Measurement Guide

Real-Time Spectrum Analyzer (RTSA)

MS2090A Field Master Pro™
MS2080A Field Master™
MS27201A Remote Spectrum Monitor
MS27200A Spectrum Monitor Module
MS2089A Site Master™

Interference Finder	**Option 24**
Real-Time Spectrum Analyzer	**Option 199**
AM/FM Modulation Measurement	**Option 509**

Note	Not all instrument models offer every option or every measurement within a given option. Refer to the Technical Data Sheet of your instrument for available options and supported measurements.

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Chapter 1 — General Information

1-1 Introduction

This measurement guide describes the real-time spectrum analyzer (RTSA) measurement functions of the Field Master, Site Master, Remote Spectrum Monitor and Spectrum Monitor Module. Real-Time spectrum analyzer functions are available when Option 199 is purchased with the instruments. Advanced functions are available only when the related option is installed and activated. Refer to Section 1-2 "Options Description" for references to discussion of the supported option. Refer to Chapter 2, "RTSA (Option 199) Overview"for an overview of the RTSA interface, setup and advanced features. Refer to Chapter 4, "IA Real-Time Spectrum Analyzer (Option 24)" for discussion of the IA RTSA interface, setup and measurement settings.

Related Manuals

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

http://www.anritsu.com/en-us/test-measurement/products/ms2080a

https://www.anritsu.com/en-US/test-measurement/products/ms2720xa

https://www.anritsu.com/en-US/test-measurement/products/ms27200a

https://www.anritsu.com/en-US/test-measurement/products/ms208xa

Product Information, Compliance, and Safety

Read the Product Information, Compliance, and Safety Guide for important safety, legal, and regulatory notices before operating the equipment:

- Field Master Series and Site Master – P/N: 10100-00069
- Remote Spectrum Monitor and Spectrum Monitor Module – P/N: 10100-00064

User Guide

For a complete overview of the instrument hardware and system functions, refer to your instrument user guide. The user guide provides information on the following topics:

- Listing of all related documentation such as measurement guides, programming and maintenance manuals.
- Instrument Care, maintenance and calibration
- External Connections to the top and side panels
- Power Requirements and Battery Information
- System settings such as Wi-Fi, GNSS/GPS, date/time, language settings, etc.
- Other advanced settings and tools such as file management, screenshot settings, port setup, and option configuration.
- Diagnostics and software updates

1-2 Options Description

This section provides a brief overview of the available options covered in this guide.

Note	Not all instrument models offer every option. Some options are available as a time-limited trial. For example, Real-time Spectrum Analyzer (RTSA) option is offered as a 90-day time limited option by ordering Option 9199. The option start time begins when the user first activates the option. Please refer to the Technical Data Sheet of your instrument for information on ordering and activating time limited options

AM/FM Modulation Measurement (Option 509)

The AM/FM modulation measurement evaluates the quality of the baseband signal retrieved from the modulated signal. The graphical representation of the baseband signal indicates the pattern of modulation depth/deviation versus frequency and time.

Interference Finder (Option 24)

The Interference Finder option includes several features for finding and analyzing interfering signals. This option adds advanced measurement setups to the real-time spectrum analyzer. It additionally adds an Interference Analyzer mode for displaying signal data on maps to aid in geo-locating interfering signals. Refer to the sections below for information on each measurement:

- "Interference Finder (Option 24)"
- "AM/FM Audio (Requires Option 24 or Option 509)"
    - "AM/FM Modulation Measurement (Option 509)"
- "IA Real-Time Spectrum Analyzer (Option 24)"
    - "Interference Map"
    - "Interference Polar"

Other Options and Features

For descriptions of other options and features not covered in this guide, refer to your instrument user guide or the product page for a comprehensive list of available documentation.

1-3 Document Conventions

The following conventions are used throughout the instrument documentation set.

User Interface Navigation

The instrument user interface consists of menus, buttons, toolbars, and dialog boxes. Elements in navigation paths are separated as follows: MARKER > PEAK SEARCH > NEXT PEAK.

Illustrations

Screen-captured images contained in this document are provided as examples. The chapters included in this measurement guide provide information on advanced measurement features, instrument settings and menu overviews, for a featured option. The actual displays, screen menus, and measurement details may differ based on the instrument, model, firmware version, installed options, and current instrument settings.

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Chapter 2 — RTSA (Option 199) Overview

2-1 Introduction

This chapter provides an overview of the Real-time Spectrum Analyzer (RTSA) user interface and describes the main graphical displays and menus presented in the SPECTRUM ANALYZER mode of RTSA application.

2-2 Selecting the Applications/Modes

The instrument applications are selected from the 9-dot icon or the current measurement icon. To select an application, press the 9-dot icon in the title bar or the current measurement icon to display the available applications and the corresponding modes, illustrated in Figure 2-1. Simply touch the desired icon to load the application or mode. The applications available for selection depend on the options that are installed and activated on your instrument. Some measurement modes and views are accessed via other measurement setup menus. Note that not all applications/modes are included in all instruments. Refer to your product's technical data sