the reference channel power.

Refer to Section 3-20 “Spectrum Emission Mask” on page 3-56.

REF LEVEL: Sets the reference level of the top graticule line. If the reference level offset is not zero, OFFSET REF LEVEL is displayed at this location.

SCALE/DIV: Sets the graticule scale/division.

REF LEVEL OFFSET: Compensates for the presence of external input attenuation or gain.

Refer to Section 3-8 “Setting Amplitude Parameters” on page 3-15.

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 3-7 “Setting Frequency Parameters” on page 3-9.

ATTEN LEVEL: When auto attenuation is off, sets input attenuation.

PRE AMP: Toggles the low-noise front-end preamplifier on or off. Refer to Section 3-8 “Setting Amplitude Parameters” on page 3-15.

TRACES/CURSORS: Displays the current status of up to six traces or cursors in a quick-view summary. When the measurement view is set to Normal (Spectrum), trace information is displayed in this area. When the measurement view is set to Spectrogram, cursor information is displayed in this area. Cursors are only available in the Spectrum measurement with the Spectrogram view selected.

The summary information includes the trace or cursor number, type, mode, and detector type. The active trace will show a highlighted background with the mode and detector type restated under the table. In Spectrogram, a reference trace (T0) will show you the settings of the trace used to fill the spectrogram. The reference trace settings are applied to all traces and cursors while in Spectrogram view. Pressing a trace or cursor in the summary panel activates the pressed trace or cursor and opens the TRACE menu. It allows you to select and set up an individual trace or cursor as desired. Refer to Section 3-10 “Setting Trace and Cursor Parameters” on page 3-21.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 3-11 “Setting Sweep Parameters” on page 3-28.

FREQ REFERENCE: Indicates the current frequency reference source of Internal High Accuracy (used after GPS has lost sync, but while the internal clock still has good GPS reference), Internal Standard Accuracy, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 3-5. Spectrum Analyzer Status Panel

3-6 Making Spectrum Analyzer Measurements

Initial Setup

- Connect a signal source to the RF In port of the instrument. For over-the-air measurements, connect an antenna that is appropriate for the frequency range to be measured. For connector descriptions, refer to "Connector Panels" on page 2-3.
- Select the spectrum analyzer. Refer to "Selecting the Analyzer" on page 3-1.

Figure 3-6. Field Master Pro Setup

3-7 Setting Frequency Parameters

Frequency-related parameters are set using the "FREQ / SPAN Menu" on page 3-12. The tuning frequency range can be entered in several different ways depending upon what makes the most sense, either for the user or for the measurement. The center frequency and span can be specified, the start and stop frequencies can be entered.

Entering Start and Stop Frequencies

The frequency settings are displayed along the bottom of the spectrum or spectrogram graph. These parameters can be accessed directly or via the FREQ SPAN menu.

1. Press FREQ SPAN on the main menu.
2. Press START FREQUENCY to open the start frequency parameter entry keypad.
3. Enter the desired start frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.
5. Press STOP FREQUENCY to open the stop frequency parameter entry keypad.
6. Enter the desired stop frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
7. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.

Note	To quickly move the start or stop frequency value up or down, press the + or – slider controls to increment the frequency by the set FREQUENCY STEP. You can also drag the frequency using the slider.

The center frequency will be set to exactly the middle of the start and stop frequencies. The current settings are shown along the bottom of the spectrum or spectrogram graph (see Figure 2-6 on page 2-11).

Entering a Center Frequency

1. Press FREQ SPAN on the main menu.
2. Press CENTER FREQUENCY to open the center frequency parameter entry keypad.
3. Enter the desired center frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.

Note	To quickly move the center frequency value up or down, press the + or - slider controls to increment the center frequency by the set FREQUENCY STEP. You can also drag the center frequency using the slider or by dragging the trace directly.

The current settings are shown along the bottom of the spectrum or spectrogram graph (see Figure 2-6 on page 2-11).

Using Offset Frequency

A user-defined frequency offset can be entered to adjust the frequency that is displayed on the instrument from the actual swept frequency. For example, if the DUT is an antenna system receiving signals in the 10 GHz range and offsetting the signals to the 1 GHz range, you can set a frequency offset in the spectrum analyzer in order to display the actual received antenna frequency in the sweep window.

Both positive and negative offset values are allowed. Negative offsets can be useful for seeing differences from expected values. Enter a negative offset of the expected value, and the received antenna frequency should display in the 0 Hz range.

When enabled, the offset value is displayed at the left of the screen in the status panel (see Section 3-5 “Status Panel”). To remove a frequency offset, open the FREQ SPAN menu and set FREQUENCY OFFSET to 0 Hz. You can also access this parameter directly from the left side status panel.

Note	Offset frequency apply to start, stop, center, and marker frequencies.

Setting the Span

1. Press FREQ SPAN on the main menu.
2. Press SPAN to open the span frequency parameter entry keypad.
3. Enter the desired span frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.
5. To select full span, press the FULL SPAN. Selecting full span overrides any previously set start and stop frequencies.

Note	To quickly move the span value up or down, press the + or - slider controls to increment the span in a 1:2:5 sequence. You can also drag the span using the slider or by pinching the trace in or out.

Zero Span IF Output (Option 89)

Zero Span IF output effectively allows the spectrum analyzer to be used as a receiver front-end, converting the input signal at the spectrum analyzer RF In connector to a signal centered at the IF output frequency. You can then process the IF signal in a way that meets your needs. That may mean using an A-to-D converter or some other signal processing method.

Zero Span IF Output provides an IF signal of 325 MHz with FFT capture bandwidth ≤ 32 MHz and 300 MHz with FFT capture bandwidth = 100 MHz. The nominal RF output level is –4 dBm with a 10 MHz, –20 dBm input, and with 0 dB input attenuation and preamp off. The spectrum can be inverted in certain RF input bands. The IF output signal is present only when the spectrum analyzer span is set to ZERO SPAN and the IF OUTPUT is toggled on (see “FREQ / SPAN Zero Span Menu” on page 3-13). You can select the IF output bandwidth of 750 kHz, 7.5 MHz, 14 MHz, 30 MHz, or 100 MHz using the “IF OUTPUT Menu” on page 3-13.

Note	The selectable bandwidth values may differ among instrument models and options.

Table 3-1.

Selected IF Filter Bandwidth	IF Output Frequency
100 MHz	300 MHz
30 MHz	325 MHz
14 MHz	325 MHz
7.5 MHz	325 MHz
750 kHz	325 MHz

The normal IF BW uses analog bandpass filters in the normal RBW chain. By changing the RBW, different filter bandwidths are selected. While the IF bandwidth is influenced by the selection of RBW filters, the digital RBW filters themselves are not employed.

The spectrum analyzer has several mixer bands. Depending on the operating frequency, the local oscillator may be above or below the input frequency. When the local oscillator frequency is below the input frequency, an increase in the input frequency results in an increase in the IF output frequency. When the local oscillator is above the input frequency, an increase in the input frequency moves it closer to the local oscillator frequency and the IF output frequency consequently decreases. The following table shows the bands and indicates where the LO frequency is, in relation to the RF frequency.

Table 3-2. IF Inversion Bands

RF Band	Start Frequency (MHz)	Stop Frequency (MHz)	Spectrum Inversion
1	0	5350	Y
2	5350	7200	Y
3	7200	9200	Y
4	9200	11100	N
5	11100	13000	N
6	13000	16500	N
7	16500	20400	Y
8	20400	26950	Y
9	26950	33810	Y
10	33810	39900	Y
11	39900	47000	N
12	47000	54000	N

"Inverted" means that the IF is spectrally inverted from the input (as the input frequency goes higher, the IF goes lower).
"Not Inverted" means that the IF is not spectrally inverted (as the input frequency goes higher, the IF goes higher).

You need to take frequency inversion into account when processing the IF signal. Assuming that the IF has been processed to yield I and Q data, inversion is easily done by swapping I and Q.

A residual frequency offset of the IF may exist compared to the RF due to the resolution of the first and second local oscillators. This offset is usually on the order of several kHz, but may be up to 10 kHz or so. To determine the residual offset, you need a second spectrum analyzer or a frequency counter.

1. Attach a signal source (or antenna) to the spectrum analyzer and set the center frequency to the center of the signal being received.
2. Set Zero Span from the FREQ/SPAN menu, and then press IF OUTPUT and enable the IF output.
3. Attach a second spectrum analyzer to the IF Out port and set the center frequency to 300 (or 325) MHz.
4. Set the span of the second spectrum analyzer to 100 kHz with the resolution needed to be able to measure an offset that may be 25 kHz or less.
5. Measure the frequency of the IF signal to see how far the signal is offset from 300 (or 325) MHz.

FREQ / SPAN Menu

CENTER FREQUENCY: Sets the center frequency of the sweep range. The current span setting will remain constant or will be adjusted to accommodate the start and stop frequency range of the instrument. The center frequency can also be dragged on the display when gestures are not toggled off.

SPAN: Sets the sweep frequency range. The current center frequency will remain constant and the start and stop frequencies will be adjusted to accommodate the new range. Pressing the plus (+) or minus (–) control increments the span value in a 1:2:5 sequence. The span can also be changed by pinching the trace in or out when gestures are not toggled off.

FULL SPAN: Pressing this button sets the span to cover the entire tunable spectrum of the instrument.

LAST SPAN: Pressing this button returns the span to the previously set span value.

ZERO SPAN: Sets the analyzer to zero span and enables the “FREQ / SPAN Zero Span Menu” on page 3-13.

START FREQUENCY: Sets the start frequency of the sweep range. The center frequency and span will be adjusted to accommodate the new start and current stop frequencies. Pressing the plus (+) or minus (–) control moves the start frequency in steps defined by the FREQUENCY STEP value.

STOP FREQUENCY: Sets the stop frequency of the sweep range. The center frequency and span will be adjusted to accommodate the current start and new stop frequencies. Pressing the plus (+) or minus (–) control moves the start frequency in steps defined by the FREQUENCY STEP value (set lower in this menu).

FREQUENCY STEP: Sets the frequency step value used for the plus (+) or minus (–) control.

FREQUENCY OFFSET: The frequency offset value accounts for frequency conversions outside of the analyzer. The offset frequency value is added to the start, stop, center, fixed marker, and normal marker frequencies. Pressing the plus (+) or minus (–) control moves the offset frequency in steps defined by the FREQUENCY STEP value.

GESTURES: Opens the “GESTURES Menu” on page 3-14.

Figure 3-7. FREQ / SPAN Menu

FREQ / SPAN Zero Span Menu

CENTER FREQUENCY: Sets the center frequency of the sweep range. The current span setting will remain constant or will be adjusted to accommodate the start and stop frequency range of the instrument. The center frequency can also be dragged on the display when gestures are not toggled off.

SPAN: Sets the sweep frequency range. The current center frequency will remain constant and the start and stop frequencies will be adjusted to accommodate the new range. Pressing the plus (+) or minus (–) control increments the span value in a 1:2:5 sequence. The span can also be changed by pinching the trace in or out when gestures are not toggled off.

FULL SPAN: Pressing this button sets the span to cover the entire tunable spectrum of the instrument.

LAST SPAN: Pressing this button returns the span to the previously set span value.

ZERO SPAN: Sets the analyzer to zero span and enables the “FREQ / SPAN Zero Span Menu” on page 3-13.

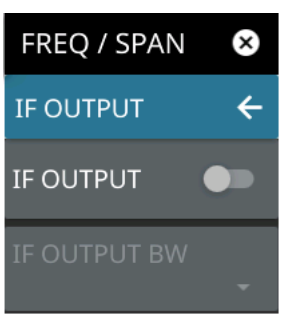
FREQUENCY STEP: Sets the frequency step value used for the plus (+) or minus (–) control.

FREQUENCY OFFSET: The frequency offset value accounts for frequency conversions outside of the analyzer. The offset frequency value is added to the start, stop, center, fixed marker, and normal marker frequencies. Pressing the plus (+) or minus (–) control moves the offset frequency in steps defined by the FREQUENCY STEP value.

IF OUTPUT: Opens the “IF OUTPUT Menu” on page 3-13. Requires Option 89.

Figure 3-8. FREQ / SPAN Menu

IF OUTPUT Menu



IF OUTPUT: Toggles the top panel IF output on or off. When IF output is on, the IF OUTPUT BW button becomes active.

IF OUTPUT BW: When IF output is on, this button provides a list of IF output bandwidth settings.

Figure 3-9. IF OUTPUT Menu

GESTURES Menu

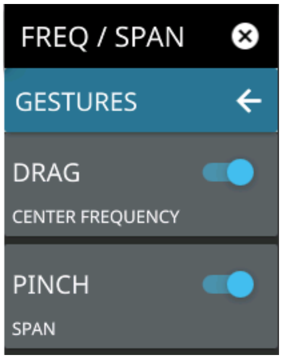
	**DRAG:** Toggles the touchscreen drag feature on or off. When toggled off, the center frequency will not change when dragging the spectrum display. This can be useful when dragging markers. **PINCH:** Toggles the touchscreen pinch feature on or off. When toggled off, the span frequency will not change when pinching the spectrum display. This can be useful when dragging markers. Note that the Drag and Pinch features can also be toggled on/off by touching the locks under the display.

Figure 3-10. GESTURES Menu

3-8 Setting Amplitude Parameters

Amplitude-related parameters are set using the "AMPLITUDE Menu" on page 3-17.

Setting Amplitude Reference Level

The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to "Indications of Excessive Signal Level" on page 3-16). To set the current amplitude reference level:

1. To automatically set an optimum reference level, press AMPLITUDE > AUTO REF LEVEL.
2. To manually set the reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm.

Note	Select AUTO ATTEN coupling of the attenuator setting and AUTO REF LEVEL to help ensure that harmonics and spurs are not introduced into the measurements.

Setting Amplitude Range and Scale

This setting applies to most analyzer modes of instrument operation and allows you to set the y-axis graticule scale.

1. Press AMPLITUDE > SCALE/DIV and enter the desired number of units per division (dB/division).
2. Set the desired y-axis amplitude units. Currently, dBm is the only available selection.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference or amplitude level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.
2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.
3. The new reference level offset value will be displayed on the instrument and the y-axis and trace amplitude is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer's dynamic range. By default, the auto attenuation automatically adjusts the attenuator as a function of the reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to "AMPLITUDE Menu" on page 3-17.
- Turn on the preamplifier.
- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to "Setting Bandwidth Parameters" on page 3-18.
- Use trace averaging if VBW is already set to 1 Hz. Refer to "Setting Trace and Cursor Parameters" on page 3-21

Preamplifier

The preamplifier can be turned on and off by toggling PRE AMP via the status panel or the AMPLITUDE menu. Figure 3-11 shows the noise floor with the preamplifier off (1) and on (2). Note that when the preamplifier is turned on, the noise floor drops significantly and a low-level signal is exposed. In order to use the preamplifier, the attenuation must be lower than 20 dB. If the preamplifier is turned on when the attenuation is greater than or equal to 20 dB, the attenuation will automatically drop to 10 dB. When AUTO ATTEN is toggled on, the REF LEVEL must be set to –40 dBm or lower to enable the preamplifier.

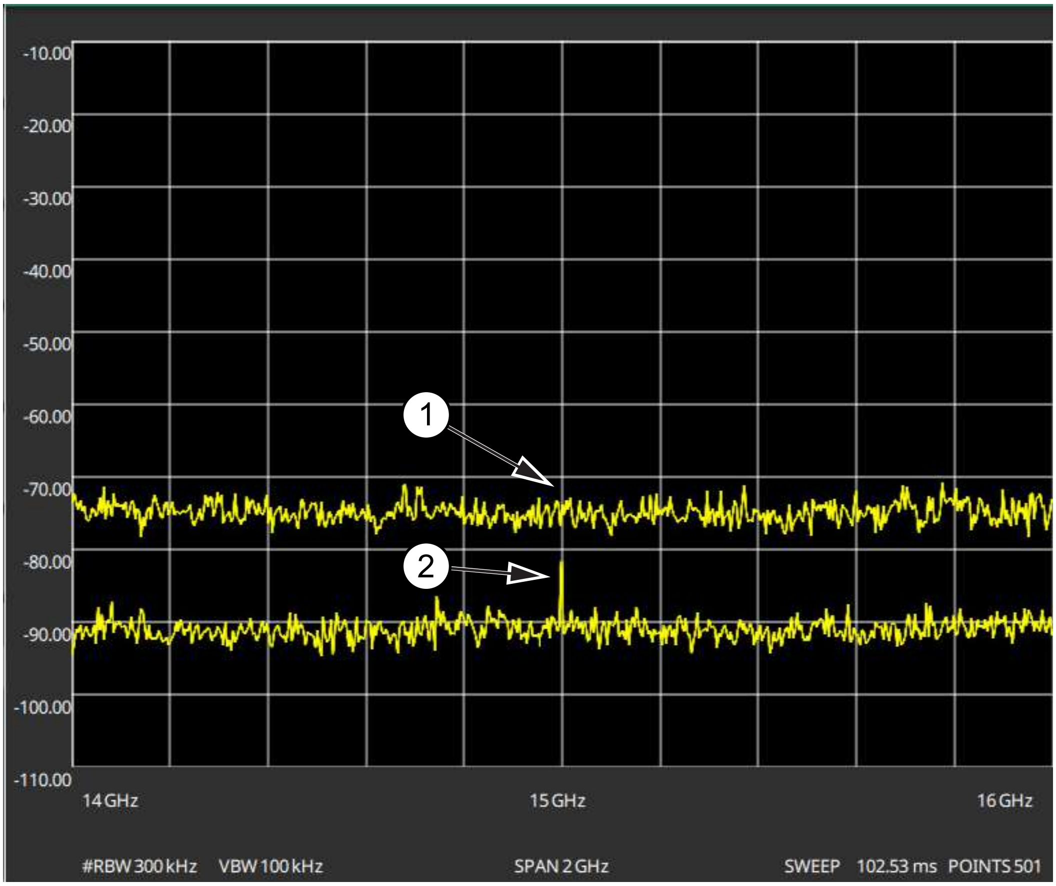


Figure 3-11. 1. Preamplifier Off
2. Preamplifier On

Indications of Excessive Signal Level

The Field Master Pro has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an "ADC Overrange" notification in the title bar (Figure 3-12). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 3-12. ADC Overrange

AMPLITUDE Menu

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this location. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values.

AUTO REF LEVEL: Auto reference level automatically adjusts the reference level to place the highest signal amplitude at about two graticule lines from the top based on the position of the trace at the time the button is pressed.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB. Pressing the plus (+) or minus (–) control changes the value by 1.

Y AXIS UNIT: Selects the y-axis amplitude units of dBm, dBW, or dBμV.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The offset is applied to all amplitude related parameters and to measurements such as the y-axis scale and marker measurements. The default offset value is 0 dB. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values. Refer to “Reference Level Offset for External Loss or External Gain” on page 3-15.

PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and the reference level is above –40 dBm. Refer to “Preamplifier” on page 3-16.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required.

ATTEN LEVEL: When auto attenuation is off, the attenuation value can be set manually to a resolution of 5 dB. Pressing the plus (+) or minus (–) control increments the value by 10.

FIELD STRENGTH: Opens the “AMPLITUDE FIELD STRENGTH Menu” on page 3-62. Refer to Section 3-22 “Field Strength” on page 3-61 for a description of the measurement.

Figure 3-13. AMPLITUDE Menu

3-9 Setting Bandwidth Parameters

Bandwidth parameters are set using the "BANDWIDTH Menu" on page 3-20.

Resolution Bandwidth

Resolution Bandwidth (RBW) determines frequency selectivity. The spectrum analyzer traces the shape of the RBW filter as it tunes past a signal. The choice of resolution bandwidth depends on several factors. Filters take time to settle. The output of the filter will take some time to settle to the correct value so that it can be measured. The narrower the filter bandwidth (resolution bandwidth), the longer the settling time needs to be, and therefore, the slower the sweep speed.

The choice of resolution bandwidth will depend upon the signal being measured. If two closely-spaced signals are to be measured individually, then a narrow bandwidth is required. If a wider bandwidth is used, then the energy of both signals will be included in the measurement. Thus, the wider bandwidth does not have the ability to look at frequencies selectively, but instead simultaneously measures all signals falling within the resolution bandwidth. Therefore, a broadband measurement would include all signals and noise within the measurement bandwidth into a single measurement.

On the other hand, a narrow-band measurement will separate the frequency components, resulting in a measurement that includes separate peaks for each signal. There are advantages to each. The ultimate decision will depend upon the type of measurement required.

There is always some amount of noise present in a measurement. Noise is often broadband in nature; that is, it exists at a broad range of frequencies. If the noise is included in the measurement, the measured value could be in error (too large) depending upon the noise level. With a wide bandwidth, more noise is included in the measurement. With a narrow bandwidth, less noise enters the resolution bandwidth filter, and the measurement is more accurate. If the resolution bandwidth is narrower, the noise floor will drop on the spectrum analyzer display. As the measured noise level drops, smaller signals that were previously obscured by the noise might now be measurable. Zero span is used for noise and noise-like measurements that are usually wider than the RBW. The RBW is ideally set to be as wide as the bandwidth of the signal you are measuring.

Video Bandwidth

Spectrum analyzers typically use another type of filtering after the detector that is called video filtering. This filter also affects the noise on the display, but in a different manner than the resolution bandwidth. In video filtering, the average level of the noise remains the same, but the variation in the noise is reduced. Therefore, the effect of video filtering is a "smoothing" of the signal noise. The resultant effect on the analyzer's display is that the noise floor compresses into a thinner trace, while the average position of the trace remains the same.

Changing the video bandwidth (VBW) does not improve sensitivity, but it does improve discernibility and repeatability when making low-level measurements. As a general rule, most field spectrum analyzer measurements are made at a video bandwidth that is a factor of 10 to 100 less than the resolution bandwidth. Using this ratio, with a resolution bandwidth of 30 kHz, typically, the video bandwidth is set between 300 Hz and 3 kHz, although it can be set anywhere from 1 Hz to 10 MHz.

Setting Frequency Bandwidth

1. Press BANDWIDTH on the main menu.
2. Toggle AUTO RBW or AUTO VBW (or both) off to manually change values. If using Auto, refer to the following sections.
3. Set the RBW and VBW to achieve the desired resolution and sweep characteristics. Lower values increase resolution and reduce noise, but at the expense of measurement (sweep) speed.
4. Set the VBW TYPE to Logarithmic (geometric mean) or Linear (arithmetic mean).

Setting Bandwidth Auto Coupling

Both resolution bandwidth and video bandwidth can be coupled to the frequency span automatically, or set manually. When set to Auto RBW, the instrument automatically adjusts the RBW in proportion to the frequency span. The default ratio of the span width to the resolution bandwidth is 100:1 and can be changed as follows:

1. Press BANDWIDTH on the main menu.
2. Press SPAN:RBW and change the coupling value, and then press ACCEPT to enter the value.

When auto-coupling between the span and RBW is selected (AUTO RBW is toggled on), the bandwidth parameter is displayed normally at the bottom of the graph. If manual RBW is selected (AUTO RBW is toggled off), the bandwidth label at the bottom of the graph is prefixed with the '#' symbol, and resolution bandwidth is set independently of the span.

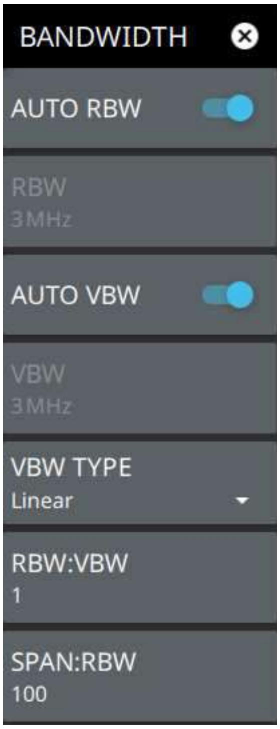
Auto coupling VBW links the video bandwidth to the resolution bandwidth so that VBW varies in proportion to RBW. If manual VBW coupling is selected, the VBW label at the bottom of the graph is prefixed with the "#" symbol and video bandwidth is set independently of resolution bandwidth.

By default, the RBW/VBW ratio is set to 3 and can be changed as follows:

1. Press BANDWIDTH on the main menu.
2. Press RBW/VBW and enter the desired value.

The RBW range varies with instrument features. Refer to "BANDWIDTH Menu" on page 3-20 and check your technical data sheet for the bandwidth range of your instrument.

BANDWIDTH Menu



AUTO RBW: When toggled on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the x-axis will be preceded by the “#” symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. Once auto RBW is toggled off, the RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

AUTO VBW: When toggled on, the instrument selects the video bandwidth based on the resolution bandwidth. The ratio of video bandwidth to resolution bandwidth can be set using the RBW:VBW button. When toggled off (manual), the VBW label at the left edge of the X-axis will be preceded by the “#” symbol.

VBW: The current video bandwidth is displayed under the VBW button. Once auto VBW is toggled off, the VBW can be changed using the keypad or slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the video bandwidth range.

VBW TYPE: Toggles between linear averaging (arithmetic mean) and logarithmic averaging (geometric mean).

RBW:VBW: This parameter displays the ratio between resolution bandwidth and video bandwidth. To change the ratio, press this button and use the keypad or the slider controls.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.

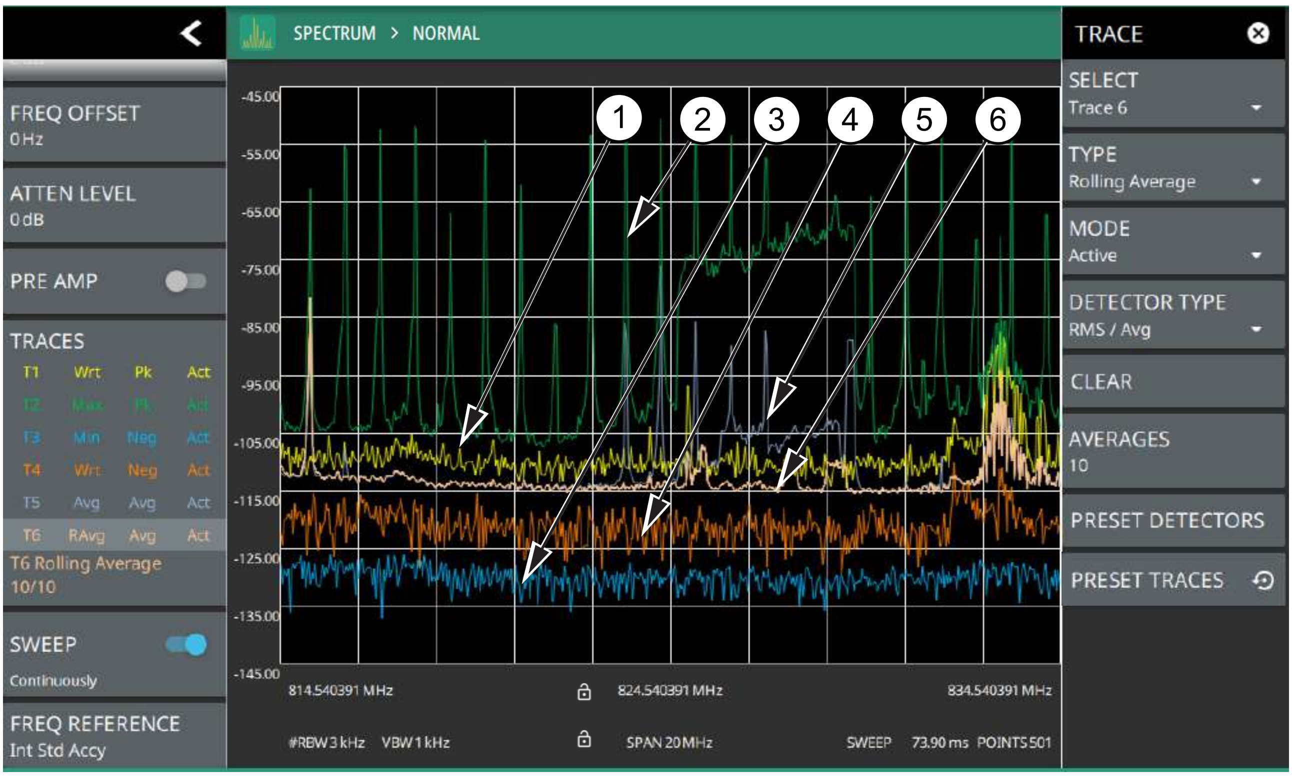
Figure 3-14. BANDWIDTH Menu

3-10 Setting Trace and Cursor Parameters

Field Master Pro can display up to 6 traces simultaneously. Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the Status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces in normal spectrum view, refer to “TRACE Menu (Spectrum View)” on page 3-22. When working with traces and cursors in Spectrogram view, refer to “TRACE Menu (Spectrogram View)” on page 3-26 and “TRACE CURSOR Menu” on page 3-27.

Traces in Spectrum View

The screenshot below shows the MS2090A with all six traces enabled on a signal, each with a different trace or detector type setting. The left side status panel shows a trace setup summary table. Touching one of the trace rows in the table will enable the trace and open the TRACE menu.



1. Clear/Write and Peak Detection: This is the default trace setting. The trace is cleared during each sweep and the largest measurement point is used for each display point.
2. Max Hold and Peak Detection: Each trace point retains its maximum value and the largest measurement point is used for each display point.
3. Min Hold and Negative Detection: Each trace point retains its minimum value and the smallest measurement point is used for each display point.
4. Clear/Write and Negative Detection: Trace points are cleared during each sweep and the smallest measurement point is used for each display point.
5. Average and RMS/Average Detection: The trace points are an average of the previous N sweeps, where N is the AVERAGES setting. RMS/Average detection depends on the video bandwidth type setting (BANDWIDTH > VBW TYPE): When VBW/AVERAGE type is set to Linear, this method detects the average power of measurement points that go into the display point. When VBW/AVERAGE type is set to Logarithmic, the traditional average of log (power) is displayed.
6. Rolling Average: The rolling average of the last N traces, where N is the AVERAGES setting.

Figure 3-15. Traces in Spectrum View

TRACE Menu (Spectrum View)

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

TRACE MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

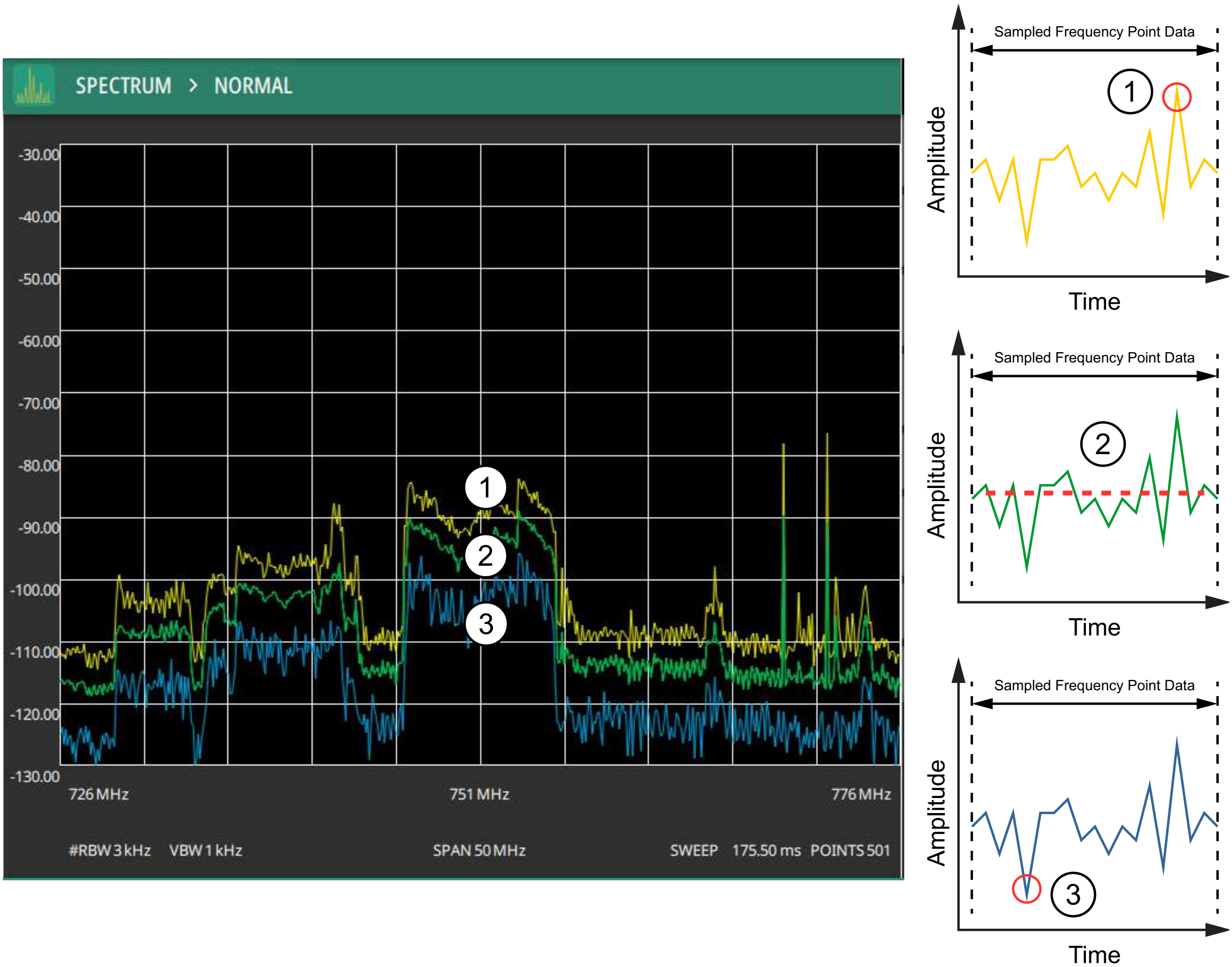
Figure 3-16. TRACE Menu (1 of 2)

	DETECTOR TYPE: Selects one of the available detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of showing each display point (see “Trace Detector Types” on page 3-24). • **Peak:** Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed. • **RMS/Avg:** In the default case, when the VBW/AVERAGE type is set to Linear, this method shows the linear average amplitude of sampled data for each display point, before converting to display units. When VBW/AVERAGE type is set to Log, this method shows the traditional average of log (power), such as dBm, for each display point, before converting to display units. Not available in ZERO SPAN. • **Negative:** Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used. **CLEAR:** Clears the currently active trace data. **AVERAGES:** Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes. **PRESET DETECTORS:** Sets all trace detectors to Peak. **PRESET TRACES:** Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 3-16. TRACE Menu (2 of 2)

Trace Detector Types

The figure below shows the available detector types:

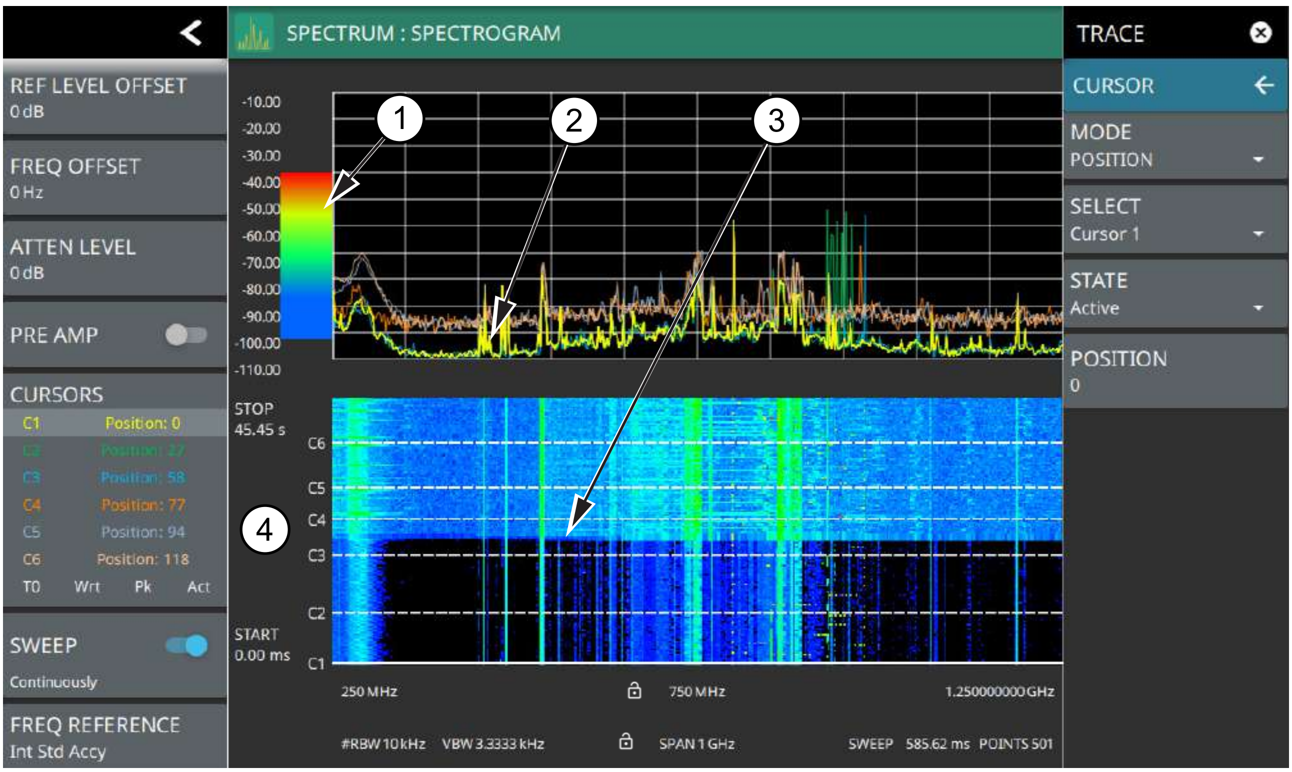


1. Yellow trace set to Peak detection.
2. Green trace set to RMS/Ave detection.
3. Blue trace set to Negative detection.

Figure 3-17. Trace Detector Types

Cursors in Spectrogram View

The screenshot below shows the MS2090A with all six cursors enabled on a signal. Cursors are shown on the spectrogram as white lines. The active cursor is a solid white line and other cursors show as dashed white lines. Cursors can be directly selected and dragged to position on the display or set via the TRACE > CURSOR menu. Cursors and their settings can also be accessed via the left side status panel by touching a cursor in the CURSORS table. The START time is the most recently completed sweep and the beginning of the spectrogram display. The STOP time is the total time length of the spectrogram, essentially the amount of time it takes for all completed sweeps to progress from the bottom to the top of the spectrogram window. The stop time will vary depending on the sweep speed, which can be faster or slower depending on settings such as span and RBW.

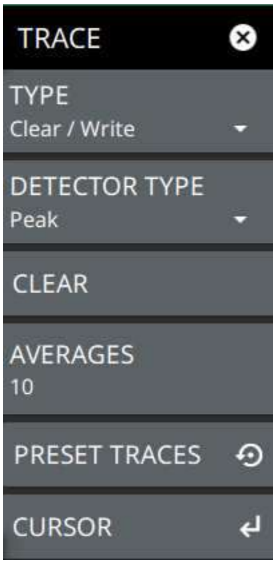


1. Color Bar settings are used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, then black is displayed. The color bar top and bottom setting, and the overall hue to the color range is set via the “SETUP Menu (Spectrogram View)” on page 3-48.
2. The traces shown in Spectrogram view are updated when the data in the spectrogram lands on the associated cursor. The traces show sweep data from that respective point in time. The bandwidth and amplitude settings in the example above were changed. Traces 1 through 3 reflect the changed settings while traces 4 through 6 are showing sweep data from earlier points in time. To freeze the spectrogram, stop the instrument from sweeping by toggling off Sweep Continuously.
3. The transition in the spectrogram here shows when the amplitude and bandwidth settings were changed.
4. The spectrogram START and STOP times shown here represent the full duration of all 142 sweeps shown in the spectrogram window. Cursors 1 through 6 are positioned throughout the spectrogram and can be dragged or set to a new time or position using the “TRACE CURSOR Menu” on page 3-27. Cursors can also be selected via the left side status menu CURSORS table. The bottom of the table shows the reference trace (T0) and its settings. The reference trace setting applies to all traces shown in the spectrum display.

Figure 3-18. Spectrogram View

TRACE Menu (Spectrogram View)

When the combined Spectrogram view is selected (MEASURE > VIEW > Combined), the TRACE and SETUP menus are updated with spectrogram and cursor setup controls.



TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

DETECTOR TYPE: Selects one of the available detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of showing each display point (see "Trace Detector Types" on page 3-24).

- **Peak:** Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed.
- **RMS/Avg:** In the default case, when the VBW/AVERAGE type is set to Linear, this method shows the average amplitude of sampled data for each display point. When VBW/AVERAGE type is set to Log, this method shows the traditional average of log (power), such as dBm, for each display point.
- **Negative:** Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used.

CLEAR: Clears the currently active trace data.

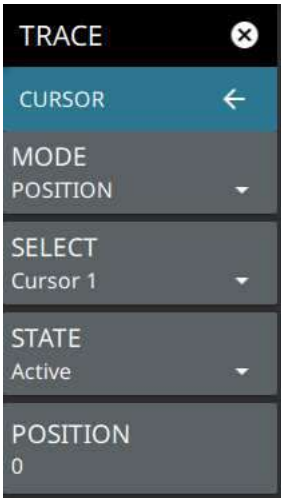
AVERAGES: Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes.

PRESET TRACES: Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

CURSOR: Opens the "TRACE CURSOR Menu" on page 3-27.

Figure 3-19. TRACE Menu (Spectrogram View)

TRACE CURSOR Menu



MODE: Every trace captured in the spectrogram has a time and a position index. Set the location of the spectrogram cursor based on either the time index or the position index. When position is selected, you can change the position index of the cursor from the POSITION button. If Time is selected, you can set the time index of the cursor from the TIME button. See the descriptions of POSITION and TIME below.

SELECT: Used to add additional cursors or to set the active cursor on the spectrogram. The active cursor also displays the associated trace on top of other traces in the spectrum display. For more information, refer to "Spectrogram with Cursors and Markers" on page 3-38.

STATE: Selects one of the following cursor states:

- **Active:** Displays the selected trace as it is updating.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

POSITION: Available when a position cursor is selected. You can change the sweep position index of the selected spectrogram cursor in relation to the number of total sweeps in the spectrogram. The number of sweeps in the spectrogram is based on the size of the spectrogram window, so the sweep index changes when changing the spectrogram cursor position index. The spectrum view also displays the currently selected trace on top of any other traces. A position of 0 (zero) represents the most recent (or live) trace. Entry into this field is disabled when the spectrogram cursor mode is set to Time.

TIME: Available when a time cursor is selected. You can change the time index of the selected spectrogram cursor in relation to the start and stop time displayed in the spectrogram. The time in the spectrogram is based on the size of the spectrogram window, so the time changes when changing the spectrogram cursor time index. The spectrum view also displays the currently selected trace on top of other traces. A time of 0 (zero) represents the most recent (or live) trace. Entry into this field is disabled when the spectrogram cursor mode is set to Position.

Figure 3-20. TRACE / CURSOR Menu (Spectrogram View)

3-11 Setting Sweep Parameters

Sweep parameters are set using the "SWEEP Menu" on page 3-29.

Single/Continuous

When the Continuous toggle is pressed, the instrument toggles between single sweep and continuous sweep. In single sweep setting, the instrument waits until SWEEP ONCE is pressed or another setting is selected.

Trace Points

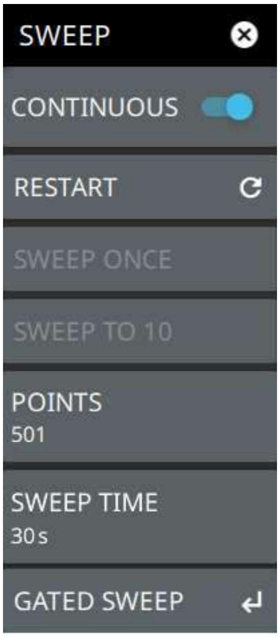
The number of points sets the number of display points in the trace that are generated from the measurement data.

Sweep Limitations

With some spectrum analyzers, the user has control over sweep time (the elapsed time of each sweep, also referred to as scan time). An analyzer cannot be swept arbitrarily fast while maintaining its specified accuracy, but will have a sweep rate limitation depending upon the resolution bandwidth, video bandwidth, and frequency range selected. The sweep rate is not usually chosen by the user, but is determined by the frequency range swept divided by the sweep time. The limitation on sweep rate comes from the settling or response time of the resolution and video bandwidth filters. If an analyzer is swept too quickly, the filters do not have time to respond, and the measurement is inaccurate. Under such conditions, the analyzer display tends to have a "smeared" look to it, with the spectral lines being wider than normal and shifted to the right and at a lower amplitude than is correct.

Anritsu Field Master Pro is designed to relieve the user from having to calculate the sweep speed or experiment to discover a sweep speed that yields accurate results. When changing the RBW and VBW, the sweep speed automatically changes to the fastest sweep speed that will yield accurate results. The sweep speed will be faster for a wide RBW or VBW and slower for a narrow RBW or VBW. Regardless of the minimum sweep time, the instrument will never sweep faster than the RBW and VBW settings will allow. The instrument is designed to ensure that no uncalibrated measurement conditions will occur.

SWEEP Menu



CONTINUOUS: Toggles between continuous sweep and single sweep. When the toggle is off, the instrument is in single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

RESTART: The restart function restarts the current sweep or measurement from the start frequency.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

SWEEP TO N: When sweep is set to single sweep and trace type is set to average, rolling average, rolling max hold, or rolling min hold, SWEEP TO N triggers N consecutive measurement sweeps, where N is the number of averages set in the TRACE menu. Each time the button is pressed, it will restart the average count, then sweep N times. This button has no function when the instrument is in continuous sweep.

POINTS: Sets the number of data points per sweep and displayed in each trace. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace.

SWEEP TIME: This button is available when the span is set to ZERO SPAN. Sets the sweep time.

GATED SWEEP: Opens the “GATED SWEEP Menu” on page 3-31.

Figure 3-21. SWEEP Menu

Gated Sweep (Option 90)

Gated sweep is only available on instruments with Option 90 installed. Gated sweep allows you to synchronize your sweep with an event so that the analyzer collects data at the appropriate time. This is useful for measuring signals in the time domain such as pulsed RF, time multiplexed, or burst modulated signals. Field Master Pro can use the GPS timing signal as the gating trigger event. This will allow you to synchronize measurements with GPS synchronized communication signals. Set up gated sweep from the "GATED SWEEP Menu" on page 3-31.

To set up the instrument for gated sweep measurements:

1. Press SWEEP > GATED SWEEP.
2. Select the GATE SOURCE. The gate source selected determines the trigger source from which the gate is controlled. Not all instrument models and options support all triggering selections, so your choices may vary. Field Master Pro supports a GPS and external trigger gate source.
3. Select one of the available FRAME TIME durations. The frame time sets the total measurement cycle time.
4. Set the GATE DELAY time. The gate delay sets the time from the triggering event to when the instrument starts sweeping and collecting data.
5. Set the GATE LENGTH time. The gate length sets the time for data capture and analysis.
6. If desired, enable PWR VS TIME (refer to "POWER VS TIME Display" on page 3-32.)

Below is an example of a gated sweep applied to a channel power measurement. The signal level shown varies cyclically with time and would not be measurable without gated sweep.

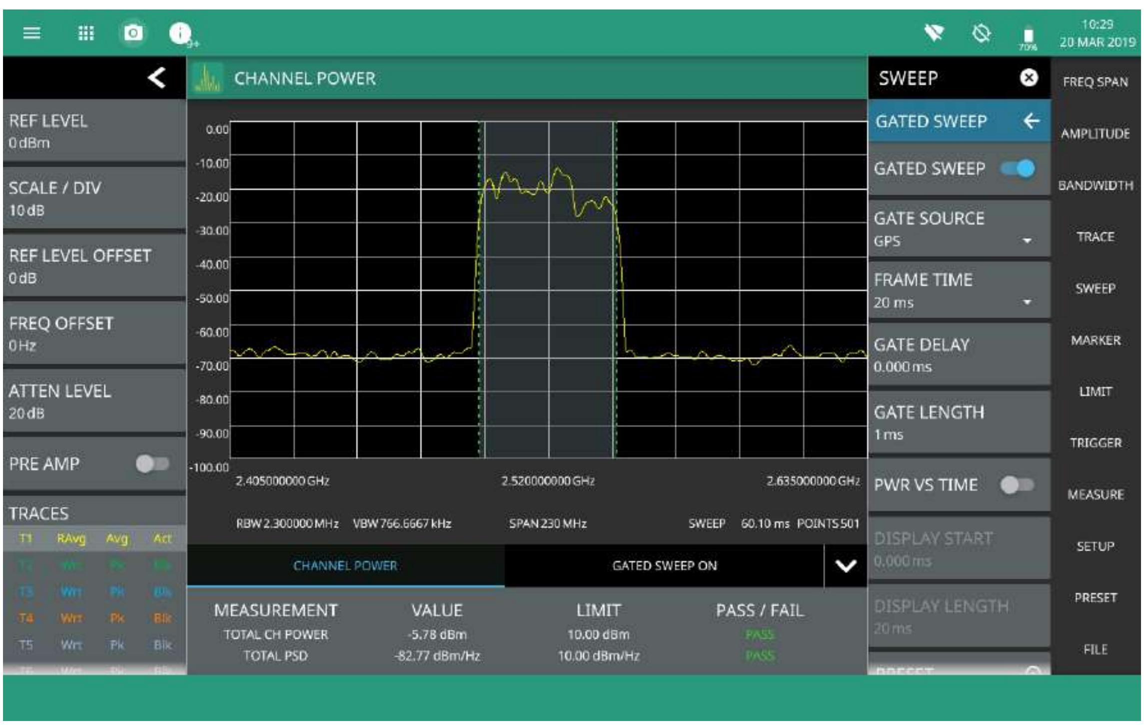


Figure 3-22. Gated Sweep Measurement

The channel power and gated sweep display panels at the bottom can be tapped to directly open either the Channel Power SETUP menu or the GATED SWEEP menu.

GATED SWEEP Menu

GATED SWEEP: Toggles gated sweep on or off.

GATED SOURCE: Selects the trigger source for the gated sweep.

- **GPS:** This setting synchronizes the trigger source to the GPS PPS.
- **External 1 or 2:** Sets the gate reference based on input from the External 1 or External 2 port.

FRAME TIME: Selects the frame time duration of 10 ms, 20 ms, or 1 s.

GATE DELAY: Sets the start of the gated sweep. When “POWER VS TIME Display” is enabled, the gate delay is indicated by the blue left border of the power vs time display. You can also drag the entire gate to set the desired gate delay.

GATE LENGTH: Sets the length of the gated sweep. When “POWER VS TIME Display” is enabled, the gate length is indicated by the width between the blue borders of the power vs time display. You can also drag the right blue border to set the desired gate length.

PWR VS TIME: Enables the “POWER VS TIME Display” on page 3-32.

DISPLAY START: When POWER VS TIME is enabled, sets the start of the graticule display.

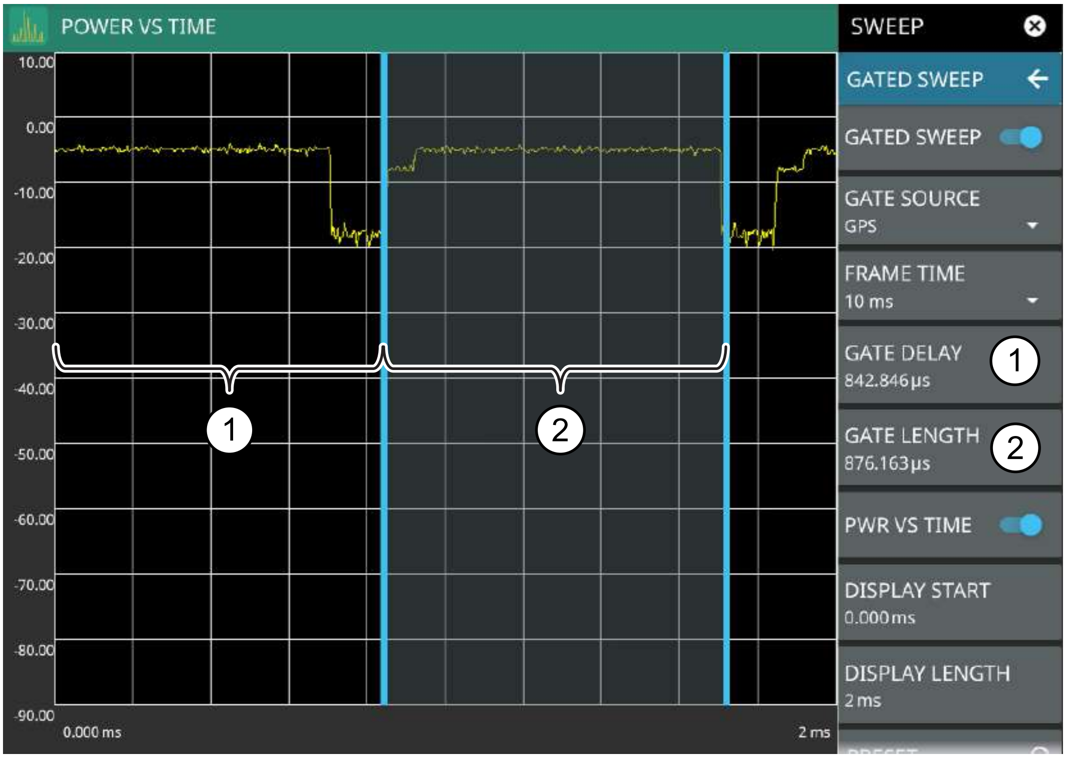
DISPLAY LENGTH: When POWER VS TIME is enabled, sets the time length of the graticule display.

PRESET GTD SWP: Presets gated sweep settings to default values.

Figure 3-23. GATED SWEEP Menu

POWER VS TIME Display

When power vs time is enabled, a time-domain graph is presented. This graph is a useful visual aid when setting up the GATE DELAY (1) and GATE LENGTH (2) times as you can simultaneously view the signal level within the set frame and relative to your gate delay and length. The display is enabled using the PWR VS TIME toggle setting and should be disabled after setting up the gate delay and length parameters. The gate delay and length are represented by the width of the displayed shaded area flanked with blue lines (see Figure 3-24).



1. Set the gate delay by dragging the left blue setting line or entering a value directly. The full time scale is shown along the bottom and the gate delay time will be displayed at the top center of the graticule when it is being adjusted.
2. Set the gate length by dragging the right blue setting line or entering a value directly. The full time scale is shown along the bottom and the gate length will be displayed at the top center of the graticule when it is being adjusted.

Figure 3-24. Power vs. Time Display

If the blue gate delay and length setting lines are set outside of the displayed graticule scale, you will see “< Gate Start” and “Gate Stop >” messages at the edge of the display indicating where the blue setting lines are located.

Once the gate has been set up, you can apply gating to the spectrum by toggling GATED SWEEP on. Gating will continue to be applied when you access other measurements and functions of the spectrum analyzer until gated sweep is toggled off or an unsupported instrument configuration is selected.

3-12 Setting Up Markers

Marker parameters are set using the “MARKER Menu” on page 3-35. Refer to the figure below when working with this section.

1. Normal spectrum view marker information display.
2. Marker located on trace. The active marker is indicated with solid green fill, other markers will show with a hollow fill, fixed markers show as a green X. The dashed vertical line is attached to the active marker and facilitates touch operations. Either the marker or the line can be dragged into position, and either can be double tapped to open a number of peak search options.
3. Selected marker in the MARKER menu and in the MARKER table. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu.

Figure 3-25. Marker Table and Marker Settings Panels

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the current center frequency.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and placed at the center frequency. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static frequency and amplitude.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   - a. Enter a new FREQUENCY value from the MARKER menu. The frequency can be entered manually or adjusted by using the slider or the + and – buttons to move the marker to the left and right.
   - b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position).
   - c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 3-36). Some peak search functions can be accessed by double tapping the marker or the blue marker line.

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed frequency, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, if Marker 2 is set as a delta marker, the delta reference is set to Marker 1. To set a delta marker and its reference:

1. Activate either a normal or fixed marker and place it in a reference location as described previously.
2. Activate a delta marker using MARKER > SELECT > Marker #, then select MODE > Delta.
3. Place the active delta marker by doing one of the following:
   - a. Enter a new FREQUNCY value.
   - b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   - c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 3-36).

A delta marker is labeled with a green delta symbol between each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1". If another marker is desired to be the reference marker, select the delta marker as the active marker and then use DELTA REFERENCE > Marker # to select the desired reference marker number.

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 3-36.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center frequency, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker, which is displayed in the upper left-hand corner of the screen. When a marker is turned on, it is a normal marker positioned at the center frequency of the selected trace.

ENABLED: Enables the selected marker. When the toggle is off, the marker is disabled and not shown on the screen.

FREQUENCY: Displays the marker frequency. For delta markers, the frequency is relative to the reference marker. Change the marker frequency by dragging it to the desired location. You can also change the marker frequency by pressing the FREQUENCY button and changing it manually using the keypad controls.

AMPLITUDE: Displays the current marker amplitude. When the marker mode is set to Normal or Delta, the amplitude is set by the trace. In that case, the amplitude is not settable by the user. The button is grayed out, but the value is still updating with every sweep. If the marker is a Fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude using the keypad control.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The frequency is fixed but the amplitude value varies from sweep to sweep.
- **Delta (Δ):** A Delta (Δ) marker displays the delta frequency and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Normal marker at the same location. The reference marker can then be switched to a Fixed marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed frequency, which are defined by the user and not related to the trace or sweep data.

FUNCTION: Sets the function of the currently selected marker to None, Noise, or Frequency Counter. For more information about using marker functions, refer to "Marker Functions" on page 3-37.

DELTA REFERENCE: Selects the Reference marker for a Delta marker. A Delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen. Refer to "Marker Table" on page 3-39.

CENTER ON MARKER: Sets the center frequency to the currently active marker's frequency value.

REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

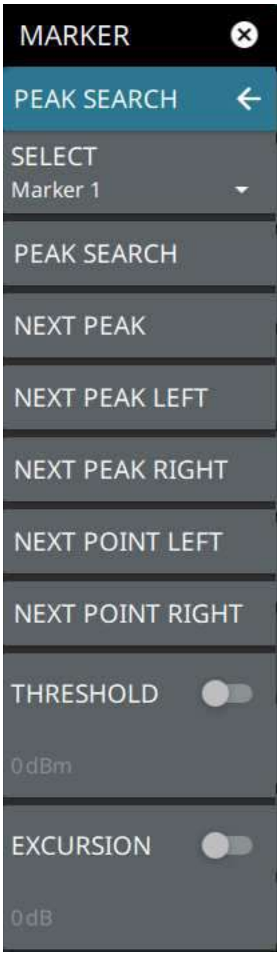
ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 3-26. MARKER Menu

MARKER PEAK SEARCH Menu

Note	Double tapping a marker opens a quick peak search menu with some of the below features.



PEAK SEARCH: Returns to the main MARKER menu.

SELECT: If the selected marker is off, it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 3-27. PEAK SEARCH Menu

Marker Functions

Noise Markers

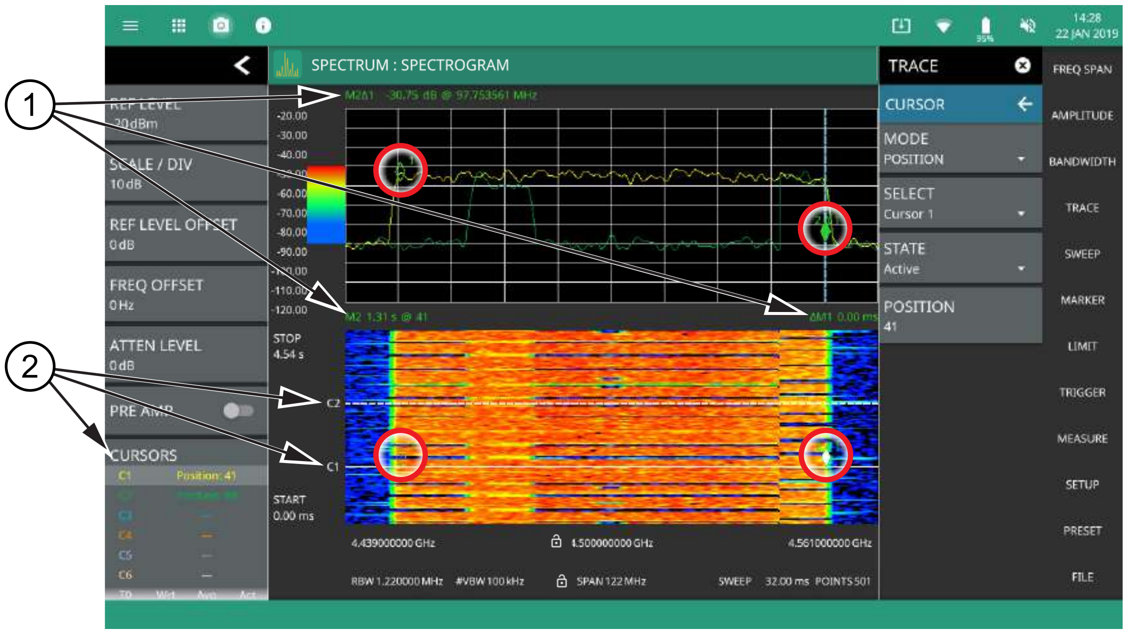
Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

Frequency Counter Marker

Sets the frequency counter for the selected marker. Marker frequency values are normally limited in resolution to individual display pixels. Each pixel may represent multiple frequencies. When counter marker is enabled, a higher resolution digital signal processing is used within the region of the counter marker to determine a more precise frequency. Using counter marker in association with marker to peak will result in the frequency of the signal peak to a much higher displayed resolution. Note that frequency accuracy is affected by the RBW setting, and sweep times may be longer when using counter marker because of the additional signal processing.

Spectrogram with Cursors and Markers

In the spectrum window, markers are shown as hollow green diamonds on the trace to which they are assigned. Active markers have a solid fill with a vertical dashed line that can be used to drag the marker position. The dashed line matches the trace color to which the marker is assigned. In the spectrogram window, markers are shown as hollow green diamonds on the cursor to which they are assigned. The active marker is shown with white fill and its time and position values are displayed in green text at the upper left side of the display. In this example, the active marker is set to Cursor C2 and is measuring a change of amplitude between two different points in time. Markers can be placed on different cursors to help you compare measurements at different points in time as well as frequency



1. **Markers:** Displays the selected marker value. Marker values at the top of the spectrum display will show the current frequency and amplitude values of the active marker and its type. In this case, marker 2 is set to a delta marker relative to Marker 1. Marker values at the top of the spectrogram window show the current time or position of the active marker (left) and other marker information such as delta time (right). In this case, marker 2 is active and is at position 41 and has a relative time delta of 0 ms. Note that you can set a marker on any cursor to measure relative time differences between signal events as well as frequency and amplitude differences. Markers displayed on traces and cursors (encircled in red) show as green diamonds with the active marker in white fill.
2. **Cursors:** Cursors are shown on the spectrogram as white dashed lines. The active cursor is a solid white line. Cursors can be directly selected and dragged to position on the display or set via the TRACE > CURSOR menu. Cursors and their settings can also be accessed via the status panel. The start time is the most recent completed sweep and the beginning of the spectrogram. The stop time is the total time length of the spectrogram, essentially the amount of time it takes for a completed sweep to get from the bottom to the top of the spectrogram diagram with the current settings.

Figure 3-28. Spectrogram with Cursors and Markers

Marker Table

The marker table display is useful for displaying many marker parameters at once. The examples shown are for the regular Spectrum view (1) and for Spectrogram view (2). Both marker tables show the marker mode and corresponding X and Y values. In spectrum view, the marker table shows the marker function and trace to which it is selected. In Spectrogram view, the marker table shows the time value and the cursor to which it is selected. The selected marker is displayed with a highlighted background. Table controls are located on the right of the header. Press the down or up arrow to collapse or expand the table, press X to close the table.

1

MARKER

MARKER	MODE	FUNCTION	TRACE	X	Y
1	Normal	Noise	1	5.800000010 GHz	-142.43 dBm/Hz
2	Normal	Off	[illegible]	6.152000010 GHz	-66.84 dBm
3	Normal	Off	1	62.690807800 GHz	-67.91 dBm
4	Off	Off	--	--	--
5	Off	Off	--	--	--
6	Off	Off	--	--	--

2

MARKER

MARKER	MODE	CURSOR	X	Y	TIME
1	Normal	1	5.800000010 GHz	-145.47 dBm/Hz	0.00 ms
2	Normal	[illegible]	6.152000010 GHz	-68.24 dBm	9.33 s
3	Normal	1	62.690807800 GHz	-70.54 dBm	0.00 ms
4	Off	--	--	--	--
5	Off	--	--	--	--
6	Off	--	--	--	--

Figure 3-29. Marker Table

You can select and change a marker’s parameters by selecting the marker from either the MARKER menu or the MARKER table.

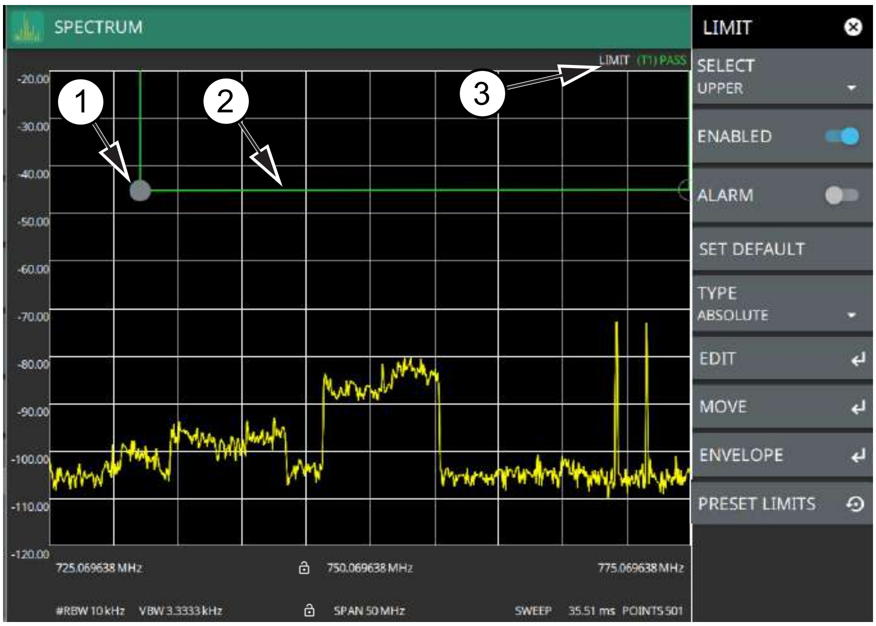
The currently selected marker’s value is shown at the top left of the spectrum window with its current amplitude and frequency values.

The selected marker is highlighted on the trace display.

3-13 Setting Up Limit Lines

Limit lines allow you to monitor when trace data crosses a defined line. Two types of limit lines can be specified: lower limit lines and upper limit lines. Limit lines can be used for visual reference, pass/fail criteria, and to trigger a save on event. By using save on event, a signal that crosses a limit line can be automatically saved (refer to Section 3-25 “Saving and Recalling Measurements” on page 3-69).

Each limit line can consist of a single segment, or as many as 40 segments across the entire frequency span of the instrument. These limit segments are retained regardless of the current frequency span of the instrument, which allows the configuring of specific limit envelopes at various frequencies of interest without having to re-configure them each time the frequency is changed. Limit line parameters are set using the “LIMIT Menu” on page 3-42.



1. Limit points are shown as gray circles. The active point is filled in gray. Points can be dragged into position or set discretely using the frequency and amplitude settings in the “LIMIT EDIT Menu”.
2. The limit line shown here is a simple upper limit line. The limit line color is green when the trace does not cross the limit line, and the limit line color turns red when the trace crosses it.
3. The limit test pass/fail status is also shown in green or red color at the top of the display. The limit test is applied to the active trace, indicated here by T1.

Figure 3-30. Simple Limit Line

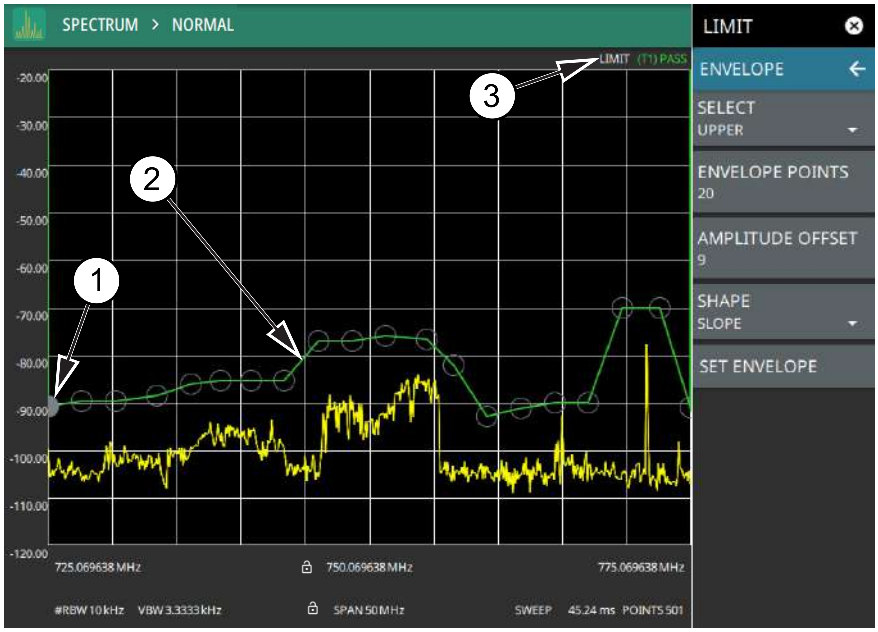
Simple Limit Line

1. Press LIMIT on the main menu.
2. Select UPPER or LOWER limit.
3. Toggle the selected limit line on using the ENABLED toggle.
4. To change the frequency or amplitude level of the limit line:
    a. Press MOVE to open the “LIMIT MOVE Menu”
    b. Enter either an X-OFFSET frequency value or Y-OFFSET amplitude value.
    c. Press LEFT, RIGHT, UP, or DOWN to move the limit line the by the value entered above.

You can set up either an upper or lower limit line, or both by repeating the procedure above.

Limit Line Envelope

Limit line envelope parameters are set using the "LIMIT ENVELOPE Menu" on page 3-45. The limit line envelope feature is a quick way to generate an envelope using the existing trace as a reference. You can set the envelope to square or slope and you can set the limit line offset from the trace when creating the envelope. Once the envelope limit line is set, you can manually edit the limit line by dragging the points or by using the "LIMIT EDIT Menu" and "LIMIT MOVE Menu".



1. Limit points are shown as gray circles. The active point is filled in gray. Points can be dragged into position or set discretely using the frequency and amplitude settings in the "LIMIT EDIT Menu".
2. The limit line shown here is an upper envelope limit line. The limit line color is green when the trace does not cross the limit line, and the limit line color turns red when the trace crosses it.
3. The limit test pass/fail status is also shown in green or red color at the top of the display. The limit test is applied to the active trace, indicated here by T1.

Figure 3-31. Envelope Limit Line

To set up a limit line envelope:

1. Press LIMIT > ENVELOPE.
2. Select either Upper or Lower limit line.
3. Set the number of limit envelope points.
4. Set the amplitude offset (in dB).
5. Select the envelope shape of Square or Slope.
6. Press SET ENVELOPE to generate the limit line envelope.

You can set up either an upper or lower limit line, or both by repeating the procedure above. To create a more complex limit line, use the "LIMIT EDIT Menu" to work with individual limit line points.

LIMIT Menu

SELECT: Selects UPPER or LOWER limit line for editing.

ENABLED: Displays the selected limit when toggled on.

ALARM: This setting is for toggling the alarm function on or off for the currently active limit line. When on, an alarm beep will occur when a data point exceeds the limit. Audio functionality will be added via an upcoming software update.

ICNIRP: This button is only available in Electromagnetic Field (EMF) Measurements (Option 444). Toggles the International Commission on Non-Ionizing Radiation Protection limit line. The ICNIRP limit takes precedence over a custom limit for EMF measurements. To set a custom limit for EMF measurements, enable the regular limit above and toggle ICNIRP off. When ICNIRP limit is toggled off, the regular upper limit setting is used to evaluate pass/fail results for EMF measurements. Both ICNIRP and custom limits are evaluated on trace 2, which is the isotropic result.

SET DEFAULT: Pressing this button deletes all limit points for the currently active limit line and sets the default limit line value, which is a single limit whose position is 2.5 grid lines from the top of the screen (for the upper limit line) or 2.5 grid lines from the bottom of the screen (for the lower limit line), depending upon which limit is active. The inactive limit line is not altered.

TYPE: Use to set the selected limit line as absolute or relative. This selection may be used at any time while working with limit lines. Absolute limit lines set the limit inflection points based upon the entered frequencies for each point. Relative limit lines set the limit inflection points relative to the current center frequency. Regardless of how a limit line is set up, saved, or recalled, it can be changed between absolute and relative by pressing the desired state.

EDIT: Opens the "LIMIT EDIT Menu" on page 3-43.

MOVE: Opens the "LIMIT MOVE Menu" on page 3-44.

ENVELOPE: Opens the "LIMIT ENVELOPE Menu" on page 3-45.

PRESET LIMITS: Presets the limit lines to default values.

Figure 3-32. LIMIT Menu

LIMIT EDIT Menu

SELECTED POINT: Displays the limit line point number. Press to select a different point from the displayed list.

FREQUENCY: Sets the frequency of a limit line inflection point. The frequency of each point in a limit line can be individually set. When a new point is added, it takes the value that is halfway between two existing points, or it takes the stop frequency of the current sweep if no point is higher in frequency than the one being added. See the ADD POINT button description for more details. Use the keypad or the left and right arrow keys to change the frequency of an inflection point. The left or right arrows move the inflection point by ±0.1. Up or down arrows move the inflection point ±1.

AMPLITUDE: Sets the amplitude of a limit line inflection point. The amplitude of each inflection point can also be individually set. By default, when a new point is added it takes the amplitude value that is on the limit line at the frequency where the point was added. Use the keypad (using +/- to set a negative value) or the plus (+) or minus (–) control to increment the value. The unit of the amplitude limit is the same as the current vertical amplitude unit (for example, dBm).

ADD POINT: Press this button to add a limit line inflection point. The precise behavior of this button depends upon which inflection point is active at the time that the button is pressed. If the active limit point is somewhere in the middle of a multi-segment limit line, then a new limit point is added that is halfway between the currently active point and the point immediately to its right. The amplitude of the inflection point will be such that it falls on the limit line. For example, if a limit point exists at 2.0 GHz with an amplitude of –30 dBm, and if the next point is 3.0 GHz with an amplitude of –50 dBm, then the added point will be at 2.5 GHz with an amplitude of –40 dBm. If the last limit point is active (assuming it is not at the right edge of the display), then the new limit point will be placed at the right edge of the display at the same amplitude as the point immediately to its left. Points may not be added beyond the current sweep limits of the instrument. Use the FREQUENCY and AMPLITUDE buttons to make adjustments to the selected point.

DELETE POINT: Press this button to delete the selected point.

ADD VERTICAL: Press this button to add an inflection point below the currently selected point.

NEXT POINT LEFT: Press this button to select the inflection point that is immediately to the left of the active point, making this newly selected point active for editing or deletion. With each button press, the active point becomes that point to the left of the previously active point, until the newly selected active point becomes the left-most point on the screen.

NEXT POINT RIGHT: Press this button to select the limit point immediately to the right of the active point, making this newly selected point active for editing or deletion. With each button press, the active point becomes that point to the right of the previously active point, until the newly selected active point becomes the right-most point on the screen.

Figure 3-33. LIMIT EDIT Menu

LIMIT MOVE Menu

CENTER: Pressing this button moves the center of the existing limit line to the center frequency of the measurement. The span of the existing limit line is not changed. Use this button as an easy way to move an existing limit line to the center of the sweep. This button has no action if no limit line is turned on.

X-OFFSET: Allows you to adjust the frequency of the limit line. All inflection points will be moved by the value entered here when using the LEFT or RIGHT buttons. Press X-OFFSET and enter a value using the keypad.

LEFT: Pressing this button moves all inflection points to the left by the X-OFFSET value.

RIGHT: Pressing this button moves all inflection points to the right by the X-OFFSET value.

Y-OFFSET: Allows you to adjust the amplitude of the limit line. All inflection points will be moved by the value entered here when using the UP or DOWN buttons. Press Y-OFFSET and enter a value using the keypad.

UP: Pressing this button moves all inflection points up by the Y-OFFSET value.

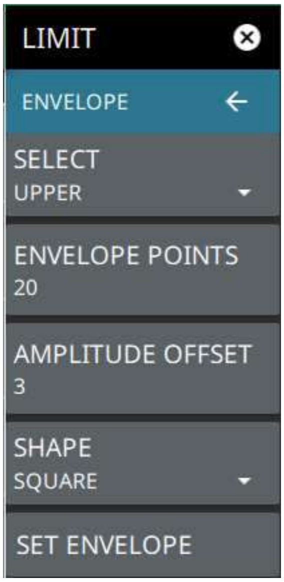
DOWN: Pressing this button moves all inflection points down by the Y-OFFSET value.

MARKER 1 OFFSET: Sets a limit line offset value from Marker 1 amplitude. This feature moves the limit line amplitude and frequency as needed to place the center of the limit line the user-specified number of dB from the position of Marker 1. Positive values place the limit line above Marker 1, and negative values place the limit line below Marker 1.

TO MARKER 1: Moves the limit line center position to the frequency and specified amplitude offset of Marker 1. Marker 1 must be enabled.

Figure 3-34. LIMIT MOVE Menu

LIMIT ENVELOPE Menu



SELECT: Press this button to select UPPER or LOWER for envelope design.

ENVELOPE POINTS: This sets the desired number of envelope points.

AMPLITUDE OFFSET: Use to define how far away from the trace to place the upper or lower envelope. The limits are ± 100 dB. For an upper envelope, usually the offset will be positive in order to place the envelope above the signal. For a lower envelope, the offset will usually be negative in order to place the envelope below the signal.

SHAPE: Use to choose whether the upper or lower envelope will be with flat tops (SQUARE setting) and vertical lines, or whether the envelope will have sloped lines (SLOPE setting) between adjacent inflection points. When the square envelope type is selected, two inflection points are used for each horizontal segment.

SET ENVELOPE: Press this button to generate the envelope using the set characteristics. If the default results are not satisfactory, you can make adjustments to the amplitude and frequency of each inflection point, and you can add or delete inflection points.

Figure 3-35. LIMIT ENVELOPE Menu

3-14 Setting Up Triggering

The TRIGGER menu is not available in regular swept frequency spectrum measurements. Trigger parameters for zero span are set using the “TRIGGER Menu in Zero Span” on page 3-46. IQ trigger (Option 124/126) are set using the “IQ TRIGGER Menu” on page 7-10.

TRIGGER Menu in Zero Span

SOURCE: The SOURCE button offers several triggering options depending on which view mode the instrument is set:

- **Free Run:** A new sweep is started immediately upon completion of the current sweep. No trigger event is required to initiate a sweep.
- **Video:** Available only in zero span. When enabled, the trigger level will be indicated graphically on the display with a horizontal VIDEO line. A new sweep is started when the input video level meets the value set via the LEVEL button. The level can also be adjusted by dragging the VIDEO line up or down. Video triggering is useful for monitoring a known frequency and its time transients, such as pulsed signal rise or fall times.
- **External 1 or 2:** A TTL signal applied to the selected External Trigger MCX input connector causes a single sweep. After the sweep is complete, the resultant trace is continuously displayed until the next trigger signal is received.

LEVEL: Used in zero span mode when the trigger source is set to Video. Sets the video trigger level threshold that initiates a sweep. The level crossing applies to rising or falling edges. Use the hysteresis setting below to adjust the sensitivity of the trigger level.

HOLDOFF: Available only when the trigger source is set to External or Video. When toggled on, the analyzer waits the user defined amount of time to re-arm the trigger between trigger events. If a trigger event is received after the previous trigger, but before the holdoff time has elapsed, that trigger event will be ignored.

PERIODIC: Used to set a periodic sweep trigger. When toggled on, the instrument waits the set time to start a sweep.

SLOPE: Used when the trigger source is set to External or Video. Sets the trigger slope to rising or falling edge.

HYSTERESIS: Hysteresis is used to address noisy trigger signals. The hysteresis setting adjusts the sensitivity of the trigger system (the difference between the firing level and the arming level as shown in Figure 3-37). A low hysteresis value sets the arming and firing levels close to each other, meaning a small signal change will cause a trigger. A large hysteresis value sets the arming and firing levels far apart, meaning a large signal change will be required to cause a trigger.

Figure 3-36. TRIGGER Menu in Zero Span

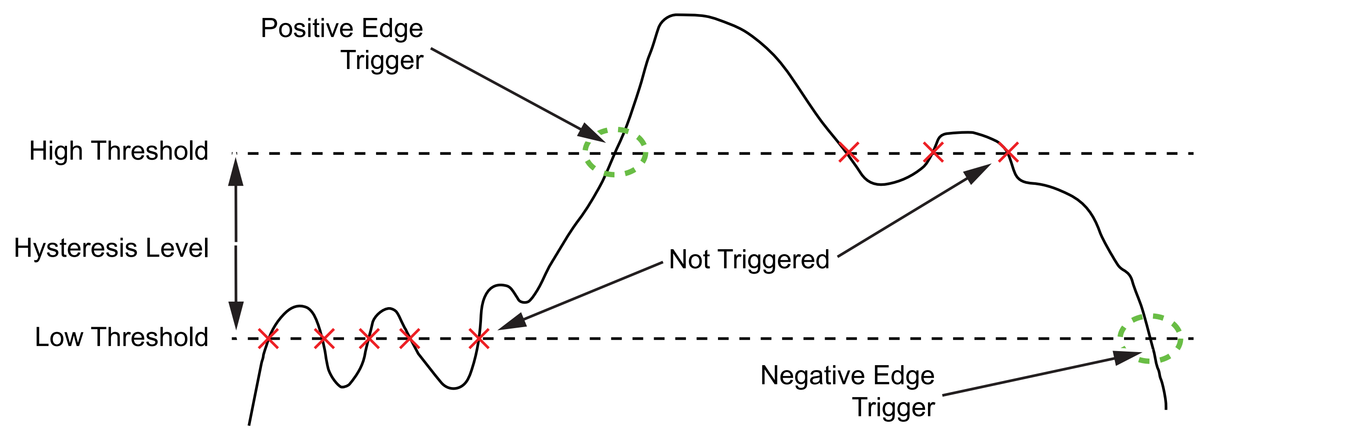
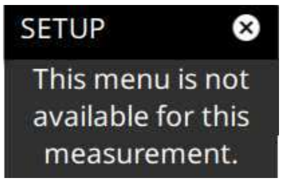


Figure 3-37. Trigger Levels and Hysteresis

3-15 Measurement Setup

Refer to "Making Spectrum Analyzer Measurements" on page 3-8 for basic information on setting up a spectrum measurement. This section provides setup information for the Spectrum measurement.

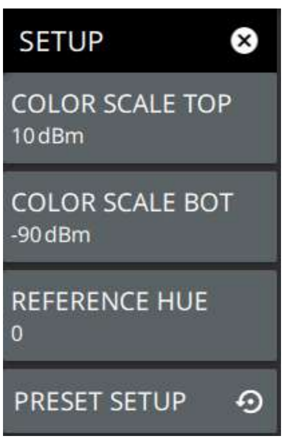
SETUP Menu (Spectrum View)



There are no advanced measurement setups for the basic spectrum analyzer measurement.

Figure 3-38. SETUP Menu (Spectrum)

SETUP Menu (Spectrogram View)



COLOR SCALE TOP: Defines the amplitudes where the top color on the color setup bar are applied. Any measurement above this amplitude will appear black on the spectrogram window.

COLOR SCALE BOT: Defines the amplitudes where the bottom setting colors on the color setup bar are applied. Any measurement below this amplitude will appear black on the spectrogram window.

REFERENCE HUE: Allows you to customize the Spectrogram color range (Color Bar) and Hue values. The color limits and the reference hue are based on a 360-degree color wheel where default 0 is red (255 0 0).

PRESET SETUP: Presets the color setup settings.

Figure 3-39. SETUP Menu (Spectrogram View)

Refer to the sections below for additional setup menus when using other measurement settings:

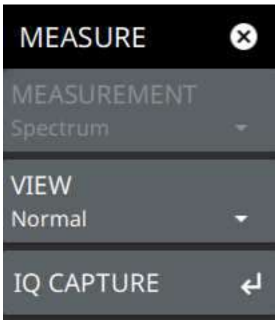
- "SETUP Menu (Channel Power)" on page 3-51
- "SETUP Menu (Occupied BW)" on page 3-53
- "SETUP Menu (ACP)" on page 3-55
- "SETUP Menu (SEM)" on page 3-57
- "SETUP Menu (Interference Finder)" on page 3-60
- "Spectrum Emission Mask Measurement Basic Setup" on page 3-57

3-16 Setting Up Advanced Measurements

The spectrum analyzer features smart measurements for setting up occupied bandwidth, channel power, adjacent channel power, and spectral emission mask tests. The following sections present brief examples demonstrating the use of these measurements.

From the MEASURE menu, select one of the desired measurements.

MEASURE Menu (Spectrum)



MEASUREMENT: Selects the desired measurement type from the following list:

- **Spectrum:** Displays the frequency domain spectrum measurement.
- **Channel Power:** The channel power table and channel lines are added to the measurement display. Refer to Section 3-17 “Channel Power” on page 3-50.
- **OBW:** The occupied bandwidth table and channel lines are added to the measurement display. Refer to Section 3-18 “Occupied Bandwidth” on page 3-52.
- **ACP:** The ACP table and channel lines are added to the measurement display. Refer to Section 3-19 “Adjacent Channel Power” on page 3-54.
- **SEM:** The spectrum emissions mask table and a spectrum mask is added to the measurement display. Refer to Section 3-20 “Spectrum Emission Mask” on page 3-56.
- **Interference:** Available when Option 24 is installed. The input parameters and channel measurements tables, max/min level lines, and total channel power signal indicator are added to the measurement display. Refer to Section 3-21 “Interference Finder” on page 3-59.
- **EMF Measurement:** Available when Option 444 is installed. The EMF measurement and information tables are added to the measurement display. Refer to Section 3-23 “Electromagnetic Field (EMF) Measurements (Option 444)” on page 3-65.

VIEW: Selects the desired measurement view from the following list:

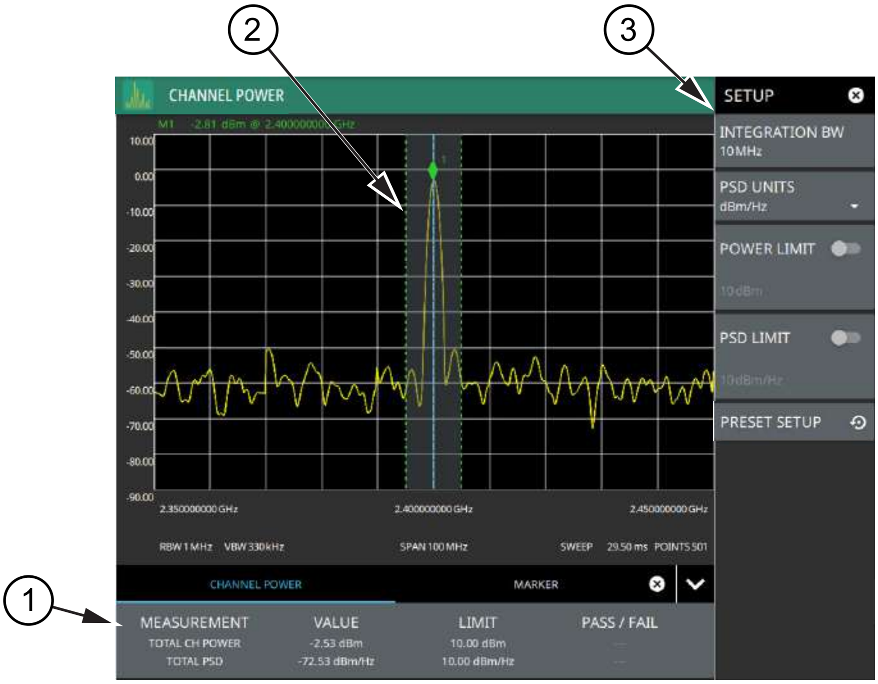
- **Normal** Spectrum View
- **Spectrogram** selects Spectrogram view. When selected, a Spectrogram view is added to the display. Spectrogram is only available when the MEASUREMENT is set to Spectrum.

IQ CAPTURE: Opens the “IQ CAPTURE Menu” on page 7-8. Refer to Chapter 7, “IQ Capture/Streaming (Option 124/126 and 125/127)” for discussion of IQ Capture and Streaming.

Figure 3-40. MEASURE Menu

3-17 Channel Power

Channel power measurements are set up using the "SETUP Menu (Channel Power)" on page 3-51. Channel power measurement is one of most common measurements for a radio transmitter. This test measures the output power, or channel power, of a transmitter over the frequency range. Out-of-specification power measurements indicate system faults, which can be in the power amplifiers or in filter circuits. Channel Power measurements can be used to validate transmitter performance, comply with government regulations, or to keep overall system interference at a minimum.



1. Channel power measurement results are shown in a table at the bottom of the display.
2. Dashed vertical lines and a shaded region define the main channel integration bandwidth.
3. All channel power measurement parameters are set via the SETUP menu.

Figure 3-41. Channel Power Measurement

Frequency and span settings for many signal standards can be set as follows:

1. Press MEASURE on the main menu.
2. Select Channel Power from the MEASUREMENT button.
3. Press SETUP and then do the following:
    - Set the channel INTEGRATION BW (bandwidth).
    - Select PSD UNITS (dBm/Hz or dBm/MHz).
    - Toggle and set the POWER LIMIT and PSD limit testing if you wish to see pass/fail test results.

Channel Power is a constant measurement; after it is turned on, it remains on until a different measurement is selected or the sweep is paused. Channel Power is calculated at the end of each sweep.

SETUP Menu (Channel Power)

The channel power SETUP menu is available in MEASURE > MEASUREMENT > Channel Power > SETUP. Once the channel power measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.

INTEGRATION BW: Sets the range of integration used in calculating the power in the channel. The integration bandwidth (IBW) is displayed as the shaded region between the bandwidth start and stop thresholds (dashed green lines).

PSD UNITS: Sets the unit bandwidth for power spectral density. The available units are dBm/Hz and dBm/MHz.

POWER LIMIT: The power limit is the threshold value used to determine whether the actual measured channel power will pass or not. If the measured channel power exceeds the set power limit, the channel power test fails; otherwise, the test passes. Pass/fail test results are shown in the measurement results table.

PSD LIMIT: If the power spectral density limit is on, the PSD Limit is the threshold value used to determine whether the actual measured PSD will pass or not. If the measured PSD exceeds the PSD Limit, the PSD test fails; otherwise the test passes.

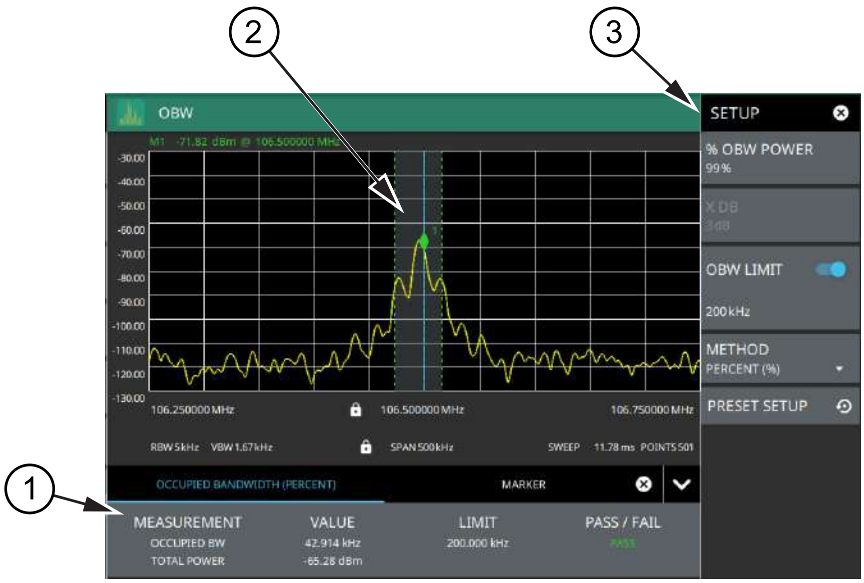
PRESET SETUP: Sets all channel power setup parameters to default. Turns off limits.

Figure 3-42. SETUP Menu (Channel Power)

3-18 Occupied Bandwidth

Occupied bandwidth measurements are set up using the "SETUP Menu (Occupied BW)" on page 3-53. Occupied Bandwidth (OBW) is a common measurement performed on radio transmitters. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending on the technique used to modulate the carrier.

- **% Integrated Power Method:** The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.
- **> dBc Method:** The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is a desired number of dB below the peak carrier level.



1. Occupied bandwidth measurement results are shown in a table at the bottom of the display.
2. Dashed vertical lines and a shaded region define the main channel.
3. All occupied bandwidth measurement parameters are set via the SETUP menu.

Figure 3-43. Occupied Bandwidth Measurement

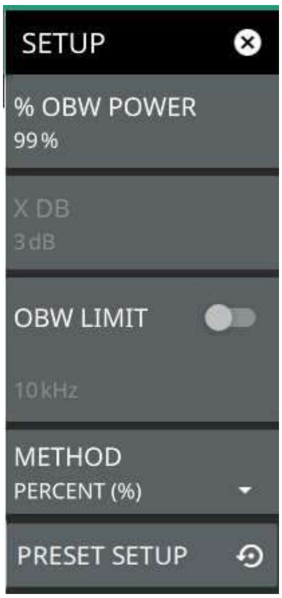
Frequency and span settings for many signal standards can be set as follows:

1. Press MEASURE on the main menu.
2. Select OBW from the MEASUREMENT button.
3. Press SETUP and then do the following:
    - Set the % OBW power or set X DB (dBc) power value
    - Select the METHOD (Percent (%) or dBc (X DB)
    - Toggle OBW limit testing if you wish to see pass/fail test results

Occupied bandwidth is a constant measurement; after it is turned on, it remains on until a different measurement is selected or the sweep is paused. OBW is calculated at the end of each sweep.

SETUP Menu (Occupied BW)

The occupied bandwidth SETUP menu is available in MEASURE > MEASUREMENT > OBW > SETUP. Once the OBW measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.



% OBW POWER: Sets the percentage of the total power that is measured within the occupied bandwidth for the current measurement. The resulting occupied bandwidth and total power values are displayed in the measurements results table.

X dB: Sets the x dB value used for the "x dB bandwidth" measurement. The occupied bandwidth is the frequency range between two points on the signal that are x dB down from the highest signal point within the OBW span.

OBW LIMIT: Enables limit checking at the specified frequency. The limit test results show as a green PASS or a red FAIL in the measurement table.

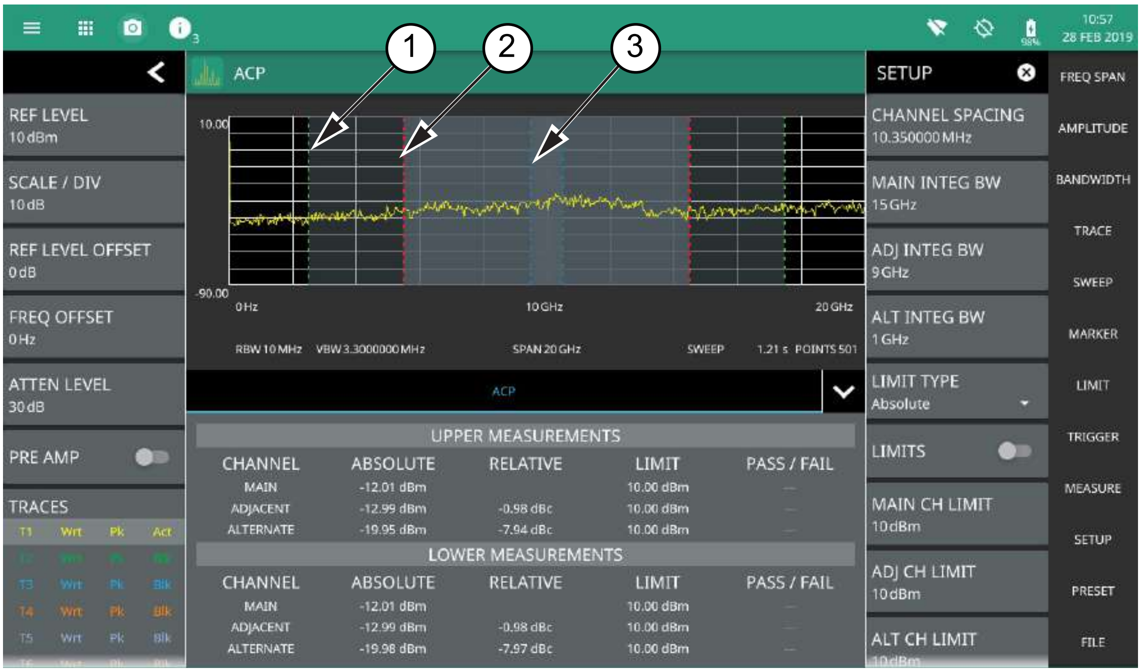
METHOD: Select the measurement method to be PERCENT (%) or X (dB).

PRESET SETUP: Sets all OBW setup parameters to default. Turns off limits.

Figure 3-44. SETUP Menu (Occupied BW)

3-19 Adjacent Channel Power

Adjacent Channel Power (ACP) measurements are set up using the "SETUP Menu (ACP)" on page 3-55. Adjacent channel power is a measure of the power that leaks into adjacent transmit channels. The ACP measurement measures the power present in the transmit channel (refer to "Channel Power" on page 3-50) along with the adjacent transmit channels that have been configured in the SETUP menu.



1. Green integration bandwidth edge of lower alternate channels.
2. Red integration bandwidth edge of lower adjacent and alternate channels.
3. Blue integration bandwidth edge of lower main and adjacent channels.

Figure 3-45. Adjacent Channel Power Ratio Measurement

Frequency and span settings for many signal standards can be set as follows:

1. Press MEASURE on the main menu.
2. Select ACP from the MEASUREMENT button.
3. Press SETUP and then do the following:
    - Channel spacing
    - Main integration bandwidth
    - adjacent integration bandwidth
    - alternate integration bandwidth
    - Limit testing
    - Main channel limit
    - adjacent channel limit
    - alternate channel limit

Adjacent channel power is a constant measurement; after it is turned on, it remains on until a different measurement is selected or the sweep is paused. ACP is calculated at the end of each sweep.

SETUP Menu (ACP)

The Adjacent Channel Power SETUP menu is available in MEASURE > MEASUREMENT > ACP > SETUP. Once the ACP measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.

CHANNEL SPACING: Sets the channel frequency spacing (center channel to center channel).

MAIN INTEG BW: Sets the range of integration used in calculating the power within the channel. The integration bandwidth (IBW) is displayed as two vertical dashed lines for each channel.

ADJ INTEG BW: Sets the range of integration bandwidth used in calculating the power in the adjacent channel.

ALT INTEG BW: Sets the range of integration used in calculating the power in the alternate channel.

LIMIT TYPE: Selects Absolute or Relative for the limit evaluation.

LIMITS: Turns on or off the use of ACP limits.

MAIN CH LIMIT: Sets the main channel limit.

ADJ CH LIMIT: Sets the adjacent channel limit.

ALT CH LIMIT: Sets the alternate channel limit.

PRESET SETUP: Sets all ACP setup parameters to default. Turns off limits.

Figure 3-46. SETUP Menu (ACP)

3-20 Spectrum Emission Mask

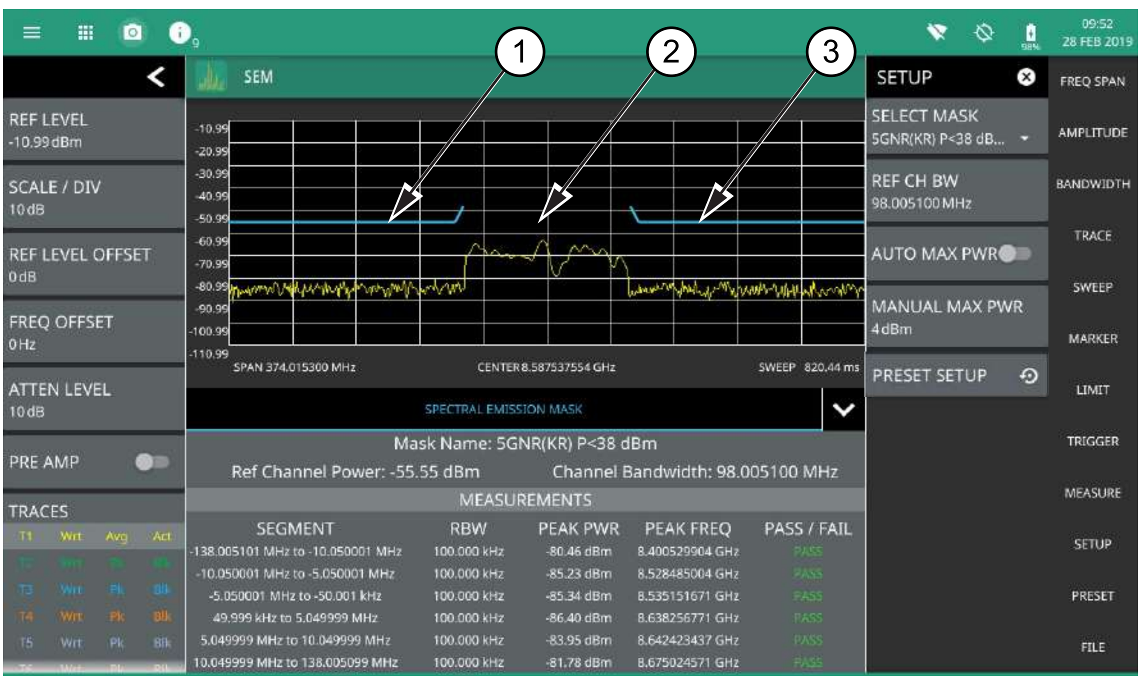
The spectrum emission mask (SEM) measurement is a relative measurement method to identify the power level of out-of-band spurious emissions outside of the in-channel bandwidth signal. The SEM measures the power ratio between in-band and adjacent channels. The SEM measurement then identifies the emissions that interfere with other channels. Then, the spurious signal levels of pairs of offset frequencies are identified and related to the carrier power.

The spectral emission mask measurement supports the testing for “Operating Band Unwanted Emissions” described in the 3GPP base station conformance testing document. There is support for 5GNR masks which are automatically built based on the current carrier frequency/channel and BW values. Masks with the (KR) designation in the title are built according to Korean regulator standards for FR1 signals. The instrument indicates if the signal is within the specified limits by displaying PASS or FAIL. The emission mask information is also displayed in a table format with different frequency ranges and whether the signal PASSED/FAILED in that region.

Measurement parameters are set up using the “SETUP Menu (SEM)” on page 3-57. Selecting the SEM measurement does the following:

- Disables all other measurements
- Adds a predefined 5GNR emission mask
- Sets the span to the mask width
- Sets the detection method to RMS

A spectrum emission mask measurement showing the 5GNR P<38 dBm mask setting is illustrated in Figure 3-47.



1. SEM Mask
2. Spectrum Emission
3. SEM Mask

Figure 3-47. SEM Measurement

Spectrum Emission Mask Measurement Basic Setup

1. Select MEASURE > MEASUREMENT > SEM from the right side menu.
2. Select SETUP and select upper or lower mask (5GNR P>38 dBm or 5GNR P<38 dBm).
3. Enter the reference channel bandwidth.
4. Toggle AUTO MAX PWR or set MANUAL MAX POWER.
5. The SEM measurement results are displayed in a table with pass/fail results.

SETUP Menu (SEM)

SELECT MASK: Selects the desired upper or lower emission mask:

- 5GNR P < 38 dB
- 5GNR P > 38 dB
- Custom

IMPORT MASK: Used to import a custom user mask.

EXPORT MASK: Exports an example user mask as a comma separated value file (see “Example Custom Signal Emission Mask” on page 3-57) or exports the currently selected custom mask.

REF CH BW: Sets the reference channel bandwidth for the measurement.

AUTO MAX PWR: Toggles automatic max power. Some segments in the mask are dependent on the main channel power. Enabling this automatically calculates the reference channel power by measuring the channel power of the center channel bandwidth. When disabled, the reference power must be entered manually below.

MANUAL MAX PWR: Used to manually enter the reference channel power for masks that have limits dependent on main channel power.

PRESET SETUP: Presets all values on the SETUP menu to default values.

Figure 3-48. SETUP Menu (SEM)

Example Custom Signal Emission Mask

To create a custom SEM, use the following steps:

1. Export the existing mask as a csv file by pressing the EXPORT MASK button in the SEM SETUP menu.
2. From the FILES menu, move the exported file to a USB device and then to a computer for editing.
3. If this is the first time exporting the file, the following data should be in the file:

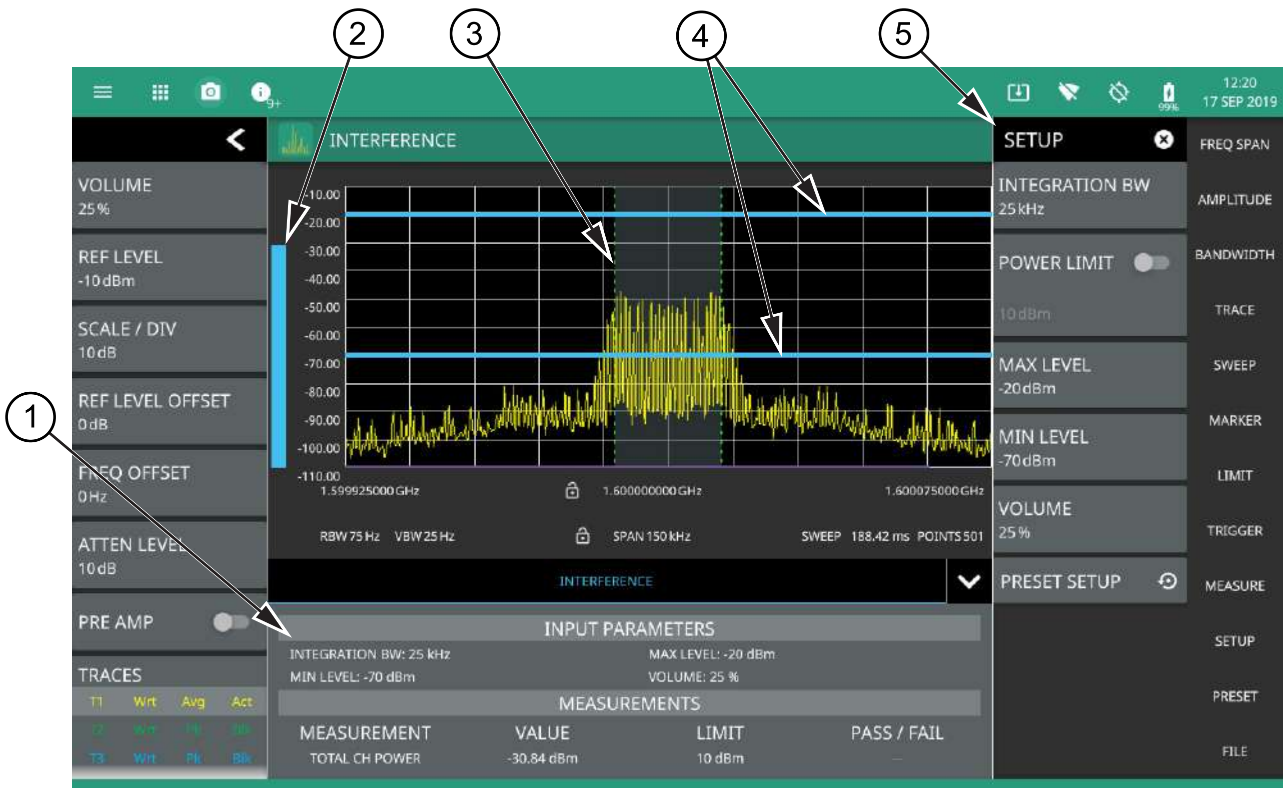
```
# Example Custom Signal Emission Mask
# Start Frequency, Stop Frequency, RBW, VBW, Is Start Amplitude Relative, Is Stop Amplitude Relative, Start Amplitude, Stop Amplitude
-3.5e6, -2.1e6, 100e6, 100e6, 0, 0, -9.5, -9.5
-2.1e6, -0.7e6, 100e6, 100e6, 0, 0, -9.5, 0.5
0.7e6, 2.1e6, 100e6, 100e6, 0, 0, 0.5, -9.5
2.1e6, 3.5e6, 100e6, 100e6, 0, 0, -9.5, -9.5
```

4. Change each of the values as desired. Note that the values must be entered in the listed order of the file header.

5. Save the file to a USB device and insert it into the MS2090A.
6. Press the IMPORT MASK button in the SEM SETUP menu and select the new file from the USB drive. The file name of the imported mask file will be displayed on the EXPORT MASK button.
7. Press the SELECT MASK button and select Custom.

3-21 Interference Finder

The interference finder measurement is set up using the "SETUP Menu (Interference Finder)" on page 3-60. The interference finder measurement is used in conjunction with a directional antenna to locate the direction of an interfering signal. This test measures the integrated power of a received signal over a specified frequency range. During the measurement, the instrument emits an audio tone that coincides with the power of the received signal. As the antenna is pointed toward the signal source, the signal level increases further into the set MAX and MIN level, and the audio increases in pitch. An example of a frequency modulated interfering signal is shown in the figure below.



1. Interference setup parameters and measurement results are shown in a table at the bottom of the display.
2. A vertical bar corresponds to the received signal strength within the integration bandwidth.
3. Dashed vertical lines and a shaded region define the received channel integration bandwidth.
4. Horizontal blue lines define the audio response range for the measurement.
5. All signal power measurement parameters are set via the SETUP menu.

Figure 3-49. Interference Finder Measurement

Frequency and level settings for many interfering signals can be set as follows:

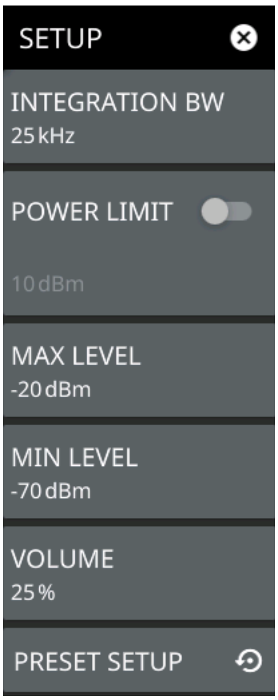
1. Press MEASURE on the main menu.
2. Select Interference from the MEASUREMENT button.
3. Press SETUP and then do the following:
   - Set the signal INTEGRATION BW (bandwidth).
   - Toggle and set the POWER LIMIT if you wish to see pass/fail test results.
   - Set the MAX LEVEL and MIN LEVEL for the audio pitch response of the measurement. Note that these settings can also be dragged into position using the indicator bars in the display panel.
   - Set the desired volume level. Note that the audio level can also be set from the left side status menu.

Interference Finder is a constant measurement; after it is turned on, it remains on until a different measurement is selected or the sweep is paused. Signal power and a corresponding audio pitch is calculated at the end of each sweep.

Note	Some directional antennas have a narrower null than their forward beam width; therefore, it may be more precise to find the null at the back of the directional antenna to determine the direction of the interfering signal. In this case, you would look for the lowest signal level and the corresponding audio would have the lowest pitch.

SETUP Menu (Interference Finder)

The interference finder SETUP menu is available in MEASURE > MEASUREMENT > Interference > SETUP. Once the interference measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.



INTEGRATION BW: Sets the range of integration used in calculating the received power. The integration bandwidth is displayed as the shaded region between the bandwidth start and stop thresholds (dashed green lines).

POWER LIMIT: The power limit is the threshold value used to determine whether the actual measured channel power will pass or not. If the measured channel power exceeds the set power limit, the channel power test fails; otherwise, the test passes. Pass/fail test results are shown in the measurement results table.

MAX LEVEL: Sets the upper level for the audio response of the measurement. This setting is useful for adjusting the resolution of the tone changes. Power levels above the MAX LEVEL will continue to emit sound an increasingly higher pitch.

MIN LEVEL: Sets the lower level for the audio response of the measurement. The MIN LEVEL also functions as a squelch. Power below this level will not emit a sound.

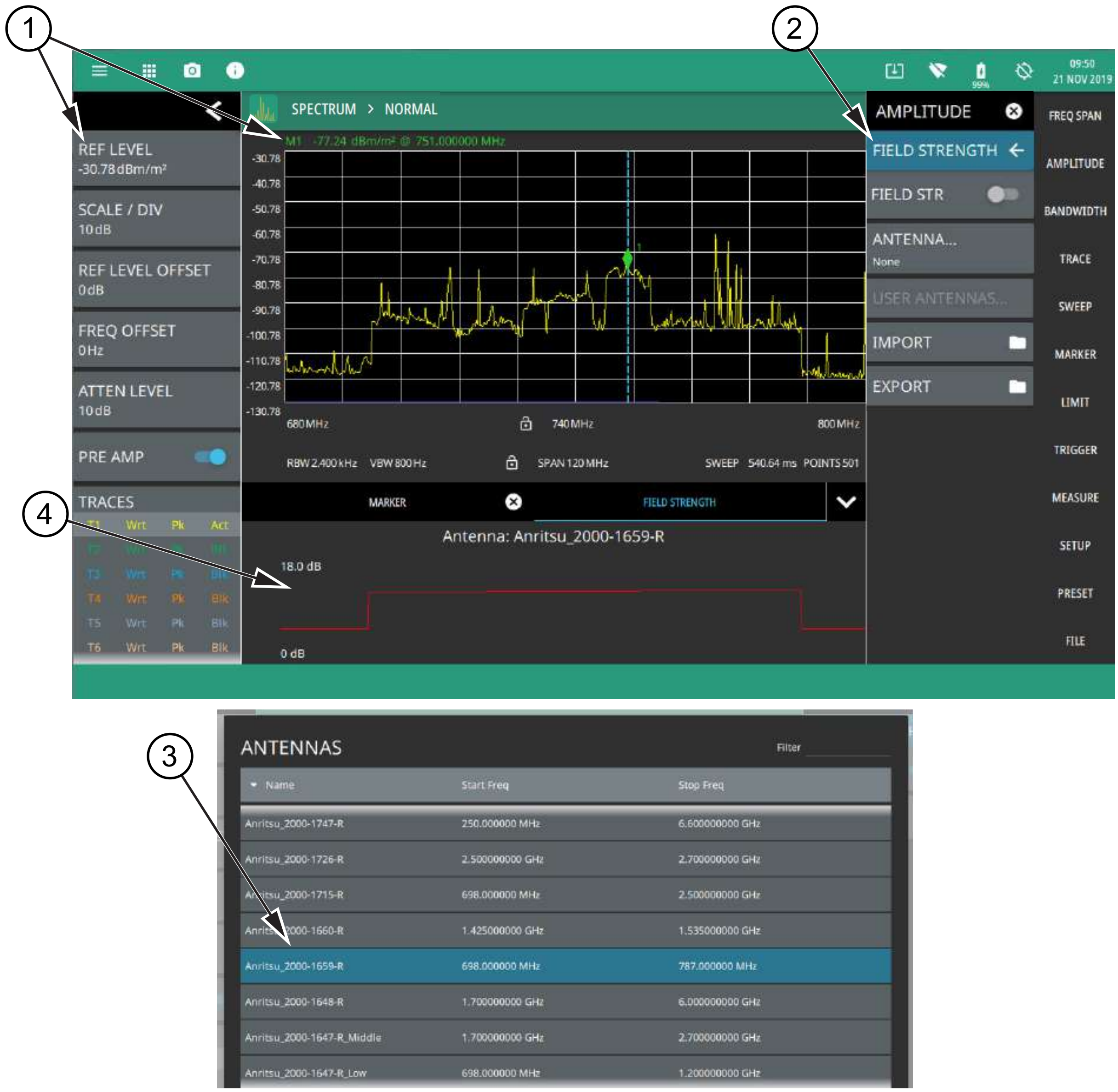
VOLUME: Sets the volume level for the audio response of the measurement. Note that the master volume can affect the range of this setting. Refer to Section 3-21 “Interference Finder” on page 3-59.

PRESET SETUP: Sets all channel power setup parameters to default. Turns off limits.

Figure 3-50. SETUP Menu (Interference Finder)

3-22 Field Strength

The field strength measurement is selected using the “AMPLITUDE FIELD STRENGTH Menu” on page 3-62. The field strength measurement is used in conjunction with an Anritsu antenna that has known antenna factors. Users can also import custom antenna factors for antennas not listed on the standard antenna selection list. When the field strength measurement is enabled, an additional plot is shown at the bottom of the display, indicating the selected antenna factor over the currently set frequency span. The field strength measurement is a measure of the RF power density that automatically compensates for the selected antenna factor. If an antenna is not selected, then the antenna gain is assumed to be 0 dB over the entire measurement range and the measurement can be manually compensated for using the “Antenna Calculations” on page 3-64, or to otherwise convert from one unit of measure to another.



1. When the field strength measurement is enabled (2), all amplitude units are converted to display field strength units (dBm/m^2 or dBW/m^2).
2. The field strength measurement and antenna is selected from the Amplitude menu.
3. The ANTENNAS dialog is displayed when ANTENNA is selected from the FIELD STRENGTH menu (2).
4. The antenna factor profile (in dB) is plotted across the currently set sweep range for the selected antenna.

Figure 3-51. Field Strength Measurement

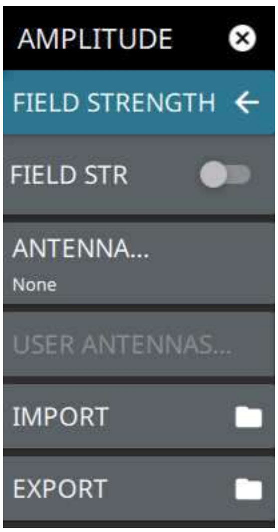
Frequency and level settings for many interfering signals can be set as follows:

1. Set up the measurement frequency and bandwidth.
2. Press the AMPLITIDE and set up the amplitude parameters.
3. Press the FIELD STRENGTH button and enable FIELD STR.
4. Press the ANTENNA button and select the antenna being used for the measurement.

Field strength is a constant measurement; after it is turned on, it remains on until FIELD STR is toggled off.

AMPLITUDE FIELD STRENGTH Menu

The FIELD STRENGTH menu is available in AMPLITUDE > FIELD STRENGTH. Once the field strength measurement is enabled, the FIELD STRENGTH menu can be quickly accessed by tapping on the Antenna factor display area below the spectrum window.



FIELD STR: Toggles the field strength measurement on or off. When toggled on, the trace detector type is set to RMS/Avg and the antenna factor profile is displayed.

ANTENNA: Displays the antenna selection dialog (see Table 3-51 on page 3-61).

USER ANTENNAS... Displays a list of user antennas. User antenna files are imported as comma separated value files. The file can contain multiple antennas and must conform to the following:

- Each antenna name must be unique, contain alpha-numeric characters only, and must be on a single line.
- Frequency must be in MHz.
- Antenna factors must be in dB.

IMPORT: Imports a user antenna file (.csv).

EXPORT: Exports a user antenna data file (.csv). If none exist, exports an example user antenna data file with instructions on how to create a usable antenna data file.

Figure 3-52. FIELD STRENGTH Menu

Example User Antenna Data

To create a list of custom antenna factors, use the following steps:

1. Export the existing USER ANTENNAS csv file by pressing the EXPORT button in the FIELD STRENGTH menu.
2. From the FILES menu, move the exported file to a USB device and then to a computer for editing.

3. If this is the first time exporting the file, read the instructions at the top of the file, then delete those rows:

```
**
This is an EXAMPLE. Make sure to REPLACE and DELETE all existing content in
this file, including these instructions.
Accepted criteria:
Each Antenna name must be unique, contain alpha-numeric characters only, and
must be on a single line
Frequency must be in MHz
Factors must be in dB
Please use the following examples as a guide:
**
```

4. Name each custom antenna and add cal factors below, per the instructions in the header:

```
Antenna_Example1
1920  35.886
1930  35.931
1940  35.976
1950  36.021
1960  36.065
1970  36.109
1980  36.153
Antenna_Example2
2110  36.706
2120  36.747
2130  36.788
2140  36.828
2150  36.869
2160  36.909
2170  36.949
```

5. Save the file to a USB and insert it into the MS2090A.
6. Press the IMPORT button in the FIELD STRENGTH menu and select the new file from the USB drive.
7. Now all the antennas in the imported file will appear in the list when pressing the USER ANTENNAS… button.

Antenna Calculations

This section provides a list of various antenna calculations to convert from one unit of measure to another.

Definitions

P = power in watts

V = voltage level in volts

R = resistance in ohms

Note that 1 mW = 10^{-3} W and 1 µV = 10^{-6} V

E = field strength in V/m

H = magnetic field strength in A/m

Z_0 = characteristic impedance of vacuum, 120π ohm ~ 377 ohm

P_d = Power density in W/m^2

r = distance from antenna in meters

AF = antenna factor, ratio of incident electromagnetic field to the output voltage

A_e = antenna equivalent area

g = antenna gain as power ratio

G = antenna gain in dBi

C_0 = speed of light in vacuum, 299,792,458 m/s

Equations

$P = V^2/R$

$V_{dB\mu V} = P_{dBm} + 107\ dB$

$A_e = g(\lambda^2/4\pi)$

$G = 10*\log(g)$

$g = 10^{G/10} = (9.73/\lambda 10^{AF/20})^2$

$f = C_0/\lambda$

$P_r = A_e P_d$

$P_d = P_t G_t/(4\pi r^2)$ (Power density at a point)

$P_d = E^2/Z_0 = E^2/120\pi = Z_0 H^2$

$E = Z_0 H = \sqrt{(P_d 120\pi)}$

$AF = 20*\log(9.73/\lambda\sqrt{g})$

The field strength equations are only valid in the far field, where electric and magnetic fields are related by the characteristic impedance of free space.

3-23 Electromagnetic Field (EMF) Measurements (Option 444)

This section describes the Electromagnetic Field (EMF) measurement functions available with Option 444. Option 444 must be used in conjunction with an Anritsu isotropic antenna at a frequency range that is within specification of the instrument and antenna used. Refer to your technical data sheet for compatible antennas.

For broadband EMF Meter compliance testing, refer to Chapter 8, "EMF Meter Measurements (Option 445)".

Note	EMF measurements require that an Anritsu EMF isotropic antenna is connected to the analyzer and that the frequency range and span is set within the operating range of the antenna.

Connecting the Antenna

1. Connect the antenna RF connector to the **RF In** port on the instrument. See Figure 3-53. The antenna connector must be *finger* tight.
2. Connect the antenna USB connector to one of the top panel USB Type A ports.
3. Set up a spectrum analyzer measurement for your signal and bandwidth of interest. The frequency range and span must be set within the operating range of the antenna.
4. While in Spectrum Analyzer mode, press MEASURE > MEASUREMENT > EMF Measurement.

The instrument is now ready to set up and start an EMF measurement.

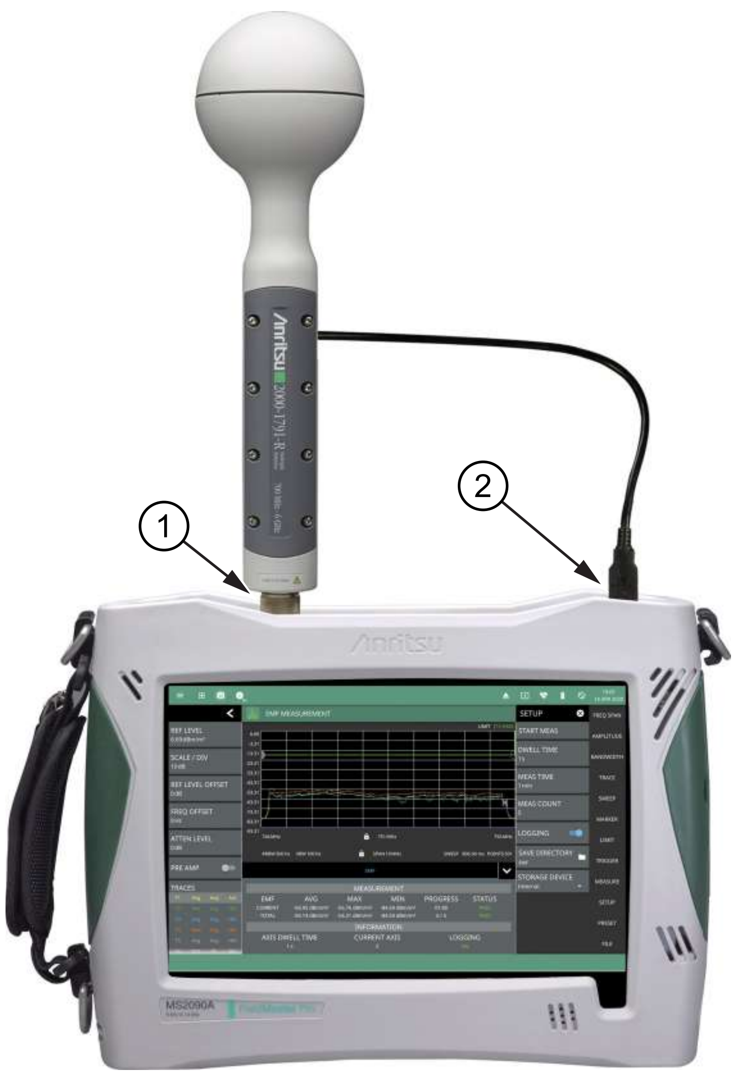
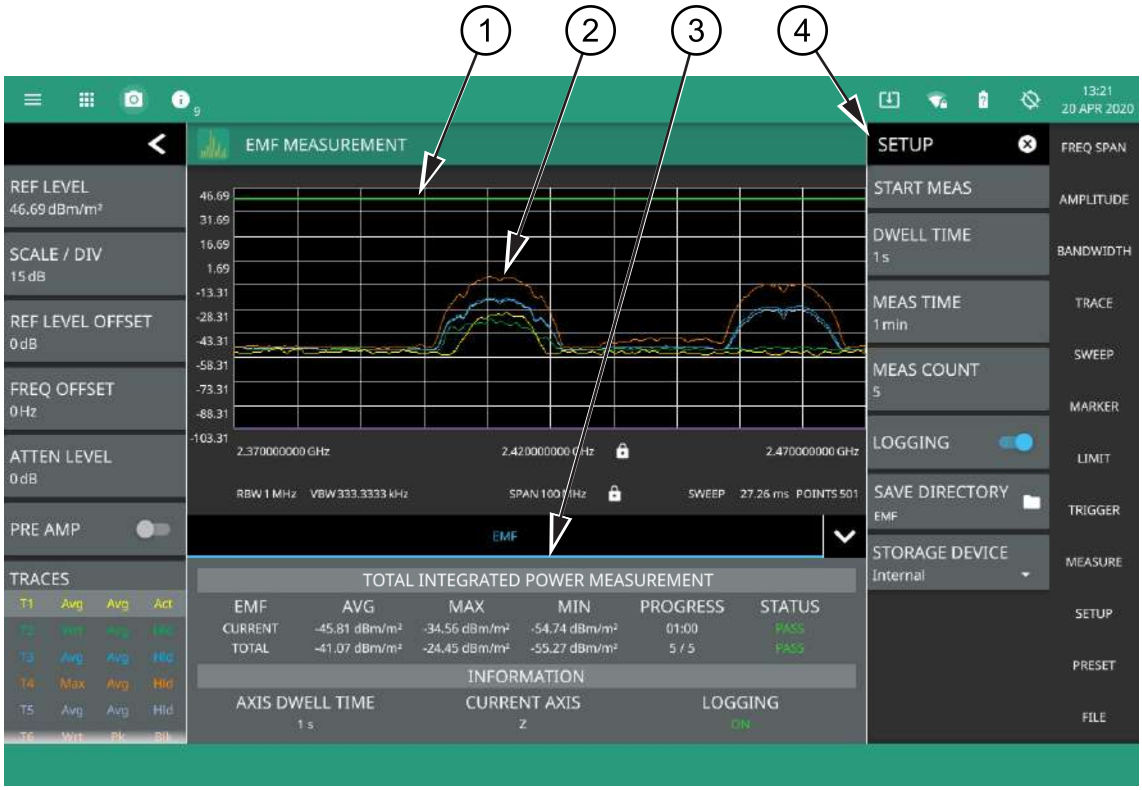


Figure 3-53. Isotropic Antenna Connection

EMF measurements are set up using the "SETUP Menu (EMF Measurement)" on page 3-67. After completing the data collection for the three axes (X, Y, and Z), the isotropic result is calculated and displayed. In addition to the traces displayed on the user interface (axis sweep data, current isotropic result, and average and max isotropic result), the max, min, and average of the total integrated power of the isotropic result over time is computed and displayed in the table below the graph region. The CURRENT values are calculated over the elapsed measurement time and the TOTAL values are calculated over the entire measurement time and total number of measurements.



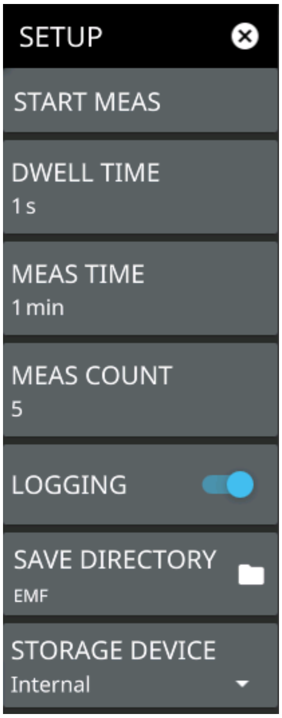
1. EMF measurement pass/fail status uses a limit line for the test criteria. You can use either a custom limit line or toggle the International Commission on Non-Ionizing Radiation Protection limit. Either limit supports the same features as in the spectrum analyzer mode. See "LIMIT Menu" on page 3-42.
2. The trace display area shows traces for the following measurements in units of dBm/m^2:
   - Trace 1: Current axis sweep data
   - Trace 2: Current isotropic result
   - Trace 3: Average isotropic result
   - Trace 4: Maximum isotropic result
   - Trace 5: Total average isotropic result

   Note that trace detectors, trace averaging, and amplitude units settings are disabled for the EMF measurement.
3. Tabular measurement data shows the current and total EMF measurement results, the current test progress, and the pass/fail status. The information area shows the axis dwell time, the current axis being measured, and the data logging state.
4. The SETUP menu is where the EMF measurement settings are configured. See "SETUP Menu (EMF Measurement)" on page 3-67.

Figure 3-54. EMF Measurement

SETUP Menu (EMF Measurement)

The EMF measurement SETUP menu is available in MEASURE > MEASUREMENT > EMF Measurement > SETUP. Once the EMF measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.



START MEAS: Initiates an EMF measurement. Once the measurement is started, all UI interface is locked until the measurement is complete. A pop-up control appears that allows you to immediately stop the measurement. Note that a valid antenna must be connected and a supported frequency range must be set before a measurement can be started. Note that the START MEAS button also appears on the MEASURE menu and provides the same functionality.

DWELL TIME: Specifies the time spent on each axis. The sweeps are averaged and saved for further computation.

MEAS TIME: Sets the duration of each EMF measurement from one minute up to 30 minutes. The default is 6 min. For example, if the axis dwell time is set to 1 s and the measurement time is 1 min, you will get one isotropic result after 3 s and approximately 20 at the end of the one-minute measurement. The CURRENT row in the summary table at the bottom of the screen displays a running average, and the max and min of the computed total integrated power of the isotropic results every 3 s. The displayed values are computed from all measurements completed thus far within the measurement time. At the end of the measurement time, the CURRENT row is cleared and the TOTAL row is updated with the max, min, and running average of all isotropic results (20 in this example).

MEAS COUNT: Sets the number of EMF measurements to complete from 1 up to 10,000. The EMF test is fully executed when the specified number of measurements have completed.

LOGGING: Logging is toggled on by default. This must be selected prior to starting the EMF measurement for the results to be logged. Each log file can hold 21 measurements for a maximum of 10,000 measurements total. All files for a measurement run will be stored in the same folder with the year, month, day, measurement time and number.

SAVE DIRECTORY: Sets the directory of where the log folders are created.

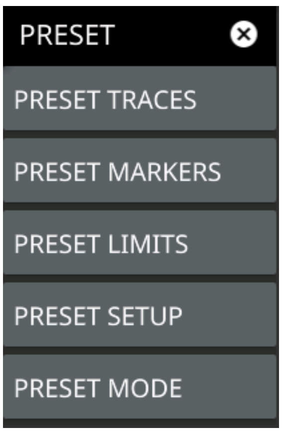
STORAGE DEVICE: Sets the storage location of either Internal memory or an externally connected storage device.

Figure 3-55. SETUP Menu (EMF Measurement)

3-24 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, "Reset Settings" on page 2-35. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting".

PRESET Menu



PRESET TRACES: Presets all trace settings to default values.

PRESET MARKERS: Presets all marker settings to default values. Turns off all markers.

PRESET LIMITS: Presets all values on the LIMIT menu to default values. Turns off all limit lines.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 3-56. PRESET Menu

3-25 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, native trace and CSV trace data, limit line setups, and screenshots. You can recall setup, native trace, and limit line files. For other file operations such as copy, move, and directory management, refer to Section 2-12 “File Management” on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 3-57:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

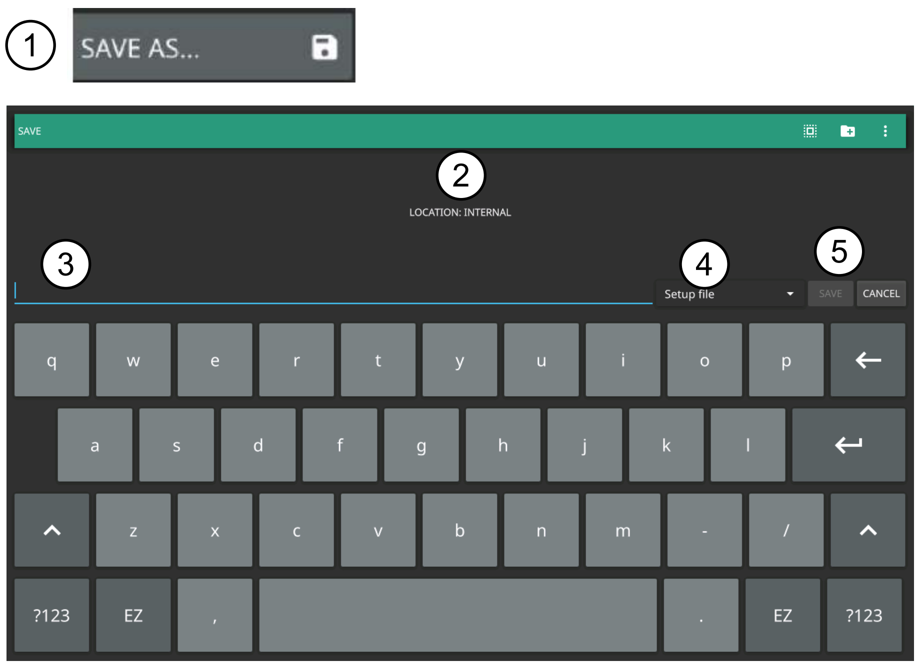


Figure 3-57. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 3-58:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

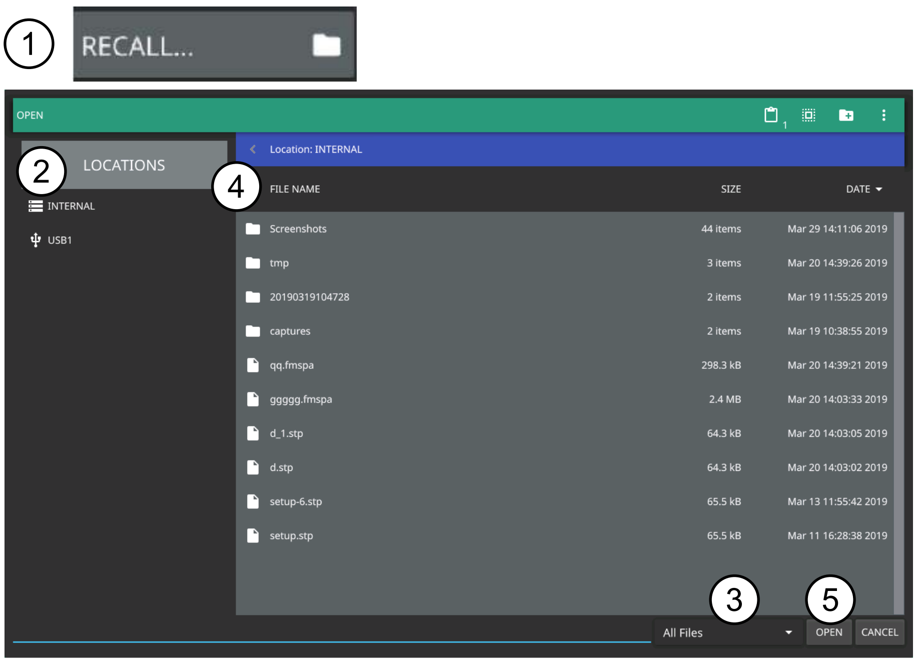


Figure 3-58. File Open Dialog

When a trace measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements, set TRACE > MODE > Active.

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fmspa file type).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Limit: Saves the current limit line point data (lim file type).
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fmspa and png file types).

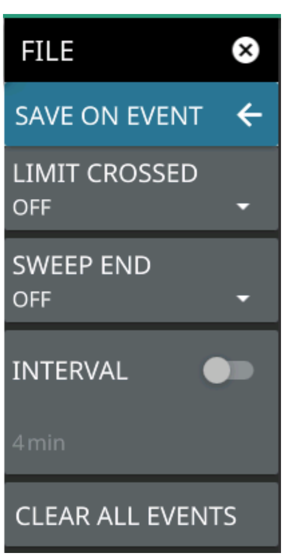
RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled to the appropriate trace. That trace will be in a Hold mode. To exit the recalled data, simply change the trace mode back to Active.

SAVE ON EVENT: Opens the "SAVE ON EVENT Menu" on page 3-71. This feature is not available in the 5GNR/LTE analyzer.

BROWSE FILES: Opens "File Management" on page 2-36.

Figure 3-59. FILE Menu

SAVE ON EVENT Menu



Save on event saves the current trace data to a folder named with the current date and time (yyyymmddhhmmss).

LIMIT CROSSED: When enabled, measurement trace data is automatically saved when the trace crosses a limit line that has been specified in the LIMIT menu. If SINGLE is selected, the first event will be saved and the event will be set to off. If CONTINUOUS is selected, each event will continue to be saved until the user turns it off or the memory is full.

SWEEP END: When enabled, measurement trace data is automatically saved after the current sweep is completed. If SINGLE is selected, the first sweep will be saved and the event will be turned off. If CONTINUOUS is selected, each sweep will continue to be saved until the user turns it off or the memory is full.

INTERVAL: A save will occur periodically. Set the desired period by entering the time.

CLEAR ALL EVENTS: Press this button to turn off all save events at once.

Figure 3-60. SAVE ON EVENT Menu

Chapter 4 — Real-Time Spectrum Analyzer Measurements

4-1 Introduction

This chapter gives a brief overview of the Anritsu Field Master Pro real-time spectrum analyzer and is intended to assist you in your first use of the instrument. The purpose of this chapter is to provide a starting point for making basic measurement setups. This chapter describes general instrument setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, limit lines, and markers. After measurements are taken, refer to Section 2-12 “File Management” and Section 4-18 “Saving and Recalling Measurements” for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

This real-time spectrum analyzer measurements chapter includes sections that describe resolution bandwidth and attenuator functions. For example, in the Field Master Pro, resolution bandwidth is determined by the intermediate frequency (IF) filter bandwidth. The spectrum analyzer traces the shape of the IF filter as it tunes past a signal. If more than one IF filter is used in a spectrum analyzer, then the narrowest one dominates and is considered the resolution bandwidth.

4-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 4-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

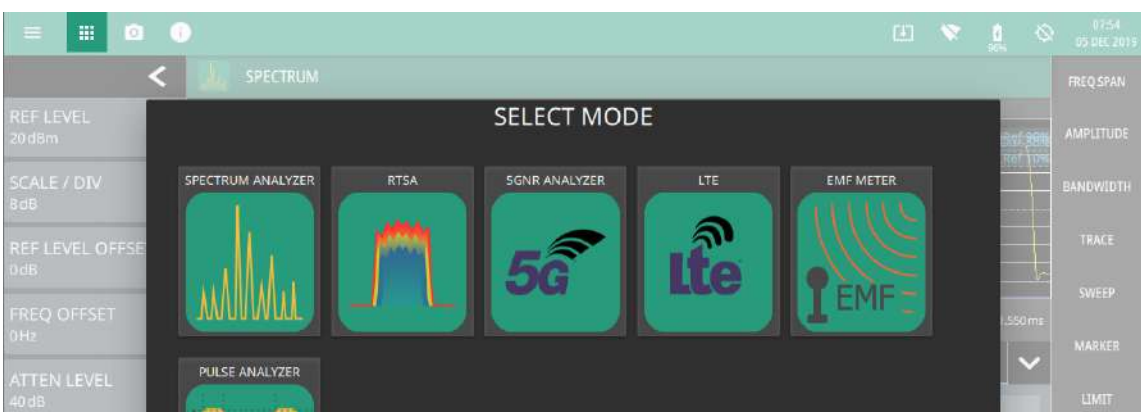


Figure 4-1. Example Analyzers

4-3 RTSA GUI Overview

This section illustrates the main graphical displays and menus presented for the RTSA.

Normal RTSA View

Normal RTSA view is the default view and is suitable for viewing signals in the frequency domain where signal amplitude, bandwidth, and harmonic qualities can be studied. Select normal view from MEASURE > VIEW > Normal. The sample display below is set up with a single trace enabled and with a marker and the upper limit line envelope set.

Figure 4-2. Normal RTSA View (1 of 2)

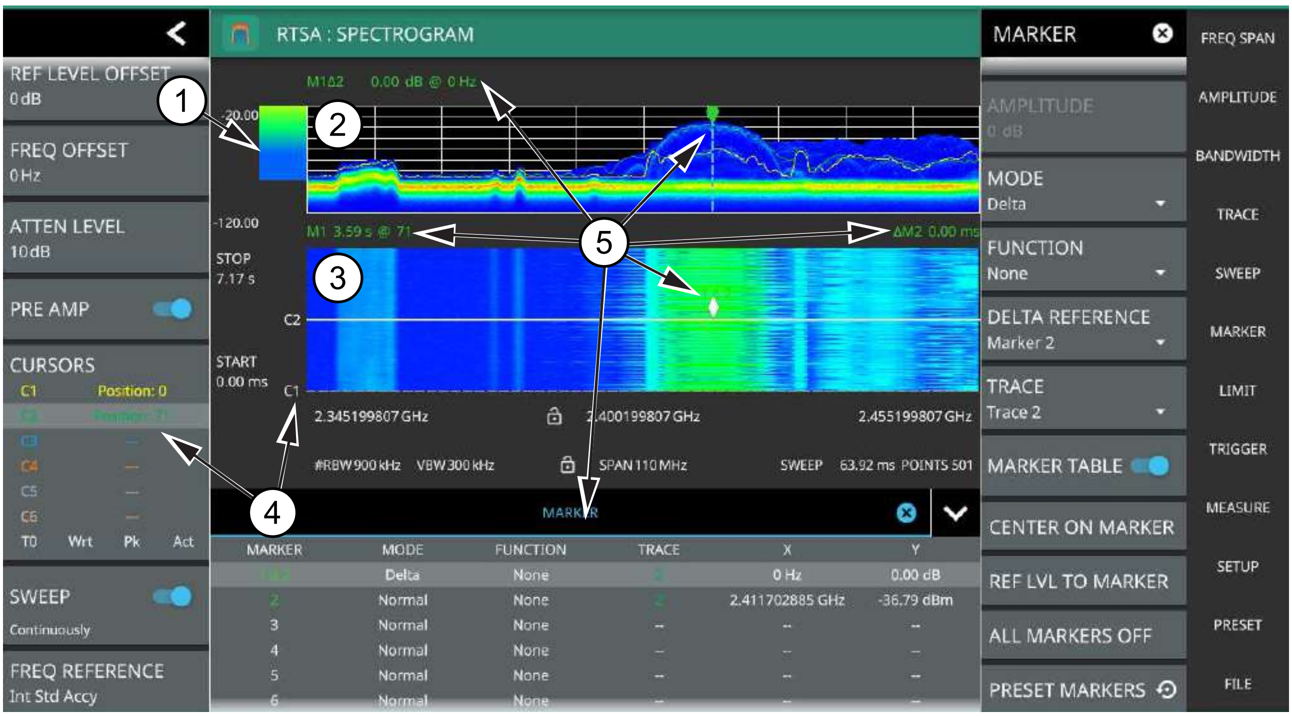
1. **Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings.
2. **Markers:** Markers are displayed as green diamonds on the trace to which they are assigned. The active marker is shown as a solid green diamond with a dashed vertical line. The marker amplitude and frequency will be displayed in green text on the top left edge of the display. In this example, a marker is shown at the signal peak with the marker table enabled. Double tap the marker to open a quick access peak search menu.
3. **Limit Lines:** Limit lines are shown as red (failing) or green (passing) lines with gray circles for each limit line point. Limit lines can be set up point-by-point or by using the envelope feature to quickly set a sloped or square envelope. The currently selected limit line point is shaded in gray. When limit lines are enabled, a pass/fail status is shown in the upper right of the window. If the trace crosses the limit, the trace color will turn red and the limit will indicate a failure. The limit is only applied to the active trace (see Section 4-10 “Setting Trace and Cursor Parameters”), which is indicated next to the pass/fail.
4. **Measurement Settings:** The x-axis shows the start, center, and stop frequencies. The y-axis displays the amplitude of the graticule lines. RBW/VBW, span, sweep time, and number of trace point settings are shown along the bottom of the spectrum display. If either resolution bandwidth or video bandwidth is set to manual, the “#” symbol will precede its label. If an offset frequency is entered, the offset value is displayed in the left side status panel. Pressing any of the editable parameters opens the keypad to edit the value directly. Information-only displays cannot be changed.
5. **Multiple Trace Display:** Each trace has a unique color and each can be set to Clear/Write, Average, Min or Max Hold, Rolling Average, or Rolling Min or Max Hold. Each trace can have Peak, RMS/Average, or Negative detectors. Traces can be set to Active, Hold/View, or Blank.

Figure 4-2. Normal RTSA View (2 of 2)

Spectrogram View

Spectrogram view is useful for identifying intermittent signals and for providing historical signal data in a comprehensive view. It provides a multi-dimensional "waterfall" display representing frequency, time, and amplitude. Frequency and time are shown on a typical two-dimensional scale while amplitude is displayed in the color dimension. The color is set by adjusting the color range of the color bar.

Select Spectrogram view from MEASURE > VIEW > Spectrogram. Once Spectrogram view is selected, the color bar can be configured from the SETUP menu. Refer to Section 4-15 "Measurement Setup" on page 4-41 for more information on setting up the Spectrogram view.



1. **Color Bar:** The color bar is used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, then black is displayed. The color bar top and bottom setting, and the overall hue to the color range is set via the "SETUP Menu" on page 4-41, which can be opened by pressing the color bar.
2. **Spectrum Window:** The upper display area shows spectrum trace data in the frequency domain. Up to six traces can display data from different times depending on how the corresponding cursors are set in the spectrogram display below. Note that the spectrum display shows trace amplitude (vertical axis) data in the time (horizontal axis) domain.
3. **Spectrogram Window:** The lower display area shows spectrogram trace data in the time (vertical axis), frequency (horizontal axis), and amplitude (color) domains. The bottom of the spectrogram displays the current sweep at the current time (0 ms) or position 0. When a sweep completes, the entire display is shifted up and the new trace is added to the bottom of the spectrogram. The spectrogram holds 142 sweeps (cursor positions) and the stop time reflects the time taken to complete all of the sweeps.
4. **Cursors (C1 to C6):** Cursor information for the currently set cursor type (time or position) is shown in the status panel. Cursors are shown on the spectrogram as white lines at the currently set cursor time or position. Refer to "Cursors in Spectrogram View" on page 4-23.
5. **Markers:** Marker and marker data are shown in a variety of locations. Markers can be placed on different cursors to help you compare measurements at different points in time as well as frequency. Refer to "Spectrogram with Cursors and Markers" on page 4-32.

Figure 4-3. RTSA Spectrogram View

4-4 Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 4-7 “Setting Frequency Parameters”.

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 4-8 “Setting Amplitude Parameters”.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 4-9 “Setting Bandwidth Parameters”.

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 4-10 “Setting Trace and Cursor Parameters”.

SWEEP: Provides controls for sweep behaviors. Refer to Section 4-11 “Setting Sweep Parameters”.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 4-12 “Setting Up Markers”.

LIMIT: Provides controls for setting up limit lines and limit alarms. Refer to Section 4-13 “Setting Up Limit Lines”.

TRIGGER: Controls the trigger source, delay and holdoff, and trigger slope settings. Refer to Section 4-14 “Setting Up Triggering”.

MEASURE: Used to select measurements such as spectrum, channel power, occupied bandwidth, adjacent channel power, spectral emissions mask, and opens the spectrogram. Refer to Section 4-15 “Measurement Setup”.

SETUP: Measurement controls for setting up advanced measurements. This menu always displays setting options for the current active measurement (refer to Section 4-16 “Setting Up Advanced Measurements”). When in Spectrogram view, provides access to the spectrogram color SETUP menu (refer to “SETUP Menu” on page 4-41).

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 4-17 “Presetting the Analyzer”.

FILE: Used to save and recall instrument setups and measurements, limit lines, and screen images. Also provides access to save on event controls. Refer to “FILE Menu” on page 4-46 and Section 2-12 “File Management”.

Figure 4-4. Main Menu

Using Menus

Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.

- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

4-5 Status Panel

The status panels and features illustrated in this section are unique to the spectrum analyzer and to the particular measurement and view that is selected. Below is the spectrum analyzer status panel that covers basic spectrum, spectrogram, channel power, occupied bandwidth, adjacent channel power, and spectral emissions mask measurements (selected via MEASURE > MEASUREMENTS menu).

Pressing editable parameters opens the associated menu with a keypad that allows you to conveniently change the parameter value. These are the same settings found in the right side menus.

POI: Probability of Intercept (POI) is the minimum signal duration that the analyzer can detect at full amplitude with 100% probability.

MIN DETECT: The minimum detection is the minimum signal duration that the analyzer can detect.

REF LEVEL: Sets the reference level of the top graticule line. If the reference level offset is not zero, OFFSET REF LEVEL is displayed at this location.

SCALE/DIV: Sets the graticule scale/division.

REF LEVEL OFFSET: Compensates for the presence of external input attenuation or gain. Refer to Section 4-8 “Setting Amplitude Parameters” on page 4-13.

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 4-7 “Setting Frequency Parameters” on page 4-9.

ATTEN LEVEL: When auto attenuation is off, sets input attenuation.

PRE AMP: Toggles the low-noise front-end preamplifier on or off. Refer to Section 4-8 “Setting Amplitude Parameters” on page 4-13.

TRACES/CURSORS: Displays the current status of up to six traces or cursors in a quick-view summary. When the measurement view is set to Normal (Spectrum), trace information is displayed in this area. When the measurement view is set to Spectrogram, cursor information is displayed in this area. Cursors are only available in the Spectrum measurement with the Spectrogram view selected.

The summary information includes the trace or cursor number, type, mode, and detector type. The active trace will show a highlighted background with the mode and detector type restated under the table. In Spectrogram, a reference trace (T0) will show you the settings of the trace used to fill the spectrogram. The reference trace settings are applied to all traces and cursors while in Spectrogram view. Pressing a trace or cursor in the summary panel activates the pressed trace or cursor and opens the TRACE menu. It allows you to select and set up an individual trace or cursor as desired. Refer to Section 4-10 “Setting Trace and Cursor Parameters” on page 4-19.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 4-11 “Setting Sweep Parameters” on page 4-26.

FREQ REFERENCE: Indicates the current frequency reference source of Internal High Accuracy (used after GPS has lost sync, but while the internal clock still has good GPS reference), Internal Standard Accuracy, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 4-5. Spectrum Analyzer Status Panel

4-6 Making RTSA Measurements

Initial Setup

- Connect a signal source to the RF port of the instrument. For over-the-air measurements, connect an antenna that is appropriate for the frequency range to be measured.
- Select the spectrum analyzer. Refer to "Selecting the Analyzer" on page 4-1.
- Connect the input signal or antenna to the RF In test port. For connector descriptions, refer to "Connector Panels" on page 2-3.

Figure 4-6. Field Master Pro Setup

4-7 Setting Frequency Parameters

Frequency-related parameters are set using the "FREQ / SPAN Menu" on page 4-11. The tuning frequency range can be entered in several different ways depending upon what makes the most sense, either for the user or for the measurement. The center frequency and span can be specified, the start and stop frequencies can be entered.

Entering Start and Stop Frequencies

The frequency settings are displayed along the bottom of the spectrum or spectrogram graph. These parameters can be accessed directly or via the FREQ SPAN menu.

1. Press FREQ SPAN on the main menu.
2. Press START FREQUENCY to open the start frequency parameter entry keypad.
3. Enter the desired start frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.
5. Press STOP FREQUENCY to open the stop frequency parameter entry keypad.
6. Enter the desired stop frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
7. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.

Note	To quickly move the start or stop frequency value up or down, press the + or – slider controls to increment the frequency by the set FREQUENCY STEP. You can also drag the frequency using the slider.

The center frequency will be set to exactly the middle of the start and stop frequencies. The current settings are shown along the bottom of the spectrum or spectrogram graph (see Figure 2-6 on page 2-11).

Entering a Center Frequency

1. Press FREQ SPAN on the main menu.
2. Press CENTER FREQUENCY to open the center frequency parameter entry keypad.
3. Enter the desired center frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.

Note	To quickly move the center frequency value up or down, press the + or - slider controls to increment the center frequency by the set FREQUENCY STEP. You can also drag the center frequency using the slider or by dragging the trace directly.

The current settings are shown along the bottom of the spectrum or spectrogram graph (see Figure 2-6 on page 2-11).

Using Offset Frequency

A user-defined frequency offset can be entered to adjust the frequency that is displayed on the instrument from the actual swept frequency. For example, if the DUT is an antenna system receiving signals in the 10 GHz range and offsetting the signals to the 1 GHz range, you can set a frequency offset in the spectrum analyzer in order to display the actual received antenna frequency in the sweep window.

Both positive and negative offset values are allowed. Negative offsets can be useful for seeing differences from expected values. Enter a negative offset of the expected value, and the received antenna frequency should display in the 0 Hz range.

When enabled, the offset value is displayed at the left of the screen in the status panel (see Section 4-5 "Status Panel"). To remove a frequency offset, open the FREQ SPAN menu and set FREQUENCY OFFSET to 0 Hz. You can also access this parameter directly from the left side status panel.

Note	Offset frequency apply to start, stop, center, and marker frequencies.

Setting the Span

1. Press FREQ SPAN on the main menu.
2. Press SPAN to open the span frequency parameter entry keypad.
3. Enter the desired span frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.
5. To select full span, press the FULL SPAN. Selecting full span overrides any previously set start and stop frequencies.

Note	To quickly move the span value up or down, press the + or - slider controls to increment the span in a 1:2:5 sequence. You can also drag the span using the slider or by pinching the trace in or out.

FREQ / SPAN Menu

CENTER FREQUENCY: Sets the center frequency of the sweep range. The current span setting will remain constant or will be adjusted to accommodate the start and stop frequency range of the instrument.

SPAN: Sets the sweep frequency range. The current center frequency will remain constant and the start and stop frequencies will be adjusted to accommodate the new range. Pressing the plus (+) or minus (–) control increments the span value in a 1:2:5 sequence. The span can also be changed by pinching the trace in or out.

FULL SPAN: Pressing this button sets the span to cover the entire tunable spectrum of the instrument.

START FREQUENCY: Sets the start frequency of the sweep range. The center frequency and span will be adjusted to accommodate the new start and current stop frequencies. Pressing the plus (+) or minus (–) control moves the start frequency in steps defined by the FREQUENCY STEP value.

STOP FREQUENCY: Sets the stop frequency of the sweep range. The center frequency and span will be adjusted to accommodate the current start and new stop frequencies. Pressing the plus (+) or minus (–) control moves the start frequency in steps defined by the FREQUENCY STEP value (set lower in this menu).

FREQUENCY STEP: Sets the frequency step value used for the plus (+) or minus (–) control.

FREQUENCY OFFSET: The frequency offset value accounts for frequency conversions outside of the analyzer. The offset frequency value is added to the start, stop, center, fixed marker, and normal marker frequencies. Pressing the plus (+) or minus (–) control moves the offset frequency in steps defined by the FREQUENCY STEP value.

GESTURES: Opens the “GESTURES Menu” on page 4-12.

Figure 4-7. FREQ / SPAN Menu

GESTURES Menu

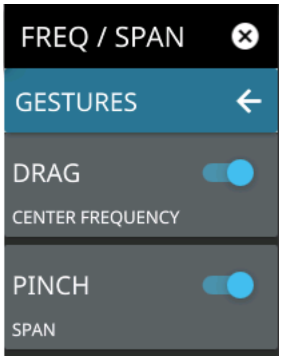
	**DRAG:** Toggles the touchscreen drag feature on or off. When toggled off, the center frequency will not change when dragging the spectrum display. This can be useful when dragging markers. **PINCH:** Toggles the touchscreen pinch feature on or off. When toggled off, the span frequency will not change when pinching the spectrum display. This can be useful when dragging markers. Note that the Drag and Pinch features can also be toggled on/off by touching the locks under the display.

Figure 4-8. GESTURES Menu

4-8 Setting Amplitude Parameters

Amplitude-related parameters are set using the “AMPLITUDE Menu” on page 4-15.

Setting Amplitude Reference Level

The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to “Indications of Excessive Signal Level” on page 4-14). To set the current amplitude reference level:

1. To automatically set an optimum reference level, press AMPLITUDE > AUTO REF LEVEL.
2. To manually set the reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm.

Note	Select AUTO ATTEN coupling of the attenuator setting and AUTO REF LEVEL to help ensure that harmonics and spurs are not introduced into the measurements.

Setting Amplitude Range and Scale

This setting applies to most analyzer modes of instrument operation and allows you to set the y-axis graticule scale.

1. Press AMPLITUDE > SCALE/DIV and enter the desired number of units per division (dB/division).
2. Set the desired y-axis amplitude units. Currently, dBm is the only available selection.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference or amplitude level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.
2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.
3. The new reference level offset value will be displayed on the instrument and the y-axis and trace amplitude is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer’s dynamic range. By default, the auto attenuation automatically adjusts the attenuator as a function of the reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to “AMPLITUDE Menu” on page 4-15.
- Turn on the preamplifier.
- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to “Setting Bandwidth Parameters” on page 4-16.
- Use trace averaging if VBW is already set to 1 Hz. Refer to “Setting Trace and Cursor Parameters” on page 4-19

Preamplifier

The preamplifier can be turned on and off by toggling PRE AMP via the status panel or the AMPLITUDE menu. Figure 4-9 shows the noise floor with the preamplifier off (1) and on (2). Note that when the preamplifier is turned on, the noise floor drops significantly and a low-level signal is exposed. In order to use the preamplifier, the attenuation must be lower than 20 dB. If the preamplifier is turned on when the attenuation is greater than or equal to 20 dB, the attenuation will automatically drop to 10 dB. When AUTO ATTEN is toggled on, the REF LEVEL must be set to –40 dBm or lower to enable the preamplifier.

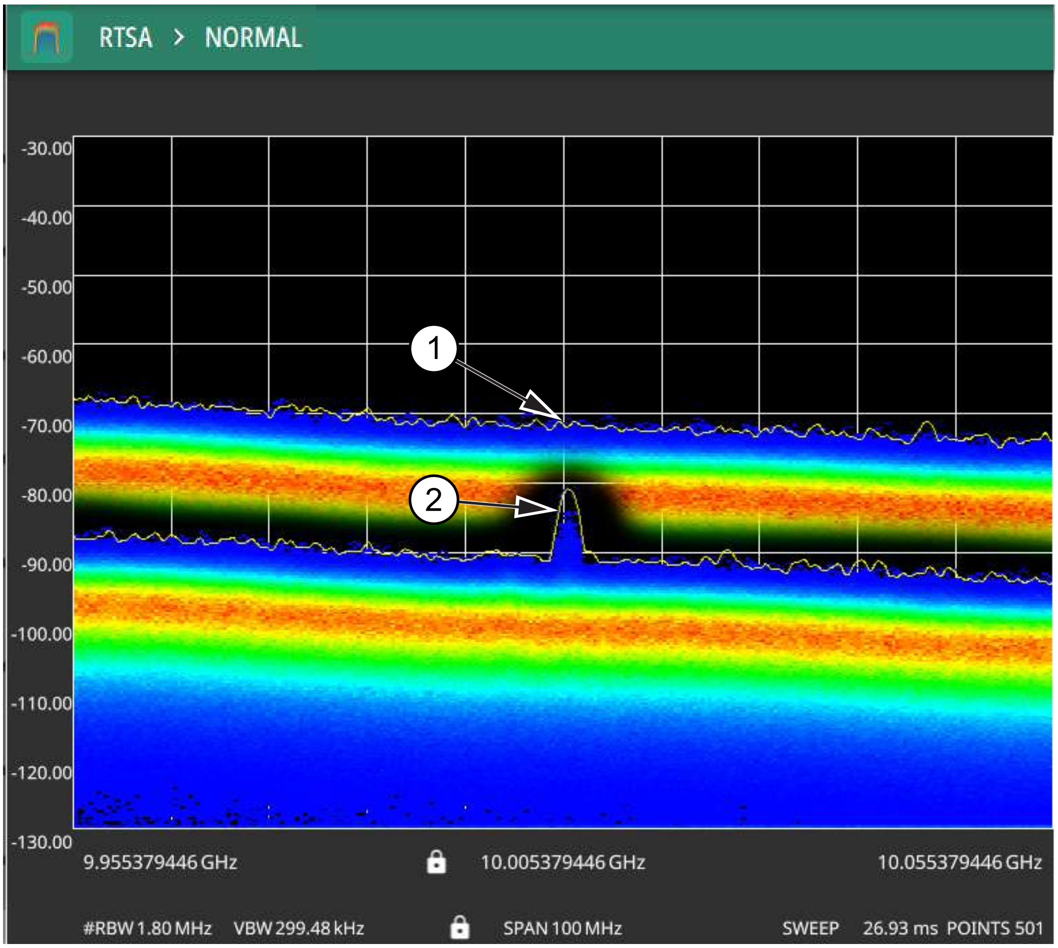


Figure 4-9. 1. Preamplifier Off
2. Preamplifier On

Indications of Excessive Signal Level

The Field Master Pro has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an "ADC Overrange" notification in the title bar (Figure 4-10). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 4-10. ADC Overrange

AMPLITUDE Menu

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this location. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values.

AUTO REF LEVEL: Auto reference level automatically adjusts the reference level to place the highest signal amplitude at about two graticule lines from the top based on the position of the trace at the time the button is pressed.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB. Pressing the plus (+) or minus (–) control changes the value by 1.

Y AXIS UNIT: Selects the y-axis amplitude units of dBm, dBW, or dBμV.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The offset is applied to all amplitude related parameters and to measurements such as the y-axis scale and marker measurements. The default offset value is 0 dB. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values. Refer to "Reference Level Offset for External Loss or External Gain" on page 4-13.

PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and the reference level is above –40 dBm. Refer to "Preamplifier" on page 4-14.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required.

ATTEN LEVEL: When auto attenuation is off, the attenuation value can be set manually to a resolution of 5 dB. Pressing the plus (+) or minus (–) control increments the value by 10.

Figure 4-11. AMPLITUDE Menu

4-9 Setting Bandwidth Parameters

Bandwidth parameters are set using the "BANDWIDTH Menu" on page 4-18.

Resolution Bandwidth

Resolution Bandwidth (RBW) determines frequency selectivity. The spectrum analyzer traces the shape of the RBW filter as it tunes past a signal. The choice of resolution bandwidth depends on several factors. Filters take time to settle. The output of the filter will take some time to settle to the correct value so that it can be measured. The narrower the filter bandwidth (resolution bandwidth), the longer the settling time needs to be, and therefore, the slower the sweep speed.

The choice of resolution bandwidth will depend upon the signal being measured. If two closely-spaced signals are to be measured individually, then a narrow bandwidth is required. If a wider bandwidth is used, then the energy of both signals will be included in the measurement. Thus, the wider bandwidth does not have the ability to look at frequencies selectively, but instead simultaneously measures all signals falling within the resolution bandwidth. Therefore, a broadband measurement would include all signals and noise within the measurement bandwidth into a single measurement.

On the other hand, a narrow-band measurement will separate the frequency components, resulting in a measurement that includes separate peaks for each signal. There are advantages to each. The ultimate decision will depend upon the type of measurement required.

There is always some amount of noise present in a measurement. Noise is often broadband in nature; that is, it exists at a broad range of frequencies. If the noise is included in the measurement, the measured value could be in error (too large) depending upon the noise level. With a wide bandwidth, more noise is included in the measurement. With a narrow bandwidth, less noise enters the resolution bandwidth filter, and the measurement is more accurate. If the resolution bandwidth is narrower, the noise floor will drop on the spectrum analyzer display. As the measured noise level drops, smaller signals that were previously obscured by the noise might now be measurable.

Setting Frequency Bandwidth

1. Press BANDWIDTH on the main menu.
2. Toggle AUTO RBW off to manually change values. If using Auto, refer to the following sections.
3. Set the RBW to achieve the desired resolution and measurement characteristics. Lower values increase resolution and reduce noise, but at the expense of measurement speed. Note that the RTSA will limit RBW settings based on span settings.

Setting Bandwidth Auto Coupling

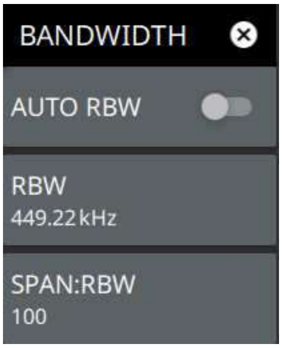
Both resolution bandwidth and video bandwidth can be coupled to the frequency span automatically, or set manually. When set to Auto RBW, the instrument automatically adjusts the RBW in proportion to the frequency span. The default ratio of the span width to the resolution bandwidth is 100:1 and can be changed as follows:

1. Press BANDWIDTH on the main menu.
2. Press SPAN:RBW and change the coupling value, and then press ACCEPT to enter the value.

When auto-coupling between the span and RBW is selected (AUTO RBW is toggled on), the bandwidth parameter is displayed normally at the bottom of the graph. If manual RBW is selected (AUTO RBW is toggled off), the bandwidth label at the bottom of the graph is prefixed with the '#' symbol, and resolution bandwidth is set independently of the span.

The RBW range varies with instrument features. Refer to "BANDWIDTH Menu" on page 4-18 and check your technical data sheet for the bandwidth range of your instrument.

BANDWIDTH Menu



AUTO RBW: When toggled on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the x-axis will be preceded by the "#" symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. Once auto RBW is toggled off, the RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.

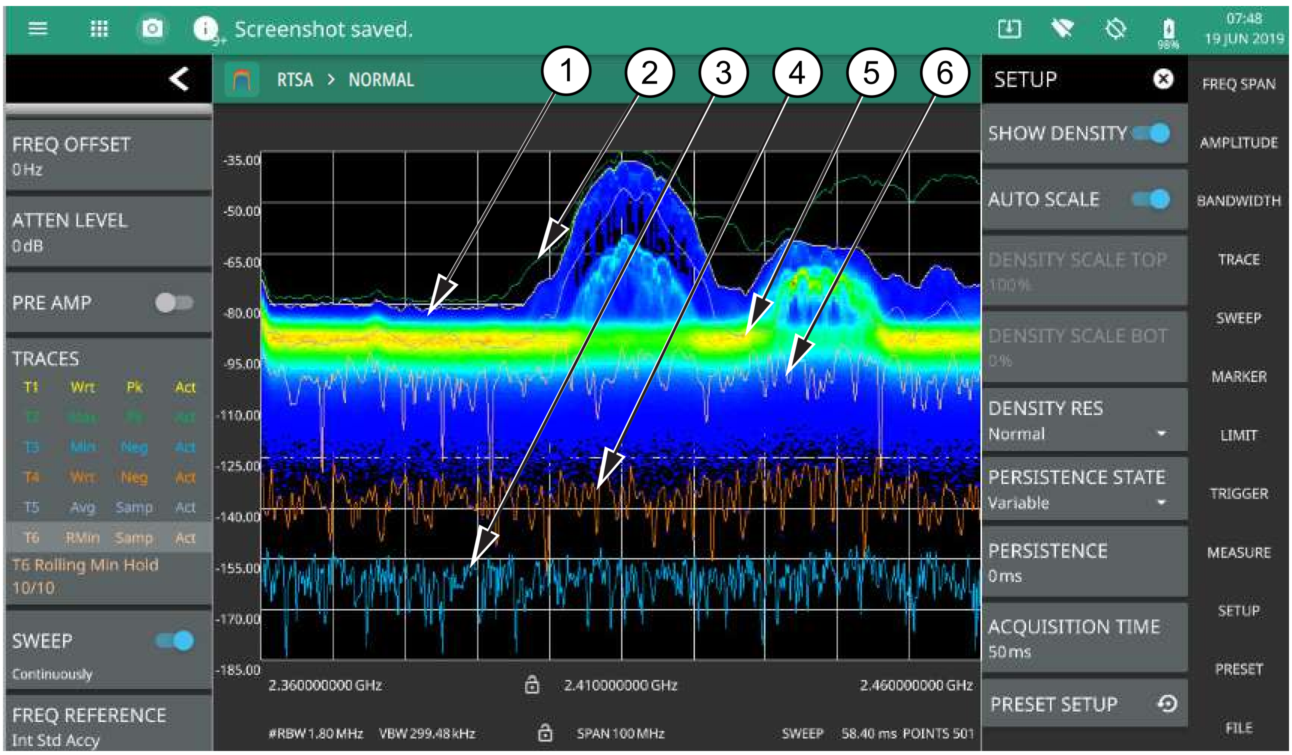
Figure 4-12. BANDWIDTH Menu

4-10 Setting Trace and Cursor Parameters

Field Master Pro can display up to 6 traces simultaneously. Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the Status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces in normal spectrum view, refer to “TRACE Menu (Normal View)” on page 4-20. When working with traces and cursors in Spectrogram view, refer to “TRACE Menu (Spectrogram View)” on page 4-24 and “TRACE CURSOR Menu” on page 4-25.

Traces in Normal View

The screenshot below shows the MS2090A with all six traces enabled on a signal, each with a different trace or detector type setting. The left side status panel shows a trace setup summary table. Touching one of the trace rows in the table will enable the trace and open the TRACE menu.



1. Clear/Write and Peak Detection: This is the default trace setting. The trace is cleared during each sweep and the largest measurement point is used for each display point.
2. Max Hold and Peak Detection: Each trace point retains its maximum value and the largest measurement point is used for each display point.
3. Min Hold and Negative Detection: Each trace point retains its minimum value and the smallest measurement point is used for each display point.
4. Clear/Write and Negative Detection: Trace points are cleared during each sweep and the smallest measurement point is used for each display point.
5. Average and Sample Detection: The trace points are an average of the previous N sweeps, where N is the AVERAGES setting. Sample detection uses the median measurement point.
6. Rolling Min Hold and Sample Detection: The trace points are the minimum of the average of the previous N sweeps, where N is the AVERAGES setting. Sample detection uses the median measurement point.

Figure 4-13. Traces in Spectrum View

TRACE Menu (Normal View)

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

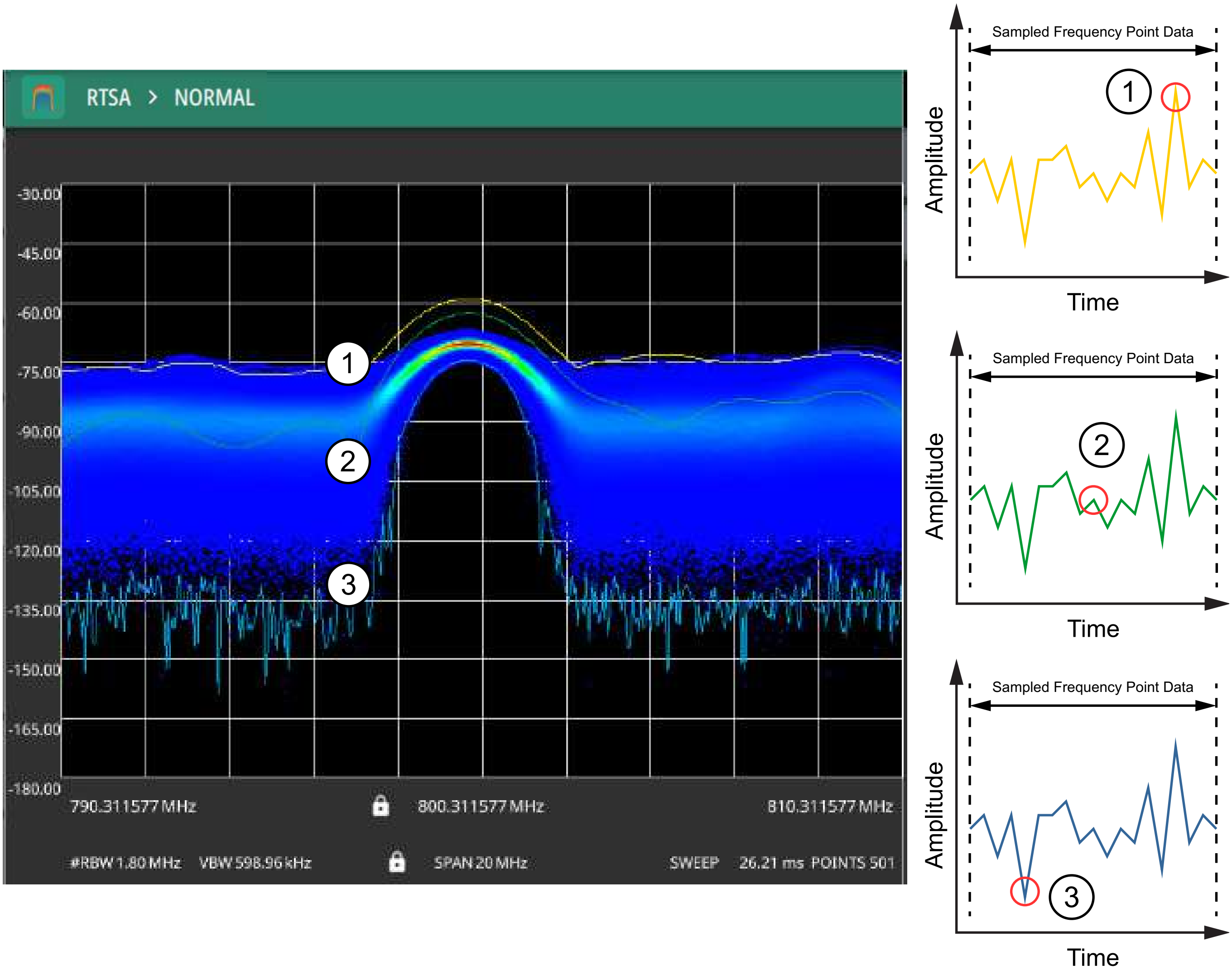
Figure 4-14. TRACE Menu (1 of 2)

	DETECTOR TYPE: Selects one of the available detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of showing each display point (see "Trace Detector Types" on page 4-22). • **Peak:** Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed. • **Negative:** Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used. • **Sample:** Shows the transient amplitude of the center of sampled data for each display point. This method is useful when measuring low-level signals and noise measurements. **CLEAR:** Clears the currently active trace data. **AVERAGES:** Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes. **PRESET DETECTORS:** Sets all trace detectors to Peak. **PRESET TRACES:** •Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 4-14. TRACE Menu (2 of 2)

Trace Detector Types

The figure below shows the available detector types:

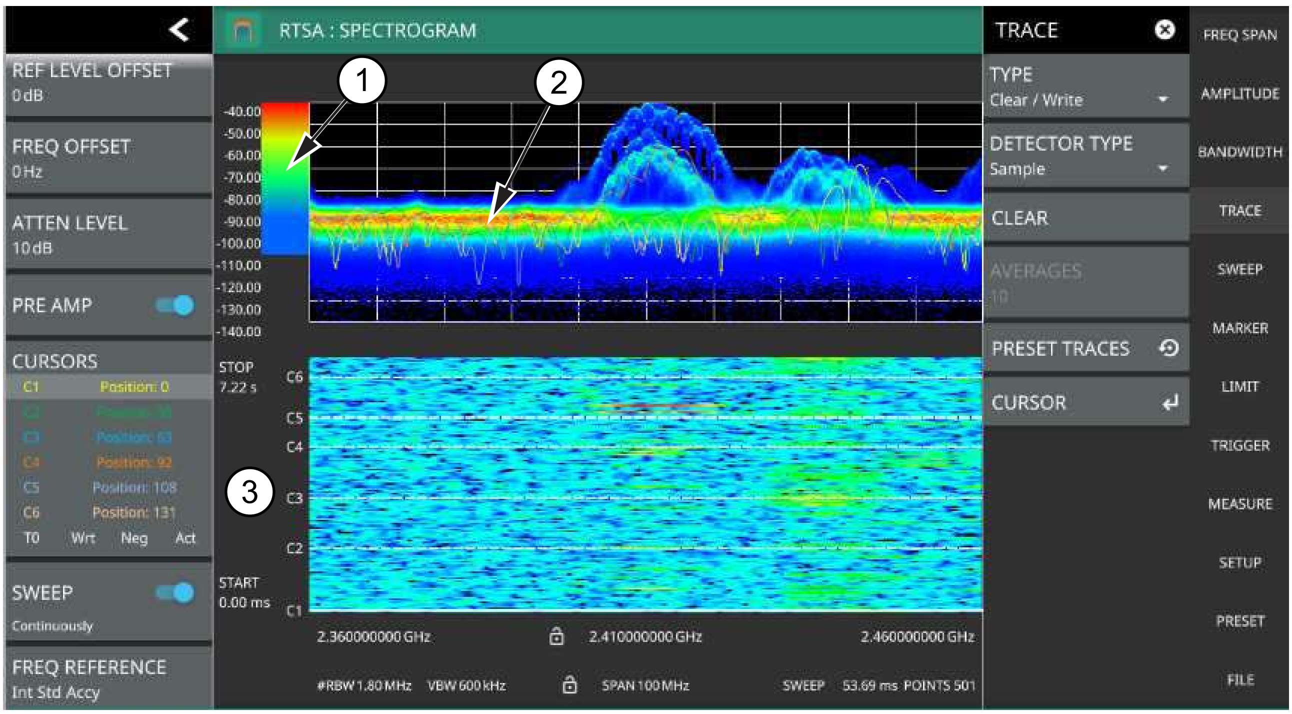


1. Yellow trace set to Peak detection.
2. Green trace set to Sample detection.
3. Blue trace set to Negative detection.

Figure 4-15. Trace Detector Types

Cursors in Spectrogram View

The screenshot below shows the MS2090A with all six cursors enabled on a signal. Cursors are shown on the spectrogram as white lines. The active cursor is a solid white line and other cursors show as dashed white lines. Cursors can be directly selected and dragged to position on the display or set via the TRACE > CURSOR menu. Cursors and their settings can also be accessed via the left side status panel by touching a cursor in the CURSORS table. The START time is the most recently completed sweep and the beginning of the spectrogram display. The STOP time is the total time length of the spectrogram, essentially the amount of time it takes for all completed sweeps to progress from the bottom to the top of the spectrogram window. The stop time will vary depending on the sweep speed, which can be faster or slower depending on settings such as span and RBW.

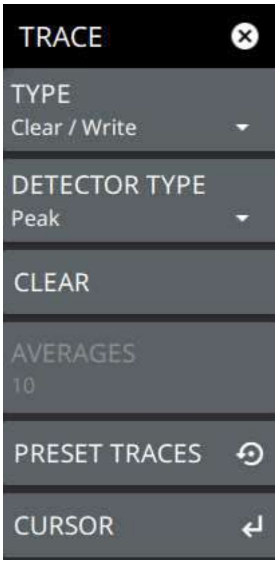


1. Color Bar settings are used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, then black is displayed. The color bar top and bottom setting, and the overall hue to the color range is set via the "SETUP Menu" on page 4-41.
2. The traces shown in Spectrogram view are updated when the data in the spectrogram lands on the associated cursor. The traces show sweep data from that respective point in time. The bandwidth and amplitude settings in the example above were changed. Traces 1 through 3 reflect the changed settings while traces 4 through 6 are showing sweep data from earlier points in time. To freeze the spectrogram, stop the instrument from sweeping by toggling off Sweep Continuously.
3. The spectrogram START and STOP times shown here represent the full duration of all 142 sweeps shown in the spectrogram window. Cursors 1 through 6 are positioned throughout the spectrogram and can be dragged or set to a new time or position using the "TRACE CURSOR Menu" on page 4-25. Cursors can also be selected via the left side status menu CURSORS table. The bottom of the table shows the reference trace (T0) and its settings. The reference trace setting apply to all traces shown in the spectrum display.

Figure 4-16. Spectrogram View

TRACE Menu (Spectrogram View)

When the combined Spectrogram view is selected (MEASURE > VIEW > Combined), the TRACE and SETUP menus are updated with spectrogram and cursor setup controls.



TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

DETECTOR TYPE: Selects one of the available detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of showing each display point (see "Trace Detector Types" on page 4-22).

- **Peak:** Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed.
- **Negative:** Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used.
- **Sample:** Shows the transient amplitude of the center of sampled data for each display point. This method is useful when measuring low-level signals and noise measurements.

CLEAR: Clears the currently active trace data.

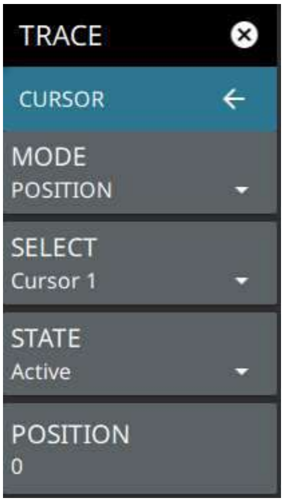
AVERAGES: Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes.

PRESET TRACES: Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

CURSOR: Opens the "TRACE CURSOR Menu" on page 4-25.

Figure 4-17. TRACE Menu (Spectrogram View)

TRACE CURSOR Menu



MODE Position/Time: Every trace captured in the spectrogram has a time and a position index. Set the location of the spectrogram cursor based on either the time index or the position index. When position is selected, you can change the position index of the cursor from the POSITION button. If Time is selected, you can set the time index of the cursor from the TIME button. See the descriptions of POSITION and TIME below.

SELECT: Used to add up to six cursors or to set the active cursor on the spectrogram. The active cursor also displays the associated trace on top of other traces in the spectrum display. For more information, refer to "Spectrogram with Cursors and Markers" on page 4-32.

STATE: Selects one of the following cursor states:

- **Active:** Displays the selected trace as it is updating.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

POSITION: Available when a position cursor is selected. You can change the sweep position index of the selected spectrogram cursor in relation to the number of total sweeps in the spectrogram. The number of sweeps in the spectrogram is based on the size of the spectrogram window, so the sweep index changes when changing the spectrogram cursor position index. The spectrum view also displays the currently selected trace on top of any other traces. A position of 0 (zero) represents the most recent (or live) trace. Entry into this field is disabled when the spectrogram cursor mode is set to Time.

TIME: Available when a time cursor is selected. You can change the time index of the selected spectrogram cursor in relation to the start and stop time displayed in the spectrogram. The time in the spectrogram is based on the size of the spectrogram window, so the time changes when changing the spectrogram cursor time index. The spectrum view also displays the currently selected trace on top of other traces. A time of 0 (zero) represents the most recent (or live) trace. Entry into this field is disabled when the spectrogram cursor mode is set to Position.

Figure 4-18. TRACE / CURSOR Menu (Spectrogram View)

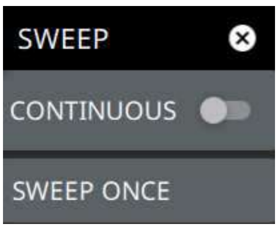
4-11 Setting Sweep Parameters

Sweep parameters are set using the “SWEEP Menu” on page 4-26.

Single/Continuous

When the CONTINUOUS toggle is pressed, the instrument toggles between single sweep and continuous sweep. In single sweep setting, the instrument waits until SWEEP ONCE is pressed or another setting is selected before updating the trace display. In single sweep, the RTSA trace is held, but the density display is continuously updated, even when CONTINUOUS is toggled off. See “SETUP Menu” on page 4-41.

SWEEP Menu



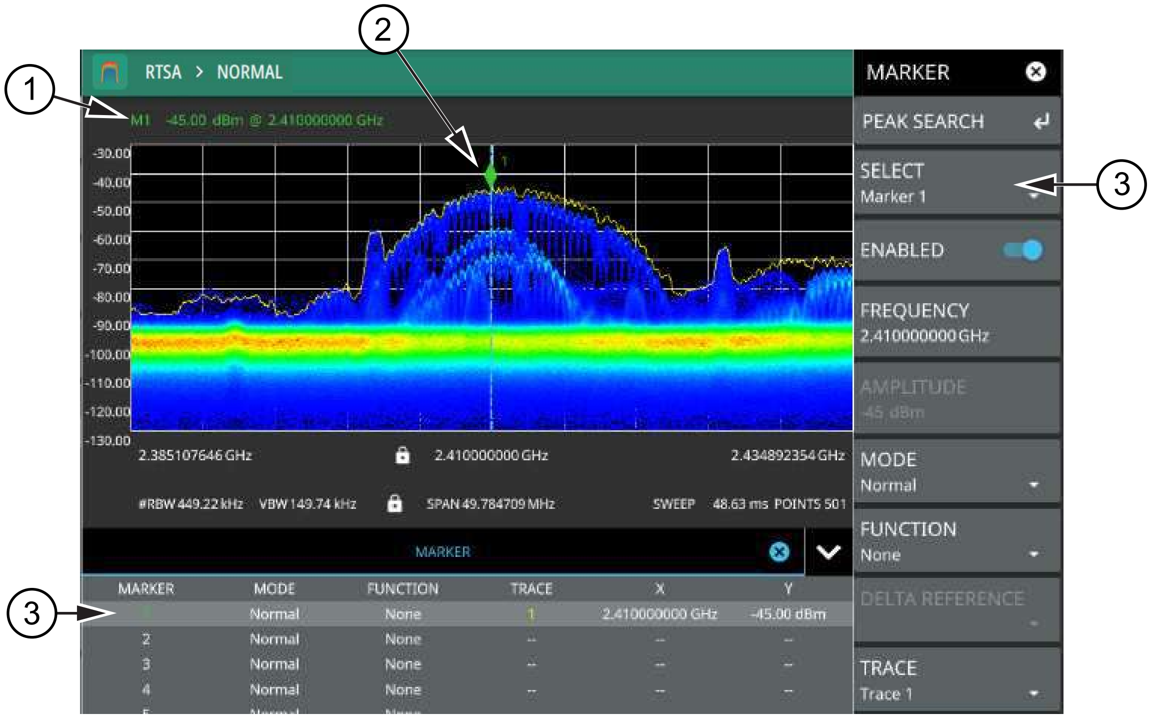
CONTINUOUS: Toggles between continuous sweep and single sweep. When the toggle is off, the instrument is in single sweep. In single sweep, the trace results of a sweep are displayed on the screen while the instrument awaits a trigger event to update the trace data. The current state of the instrument is displayed in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

Figure 4-19. SWEEP Menu

4-12 Setting Up Markers

Marker parameters are set using the “MARKER Menu” on page 4-29. Refer to the figure below when working with this section.



1. Normal spectrum view marker information display.
2. Marker located on trace. The active marker is indicated with solid green fill, other markers will show with a hollow fill, fixed markers show as a green X. The dashed vertical line is attached to the active marker and facilitates touch operations. Either the marker or the line can be dragged into position, and either can be double tapped to open a number of peak search options.
3. Selected marker in the MARKER menu and in the MARKER table. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu.

Figure 4-20. Marker Table and Marker Settings Panels

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the current center frequency.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and placed at the center frequency. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static frequency and amplitude.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   - a. Enter a new FREQUENCY value from the MARKER menu. The frequency can be entered manually or adjusted by using the slider or the + and – buttons to move the marker to the left and right.
   - b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position).
   - c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 4-30). Some peak search functions can be accessed by double tapping the marker or the blue marker line.

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed frequency, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, if marker 2 is set as a delta marker, the delta reference is set to Marker 3. To set a delta marker and its reference:

1. Activate a marker and place it in a reference location as described previously.
2. Select another marker using MARKER > SELECT.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   - a. Enter a new FREQUENCY value from the MARKER menu. The frequency can be entered manually or adjusted by using the slider or the + and – buttons to move the marker to the left and right.
   - b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position).
   - c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks ("MARKER PEAK SEARCH Menu" on page 4-30). Some peak search functions can be accessed by double-tapping the marker or the blue marker line.
4. Place the active delta marker by:
   - a. Entering a new FREQUENCY value.
   - b. Dragging the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   - c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 4-30).

A delta marker is labeled with a green delta symbol between the each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1".

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 4-30.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center frequency, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker, which is displayed in the upper left-hand corner of the screen. When a marker is turned on, it is a normal marker positioned at the center frequency of the selected trace.

ENABLED: Enables the selected marker. When the toggle is off, the marker is disabled and not shown on the screen.

FREQUENCY: Displays the marker frequency. For delta markers, the frequency is relative to the reference marker. Change the marker frequency by dragging it to the desired location. You can also change the marker frequency by pressing the FREQUENCY button and changing it manually using the keypad controls.

AMPLITUDE: Displays the current marker amplitude. When the marker mode is set to Normal or Delta, the amplitude is set by the trace. In that case, the amplitude is not settable by the user. The button is grayed out, but the value is still updating with every sweep. If the marker is a Fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude using the keypad control.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The frequency is fixed but the amplitude value varies from sweep to sweep.
- **Delta:** A Delta (Δ) marker displays the delta frequency and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Fixed marker at the same location. The reference marker can then be switched to a Normal marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed frequency, which are defined by the user and not related to the trace or sweep data.

FUNCTION: Sets the function of the currently selected marker to None, Noise or Frequency Counter. For more information about using marker functions, refer to "Marker Functions" on page 4-31.

DELTA REFERENCE: Selects the Reference marker for a Delta marker. A Delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen. Refer to "Marker Table" on page 4-33.

CENTER ON MARKER: Sets the center frequency to the currently active marker's frequency value.

REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 4-21. MARKER Menu

MARKER PEAK SEARCH Menu

Note	Double tapping a marker opens a quick peak search menu with some of the below features.

PEAK SEARCH: Returns to the main MARKER menu.

SELECT: If the selected marker is off, it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 4-22. PEAK SEARCH Menu

Marker Functions

Noise Markers

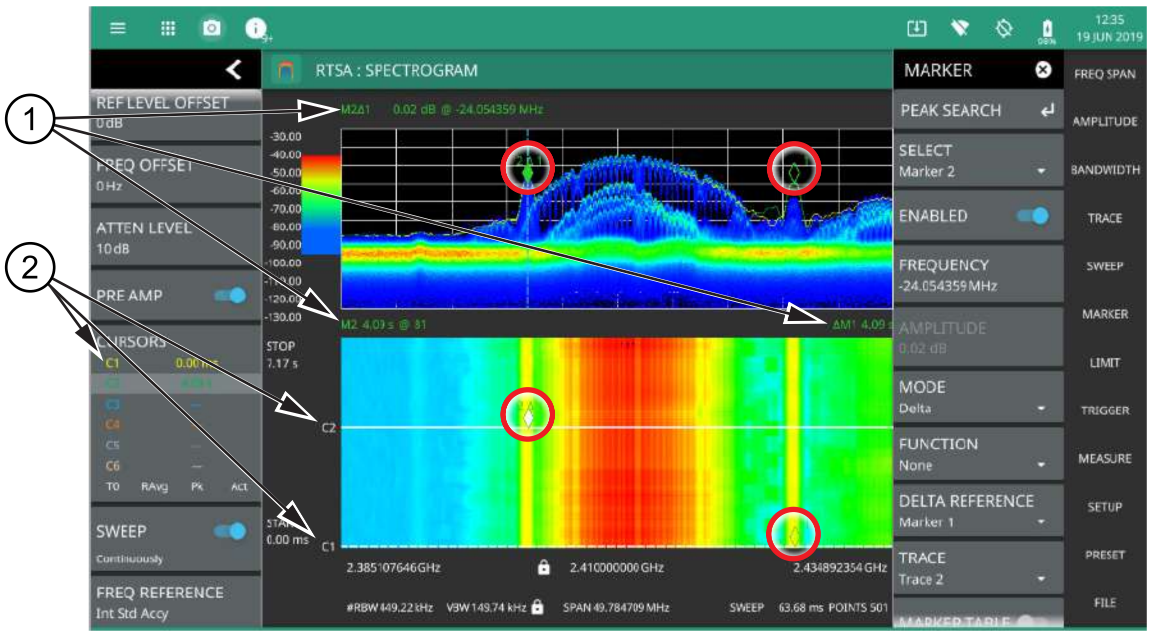
Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

Frequency Counter Marker

Sets the frequency counter for the selected marker. Marker frequency values are normally limited in resolution to individual display pixels. Each pixel may represent multiple frequencies. When counter marker is enabled, a higher resolution digital signal processing is used within the region of the counter marker to determine a more precise frequency. Using counter marker in association with marker to peak will result in the frequency of the signal peak to a much higher displayed resolution. Note that frequency accuracy is affected by the RBW setting, and sweep times may be longer when using counter marker because of the additional signal processing.

Spectrogram with Cursors and Markers

In the spectrum window, markers are shown as hollow green diamonds on the trace to which they are assigned. Active markers have a solid fill with a vertical dashed line that can be used to drag the marker position. The dashed line matches the trace color to which the marker is assigned. In the spectrogram window, markers are shown as hollow green diamonds on the cursor to which they are assigned. The active marker is shown with white fill and its time and position values are displayed in green text at the upper left side of the display. In this example, the active marker is set to Cursor C2 and is measuring a change of amplitude between two different points in time. Markers can be placed on different cursors to help you compare measurements at different points in time as well as frequency



1. **Markers:** Displays the selected marker value. Marker values at the top of the spectrum display will show the current frequency and amplitude values of the active marker and its type. In this case, marker 2 is set to a delta marker relative to Marker 1. Marker values at the top of the spectrogram window show the current time or position of the active marker (left) and other marker information such as delta time (right). In this case, marker 2 is active and is at position 41 and has a relative time delta of 0 ms. Note that you can set a marker on any cursor to measure relative time differences between signal events as well as frequency and amplitude differences. Markers displayed on traces and cursors (encircled in red) show as green diamonds with the active marker in white fill.
2. **Cursors:** Cursors are shown on the spectrogram as white dashed lines. The active cursor is a solid white line. Cursors can be directly selected and dragged to position on the display or set via the TRACE > CURSOR menu. Cursors and their settings can also be accessed via the status panel. The start time is the most recent completed sweep and the beginning of the spectrogram. The stop time is the total time length of the spectrogram, essentially the amount of time it takes for a completed sweep to get from the bottom to the top of the spectrogram diagram with the current settings.

Figure 4-23. Spectrogram with Cursors and Markers

Marker Table

The marker table display is useful for displaying many marker parameters at once. The examples shown are for the regular Spectrum view (1) and for Spectrogram view (2). Both marker tables show the marker mode and corresponding X and Y values. In spectrum view, the marker table shows the marker function and trace to which it is selected. In Spectrogram view, the marker table shows the time value and the cursor to which it is selected. The selected marker is displayed with a highlighted background. Table controls are located on the right of the header. Press the down or up arrow to collapse or expand the table, press X to close the table.

1

MARKER

MARKER	MODE	FUNCTION	TRACE	X	Y
1	Normal	Noise	1	5.800000010 GHz	-142.43 dBm/Hz
2	Normal	Off	[illegible]	6.152000010 GHz	-66.84 dBm
3	Normal	Off	1	62.690807800 GHz	-67.91 dBm
4	Off	Off	--	--	--
5	Off	Off	--	--	--
6	Off	Off	--	--	--

2

MARKER

MARKER	MODE	CURSOR	X	Y	TIME
1	Normal	1	5.800000010 GHz	-145.47 dBm/Hz	0.00 ms
2	Normal	[illegible]	6.152000010 GHz	-68.24 dBm	9.33 s
3	Normal	1	62.690807800 GHz	-70.54 dBm	0.00 ms
4	Off	--	--	--	--
5	Off	--	--	--	--
6	Off	--	--	--	--

Figure 4-24. Marker Table

You can select and change a marker's parameters by selecting the marker from either the MARKER menu or the MARKER table.

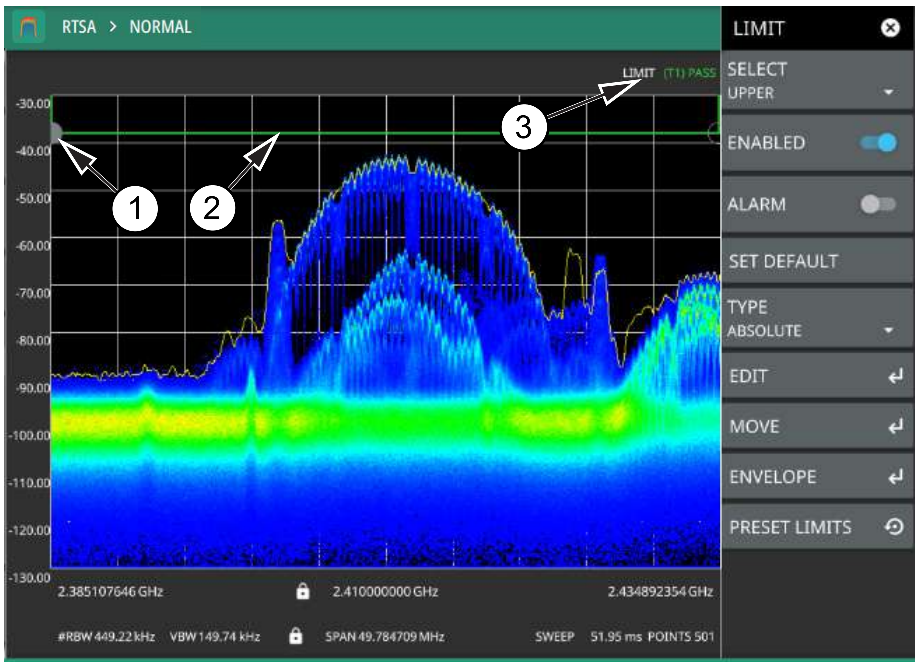
The currently selected marker's value is shown at the top left of the spectrum window with its current amplitude and frequency values.

The selected marker is highlighted on the trace display.

4-13 Setting Up Limit Lines

Limit lines allow you to monitor when trace data crosses a defined line. Two types of limit lines can be specified: lower limit lines and upper limit lines. Limit lines can be used for visual reference, pass/fail criteria, and to trigger a save on event. By using save on event, a signal that crosses a limit line can be automatically saved (refer to Section 4-18 "Saving and Recalling Measurements" on page 4-44).

Each limit line can consist of a single segment, or as many as 40 segments across the entire frequency span of the instrument. These limit segments are retained regardless of the current frequency span of the instrument, which allows the configuring of specific limit envelopes at various frequencies of interest without having to re-configure them each time the frequency is changed. Limit line parameters are set using the "LIMIT Menu" on page 4-36.



1. Limit points are shown as gray circles. The active point is filled in gray. Points can be dragged into position or set discretely using the frequency and amplitude settings in the "LIMIT EDIT Menu".
2. The limit line shown here is a simple upper limit line. The limit line color is green when the trace does not cross the limit line, and the limit line color turns red when the trace crosses it.
3. The limit test pass/fail status is also shown in green or red color at the top of the display. The limit test is applied to the active trace, indicated here by T1.

Figure 4-25. Simple Limit Line

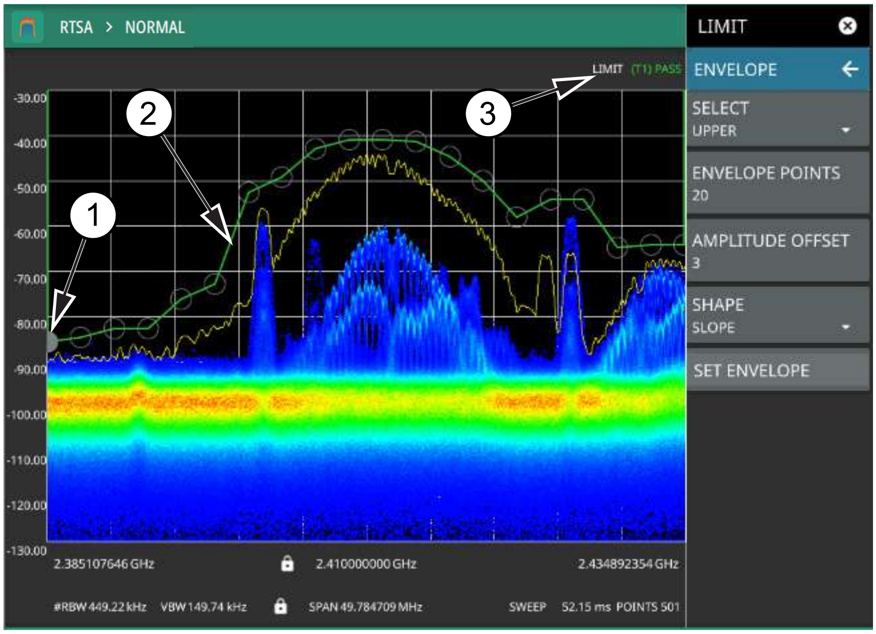
Simple Limit Line

1. Press LIMIT on the main menu.
2. Select UPPER or LOWER limit.
3. Toggle the selected limit line on using the ENABLED toggle.
4. To change the frequency or amplitude level of the limit line:
   a. Press MOVE to open the "LIMIT MOVE Menu"
   b. Enter either an X-OFFSET frequency value or Y-OFFSET amplitude value.
   c. Press LEFT, RIGHT, UP, or DOWN to move the limit line the by the value entered above.

You can set up either an upper or lower limit line, or both by repeating the procedure above.

Limit Line Envelope

Limit line envelope parameters are set using the "LIMIT ENVELOPE Menu" on page 4-39. The limit line envelope feature is a quick way to generate an envelope using the existing trace as a reference. You can set the envelope to square or slope and you can set the limit line offset from the trace when creating the envelope. Once the envelope limit line is set, you can manually edit the limit line by dragging the points or by using the "LIMIT EDIT Menu" and "LIMIT MOVE Menu".



1. Limit points are shown as gray circles. The active point is filled in gray. Points can be dragged into position or set discretely using the frequency and amplitude settings in the "LIMIT EDIT Menu".
2. The limit line shown here is an upper envelope limit line. The limit line color is green when the trace does not cross the limit line, and the limit line color turns red when the trace crosses it.
3. The limit test pass/fail status is also shown in green or red color at the top of the display. The limit test is applied to the active trace, indicated here by T1.

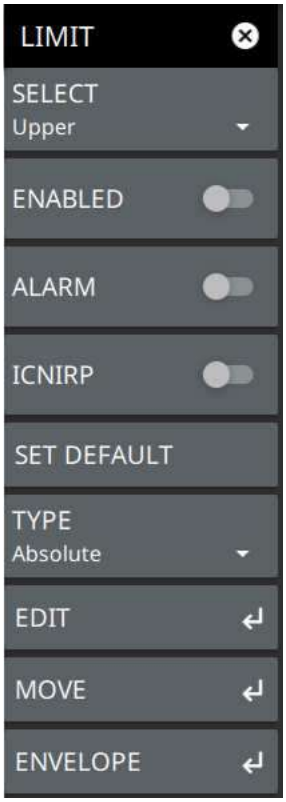
Figure 4-26. Envelope Limit Line

To set up a limit line envelope:

1. Press LIMIT > ENVELOPE.
2. Select either Upper or Lower limit line.
3. Set the number of limit envelope points.
4. Set the amplitude offset (in dB).
5. Select the envelope shape of Square or Slope.
6. Press SET ENVELOPE to generate the limit line envelope.

You can set up either an upper or lower limit line, or both by repeating the procedure above. To create a more complex limit line, use the "LIMIT EDIT Menu" to work with individual limit line points.

LIMIT Menu



SELECT: Selects UPPER or LOWER limit line for editing.

ENABLED: Displays the selected limit when toggled on.

ALARM: This setting is for toggling the alarm function on or off for the currently active limit line. When on, an alarm beep will occur when a data point exceeds the limit. Audio functionality will be added via an upcoming software update.

SET DEFAULT: Pressing this button deletes all limit points for the currently active limit line and sets the default limit line value, which is a single limit whose position is 2.5 grid lines from the top of the screen (for the upper limit line) or 2.5 grid lines from the bottom of the screen (for the lower limit line), depending upon which limit is active. The inactive limit line is not altered.

TYPE: Use to set the selected limit line as absolute or relative. This selection may be used at any time while working with limit lines. Absolute limit lines set the limit inflection points based upon the entered frequencies for each point. Relative limit lines set the limit inflection points relative to the current center frequency. Regardless of how a limit line is set up, saved, or recalled, it can be changed between absolute and relative by pressing the desired state.

EDIT: Opens the “LIMIT EDIT Menu” on page 4-37.

MOVE: Opens the “LIMIT MOVE Menu” on page 4-38.

ENVELOPE: Opens the “LIMIT ENVELOPE Menu” on page 4-39.

PRESET LIMITS: Presets the limit lines to default values.

Figure 4-27. LIMIT Menu

LIMIT EDIT Menu

SELECTED POINT: Displays the limit line point number. Press to select a different point from the displayed list.

FREQUENCY: Sets the frequency of a limit line inflection point. The frequency of each point in a limit line can be individually set. When a new point is added, it takes the value that is halfway between two existing points, or it takes the stop frequency of the current sweep if no point is higher in frequency than the one being added. See the ADD POINT button description for more details. Use the keypad or the left and right arrow keys to change the frequency of an inflection point. The left or right arrows move the inflection point by ±0.1. Up or down arrows move the inflection point ±1.

AMPLITUDE: Sets the amplitude of a limit line inflection point. The amplitude of each inflection point can also be individually set. By default, when a new point is added it takes the amplitude value that is on the limit line at the frequency where the point was added. Use the keypad (using +/- to set a negative value) or the plus (+) or minus (–) control to increment the value. The unit of the amplitude limit is the same as the current vertical amplitude unit (for example, dBm).

ADD POINT: Press this button to add a limit line inflection point. The precise behavior of this button depends upon which inflection point is active at the time that the button is pressed. If the active limit point is somewhere in the middle of a multi-segment limit line, then a new limit point is added that is halfway between the currently active point and the point immediately to its right. The amplitude of the inflection point will be such that it falls on the limit line. For example, if a limit point exists at 2.0 GHz with an amplitude of –30 dBm, and if the next point is 3.0 GHz with an amplitude of –50 dBm, then the added point will be at 2.5 GHz with an amplitude of –40 dBm. If the last limit point is active (assuming it is not at the right edge of the display), then the new limit point will be placed at the right edge of the display at the same amplitude as the point immediately to its left. Points may not be added beyond the current sweep limits of the instrument. Use the FREQUENCY and AMPLITUDE buttons to make adjustments to the selected point.

DELETE POINT: Press this button to delete the selected point.

ADD VERTICAL: Press this button to add an inflection point below the currently selected point.

NEXT POINT LEFT: Press this button to select the inflection point that is immediately to the left of the active point, making this newly selected point active for editing or deletion. With each button press, the active point becomes that point to the left of the previously active point, until the newly selected active point becomes the left-most point on the screen.

NEXT POINT RIGHT: Press this button to select the limit point immediately to the right of the active point, making this newly selected point active for editing or deletion. With each button press, the active point becomes that point to the right of the previously active point, until the newly selected active point becomes the right-most point on the screen.

Figure 4-28. LIMIT EDIT Menu

LIMIT MOVE Menu

CENTER: Pressing this button moves the center of the existing limit line to the center frequency of the measurement. The span of the existing limit line is not changed. Use this button as an easy way to move an existing limit line to the center of the sweep. This button has no action if no limit line is turned on.

X-OFFSET: Allows you to adjust the frequency of the limit line. All inflection points will be moved by the value entered here when using the LEFT or RIGHT buttons. Press X-OFFSET and enter a value using the keypad.

LEFT: Pressing this button moves all inflection points to the left by the X-OFFSET value.

RIGHT: Pressing this button moves all inflection points to the right by the X-OFFSET value.

Y-OFFSET: Allows you to adjust the amplitude of the limit line. All inflection points will be moved by the value entered here when using the UP or DOWN buttons. Press Y-OFFSET and enter a value using the keypad.

UP: Pressing this button moves all inflection points up by the Y-OFFSET value.

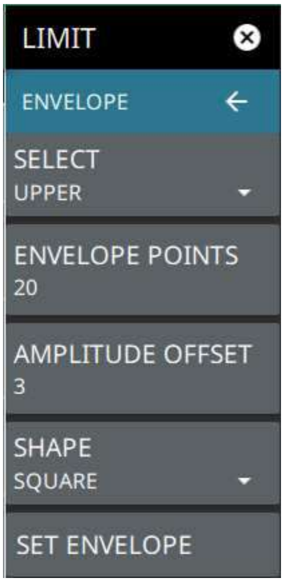
DOWN: Pressing this button moves all inflection points down by the Y-OFFSET value.

MARKER 1 OFFSET: Sets a limit line offset value from Marker 1 amplitude. This feature moves the limit line amplitude and frequency as needed to place the center of the limit line the user-specified number of dB from the position of Marker 1. Positive values place the limit line above Marker 1, and negative values place the limit line below Marker 1.

TO MARKER 1: Moves the limit line center position to the frequency and specified amplitude offset of Marker 1. Marker 1 must be enabled.

Figure 4-29. LIMIT MOVE Menu

LIMIT ENVELOPE Menu



SELECT: Press this button to select UPPER or LOWER for envelope design.

ENVELOPE POINTS: This sets the desired number of envelope points.

AMPLITUDE OFFSET: Use to define how far away from the trace to place the upper or lower envelope. The limits are ± 100 dB. For an upper envelope, usually the offset will be positive in order to place the envelope above the signal. For a lower envelope, the offset will usually be negative in order to place the envelope below the signal.

SHAPE: Use to choose whether the upper or lower envelope will be with flat tops (SQUARE setting) and vertical lines, or whether the envelope will have sloped lines (SLOPE setting) between adjacent inflection points. When the square envelope type is selected, two inflection points are used for each horizontal segment.

SET ENVELOPE: Press this button to generate the envelope using the set characteristics. If the default results are not satisfactory, you can make adjustments to the amplitude and frequency of each inflection point, and you can add or delete inflection points.

Figure 4-30. LIMIT ENVELOPE Menu

4-14 Setting Up Triggering

TRIGGER Menu

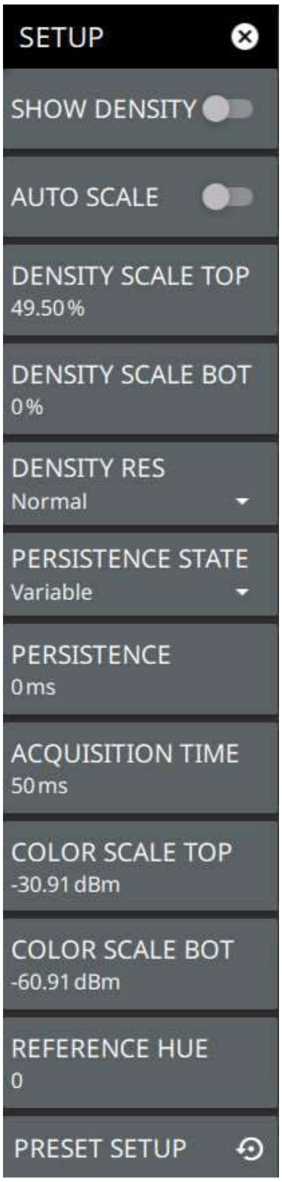
IQ TRIGGER: Opens the “IQ TRIGGER Menu” on page 7-10.

Figure 4-31. TRIGGER Menu

4-15 Measurement Setup

Refer to "Making RTSA Measurements" on page 4-8 for basic information on setting up a spectrum measurement.

SETUP Menu



SHOW DENSITY: Toggles the density display on or off. Density displays the relative time density of a signal in a color scale ranging from blue to red. Signals that persist longer or more often during the acquisition time are indicated in red color. Brief transient signals are shown in blue color.

AUTOSCALE: When toggled on, automatically adjusts the DENSITY SCALE TOP and DENSITY SCALE BOT settings of the density display based on the amplitude of the signal.

DENSITY SCALE TOP: Sets the percentage of signal time for the top (red) density scale.

DENSITY SCALE BOT: Sets the percentage of signal time for the bottom (blue) density scale. Any signal that appears at a rate lower than the DENSITY SCALE BOT setting will not appear in the density plot.

DENSITY RES: Density resolution sets the FFT size of the RTSA capture. Normal resolution sets a 512 point FFT; High resolution sets a 1024 point FFT. Higher resolution gives finer frequency detail to the density display, but increases POI. Lower resolution will result in a lower POI, but gives less frequency detail to the density display.

PERSISTENCE STATE: Toggles the persistence state between Variable or Infinite. Infinite persistence means the density plot will not fade away after a signal is no longer present. It is useful for seeing very fast and infrequent signals. Variable persistence sets a user defined time for the density colors to fade. Longer persistence values can be used to best illustrate the signals being observed.

PERSISTENCE: Sets the decay time of the density display.

ACQUISITION TIME: The acquisition time sets the update interval for each spectrum trace, spectrogram line, and density display. During the acquisition interval, spectral data from multiple FFTs of the input signal are taken and combined. The acquisition time is adjustable to allow resolving multiple, brief signal events in time and to observe longer term behaviors.

COLOR SCALE TOP: Defines the amplitudes where the top color on the color setup bar are applied. Any measurement above this amplitude will appear black on the spectrogram window (shown only in Spectrogram).

COLOR SCALE BOT: Defines the amplitudes where the bottom setting colors on the color setup bar are applied. Any measurement below this amplitude will appear black on the spectrogram window (shown only in Spectrogram).

REFERENCE HUE: Allows you to customize the Spectrogram color range (Color Bar) and Hue values. The color limits and the reference hue are based on a 360-degree color wheel where default 0 is red (255 0 0) (shown only in Spectrogram).

PRESET SETUP: Presets the color setup settings.

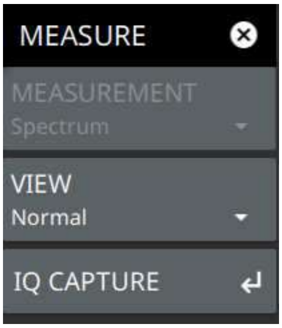
Figure 4-32. SETUP Menu (Spectrogram View)

4-16 Setting Up Advanced Measurements

The RTSA allows setting a normal spectrum view or a spectrogram view.

From the MEASURE menu, select one of the desired measurement views.

MEASURE Menu (Spectrum)



MEASUREMENT: There is no Measurement menu available.

VIEW: Selects the desired measurement view from the following list:

- **Normal** Spectrum View
- **Spectrogram** Selects Spectrogram view. When selected, a Spectrogram view is added to the display. Spectrogram is only available when the MEASUREMENT is set to Spectrum.

IQ CAPTURE: Opens the "IQ CAPTURE Menu" on page 7-8.

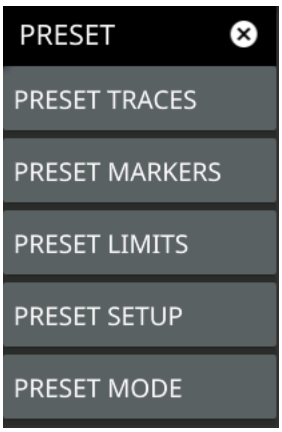
Refer to Chapter 7, "IQ Capture/Streaming (Option 124/126 and 125/127)" for discussion of IQ Capture and Streaming.

Figure 4-33. MEASURE Menu

4-17 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, "Reset Settings" on page 2-35. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting".

PRESET Menu



PRESET TRACES: Presets all trace settings to default values.

PRESET MARKERS: Presets all marker settings to default values. Turns off all markers.

PRESET LIMITS: Presets all values on the LIMIT menu to default values. Turns off all limit lines.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 4-34. PRESET Menu

4-18 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, native trace and CSV trace data, limit line setups, and screenshots. You can recall setup, native trace, and limit line files. For other file operations such as copy, move, and directory management, refer to Section 2-12 "File Management" on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 4-35:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

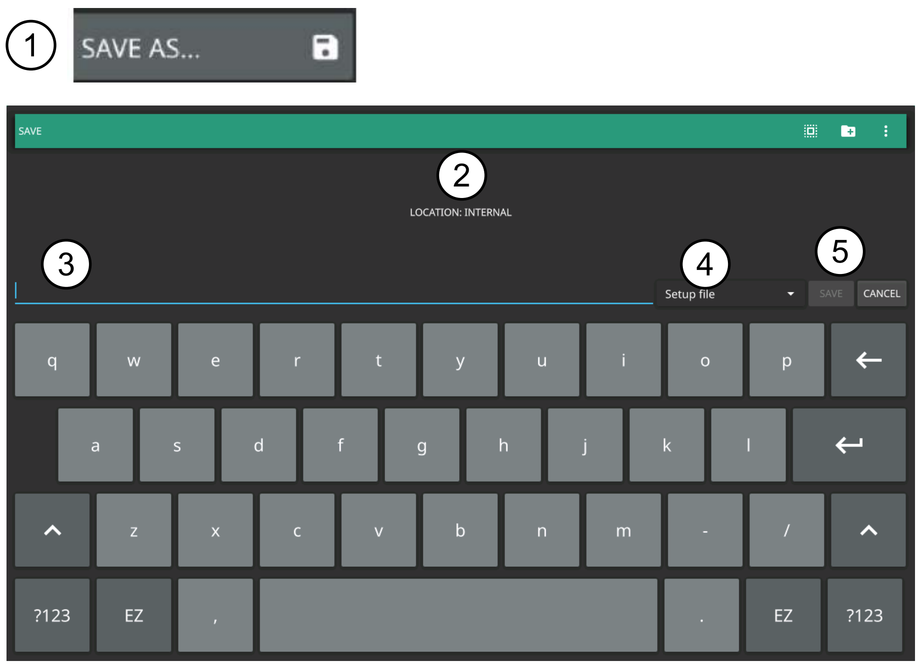


Figure 4-35. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 4-36:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

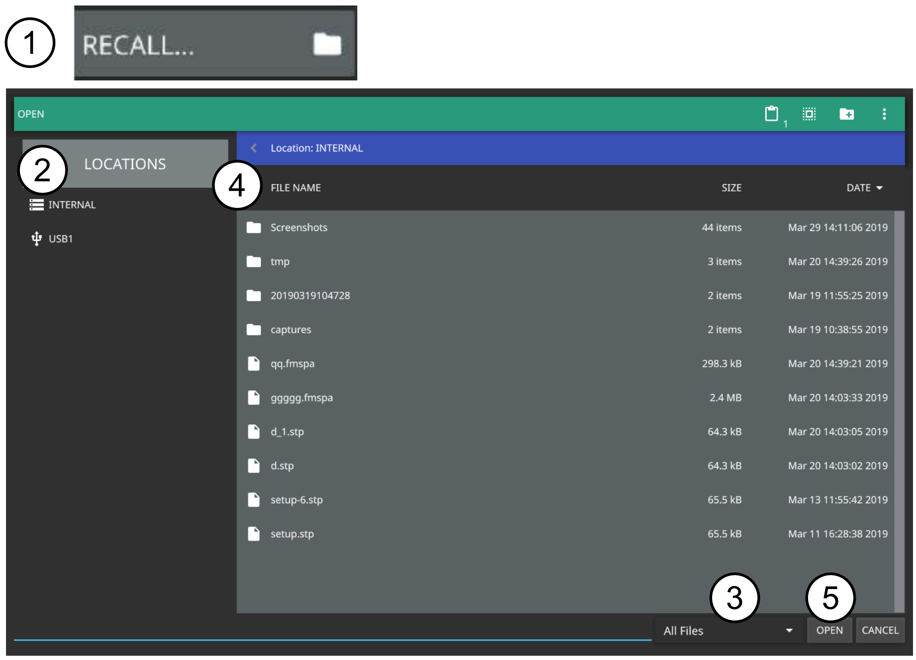


Figure 4-36. File Open Dialog

When a trace measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements, set TRACE > MODE > Active.

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fmrtsa file type).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Limit: Saves the current limit line point data (lim file type).
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fmrtsa and png file types).

RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled to the appropriate trace. That trace will be in a Hold mode. To exit the recalled data, simply change the trace mode back to Active.

BROWSE FILES: Opens "File Management" on page 2-36.

Figure 4-37. FILE Menu

Chapter 5 — LTE Measurements

5-1 Introduction

This chapter gives a brief overview of the Anritsu Field Master Pro Long Term Evolution (LTE) analyzer and its measurement capabilities. Th e purpose of this chapter is to provide a starting point for making LTE measurements. This chapter describes measurement setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, and markers. After measurements are taken, refer to Section 5-18 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

A basic understanding of the measurement concepts presented in Chapter 3, "Spectrum Analyzer Measurements" is recommended before performing the procedures in this chapter. LTE measurements include the use of additional functions beyond frequency, span, amplitude, and marker functions. Section 5-4 through Section 5-9 explain general setup procedures and settings. Section 5-10 through Section 5-16 provide example LTE measurements that are available in the LTE analyzer.

LTE measurement setups typically conform to the 3GPP and device manufacturer standards. Field Master Pro is designed to make setting up your measurement as easy as possible. Simply refer to the specification for the measurement and base station settings that you are testing, select the measurement, and enter the base station measurement setup parameters.

The LTE signal analyzer offers the following measurement options:

RF Measurements

The following display types are provided for RF measurements:

- LTE Channel Power
- LTE Channel Spectrum
- Gated Sweep (Option 90) and POWER VS. TIME Display

Modulation Measurements

LTE modulation measurements for both frequency division duplex (FDD) and time division duplex (TDD) signals can be viewed in:

- LTE Demod Summary and Multi PCI
- LTE Carrier Aggregation
- LTE Control Channel
- LTE Constellation

5-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 5-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

Figure 5-1. Example Analyzers

5-3 Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 5-4 "Setting Frequency and Bandwidth Parameters" on page 5-4.

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 5-5 "Setting Amplitude" on page 5-6.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 5-6 "Setting Bandwidth Parameters" on page 5-9.

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 5-7 "Setting Trace Parameters" on page 5-10.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90). Refer to Section 5-8 "Setting Sweep Parameters" on page 5-12.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 5-9 "Setting Up Markers" on page 5-16.

LIMIT: Not used in the LTE analyzer.

TRIGGER: Not used in the LTE analyzer.

MEASURE: Used to select measurements such as LTE demodulation summary, channel power, channel spectrum, and views such as time alignment error and resource block power. Refer to "MEASURE Menu (LTE)" on page 5-22.

SETUP: Measurement controls for setting advanced measurements. Refer to Section 5-10 "LTE Measurement Setup" on page 5-21.

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 5-17 "Presetting the Analyzer" on page 5-49.

FILE: Used to save and recall instrument setups and measurements. Refer to Section 5-18 "Saving and Recalling Measurements" on page 5-50.

Figure 5-2. Main Menu

Using Menus

Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.
- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

5-4 Setting Frequency and Bandwidth Parameters

Frequency and channel bandwidth parameters are set using the “FREQUENCY Menu” on page 5-4. The channel center frequency and bandwidth can be set manually. When set to manual band, the EARFCN is unassigned. When a predefined EARFCN is selected, the uplink and downlink carrier frequencies are set automatically.

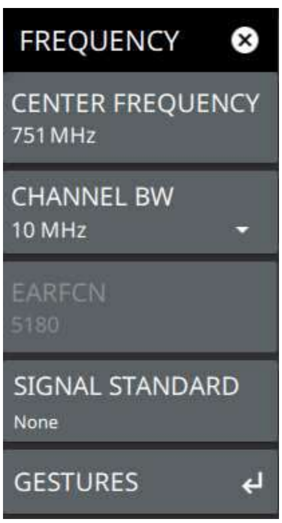
Configuring the Band

These settings are also displayed in the left side status panel and can be directly accessed from those controls.

1. Press FREQ SPAN > CENTER FREQUENCY, and then enter the center frequency using the keypad.
2. Select the channel bandwidth from the CHANNEL BW selection list.
3. Select the EARFCN code form the drop-down selection.

FREQUENCY Menu

The FREQUENCY menu is available in all LTE measurements.



CENTER FREQUENCY: Sets the center frequency of the measurement channel.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

EARFCN: E-UTRA Absolute Radio Frequency Channel Number (EARFCN) uniquely identifies the LTE band and carrier frequency. Sets the uplink and downlink carrier frequencies, which range from 0 to 65535.

SIGNAL STANDARD: Opens the “SIGNAL STANDARDS Dialog” on page 5-5. This dialog provides a selection list of predefined LTE signal standards. Selecting an LTE signal standard configures the instrument for measurements in the selected band.

GESTURES: Opens the “GESTURES Menu” on page 5-5. Not shown in LTE Demod Summary measurement.

Figure 5-3. FREQUENCY Menu (LTE Measurements)

SIGNAL STANDARDS Dialog

The SIGNAL STADARDS dialog is available in all LTE measurements.

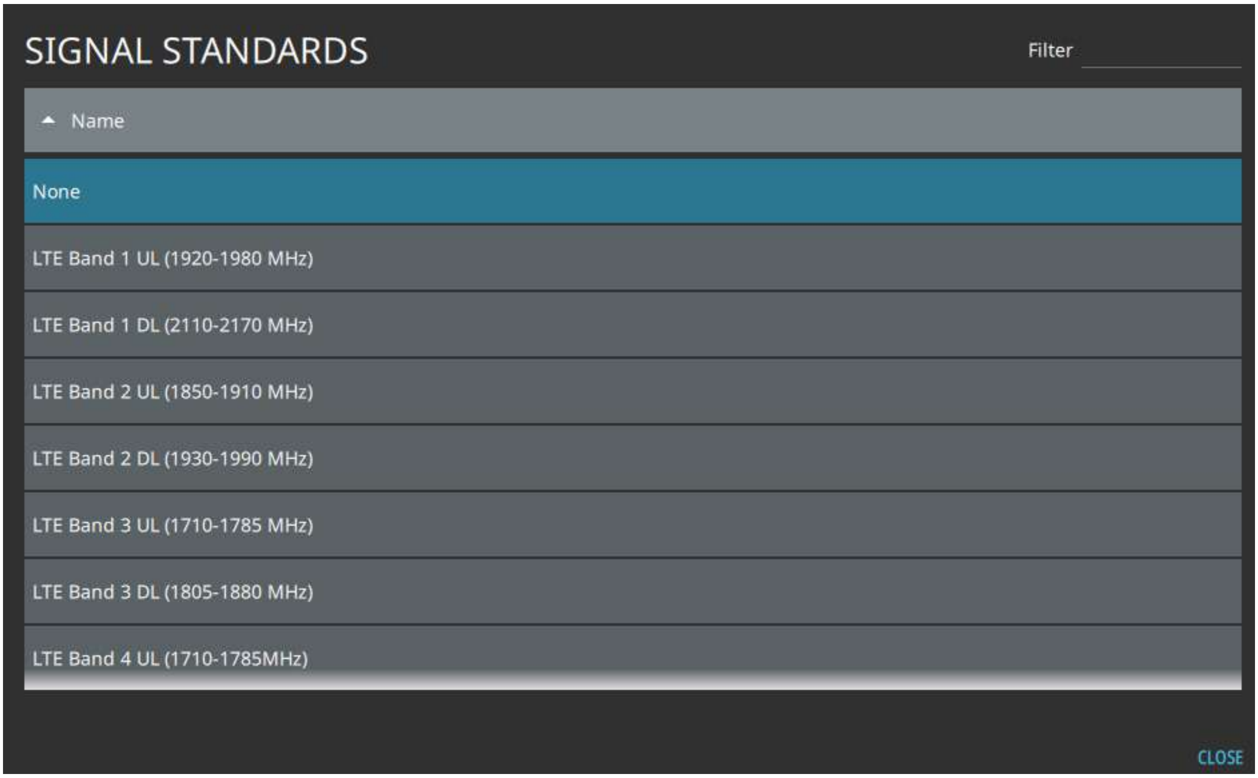
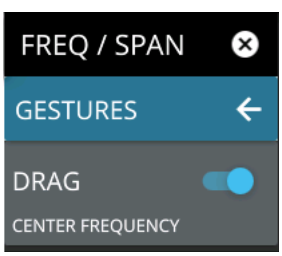


Figure 5-4. SIGNAL STANDARDS Dialog (LTE Measurements)

GESTURES Menu

The GESTURES menu is only available in RF measurements (trace displays).



DRAG: Toggles the touchscreen drag feature on or off. When toggled off, the center frequency will not change when dragging the spectrum display. This can be useful when dragging markers.

Note that the Drag feature can also be toggled on/off by touching the locks under the display.

Figure 5-5. GESTURES Menu (LTE RF Measurements)

5-5 Setting Amplitude

Amplitude-related parameters are set using the "AMPLITUDE Menu" on page 5-8.

Setting Amplitude Parameters

The MS2090A LTE measurement has two different types of amplitude settings, one for the data capture used to decode the signal internally, and one for the display. The amplitude range refers to the amplitude level used to capture the data. The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to "Indications of Excessive Signal Level" on page 5-7). To set the current amplitude reference level:

1. To automatically set optimum settings, press AMPLITUDE > AUTO RANGE. The instrument will dynamically update the attenuation and preamp settings for the capture. AUTO RANGE helps ensure that harmonics and spurs are not introduced into the measurements while giving enough power to accurately decode the signal. When auto range is on, the amplifier and preamp cannot be set manually and the reference level is only used to adjust the top end of the y-axis of the plot or graph.
2. To manually set the range and reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm, or use the AUTO REF LEVEL (available when AUTO RANGE is disabled). This will set the attenuation and preamp for both the plot and the capture.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.
2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.
3. The new reference level offset value will be displayed on the instrument and the reference level is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer's dynamic range. Normally, the input attenuation automatically adjusts as a function of reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to "AMPLITUDE Menu" on page 5-8.
- Turn on the preamplifier.

For RF-based measurements:

- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to "Setting Bandwidth Parameters" on page 5-9.
- Use trace averaging if VBW is already set to 1 Hz.

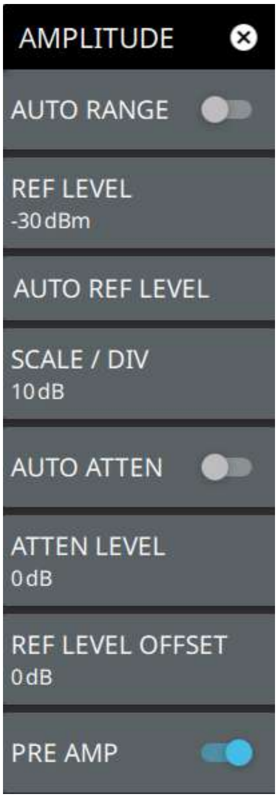
Indications of Excessive Signal Level

The Field Master Pro has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an "ADC Overrange" notification in the title bar (Figure 5-6). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 5-6. ADC Overrange

AMPLITUDE Menu

The AMPLITUDE menu is available in all LTE measurements.



AUTO RANGE: The instrument will dynamically update the attenuation and preamp settings for the measurement. Auto range helps ensure that harmonics and spurs are not introduced into the measurements.

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this menu location. If auto range is enabled, the reference level is graphical only and will have no impact on attenuation or preamp.

AUTO REF LEVEL: Auto reference level will change the reference value so as to place the highest signal amplitude at about two graticule lines from the top. This feature is not available when auto range is enabled.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required. Auto attenuation is not available when auto range is enabled.

ATTEN LEVEL: Manually sets the attenuation level. This feature is not available when auto range or auto attenuation is enabled.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The default offset value is 0 dB. The reference level on the Y-axis will reflect the new offset value. For example, if the reference level was 0 dBm and an offset value of –10 dB is applied, the offset reference level will be 10 dBm.

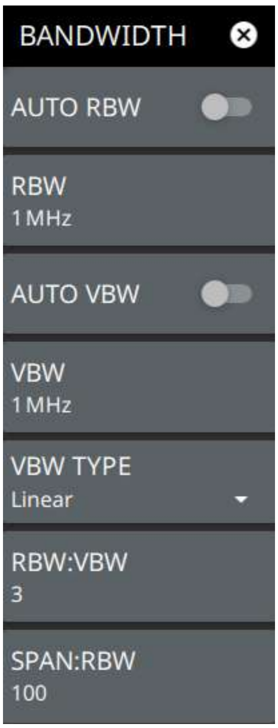
PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and reference level is above –40 dBm.

Figure 5-7. AMPLITUDE Menu (LTE Measurements)

5-6 Setting Bandwidth Parameters

BANDWIDTH Menu

The BANDWIDTH menu is only available for RF measurements (trace display). See the "LTE Measurement Setup" on page 5-21.



AUTO RBW: When toggle on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the X-axis will be preceded by the "#" symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. The RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

AUTO VBW: When toggled on, the instrument selects the video bandwidth based on the resolution bandwidth. The ratio of video bandwidth to resolution bandwidth can be set using the RBW:VBW button. When toggled off (manual), the VBW label at the left edge of the X-axis will be preceded by the "#" symbol.

VBW: The current video bandwidth is displayed under the VBW button. The VBW can be changed using the keypad or slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the video bandwidth range.

VBW TYPE: Toggles between linear averaging (arithmetic mean) and logarithmic averaging (geometric mean).

RBW:VBW: This parameter displays the ratio between resolution bandwidth and video bandwidth. To change the ratio, press this button and use the keypad or the slider controls.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.

Figure 5-8. BANDWIDTH Menu (LTE RF Measurements)

5-7 Setting Trace Parameters

Traces are not used in LTE Demod Summary measurements. Just as in the spectrum analyzer, Field Master Pro can display up to 6 traces simultaneously in LTE RF-based measurements (refer to Section 5-10 "LTE Measurement Setup"). Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the left side status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces in a LTE spectrum measurement, refer to the "TRACE Menu" on page 5-10.

TRACE Menu

The TRACE menu is only available for RF measurements (trace display). Refer to Section 5-10 "LTE Measurement Setup".

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

TRACE MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

Figure 5-9. TRACE Menu (LTE RF Measurements) (1 of 2)

	DETECTOR TYPE: Selects one of three detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of dealing with how measurement points will be shown at each display point (see “Trace Detector Types” on page 3-24). • **Peak:** This method causes the highest amplitude measurement point to be shown for each display point, assuring that a narrow peak is not missed. • **RMS/Avg:** In the default case, when the VBW/AVERAGE type is set to Linear, this method detects the average power of measurement points that go into the display point. When VBW/AVERAGE type is set to Log, the traditional average of log (power), such as dBm, is displayed for the detector, as well as for VBW and trace average. • **Negative:** This method causes the lowest amplitude measurement point to be shown for each display point. This method is also useful when looking at modulated signals, to see if some frequencies are not being used. **CLEAR:** Clears the currently active trace data. **AVERAGES:** Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes. **PRESET DETECTORS:** Sets all trace detectors to Peak. **PRESET:** Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 5-9. TRACE Menu (LTE RF Measurements) (2 of 2)

5-8 Setting Sweep Parameters

When setting up an LTE Demod Summary measurement, sweep parameters are set using the “SWEEP Menu – LTE Demod Summary Measurements” on page 5-12. When setting up an LTE RF measurement, sweep parameters are set using the “SWEEP Menu – LTE RF Measurements” on page 5-12.

SWEEP Menu – LTE Demod Summary Measurements

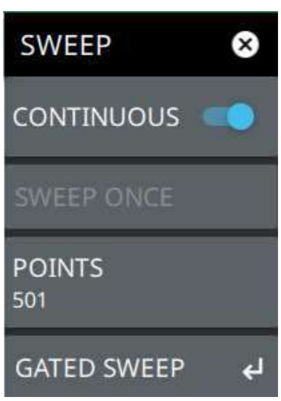
CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

HOLD: Hold will hold the current data display while the analyzer continues to capture and analyze data in the background.

Figure 5-10. SWEEP Menu - LTE Demod Summary Measurements

SWEEP Menu – LTE RF Measurements



CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

POINTS: Sets the number of data points per sweep and displayed in each trace. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace.

GATED SWEEP: Opens the “GATED SWEEP Menu” on page 5-14.

Figure 5-11. SWEEP Menu - LTE RF Measurements

Gated Sweep (Option 90)

Gated sweep is only available on instruments with Option 90 installed and only when an RF-based measurement is selected (Channel Power or Channel Spectrum). Gated sweep allows you to synchronize your sweep with an event so that the analyzer collects data at the appropriate time. This is useful for measuring signals in the time domain such as pulsed RF, time multiplexed, or burst modulated signals. Field Master Pro can use the GPS timing signal as the gating trigger event. This will allow you to synchronize measurements with GPS synchronized communication signals. Set up gated sweep from the “GATED SWEEP Menu” on page 5-14.

To set up the instrument for gated sweep measurements:

1. Press SWEEP > GATED SWEEP.
2. Select the GATE SOURCE. The gate source selected determines the trigger source from which the gate is controlled. Not all instrument models and options support all triggering selections, so your choices may vary. Field Master Pro supports a GPS and external trigger gate source.
3. Select one of the available FRAME TIME durations. The frame time sets the total measurement cycle time.
4. Set the GATE DELAY time. The gate delay sets the time from the triggering event to when the instrument starts sweeping and collecting data.
5. Set the GATE LENGTH time. The gate length sets the time for data capture and analysis.
6. If desired, enable PWR VS TIME (refer to “POWER VS. TIME Display” on page 5-15.)

Below is an example of a gated sweep applied to a channel power measurement. The signal level shown varies cyclically with time and would not be measurable without gated sweep.

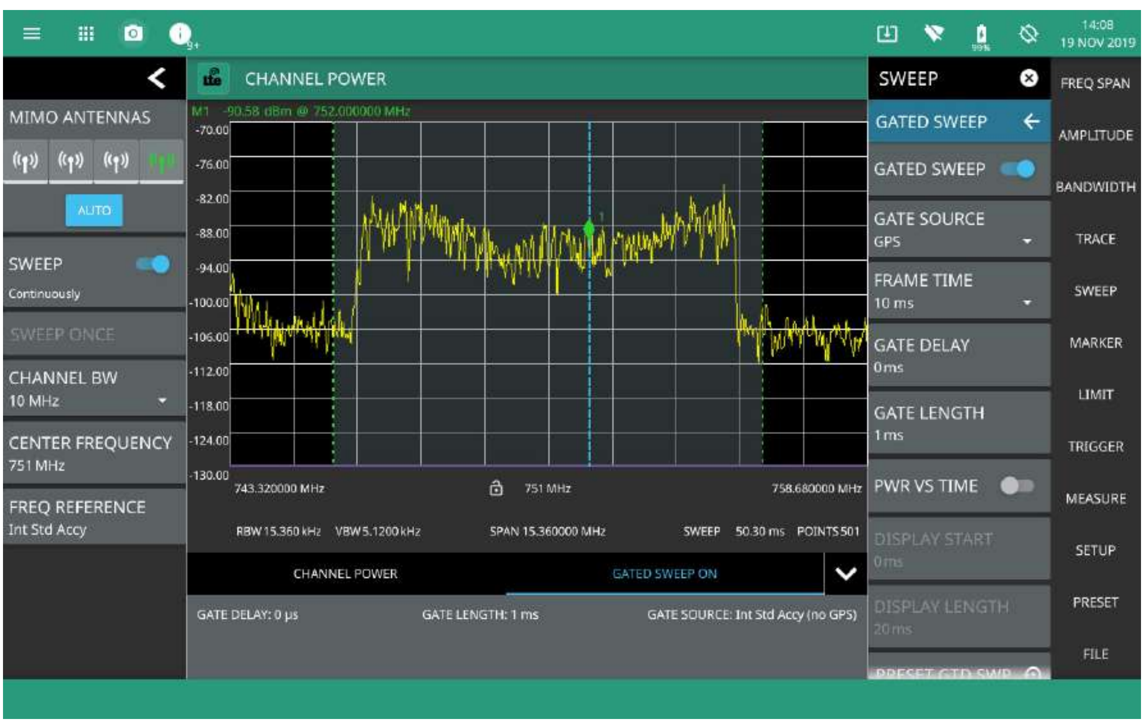


Figure 5-12. Gated Sweep Measurement

The channel power and gated sweep display panels at the bottom can be tapped to open either the Channel Power SETUP menu or the GATED SWEEP menu.

GATED SWEEP Menu

GATED SWEEP: Toggles gated sweep on or off.

GATED SOURCE: Selects the trigger source for the gated sweep.

- **GPS:** This setting synchronizes the trigger source to the GPS PPS.
- **External 1 or 2:** Sets the gate reference based on input from the External 1 or External 2 port.

FRAME TIME: Selects the frame time duration of 10 ms, 20 ms, or 1 s.

GATE DELAY: Sets the start of the gated sweep. When "POWER VS. TIME Display" is enabled, the gate delay is indicated by the blue left border of the power vs time display. You can also drag the entire gate to set the desired gate delay.

GATE LENGTH: Sets the length of the gated sweep. When "POWER VS. TIME Display" is enabled, the gate length is indicated by the width between the blue borders of the power vs time display. You can also drag the right blue border to set the desired gate length.

PWR VS TIME: Enables the "POWER VS. TIME Display" on page 5-15.

DISPLAY START: When Power vs Time is selected, sets the start of the graticule display.

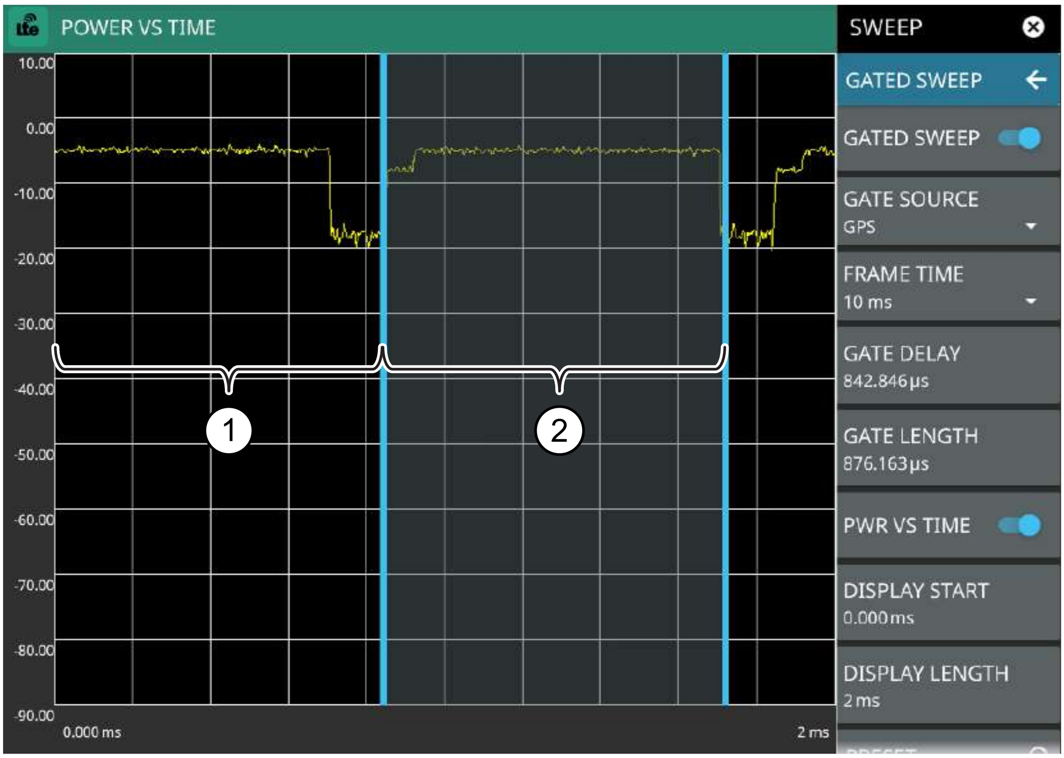
DISPLAY LENGTH: When Power vs Time is selected, sets the time length of the graticule display.

PRESET: Presets gated sweep settings to default values.

Figure 5-13. GATED SWEEP Menu

POWER VS. TIME Display

When power vs time is enabled, a time-domain graph is presented. This graph is a useful visual aid when setting up the GATE DELAY (1) and GATE LENGTH (2) times as you can simultaneously view the signal level within the set frame and relative to your gate delay and length. The display is enabled using the PWR VS TIME toggle setting and should be disabled after setting up the gate delay and length parameters. The gate delay and length are represented by the width of the displayed shaded area flanked with blue lines (see Figure 5-14).



1. Set the gate delay by dragging the left blue setting line. The full time scale is shown along the bottom and the gate delay time will be displayed at the top center of the graticule when it is being adjusted.
2. Set the gate length by dragging the right blue setting line. The full time scale is shown along the bottom and the gate length will be displayed at the top center of the graticule when it is being adjusted.

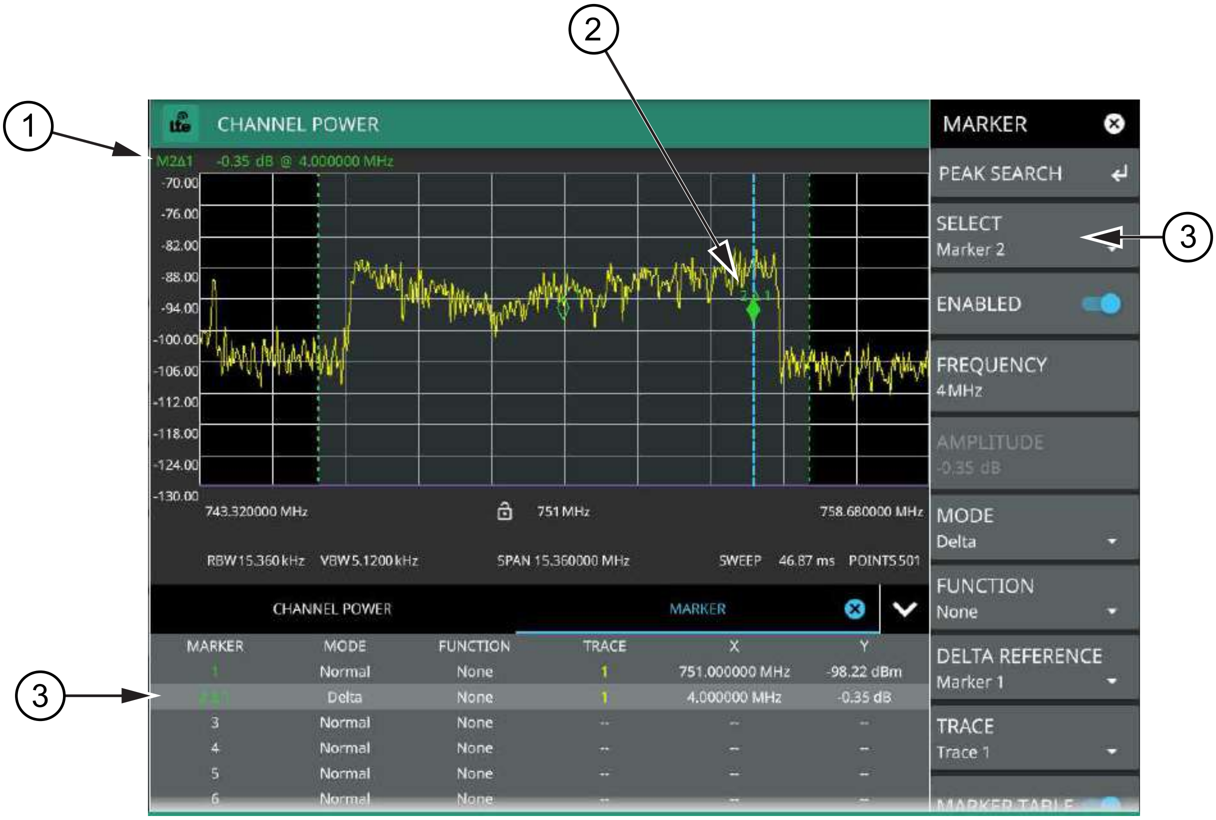
Figure 5-14. Power vs. Time Display

If the blue gate delay and length setting lines are set outside of the displayed graticule scale, you will see “< Gate Start” and “Gate Stop >” messages at the edge of the display indicating where the blue setting lines are located.

Once the gate has been set up, you can apply gating to the spectrum by toggling GATED SWEEP on. Gating will continue to be applied when you access other measurements and functions of the spectrum analyzer until gated sweep is toggled off or an unsupported instrument configuration is selected.

5-9 Setting Up Markers

Markers are not used in LTE Demod Summary measurements. Marker parameters are set using the "MARKER Menu" on page 5-18. Refer to the figure below when working with this section.



1. Normal spectrum view marker information display.
2. Marker located on trace. The active marker is indicated with solid green fill, other markers will show with a hollow fill, fixed markers show as a green X.
3. Selected marker in the MARKER menu and in the marker table. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu.

Figure 5-15. Marker Table and Marker Settings Panels

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the current center frequency.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and placed at the center frequency. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static frequency and amplitude.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   a. Enter a new FREQUENCY value.
   b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 5-19).

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed frequency, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, Delta Marker 3 displays x-axis and y-axis data relative to Marker 3. To set a delta marker and its reference:

1. Activate a marker and place it in a reference location as described previously.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers.
3. Set the second marker's MODE to Delta.
4. Place the active delta marker by:
   a. Entering a new FREQUENCY value.
   b. Dragging the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 5-19).

A delta marker is labeled with a green delta symbol between the each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1".

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 5-19.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center frequency, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker, which is displayed in the upper left-hand corner of the screen. When a marker is turned on, it is a normal marker positioned at the center frequency of the selected trace.

ENABLED: Enables the selected marker.

FREQUENCY: Displays the marker frequency. For delta markers, the frequency is relative to the reference marker. Change the marker frequency by pressing on the marker and dragging it to the desired location. You can also change the marker frequency by touching the value to open the keypad.

AMPLITUDE: Displays the current marker amplitude. If the marker is a fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The frequency is fixed but the amplitude value varies from sweep to sweep.
- **Delta (Δ):** A Delta (Δ) marker displays the delta frequency and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Fixed marker at the same location. The reference marker can then be switched to a Normal marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed frequency, which are defined by the user and not related to the trace or sweep data.

MARKER FUNCTION: Sets the function of the currently selected marker to None, Noise, or Frequency Counter. For more information about using marker functions, refer to "Marker Functions" on page 5-20.

DELTA REFERENCE: Selects the reference marker for a delta marker. A delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen. Refer to "Marker Table" on page 5-20.

CENTER ON MARKER: Sets the center frequency to the currently active marker's frequency value.

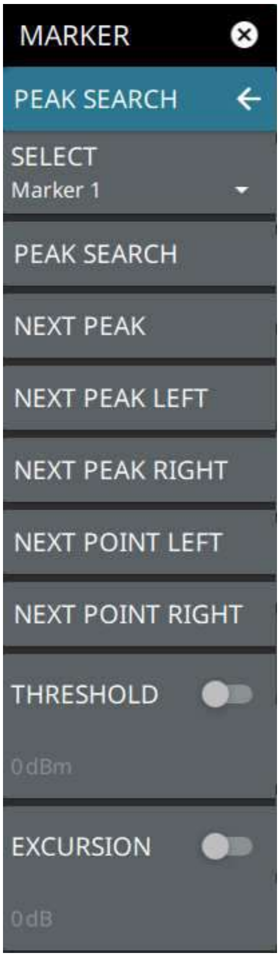
REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET: Presets marker selections to default values.

Figure 5-16. MARKER Menu

MARKER PEAK SEARCH Menu



SELECT: If the selected marker is off it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1. Pressing the PEAK SEARCH button also opens the PEAK SEARCH menu.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 5-17. PEAK SEARCH Menu

Marker Functions

Noise Markers

Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

Frequency Counter Marker

Sets the frequency counter for the selected marker. Marker frequency values are normally limited in resolution to individual display pixels. Each pixel may represent multiple frequencies. When counter marker is enabled, a higher resolution digital signal processing is used within the region of the counter marker to determine a more precise frequency. Using counter marker in association with marker to peak will result in the frequency of the signal peak to a much higher displayed resolution. Note that frequency accuracy is affected by the RBW setting, and sweep times may be longer when using counter marker because of the additional signal processing.

Marker Table

The Marker table display is useful for displaying many marker parameters at once. The example shown is for the LTE Channel Power measurement. The marker table shows the marker mode and corresponding X and Y values, and the trace to which it is selected. The selected marker is displayed with a highlighted background. Table controls are located on the right of the header. Press the down or up arrow to collapse or expand the table, press X to close the table.

MARKER	MODE	FUNCTION	TRACE	X	Y
1	Normal	Noise	1	5.800000010 GHz	-142.43 dBm/Hz
2	Normal	Off	[illegible]	6.152000010 GHz	-66.84 dBm
3	Normal	Off	1	62.690807800 GHz	-67.91 dBm
4	Off	Off	--	--	--
5	Off	Off	--	--	--
6	Off	Off	--	--	--

Figure 5-18. Marker Table

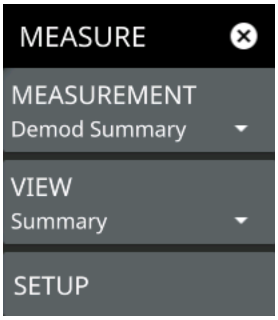
1. You can select and change a marker's parameters by selecting the marker from either the MARKER menu or the MARKER table.
2. The currently selected marker's value is shown at the top left of the spectrum window with its current amplitude and frequency values.
3. The selected marker is highlighted on the trace display.

5-10 LTE Measurement Setup

LTE base station validation qualifies the performance of both FDD and TDD gNB base stations with essential measurements that are in full compliance with 3GPP. The LTE analyzer features smart measurements that make configuring these measurements and views for LTE compliance testing easy:

- LTE demod summary measurements:
    - Frequency Error
    - Time Offset
    - Cell, Sector and Group ID
    - Modulation Quality
    - Primary/Secondary Synchronization Signal (PSS/SSS) Status
    - Primary Broadcast Channel (PBCH) Power
    - Synchronization Signal (SS) Power
    - Reference Signal (RS) Power
    - Multiple Input Multiple Output Antenna Power (Four Antennas)
    - Time Alignment Error between MIMO Antenna Pairs
    - Resource Block Utilization and OSTP
- LTE Multi PCI demod summary measurements
- Channel Power (CP)
- Channel Spectrum (Occupied Bandwidth)
- Carrier Aggregation
- Control Channel
- Constellation

MEASURE Menu (LTE)



MEASUREMENT: Selects the desired measurement type from the following list:

- **LTE Demod Summary:** Displays the current beam measurement status in a quick-view summary that includes the PCI and received power measurement summaries. See “LTE Demod Summary and Multi PCI” on page 5-23.
- **LTE Multi PCI:** Displays the current beam measurement status in a quick-view summary that includes the PCI and received power measurement summaries. See “LTE Multi PCI” on page 5-28.
- **Channel Power:** Provides an RF channel power measurement that includes the total channel power, power spectral density (PSD), and pass/fail compliance testing. See “LTE Channel Power” on page 5-31.
- **Channel Spectrum:** Provides an RF occupied bandwidth measurement that includes the occupied bandwidth, total power, and pass/fail compliance testing. See “LTE Channel Spectrum” on page 5-34.
- **Carrier Aggregation:** Provides a component carrier measurement that includes the PCI, reference signal power, EVM, and Frequency error measurement summaries. See “LTE Carrier Aggregation” on page 5-37.
- **Control Channel:** Provides a component carrier measurement that includes the PCI, reference signal power, EVM, and frequency error measurement summaries. See “LTE Control Channel” on page 5-40.
- **Constellation:** Provides a constellation measurement that includes the PCI summary, reference signal power, EVM, and frequency error measurement summaries. See “LTE Constellation” on page 5-44.

VIEW: When the measurement is Demod Summary, you can select the type of view:

- “LTE Demod Summary View” on page 5-23
- “LTE Time Alignment Error (TAE) View” on page 5-25
- “LTE Resource Block View” on page 5-26

SETUP: Opens one of the measurement SETUP menus. The LTE SETUP menus can be access directly via the SETUP or MEASURE menus after the desired measurement has been selected. The setup menu depends on the current measurement and view selected.

- “SETUP Menu (LTE Demod Summary)” on page 5-27
- “SETUP Menu (LTE Multi PCI)” on page 5-30
- “SETUP Menu (LTE Channel Power)” on page 5-32
- “SETUP Menu (LTE Channel Spectrum)” on page 5-35
- “SETUP Menu (LTE Carrier Aggregation)” on page 5-38
- “SETUP Menu (LTE Control Channel)” on page 5-41
- “SETUP Menu (LTE Constellation)” on page 5-47

Figure 5-19. LTE MEASURE Menu

5-11 LTE Demod Summary and Multi PCI

LTE demod summary measurements are used for compliance testing of 3GPP LTE networks and can evaluate active antenna systems for dynamic physical layer attributes and received power levels of the transmitted signal.

Field Master Pro can analyze a single physical-layer cell or multiple physical-layer cells at one time. The following considerations apply to each measurement.

Single PCI:

- Better for conducted measurements, directional antenna measurements, or if only one cell is present.
- Only one cell is reported. If multiple cells are present, the analysis may jump to different cells or not analyze any of the cells.

Multi PCI:

- Better sync in over the air field conditions.
- Multiple Cells can be reported and sorted on various measurement parameters.

LTE demodulation summary views present the same measurement parameters in both frequency division duplex (FDD) and time division duplex (TDD). FDD or TDD duplex type is selected using the “SETUP Menu (LTE Demod Summary)” on page 5-27. This section illustrates several LTE FDD measurements using both single PCI and multi PCI analysis techniques.

LTE Demod Summary View

An example FDD LTE demod summary measurement is shown in Figure 5-20.

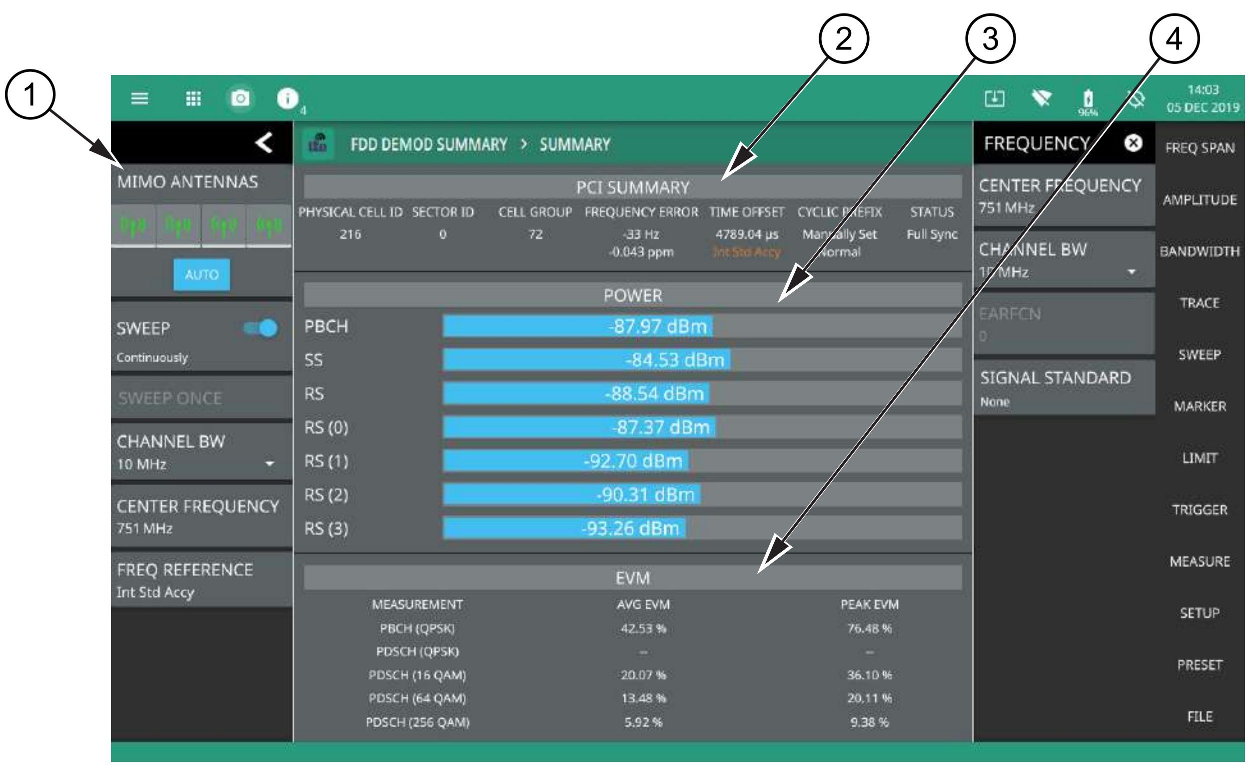


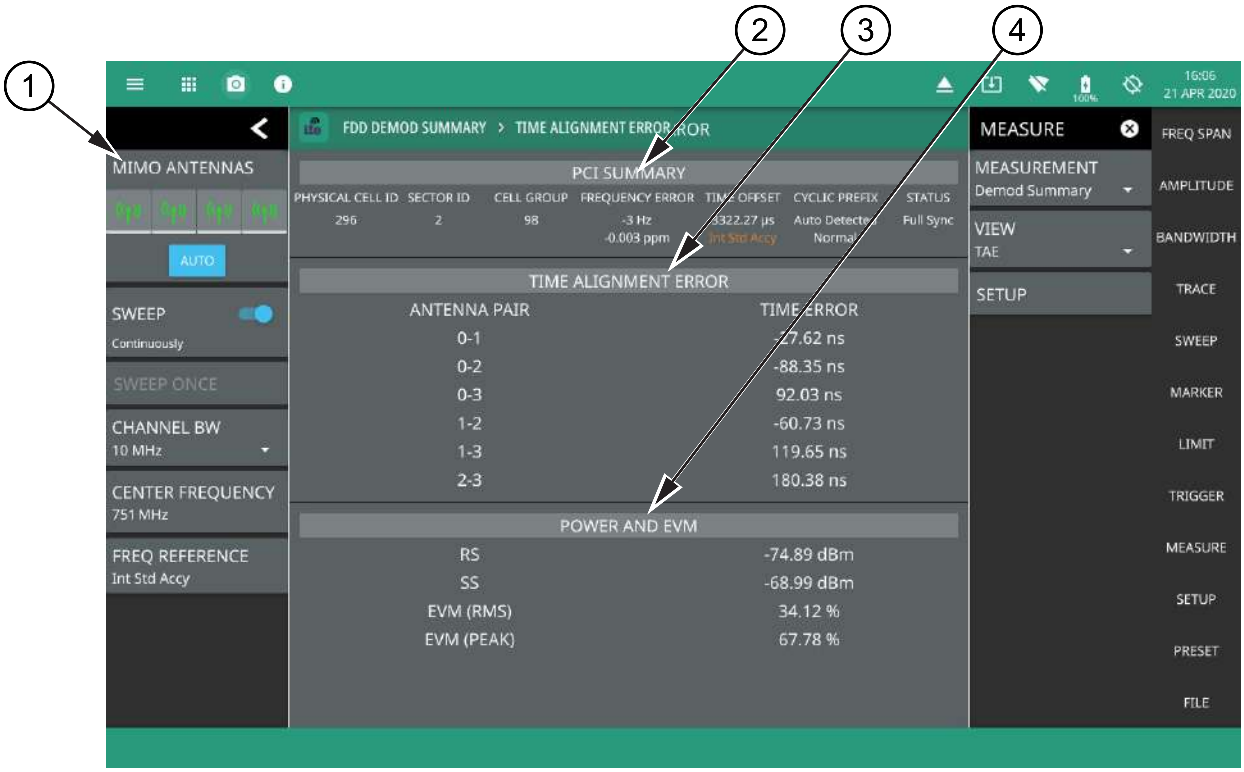
Figure 5-20. LTE FDD Demod Summary Measurement (1 of 2)

1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, sweep setting, and frequency and bandwidth configuration. See "Status Panel (LTE Demod Summary)" on page 5-27.
2. **PCI Summary**: This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **Power Summary**: Shows the received power for each of the following:
   - PBCH: Physical broadcast channel, the main purpose of which is to carry the broadcast master information block.
   - SS: Synchronization signal is used as a preamble sequence in LTE for synchronization purposes.
   - RS: Reference signal is used as a pilot subcarrier for channel estimation and tracking in LTE.
   - RS (0 through 3): Reference signal power of each of the MIMO antennas.
4. **EVM Summary**: Shows the RMS (%) of the error vectors between the reconstructed ideal signals and the received signals, divided by the RMS value of the ideal signals. The first column lists the average EVM (rms) value and the second column lists the peak measured value for each of the following as they are received:
   - PBCH (QPSK): Physical broadcast channel, the main purpose of which is to carry the broadcast master information block.
   - PDSCH (QPSK): Physical downlink shared channel (quadrature phase shift keying).
   - PDSCH (16-QAM, 64-QAM, 256-QAM): Physical downlink shared channel (quadrature amplitude modulation; 16, 64, and 256 states).

Figure 5-20. LTE FDD Demod Summary Measurement (2 of 2)

LTE Time Alignment Error (TAE) View

An example LTE time alignment error measurement is shown in Figure 5-21.

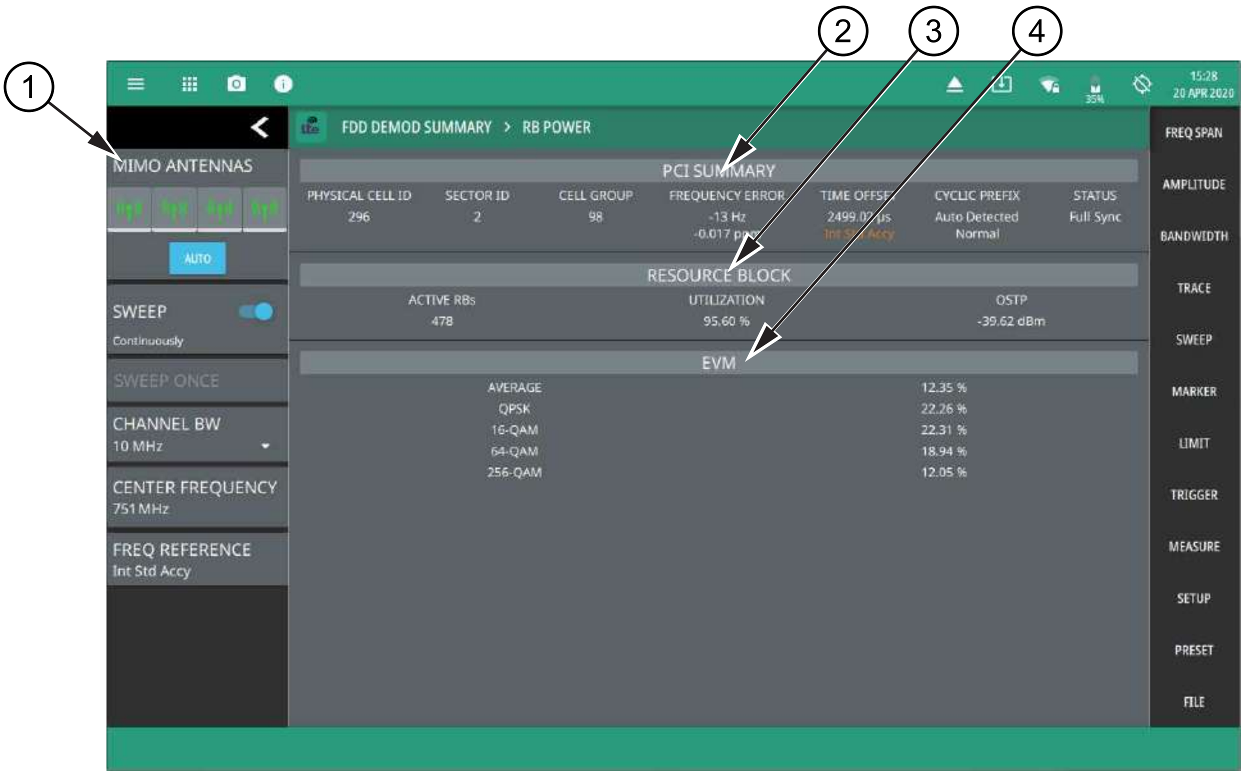


1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, sweep setting, and frequency and bandwidth configuration. See "Status Panel (LTE Demod Summary)" on page 5-27.
2. **PCI SUMMARY:** This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **Time Alignment Error:** Measures the delay between the signals from two antennas at the antenna ports.
4. **Power and EVM:** Measures the power of the reference and secondary sync signals, and the PBCH peak and RMS EVM. (EVM will only display for specific antenna combinations of {0}, {0,1}, {0,1,2,3}. All other combinations will display a blank EVM value.)

Figure 5-21. LTE Time Alignment Error Measurement

LTE Resource Block View

An example LTE resource block measurement is shown in Figure 5-22.



1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, sweep setting, and frequency and bandwidth configuration. See “Status Panel (LTE Demod Summary)” on page 5-27.
2. **PCI Summary**: This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument’s reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **Resource Block**: Shows the number of active resource blocks, utilization (%), and the OFDM Symbol Transmit Power (OSTP) in dBm.
4. **EVM**: Shows the RMS (%) of the error vectors between the reconstructed ideal signals and the received signals, divided by the RMS value of the ideal signals for the average signal, QPSK, 16-QAM, 64-QAM, and 256-QAM.

Figure 5-22. LTE Resource Block Measurement

SETUP Menu (LTE Demod Summary)

The SETUP menu is available in MEASURE > MEASUREMENT > Demod Summary > SETUP.

ANTENNA: Sets the MIMO antenna number (0 to 3, or AUTO) to use during a measurement. AUTO will use the antenna with the highest received signal power.

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal, Extended, or Auto. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

UL/DL CONFIG: Available only in TDD duplex type. Sets the uplink/downlink (UL/DL) configuration, or Frame Format. This selection determines which subframes are uplink subframes and which are downlink subframes, and where the transitions between uplink and downlink subframes occur.

CFI: Selects the control format indicator (CFI) which indicates how many OFDM symbols are used for carrying the control channel at each subframe. CFI1 uses the first symbol at the subframe for PDCCH allocation. CFI2 uses the first and the second symbol for PDCCH. CFI3 uses the first three symbols for PDCCH.

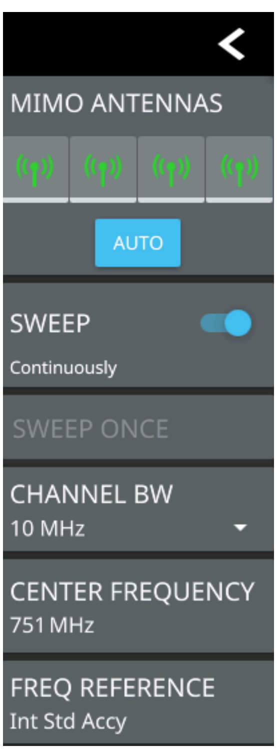
PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-23. LTE SETUP Menu (LTE Demod Summary Measurement)

Status Panel (LTE Demod Summary)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-24 shows the LTE status panel that covers the LTE demod summary measurements.



MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-24. Status Panel (LTE Demod Summary Measurement)

LTE Multi PCI

The following measurement is set up to display LTE Multi PCI data. The multi PCI displays the measurement results of every detected beam in a single, sortable table with a bar graph of the selected measurement.

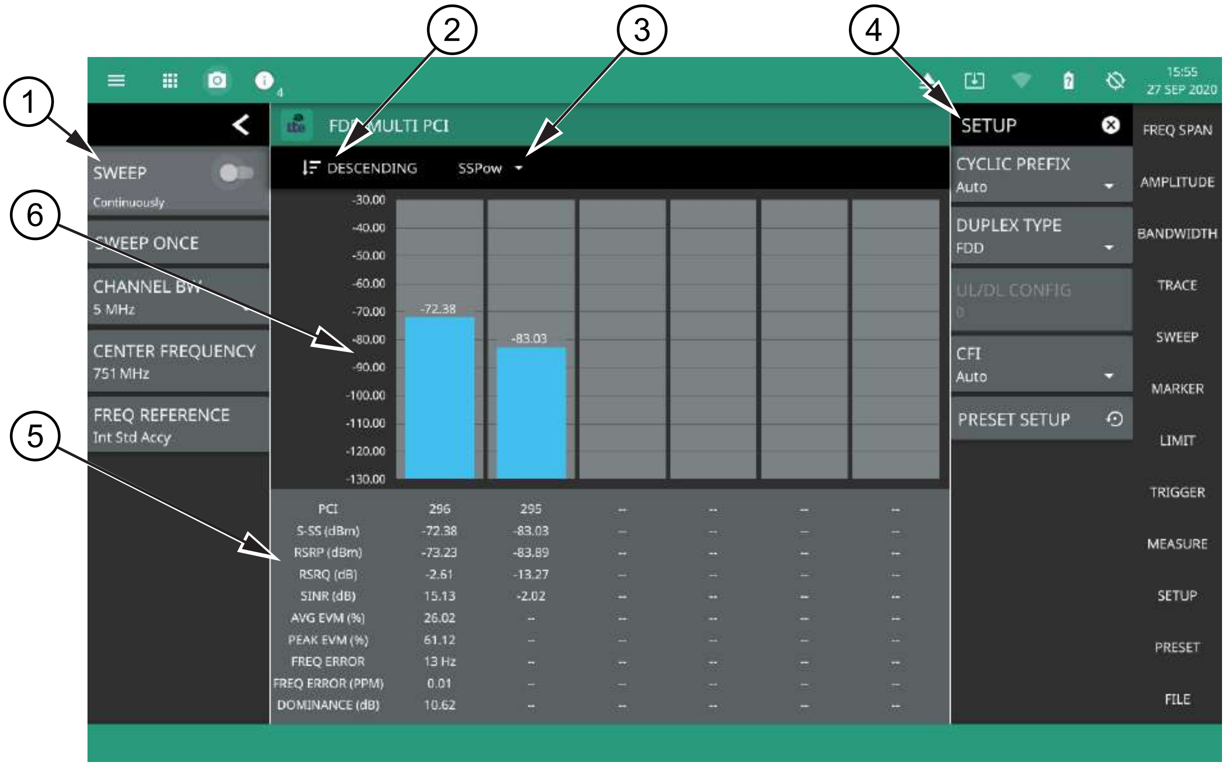


Figure 5-25. LTE Multi PCI (1 of 2)

1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency and band configuration. See “Status Panel (LTE Multi PCI)” on page 5-30.
2. **Sort:** Sets the selected measurement sort order of Descending or Ascending.
3. **Bar Graph Measurement:** Selects which measurement is plotted on the bar graph (RSRP, RSRQ, SINR, PCI, SSPower).
4. **SETUP Menu**: The control channel measurement settings are configured in the SETUP menu. See “SETUP Menu (LTE Multi PCI)” on page 5-30.
5. **Table Display:** fields show the beam index value of the corresponding physical-layer cell ID.
    - **PCI:** These fields show the physical-layer cell ID number. When PCI is selected for the bar graph measurement, the values can be sorted in ascending or descending order by tapping the sort button in the bar graph header.
    - **S-SS (dBm):** These fields show the secondary synchronization signal power of the corresponding physical-layer cell ID, measured in dBm. When SSPower is selected for the bar graph measurement, the values can be sorted in ascending or descending order by tapping the sort button in the bar graph header.
    - **RSRP (dBm):** These fields show the reference signal received power, the average power of resource elements (RE) that carry cell-specific reference signals (RS) over the entire bandwidth. When RSRP is selected for the bar graph measurement, the values can be sorted in ascending or descending order by tapping the sort button in the bar graph header.
    - **RSRQ (dB):** These fields show the reference signal received quality, which provide additional information when RSRP is not sufficient to make a reliable handover or cell reselection decision. RSRQ is the ratio between RSRP and RSSI measured in dB. When RSRQ is selected for the bar graph measurement, the values can be sorted in ascending or descending order by tapping the sort button in the bar graph header.
    - **SINR (dB):** These fields show the signal-to-noise and interference ratio of the corresponding physical-layer cell ID, measured in dB. When SINR is selected for the bar graph measurement, the values can be sorted in ascending or descending order by tapping the sort button in the bar graph header.
    - **AVG EVM (%):** Shows the dominant cell’s AVG EVM of all of the error vectors between the reconstructed ideal signals and the received signals, divided by the RMS value of the ideal signals.
    - **PEAK EVM (%):** Shows the dominant cell’s peak EVM of all of the error vectors between the reconstructed ideal signals and the received signals, divided by the RMS value of the ideal signals.
    - **FREQ ERROR (Hz and PPM):** This is the difference between the measured carrier frequency and the specified carrier frequency of the dominant cell. This number is only as accurate as the frequency reference that is used, and is typically only useful with a good external frequency reference or GPS.
    - **DOMINANCE:** Dominance is the ratio of the dominant cell’s power for the largest signal to the sum of all other signals found, measured in dB.
6. **Bar Graph Display:** Shows the selected measurement as a bar graph with the current value at the top of the graph.

Figure 5-25. LTE Multi PCI (2 of 2)

SETUP Menu (LTE Multi PCI)

The SETUP menu is available in MEASURE > MEASUREMENT > Multi PCI > SETUP.

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal, Extended, or Auto. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

UL/DL CONFIG: Available only in TDD duplex type. Sets the uplink/downlink (UL/DL) configuration, or Frame Format. This selection determines which subframes are uplink subframes and which are downlink subframes, and where the transitions between uplink and downlink subframes occur.

CFI: Selects the control format indicator (CFI) which indicates how many OFDM symbols are used for carrying the control channel at each subframe. CFI1 uses the first symbol at the subframe for PDCCH allocation. CFI2 uses the first and the second symbol for PDCCH. CFI3 uses the first three symbols for PDCCH.

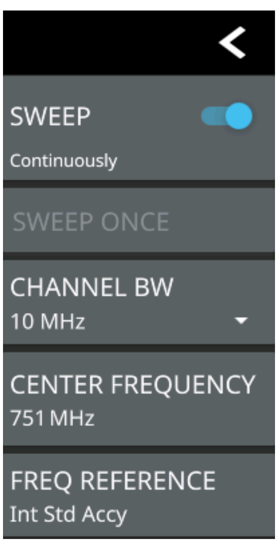
PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-26. LTE SETUP Menu (LTE Multi PCI)

Status Panel (LTE Multi PCI)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-27 shows the LTE status panel that covers the LTE Multi PCI measurements.



SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

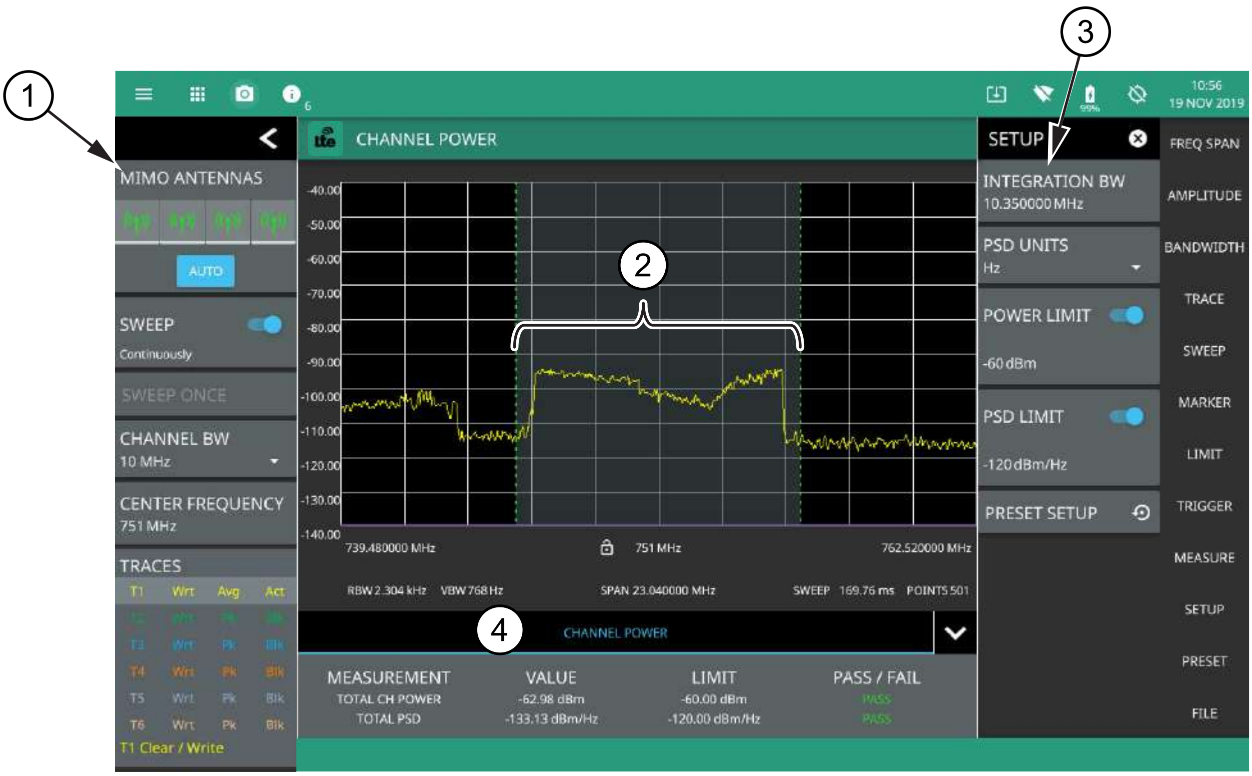
FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-27. Status Panel (LTE Multi PCI Measurement)

5-12 LTE Channel Power

Channel power measurements are one of most common measurements for a radio transmitter. This test measures the output power of a transmitter within the specified channel bandwidth. Out-of-specification power measurements indicate system faults, which can be in the power amplifiers or in filter circuits. Channel power measurements can be used to validate transmitter performance, comply with government regulations, or to keep overall system interference at a minimum.

The channel power measurement is a test performed to measure the power transmitted within a specified frequency or channel bandwidth. The total RF power and power spectral density (PSD) is determined from a channel power measurement. An example of a channel power measurement is shown in Figure 5-28.



1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, sweep setting, and frequency and bandwidth configuration. See “Status Panel (LTE Channel Power)” on page 5-33.
2. **Channel Power:** Channel power is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds.
3. **SETUP Menu**: The channel power settings are configured in the SETUP menu. See “SETUP Menu (LTE Channel Power)” on page 5-32.
4. **Channel Power Summary**: This area shows the channel power measurement summary data and pass/fail test results, when enabled:
   - The total channel power value and the test limit are expressed in dBm with a pass/fail result.
   - The total PSD limit is expressed in dBm with a pass/fail result.
   - Tapping this summary area opens the “SETUP Menu (LTE Channel Power)” on page 5-32.

Figure 5-28. LTE Channel Power Measurement

SETUP Menu (LTE Channel Power)

The channel power SETUP menu is available in MEASURE > MEASUREMENT > Channel Power > SETUP. Once the channel power measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

INTEGRATION BW: Sets the range of integration used in calculating the power in the channel. The integration bandwidth (IBW) is displayed as the shaded region between the bandwidth start and stop thresholds (dashed green lines).

PSD UNITS: Sets the unit bandwidth for power spectral density (PSD). The available units are dBm/Hz and dBm/MHz.

POWER LIMIT: The power limit is the threshold value used to determine whether the actual measured channel power will pass or not. If the measured channel power exceeds the set power limit, the channel power test fails; otherwise, the test passes. Pass/fail test results are shown in the measurement results table.

PSD LIMIT: If the power spectral density limit is on, the PSD limit is the threshold value used to determine whether the actual measured PSD will pass or not. If the measured PSD exceeds the PSD limit, the PSD test fails; otherwise the test passes.

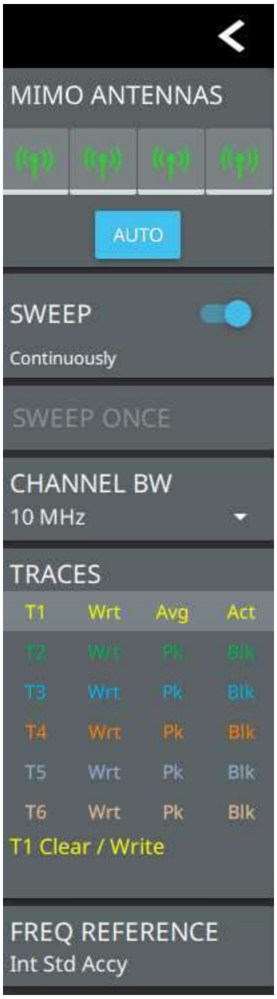
PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-29. LTE SETUP Menu (Channel Power)

Status Panel (LTE Channel Power)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-30 shows the LTE status panel that covers the LTE channel power measurements.



MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace will show a highlighted background with the mode and detector type restated under the table. Pressing a trace in the summary panel activates the pressed trace and opens the TRACE menu, which allows you to select and set up an individual trace as desired. Refer to Section 5-7 “Setting Trace Parameters” on page 5-10.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-30. Status Panel (LTE Channel Power Measurement)

5-13 LTE Channel Spectrum

Channel spectrum (occupied bandwidth) is a common measurement performed on radio transmitters. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending upon the technique used to modulate the carrier.

- % Integrated Power Method: The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.
- X dB Method: The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is a desired number of dB below the peak carrier level.

An occupied bandwidth measurement using the % integrated power is shown in Figure 5-31. The occupied bandwidth here is the bandwidth containing 99% of the total channel power. This is calculated from 0.5 % of the total mean power below the lower frequency limit and 0.5% above its upper frequency limit of the signal. Alternatively, the measurement can be set up to use the X dB method where the occupied bandwidth is determined from the upper and lower bandwidth edges that are X dB down from the total mean power of the signal.

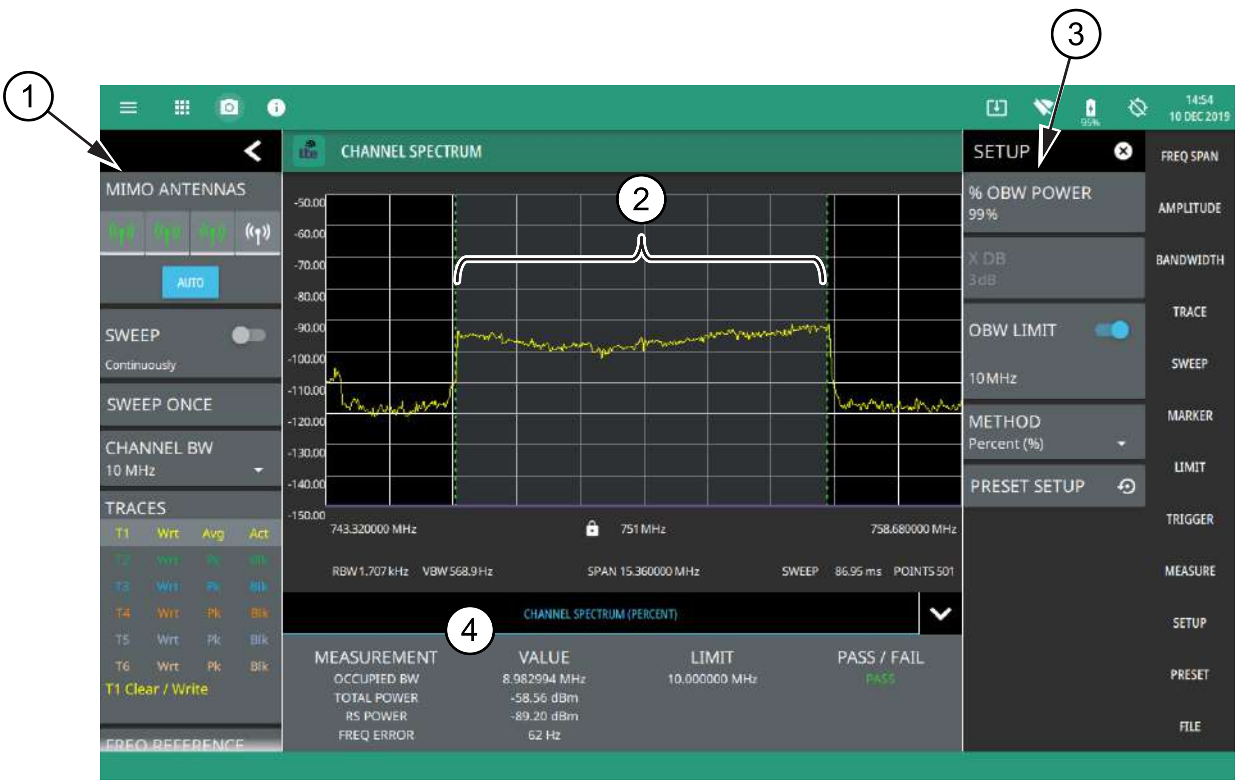


Figure 5-31. LTE Channel Spectrum (Occupied Bandwidth) Measurement (1 of 2)

1. **LTE Channel Spectrum Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency and band configuration. See “Status Panel (LTE Channel Spectrum)” on page 5-36.
2. **Occupied Bandwidth:** Occupied bandwidth is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds. The analyzer will determine and track the occupied bandwidth of the signal within the current span.
3. **SETUP Menu**: The occupied bandwidth settings are configured in the SETUP menu. See “SETUP Menu (LTE Channel Spectrum)” on page 5-35.
4. **OBW Summary**: This area shows the occupied bandwidth measurement summary data and pass/fail test results, when enabled:
   - The occupied bandwidth value and the test limit are expressed in frequency units with a pass/fail result.
   - The total power is integrated over the measured bandwidth and is expressed in dBm.
   - The received signal power is expressed in dBm.
   - The transmit signal frequency error is expressed in frequency units (Hz).
   - Tapping this summary area opens the OBW SETUP menu.

Figure 5-31. LTE Channel Spectrum (Occupied Bandwidth) Measurement (2 of 2)

SETUP Menu (LTE Channel Spectrum)

The Occupied Bandwidth SETUP menu is available in MEASURE > MEASUREMENT > Channel Spectrum > SETUP. Once the channel spectrum measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

% OBW POWER: Sets the percentage of the total power that is measured within the occupied bandwidth for the current measurement. The resulting occupied bandwidth and total power values are displayed in the measurements results table.

X dB: Sets the x dB value used for the "x dB bandwidth" measurement. The occupied bandwidth is the frequency range between two points on the signal that are x dB down from the highest signal point within the OBW span.

OBW LIMIT: Enables limit checking at the specified frequency. The limit test results show as a green PASS or a red FAIL in the measurement table.

METHOD: Select the measurement method to be PERCENT (%) or X (dB).

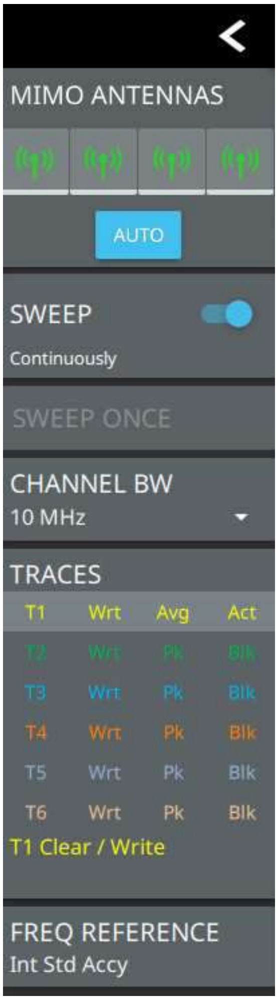
PRESET: Presets the SETUP menu to default settings.

Figure 5-32. LTE SETUP Menu (Channel Spectrum)

Status Panel (LTE Channel Spectrum)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-33 shows the LTE status panel that covers the LTE Channel Spectrum measurements.



MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

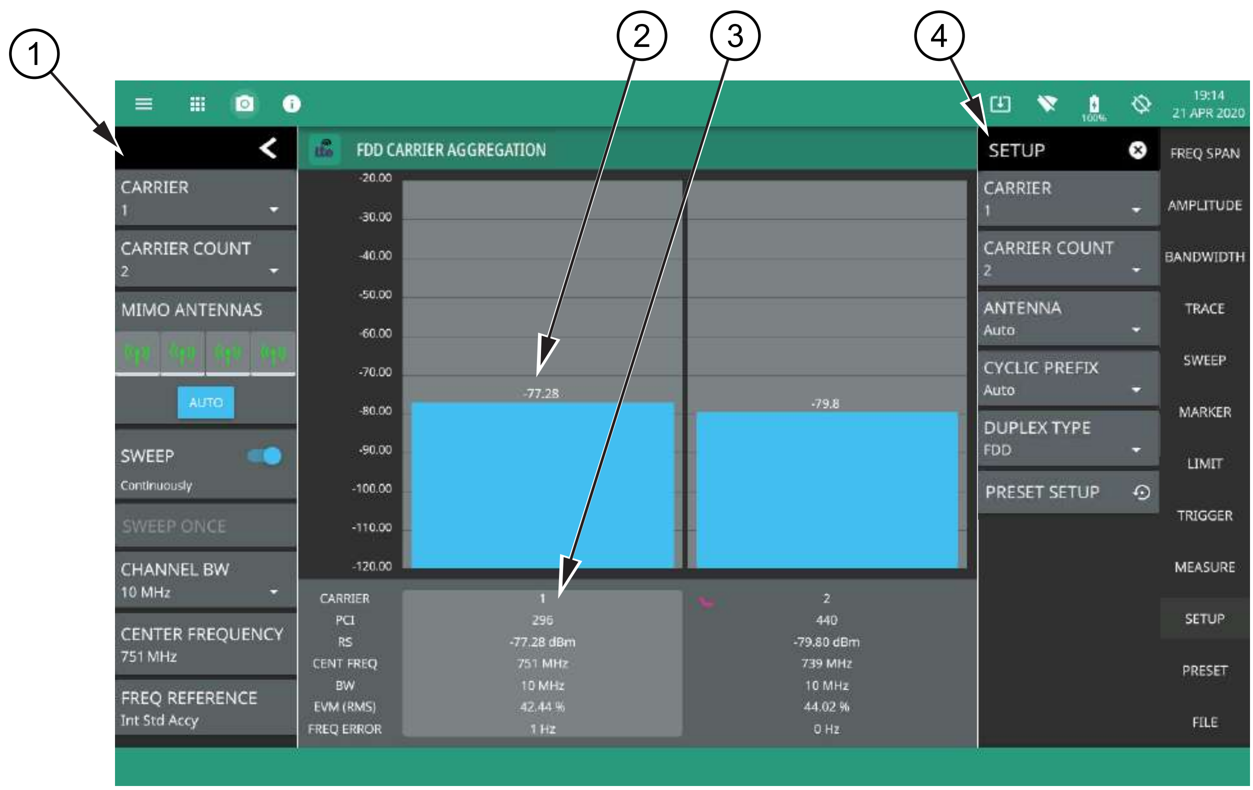
TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-33. Status Panel (LTE Channel Spectrum Measurement)

5-14 LTE Carrier Aggregation

LTE carrier aggregation measurements are used for compliance testing of 3GPP LTE networks and can evaluate active antenna systems for dynamic physical layer attributes and received power levels of the transmitted signal. Carrier aggregation displays up to eight component carrier (CC) measurements. Each carrier can be set up uniquely for signal band. An example LTE carrier aggregation measurement is shown in Figure 5-34.



1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, current carrier and carrier count, sweep setting, and channel bandwidth configuration. See “Status Panel (LTE Carrier Aggregation)” on page 5-39.
2. **Signal Level**: This area shows a bar graph of the signal level of the specific carrier.
3. **Summary Display**: Shows data for each numbered component carrier. The highlighted summary display area is the component carrier data that can be edited, and this area can be touched to select that component carrier for editing. A rotating magenta circle indicates which carrier is currently being measured.
   - Physical Cell ID (PCI) identifying information sent by the transmitter in the sync signal.
   - Reference Signal (RS) power is displayed in dBm. The reference signal is used for downlink channel estimation.
   - Center frequency of the measurement channel.
   - Channel bandwidth (BW) sets the bandwidth of the component carrier.
   - EVM (RMS) shows the percentage value of all the error vectors between the reconstructed ideal signals and the received signals divided by the RMS value of the ideal signals.
   - Frequency error is the difference between the measured carrier frequency and the specified carrier frequency. This measurement is only as accurate as the frequency reference that is used and is typically only useful with a good external frequency reference or GPS.
4. **SETUP Menu**: The component carrier settings are configured in the SETUP menu. See “SETUP Menu (LTE Carrier Aggregation)” on page 5-38.

Figure 5-34. LTE Carrier Aggregation Measurement

SETUP Menu (LTE Carrier Aggregation)

The carrier aggregation SETUP menu is available in MEASURE > MEASUREMENT > Carrier Aggregation > SETUP.

CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area and any setting changes will apply to the active carrier. Note that the active carrier is not necessarily the one that is currently being measured.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

ANTENNA: Sets the MIMO antenna number (0 to 3, or AUTO) to use during a measurement. AUTO will use the antenna with the highest received signal power.

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal, Extended, or Auto. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

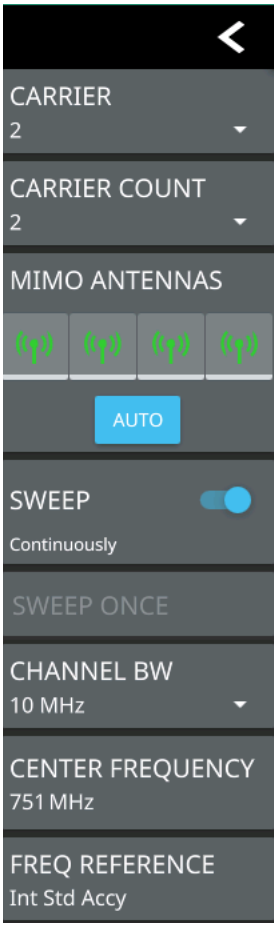
PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-35. LTE SETUP Menu (Carrier Aggregation)

Status Panel (LTE Carrier Aggregation)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-36 shows the LTE status panel that covers the LTE carrier aggregation measurement.



CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-36. Status Panel (LTE Carrier Aggregation Measurement)

5-15 LTE Control Channel

LTE control channel measurement shows the power levels of key physical layer control channels and can evaluate active antenna systems for dynamic physical layer attributes and received power levels. An example LTE control channel measurement is shown in Figure 5-37.

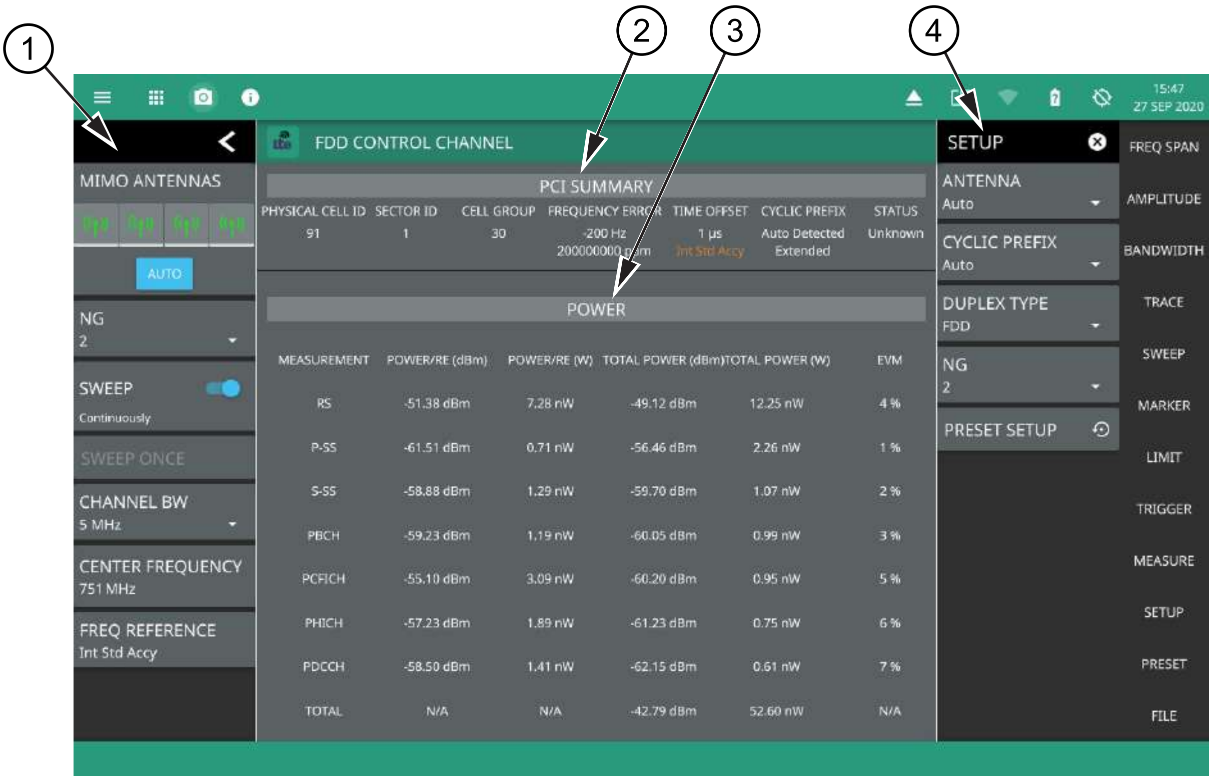


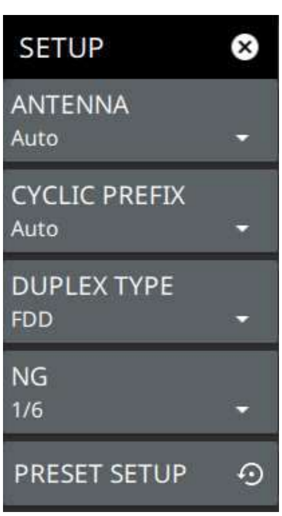
Figure 5-37. LTE Control Channel Measurement (1 of 2)

1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, NG parameter, sweep setting, and channel bandwidth configuration. See "Status Panel (LTE Control Channel)" on page 5-43.
2. **PCI SUMMARY:** This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, cyclic prefix, and sync status. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **POWER**: Shows power levels in dBm and watts of each physical layer control:
    - Reference Signal (RS) Power: The reference signal is used for downlink channel estimation.
    - Primary Synchronization Signal (P-SS) Power. The primary sync signal is used to obtain slot synchronization. It contains information needed for cell search.
    - Secondary Synchronization Signal (S-SS) Power: The secondary sync signal is used to obtain frame synchronization and cell identity. It contains information needed for cell search.
    - Physical Broadcast Channel (PBCH) Power: This physical channel carries system information for user equipment (UE) requiring access to the network.
    - Physical Control Format Indicator Channel (PCFICH) Power: This channel provides information to enable the UE to decode the PDCCH and PDSCH channels.
    - Physical Hybrid Automatic Repeat Request Indicator Channel (PHICH): Transmits the channel coded HARQ indicator codeword used for error correction.
    - Physical Downlink Control Channel (PDCCH): Physical channel that carries downlink control information (DCI) such as scheduling assignments and other control information.
    - TOTAL: Displays total POWER/RE (power per resource element) and POWER in dBm and watts. The total power for a signal is calculated as the product of the EPRE (Energy per Resource Element) for the signal and the number of REs in one unit (sub-frame, half-frame, or frame) depending on periodicity of the signal in the frame (signal present in every sub-frame, half-frame, or frame), averaged over the number of symbols in the same unit over which REs are counted. Total EVM is not calculated.
4. **SETUP Menu**: The control channel measurement settings are configured in the SETUP menu. See "SETUP Menu (LTE Control Channel)" on page 5-41.

Figure 5-37. LTE Control Channel Measurement (2 of 2)

SETUP Menu (LTE Control Channel)

The control channel SETUP menu is available in MEASURE > MEASUREMENT > Control Channel > SETUP.



ANTENNA: Sets the MIMO antenna number (0 to 3, or AUTO) to use during a measurement. AUTO will use the antenna with the highest received signal power.

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal, Extended, or Auto. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

NG: Selects the NG parameter of 1/6, 1/2, 1, or 2. NG is a parameter that determines the number of PHICH (Physical Hybrid ARQ Indicator Channel) groups in an LTE sub-frame (this number is constant for all sub-frames).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-38. SETUP Menu (LTE Control Channel)

Status Panel (LTE Control Channel)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-39 shows the LTE status panel that covers the LTE control channel measurement.

MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

NG: Selects the NG parameter of 1/6, 1/2, 1, or 2. NG is a parameter that determines the number of PHICH (Physical Hybrid ARQ Indicator Channel) groups in an LTE sub-frame (this number is constant for all sub-frames).

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-39. Status Panel (LTE Control Channel Measurement)

5-16 LTE Constellation

The LTE constellation measurement displays the demodulated symbol point location on an IQ coordinate plot, which illustrates the constellation of a particular modulation format. Field Master Pro displays QPSK, 16-QAM, 64-QAM, and 256-QAM constellations with power and EVM tabular data. An example LTE constellation display and measurement is shown in Figure 5-40.

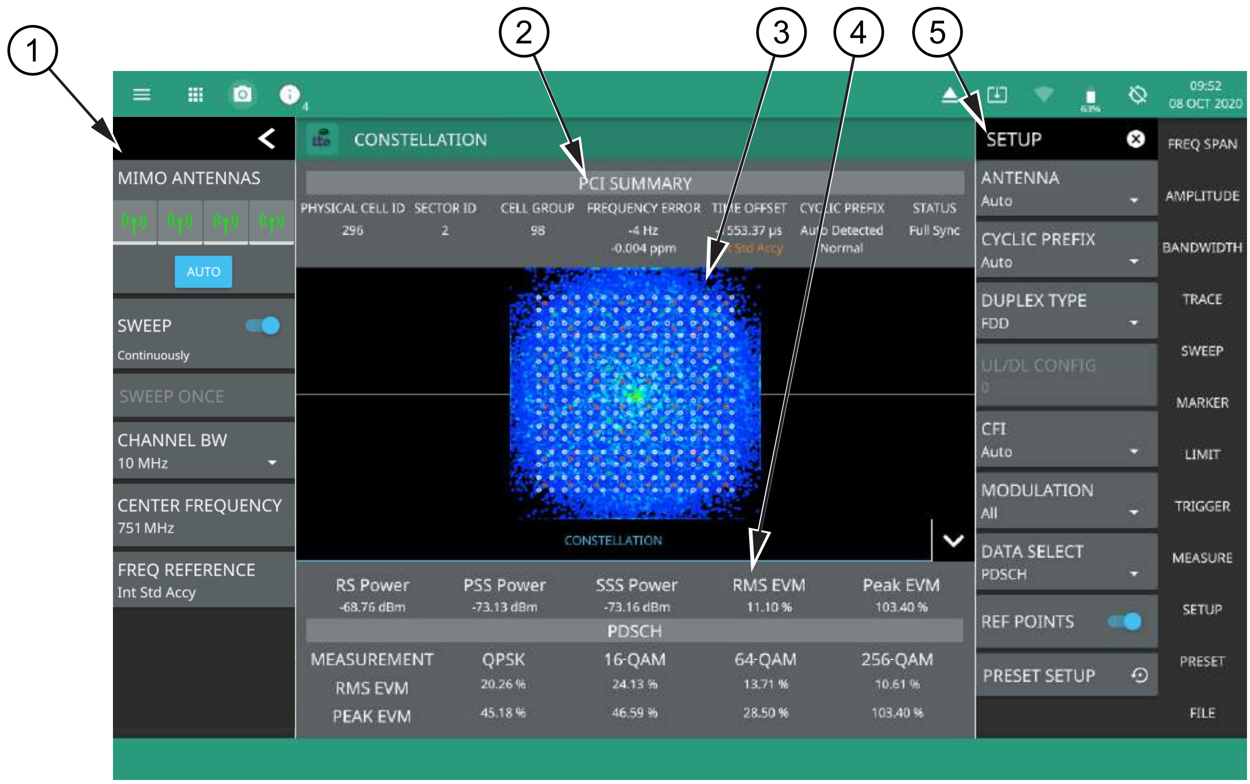
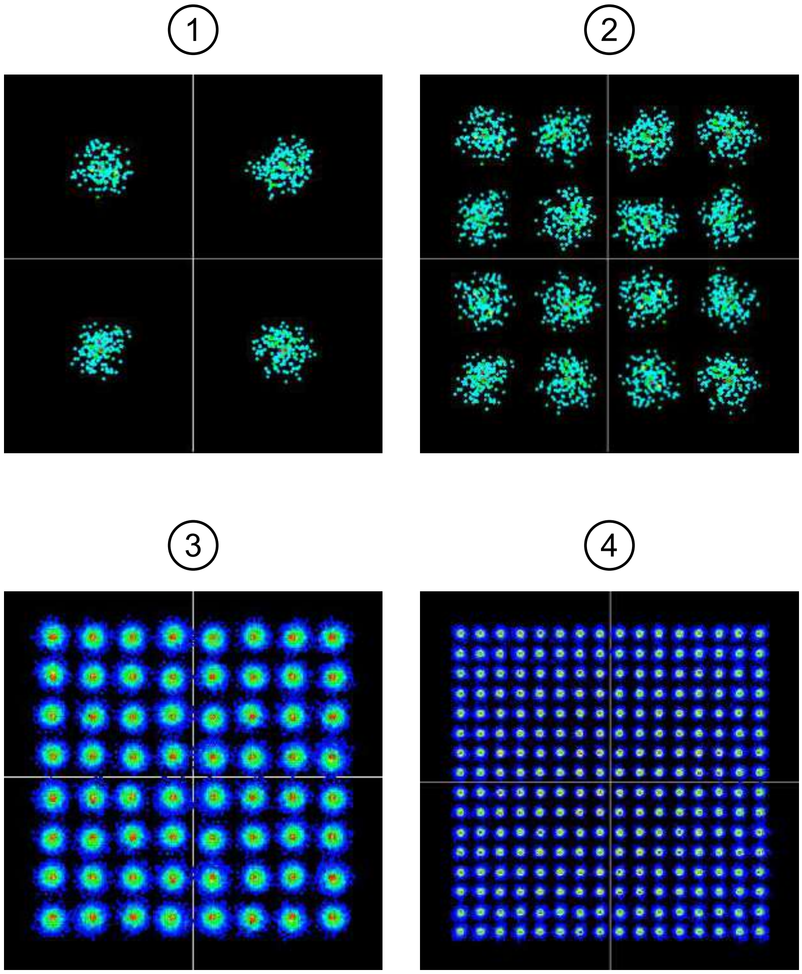


Figure 5-40. LTE Constellation Measurement (1 of 2)

1. **LTE Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the MIMO antenna selection and status, sweep setting, and channel bandwidth and frequency configuration. See “Status Panel (LTE Constellation)” on page 5-48.
2. **PCI SUMMARY:** This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, cyclic prefix, and sync status. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument’s reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **Constellation**: This area displays the demodulated symbol point location on an IQ coordinate plot. Points are drawn in colors that are associated with the symbol point density. Warmer colors (red/orange) indicate a higher symbol density where cooler colors (cyan/blue) indicate lower symbol density. The ideal symbol reference point location overlay can be toggled on or off via the SETUP menu.
4. **POWER**: Shows power levels in dBm of each physical layer control:
   - Reference Signal (RS) Power: The reference signal is used for downlink channel estimation.
   - Primary Synchronization Signal (PSS) Power. The primary sync signal is used to obtain slot synchronization. It contains information needed for cell search.
   - Secondary Synchronization Signal (SSS) Power: The secondary sync signal is used to obtain frame synchronization and cell identity. It contains information needed for cell search.
   - Error Vector Magnitude (EVM): RMS and PEAK EVM are shown for each demodulated format (QPSK, 16-QAM, 64-QAM, 256-QAM), including the total RMS EVM and PEAK EVM for the measurement at the top of the table.
5. **SETUP Menu**: The constellation measurement settings are configured in the SETUP menu. See “SETUP Menu (LTE Constellation)” on page 5-47.

Figure 5-40. LTE Constellation Measurement (2 of 2)

Figure 5-41, "LTE Constellation Measurement Examples" illustrates example LTE constellation diagrams. The examples are presented with the reference point overlay enabled for the specific modulation type. A tighter grouping of points generally means a better quality signal with fewer symbol errors. Also, the point color indicates the relative symbol density at that location. Red, orange and yellow points represent a higher symbol count and green, cyan, and blue represent a lower symbol count.



1. Over-the-air QPSK measurement.
2. Over-the-air 16-QAM measurement.
3. Conducted 64-QAM measurement.
4. Conducted 256-QAM measurement.

Figure 5-41. LTE Constellation Measurement Examples

Note	The reference point overlay is displayed individually when the modulation format is selected (QPSK, 16-QAM, 64-QAM, or 256-QAM). When the modulation format is set to All, then all modulation reference points are shown. Each modulation format reference point is color coded. These colors do not match the display point colors.

SETUP Menu (LTE Constellation)

The constellation SETUP menu is available in MEASURE > MEASUREMENT > Constellation > SETUP.

ANTENNA: Sets the MIMO antenna number (0 to 3, or AUTO) to use during a measurement. AUTO will use the antenna with the highest received signal power.

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal, Extended, or Auto. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

UL/DL CONFIG: Available only in TDD duplex type. Sets the uplink/downlink (UL/DL) configuration, or Frame Format. This selection determines which subframes are uplink subframes and which are downlink subframes, and where the transitions between uplink and downlink subframes occur.

CFI: Selects the control format indicator (CFI) which indicates how many OFDM symbols are used for carrying the control channel at each subframe. CFI1 uses the first symbol at the subframe for PDCCH allocation. CFI2 uses the first and the second symbol for PDCCH. CFI3 uses the first three symbols for PDCCH.

MODULATION: Selects the modulation format (ALL, QPSK, 16-QAM, 64-QAM, 256-QAM). When the data format is set to PBCH, only QPSK is available.

DATA SELECT: Selects the data format of Physical Downlink Shared Channel (PDSCH) or Physical Broadcast Channel (PBCH).

REF POINTS: Toggles the ideal reference point locations on or off. Note that each modulation format reference point is color coded.

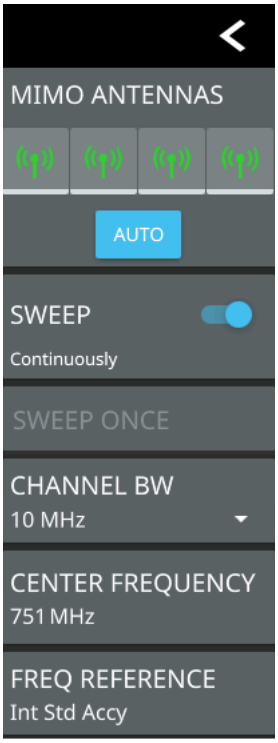
PRESET SETUP: Presets the SETUP menu to default settings.

Figure 5-42. SETUP Menu (LTE Constellation)

Status Panel (LTE Constellation)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 5-43 shows the LTE status panel that covers the LTE constellation measurement.



MIMO ANTENNAS: Toggles the current MIMO antenna setting between AUTO or to select one of the available antennas. When a single antenna is selected, a blue underscore will appear below the antenna icon. The antenna icon is highlighted green when receiving a signal.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

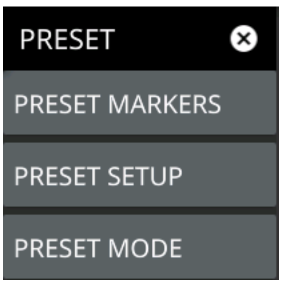
FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 5-43. Status Panel (LTE Constellation)

5-17 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the LTE analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, “Reset Settings” on page 2-35. To recover from system software faults, refer to Appendix A, “Instrument Messages and Troubleshooting”.

PRESET Menu



PRESET MARKERS: Presets all values on the MARKER menu to default values. Not available in LTE Demod Summary measurement.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 5-44. PRESET Menu

5-18 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, native trace and CSV trace data, limit line setups, and screenshots. You can recall setup, native trace, and limit line files. For other file operations such as copy, move, and directory management, refer to Section 2-12 “File Management” on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 5-45:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

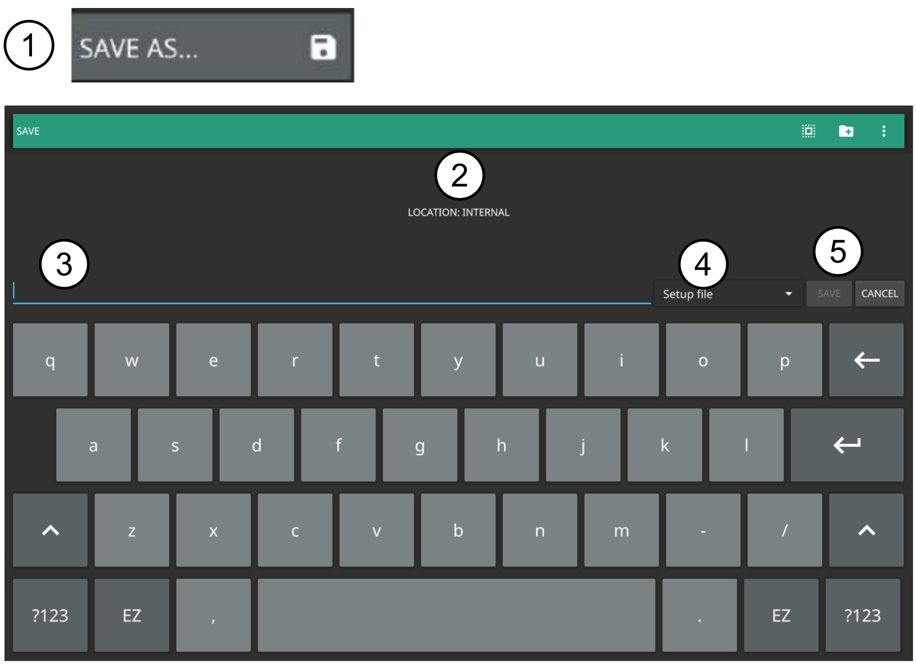


Figure 5-45. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 5-46:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

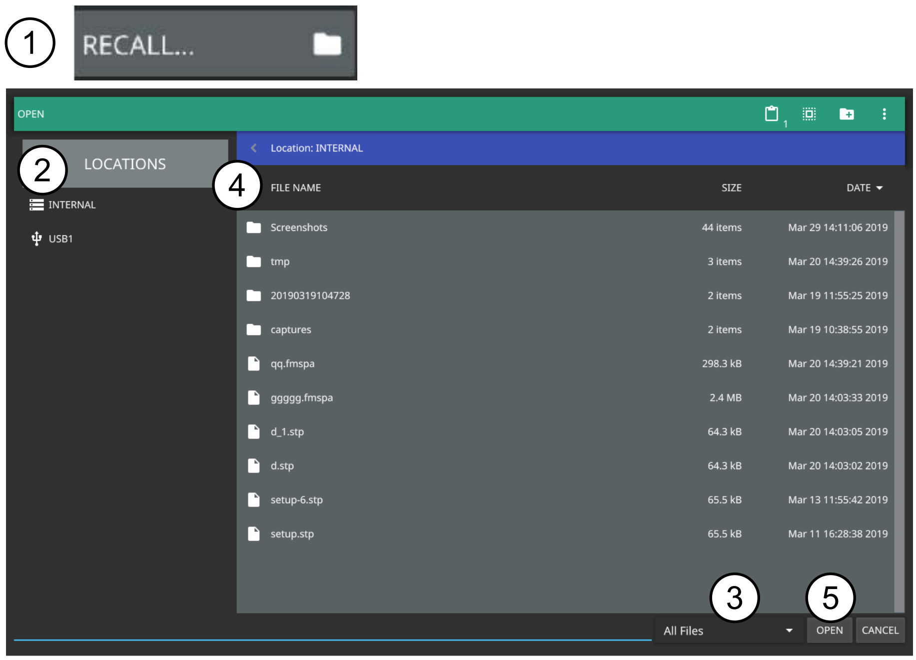


Figure 5-46. File Open Dialog

When a trace measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements:

- For a LTE demod summary measurement, disable SWEEP > HOLD
- For an RF-based measurement, set TRACE > MODE > Active

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fmlte file type).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fmlte and png file types).

RECALL: Opens the Recall File dialog to retrieve a file from a desired location.

LTE CAPTURE: Initiates a digitized LTE data capture at the selected bandwidth. LTE captures are saved to the internal storage space in the captures folder (bin file type). This feature is meant to help identify LTE signal characteristics during early development.

BROWSE FILES: Opens "File Management" on page 2-36.

Figure 5-47. FILE Menu

Chapter 6 — 5GNR Measurements

6-1 Introduction

This chapter gives a brief overview of the Anritsu Field Master Pro 5GNR analyzer and its measurement capabilities. The purpose of this chapter is to provide a starting point for making 5GNR measurements. This chapter describes measurement setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, and markers. After measurements are taken, refer to Section 6-18 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

A basic understanding of the measurement concepts presented in Chapter 3, "Spectrum Analyzer Measurements" is recommended before performing the procedures in this chapter. 5GNR measurements include the use of additional functions beyond frequency, span, amplitude, and marker functions. Section 6-4 through Section 6-9 explain general setup procedures and settings. Section 6-10 through Section 6-16 provide example 5GNR measurements that are available in the 5GNR analyzer.

5GNR measurement setups typically conform to the 3GPP and device manufacturer standards. They can be configured manually or based on the band selection and accompanying ARFCN and GSCN assignments. Field Master Pro is designed to make setting up your measurement as easy as possible. Simply refer to the specification for the measurement and base station settings that you are testing, select the measurement, and enter the base station measurement setup parameters.

The 5GNR signal analyzer offers the following measurement options:

RF Measurements

The following display types are provided for RF measurements:

- 5GNR Channel Power
- 5GNR Occupied Bandwidth
- Gated Sweep (Option 90) and POWER VS. TIME Display
- 5GNR EIRP

Modulation Measurements

LTE modulation measurements for both frequency division duplex (FDD) and time division duplex (TDD) signals can be viewed in:

- 5GNR Summary and Multi PCI
- 5GNR Carrier Aggregation
- 5GNR Constellation

6-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 6-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

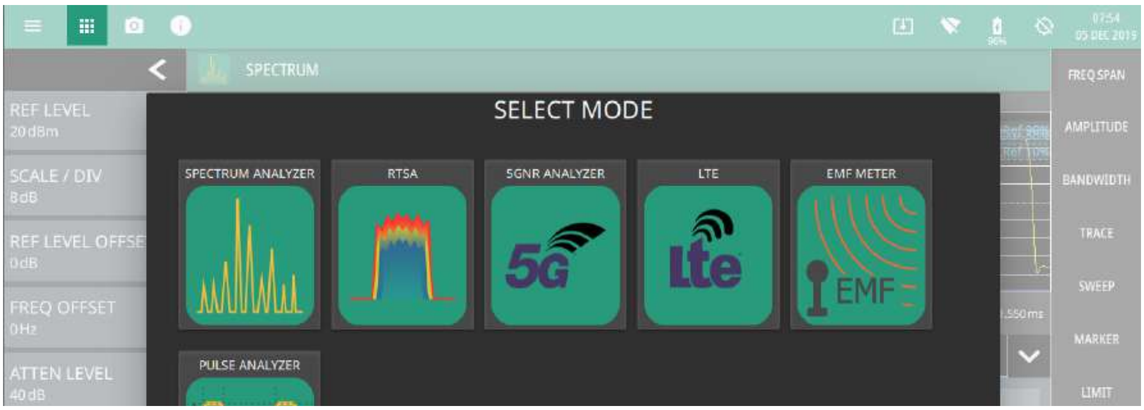


Figure 6-1. Example Analyzers

6-3 Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 6-4 “Setting Frequency and Band Parameters” on page 6-4.

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 6-5 “Setting Amplitude” on page 6-7.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 6-6 “Setting Bandwidth Parameters” on page 6-10.

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 6-7 “Setting Trace Parameters” on page 6-11.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90). Refer to Section 6-8 “Setting Sweep Parameters” on page 6-13.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 6-9 “Setting Up Markers” on page 6-17.

LIMIT: Not used in the 5GNR analyzer.

TRIGGER: Not used in the 5GNR analyzer.

MEASURE: Used to select measurements such as 5GNR summary, channel power, occupied bandwidth, and equivalent isotropic radiated power. Refer to “MEASURE Menu (5GNR)” on page 6-23.

SETUP: Measurement controls for setting advanced measurements.Section 6-10 “5GNR Measurement Setup” on page 6-22

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 6-17 “Presetting the Analyzer” on page 6-50.

FILE: Used to save and recall instrument setups and measurements. Refer to Section 6-18 “Saving and Recalling Measurements” on page 6-51.

Figure 6-2. Main Menu

Using Menus

Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.
- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

6-4 Setting Frequency and Band Parameters

Frequency and band parameters are set using the "FREQUENCY Menu" on page 6-5. The channel center frequency can be set manually. When set to manual band, the ARFCN and GSCN are unassigned. When a predefined band is selected, the center frequency and SSB offset must be set by the ARFCN and GSCN, respectively.

Configuring the Band

The band settings are displayed in the left side status panel and can be directly accessed from those controls. These parameters can also be accessed via the FREQ SPAN menu.

1. Press FREQ SPAN > BAND CONFIG.
2. Select a band from the BAND selection list. When a band is selected, the ARFCN, GSCN, and CHANNEL BW setting can be accessed.
3. Set the ARFCN, GSCN, CHANNEL BW according to the specification.
4. Select a subcarrier spacing.
5. Select the mapping pattern:
    - P1 for the 3GPP Phase 1 standard, March 2018.
    - P2 for the 3GPP Phase 2 standard, September 2018.
    - Auto to use the most recent standard.

FREQUENCY Menu

The FREQUENCY menu is available in all 5GNR measurements.

BAND CONFIG: Opens the “BAND CONFIG Menu” below.

CENTER FREQUENCY: Sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

SSB OFFSET: SSB is the synchronous signal block. The SSB offset sets the frequency offset between the SSB and the center frequency of the channel. Negative values result in an offset lower than the center frequency. Positive values result in an offset higher than the center frequency.

AUTO SSB DETECT: Auto detects the center position of the SSB according to the 3GPP raster of GSCN values. If the search is successful, the correct SSB OFFSET is automatically applied and the signal should synchronize for demodulation. See Figure 6-4, “AUTO DETECT SSB Dialogs (5GNR Measurements)”.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

MAPPING PATTERN: Select which mapping pattern: P1 for the 3GPP Phase 1 standard, March 2018. P2 for the 3GPP Phase 2 standard, September 2018. Auto selects the most recent standard.

GESTURES: Opens the “GESTURES Menu” on page 6-6. Not shown in 5GNR Summary measurement.

Figure 6-3. FREQUENCY Menu (5GNR Measurements)

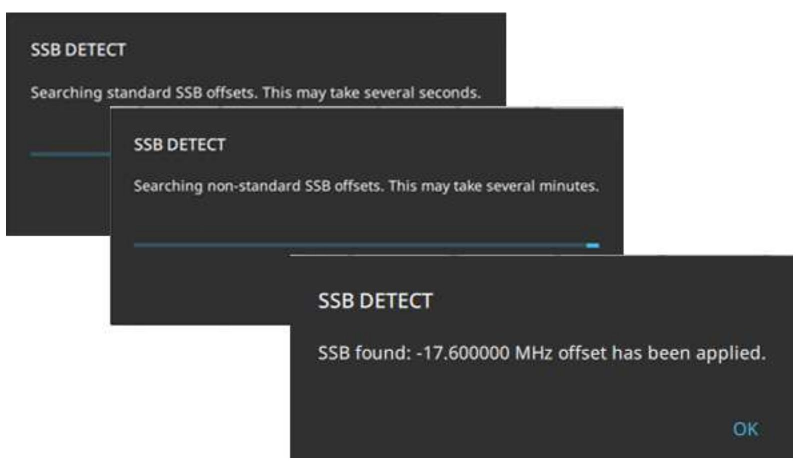


Figure 6-4. AUTO DETECT SSB Dialogs (5GNR Measurements)

BAND CONFIG Menu

The BAND CONFIG menu is available in all 5GNR measurements.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the absolute radio frequency channel number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

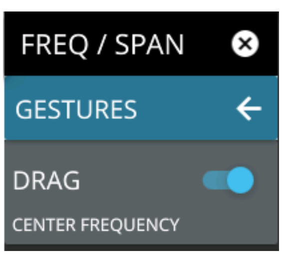
CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

GSCN: GSCN is the global synchronization raster channel. The GSCN identifies the mapping/offset of the synchronous signal block (SSB). The available input range is dependent on the selected band.

Figure 6-5. BAND CONFIG Menu (5GNR Measurements)

Note	The instrument must properly sync to and decode the signal to which the center frequency (or ARFCN), SSB offset (or GSCN), and subcarrier spacing are set to correctly match the 5GNR signal under test.

GESTURES Menu



DRAG: Toggles the touchscreen drag feature on or off. When toggled off, the center frequency will not change when dragging the spectrum display. This can be useful when dragging markers.

Note that the Drag feature can also be toggled on/off by touching the locks under the display.

Figure 6-6. GESTURES Menu

6-5 Setting Amplitude

Amplitude-related parameters are set using the “AMPLITUDE Menu” on page 6-9.

Setting Amplitude Parameters

The MS2090A 5GNR measurement has two different types of amplitude settings, one for the IQ capture used to decode the signal, and one for the display. The amplitude range refers to the amplitude level used to capture the data. The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to “Indications of Excessive Signal Level” on page 6-8). To set the current amplitude reference level:

1. To automatically set optimum settings, press AMPLITUDE > AUTO RANGE. The instrument will dynamically update the attenuation and preamp settings for the capture. AUTO RANGE helps ensure that harmonics and spurs are not introduced into the measurements while giving enough power to accurately decode the signal. When auto range is on, the amplifier and preamp cannot be set manually and the reference level is only used to adjust the top end of the y-axis of the plot or graph.
2. To manually set the range and reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm, or use the AUTO REF LEVEL (available when AUTO RANGE is disabled). This will set the attenuation and preamp for both the plot and the capture.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.
2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.
3. The new reference level offset value will be displayed on the instrument and the reference level is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer’s dynamic range. Normally, the input attenuation automatically adjusts as a function of reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to “AMPLITUDE Menu” on page 6-9.
- Turn on the preamplifier.

For RF-based measurements:

- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to “Setting Bandwidth Parameters” on page 6-10.
- Use trace averaging if VBW is already set to 1 Hz.

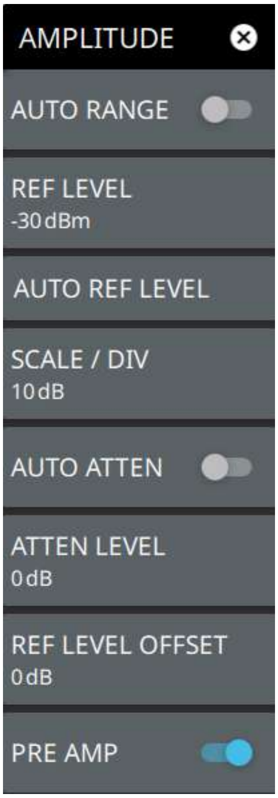
Indications of Excessive Signal Level

The Field Master Pro has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an "ADC Overrange" notification in the title bar (Figure 6-7). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 6-7. ADC Overrange

AMPLITUDE Menu

The AMPLITUDE menu is available in all 5GNR measurements.



AUTO RANGE: The instrument will dynamically update the attenuation and preamp settings for the measurement. Auto range helps ensure that harmonics and spurs are not introduced into the measurements.

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this menu location. If auto range is enabled, the reference level is graphical only and will have no impact on attenuation or preamp.

AUTO REF LEVEL: Auto reference level will change the reference value so as to place the highest signal amplitude at about two graticule lines from the top. This feature is not available when auto range is enabled.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required. Auto attenuation is not available when auto range is enabled.

ATTEN LEVEL: Manually sets the attenuation level. This feature is not available when auto range or auto attenuation is enabled.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The default offset value is 0 dB. The reference level on the Y-axis will reflect the new offset value. For example, if the reference level was 0 dBm and an offset value of –10 dB is applied, the offset reference level will be 10 dBm.

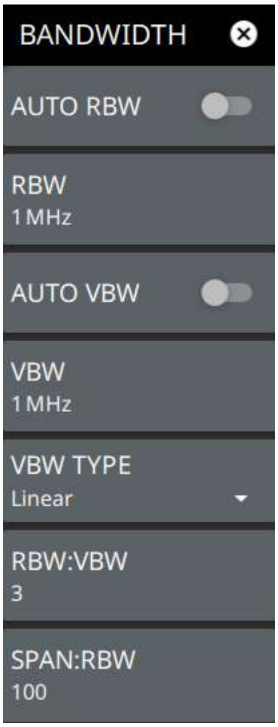
PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and reference level is above –40 dBm.

Figure 6-8. AMPLITUDE Menu (5GNR Measurements)

6-6 Setting Bandwidth Parameters

BANDWIDTH Menu

The BANDWIDTH menu is only available for RF-based measurements. See the “5GNR Measurement Setup” on page 6-22.



AUTO RBW: When toggle on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the X-axis will be preceded by the “#” symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. The RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

AUTO VBW: When toggled on, the instrument selects the video bandwidth based on the resolution bandwidth. The ratio of video bandwidth to resolution bandwidth can be set using the RBW:VBW button. When toggled off (manual), the VBW label at the left edge of the X-axis will be preceded by the “#” symbol.

VBW: The current video bandwidth is displayed under the VBW button. The VBW can be changed using the keypad or slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the video bandwidth range.

VBW TYPE: Toggles between linear averaging (arithmetic mean) and logarithmic averaging (geometric mean).

RBW:VBW: This parameter displays the ratio between resolution bandwidth and video bandwidth. To change the ratio, press this button and use the keypad or the slider controls.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.

Figure 6-9. BANDWIDTH Menu (5GNR RF Measurements)

6-7 Setting Trace Parameters

Traces are not used in 5GNR Summary measurements. Just as in the spectrum analyzer, Field Master Pro can display up to 6 traces simultaneously in 5GNR RF-based measurements (refer to Section 6-10 “5GNR Measurement Setup”). Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the left side status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces in a 5GNR spectrum measurement, refer to the “TRACE Menu” on page 6-11.

TRACE Menu

The TRACE menu is only available for RF-based measurements. Refer to Section 6-10 “5GNR Measurement Setup”.

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

TRACE MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

Figure 6-10. TRACE Menu (5GNR RF Measurements) (1 of 2)

	DETECTOR TYPE: Selects one of three detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of dealing with how measurement points will be shown at each display point (see “Trace Detector Types” on page 3-24). • **Peak:** This method causes the highest amplitude measurement point to be shown for each display point, assuring that a narrow peak is not missed. • **RMS/Avg:** In the default case, when the VBW/AVERAGE type is set to Linear, this method detects the average power of measurement points that go into the display point. When VBW/AVERAGE type is set to Log, the traditional average of log (power), such as dBm, is displayed for the detector, as well as for VBW and trace average. • **Negative:** This method causes the lowest amplitude measurement point to be shown for each display point. This method is also useful when looking at modulated signals, to see if some frequencies are not being used. **CLEAR:** Clears the currently active trace data. **AVERAGES:** Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes. **PRESET DETECTORS:** Sets all trace detectors to Peak. **PRESET:** Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 6-10. TRACE Menu (5GNR RF Measurements) (2 of 2)

6-8 Setting Sweep Parameters

When setting up a 5GNR Summary measurement, sweep parameters are set using the “SWEEP Menu – Summary Measurements” on page 6-13. When setting up a 5GNR RF measurement, sweep parameters are set using the “SWEEP Menu – RF Measurements” on page 6-13.

SWEEP Menu – Summary Measurements

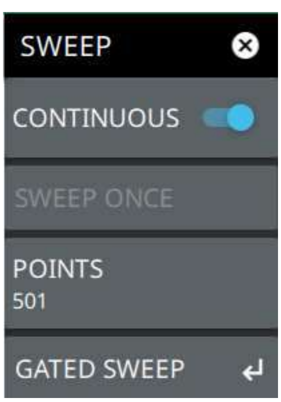
CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

HOLD: Hold will hold the current data display while the analyzer continues to capture and analyze data in the background.

Figure 6-11. SWEEP Menu - 5GNR Summary Measurements

SWEEP Menu – RF Measurements



CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

POINTS: Sets the number of data points per sweep and displayed in each trace. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace.

GATED SWEEP: Opens the “GATED SWEEP Menu” on page 6-15.

Figure 6-12. SWEEP Menu - 5GNR RF Measurements

Gated Sweep (Option 90)

Gated sweep is only available on instruments with Option 90 installed and only when an RF-based measurement is selected (Channel Power, OBW, EIRP, etc.). Gated sweep allows you to synchronize your sweep with an event so that the analyzer collects data at the appropriate time. This is useful for measuring signals in the time domain such as pulsed RF, time multiplexed, or burst modulated signals. Field Master Pro can use the GPS timing signal as the gating trigger event. This will allow you to synchronize measurements with GPS synchronized communication signals. Set up gated sweep from the "GATED SWEEP Menu" on page 6-15.

To set up the instrument for gated sweep measurements:

1. Press SWEEP > GATED SWEEP.
2. Select the GATE SOURCE. The gate source selected determines the trigger source from which the gate is controlled. Not all instrument models and options support all triggering selections, so your choices may vary. Field Master Pro supports a GPS and external gate source.
3. Select one of the available FRAME TIME durations. The frame time sets the total measurement cycle time.
4. Set the GATE DELAY time. The gate delay sets the time from the triggering event to when the instrument starts sweeping and collecting data.
5. Set the GATE LENGTH time. The gate length sets the time for data capture and analysis.
6. If desired, enable PWR VS TIME (refer to "POWER VS. TIME Display" on page 6-16.)

Below is an example of a gated sweep applied to a channel power measurement. The signal level shown varies cyclically with time and would not be measurable without gated sweep.

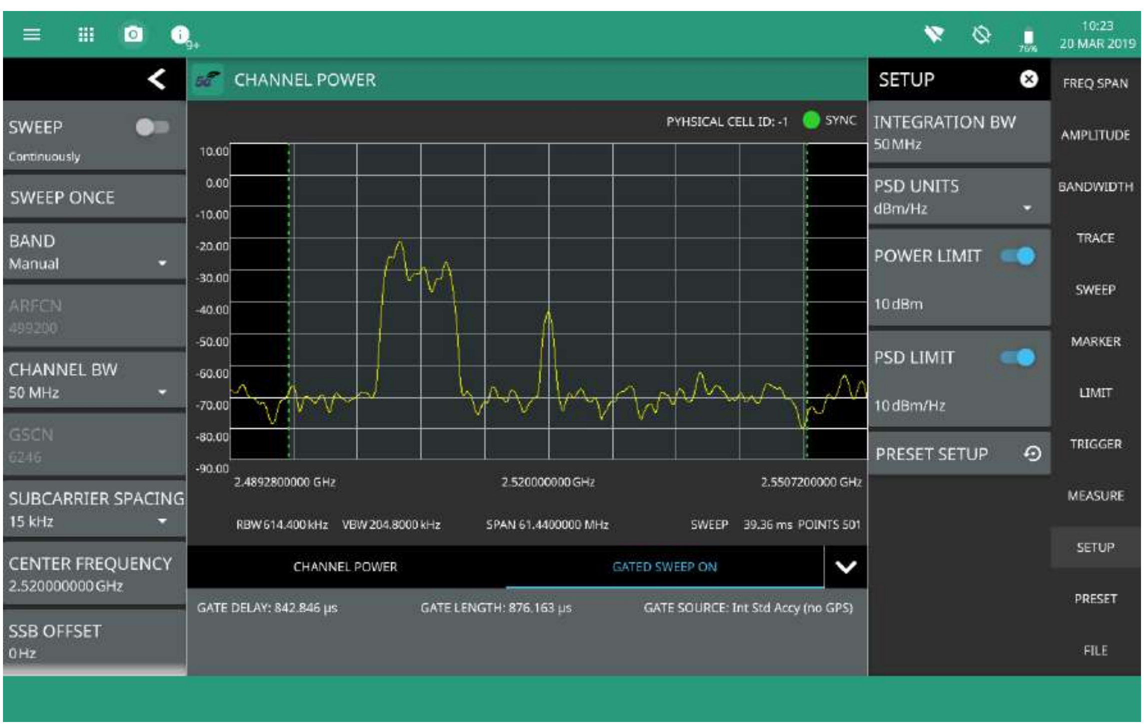


Figure 6-13. Gated Sweep Measurement

The channel power and gated sweep display panels at the bottom can be tapped to open either the Channel Power SETUP menu or the GATED SWEEP menu.

GATED SWEEP Menu

GATED SWEEP: Toggles gated sweep on or off.

GATED SOURCE: Selects the trigger source for the gated sweep.

- **GPS:** This setting synchronizes the trigger source to the GPS PPS.
- **External 1 or 2:** Sets the gate reference based on input from the External 1 or External 2 port.

FRAME TIME: Selects the frame time duration of 10 ms, 20 ms, or 1 s.

GATE DELAY: Sets the start of the gated sweep. When “POWER VS. TIME Display” is enabled, the gate delay is indicated by the blue left border of the power vs time display. You can also drag the entire gate to set the desired gate delay.

GATE LENGTH: Sets the length of the gated sweep. When “POWER VS. TIME Display” is enabled, the gate length is indicated by the width between the blue borders of the power vs time display. You can also drag the right blue border to set the desired gate length.

PWR VS TIME: Enables the “POWER VS. TIME Display” on page 6-16.

DISPLAY START: When Power vs Time is selected, sets the start of the graticule display.

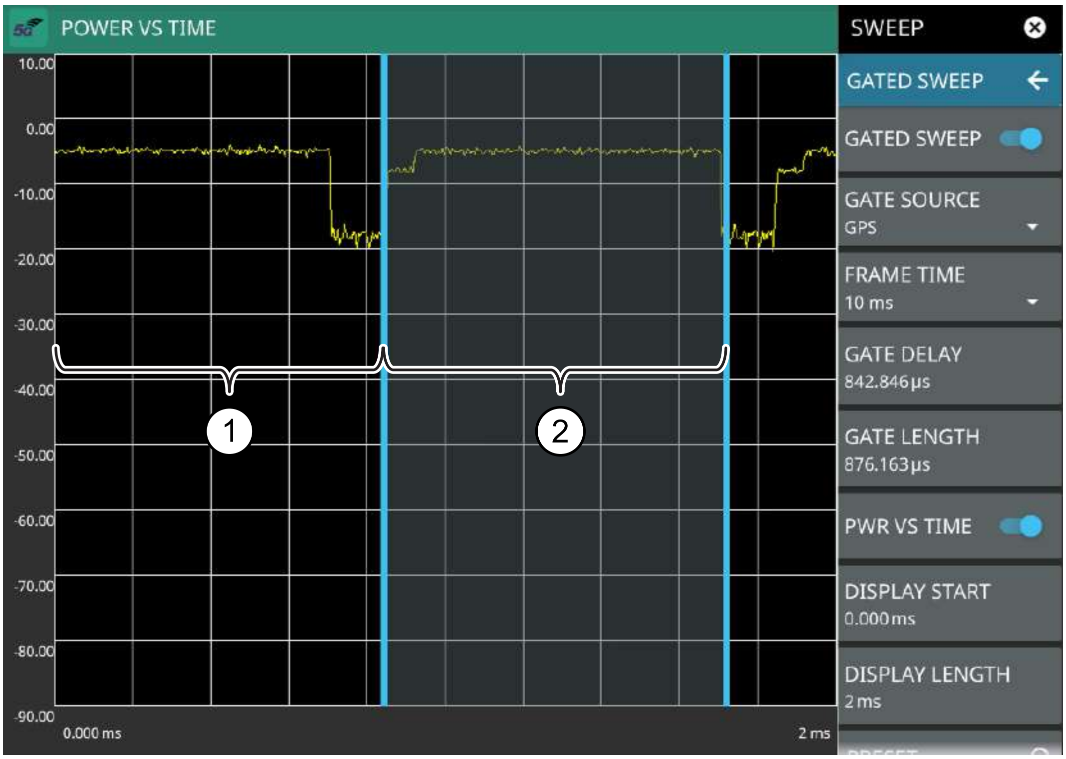
DISPLAY LENGTH: When Power vs Time is selected, sets the time length of the graticule display.

PRESET: Presets gated sweep settings to default values.

Figure 6-14. GATED SWEEP Menu

POWER VS. TIME Display

When power vs time is enabled, a time-domain graph is presented. This graph is a useful visual aid when setting up the GATE DELAY (1) and GATE LENGTH (2) times as you can simultaneously view the signal level within the set frame and relative to your gate delay and length. The display is enabled using the PWR VS TIME toggle setting and should be disabled after setting up the gate delay and length parameters. The gate delay and length are represented by the width of the displayed shaded area flanked with blue lines (see Figure 6-15).



1. Set the gate delay by dragging the left blue setting line. The full time scale is shown along the bottom and the gate delay time will be displayed at the top center of the graticule when it is being adjusted.
2. Set the gate length by dragging the right blue setting line. The full time scale is shown along the bottom and the gate length will be displayed at the top center of the graticule when it is being adjusted.

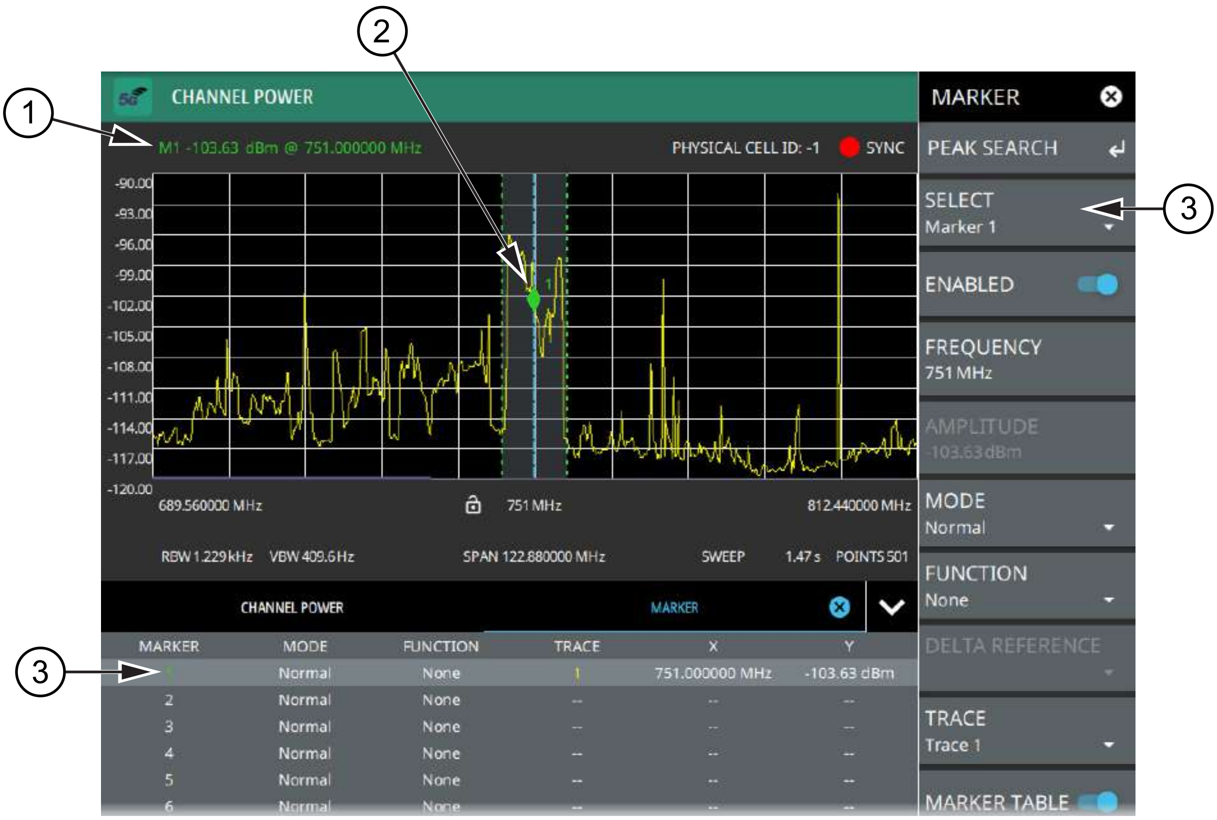
Figure 6-15. Power vs. Time Display

If the blue gate delay and length setting lines are set outside of the displayed graticule scale, you will see “< Gate Start” and “Gate Stop >” messages at the edge of the display indicating where the blue setting lines are located.

Once the gate has been set up, you can apply gating to the spectrum by toggling GATED SWEEP on. Gating will continue to be applied when you access other measurements and functions of the spectrum analyzer until gated sweep is toggled off or an unsupported instrument configuration is selected.

6-9 Setting Up Markers

Markers are not used in 5GNR Summary measurements. Marker parameters are set using the “MARKER Menu” on page 6-19. Refer to the figure below when working with this section.



1. Normal spectrum view marker information display.
2. Marker located on trace. The active marker is indicated with solid green fill, other markers will show with a hollow fill, fixed markers show as a green X.
3. Selected marker in the MARKER menu and in the marker table. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu.

Figure 6-16. Marker Table and Marker Settings Panels

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the current center frequency.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and placed at the center frequency. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static frequency and amplitude.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   a. Enter a new FREQUENCY value.
   b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker’s position.
   c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to “MARKER PEAK SEARCH Menu” on page 6-20).

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed frequency, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, Delta Marker 3 displays x-axis and y-axis data relative to Marker 3. To set a delta marker and its reference:

1. Activate a marker and place it in a reference location as described previously.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers.
3. Set the second marker's MODE to Delta.
4. Place the active delta marker by:
   a. Entering a new FREQUENCY value.
   b. Dragging the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 6-20).

A delta marker is labeled with a green delta symbol between the each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1".

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 6-20.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center frequency, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker, which is displayed in the upper left-hand corner of the screen. When a marker is turned on, it is a normal marker positioned at the center frequency of the selected trace.

ENABLED: Enables the selected marker.

FREQUENCY: Displays the marker frequency. For delta markers, the frequency is relative to the reference marker. Change the marker frequency by pressing on the marker and dragging it to the desired location. You can also change the marker frequency by touching the value to open the keypad.

AMPLITUDE: Displays the current marker amplitude. If the marker is a fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The frequency is fixed but the amplitude value varies from sweep to sweep.
- **Delta (Δ):** A Delta (Δ) marker displays the delta frequency and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Fixed marker at the same location. The reference marker can then be switched to a Normal marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed frequency, which are defined by the user and not related to the trace or sweep data.

MARKER FUNCTION: Sets the function of the currently selected marker to None, Noise, or Frequency Counter. For more information about using marker functions, refer to "Marker Functions" on page 6-21.

DELTA REFERENCE: Selects the reference marker for a delta marker. A delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen. Refer to "Marker Table" on page 6-21.

CENTER ON MARKER: Sets the center frequency to the currently active marker's frequency value.

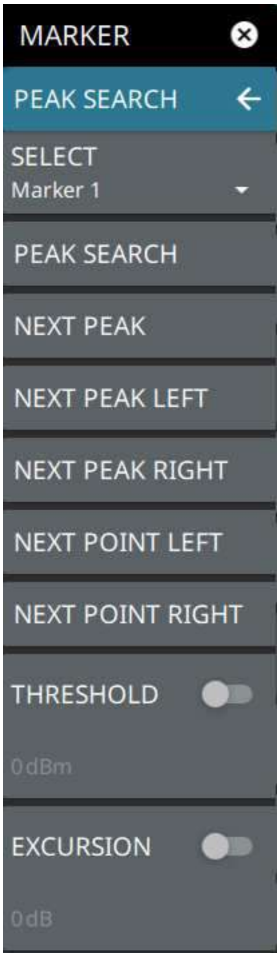
REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET: Presets marker selections to default values.

Figure 6-17. MARKER Menu

MARKER PEAK SEARCH Menu



SELECT: If the selected marker is off it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1. Pressing the PEAK SEARCH button also opens the PEAK SEARCH menu.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 6-18. PEAK SEARCH Menu

Marker Functions

Noise Markers

Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

Frequency Counter Marker

Sets the frequency counter for the selected marker. Marker frequency values are normally limited in resolution to individual display pixels. Each pixel may represent multiple frequencies. When counter marker is enabled, a higher resolution digital signal processing is used within the region of the counter marker to determine a more precise frequency. Using counter marker in association with marker to peak will result in the frequency of the signal peak to a much higher displayed resolution. Note that frequency accuracy is affected by the RBW setting, and sweep times may be longer when using counter marker because of the additional signal processing.

Marker Table

The Marker table display is useful for displaying many marker parameters at once. The example shown is for the 5GNR Channel Power measurement. The marker table shows the marker mode and corresponding X and Y values, and the trace to which it is selected. The selected marker is displayed with a highlighted background. Table controls are located on the right of the header. Press the down or up arrow to collapse or expand the table, press X to close the table.

MARKER	MODE	FUNCTION	TRACE	X	Y
1	Normal	Noise	1	5.800000010 GHz	-142.43 dBm/Hz
2	Normal	Off	[illegible]	6.152000010 GHz	-66.84 dBm
3	Normal	Off	1	62.690807800 GHz	-67.91 dBm
4	Off	Off	--	--	--
5	Off	Off	--	--	--
6	Off	Off	--	--	--

Figure 6-19. Marker Table

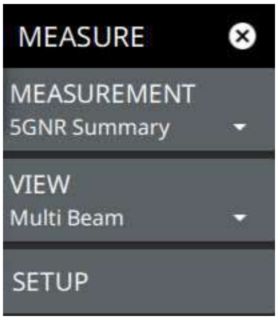
1. You can select and change a marker's parameters by selecting the marker from either the MARKER menu or the MARKER table.
2. The currently selected marker's value is shown at the top left of the spectrum window with its current amplitude and frequency values.
3. The selected marker is highlighted on the trace display.

6-10 5GNR Measurement Setup

5GNR base station validation qualifies the performance of gNB base stations with essential measurements that are in full compliance with 3GPP TS 38.104 V15. The 5GNR analyzer features smart measurements that make configuring these measurements and views for 5GNR compliance testing easy:

- 5GNR summary with multi beam and single beam views measures:
  - Frequency Error
  - Time Offset (time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GPS when the instrument has GPS lock)
  - Cell/Sector ID
  - Modulation Quality
  - Synchronization Signal Block (SSB)
  - Error Vector Magnitude (EVM, peak and average)
  - Secondary Synchronization Reference Signal Received Power (SS-RSRP)
  - Secondary Synchronization Signal Reference Signal Received Quality (SS-RSRQ)
  - Secondary Synchronization Signal-to-noise and Interference Ratio (SS-SINR)
- 5GNR Multi PCI with multi beam and table views enhances the summary measurements with the ability to simultaneously measure multiple physical-layer cells.
- Occupied Bandwidth (OBW)
- Channel Power (CP)
- Equivalent Isotropic Radiated Power (EIRP)
- Carrier Aggregation
- Constellation

MEASURE Menu (5GNR)



MEASUREMENT: Selects the desired measurement type from the following list:

- **5GNR Summary:** Displays the current beam measurement status in a quick-view summary that includes the PCI summary, sync signal (SS), and channel summary. See “5GNR Summary and Multi PCI” on page 6-24.
- **Channel Power:** Provides an RF channel power measurement that includes the total channel power, power spectral density (PSD), and pass/fail compliance testing. “5GNR Channel Power” on page 6-33.
- **OBW:** Provides an RF occupied bandwidth measurement that includes the occupied bandwidth, total power, and pass/fail compliance testing. “5GNR Occupied Bandwidth” on page 6-36.
- **EIRP:** Provides an EIRP display that includes the input parameters setup and measurement status. “5GNR EIRP” on page 6-39.
- **Multi PCI:** Displays the current beam measurement status of multiple cells in a quick-view summary that includes the PCI summary, sync signal (SS), and channel summary. See “5GNR Summary and Multi PCI” on page 6-24.
- **Carrier Aggregation:** Provides a component carrier measurement that includes the PCI, reference signal power, EVM, and frequency error measurement summaries. See “5GNR Carrier Aggregation” on page 6-44.
- **Constellation:** Provides a constellation measurement that includes the PCI summary, reference signal power, EVM, and frequency error measurement summaries. See “5GNR Constellation” on page 6-47.

VIEW: When the measurement is 5GNR Summary, you can select the type of view:

- Multi Beam: Displays eight beam power levels and measurement summaries on a total of eight summary pages. See “5GNR Summary Multi Beam View” on page 6-24.
- Single Beam: Displays a total of 64 individual summary views for each beam. See “5GNR Summary Single Beam View” on page 6-26.

When the measurement is 5GNR Multi PCI, you can select the type of view:

- Scanner: Displays eight beam power levels and summaries on a total of eight summary pages. See “5GNR Multi PCI Scanner View” on page 6-28.
- Table: Displays all received PCI measurement data in a single table view. See “5GNR Multi PCI Table View” on page 6-30.

SETUP: Opens one of the measurement SETUP menus. The 5GNR SETUP menus can be access directly via the SETUP or MEASURE menus after the desired measurement has been selected. The setup menu depends on the current measurement and view selected.

- “SETUP Menu (5GNR Summary/Multi PCI)” on page 6-31
- “SETUP Menu (5GNR Channel Power)” on page 6-34
- “SETUP Menu (5GNR OBW)” on page 6-37
- “SETUP Menu (5GNR EIRP)” on page 6-42
- “SETUP Menu (5GNR Carrier Aggregation)” on page 6-45
- “SETUP Menu (5GNR Constellation)” on page 6-48

Figure 6-20. 5GNR MEASURE Menu

6-11 5GNR Summary and Multi PCI

5GNR summary measurements are used for compliance testing of 5GNR networks and can evaluate active antenna systems for beamforming profiles and dynamic physical layer attributes of the transmitted signal. Field Master Pro can analyze a single physical-layer cell or multiple physical-layer cells at one time. The following considerations apply to each measurement.

Single PCI:

- Better for conducted measurements, directional antenna measurements, or if only one cell is present.
- Only one cell is reported. If multiple cells are present, the analysis may jump to different cells or not analyze any of the cells.

Multi PCI:

- Better sync in over the air field conditions.
- Multiple Cells can be reported and sorted on various measurement parameters.

This section illustrates several 5GNR summary measurements using both single PCI and multi PCI analysis techniques.

5GNR Summary Multi Beam View

The following measurement is set up to display 5GNR summary data in a multiple beam view. In multi beam view, a maximum of eight beams can be displayed at once on a single page. Field Master Pro can capture data for as many as 64 beams in a total of eight pages.

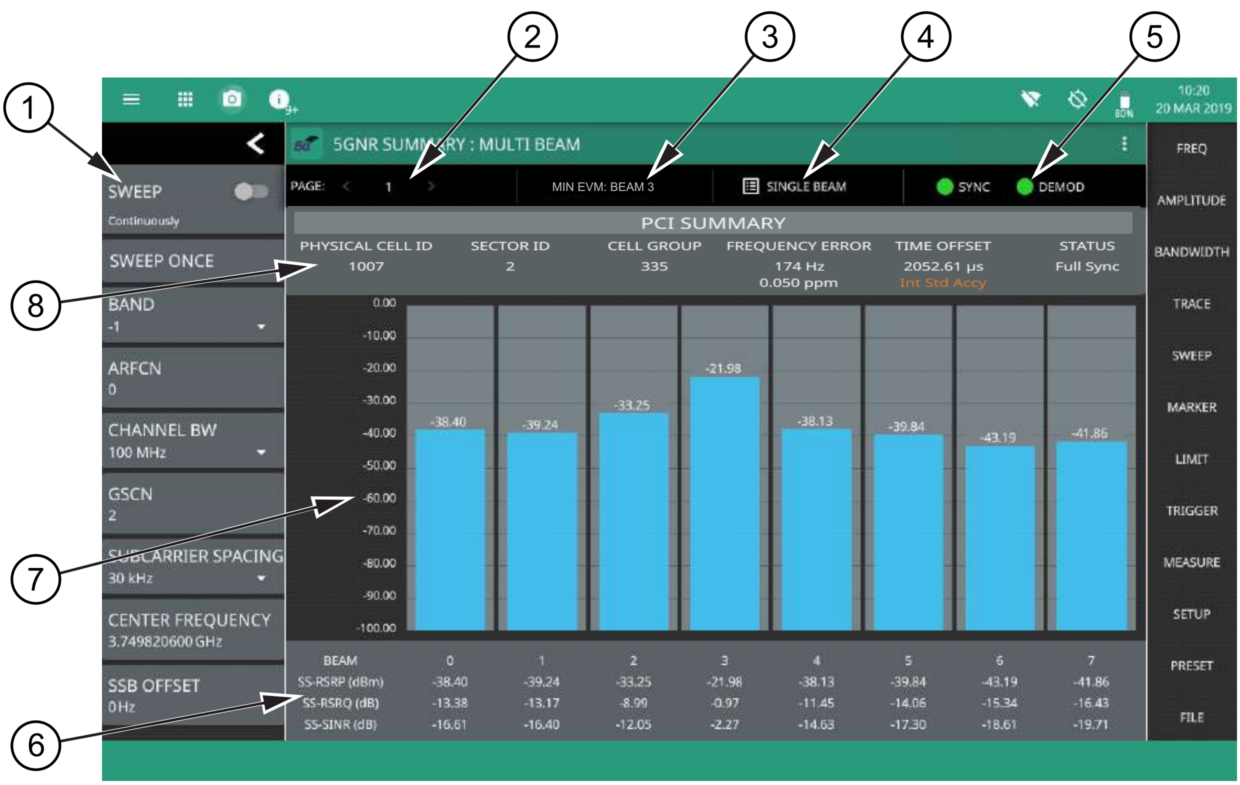


Figure 6-21. 5GNR Summary – Multi Beam View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/Multi PCI)" on page 6-31.
2. **PAGE:** This field indicates the current multi beam page. A maximum of eight pages (numbered 1 through 8) with eight beams (numbered 0 to 63) on each page can be displayed in multi beam view. You can cycle through the pages using the left/right (</>) arrows or touch the number to select the desired page.
3. **MIN EVM BEAM:** This field shows which beam measures the lowest error vector magnitude (EVM).
4. **SINGLE/MULTI BEAM:** This field shows the current view setting. Touch this field to toggle between SINGLE BEAM or MULTI BEAM views. You can also change the view setting from the MEASURE menu.
5. **SYNC/DEMOD:** Valid 5GNR measurements require the signal synchronization and demodulation. The indicators here blink green when the received signal is synchronized and properly demodulated, indicating that you have a valid measurement.
6. **Summary Data:** For each beam, the following synchronization signal summary data is displayed:
   • SS-RSRP: Secondary synchronization signal reference signal received power measured in dBm.
   • SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   • SS-SINR: Secondary synchronization signal-to-noise and interference ratio measured in dB.
7. **Beam Display**: This area shows the received signal strength of each beam as a vertical bar. The top of the bar is annotated with the maximum signal strength (in dBm). The number of beams displayed depends on how many beams are defined by the band configuration. From 1 to 8 beams can be displayed at once on a page. When more than 8 beams are measured, additional beams can be accessed from additional pages. The beams are numbered from 0 up to 63. If you touch a beam, the view changes to display the selected beam in single beam view.
8. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset, and sync status. Also noted is the instrument's reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).

Figure 6-21. 5GNR Summary – Multi Beam View (2 of 2)

5GNR Summary Single Beam View

5GNR summary measurements in single beam view provide the same information as the multi beam view with added measurements as described in Figure 6-22.

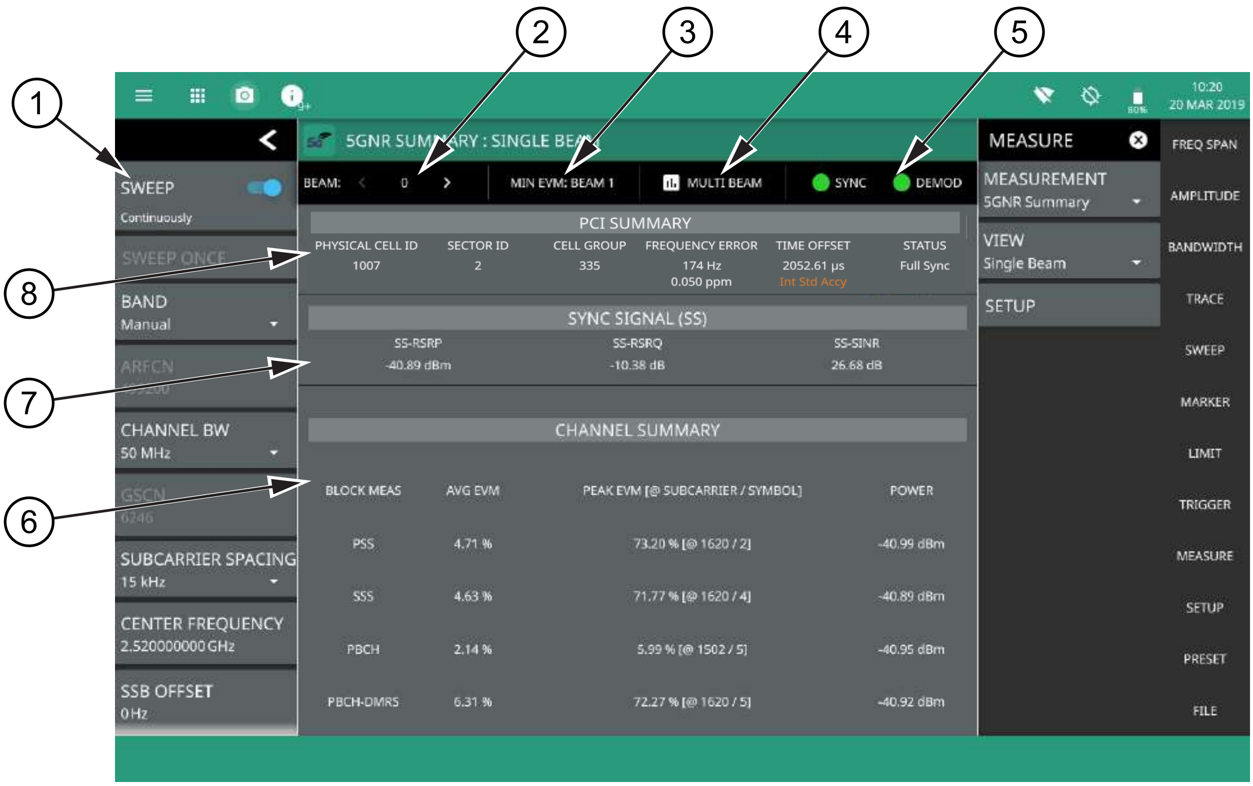


Figure 6-22. 5GNR Summary – Single Beam View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/Multi PCI)" on page 6-31.
2. **BEAM:** This field indicates the current beam summary page. A maximum of 64 beams (numbered 0 to 63) can be individually displayed in single beam view. You can cycle through the beam pages using the left/right (</>) arrows or touch the number to select the desired beam.
3. **MIN EVM BEAM:** This field shows which beam measures lowest error vector magnitude (EVM).
4. **SINGLE/MULTI BEAM:** This field shows the current view setting. Touch this field to toggle between SINGLE BEAM or MULTI BEAM views. You can also change the view setting from the MEASURE menu.
5. **SYNC/DEMOD:** Valid 5GNR measurements require the signal synchronization and demodulation. The indicators here blink green when the received signal is synchronized and properly demodulated, indicating that you have a valid measurement.
6. **Channel Summary**: For the current beam, shows the average error vector magnitude (EVM), peak EVM (@ subcarrier/symbol) and received power in dBm for each block measurement:
   - PSS: The primary synchronization signal provides the primary frame boundary (i.e., the position of the first symbol in the frame).
   - SSS: Similar to PSS, the secondary synchronization signal provides the secondary subframe boundary.
   - PBCH: This is the physical broadcast channel, the main purpose of which is to carry the broadcast master information block.
   - PBCH-DMRS: In 5GNR measurements, the PBCH decoding relies on a demodulation reference signal (DMRS, which is a physical layer reference signal used for decoding) rather than a cell specific reference signal (CRC).
7. **Sync Signal (SS) Summary Data:** Shows the following synchronization signal summary data for the current beam:
   - SS-RSRP: Secondary synchronization signal reference signal received power measured in dBm.
   - SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   - SS-SINR: Secondary synchronization signal-to-noise and interference ratio measured in dB.
8. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS, SSS, or Beam Index failure, Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).

Figure 6-22. 5GNR Summary – Single Beam View (2 of 2)

5GNR Multi PCI Scanner View

The following measurement is set up to display 5GNR summary data of multiple cells in a multiple beam scanner view. In scanner view, a maximum of eight beams can be displayed at once on a single page. Field Master Pro can capture data for as many as 64 beams in a total of eight pages.

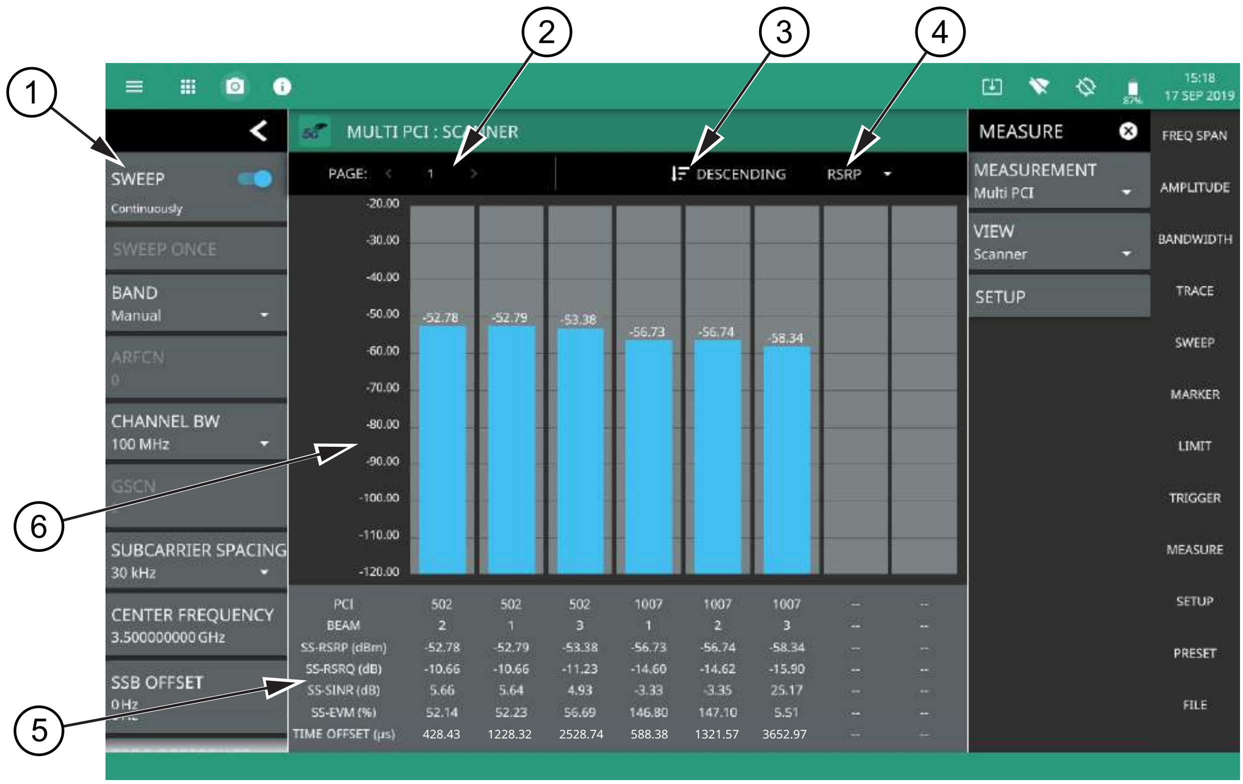


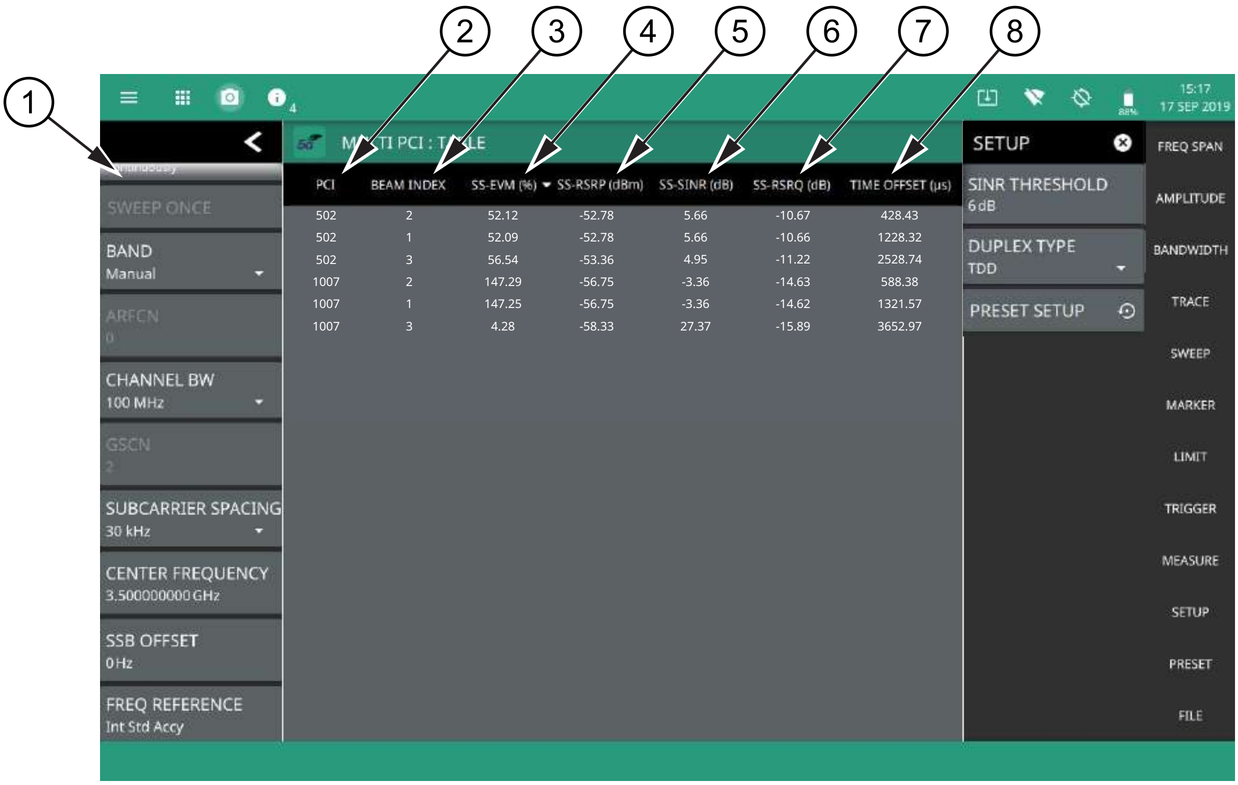
Figure 6-23. 5GNR Multi PCI – Multiple Beam Scanner View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/Multi PCI)" on page 6-31.
2. **PAGE:** This field indicates the current multi beam page. A maximum of eight pages (numbered 1 through 8) with eight beams (numbered 0 to 63) on each page can be displayed in multi beam view. You can cycle through the pages using the left/right (</>) arrows or touch the number to select the desired page.
3. **Ascending/Descending Sort:** This field selects the sort order of the selected value. The beam data is sorted from left to right in either ascending or descending order of magnitude.
4. **RSRP, SINR, PCI:** Selects on which value to sort.
5. **PCI Summary Data:** For each beam, the following synchronization signal summary data is displayed:
   - PCI: Physical-layer cell identity.
   - Beam: Beam index number.
   - SS-RSRP: Secondary synchronization signal reference signal received power measured in dBm.
   - SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   - SS-SINR: Secondary synchronization signal-to-noise and interference ratio measured in dB.
   - SS-EVM: Error vector magnitude measured in percentage.
   - Time Offset: Time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GPS when the instrument has GPS lock.
6. **Beam Display**: This area shows the received signal strength of each beam as a vertical bar. The top of the bar is annotated with the maximum signal strength (in dBm). The number of beams displayed depends on how many beams are defined by the band configuration. From 1 to 8 beams can be displayed at once on a page. When more than 8 beams are measured, additional beams can be accessed from additional pages. The beams are numbered from 0 up to 63.

Figure 6-23. 5GNR Multi PCI – Multiple Beam Scanner View (2 of 2)

5GNR Multi PCI Table View

The following measurement is set up to display 5GNR Multi PCI data in a table view. The multi PCI table view displays the measurement results of every detected beam in a single, sortable table.



1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See “Status Panel (5GNR Summary/Multi PCI)” on page 6-31.
2. **PCI:** These fields show the physical-layer cell ID value. The values can be sorted in ascending or descending order by tapping the column head.
3. **BEAM INDEX:** These fields show the beam index value of the corresponding physical-layer cell ID.
4. **SS-EVM (%):** These fields show the error vector magnitude values of the corresponding physical-layer cell ID and beam index, measured in percentage.
5. **SS-RSRP (dBm):** These fields show the secondary synchronization signal reference signal received power of the corresponding physical-layer cell ID and beam index, measured in dBm. The values can be sorted in ascending or descending order by tapping the column head.
6. **SS-SINR (dB):** These fields show the secondary synchronization signal-to-noise and interference ratio of the corresponding physical-layer cell ID and beam index, measured in dB. The values can be sorted in ascending or descending order by tapping the column head.
7. **SS-RSRQ (dB):** These fields show the secondary synchronization signal reference signal received quality of the corresponding physical-layer cell ID and beam index, measured in dB.
8. **Time Offset (µs):** Time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GPS when the instrument has GPS lock.

Figure 6-24. 5GNR Multi PCI – Table View

SETUP Menu (5GNR Summary/Multi PCI)

The 5GNR Summary and Multi PCI SETUP menu is available in MEASURE > MEASUREMENT > 5GNR Summary or Multi PCI > SETUP.

SINR THRESHOLD: Sets the threshold level that the secondary synchronization signal-to-noise and interference ratio that a beam must overcome to be analyzed.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

PRESET: Presets the SETUP menu to default settings.

Figure 6-25. 5GNR SETUP Menu (5GNR Summary and Multi PCI)

Status Panel (5GNR Summary/Multi PCI)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 6-26 shows the 5GNR status panel that covers the 5GNR summary and Multi PCI measurements.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

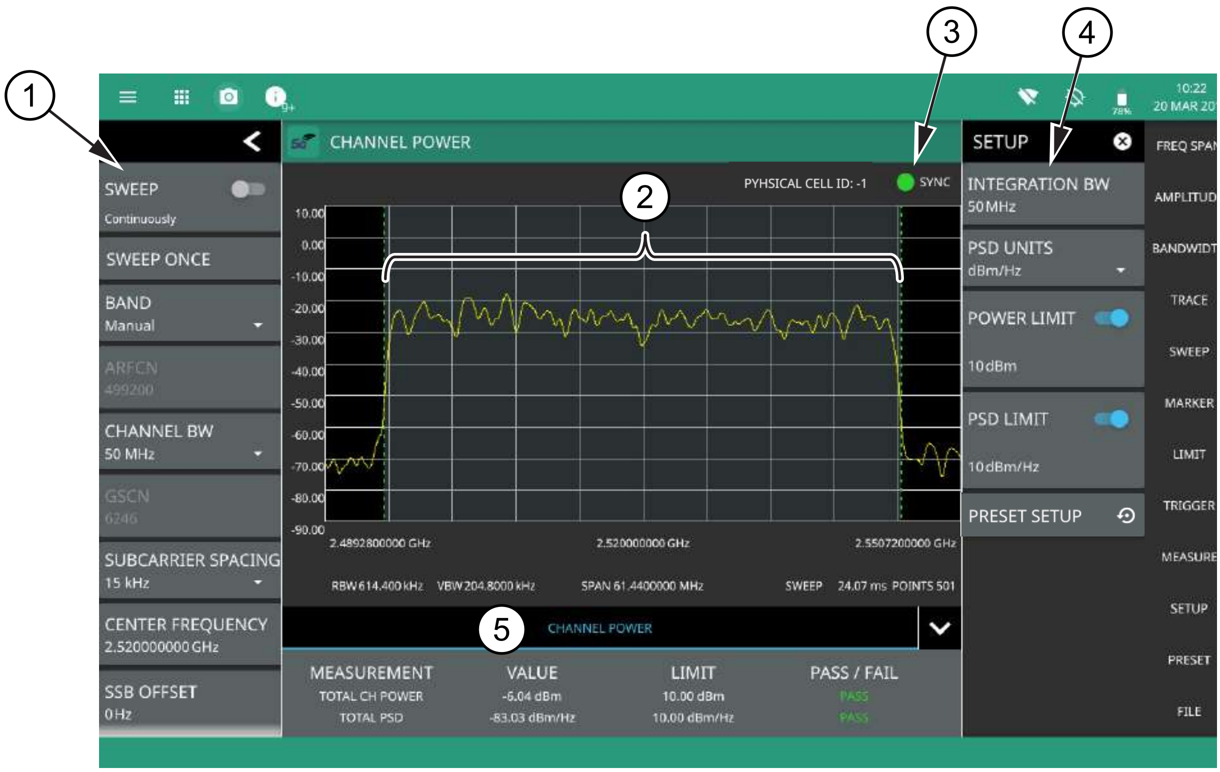
FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-26. Status Panel (5GNR Summary and Multi PCI Measurement)

6-12 5GNR Channel Power

Channel power measurements are one of most common measurements for a radio transmitter. This test measures the output power of a transmitter within the specified channel bandwidth. Out-of-specification power measurements indicate system faults, which can be in the power amplifiers or in filter circuits. Channel power measurements can be used to validate transmitter performance, comply with government regulations, or to keep overall system interference at a minimum.

The channel power measurement is a test performed to measure the power transmitted within a specified frequency or channel bandwidth. The total RF power and power spectral density (PSD) is determined from a channel power measurement. An example of a channel power measurement is shown in Figure 6-27.



1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Channel Power)" on page 6-35.
2. **Channel Power:** Channel power is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds.
3. **SYNC:** Valid 5GNR channel power measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.
4. **SETUP Menu**: The channel power settings are configured in the SETUP menu. See "SETUP Menu (5GNR Channel Power)" on page 6-34.
5. **Channel Power Summary**: This area shows the channel power measurement summary data and pass/fail test results, when enabled:
   - The total channel power value and the test limit are expressed in dBm with a pass/fail result.
   - The total PSD limit is expressed in dBm with a pass/fail result.
   - Tapping this summary area opens the Channel Power SETUP menu.

Figure 6-27. 5GNR Channel Power Measurement

SETUP Menu (5GNR Channel Power)

The Channel Power SETUP menu is available in MEASURE > MEASUREMENT > Channel Power > SETUP. Once the channel power measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

INTEGRATION BW: Sets the range of integration used in calculating the power in the channel. The integration bandwidth (IBW) is displayed as the shaded region between the bandwidth start and stop thresholds (dashed green lines).

PSD UNITS: Sets the unit bandwidth for power spectral density (PSD). The available units are dBm/Hz and dBm/MHz.

POWER LIMIT: The power limit is the threshold value used to determine whether the actual measured channel power will pass or not. If the measured channel power exceeds the set power limit, the channel power test fails; otherwise, the test passes. Pass/fail test results are shown in the measurement results table.

PSD LIMIT: If the power spectral density limit is on, the PSD limit is the threshold value used to determine whether the actual measured PSD will pass or not. If the measured PSD exceeds the PSD limit, the PSD test fails; otherwise the test passes.

PRESET: Presets the SETUP menu to default settings.

Figure 6-28. 5GNR SETUP Menu (Channel Power)

Status Panel (5GNR Channel Power)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 6-29 shows the 5GNR status panel that covers the 5GNR channel power measurements.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-29. Status Panel (5GNR Channel Power Measurement)

6-13 5GNR Occupied Bandwidth

Occupied Bandwidth (OBW) is a common measurement performed on radio transmitters. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending upon the technique used to modulate the carrier.

- % Integrated Power Method: The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.
- X dB Method: The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is a desired number of dB below the peak carrier level.

An Occupied Bandwidth measurement using the % integrated power is shown in Figure 6-30. The occupied bandwidth here is the bandwidth containing 99% of the total channel power. This is calculated from 0.5 % of the total mean power below the lower frequency limit and 0.5% above its upper frequency limit of the signal. Alternatively, the measurement can be set up to use the X dB method where the occupied bandwidth is determined from the upper and lower bandwidth edges that are X dB down from the total mean power of the signal.

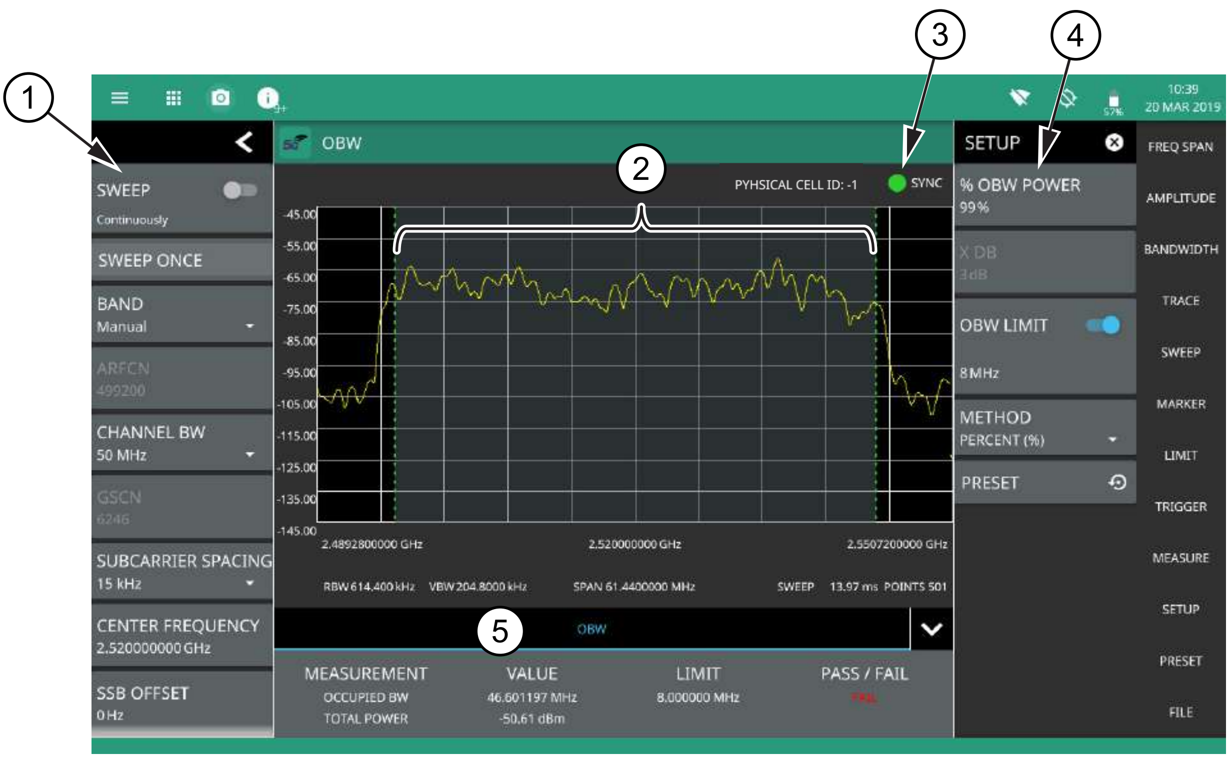


Figure 6-30. 5GNR Occupied Bandwidth Measurement (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR OBW)" on page 6-38.
2. **Occupied Bandwidth:** Occupied bandwidth is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds. The analyzer will determine and track the occupied bandwidth of the signal within the current span.
3. **SYNC:** Valid 5GNR occupied bandwidth measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.
4. **SETUP Menu**: The occupied bandwidth settings are configured in the SETUP menu. See "SETUP Menu (5GNR OBW)" on page 6-37.
5. **OBW Summary**: This area shows the occupied bandwidth measurement summary data and pass/fail test results, when enabled:
   - The occupied bandwidth value and the test limit are expressed in frequency units with a pass/fail result.
   - The transmit signal frequency error is expressed in frequency units.
   - The total power is integrated over the measured bandwidth and is expressed in dBm.
   - Tapping this summary area opens the OBW SETUP menu.

Figure 6-30. 5GNR Occupied Bandwidth Measurement (2 of 2)

SETUP Menu (5GNR OBW)

The Occupied Bandwidth SETUP menu is available in MEASURE > MEASUREMENT > OBW > SETUP. Once the OBW measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

% OBW POWER: Sets the percentage of the total power that is measured within the occupied bandwidth for the current measurement. The resulting occupied bandwidth and total power values are displayed in the measurements results table.

X dB: Sets the x dB value used for the "x dB bandwidth" measurement. The occupied bandwidth is the frequency range between two points on the signal that are x dB down from the highest signal point within the OBW span.

OBW LIMIT: Enables limit checking at the specified frequency. The limit test results show as a green PASS or a red FAIL in the measurement table.

METHOD: Select the measurement method to be PERCENT (%) or X (dB).

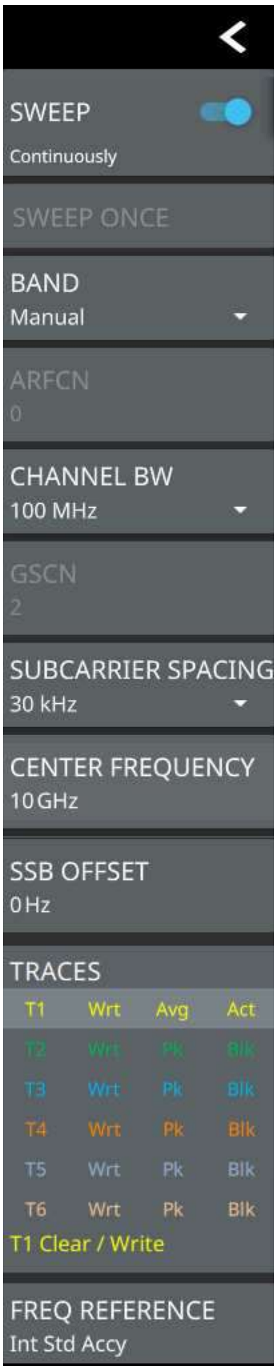
PRESET: Presets the SETUP menu to default settings.

Figure 6-31. 5GNR SETUP Menu (OBW)

Status Panel (5GNR OBW)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 6-32 shows the 5GNR status panel that covers the 5GNR OBW measurements.



SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the absolute radio frequency channel number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-32. Status Panel (5GNR OBW Measurement)

6-14 5GNR EIRP

In antenna measurements, EIRP is equivalent isotropic radiated power. The measured radiated power in a single direction is known as the EIRP. EIRP is especially valuable for over-the-air power measurements of 5GNR signals, which utilize beamforming for signal transmission, unlike older wireless technologies, which are typically radiated omnidirectionally. EIRP gives a better reflection of atmospheric energy of the beam than a typical channel power measurement. Integrating EIRP in a 360 degree sphere around a beamforming transmitter would give the total radiated power (TRP). Note the EIRP should only be measured in the far field, where beams are fully formed.

EIRP Normal View

An EIRP measurement with the normal spectrum view is shown in Figure 6-33

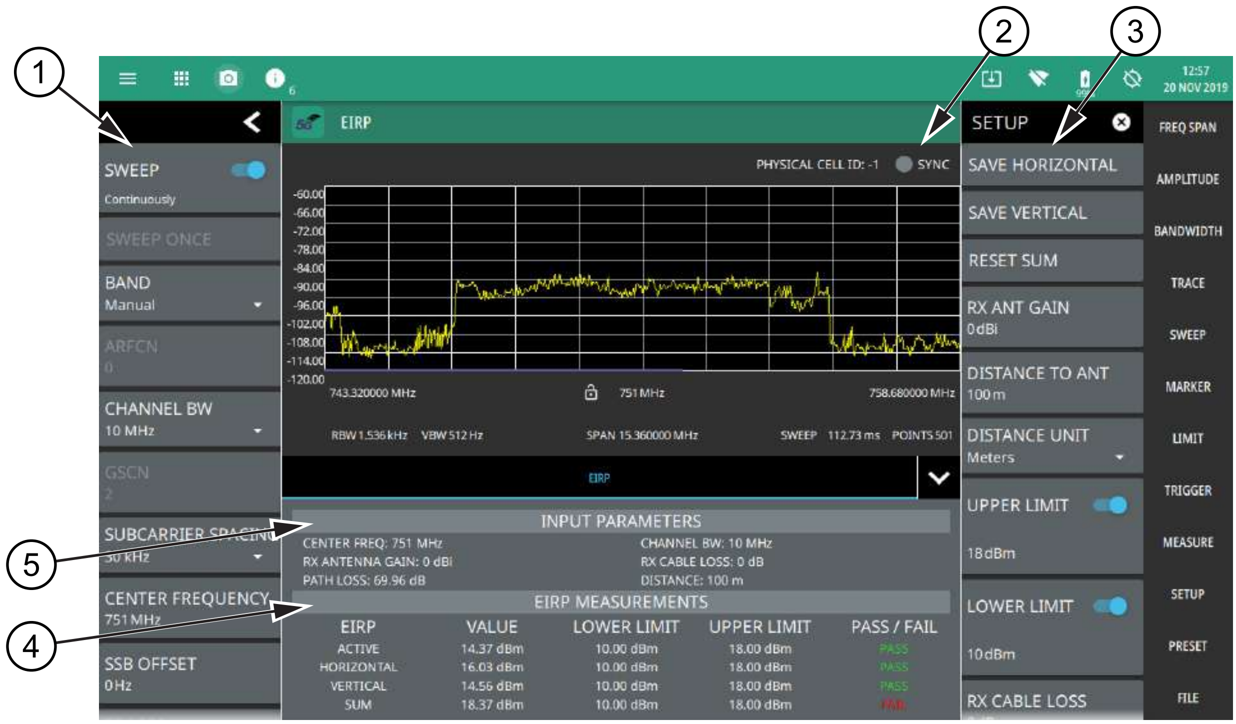


Figure 6-33. 5GNR EIRP Normal View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR EIRP)" on page 6-43.
2. **SYNC:** Valid 5GNR occupied bandwidth measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.
3. **SETUP Menu**: The EIRP settings are configured in the SETUP menu. See "SETUP Menu (5GNR EIRP)" on page 6-42.
4. **EIRP Measurement Summary**: This area shows the measurement results summary with pass/fail test results, when enabled:
   - The ACTIVE EIRP value and upper/lower test limits are expressed in dBm with a pass/fail result.
   - The saved HORIZONTAL EIRP value with upper/lower test limits expressed in dBm with a pass/fail result.
   - The saved VERTICAL EIRP value with upper/lower test limits expressed in dBm with a pass/fail result.
   - The effective sum of the saved HORIZONTAL and VERTICAL EIRP values, with upper/lower test limits expressed in dBm with a pass/fail result.
   - Tapping this summary area opens the EIRP SETUP menu.
5. **EIRP Input Parameters**: This area shows the input parameters for the measurement:
   - Gate delay and length parameters are applied when gated sweep is enabled (requires Option 90). See "Gated Sweep (Option 90)" on page 6-14.
   - The frequency and band parameters are configured in the BAND CONFIG menu. See "BAND CONFIG Menu" on page 6-6.
   - Receiver antenna gain parameters are configured in the EIRP SETUP menu. See "SETUP Menu (5GNR EIRP)" on page 6-42.

Figure 6-33. 5GNR EIRP Normal View (2 of 2)

EIRP Normal View

An EIRP measurement with the quick view is shown in Figure 6-34. This simplified view provides a conceptional visual of the EIRP measurement and displays the summary measurement data and input parameters. The adjustable parameters can be touched directly to change their value. Set up the measurement parameters using the “BAND CONFIG Menu” on page 6-6 and “SETUP Menu (5GNR EIRP)” on page 6-42.

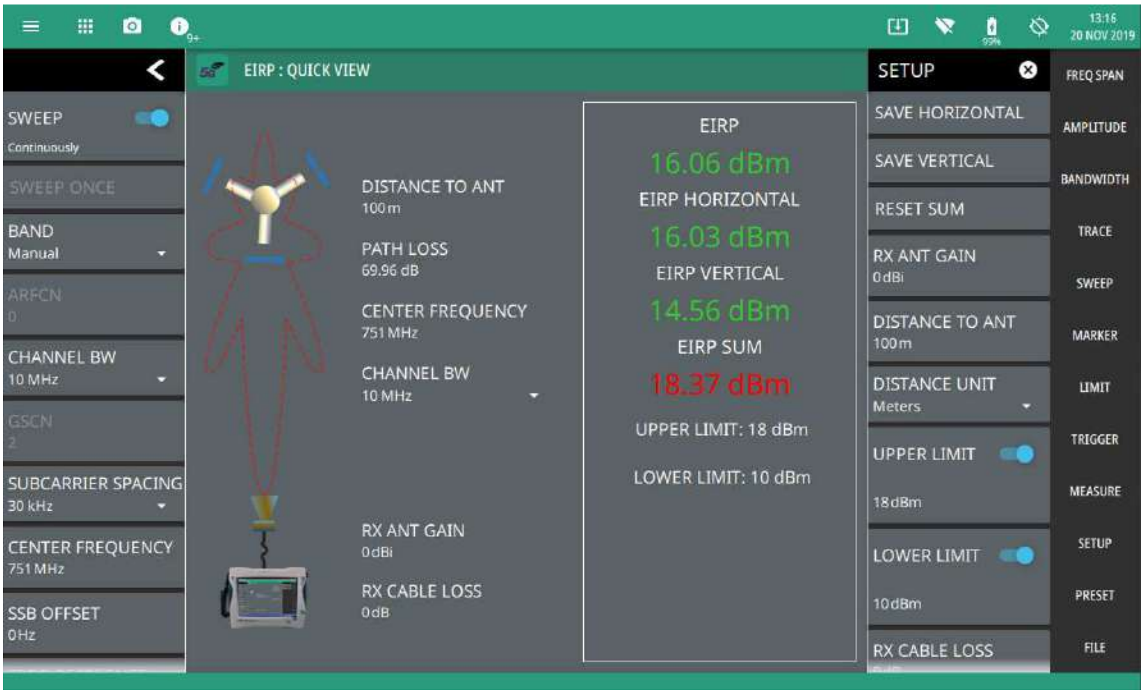
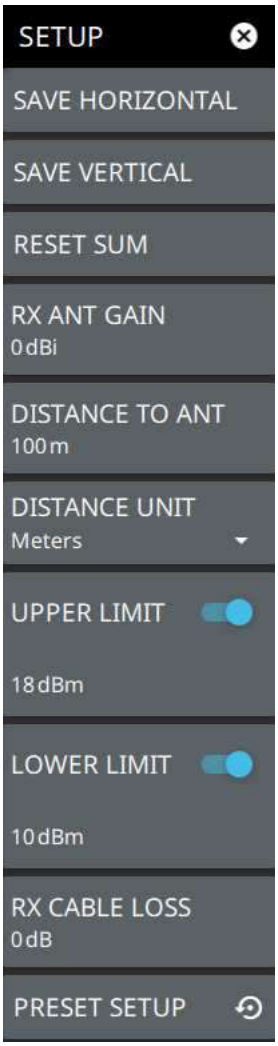


Figure 6-34. 5GNR EIRP Quick View

SETUP Menu (5GNR EIRP)

The EIRP SETUP menu is available in MEASURE > MEASUREMENT > EIRP > SETUP. Once the EIRP measurement is selected in the normal view, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.



SAVE HORIZONTAL: Saves the current EIRP measurement as the horizontally polarized EIRP value. The antenna must be set up for horizontal polarization for a valid measurement.

SAVE VERTICAL: Saves the current EIRP measurement as the vertically polarized EIRP value. The antenna must be set up for vertical polarization for a valid measurement.

RESET SUM: Clears the saved horizontal and vertical EIRP measurements and resets the sum.

RX ANT GAIN: Sets the antenna gain value from 0 dBi to 999 dBi with a resolution of 0.01 dB. For the most accurate reading, any cable loss between the antenna and the instrument should be subtracted from the RX ANT GAIN.

DISTANCE TO ANT: Sets the straight line distance between the antenna and signal source. The range can be set from 1 m to 1000 m (approximately 3.3 ft to 3300 ft) with a resolution of 0.01 (m or ft).

DISTANCE UNIT: Sets the distance unit of measure to Meters or Feet.

UPPER LIMIT: Enables the pass/fail compliance test for the upper radiated power. Once enabled, the settable range is –99 dBm to 100 dBm.

LOWER LIMIT: Enables the pass/fail compliance test. Once enabled, the settable range is –99 dBm to 100 dBm.

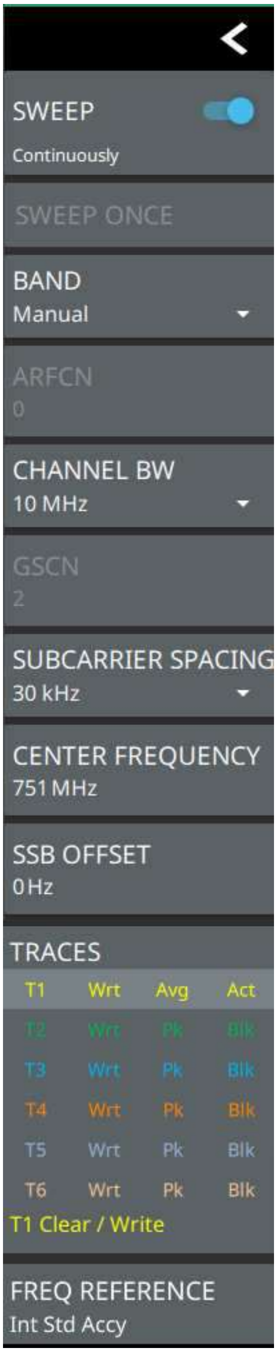
RX CABLE LOSS: Sets the cable loss parameter in dB/m.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 6-35. SETUP Menu (EIRP)

Status Panel (5GNR EIRP)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected. Figure 6-36 shows the 5GNR status panel that covers the 5GNR EIRP measurements.



SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-36. Status Panel (5GNR EIRP Measurements)

6-15 5GNR Carrier Aggregation

5GNR carrier aggregation measurements are used for compliance testing of 5GNR networks and can evaluate active antenna systems for dynamic physical layer attributes and received power levels of the transmitted signal.

5GNR Carrier Aggregation View

Carrier aggregation displays up to eight component carrier (CC) measurements. Each carrier can be set up uniquely for signal band. An example 5GNR carrier aggregation measurement is shown in Figure 6-37.

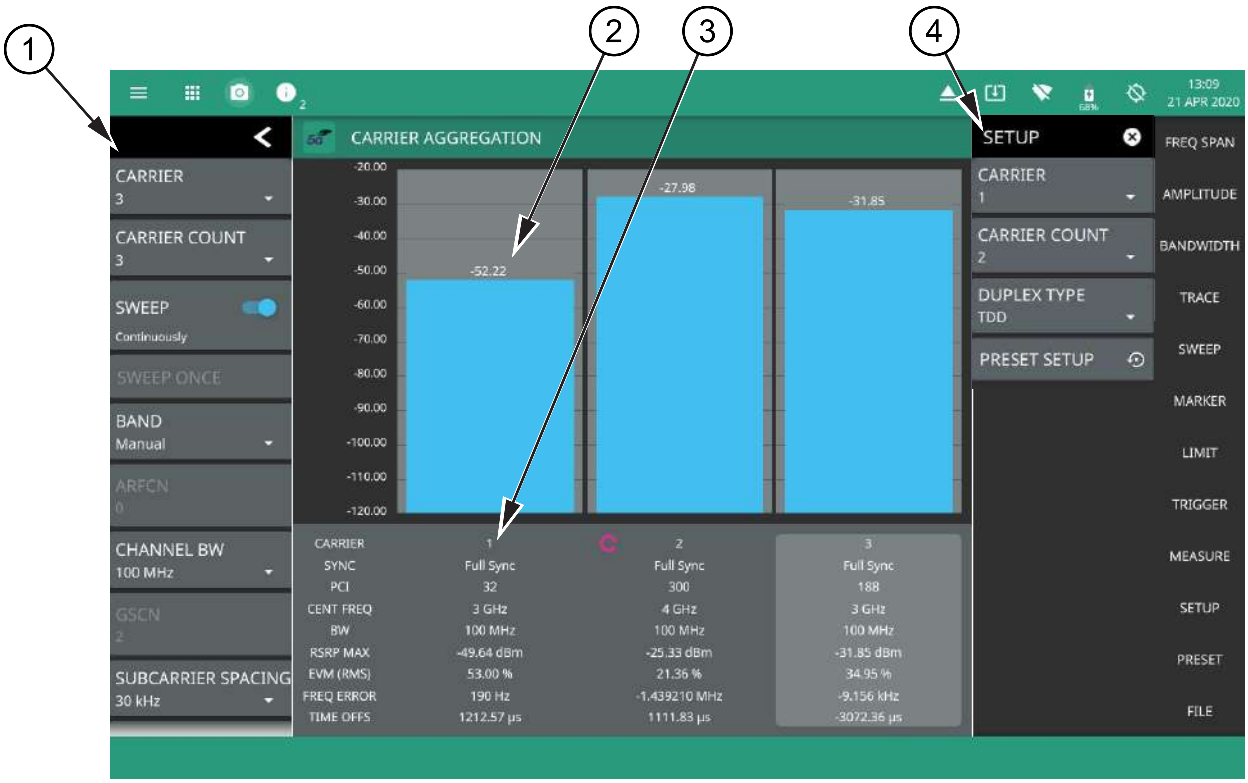


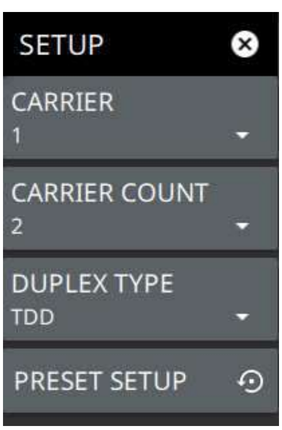
Figure 6-37. 5GNR Carrier Aggregation (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See “Status Panel (5GNR Carrier Aggregation)” on page 6-46.
2. **Signal Level**: This area shows a bar graph of the RSRP of the SSB beam with the lowest detected EVM.
3. **Summary Display**: Shows data for each numbered component carrier. The highlighted summary display area is the component carrier data that can be edited, and this area can be touched to select that component carrier for editing. A rotating magenta circle indicates which carrier is currently being measured.
   - Sync status indicating primary synchronization signal (PSS) full synchronization or PSS failure.
   - Physical Cell ID (PCI) identifying information sent by the transmitter in the sync signal.
   - Center frequency of the measurement channel.
   - Channel bandwidth (BW) sets the bandwidth of the component carrier.
   - Reference Signal Received Power (RSRP) max power is displayed in dBm. The reference signal is used for downlink channel estimation.
   - EVM (RMS) shows the percentage value of all the error vectors between the reconstructed ideal signals and the received signals divided by the RMS value of the ideal signals.
   - Frequency error is the difference between the measured carrier frequency and the specified carrier frequency. This measurement is only as accurate as the frequency reference that is used and is typically only useful with a good external frequency reference or GPS.
   - Time offset shows the time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GPS when the instrument has GPS lock.
4. **SETUP Menu**: The component carrier settings are configured in the SETUP menu. See “SETUP Menu (5GNR Carrier Aggregation)” on page 6-45.

Figure 6-37. 5GNR Carrier Aggregation (2 of 2)

SETUP Menu (5GNR Carrier Aggregation)

The carrier aggregation SETUP menu is available in MEASURE > MEASUREMENT > Carrier Aggregation > SETUP.



CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 6-38. 5GNR SETUP Menu (Carrier Aggregation)

Status Panel (5GNR Carrier Aggregation)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 6-39 shows the 5GNR status panel that covers the 5GNR carrier aggregation measurement.

CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to “Options Settings” on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-39. Status Panel (5GNR Carrier Aggregation Measurement)

6-16 5GNR Constellation

5GNR constellation measurement displays the demodulated symbol point location of a selected SSB beam on an IQ coordinate plot, which illustrates the constellation of a particular modulation format. Field Master Pro displays QPSK constellation with a PCI summary and power tabular data. An example 5GNR constellation display and measurement is shown in Figure 6-40.

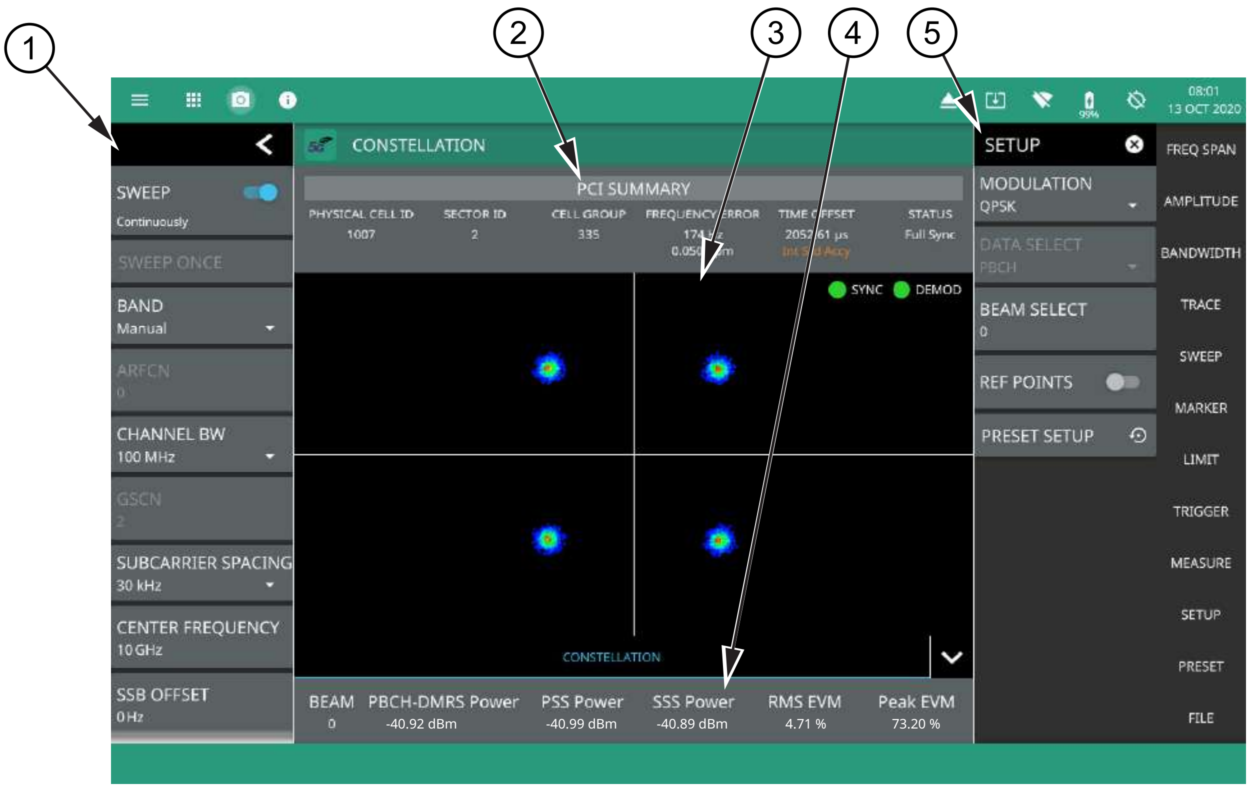


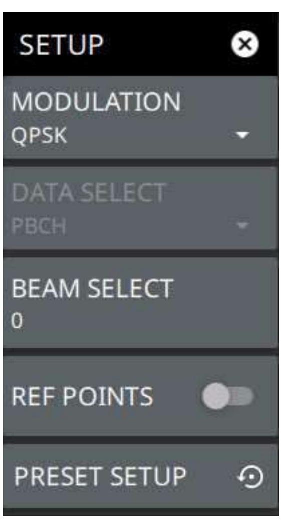
Figure 6-40. 5GNR Constellation Measurement (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See “Status Panel (5GNR Constellation)” on page 6-49.
2. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS, SSS, or Beam Index failure, Full Sync, or an Unknown condition. Also noted is the instrument’s reference clock accuracy of Internal, External, or GPS high accuracy (requires GPS).
3. **Constellation**: This area displays the demodulated symbol point location on an IQ coordinate plot. Points are drawn in colors that are associated with the symbol point density. Warmer colors (red/orange) indicate a higher symbol density where cooler colors (cyan/blue) indicate lower symbol density. The ideal symbol reference point location overlay can be toggled on or off via the SETUP menu.
4. **Channel Summary**: For the currently selected beam, shows the RMS error vector magnitude (EVM), peak EVM (@ subcarrier/symbol) and received power in dBm for each block measurement:
   - PBCH-DMRS: In 5GNR measurements, the PBCH decoding relies on a demodulation reference signal (DMRS, which is a physical layer reference signal used for decoding) rather than a cell specific reference signal (CRC).
   - PSS: The primary synchronization signal provides the primary frame boundary (i.e., the position of the first symbol in the frame).
   - SSS: Similar to PSS, the secondary synchronization signal provides the secondary subframe boundary.
5. **SETUP Menu**: The constellation measurement settings are configured in the SETUP menu. See “SETUP Menu (5GNR Constellation)” on page 6-48.

Figure 6-40. 5GNR Constellation Measurement (2 of 2)

SETUP Menu (5GNR Constellation)

The control channel SETUP menu is available in MEASURE > MEASUREMENT > Constellation > SETUP.



MODULATION: Selects the modulation format (only QPSK is available).

DATA SELECT: Selects the data format (only Physical Broadcast Channel (PBCH) is available).

BEAM SELECT: Selects the 5GNR SSB beam for the demodulation and display.

REF POINTS: Toggles the ideal reference point locations on or off.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 6-41. SETUP Menu (5GNR Constellation)

Status Panel (5GNR Constellation)

The status panels illustrated in this section are unique to the current analyzer and to the particular measurement and view that is selected.

Figure 6-42 shows the 5GNR status panel that covers the 5GNR constellation measurement.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-34.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

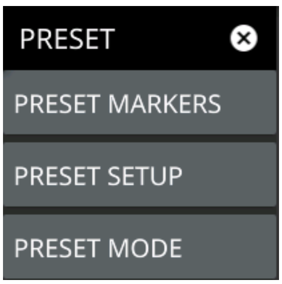
FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 6-42. Status Panel (5GNR Constellation)

6-17 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, "Reset Settings" on page 2-35. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting".

PRESET Menu



PRESET MARKERS: Presets all values on the MARKER menu to default values. Not available in 5GNR Summary measurement.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 6-43. PRESET Menu

6-18 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, native trace and CSV trace data, limit line setups, and screenshots. You can recall setup, native trace, and limit line files. For other file operations such as copy, move, and directory management, refer to Section 2-12 “File Management” on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 6-44:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

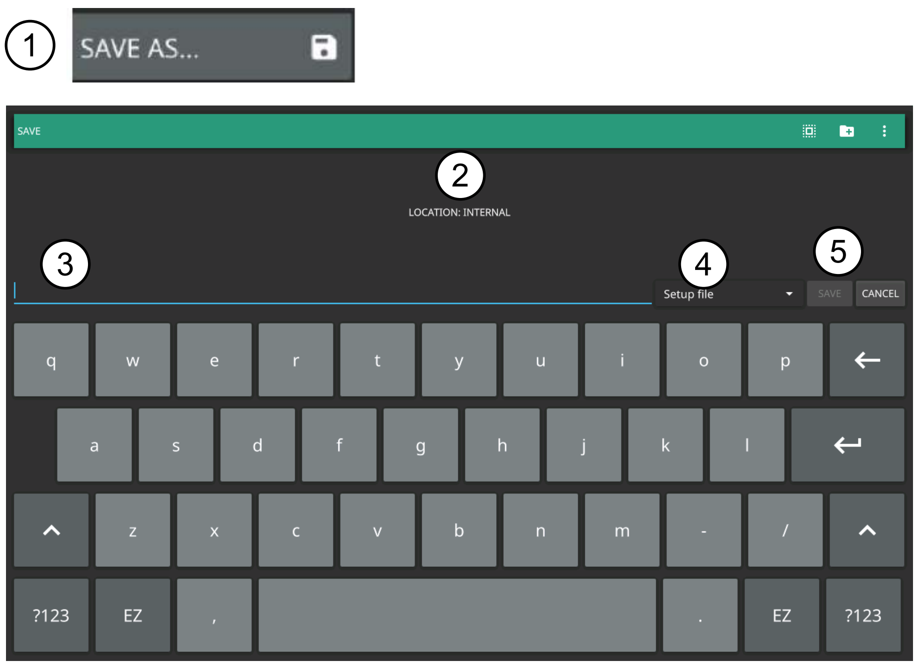


Figure 6-44. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 6-45:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

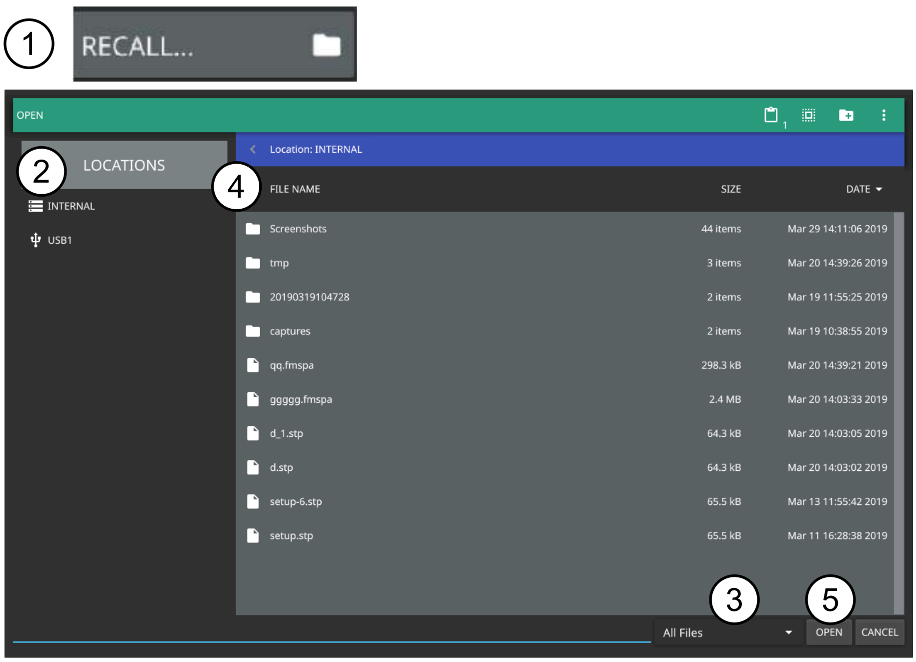


Figure 6-45. File Open Dialog

When a trace measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements:

- For a 5GNR summary measurement, disable SWEEP > HOLD
- For an RF-based measurement, set TRACE > MODE > Active

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fm5gnr file type).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fm5gnr and png file types).

RECALL: Opens the Recall File dialog to retrieve a file from a desired location.

5G CAPTURE: Initiates a digitized 5G data capture. 5G captures are saved to the internal storage space in the captures folder (bin file type). This feature is meant to help identify 5GNR signal characteristics during early development.

CAPTURE SYNC FAIL: Automatically initiates a digitized 5G data capture when synchronization fails. The setting can be configured to capture just a single event or repeat events. 5G captures are saved to the internal storage space.

BROWSE FILES: Opens "File Management" on page 2-36.

Figure 6-46. FILE Menu

Chapter 7 — IQ Capture/Streaming (Option 124/126 and 125/127)

7-1 Introduction

IQ capture and streaming is available in the spectrum analyzer and real-time spectrum analyzer modes only. The feature attains the magnitude/phase or real/imaginary raw data components of a waveform and either saves the data to a file on internal or external USB storage media, or streams the data out of the Data, USB, or Ethernet ports. The following sections describe details of the IQ data format and structure. Refer to Section 7-5 “IQ Capture/Streaming Measurement” on page 7-7 to get started with an IQ capture or an IQ stream.

Note	Options 126 and 127 are export license free. Option 126 limits bit depth to 8 or 10 bits when bandwidth is 110 MHz; Option 127 limits streams to 100 MHz BW or less.

7-2 IQ Capture Block Mode

This mode captures a single block of IQ data. IQ data is first stored to high speed DDR4 SDRAM buffer memory and then it can be saved to flash memory or sent to a remote user via Ethernet. The capture length (duration) is limited by the size of the buffer memory (2 GB) and IQ data rate, which is determined by the capture bandwidth. The IQ capture bandwidth must be set to one of the available values listed in the user interface. The output data rate for a single IQ data pair is depended on the selected bandwidth. The output data rate does not change, regardless of bit resolution. The maximum capture length is limited by memory, capture bandwidth and bit resolution. Refer to the *MS2090A Technical Data Sheet* for more information.

7-3 IQ Data Format

The `TRAC:IQ:DATA?` query returns a modified version of the SCPI standard (IEEE 488.2) block data format. The header contains three fields with a newline delimiter separating the header from the IQ binary data:

#AXL\n: **A** is a single ASCII digit specifying the number of digits in X.

X is one or more ASCII digits specifying the number of bytes of binary IQ data and ASCII GPS location coordinates.

L is the ASCII string containing the GPS location in the form 'latitude, longitude' in decimal degrees. The coordinates record where the IQ capture was triggered.

\n is a single byte newline delimiter marking the end of the GPS location component and start of the IQ data.

The IQ data is in binary format and is described below.

IQ Frame Structure

IQ data is organized into two levels: frame and extended frame. The lowest level is a 64 bit frame. which may contain one to four IQ sample pairs depending on the selected IQ bit resolution. The second level is an extended frame which can be used for the stamp information. The first column of the IQ vector contains I and the second column contains Q.

64 bit Frame

The 64 bit frame contains one to four IQ sample pairs depending on the selected IQ bit resolution.

Table 7-1. IQ Frame Structure

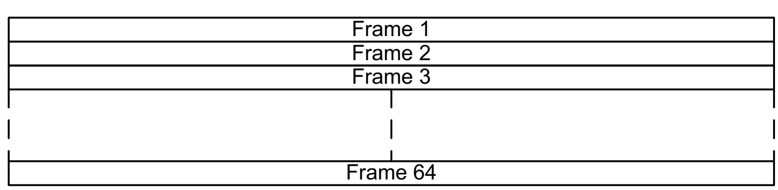
IQ Bit Resolution	Sample Pairs Per Frame	IQ Frame Structure
32	1	32-bit I | 32-bit Q
16	2	16 bit I | 16 bit I | 16 bit Q | 16 bit Q
10	3	10 bit I | 10 bit I | 10 bit I | 0 | 0 | 10 bit Q | 10 bit Q | 10 bit Q | 0 | 0
8	4	8 bit I | 8 bit I | 8 bit I | 8 bit I | 8 bit Q | 8 bit Q | 8 bit Q | 8 bit Q

Note	The frame structure will be modified slightly when there is a time stamp as described in “IQ Timestamps” on page 7-3.

IQ Extended Frame

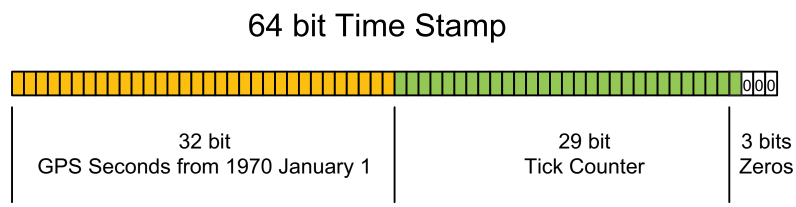
An extended frame consists of 64 frames. When time stamp information is used, each frame contains one bit of a 64 bit time stamp data. An extended frame is 64 frames that contain a time stamp.

Extended Frame



IQ Timestamps

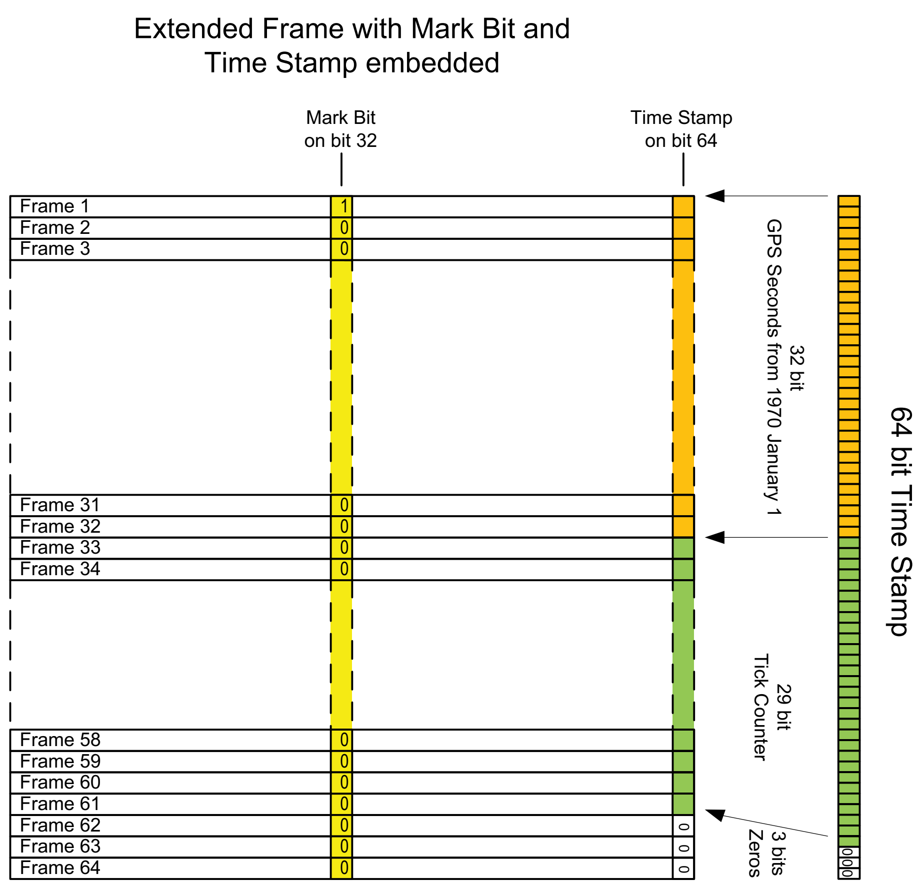
IQ timestamps are available for IQ capture. This section describes how the time stamp is embedded into the IQ data. Within each 64-bit frame, only the first four extended frames contain time stamp information (see the 64-bit time stamp frame diagram below).



The GPS seconds is the time in seconds from January 1, 1970. The tick counter counts at a rate of 270 MHz and it is reset to 0 on every second, triggered by the GPS PPS signal. The time stamp records the time at the beginning of each extended frame. The elapsed time between each frame is calculated with the following formula:

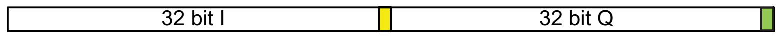
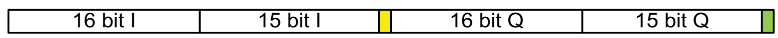
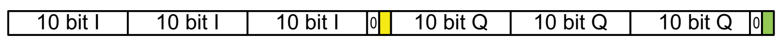
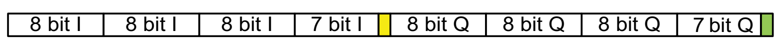
$$\textit{Elapsed Time Between Each Frame} = \frac{1}{\textit{Output Data Rate}} \times \textit{IQ Sample Pairs per Frame}$$

To insert the time stamp without interrupting the IQ data sequence, the 64 bit time stamp is rotated and inserted into the extended frame by using bit 64 from each frame. To indicate the beginning of an extended frame with a time stamp, a mark bit is set to ‘1’ for the first frame and ‘0’ for the remaining 63 frames. The mark bit uses bit 32 of each frame.



Embedding the time stamp requires using two bits from each frame, which requires modifying the IQ frame structure as shown below:

Table 7-2. IQ Frame Structure with Time Stamps

IQ Bit Resolution	IQ Frame Structure
32	 Each frame contains only one IQ sample pair (one I and one Q). The first column of the IQ vector contains I and the second column contains Q. All the frames will have 32 bits each for I and Q. Each I and Q sample is followed the mark or time stamp bit. Within each super frame, only the first four extended frames contain time stamp information. The remaining extended frames will have a zero valued mark and a time stamp bit.
16	 Each frame contains two IQ sample pairs (two I and two Q). The first I and first Q sample in the frame will always have 16 bits; the second I and second Q sample will have 15 bits followed by the mark and a time stamp bit.
10	 Each frame contains three IQ sample pairs (three I and three Q). All of the frames will have 10 bits each for I and Q. Each I and Q sample is followed by one zero, then the mark or time stamp bit. Within each super frame, only the first four extended frames contain time stamp information. The remaining extended frames will have a zero valued mark and a time stamp bit.
8	 Each frame contains four IQ sample pairs (four I and four Q). The first three I and first three Q samples in the frame will always have eight bits. The fourth I and fourth Q sample will have seven bits if the frame is in the first four extended frames, which uses one bit for mark and one bit for the time stamp. Having only seven effective bits instead of eight bits on every fourth sample will slightly increase the noise floor.

Sometimes, the first mark bit does not always begin at the start of the IQ capture. There could be a number of IQ samples recorded before the first time the mark bit is set to one. In the example below, there are five frames before the first timestamp, which doesn't start until the sixth frame. The first column of the IQ vector contains Q and the second column contains I.

Table 7-3. IQ Frame Structure with Time Stamps

N	Frame Data (one I and one Q sample per frame)
0	[I-------TQ-------0]
1	[I-------TQ-------0]
2	[I-------TQ-------0]
3	[I-------TQ-------0]
4	[I-------TQ-------0]
5	[I-------TQ-------0] <- first mark bit, 'T' is the MSB of the timestamp
6	[I-------TQ-------0] <- 'T' is MSB - 1 bit of the timestamp
7	[I-------TQ-------0] <- 'T' is MSB - 2 bit of the timestamp
8	[I-------TQ-------0] <- etc.

To get the timestamp for frames N=0 though N=4, you must extrapolate the timestamp from frame five backward. To get the timestamps for frames 6 through 68, you must extrapolate the timestamp forward. The time between each frame is equal to (1/Output Data Rate) x (Number of I or Q samples per frame).

IQ Bit Resolution	Time Between Each Frame
32	1/(Output Data Rate)
16	2/(Output Data Rate)
10	3/(Output Data Rate)
8	4/(Output Data Rate)

Once the 64 bits of timestamp is put together, you get a number that looks like:

[S-------T-----0000]

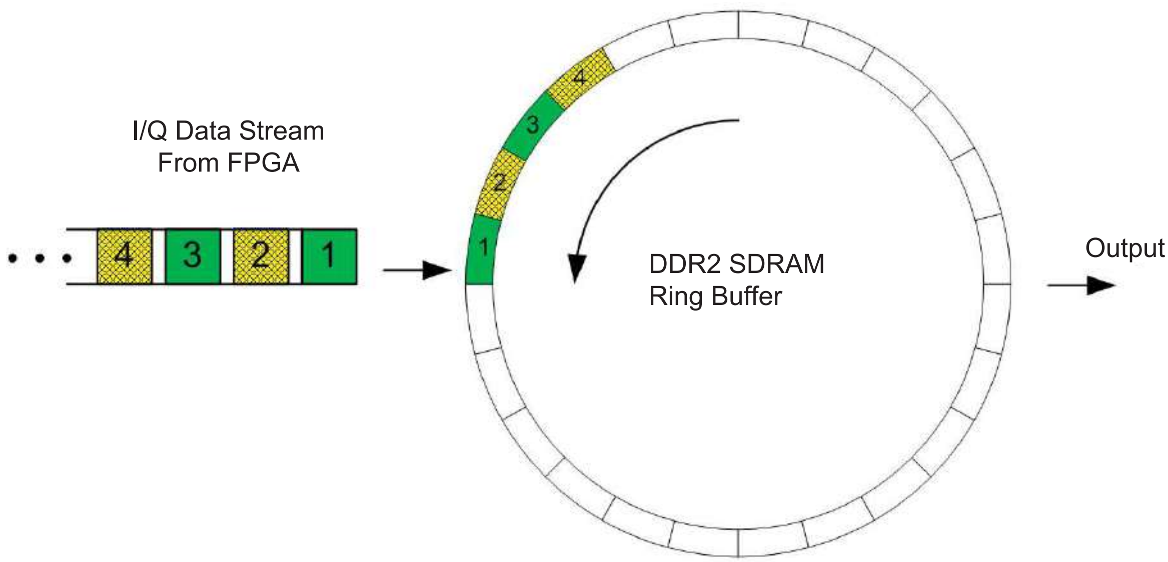
Where 'S-------' is 32 bits specifying the timestamp in seconds since 1970 (time_t), 'T-----' is 28 bits specifying the offset from that second (in clock ticks at 270 MHz), and '0000' are four unused bits.

Note	There could be some frames at the very end of the capture that have an incomplete timestamp because the capture stops before there is a complete group of 64 frames to make an extended frame. In that case you would extrapolate from the previous timestamp.

7-4 IQ Streaming

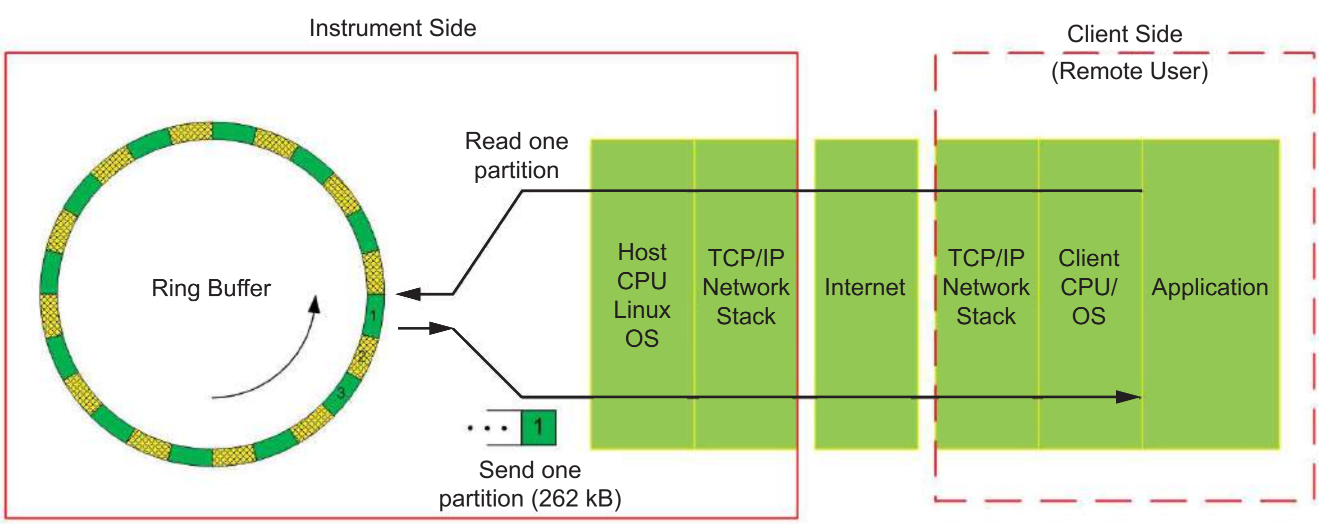
In streaming, the IQ data uses the same frame and extended frame structure as in block mode.

IQ data is captured to high speed DDR4 SDRAM memory, configured as a ring buffer. The buffer memory is 2 GB. The data stream rate to memory is determined by the selected IQ bandwidth. When the buffer is full, new IQ data is stored from the first partition again.



Data Transmission to Remote User

When the IQ is sent out from the memory to the remote user, the data flow rate has to be managed. The simplest way to manage the data flow is to send out one partition and wait for a read command from the remote user before sending another partition. The user may not be able to receive all the partitions if the read command for each partition is delayed due to latency in the CPU, OS, network, and user application. The IQ data is continuously filling the memory partitions at a rate proportional to the selected IQ capture bandwidth. If the read command arrives after the start of a partition, that partition is skipped and will not be sent. The next partition will be sent instead.



To read the IQ data, use the `TRAC:IQ:DATA?` SCPI command. This returns the partition with the most recently captured IQ data. During streaming, the client has to continuously send `TRAC:IQ:DATA?` SCPI command to another partition's IQ data.

The capture of IQ data and filling of partitions will continue until it is aborted with the `:ABORT` command or other commands that change frequency or attenuation settings. To determine if the capture was aborted, check the output of `STATus:OPERation?`.

The `STATus:OPERation?` query responds with an integer. Convert this integer to binary.
Bit 9 is set to 1 when the `MEAS:IQ:CAPT` command is issued.
Bit 9 is set to 0 if the capture is aborted by the `:ABORT` command or other command that invalidates the capture.

7-5 IQ Capture/Streaming Measurement

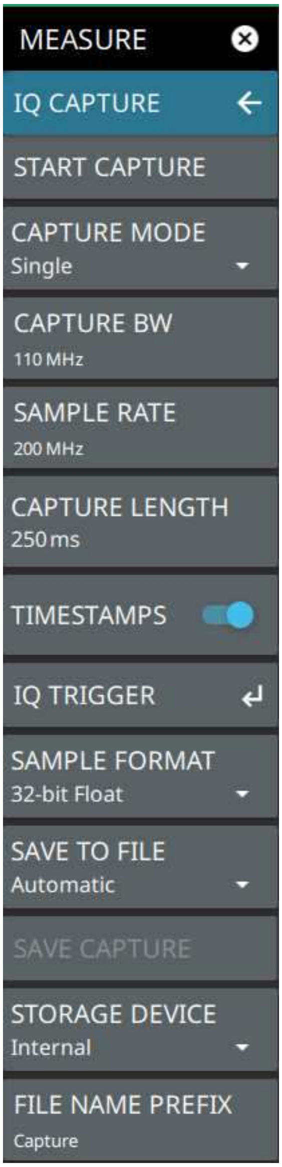
Setting up an IQ capture/streaming measurement begins with setting up the basic measurement parameters:

- For spectrum analyzer measurement setup, refer to Chapter 3, "Spectrum Analyzer Measurements"
- For real-time spectrum analyzer measurement setup, refer to Chapter 4, "Real-Time Spectrum Analyzer Measurements"
- For optimal dynamic range, noise floor, and residual spurs, set the reference level to just above the peak signal level when performing 16-,10-, or 8-bit captures. Otherwise, high level spurs may be present.
- Turn on the preamp when the reference level is set to –40 dBm or lower. With signal levels at –40 dBm and preamp off, spurs may be –15 dB from the signal level with 8-bit captures.

Note	When capturing IQ data from spectrum analyzer mode, the analyzer stops sweeping to start the capture. When the span is wider than the capture bandwidth or the RBW is very narrow, the LO will have to be tuned to the center frequency before the capture starts.

Once your basic measurement is configured, access the IQ Capture menu from the main MEASURE menu.

IQ CAPTURE Menu



START/STOP CAPTURE: Touch this button to execute an IQ capture. When a capture is initiated, this button changes to STOP CAPTURE and can be touched to stop the continuous captures. Note that the captured data will still be saved unless the CANCEL SAVE button below is touched. Check the IQ status table at the bottom of the display.

CANCEL SAVE: This button appears after a capture has been initiated. Touch this button to present a dialog that allows you the choice to cancel the IQ capture save and discard the captured data, or to continue with the capture and save the data.

CAPTURE MODE: Selects the IQ capture mode:

- **Single** for a one-time capture to internal or external (USB) storage
- **Continuous** for capture to internal or external (USB) storage. Automatically initiates a new capture once the previous capture is saved.
- **Streaming** for continuous IQ data streaming out of the Ethernet, USB, or Data Out port (refer to "IQ STREAMING Menu" on page 7-9).

CAPTURE BW: IQ capture bandwidth is the frequency range of data to be collected for the duration of the IQ length. IQ capture bandwidth and sampling rate are linked and are selected from the same dialog.

SAMPLE RATE: Sets the IQ sampling rate of data to be collected for the duration of the IQ length. IQ sampling rate and capture bandwidth are linked and are selected from the same dialog.

CAPTURE LENGTH: Sets the duration of the waveform data capture. The maximum allowable capture period is dependent on available space on the selected storage device.

TIMESTAMPS: Toggles data collection timestamps on or off (see "IQ Timestamps" on page 7-3).

IQ TRIGGER: Opens the "IQ TRIGGER Menu" on page 7-10.

SAMPLE FORMAT: Sets the sampling bit format (32-bit floating decimal, 32-, 16-, 10-, or 8-bit integers).

SAVE TO FILE: Toggles automatic or manual file saving. When set to manual, touch the SAVE CAPTURE button to save the next completed IQ capture.

SAVE CAPTURE: Saves captured data to a file when SAVE TO FILE is set to Manual.

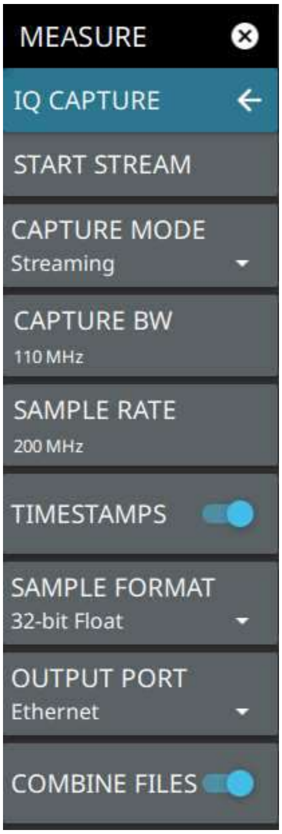
STORAGE DEVICE: Sets the capture file save location. You can select Internal or one of the available USB ports when storage media is detected.

FILE NAME PREFIX: Sets the file name prefix of the capture file. Files are stored a "Captures" folder internally or to USB storage media. File naming contains the following:

prefix_year-month-day-time-##_capturetime in ns_number in scientific notation.dgz or .dgzm

Figure 7-1. IQ CAPTURE Menu

IQ STREAMING Menu



START STREAM: Touch this button to start IQ data streaming from the selected output port. When streaming is initiated, this button changes to STOP STREAM and can be touched to stop the stream.

CAPTURE MODE: Selects the IQ capture mode:

- **Single** for a one-time capture to internal or external (USB) storage (refer to "IQ CAPTURE Menu" on page 7-8)
- **Continuous** for capture to internal or external (USB) storage (refer to "IQ CAPTURE Menu" on page 7-8)
- **Streaming** for continuous IQ data streaming out of the Ethernet, USB, or Data Out port.

CAPTURE BW: IQ capture bandwidth is the frequency range of data to be collected for the duration of the IQ length. IQ capture bandwidth and sampling rate are linked and are selected from the same dialog.

SAMPLE RATE: Sets the IQ sampling rate of data to be collected for the duration of the IQ length. IQ sampling rate and capture bandwidth are linked and are selected from the same dialog.

TIMESTAMPS: Toggles data collection timestamps on or off (see "IQ Timestamps" on page 7-3.

SAMPLE FORMAT: Sets the sampling bit format (32-bit floating decimal, 32-, 16-, 10-, or 8-bit integers).

OUTPUT PORT: Selects the output port to stream the IQ data. If using the Data Out port and the MA25424A, see "Setting Up the Data Out Port and MA25424A" on page 7-12.

COMBINE FILES: IQ streams are captured in individual files that are combined once the stream stops. When this toggle is on, files will be concatenated by the instrument at the end of the stream into one file. This can be time consuming depending on the stream time. You can also save the streams as individual files and use the "IQ Streaming Tools" on page 7-11 to combine the files.

Figure 7-2. IQ STREAMING Menu

Once the IQ Capture menu is accessed, the IQ CAPTURE table is displayed at the bottom of the screen.

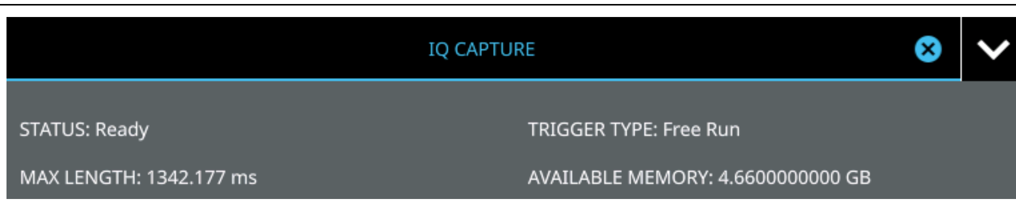


Figure 7-3. IQ CAPTURE Table

The IQ CAPTURE table provides the following:

- STATUS: Current status of the IQ Capture. When a capture is in process, "Saving (xx%)" will be shown with an X to stop the current capture. When streaming is in process, the status will show "Streaming."
- TRIGGER TYPE: Indicates the currently selected IQ trigger type.
- WAITING FOR TRIGGER: Indicates the capture has been started but is waiting for a trigger to initiate.
- MAX LENGTH: Indicates how long a capture can be with the current settings and available storage.
- AVAILABLE MEMORY: Indicates how much storage space is available on the target device (internal or external).

IQ TRIGGER Menu

Note	Trigger commands are shared between IQ capture and zero span, so these two functions are mutually exclusive.

TIMESTAMPS: toggles data collection timestamps on or off (see “IQ Timestamps” on page 7-3.

SOURCE: The SOURCE button offers several triggering options depending on which view mode the instrument is set:

- **External 1 or 2:** A TTL signal applied to the selected External Trigger MCX input connector causing a single capture. After the capture is complete, if mode is single, the capture will stop waiting for triggers until capture is started again. If mode is continuous, once the capture is saved, it will look for the next trigger event to initiate another capture. Any trigger made during the capturing or saving period will be ignored.
- **Free Run:** When trigger is free run (or manual), a trigger is only initiated when the START CAPTURE button is pressed or when a remote command is sent.
- **Video:** Sets the video trigger level. When RF energy is detected above that level, a capture is initiated. Note that the user must first press START CAPTURE before the analyzer will begin looking for the trigger.

LEVEL: Used when the trigger source is set to Video. Sets the video trigger level threshold that initiates a capture. The level crossing applies to rising, falling, or both edges. Use the hysteresis setting below to adjust the sensitivity of the trigger level.

DELAY: Sets the IQ trigger delay when the trigger source is not set to Free Run. IQ trigger delay can be set to positive and negative values. A negative value includes data from the specified time before the trigger event.

TIME INTERVAL: Used to set a periodic trigger event. The analyzer waits the user defined amount of time between trigger events.

SLOPE: Used when the trigger source is set to External or Video. Sets the trigger slope to rising, falling, or both. When slope is set to Both, the analyzer triggers on both the rising and falling edges. Triggering on both rising and falling edges is not available in zero span.

HYSTERESIS: Hysteresis is used to address noisy trigger signals. The hysteresis setting adjusts the sensitivity of the trigger system (the difference between the firing level and the arming level as shown in Figure 7-5). A low hysteresis value sets the arming and firing levels close to each other, meaning a small signal change will cause a trigger. A large hysteresis value sets the arming and firing levels far apart, meaning a large signal change will be required to cause a trigger.

IQ CAPTURE: Returns to the IQ CAPTURE menu.

Figure 7-4. IQ TRIGGER Menu

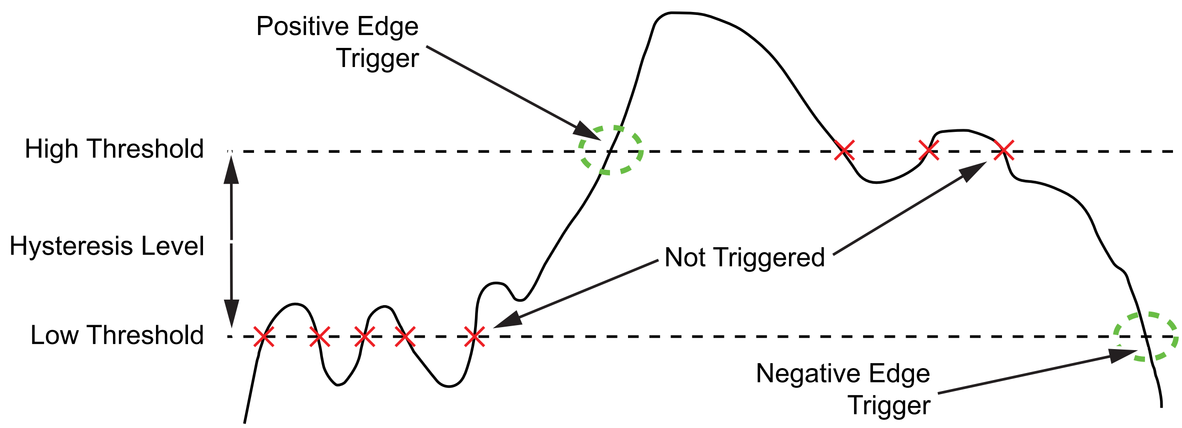


Figure 7-5. Trigger Levels and Hysteresis

IQ Streaming Tools

The IQ STREAMING menu allows you to concatenate an existing IQ metadata file (.dgzm) with a session of IQ data files (.dgz) that were streamed to a USB device after the stream operation is complete. The data files must all come from the same stream session.

1. Access the System menu (3-line icon in the upper left corner).
2. Press TOOLS to access the instrument tools menu, then select IQ STREAMING.

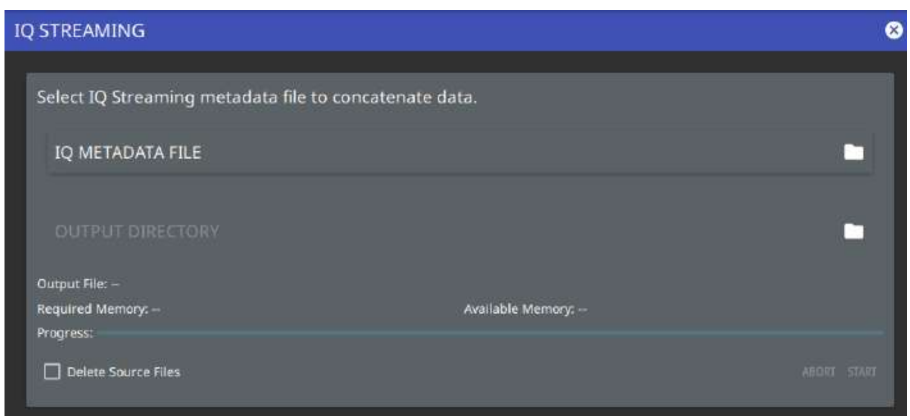


Figure 7-6. IQ Streaming

1. Touch IQ METADATA FILE and then select the metadata file that you wish to concatenate with IQ data streams. All of the data stream files in the selected directory will be concatenated with the metadata file.
2. Touch the OUTPUT DIRECTORY and select the destination for the concatenated files. If desired, select Delete Source Files.
3. Press Start to begin the concatenation. The progress bar will indicate relative progress.

Note	Concatenating files can be time consuming depending on the streaming parameters and time. The process can be much faster if performed on a PC using the MS2090A PC application. Refer to Appendix C, “MS2090A PC Software” for details on using this application.

7-6 Setting Up the Data Out Port and MA25424A

Set up the MS2090A and MA25424A for IQ streaming to IQC5000B as shown below:

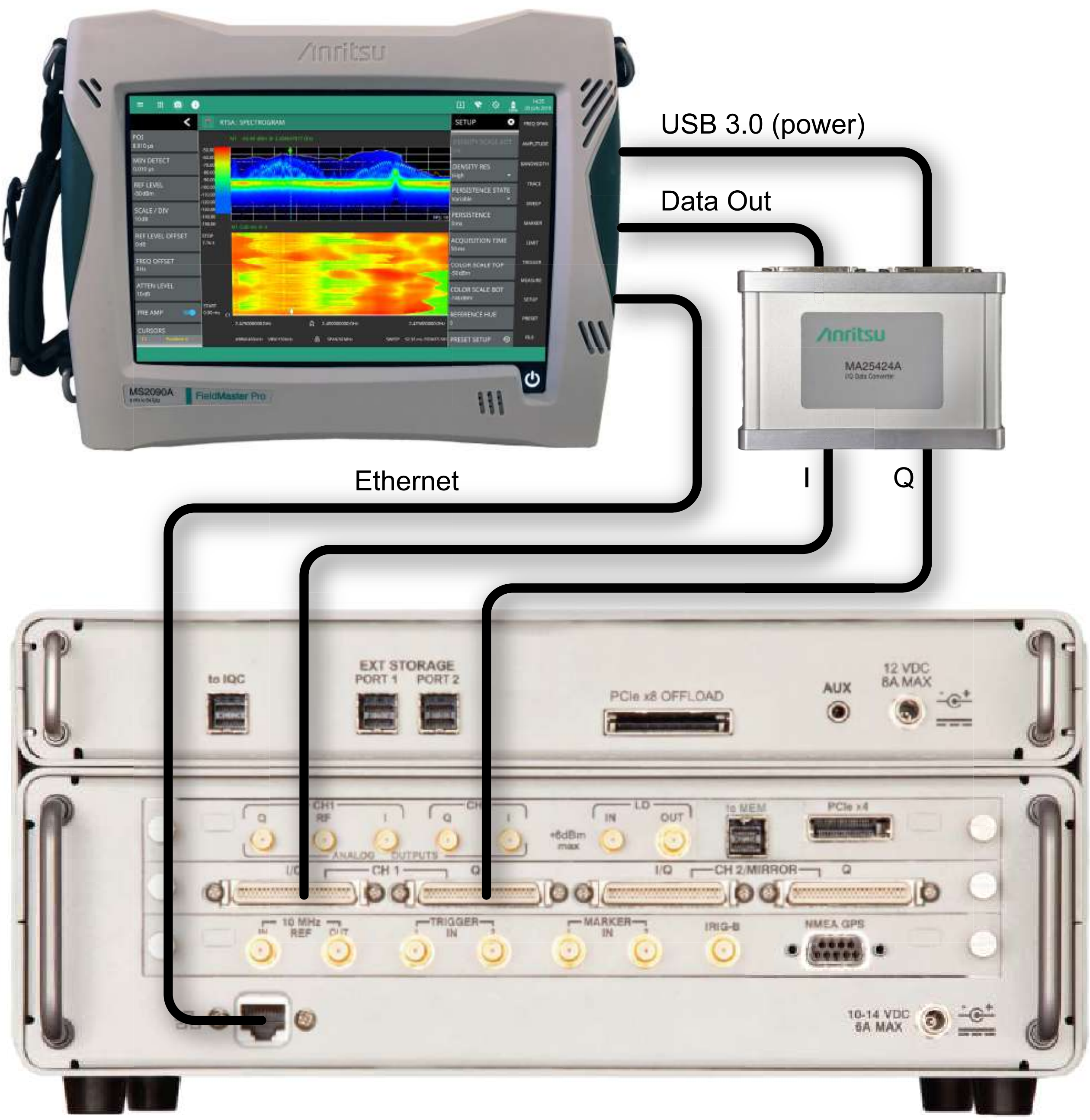


Figure 7-7. MA25424A and IQC5000B Setup

The IQC5000B controls the IQ streaming operation via the Ethernet connection to the MS2090A. The MS2090A Data Out and USB ports connect to the MA25424A Data In and USB ports (note that the USB port is used for power and this could come from any external USB 3.0 power supply capable of supplying ~4 W). The MA25424A splits the I and Q signal components to the two respective I and Q output ports (IEEE 1284-C) and streams the data to the IQC5000B I and Q input ports.

Refer to the IQC5000B documentation for a description of its controls.

Chapter 8 — EMF Meter Measurements (Option 445)

8-1 Introduction

This chapter covers the Anritsu Field Master Pro EMF Meter (Option 445). The EMF Meter is used for electromagnetic field (EMF) compliance testing over the broadband frequency range determined by the EMF probe that is connected to the analyzer. Refer to your technical data sheet for compatible probes.

For frequency selective EMF analysis, EMF Option 444 is covered in Section 3-23 "Electromagnetic Field (EMF) Measurements (Option 444)".

Note	EMF measurements require that an Anritsu isotropic EMF probe is connected to the analyzer.

This chapter describes the measurement setup, including selecting the EMF Meter mode and setting the limit testing criteria. After measurements are taken, refer to Section 2-12 "File Management" and Section 8-6 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

8-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon at the top of the display area. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 8-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

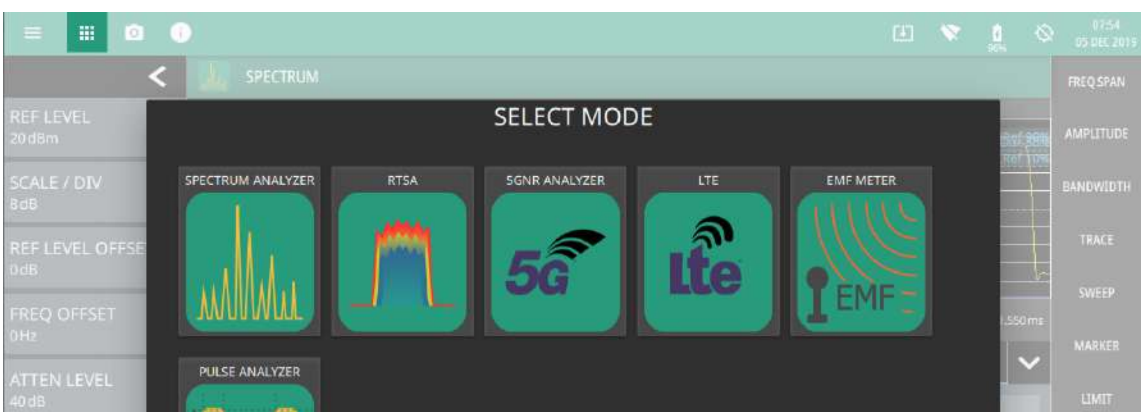


Figure 8-1. Example Analyzers

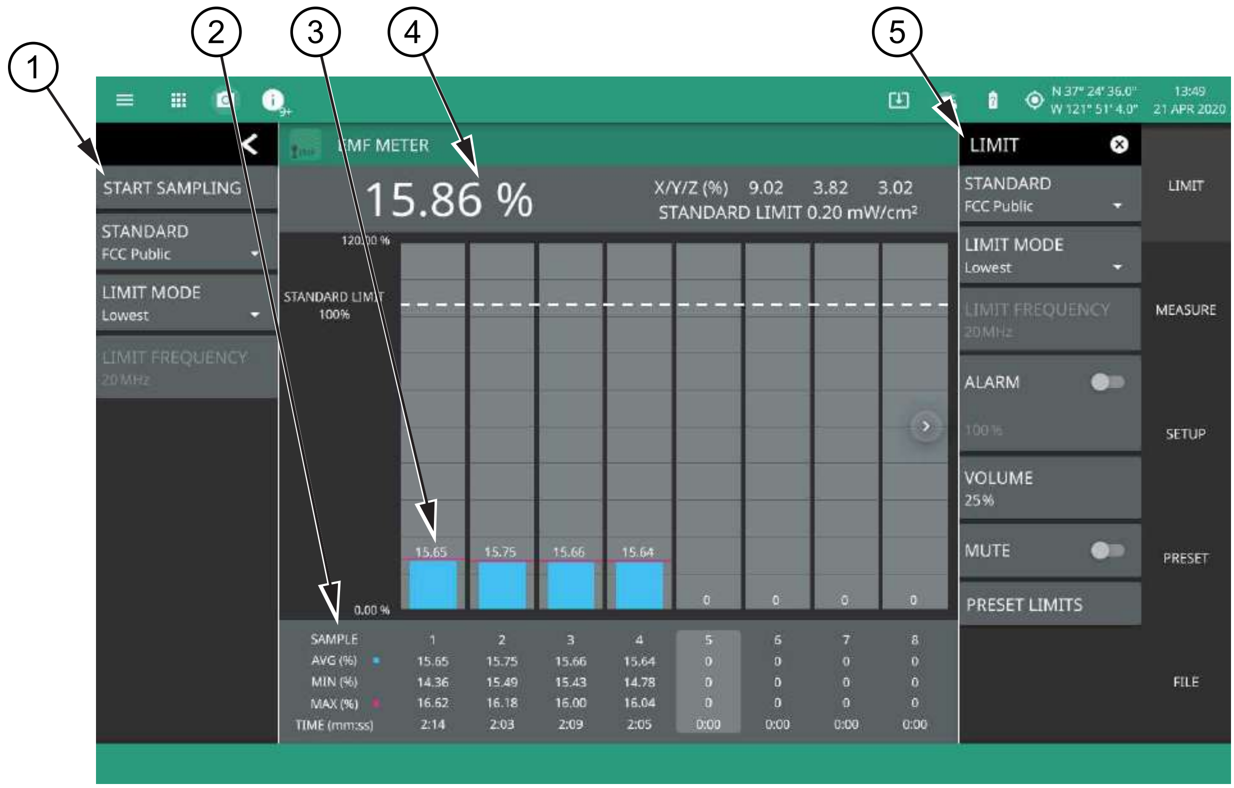
8-3 Connecting the Probe

1. Connect the probe USB connector to one of the top panel USB Type A ports.
2. Set up the EMF Meter for compliance testing of your standard using the following sections.

Figure 8-2. EMF Meter Probe Connection

8-4 EMF Meter Overview

EMF Meter limit testing is set up using the "LIMIT Menu (EMF Meter)" on page 8-4. After completing the data collection for the three axes (X, Y, and Z), the isotropic result is calculated and displayed for each sample. Up to 16 samples can be saved into a single file. The max, min, and average values of the isotropic result are computed and displayed in the table below the graph region for each sample. The current sample data is displayed at the top of the display area.



1. The status panel provides controls for starting a new set of eight measurement samples across the frequency range of the connected probe, selecting the standard for the limit test, and for selecting the limit mode (lowest or selected frequency).
2. Tabular measurement data shows the EMF measurement results (average, maximum, and minimum) along with the test time for each sample.
3. The bar graph area displays the sampled result on a percentage scale relative to the current test limit.
4. The upper data area shows the currently selected sample data for each axis and the calculated total result (%) along with the currently set standard limit in mW/cm^2.
5. The LIMIT menu is where most of the EMF measurement settings are configured. See "LIMIT Menu (EMF Meter)" on page 8-4.

Figure 8-3. EMF Meter Measurement

EMF Meter Measurement

Press START SAMPLING and move the EMF probe through the sector of interest. The EMF probe handle can be removed and the probe can be attached to a standard tripod with a ¼ inch mounting screw for stationary measurements. When finished measuring a sector, press STOP SAMPLING. The meter will automatically save the data to the current sample and then move to the next sample. Up to 16 samples can be taken by starting and stopping the sampling. The data can then be saved as a screenshot (png) or as a comma separated value (csv) file and viewed on a PC.

LIMIT Menu (EMF Meter)

The EMF Meter measurement is primarily set up using the LIMIT menu.

STANDARD: Selects the limit test standard to use for compliance testing:

- FCC Public: FCC field density limit for the general public
- FCC Workers: FCC field density limit for the workers
- Icpublic: International Commission on Non-Ionizing Radiation Protection (ICNIRP) limit for the general public
- Icworker: International Commission on Non-Ionizing Radiation Protection (ICNIRP) limit for workers

LIMIT MODE: Selects the lowest limit value within the frequency range of the probe or the limit value of the specified frequency. Note that selecting "frequency" does not mean that the probe is only measuring at the set frequency. It is still a broadband measurement. Frequency limit mode means that the percentage calculation of the EMF energy is based on the limit of the set frequency.

LIMIT FREQUENCY: When LIMIT MODE is set to frequency, the test limit criteria is applied at the set frequency rather than the lowest limit within the EMF probe frequency range.

ALARM: Toggles the alarm on or off. An alarm will sound when a test limit threshold for any sample is crossed.

VOLUME: Sets the alarm volume from 0% to 100%.

MUTE: Sets the alarm volume to minimum (effectively 0%).

PRESET LIMITS: Presets all limit parameters to factory default.

Figure 8-4. LIMIT Menu (EMF Meter)

MEASURE Menu (EMF Meter)

The MEASURE menu is used to select a sample and to start sampling a new set of data.

SELECTED SAMPLE: Selects one of the 16 available samples. The selected sample is where data will be stored when START SAMPLING is pressed. The selected sample is highlighted in the tabular display area and can also be selected by touching the bar graph or table area of the desired sample.

START SAMPLING: Initiates a new measurement. During a series of measurements, the meter will cycle through and update each of the 16 sample data sets. After pressing, this button will become STOP SAMPLING and can be pressed to stop the current sample. After stopping a sample, the selected sample will automatically increment to the next available sample.

CLEAR SELECTED: Clears the currently selected sample data.

CLEAR ALL: Clears all 16 sets of sampled data.

Figure 8-5. MEASURE Menu (EMF Meter)

SETUP Menu (EMF Meter)

The SETUP menu is used to toggle the EMF Meter probe calibration.

EMF METER CAL: Toggles the internal EMF Meter probe calibration on or off. This enables correction factors that are stored in the probe's memory. The measured values are corrected at a given frequency using the factors measured during the latest factory calibration.

Figure 8-6. LIMIT Menu (EMF Meter)

8-5 Presetting the Meter

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, "Reset Settings" on page 2-35. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting".

PRESET Menu

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 8-7. PRESET Menu

8-6 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, CSV measurement data, and screenshots. You can recall setup and CSV data files. For other file operations such as copy, move, and directory management, refer to Section 2-12 "File Management" on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 8-8:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

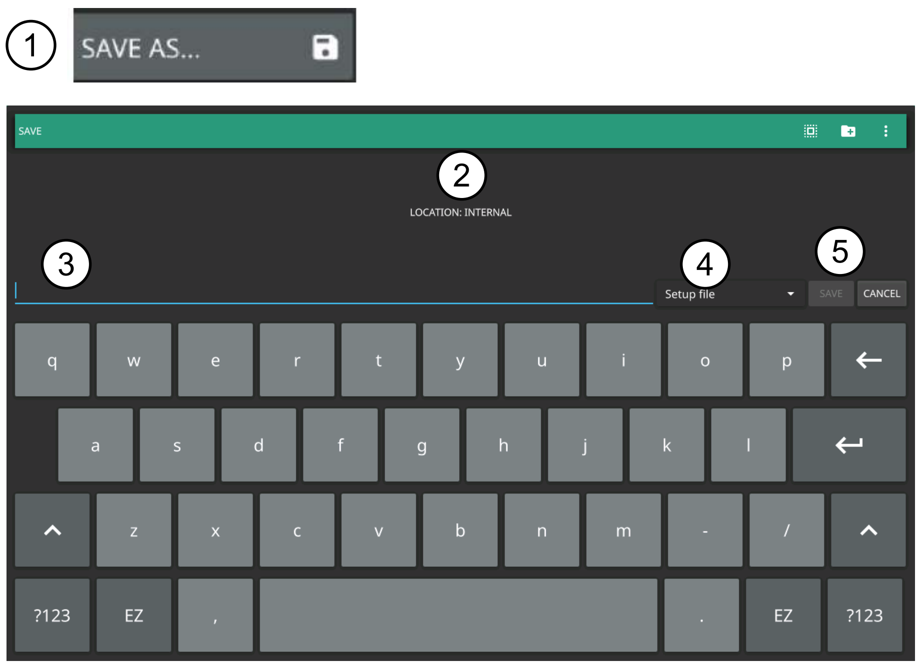


Figure 8-8. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 8-9:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

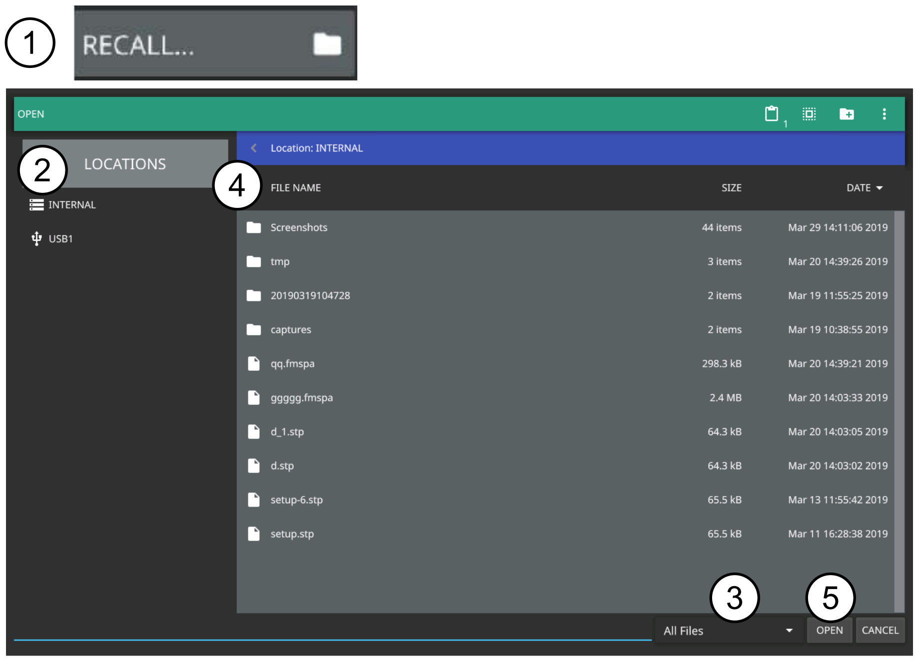


Figure 8-9. File Open Dialog

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Measurement: Saves the current measurement data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- KML: Saves measurement data in Keyhole Markup Language format, including the instrument model number, installed options, sample data with GPS coordinates, if GPS is installed.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both csv and png file types).

RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled to the appropriate trace. That trace will be in a Hold mode. To exit the recalled data, simply change the trace mode back to Active.

BROWSE FILES: Opens “File Management” on page 2-36.

Figure 8-10. FILE Menu

Chapter 9 — Pulse Analyzer Measurements (Option 421)

9-1 Introduction

This chapter gives a brief overview of the Anritsu Field Master Pro pulse analyzer and is intended to assist you in setting up a pulse measurement. Refer to Chapter 2, "Instrument Overview" and Chapter 3, "Spectrum Analyzer Measurements"as a starting point for getting familiar with the instrument and making basic measurement setups. This chapter describes instrument setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, and pulse references for making pulse measurements. For a detailed description of how the pulse measurements are calculated, refer to Section 9-4 "Pulse Measurements" on page 9-6. After measurements are taken, refer to Section 2-12 "File Management" and Section 9-17 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files. For detailed information about other specific measurements, refer to the appropriate chapter in this guide.

9-2 Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 9-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.

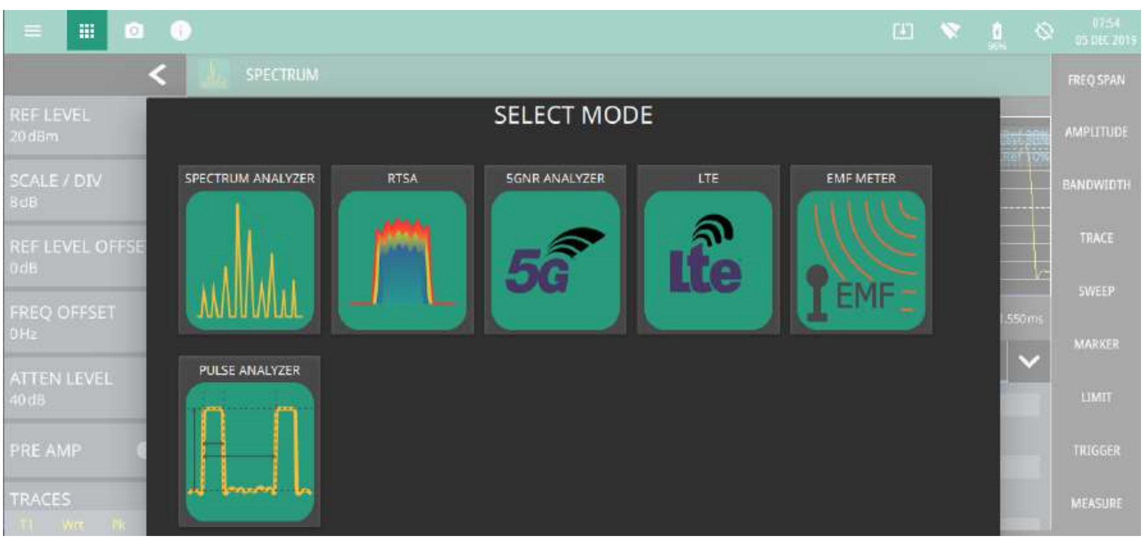


Figure 9-1. Example Analyzers

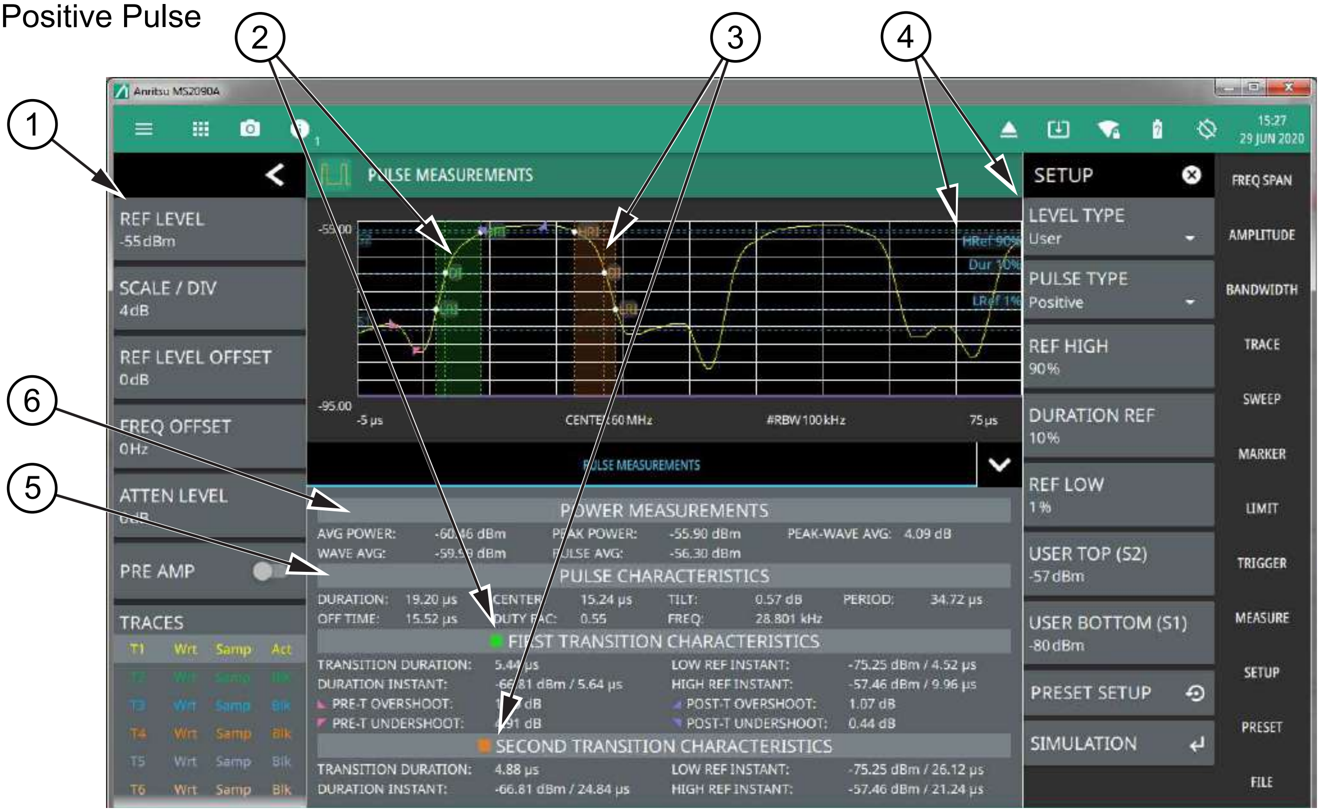
9-3 Pulse Analyzer GUI Overview

This section illustrates the main graphical displays and SETUP menu presented for the Pulse Analyzer view. For a detailed description of the pulse measurement, refer to Section 9-4 “Pulse Measurements” on page 9-6.

Pulse Trace Profile and Summary Data

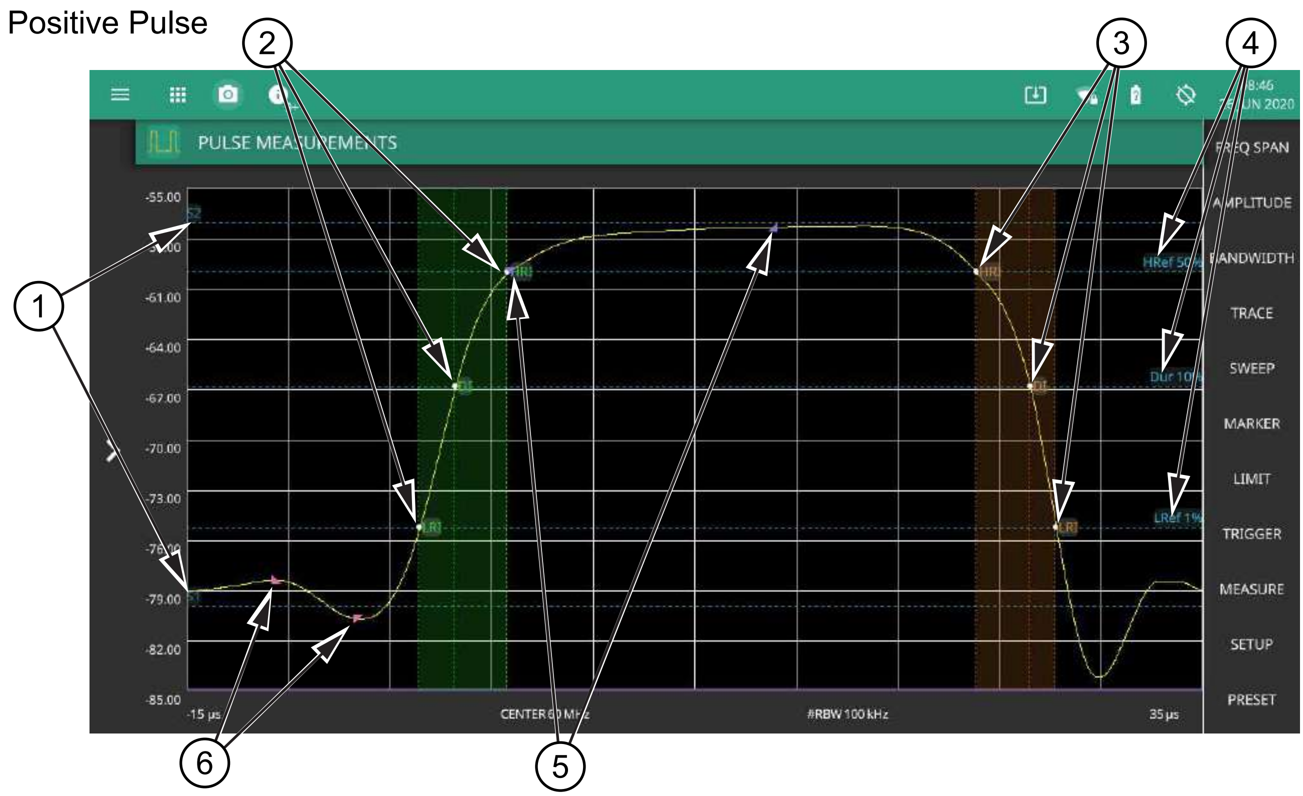
Figure 9-2, “Positive Pulse Trace with Measurement Summary Data (Pulse Analyzer View)”shows an overview of the trace and summary data for a positive pulse type, Figure 9-3, “Positive Pulse Measurement Points and Reference Lines (Pulse Analyzer View)” shows a full-screen trace with details of the measurement points, pulse markers, and labels for the same measurement setup. Figure 9-4, “Negative Pulse Trace with Measurement Summary Data (Pulse Analyzer View)”shows an overview of the trace and summary data for a negative pulse type, Figure 9-5, “Negative Pulse Measurement Points and Reference Lines (Pulse Analyzer View)” shows a full-screen trace with details of the measurement points and labels for the same measurement setup.

Positive Pulse



1. **Status Panel:** The pulse analyzer shares the spectrum analyzer status panel, displaying general settings for the current measurement. Refer to Section 9-6 “Status Panel” on page 9-12.
2. **First Transition Measurement Characteristics:** The first pulse transition is shown in a green shaded area with measurement points and labels displayed on the currently selected trace and measurement data in the corresponding summary table.
3. **Second Transition Measurement Characteristics:** The second pulse transition is shown in an orange shaded area with measurement points and labels displayed on the currently selected trace and measurement data in the corresponding summary table.
4. **Reference Level Lines:** Reference levels are shown as dashed blue lines with labels that correspond to their configuration buttons in the SETUP menu.
5. **Pulse Characteristics:** This data shows the overall pulse measurements.
6. **Power Measurements:** This data shows the signal power measurements.

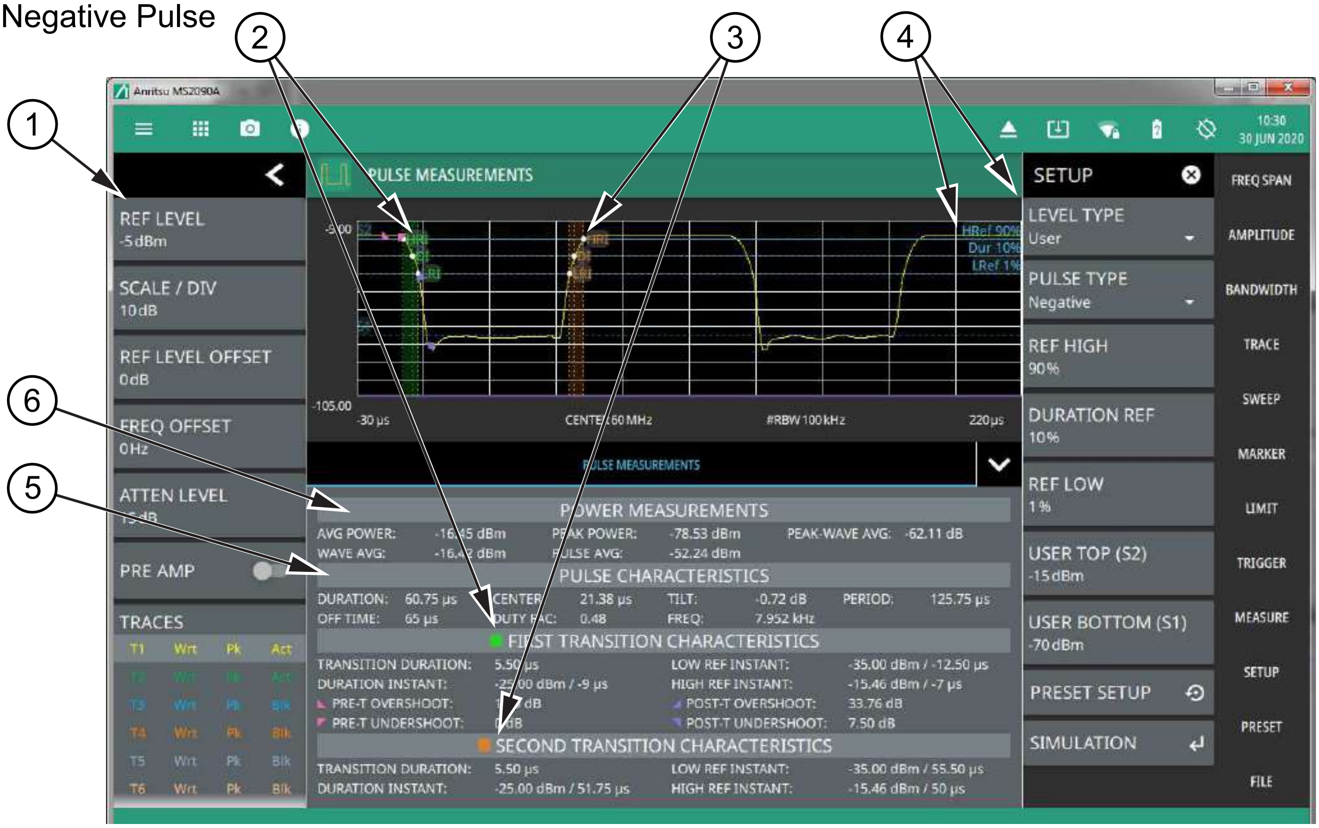
Figure 9-2. Positive Pulse Trace with Measurement Summary Data (Pulse Analyzer View)



1. **Level Reference:** Top and bottom level references are used as a basis for all other references. These can be set to Auto or User. When set to User, the dashed blue lines (S1 and S2) are in use.
   - S2: USER TOP (S2)
   - S1: USER BOTTOM (S1)
2. **First Transition Measurement Points:** The first pulse transition is shown in a green shaded area with measurement points and labels displayed on the currently selected trace. Green labels indicate the first transition measurement points at instants shown at the intersection of the dashed green and blue line crossings.
   - LRI: Low Reference Instant
   - HRI: High Reference Instant
   - DI: Duration Instant
3. **Second Transition Measurement Points:** The second pulse transition is shown in an orange shaded area with measurement points and labels displayed on the currently selected trace. Orange labels indicate the second transition measurement points at instants shown at the intersection of the dashed orange and blue line crossings.
   - LRI: Low Reference Instant
   - HRI: High Reference Instant
   - DI: Duration Instant
4. **Reference Level Lines:** Reference levels are shown as dashed blue lines with labels that correspond to their configuration buttons in the SETUP menu.
   - HRef: REF HIGH (High Reference Level)
   - LRef: REF LOW (Low Reference Level)
   - Dur: DURATION REF (Pulse Duration Reference Level)
5. **Post Transition Markers:** Blue triangle markers indicate the post-transition overshoot and undershoot.
6. **Pre Transition Markers:** Magenta triangle markers indicate the pre-transition overshoot and undershoot.

Figure 9-3. Positive Pulse Measurement Points and Reference Lines (Pulse Analyzer View)

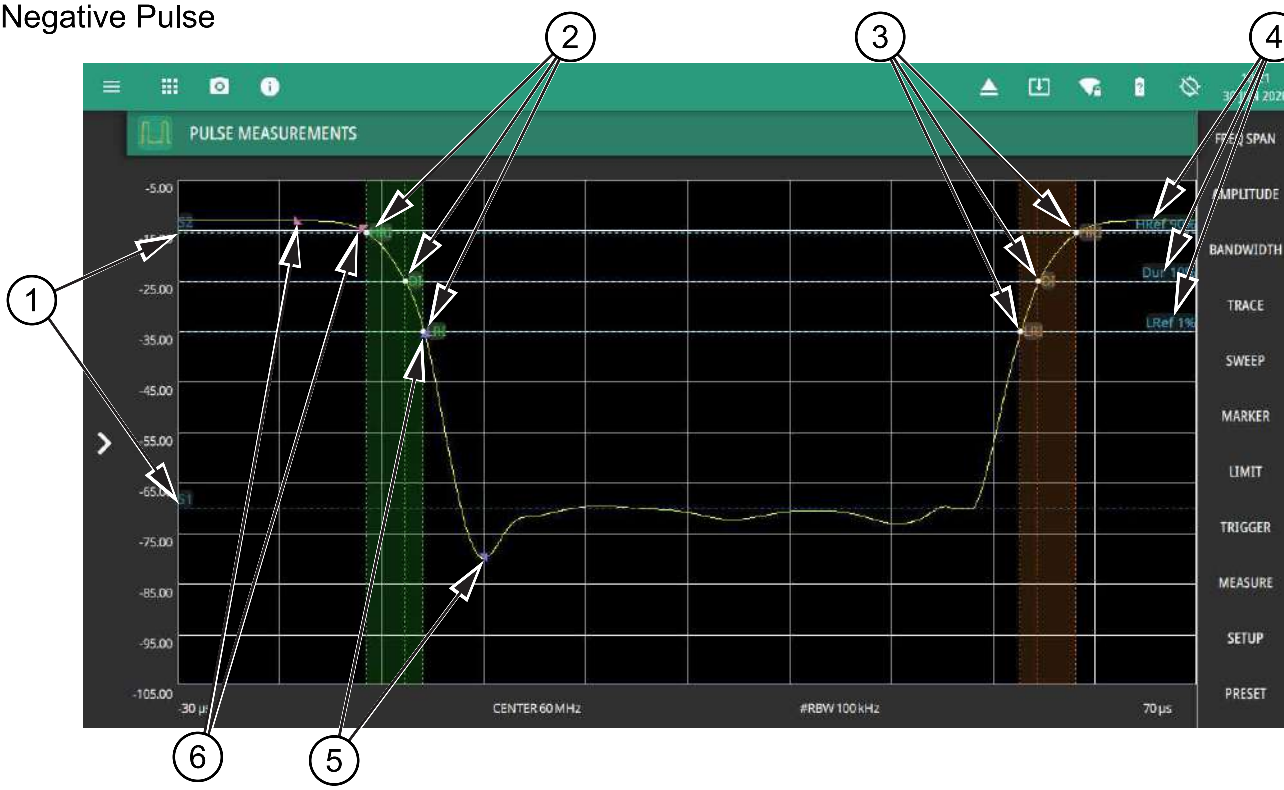
Negative Pulse



1. **Status Panel:** The pulse analyzer shares the spectrum analyzer status panel, displaying general settings for the current measurement. Refer to Section 9-6 “Status Panel” on page 9-12.
2. **First Transition Measurement Characteristics:** The first pulse transition is shown in a green shaded area with measurement points and labels displayed on the currently selected trace and measurement data in the corresponding summary table.
3. **Second Transition Measurement Characteristics:** The second pulse transition is shown in an orange shaded area with measurement points and labels displayed on the currently selected trace and measurement data in the corresponding summary table.
4. **Reference Level Lines:** Reference levels are shown as dashed blue lines with labels that correspond to their configuration buttons in the SETUP menu.
5. **Pulse Characteristics:** This data shows the overall pulse measurements.
6. **Power Measurements:** This data shows the signal power measurements.

Figure 9-4. Negative Pulse Trace with Measurement Summary Data (Pulse Analyzer View)

Negative Pulse



1. **Level Reference:** Top and bottom level references are used as a basis for all other references. These can be set to Auto or User. When set to User, the dashed blue lines (S1 and S2) are in use.
   - S2: USER TOP (S2)
   - S1: USER BOTTOM (S1)
2. **First Transition Measurement Points:** The first pulse transition is shown in a green shaded area with measurement points and labels displayed on the currently selected trace. Green labels indicate the first transition measurement points at instants shown at the intersection of the dashed green and blue line crossings.
   - LRI: Low Reference Instant
   - HRI: High Reference Instant
   - DI: Duration Instant
3. **Second Transition Measurement Points:** The second pulse transition is shown in an orange shaded area with measurement points and labels displayed on the currently selected trace. Orange labels indicate the second transition measurement points at instants shown at the intersection of the dashed orange and blue line crossings.
   - LRI: Low Reference Instant
   - HRI: High Reference Instant
   - DI: Duration Instant
4. **Reference Level Lines:** Reference levels are shown as dashed blue lines with labels that correspond to their configuration buttons in the SETUP menu.
   - HRef: REF HIGH (High Reference Level)
   - LRef: REF LOW (Low Reference Level)
   - Dur: DURATION REF (Pulse Duration Reference Level)
5. **Post Transition Markers:** Blue triangle markers indicate the post-transition overshoot and undershoot.
6. **Pre Transition Markers:** Magenta triangle markers indicate the pre-transition overshoot and undershoot.

Figure 9-5. Negative Pulse Measurement Points and Reference Lines (Pulse Analyzer View)

9-4 Pulse Measurements

Finding the High/Low Reference Levels Using the Histogram Algorithm

When the pulse level type is set to AUTO a histogram algorithm method is used for determining the high and low state levels as described in the *IEEE Standard for Pulses, Transitions, and Related Waveforms* (181-2011), Section 5.2.1. The trace data is taken as input and the amplitudes are operated on in terms of dBm units. The trace data is converted into a histogram where the number of bins is determined by a fixed bin width of 0.01 across the total range of values in the trace data (trace max to trace min). In other words, each trace point amplitude results in an incremented "count" in the histogram bin that corresponds to the amplitude range in which that amplitude falls. To find the high and low state levels, the resulting histogram is split into an "upper" and "lower" histogram where the former consists of all the bins that correspond to the upper 50% range of amplitudes, and the latter the lower 50% range. Then the high state is determined to be the mode of the upper histogram, i.e. the amplitude corresponding to the histogram bin with the highest count. The low state is similarly determined to be the mode of the lower histogram.

If the count of either mode is not greater than at least 1% of the total number of points in the trace data input, then the histogram is recreated using a bin width that is ten times larger. This process of regenerating the histogram with larger a bin width is repeated until the mode of the histogram is at least 1% of the total number of points. This means that the best case resolution of the resulting high state and low state is 0.01 dBm (the starting bin width), and depending on how much the state levels fluctuate, the resolution can fall back to 0.1 dBm, 1 dBm, and so on.

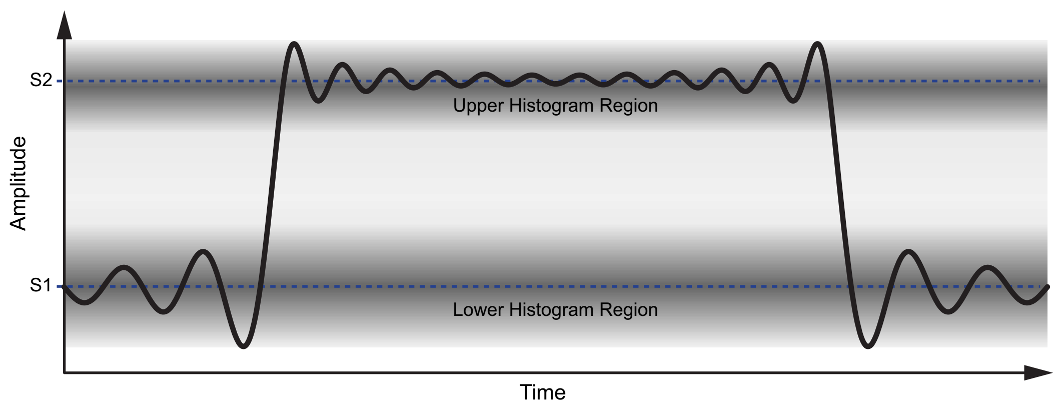


Figure 9-6. Finding High and Low Reference Levels

When the pulse level type is set to USER, the user determines the high and low state levels and enters the level using the USER TOP (S2) and USER BOTTOM (S1) settings.

Finding the Reference Level Instants

Instants are a specific time value within a waveform time duration. They are typically referenced relative to the initial instant of the waveform. The following sections describe how the pulse measurements are determined (see Figure 9-7 and Figure 9-8).

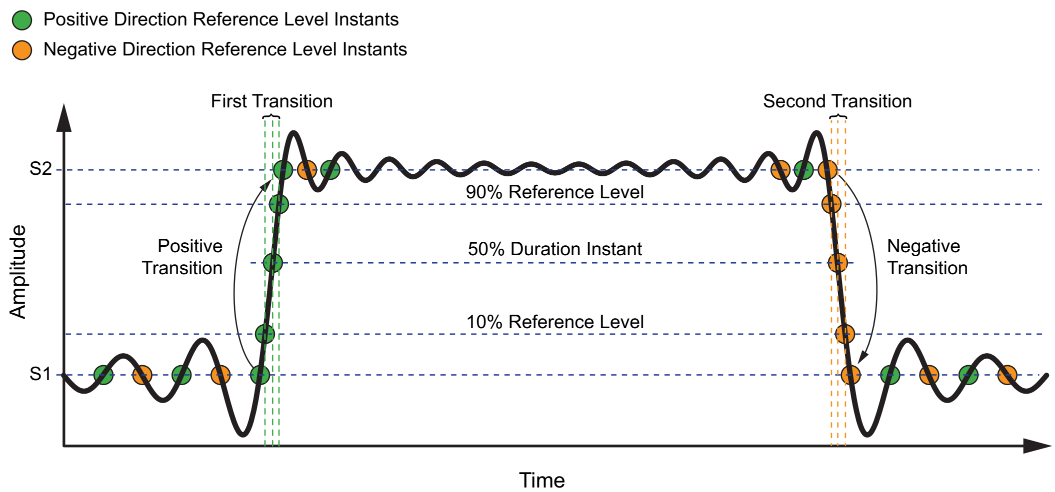


Figure 9-7. Positive Pulse Waveform Instants and Transitions

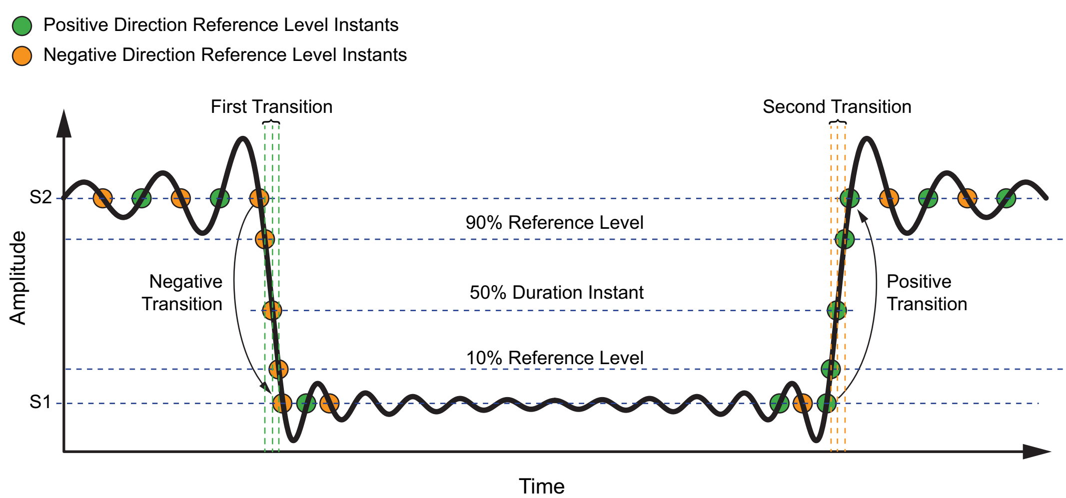


Figure 9-8. Negative Pulse Waveform Instants and Transitions

Finding the Transitions

Transitions are contiguous regions of a waveform that connect, either directly or via intervening transients, two state occurrences that are consecutive in time but are occurrences of different states. To find the transition, begin with a filtered list of reference level instants that contain only those that cross the low or high reference levels. Each reference level instant in the list has a corresponding index and direction (e.g. the trace index immediately before the amplitude crossing the reference level, and direction indicating whether the trace crosses from above to below the reference level or vice versa).

This filtered list of instants is sorted in ascending index order. Then all positive and negative transitions (between the high/low reference levels) are found by searching for consecutive instants in the filtered list that both have the same direction. The waveform is defined to be in the "high state" if it exceeds the 90% reference level and in the "low state" if it drops below the 10% reference level. This is the chosen alternative rather than using the state upper/lower boundaries (which the IEEE standard says is optional).

Finding Pulse Duration and Period

The pulse duration is determined by using the positive and negative transitions as describe above to check if it is a valid pulse. If so, then any pulse duration reference levels (50%) are verified to exist within the positive/negative transition. This reference level determines the starting and ending period of the pulse. The duration is just the difference between the ending point and the starting point.

The pulse period also first determines that we have a valid pulse from the positive and negative transitions. Unlike the pulse duration measurement, the pulse period must have the pulse repeat, or a pulse train, to have a measurement. There should be at least 3 transitions in the 50% reference level to produce a valid measurement. The period is the distance between the starting level of the first pulse and the starting level for the second pulse.

Finding the Wave Average

The wave average is determined by averaging the power levels of all points within all complete periods that are available on the trace. To determine where to start and stop, the number of transitions are used to determine if there is at least one full period. The system returns "nan" if there is not a full period. Otherwise, the starting point for this measurement is the beginning of the first transition and the end point is the beginning of the transition of the last full period.

For instance, a trace with six transitions has some quantity of points before the first transition followed by two full periods, then followed by less than one full period. Once the start and end of all the complete periods have been found, all points between them are summed together and divided by the total number of points used in the measurement.

Finding Trace Average

The trace average is the exponential average of all the points in the trace. Unlike the wave average, it is not constrained to full pulses.

Finding the Pulse Average

The pulse average is the average of the points in the high state of the pulse (typically those points above the 90% reference line). This only applies to positive pulses. If there is no positive pulse, then no measurement is returned.

Finding the Pulse Center Instant and Repetition Frequency

The Pulse repetition frequency is determined from the inverse of the pulse period (1/pulse period) as a frequency value. The pulse center instant is determine by taking the pulse duration (50%) start time and adding the pulse duration mid point, which is one-half of the pulse duration (pulse duration/2).

Finding the Pulse Peak

The pulse peak is the maximum value in a waveform after a positive transition. If there is no positive transition, the peak amplitude of the overall waveform is returned.

Finding the Pulse Tilt

The pulse tilt measures the distortion of a waveform state where the overall slope of the state is essentially constant and other than zero. The slope may be of either polarity and is calculated for either negative or positive pulses. A complete pulse (with at least two transitions) is needed to ensure that there is a waveform state for which tilt can be measured. If there is enough trace data within the waveform state, the first and last 25% of samples where overshoot distortion is most likely to occur is removed. The slope of the remaining 50% of state trace data is then calculated using the *least squares* method, and the tilt is calculated by multiplying the slope by the number of trace points in the state.

Finding the Wave Amplitude

The wave amplitude is found by subtracting the amplitude of the lower state level from the amplitude of the upper state level in dB units.

Finding the Peak to Wave Average

The peak to wave average is found by subtracting the wave average from the pulse peak in terms of dB. This requires the wave average to have a valid value, so there must be at least one full period for a measurement.

Finding the Pre- and Post-Transition Aberration Region

The pre-transition aberration region is determined to be the region of the trace before the last state crossing before the first transition, and with a width equal to three times the duration of the first transition. It is upper bounded by the available trace data before the transition. The post-transition aberration region is the region beginning at the first state crossing past the first transition, and ending at three times the transition duration or at the beginning of the next transition, whichever comes first.

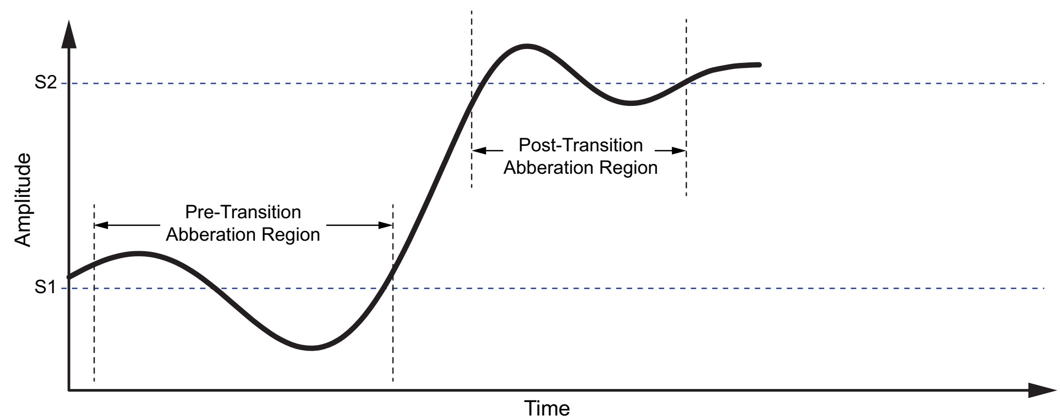


Figure 9-9. Positive Pulse Aberration Regions

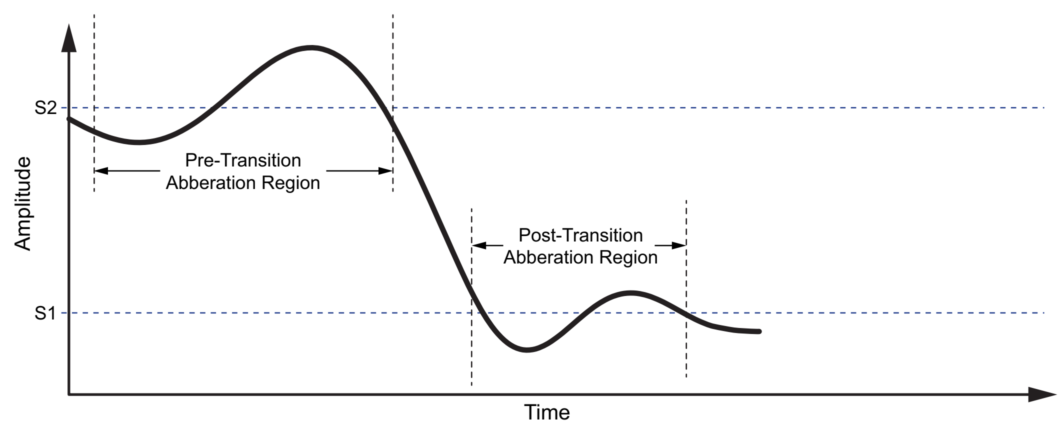


Figure 9-10. Negative Pulse Aberration Regions

Finding the Overshoot and Undershoot of Each Aberration Region

The overshoot and undershoot of each region are calculated by taking the difference between the maximum and minimum trace value of each aberration region and the local state level. Local state level being (Low = pre-transition → High = post-transition) in a positive transition, and (High = pre-transition → Low = post-transition) in a negative transition.

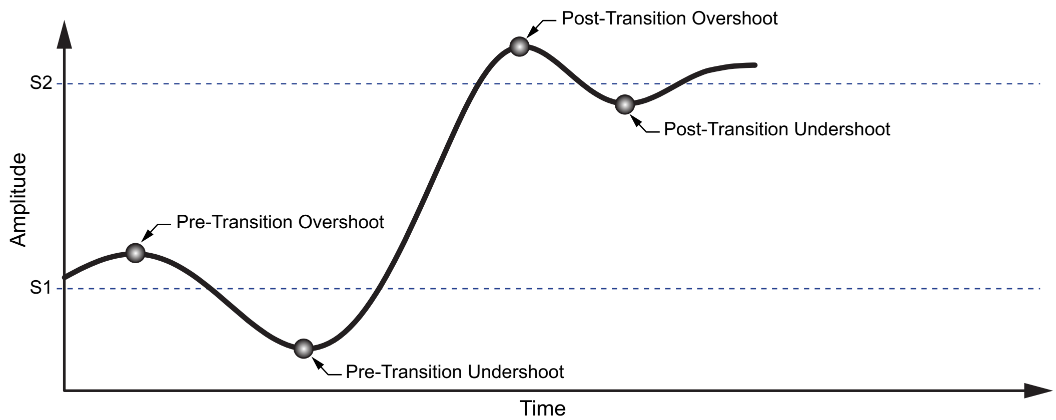


Figure 9-11. Positive Pulse Overshoot and Undershoot

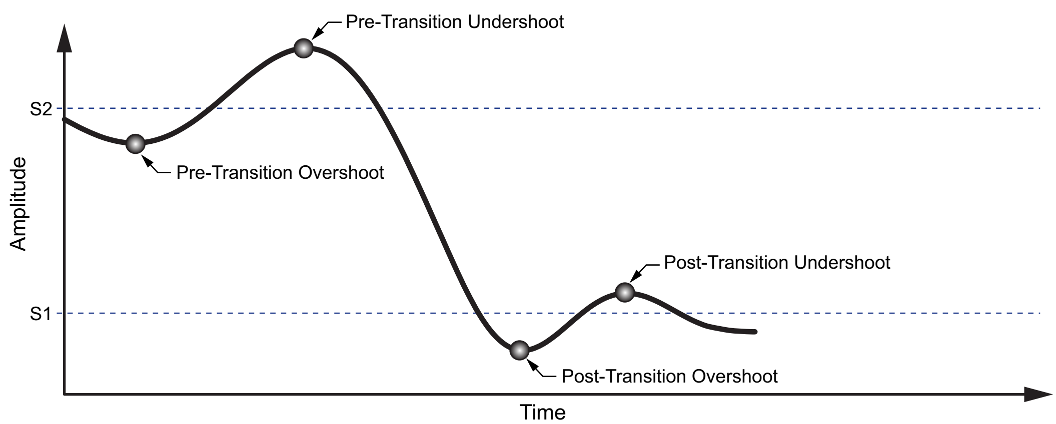


Figure 9-12. Negative Pulse Overshoot and Undershoot

Tips for Improving Pulse Measurement Results

- Set the reference level as close to the top of the trace as possible.
- Use trace averaging.
- For custom or irregular pulses, use a user defined top reference level (S2) instead of auto detection.
- Use single sweep and sweep once buttons to take measurements one at a time.

9-5 Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 9-8 "Setting Frequency Parameters".

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 9-9 "Setting Amplitude Parameters".

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 9-10 "Setting Bandwidth Parameters".

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 9-11 "Setting Trace Parameters".

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90). Refer to Section 9-12 "Setting Sweep Parameters".

MARKER: Traditional markers are not available in Pulse Analyzer.

LIMIT: Limit is not available in Pulse Analyzer.

TRIGGER: Controls the trigger source, delay and holdoff, and trigger slope settings. Refer to Section 9-14 "Setting Up Triggering".

MEASURE: Used to select measurements such as spectrum, channel power, occupied bandwidth, adjacent channel power, spectral emissions mask, and opens the spectrogram. Refer to Section 9-15 "Measurement Setup".

SETUP: Measurement controls for setting up advanced measurements. This menu always displays setting options for the current active measurement (refer to "SETUP Menu" on page 9-32).

PRESET: Opens the PRESET menu with selective trace, marker, and setup preset commands, or an all inclusive analyzer preset command. Refer to Section 9-16 "Presetting the Analyzer".

FILE: Used to save and recall instrument setups and measurements, and screen images. Also provides access to save on event controls. Refer to "FILE Menu" on page 9-39 and Section 2-12 "File Management".

Figure 9-13. Main Menu

Using Menus

Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.
- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

9-6 Status Panel

The status panels and features illustrated in this section are unique to the spectrum analyzer and to the particular measurement and view that is selected. Below is the spectrum analyzer status panel that covers basic spectrum, spectrogram, channel power, occupied bandwidth, adjacent channel power, and spectral emissions mask measurements (selected via MEASURE > MEASUREMENTS menu).

Pressing any of these parameters opens the associated menu with a keypad that allows you to conveniently change the parameter value. These are the same settings found in the right side menus.

REF LEVEL: Sets the reference level of the top graticule line. If the reference level offset is not zero, OFFSET REF LEVEL is displayed at this location.

SCALE/DIV: Sets the graticule scale/division.

REF LEVEL OFFSET: Compensates for the presence of external input attenuation or gain.

Refer to Section 9-9 "Setting Amplitude Parameters" on page 9-15.

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 9-8 "Setting Frequency Parameters" on page 9-14.

ATTEN LEVEL: When auto attenuation is off, sets input attenuation.

PRE AMP: Toggles the low-noise front-end preamplifier on or off. Refer to Section 9-9 "Setting Amplitude Parameters" on page 9-15.

TRACES: Displays the current status of up to six traces in a quick-view summary.

The summary information includes the trace or cursor number, type, mode, and detector type. The active trace will show a highlighted background with the mode and detector type restated under the table. In Spectrogram, a reference trace (T0) will show you the settings of the trace used to fill the spectrogram. The reference trace settings are applied to all traces and cursors while in Spectrogram view. Pressing a trace or cursor in the summary panel activates the pressed trace or cursor and opens the TRACE menu. It allows you to select and set up an individual trace or cursor as desired. Refer to Section 9-11 "Setting Trace Parameters" on page 9-21.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 9-12 "Setting Sweep Parameters" on page 9-24.

FREQ REFERENCE: Indicates the current frequency reference source of Internal High Accuracy (used after GPS has lost sync, but while the internal clock still has good GPS reference), Internal Standard Accuracy, External, or GPS Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 9-14. Pulse Analyzer Status Panel

9-7 Making Pulse Analyzer Measurements

Initial Setup

- Connect a signal source to the RF In test port of the instrument. For over-the-air measurements, connect an antenna that is appropriate for the frequency to be measured. Refer to “Connector Panels” on page 2-3.
- Select the pulse analyzer. Refer to “Selecting the Analyzer” on page 9-1.

Figure 9-15. Field Master Pro Setup

9-8 Setting Frequency Parameters

Frequency-related parameters are set using the "FREQ / SPAN Menu" on page 9-14. Pulse measurements are conducted in zero span so only the center frequency needs to be entered. Additionally, a frequency offset can be used, depending on what makes the most sense, either for the user or for the measurement.

Entering a Center Frequency

1. Press FREQ SPAN on the main menu.
2. Press CENTER FREQUENCY to open the center frequency parameter entry keypad.
3. Enter the desired center frequency. When entering a frequency with the keypad, available frequency units (GHz, MHz, kHz, and Hz) will be displayed along the left edge of the menu.
4. Press the appropriate frequency unit to terminate the entry or press ACCEPT to terminate the entry with the current frequency unit.

Note	To quickly move the center frequency value up or down, press the + or - slider controls to increment the center frequency by the set FREQUENCY STEP. You can also drag the center frequency using the slider or by dragging the trace directly.

The current settings are shown along the bottom of the pulse graph (see Figure 2-6 on page 2-11).

Using Offset Frequency

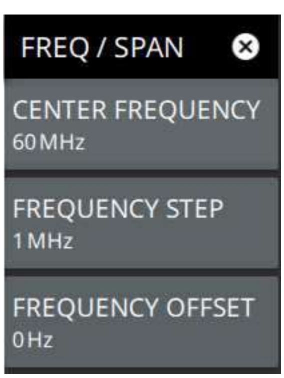
A user-defined frequency offset can be entered to adjust the frequency that is displayed on the instrument from the actual swept frequency. For example, if the DUT is an antenna system receiving signals in the 10 GHz range and offsetting the signals to the 1 GHz range, you can set a frequency offset in the spectrum analyzer in order to display the actual received antenna frequency in the sweep window.

Both positive and negative offset values are allowed. Negative offsets can be useful for seeing differences from expected values. Enter a negative offset of the expected value, and the received antenna frequency should display in the 0 Hz range.

When enabled, the offset value is displayed at the left of the screen in the status panel (see Section 9-6 "Status Panel"). To remove a frequency offset, open the FREQ SPAN menu and set FREQUENCY OFFSET to 0 Hz. You can also access this parameter directly from the left side status panel.

Note	Offset frequency apply to start, stop, center, and marker frequencies.

FREQ / SPAN Menu



CENTER FREQUENCY: Sets the center frequency of the sweep range.

FREQUENCY STEP: Sets the frequency step value used for the plus (+) or minus (–) control.

FREQUENCY OFFSET: The frequency offset value accounts for frequency conversions outside of the analyzer. The offset frequency value is added to the start, stop, center, fixed marker, and normal marker frequencies. Pressing the plus (+) or minus (–) control moves the offset frequency in steps defined by the FREQUENCY STEP value.

Figure 9-16. FREQ / SPAN Menu

9-9 Setting Amplitude Parameters

Amplitude-related parameters are set using the “AMPLITUDE Menu” on page 9-17.

Setting Amplitude Reference Level

The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to “Indications of Excessive Signal Level” on page 9-16). To set the current amplitude reference level:

1. To automatically set an optimum reference level, press AMPLITUDE > AUTO REF LEVEL.
2. To manually set the reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm.

Note	Select AUTO ATTEN coupling of the attenuator setting and AUTO REF LEVEL to help ensure that harmonics and spurs are not introduced into the measurements.

Setting Amplitude Range and Scale

This setting applies to most analyzer modes of instrument operation and allows you to set the y-axis graticule scale.

1. Press AMPLITUDE > SCALE/DIV and enter the desired number of units per division (dB/division).
2. Set the desired y-axis amplitude units. Currently, dBm is the only available selection.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference or amplitude level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.
2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.
3. The new reference level offset value will be displayed on the instrument and the y-axis and trace amplitude is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer’s dynamic range. By default, the auto attenuation automatically adjusts the attenuator as a function of the reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to “AMPLITUDE Menu” on page 9-17.
- Turn on the preamplifier.
- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to “Setting Bandwidth Parameters” on page 9-18.
- Use trace averaging if VBW is already set to 1 Hz. Refer to “Setting Trace Parameters” on page 9-21

Preamplifier

The preamplifier can be turned on and off by toggling PRE AMP via the status panel or the AMPLITUDE menu. Figure 9-17 shows the noise floor with the preamplifier off (1) and on (2). Note that when the preamplifier is turned on, the noise floor drops significantly and a low-level signal is exposed. In order to use the preamplifier, the attenuation must be lower than 20 dB. If the preamplifier is turned on when the attenuation is greater than or equal to 20 dB, the attenuation will automatically drop to 10 dB. When AUTO ATTEN is toggled on, the REF LEVEL must be set to –40 dBm or lower to enable the preamplifier. The below image shows the effect of the preamplifier in a frequency sweep to illustrate how a signal can be exposed from the analyzer noise.

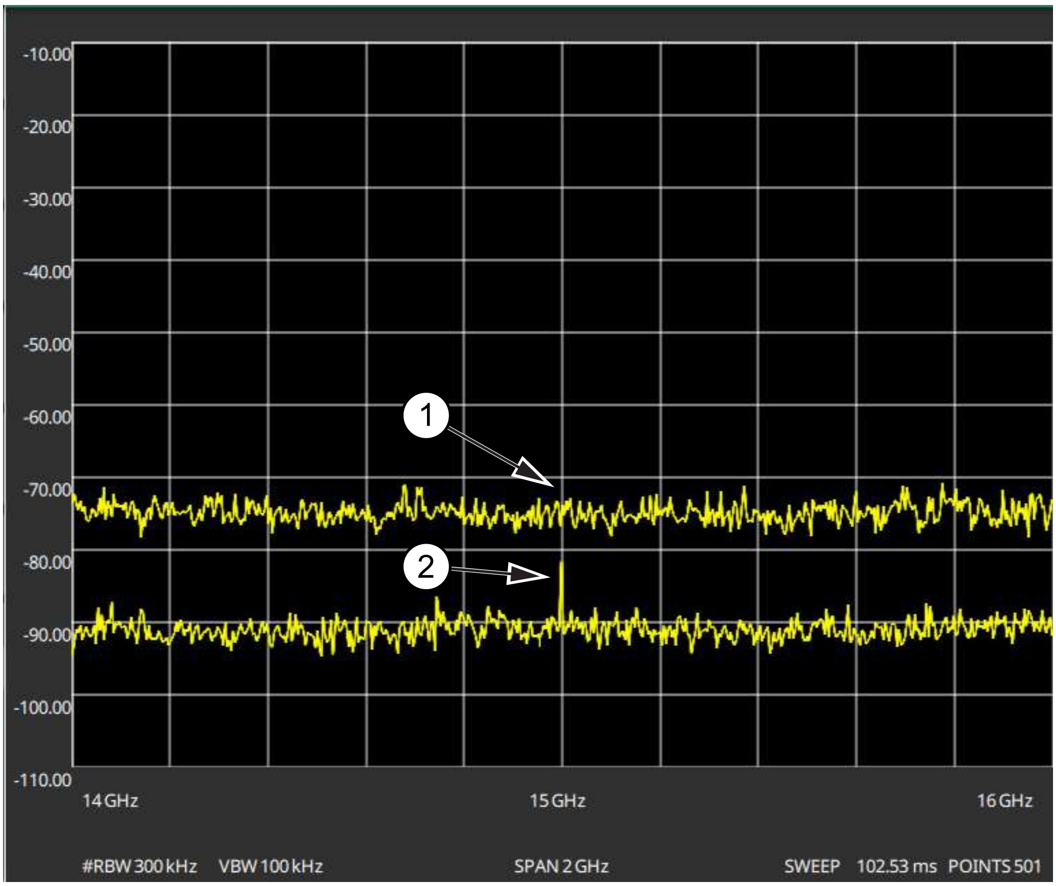


Figure 9-17. 1. Preamplifier Off
2. Preamplifier On

Indications of Excessive Signal Level

The Field Master Pro has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an “ADC Overrange” notification in the title bar (Figure 9-18). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 9-18. ADC Overrange

AMPLITUDE Menu

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this location. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values.

AUTO REF LEVEL: Auto reference level automatically adjusts the reference level to place the highest signal amplitude at about two graticule lines from the top based on the position of the trace at the time the button is pressed.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB. Pressing the plus (+) or minus (–) control changes the value by 1.

Y AXIS UNIT: Selects the y-axis amplitude units of dBm, dBW, or dBµV.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The offset is applied to all amplitude related parameters and to measurements such as the y-axis scale and marker measurements. The default offset value is 0 dB. Pressing the plus (+) or minus (–) control increments the value by 10. The plus/minus (+/-) button on the keypad toggles between positive and negative values. Refer to “Reference Level Offset for External Loss or External Gain” on page 9-15.

PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and the reference level is above –40 dBm. Refer to “Preamplifier” on page 9-16.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required.

ATTEN LEVEL: When auto attenuation is off, the attenuation value can be set manually to a resolution of 5 dB. Pressing the plus (+) or minus (–) control increments the value by 10.

Figure 9-19. AMPLITUDE Menu

9-10 Setting Bandwidth Parameters

Bandwidth parameters are set using the “BANDWIDTH Menu” on page 9-20.

Resolution Bandwidth

Resolution Bandwidth (RBW) determines frequency selectivity. The spectrum analyzer traces the shape of the RBW filter as it tunes past a signal. The choice of resolution bandwidth depends on several factors. Filters take time to settle. The output of the filter will take some time to settle to the correct value so that it can be measured. The narrower the filter bandwidth (resolution bandwidth), the longer the settling time needs to be, and therefore, the slower the pulse transition.

There is always some amount of noise present in a measurement. Noise is often broadband in nature; that is, it exists at a broad range of frequencies. If the noise is included in the measurement, the measured value could be in error (too large) depending upon the noise level. With a wide bandwidth, more noise is included in the measurement. With a narrow bandwidth, less noise enters the resolution bandwidth filter and the measurement is more accurate. If the resolution bandwidth is narrower, the noise floor will drop on the spectrum analyzer display. As the measured noise level drops, smaller signals that were previously obscured by the noise might now be measurable. Zero span is used for noise and noise-like measurements that are usually wider than the RBW. The RBW is ideally set to be as wide as the bandwidth of the signal you are measuring.

Video Bandwidth

Spectrum analyzers typically use another type of filtering after the detector that is called video filtering. This filter also affects the noise on the display, but in a different manner than the resolution bandwidth. In video filtering, the average level of the noise remains the same, but the variation in the noise is reduced. Therefore, the effect of video filtering is a “smoothing” of the signal noise. The resultant effect on the analyzer’s display is that the noise floor compresses into a thinner trace, while the average position of the trace remains the same.

Changing the video bandwidth (VBW) does not improve sensitivity, but it does improve discernibility and repeatability when making low-level measurements. To avoid any smoothing, the video bandwidth must be set equal to or wider than the resolution bandwidth.

Setting Resolution Bandwidth

1. Press BANDWIDTH on the main menu.
2. Toggle AUTO RBW or AUTO VBW (or both) off to manually change values. If using Auto, refer to the following sections.
3. Set the RBW and VBW to achieve the desired resolution and sweep characteristics. Lower values increase resolution and reduce noise, but at the expense of measurement (sweep) speed.
4. Set the VBW TYPE to Logarithmic (geometric mean) or Linear (arithmetic mean).

Setting Bandwidth Auto Coupling

Both resolution bandwidth and video bandwidth can be coupled to the frequency span automatically, or set manually. When set to Auto RBW, the instrument automatically adjusts the RBW in proportion to the frequency span. The default ratio of the span width to the resolution bandwidth is 100:1 and can be changed as follows:

1. Press BANDWIDTH on the main menu.
2. Press SPAN:RBW and change the coupling value, and then press ACCEPT to enter the value.

When auto-coupling between the span and RBW is selected (AUTO RBW is toggled on), the bandwidth parameter is displayed normally at the bottom of the graph. If manual RBW is selected (AUTO RBW is toggled off), the bandwidth label at the bottom of the graph is prefixed with the '#' symbol, and resolution bandwidth is set independently of the span.

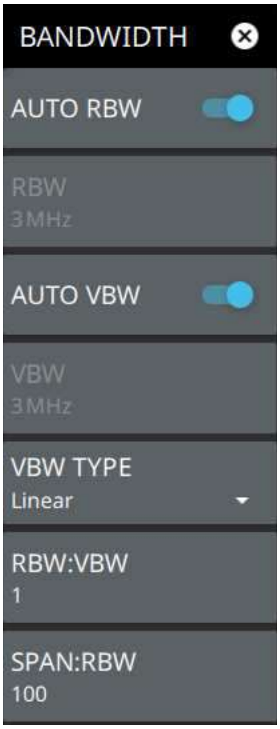
Auto coupling VBW links the video bandwidth to the resolution bandwidth so that VBW varies in proportion to RBW. If manual VBW coupling is selected, the VBW label at the bottom of the graph is prefixed with the "#" symbol and video bandwidth is set independently of resolution bandwidth.

By default, the RBW/VBW ratio is set to 3 and can be changed as follows:

1. Press BANDWIDTH on the main menu.
2. Press RBW/VBW and enter the desired value.

The RBW range varies with instrument features. Refer to "BANDWIDTH Menu" on page 9-20 and check your technical data sheet for the bandwidth range of your instrument.

BANDWIDTH Menu



AUTO RBW: When toggled on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the x-axis will be preceded by the “#” symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. Once auto RBW is toggled off, the RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

AUTO VBW: When toggled on, the instrument selects the video bandwidth based on the resolution bandwidth. The ratio of video bandwidth to resolution bandwidth can be set using the RBW:VBW button. When toggled off (manual), the VBW label at the left edge of the X-axis will be preceded by the “#” symbol.

VBW: The current video bandwidth is displayed under the VBW button. Once auto VBW is toggled off, the VBW can be changed using the keypad or slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the video bandwidth range.

VBW TYPE: Toggles between linear averaging (arithmetic mean) and logarithmic averaging (geometric mean).

RBW:VBW: This parameter displays the ratio between resolution bandwidth and video bandwidth. To change the ratio, press this button and use the keypad or the slider controls.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.

Figure 9-20. BANDWIDTH Menu

9-11 Setting Trace Parameters

Field Master Pro can display up to 6 traces simultaneously. Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the Status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces, refer to “TRACE Menu” on page 9-22.

Traces in Pulse Mode (Pulse Analyzer View)

The screenshot below shows the MS2090A Pulse Analyzer view with all six traces enabled on a signal, each with a different trace or detector type setting. The left side status panel shows a trace setup summary table. Touching one of the trace rows in the table will enable the trace and open the TRACE menu. In Pulse Viewer mode, the pulse instant and transition indicators are not shown.

1. Clear/Write and Peak Detection: This is the default trace setting. The trace is cleared during each sweep and the largest measurement point is used for each display point.
2. Max Hold and Peak Detection: Each trace point retains its maximum value and the largest measurement point is used for each display point.
3. Min Hold and Negative Detection: Each trace point retains its minimum value and the smallest measurement point is used for each display point.
4. Clear/Write and Negative Detection: Trace points are cleared during each sweep and the smallest measurement point is used for each display point.
5. Average and Sample Detection: The trace points are an average of the previous N sweeps, where N is the AVERAGES setting. RMS/Average detection depends on the video bandwidth type setting (BANDWIDTH > VBW TYPE): When VBW/AVERAGE type is set to Linear, this method detects the average power of measurement points that go into the display point. When VBW/AVERAGE type is set to Logarithmic, the traditional average of log (power) is displayed.
6. Rolling Average: The rolling average of the last N traces, where N is the AVERAGES setting.

Figure 9-21. Traces in Pulse View (Pulse Analyzer View)

TRACE Menu

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.

TRACE MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.

Blank: Does not display the trace and is not updating. It is the same as if the trace was off.**DETECTOR TYPE:** Selects one of the available detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of showing each display point (see "Trace Detector Types" on page 9-23).

- **Peak:** Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed.
- **Sample:** Shows the transient amplitude of the center of sampled data for each display point. This method is useful when measuring low-level signals and noise measurements.
- **Negative:** Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used.

CLEAR: Clears the currently active trace data.

AVERAGES: Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes.

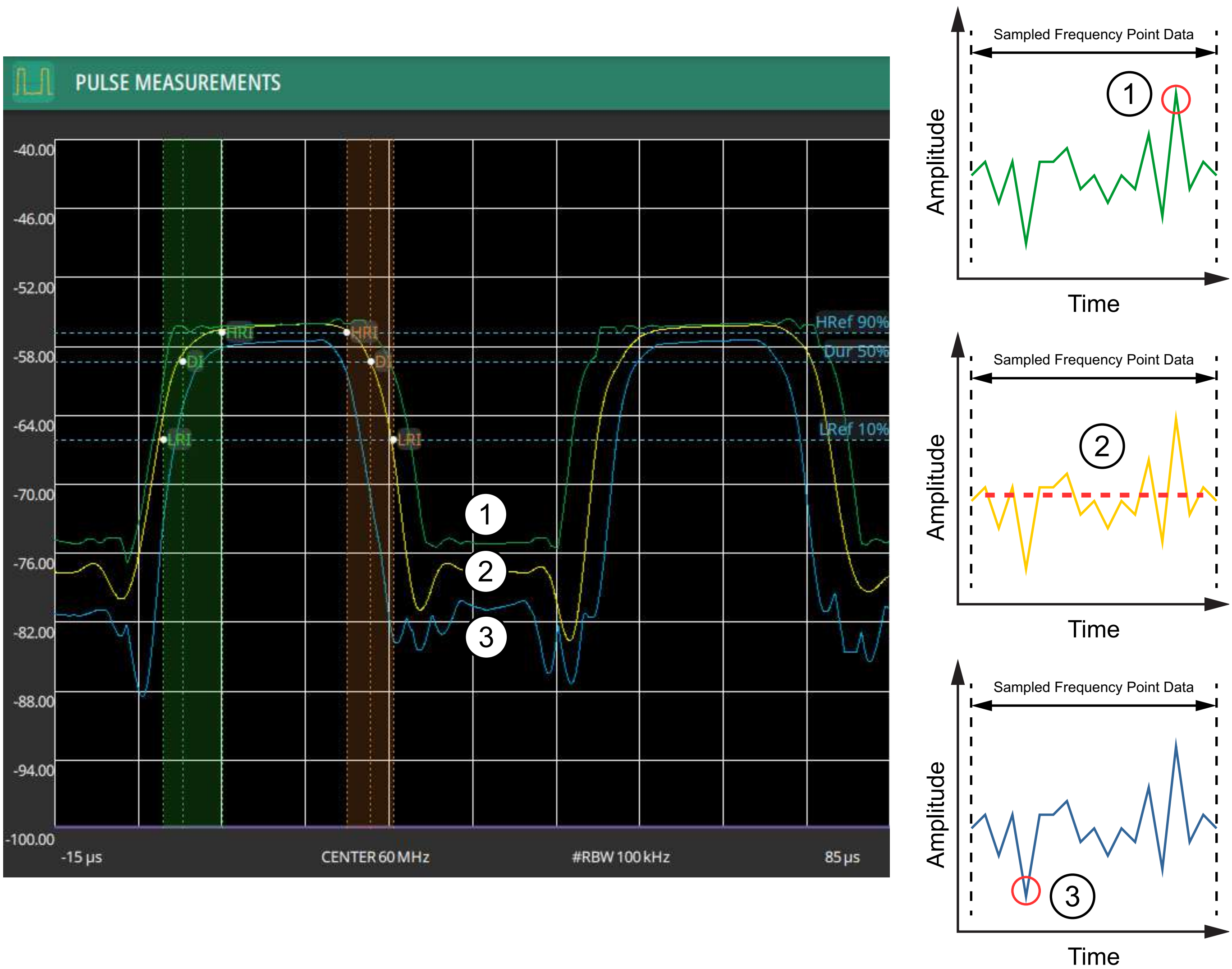
PRESET DETECTORS: Sets all trace detectors to Peak.

PRESET TRACES: Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 9-22. TRACE Menu

Trace Detector Types

The figure below shows the available detector types:



1. Green trace set to Peak detection.
2. Yellow trace set to Sample detection.
3. Blue trace set to Negative detection.

Figure 9-23. Trace Detector Types (Pulse Analyzer View)

9-12 Setting Sweep Parameters

Sweep parameters are set using the "SWEEP Menu" on page 9-24.

Single/Continuous

When the Continuous toggle is pressed, the instrument toggles between single sweep and continuous sweep. In single sweep setting, the instrument waits until SWEEP ONCE is pressed or another setting is selected.

Trace Points

The number of points sets the number of display points in the trace that are generated from the measurement data.

SWEEP Menu

CONTINUOUS: Toggles between continuous sweep and single sweep. When the toggle is off, the instrument is in single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

RESTART: The restart function restarts the current sweep or measurement from the start frequency.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

SWEEP TO N: When sweep is set to single sweep and trace type is set to average, rolling average, rolling max hold, or rolling min hold, SWEEP TO N triggers N consecutive measurement sweeps, where N is the number of averages set in the TRACE menu. Each time the button is pressed, it will restart the average count, then sweep N times. This button has no function when the instrument is in continuous sweep.

SWEEP TIME: Sets the sweep time.

Figure 9-24. SWEEP Menu

9-13 Setting Up Markers (Pulse Viewer Mode)

The MARKER menu is only available when the view mode is set to Pulse Viewer (refer to Section 9-15 “Measurement Setup” on page 9-32). Marker parameters are set using the “MARKER Menu” on page 9-27. Refer to the figure below when working with this section.

In Pulse Viewer, markers can be placed on the time domain pulse trace similarly as in a normal spectrum frequency domain trace and all of the typical marker functions are available. The active marker is indicated with a solid green fill, other markers will show with a hollow fill, fixed markers show as a green X. A dashed vertical line is attached to the active marker and facilitates touch operations. Either the marker or the line can be dragged into position, and either can be double tapped to open a number of peak search options.

1. Marker 1 is a normal marker with a hollow fill (not active) and is placed on the trace at the peak of the pulse.
2. Marker 2 is a delta marker relative to Marker 2 and will indicate the difference in time and amplitude from Marker 1. It has a solid fill (active marker) and a dashed blue line that aids in touch drag operation to move it to the desired location.
3. The MARKER menu provides marker controls such as selecting the active marker and on which trace it should be place, their mode (normal, delta, or fixed), selecting marker functions, and accessing marker peak search operations. You can also enable the MARKER table described below.
4. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu. In this example, the active marker is highlighted and the relative X and Y position values are shown (these values are also shown in the MARKER menu for the currently selected (active) marker.

Figure 9-25. Marker Table and Marker Settings Panels (Pulse Viewer Mode)

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the center of the time display.
2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and be placed at the center of the time display. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static time and amplitude.
3. Place a marker by first selecting it as the active marker, then do one of the following:
   - **a.** Enter a new TIME value from the MARKER menu. The time can be entered manually or adjusted by using the slider or the + and – buttons to move the marker to the left and right.
   - **b.** Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position).
   - **c.** Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 9-28). Some peak search functions can be accessed by double tapping the marker or the blue marker line.

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed time value, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring time and amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, if Marker 2 is set as a delta marker, the delta reference is set to Marker 1. To set a delta marker and its reference:

1. Activate either a normal or fixed marker and place it in a reference location as described previously.
2. Activate a delta marker using MARKER > SELECT > Marker #, then select MODE > Delta.
3. Place the active delta marker by doing one of the following:
   - **a.** Enter a new TIME value.
   - **b.** Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.
   - **c.** Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 9-28).

A delta marker is labeled with a green delta symbol between each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1". If another marker is desired to be the reference marker, select the delta marker as the active marker and then use DELTA REFERENCE > Marker # to select the desired reference marker number.

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 9-28.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center of the time display, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker. When a marker is turned on, it is a normal marker positioned at the center of the time display on the active trace.

ENABLED: Enables the selected marker. When the toggle is off, the marker is disabled and not shown on the screen.

TIME: Displays the marker time value. For delta markers, the time value is relative to the reference marker. Change the marker time position by dragging it to the desired location. You can also change the marker time value by pressing the TIME button and changing it manually using the keypad controls.

AMPLITUDE: Displays the current marker amplitude. When the marker mode is set to Normal or Delta, the amplitude is set by the trace. In that case, the amplitude is not settable by the user. The button is grayed out, but the value is still updating with every sweep. If the marker is a Fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude using the keypad control.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The time value is fixed but the amplitude value varies from sweep to sweep.
- **Delta (Δ):** A Delta (Δ) marker displays the delta time value and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Normal marker at the same location. The reference marker can then be switched to a Fixed marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed time, which are defined by the user and not related to the trace or sweep data.

FUNCTION: Sets the function of the currently selected marker to None or Noise. For more information about using marker functions, refer to "Marker Functions" on page 9-29.

DELTA REFERENCE: Selects the Reference marker for a Delta marker. A Delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen.

REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

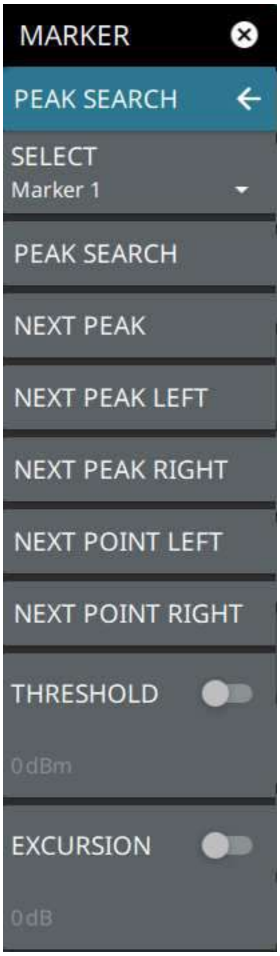
ALL MARKERS OFF: Turns all markers off, but markers will retain their last time position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 9-26. MARKER Menu

MARKER PEAK SEARCH Menu

Note	Double tapping a marker opens a quick peak search menu with some of the below features.



PEAK SEARCH: Returns to the main MARKER menu.

SELECT: If the selected marker is off, it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 9-27. PEAK SEARCH Menu

Marker Functions

Noise Markers

Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

9-14 Setting Up Triggering

Trigger parameters are set using the “TRIGGER Menu” on page 9-30.

TRIGGER Menu

SOURCE: The SOURCE button offers several triggering options depending on which view mode the instrument is set:

- **Free Run:** A new sweep is started immediately upon completion of the current sweep. No trigger event is required to initiate a sweep.
- **Video:** When enabled, the trigger level will be indicated graphically on the display with a horizontal VIDEO line. A new sweep is started when the input video level meets the value set via the LEVEL button. The level can also be adjusted by dragging the VIDEO line up or down. Video triggering is useful for monitoring a known time position and its transients, such as pulsed signal rise or fall times.
- **External 1 or 2:** A TTL signal applied to the selected External Trigger MCX input connector causes a single sweep. After the sweep is complete, the resultant trace is continuously displayed until the next trigger signal is received.

LEVEL: Used when the trigger source is set to Video. Sets the video trigger level threshold that initiates a sweep. The level crossing applies to rising or falling edges. Use the hysteresis setting below to adjust the sensitivity of the trigger level.

HOLDOFF: Available only when the trigger source is set to External or Video. When toggled on, the analyzer waits the user defined amount of time to re-arm the trigger between trigger events. If a trigger event is received after the previous trigger, but before the holdoff time has elapsed, that trigger event will be ignored.

PERIODIC: Used to set a periodic sweep trigger. When toggled on, the instrument waits the set time to start a sweep.

SLOPE: Used when the trigger source is set to External or Video. Sets the trigger slope to rising or falling edge.

HYSTERESIS: Hysteresis is used to address noisy trigger signals. The hysteresis setting adjusts the sensitivity of the trigger system (the difference between the firing level and the arming level as shown in Figure 9-29). A low hysteresis value sets the arming and firing levels close to each other, meaning a small signal change will cause a trigger. A large hysteresis value sets the arming and firing levels far apart, meaning a large signal change will be required to cause a trigger.

Figure 9-28. TRIGGER Menu in Pulse Analyzer mode

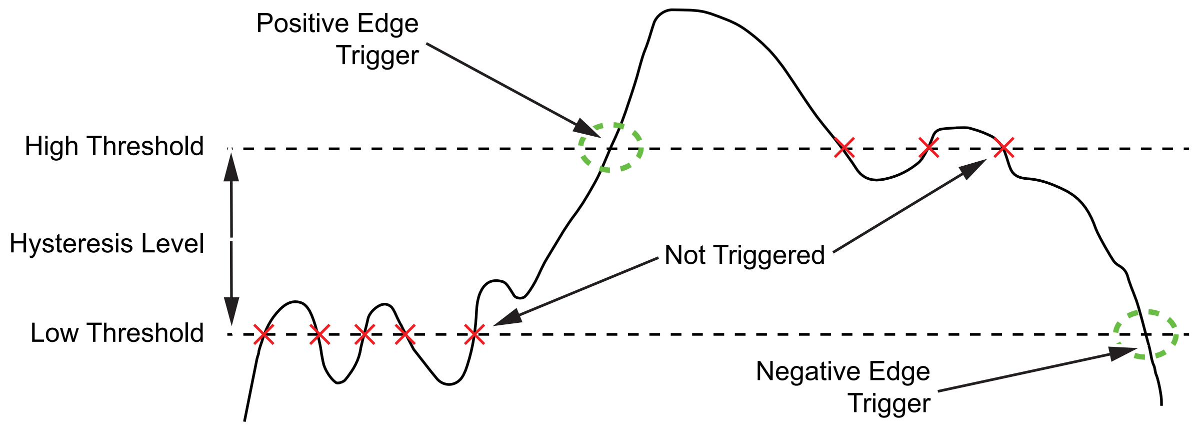
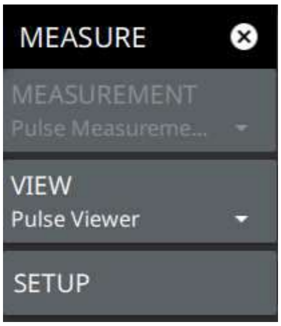


Figure 9-29. Trigger Levels and Hysteresis

9-15 Measurement Setup

Refer to Chapter 3, "Spectrum Analyzer Measurements" for basic information on setting up a spectrum measurement. This section provides setup information for the Pulse measurement.

MEASURE Menu



VIEW: Selects Pulse Analyzer or Pulse Viewer.

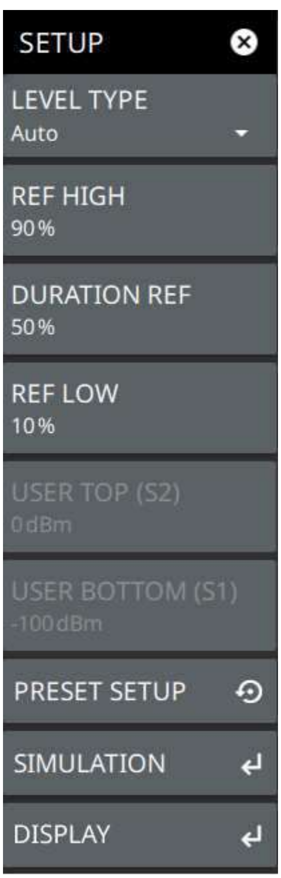
Pulse Analyzer view provides the signal trace with pulse instant and transition indicators on the trace along with pulse analytics below the trace display. Refer to Section 9-3 "Pulse Analyzer GUI Overview" on page 9-2 and Section 9-4 "Pulse Measurements" on page 9-6.

Pulse Viewer displays the signal trace without the pulse instant and transition indicators nor the pulse analytics, and it enables the MARKER menu and faster sweep updates. Refer to Section 9-13 "Setting Up Markers (Pulse Viewer Mode)" on page 9-25.

SETUP: Opens the SETUP menu. The SETUP menu can also be accessed directly from the main menu.

Figure 9-30. MEASURE Menu

SETUP Menu



LEVEL TYPE: Selects the desired measurement type from the following list:

- **Auto:** Automatically sets the top and bottom reference levels based on the received signal. See Section 9-4 "Pulse Measurements".
- **User:** Provides manual setting of the top and bottom reference levels. When se to User, use the USER TOP (S2) and USER BOTTOM (S1) buttons below.

REF HIGH: Sets the high reference level.

DURATION REF: Sets the duration reference level.

REF LOW: Sets the low reference level.

USER TOP (S2): Used to set the top reference level when LEVEL TYPE is set to User.

USER BOTTOM (S1): Used to set the bottom reference level when LEVEL TYPE is set to User.

PRESET SETUP: Presets all values on the SETUP menu to default values.

SIMULATION: Opens the PULSE SIMULATION menu. Refer to "PULSE SIMULATION Menu" on page 9-33.

DISPLAY: Opens the DISPLAY menu. Refer to "PULSE SIMULATION Menu" on page 9-33.

Figure 9-31. Pulse SETUP Menu

PULSE SIMULATION Menu

SIMULATION: Toggles pulse simulation on or off. When simulation mode is on, the analyzer stops sweeping and displays an example trace to show the Pulse Analyzer measurement capabilities.

WAVEFORM TYPE: Selects the desired waveform type. You can select a single positive, or a single negative pulse, pulse train, or double pulse. See Figure 9-33 for a double pulse simulation.

AMP HIGH: sets the upper amplitude of the simulated pulse.

AMP LOW: sets the lower amplitude of the simulated pulse.

PERIOD: sets the period of the simulated pulse.

DUTY FACTOR: sets the duty factor of the simulated pulse.

Figure 9-32. PULSE SIMULATION Menu

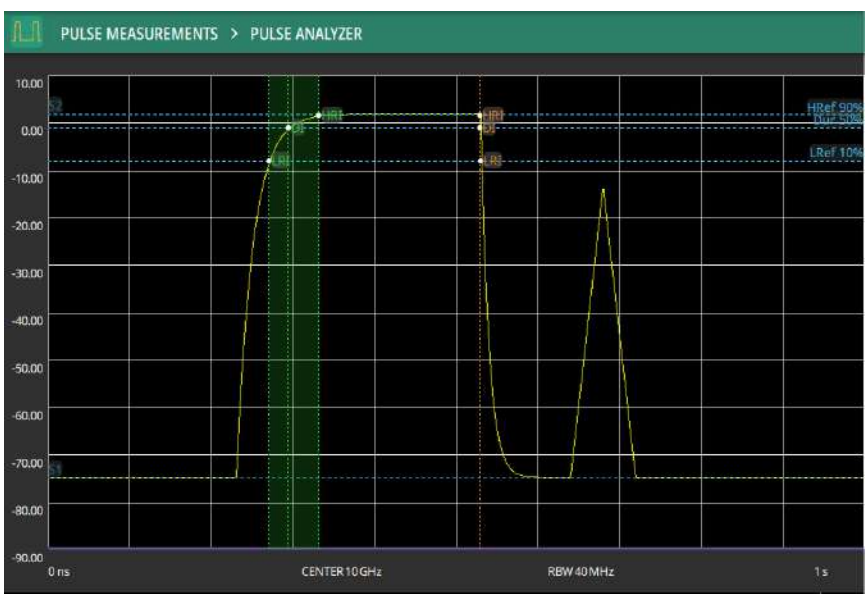


Figure 9-33. Double Pulse Waveform Simulation (Pulse Analyzer View)

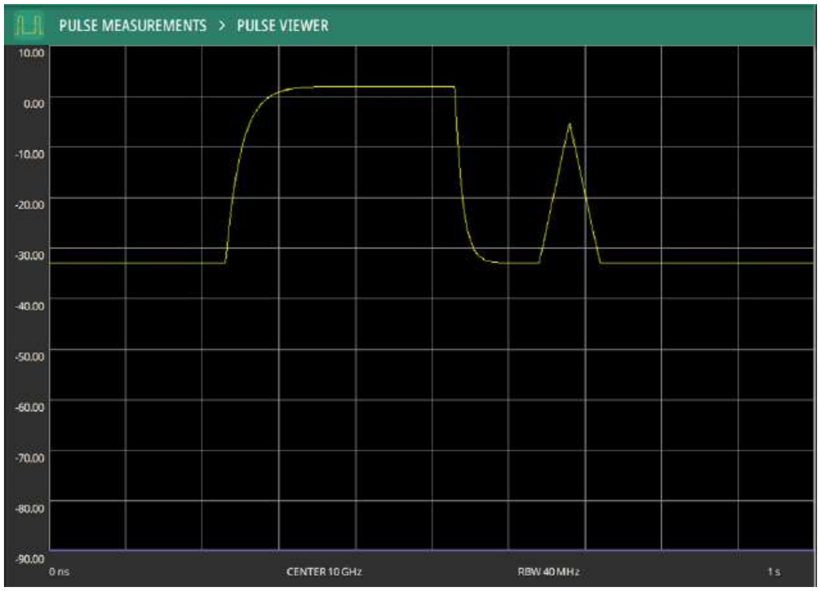


Figure 9-34. Double Pulse Waveform Simulation (Pulse Viewer)

DISPLAY Menu

REF HIGH: Toggles the high level reference line on or off.

DURATION REF: Toggles the duration reference line on or off.

REF LOW: Toggles the low level reference line on or off.

POST-T OVER: Toggles the post-transition overshoot marker on or off.

POST-T UNDER: Toggles the post-transition undershoot marker on or off.

PRE-T OVER: Toggles the pre-transition overshoot marker on or off.

PRE-T UNDER: Toggles the pre-transition undershoot marker on or off.

S2 HIGH: Toggles the high (S2) reference line on or off.

S1 LOW: Toggles the low (S1) reference line on or off.

HRI FIRST: Toggles the first-transition high reference instant marker on or off.

LRI FIRST: Toggles the first-transition low reference instant marker on or off.

DI FIRST: Toggles the first-transition duration instant marker on or off.

HRI SECOND: Toggles the second-transition high reference instant marker on or off.

LRI SECOND: Toggles the second-transition low reference instant marker on or off.

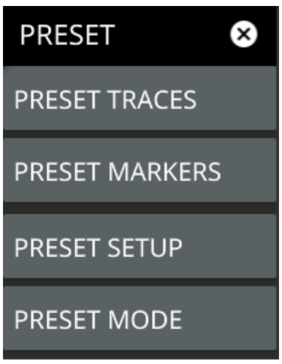
DI SECOND: Toggles the second-transition duration instant marker on or off.

Figure 9-35. Pulse DISPLAY Menu Markers and Reference Lines Toggles

9-16 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to Chapter 2, "Reset Settings" on page 2-35. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting".

PRESET Menu



PRESET TRACES: Presets all trace settings to default values.

PRESET MARKERS: Presets all marker settings to default values. Turns off all markers.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.

Figure 9-36. PRESET Menu

9-17 Saving and Recalling Measurements

The Field Master Pro can save measurement setups, native trace and CSV trace data, and screenshots. You can recall setup and native trace files. For other file operations such as copy, move, and directory management, refer to Section 2-12 “File Management” on page 2-36.

Saving a Measurement

To save a measurement or setup, refer to Figure 9-37:

1. Press FILE > SAVE AS...
2. If desired, press the save location to change the destination.
3. Enter the desired file name using the touchscreen keyboard.
4. Select the type of file to save from the selection list.
5. Press SAVE to save the file.

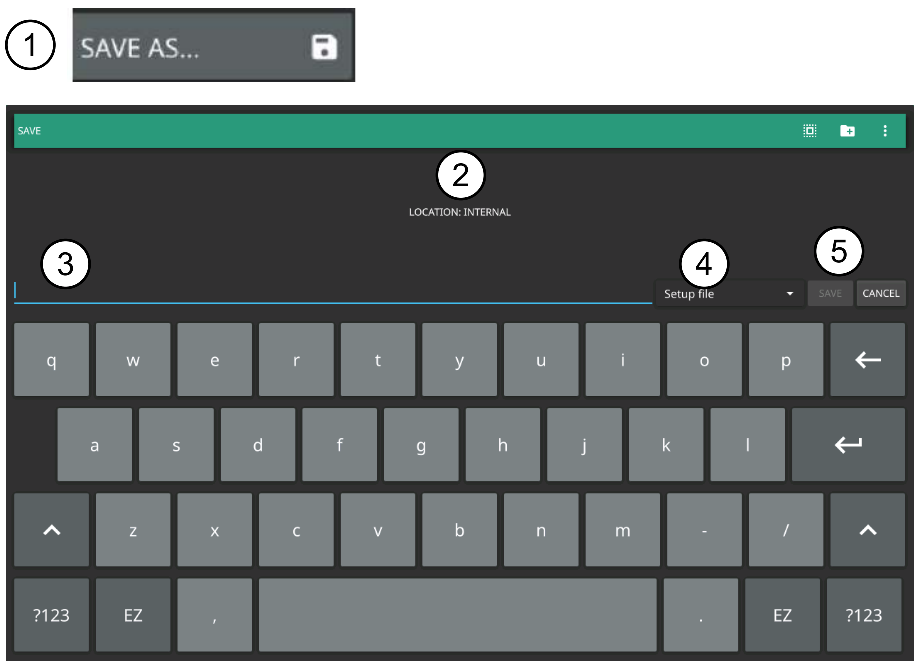


Figure 9-37. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup and native trace measurement. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to Figure 9-38:

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.

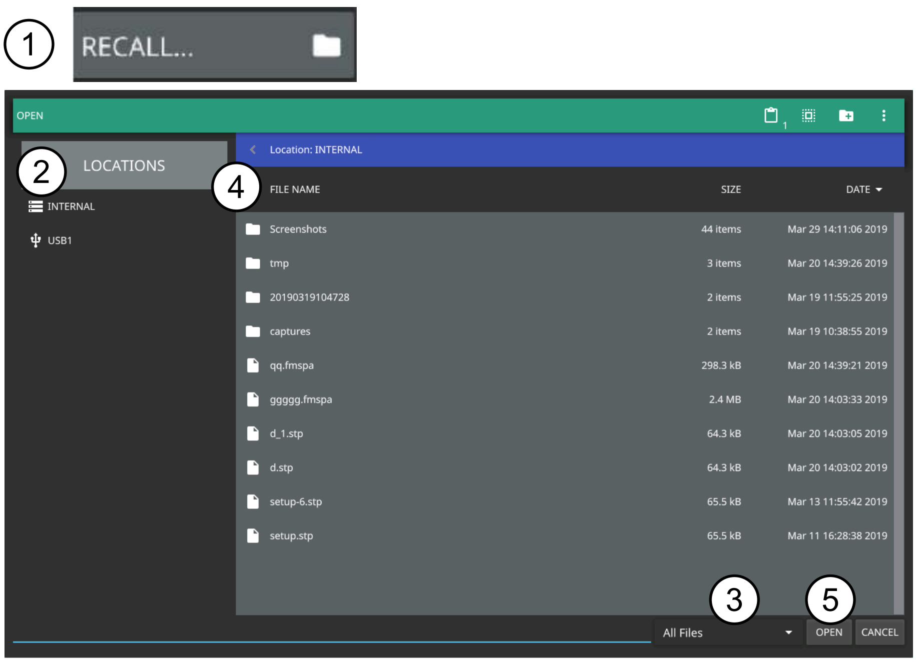


Figure 9-38. File Open Dialog

When a trace measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements, set TRACE > MODE > Active.

FILE Menu

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fmpa file type).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fmpa and png file types).

RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled to the appropriate trace. That trace will be in a Hold mode. To exit the recalled data, simply change the trace mode back to Active.

BROWSE FILES: Opens “File Management” on page 2-36.

Figure 9-39. FILE Menu

Appendix A — Instrument Messages and Troubleshooting

A-1 Introduction

This appendix provides a list of instrument messages and their meaning and procedures for a full system recovery. If any error condition persists, contact your local Anritsu Service Center (http://www.anritsu.com/contact-us).

Field Master Pro displays the following message types:

- Self-Test Messages, indicating self-test pass or fail conditions.
- File Management Messages, relating to the system (three-bar) menu FILES actions.
- Informational Messages, such as notification of a screen capture.
- Warning Messages, such as an ADC over-range warning.
- Error Messages, such as an internal instrument fault.

Messages have the following display characteristics:

- Transient messages appear briefly and then fade away.
- Persistent messages remain on the display and require user intervention to correct the condition.
- Some messages are logged but not displayed, such as messages in the event log.
- Messages may be displayed either in the toolbar or in a pop-up window.

Procedures to recover from system software faults can be found in Section A-7 “System Recovery” on page A-12.

A-2 Self-Test Messages

Field Master Pro has built-in diagnostics that allow you to run a built-in self test. The test results can be viewed on the screen and saved to a log file. To run self test, use the 3-line menu to access DIAGNOSTICS, then select SELF TEST and RUN SELF TEST. Below is a sample list of self tests with passing results:

```
TEST DATE: 2019-03-21 09:51:47 MDT


OVERALL STATUS : PASS


SYSTEM : OVERALL STATUS : PASS
  System voltage : 13.00 V, 4.00 V ,15.01 V  (PASS)
  System power : 32.2083 W
  External current : 2.50 A, 2.50 A ,2.32 A  (PASS)
  Battery current : 4.00 A, 4.00 A ,0.18 A  (PASS)
  +0.85V LP core supply : 0.85 V, 0.09 V ,0.85 V  (PASS)
  +3.3V LP supply : 3.30 V, 0.33 V ,3.25 V  (PASS)
  +1.8V LP Vaux supply : 1.80 V, 0.18 V ,1.82 V  (PASS)
  +1.8V LP IO supply : 1.80 V, 0.18 V ,1.81 V  (PASS)
  +0.85V FP core supply : 0.85 V, 0.09 V ,0.85 V  (PASS)
  +1.8V DDR PLL supply : 1.80 V, 0.18 V ,1.81 V  (PASS)
  +0.85V PS transceiver AVCC : 0.85 V, 0.09 V ,0.85 V  (PASS)
  +1.8V PS transceiver AVTT : 1.80 V, 0.18 V ,1.83 V  (PASS)
  +2.5V DDR SODIMM supply : 2.50 V, 0.25 V ,2.49 V  (PASS)
  +1.2V DDR SODIMM supply : 1.20 V, 0.12 V ,1.20 V  (PASS)
  +0.85V FPGA core supply : 0.85 V, 0.09 V ,0.86 V  (PASS)
  +0.9V transceiver AVCC supply : 0.90 V, 0.09 V ,0.90 V  (PASS)
  +1.2V transceiver AVTT supply : 1.20 V, 0.12 V ,1.21 V  (PASS)
  +1.0V Ethernet supply : 1.00 V, 0.10 V ,0.99 V  (PASS)
  +1.8V FPGA supply : 1.80 V, 0.18 V ,1.79 V  (PASS)
  +2.5V FPGA supply : 2.50 V, 0.25 V ,2.48 V  (PASS)
  +3.3V FPGA supply : 3.30 V, 0.33 V ,3.29 V  (PASS)
  +5.0V USB/misc supply : 5.00 V, 0.50 V ,5.00 V  (PASS)
  +3.9V analog supply : 3.90 V, 0.39 V ,3.96 V  (PASS)
  +5.7V analog supply : 5.70 V, 0.57 V ,5.67 V  (PASS)
  -5.7V analog supply : -5.70 V, 0.57 V ,-5.26 V  (PASS)
  +12.8V analog supply : 12.80 V, 1.28 V ,12.82 V  (PASS)
  +24.0V analog supply : 24.00 V, 2.40 V ,23.92 V  (PASS)
  Backlight voltage : 22.00 V, 4.40 V ,19.56 V  (PASS)
  Backlight current : 0.20 A, 0.20 A ,0.18 A  (PASS)
  12.0V for fan : 12.00 V, 1.20 V ,12.00 V  (PASS)
  CPU Temperature : 61.0 C
```

```
    Motherboard Temperature : 46.5 C
    Fan speed, percent of full speed : 7 %
    Fan speed : 2638 RPM
    Temperature at Reference : 45.3 C

  SPA : OVERALL STATUS : PASS
    +12VG : 12.00 V, 1.20 V ,11.90 V  (PASS)
    +5V_PREAMP : 5.00 V, 0.50 V ,4.99 V  (PASS)
    +5VA : 5.00 V, 0.50 V ,5.02 V  (PASS)
    +5VG : 5.00 V, 0.50 V ,4.99 V  (PASS)
    +5VH : 5.00 V, 0.50 V ,5.02 V  (PASS)
    +5VI : 5.00 V, 0.50 V ,5.05 V  (PASS)
    +5V_VCO : 5.00 V, 0.50 V ,5.09 V  (PASS)
    +5VM : 5.00 V, 0.50 V ,5.01 V  (PASS)
    +5VP : 5.00 V, 0.50 V ,5.05 V  (PASS)
    +5V_SAW : 5.00 V, 0.50 V ,4.99 V  (PASS)
    +3V3_HBPA : 3.30 V, 0.33 V ,3.31 V  (PASS)
    +3V3_IF : 3.30 V, 0.33 V ,3.29 V  (PASS)
    +3V6 : 3.60 V, 0.36 V ,3.55 V  (PASS)
    +3V3_CAL : 3.30 V, 0.33 V ,3.36 V  (PASS)
    +3V3G : 3.30 V, 0.33 V ,3.33 V  (PASS)
    +3V3H : 3.30 V, 0.33 V ,3.29 V  (PASS)
    +3V3M : 3.30 V, 0.33 V ,3.32 V  (PASS)
    +3V3P : 3.30 V, 0.33 V ,3.33 V  (PASS)
    ADC_AVDD3_3V3 : 3.30 V, 0.33 V ,3.33 V  (PASS)
    +3V3IFA : 3.30 V, 0.33 V ,3.33 V  (PASS)
    +3V3DET : 3.30 V, 0.33 V ,3.35 V  (PASS)
    +3V3IFC : 3.30 V, 0.33 V ,3.37 V  (PASS)
    +3V3IFD : 3.30 V, 0.33 V ,3.35 V  (PASS)
    +3V3IF_OUT : 3.30 V, 0.33 V ,3.33 V  (PASS)
    SPARE : 0.00 V, 1.00 V ,0.00 V  (PASS)
    -5V : -5.00 V, 0.50 V ,-5.13 V  (PASS)
    +24VH : 24.00 V, 2.40 V ,24.18 V  (PASS)
    +3V3D : 3.30 V, 0.33 V ,3.27 V  (PASS)
    +2V5D : 2.50 V, 0.25 V ,2.50 V  (PASS)
    ADC_AVDD2_2V5 : 2.50 V, 0.25 V ,2.50 V  (PASS)
    ADC_AVDD1_1V25 : 1.25 V, 0.13 V ,1.25 V  (PASS)
    ADC_DRVDD_1V25 : 1.25 V, 0.13 V ,1.25 V  (PASS)
    DCM Not Available For This Option : 0.00 V, 0.00 V ,0.00 V  (PASS)
    Thermal Sensor 1 (Mid-band 1st IF) : 35.00 C, 90.00 C ,44.75 C  (PASS)
```

```
Thermal Sensor 2 (Mid-band 2nd IF) : 35.00 C, 90.00 C ,46.00 C  (PASS)
Thermal Sensor 3 (Low-band RF) : 35.00 C, 90.00 C ,42.00 C  (PASS)
DCM Temperature Not Available For This Option : 0.00 C, 0.00 C ,0.00 C  (PASS)
ADC Thermal Sensor : 35.00 C, 90.00 C ,39.93 C  (PASS)
```

If any self test fails, try resetting the instrument with a master reset and reboot, and run the test again. If the condition persists, contact your local Anritsu Service Center (http://www.anritsu.com/contact-us).

A-3 File Management Messages

File management functions (accessed by via 3-line icon > FILES) are used to organize, copy, and rename files. The following messages are displayed in a persistent dialog when using the file manager features.

Cannot access File or Directory

User does not have permission to access the file or directory.

Cannot copy/move items: no write permission on folder

User does not have permission to access the file or directory.

Cannot move items: origin and destination folders are the same

When attempting to move a file to the same location.

Could not remove the directory/file

The file cannot be deleted.

Error creating new folder

A folder cannot be created.

File or Directory does not exist

When attempting to access a file or directory that does not exist.

Path or url may not exist or cannot be read

The file location cannot be accessed.

Rename error

The file or directory cannot be renamed.

There is no space to copy

There is not enough space to copy the file.

A-4 Informational Messages

Battery Over Charge Temperature

In Toolbar, Not Logged, Persistent

Cannot start measurement without a connected Antenna

In Toolbar, Not Logged, Persistent

Concatenation has been aborted

When user aborts concatenation of streaming metadata files

External reference detected - switching reference source to external

In Toolbar, Logged, Transient

External reference disconnected – switching reference source to GPS

In Toolbar, Logged, Transient

External reference disconnected – switching reference source to internal

In Toolbar, Logged, Transient

External reference disconnected – switching reference source to Internal High

In Toolbar, Logged, Transient

File Does Not Exist

In Toolbar, Not Logged, Transient

File Recall Failed

In Toolbar, Not Logged, Transient

File Recalled Successfully

In Toolbar, Not Logged, Transient

File Save Failed

In Toolbar, Not Logged, Transient

File Saved Successfully

In Toolbar, Not Logged, Transient

File successfully saved as: filename

When saving a file (e.g., trace, setup).

GPS reference detected - acquiring GPS

In Toolbar, Logged, Transient

GPS reference acquired - switching reference source to GPS

In Toolbar, Logged, Transient

GPS reference disconnected – switching reference source to Internal

In Toolbar, Logged, Transient

GPS reference no longer available – switching reference source to Internal High

In Toolbar, Logged, Transient

Internal High reference no longer valid – switching frequency reference source to Internal

In Toolbar, Logged, Transient

Internal High reference no longer valid – switching time reference source to Internal

In Toolbar, Logged, Transient

Limit recall initiated

When a limit setup file is selected for recall.

Memory Full

Popup, Not Logged, Transient

Preset Completed

In Toolbar, Not Logged, Transient

Presetting Instrument

In Toolbar, Not Logged, Transient

Rebooting Instrument

In Toolbar, Not Logged, Transient

Recall initiated

When a file is selected for recall.

Reset Completed

In Toolbar, Logged, Transient

Resetting Instrument

In Toolbar, Logged, Transient

Successfully concatenated %1 files

When the concatenation of streaming metadata files is complete.

Screenshot saved.

When saving a screenshot is successful

Self test Passed

In Toolbar, Logged, Transient

Self test Failed

In Toolbar, Logged, Transient

Software update files found on USB

In Toolbar, Not Logged, Transient

Stopped saving sweeps after sweep complete.

When the save on event triggers are disabled after end-of-sweep.

Stopped saving sweeps after limit crossing.

When the save on event triggers are disabled after a limit fails.

File Saved Successfully

When a save on event trigger causes a file to be saved.

The selected mode is not yet available.

When an unavailable mode is selected.

Trace copied to memory

Trace cleared from memory

USB drive x ejected

In Toolbar, Not Logged, Transient

A-5 Warning Messages

ADC Overrange

In Toolbar, Logged, Persistent

Battery Fault

In Toolbar, Logged, Transient

Battery level is critically low. Automatic shutdown is imminent.

Popup, Logged, Persistent

Battery level low.

Popup, Logged, Persistent

Battery Low warning

Pop-up Window, Logged, Persistent: Requires User Intervention

This message is sent once per low battery charge condition per boot cycle per charge cycle. A low battery charge condition is defined as the battery charge being at or below 10%.

Booted from backup SW slot. Reinstall SW to clear this message.

Popup, Logged, Persistent

Could not read from input file. Please verify that the storage device is still accessible and try again

Could not create output file. Please verify that the device is accessible and can be written to

Error occurred during concatenation. Error code: %1"

Failed to recall limit

When the limit setup file selected for recall could not be accessed.

Failed to save file: filename

When any other error occurred while trying to save a file.

Failed to save screenshot. Device may be full.

When saving a screenshot fails.

IF Gain Calibration is off

In Toolbar, Logged, Persistent

IF Shape Calibration is off

In Toolbar, Logged, Persistent

Limit recall initiated

When a limit setup file is selected for recall.

Not enough available space to save file: filename

When the entire file could not be written.

Recall file does not exist

When the file selected for recall could not be accessed.

Reference Level Calibration is off

In Toolbar, Logged, Persistent

Restart required for new settings to take effect.

Persistent. When hostname or options (in the Debug menu) are changed.

Shutdown Battery Level Reached

Pop-up Window, Logged, Persistent: Requires User Intervention

Sent after a **Battery Low** warning. A shutdown will occur when the battery charge is or below 5%.

Shutdown Temperature Reached

Popup, Logged, Persistent

Simulated Test Signal data being displayed

In Toolbar, Logged, Persistent

Temperature High Warning

In Toolbar, Logged, Persistent

The selected mode is not yet available.

When an unavailable mode is selected.

A-6 Error Messages

Command Error

In Toolbar, Logged, Persistent

Could not lock to external reference - check connection and try again

In Toolbar, Logged, Transient

Failed to connect to hardware

Persistent. When the connection to the hardware (server) could not be established.

Failed to recall limit

When the limit setup file selected for recall could not be accessed.

Failed to save file: filepath/filename

When any other error occurred while trying to save a file or when the connection to the hardware (server) is broken.

Failed to save screenshot. Device may be full.

When saving a screenshot fails.

HW communication problem

In Toolbar, Logged, Persistent

Not enough available space to save file: filepath/filename

When the entire file could not be written.

Out of Range

In Toolbar, Not Logged, Transient

PLL Unlock Error (x)

In Toolbar, Logged, Persistent

Query Error

In Toolbar, Not Logged, Transient

Recall file does not exist

When the file selected for recall could not be accessed.

SPA FPGA Programming Error

In Toolbar, Logged, Persistent

Unexpected software exception. Reboot required.

When the instrument software requires a reboot due to unknown error, Persistent

Options #### are not valid. Running without any options

In Toolbar, Not Logged, Persistent. This error may occur after a firmware update. Indicates that invalid option numbers were detected (#### indicates the invalid option numbers).

Options listed (####) are not valid. Restored to previous options

In Toolbar, Not Logged, Transient. This error may occur when upgrading options from an options upgrade file fails due to an invalid option configuration. The options will be restored to the previous options numbers.

Failed to upgrade options. Restored to previous options #"

In Toolbar, Not Logged, Transient. This error may occur when upgrading options from an options upgrade file fails due to an unknown reason. The options will be restored to the previous options numbers.

A-7 System Recovery

This section can be referred to in the event the MS2090A does not boot properly and the normal attempts to restart the instrument have failed.

Introduction

If the MS2090A fails to boot properly, a second boot attempt will load a recovery menu as shown in Figure A-1. This menu is only displayed when the instrument fails a normal boot process. A failure to boot properly might not indicate a problem. A boot disruption, such as removing power before the instrument can complete the boot process, will initiate a recovery menu on the next boot.

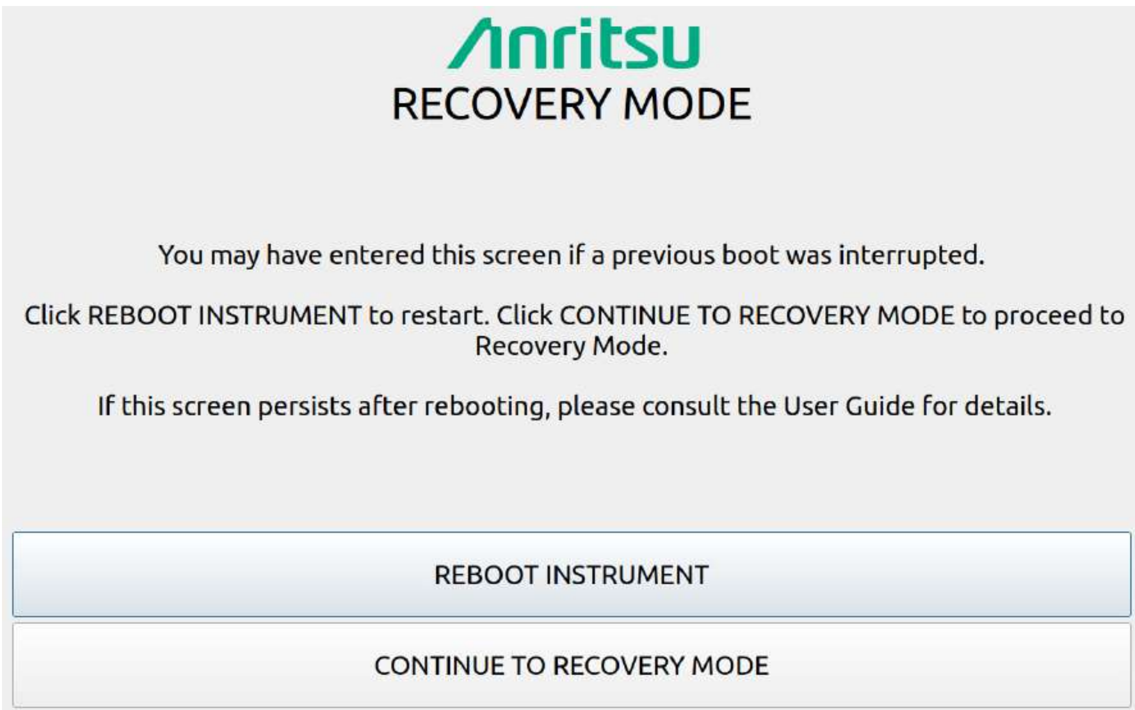


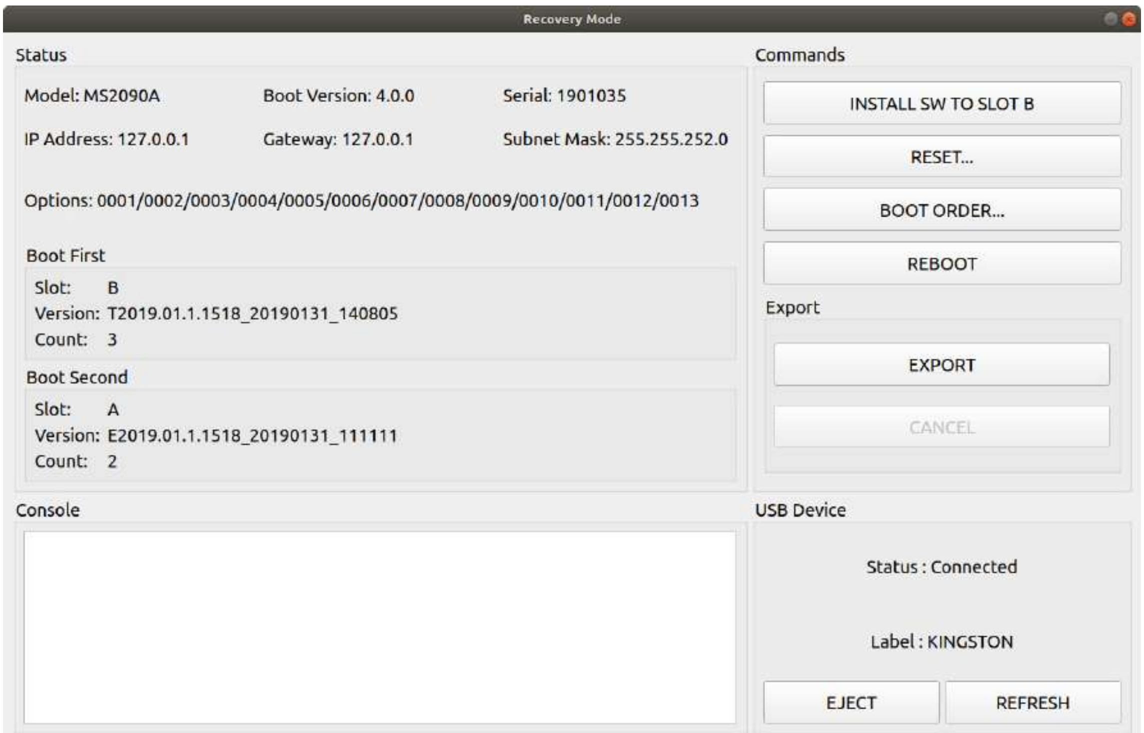
Figure A-1. Recovery Mode

If you see this screen:

1. Press the REBOOT INSTRUMENT button once the recovery menu loads.
2. If boot failure continues, a system recovery can be performed by pressing CONTINUE TO RECOVERY MODE.

The Recovery Mode menu (Figure A-2) shows instrument information and provides a variety of recovery options in ascending invasive order:

1. Press REBOOT to reboot the instrument without any further action.
2. Save all internal user files and logs by inserting a USB device and press the EXPORT button.
3. Refer to "Reset" on page A-14 for information about various reset options.
4. Refer to "Boot Order" on page A-14 to select a different boot order.
5. Refer to "Install SW to SLOT X" on page A-15 to reload or update the system software.



Status: Shows the Model, Boot Version, Serial Number of the MS2090A, IP Address, Gateway, Subnet Mask.

Options: Shows the Options currently installed.

Boot First: Shows the Slot, Version, and Count in the Boot First position.

Boot Second: Shows the Slot, Version, and Count in the Boot Second position.

Console: Provides a readout of the reboot activity.

Commands: Choose the command method to restart the instrument:

- INSTALL SOFTWARE TO SLOT B: Indicates which slot will be overwritten as described in "Install SW to SLOT X"
- RESET: Provides the RESET dialog as shown in "Reset" on page A-14.
- BOOT ORDER: Provides the Boot Order dialog as shown in "Boot Order" on page A-14.
- REBOOT: Reboots the instrument.

Export: Press EXPORT to save all internal user files and logs to a USB device. Press CANCEL to cancel the export. The saved files can be copied back to internal memory by using the file management menus.

USB Device: This section provides:

- Status: The USB memory device is connected or unconnected.
- Label: The Manufacturer of the USB memory stick.
- EJECT: Select to eject and remove the USB memory stick.
- REFRESH: Select to reconnect to the USB memory stick.

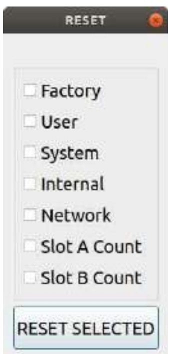
Figure A-2. Recovery Mode

Reset

The recovery RESET dialog is shown in Figure A-3. Here you can reset the MS2090A from the choices shown. In rare cases, system, internal, or other user files may interfere with instrument operation, so choosing to delete this data in that order may resolve a problem.

Caution	Any data that is deleted by the following selections is unrecoverable. Use the EXPORT button to save this data before proceeding.

Once reset options are selected, press the RESET SELECTED button.



Factory: Performs a Factory reset, which deletes last saved settings files for all applications.

User: Performs a User reset, which deletes all user setup, measurement, csv, limit, screenshot, IQ captures, and user calibration files.

System: Performs a Factory reset and also deletes event and error logs.

Internal: For service use only. Performs an Internal reset, which deletes non-volatile system files, except for critical files such as the serial number, options, and network configuration. Does not take effect until the next boot.

Network: Performs a Network reset, which deletes manual Ethernet settings and reverts the networking to DHCP. All saved Wireless networks will also be lost.

Slot A Count: Resets Slot A Count to 3. This is used for the recovery mode countdown.

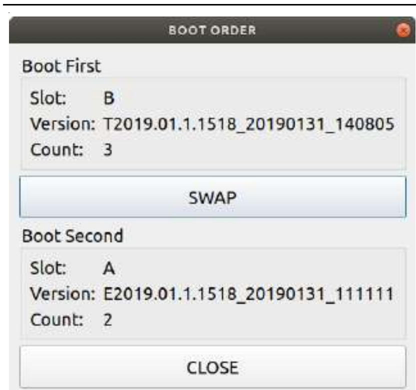
Slot B Count: Resets Slot B Count to 3. This is used for the recovery mode countdown.

RESET SELECTED: Resets the MS2090A by the method chosen.

Figure A-3. RESET Dialog

Boot Order

The order of which slot boots first can be changed from the BOOT ORDER menu (shown in Figure A-4). You may want to change the boot order to select a different software image in case of corruption or for preference. Pressing SWAP will change the boot sequence order: Slot A or Slot B. Once selected, press CLOSE and then reboot the instrument. This setting can only be changed from the Recovery Mode menu.



Boot First: Provides the first boot version to boot.
- Slot: Provides the slot designated location.
- Version: Provides the boot version number.
- Count: Boot attempts with this version.

SWAP: Swap Slot A and Slot B in the boot sequence.

Boot Second: Provides the first boot version to boot.
- Slot: Provides the slot designated location.
- Version: Provides the boot version number.
- Count: Boot attempts with this version.

Close: Closes the BOOT ORDER dialog.

Figure A-4. BOOT ORDER

Install SW to SLOT X

The recovery mode shows two slots (A and B). These slots contain different system software packages that are installed. Each slot contains the following information:

- Slot name (A,B): Boot version package (A or B).
- Slot count (3,2,1): The count indicates how many unsuccessful boot attempts before the slot is marked as unbootable. Every failed attempt decrements the value until it reaches 0 (unbootable). This count can be reset to 3 using the "Reset" menu.
- Slot version: The version represents the software package version available in the slot.

You can install a new software package by inserting a USB memory device with the system software file (.raucb) and pressing "Install SW to SLOT X." The X will be replaced with an A or B depending on which slot is to be overwritten. You will not be able to select which system software file will be installed from the attached USB, it will always install the first one found.

Appendix B — Software Option Upgrades

B-1 Introduction

Upgrading software options on MS2090A consists of two main steps:

1. Export and send the unit's configuration file to Anritsu.
2. Import the new license file provided by Anritsu

B-2 Exporting a Software Configuration File

Exporting the configuration file:

1. Insert a USB memory device.
2. Open the System menu from the upper left 3-bar icon.
3. Navigate to Settings > Options menu.
4. Touch SAVE CONFIG at the lower left of INSTALLED OPTIONS.
5. Save the configuration file to a USB memory device, preserving the default filename. The filename will be in the format of MS2090A_XXXXXXX.config on the USB drive when the operation is complete.
6. Email the file to [Anritsu] (example@example.com).

B-3 Importing Software License

Importing a new license file:

1. After receiving a new license file from Anritsu, place the file on the USB memory device in the top (root) level, not in any directory.
2. Open the System menu from the upper left 3-bar icon.
3. Navigate to Settings > Options menu
4. Touch ENABLE OPTIONS USING FILE at the lower right of INSTALLED OPTIONS.

   The instrument will search for a valid license file on the USB memory device and apply the changes to the system.
5. Reboot the instrument and ensure all changes are applied.

Appendix C — MS2090A PC Software

C-1 Introduction

The MS2090A PC software provides remote access to a network connected instrument and displays the same MS2090A user interface, instrument controls, and live measurement data on the computer screen. The software also allows you to load measurement and setup data from saved files and then perform measurement analysis on the recalled traces, even when instrument hardware is not available or is not connected to the PC by using the localhost (refer to Section C-4 “Connecting to the MS2090A or Localhost”). The user interface provides the same functionality when an instrument is connected with a few exceptions:

- File operations will interface with the PC file system rather than on the instrument and save on event operations will be saved to the instrument memory (refer to Section C-6 “FILE (File Management)”).
- In RTSA mode, the display density is not shown due to data transfer requirements, so you will just see the spectrum trace. The trace persistence state and time still function normally.

Connecting to the localhost is like connecting to an instrument so there is no expectation of carrying over settings or trace data from one to the other. The localhost will include option controlled functionality with most options automatically enabled (refer to Section C-5 “Working with the Localhost”).

C-2 PC Requirements

Minimum computer requirements are listed below:

- Intel Core i5 or higher processor
- 8 GB Ram
- Windows 10, 64-bit
- 1 GB disk space
- Open GL (ES) 2.0 support
- Display resolution 1280 x 800
- Ethernet or Wi-Fi (for connecting to an MS2090A instrument)

C-3 Installation

1. Download the MS2090A software from the product page:

   http://www.anritsu.com/en-US/test-measurement/products/ms2090a

2. Launch the MS2090A executable file and follow the on-screen instructions after selecting YES to the User Account Control dialog.

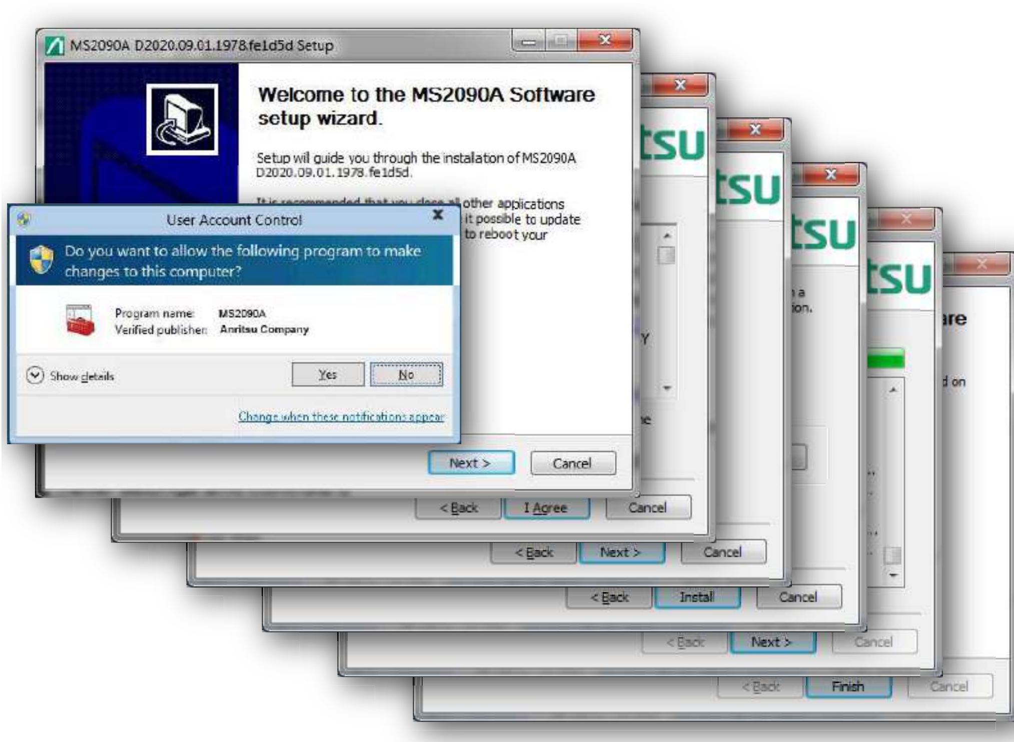
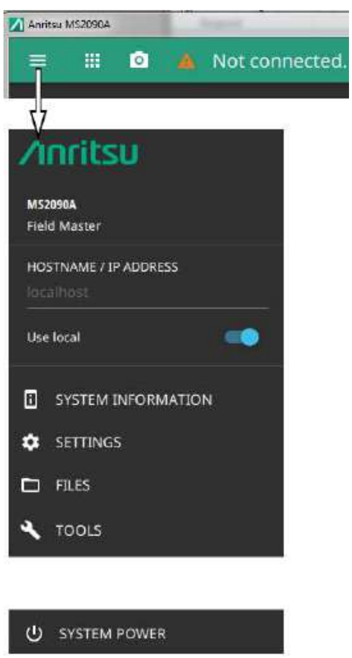


Figure C-1. MS2090A Installation

C-4 Connecting to the MS2090A or Localhost

Connecting to a networked instrument or to the localhost is established via the system menu. If connecting to an instrument, the instrument must first be connected to the network via Ethernet or WiFi and the IP address of the instrument must be known.



The System menu identifies the instrument model and serial number.

HOSTNAME/IP ADDRESS: Displayed only on the MS2090A PC software. This field is used to specify the IP address or hostname of an instrument that is connected to the network.

When **Use local** (localhost) is toggled on, the software will connect locally to provide some UI functionality.

Note that some of the system menus have limited functionality when the software is connected to the localhost. When connected to an instrument, refer to "System Menu" on page 2-21.

SYSTEM INFORMATION: Displays information about the instrument and software.

SETTINGS: Provides access to setting the display color theme and screenshot capture settings (refer to "Display Settings" on page 2-23).

FILES: Opens the Windows file explorer. Refer to "FILE (File Management)" on page C-5.

TOOLS: Opens the "Tools Menu" on page 2-40.

SYSTEM POWER: Opens a dialog to RESTART or POWER OFF the instrument.

Figure C-2. System Menu

C-5 Working with the Localhost

The localhost setting provides a simulated connection to the instrument hardware, but does not provide simulated data. When an instrument is not connected and the MS2090A software instead connects with the localhost, most of the menus are available and operate the same as they do on the instrument, but there are some differences as discussed in the following sections. In order to analyze measurement data, this data must first be acquired using instrument hardware and then saved locally to the PC or transferred to the PC from instrument storage at a later time.

Some notes and caveats when connected to the localhost:

- The PC software supports the following modes:
  - Spectrum analyzer
  - RTSA (trace data only)
  - 5G Analyzer
  - LTE Analyzer
  - Pulse Analyzer
  - EMF Meter
- The software must be set to the correct mode to recall a file for that mode. For example, to recall a .fm5gnr file, the 5G mode from the PC software must be selected first.
- Trace files will be recalled into a "HOLD" state, just like they would be on an instrument. This means that if the user changes the span, center frequency, or other settings that invalidate the data, all trace data will be cleared from the screen. The only way to get it back is to recall the trace again.
- Some buttons presented in the interface may not be applicable when connected to the localhost. Selecting them will have no effect.

- Measurements such as channel power or occupied bandwidth can be performed on recalled trace data, but the sweep must be set to Continuous. The same is true for evaluating the trace on a limit line.
- Measurements that change the span, such as SEM, are not functional unless the original file was saved while making an SEM measurement.

Measurement Setup Parameters

Since most of the setup parameters are available, you can use the PC software to create measurement setup files (.stp) for later use on the instrument; however, when recalling and analyzing measurement data, changing settings that would affect the data acquisition may cause the recalled data to be removed from the display. For example, you can change amplitude parameters, but you cannot change frequency parameters such as start/stop, span, and bandwidth parameters since there would be no data associated with those changed parameters. You can apply measurement features to the saved measurement data such as markers and limit lines and you can change many measurement and view settings. Opening a .fmxxxx measurement file when connected to the localhost will work basically the same as recalling a measurement on an instrument.

Below is a summary of menu behaviors when working with recalled measurement data and when connected to the localhost. Note that when connected to an instrument, the menus behave the same as on the instrument.

FREQ SPAN

Changes here suppress recalled data.

AMPLITUDE

Changes to REF LEVEL, SCALE/DIV, Y AXIS UNIT will change the graticule. PRE AMP and ATTEN LEVEL have no affect. All other changes will suppress recalled data.

BANDWIDTH

Changes here suppress recalled data.

TRACE

You can select different Traces or add Cursors if spectrogram data was captured. Most other trace settings have no affect.

SWEEP

You can recall GATED SWEEP and PWR VS TIME data, and you can change the GATE DELAY. Most other sweep settings have no affect.

MARKER

All marker measurements are available.

LIMIT

All limit line functions are available.

TRIGGER

Trigger functions have no affect.

MEASURE

Some measurements can be selected when the appropriate data is recalled. For example, a an Channel Power, OBW, and ACP measurements can be applied to a normal spectrum trace.

SETUP

Setup parameters for Channel Power, OBW, and ACP can be adjusted.

PRESET

Preset functions will preset the selected items and suppressed recalled measurement data.

C-6 FILE (File Management)

The PC file system is used for all file operations when connected to either an instrument or to the localhost. The FILE menu buttons will display the Windows Save As or Recall File dialogs; the FILES system menu will launch Windows Explorer. Note that files cannot be recalled from nor written to a connected instrument. Also, SAVE ON EVENT files will always be saved to the instrument and not the local PC.

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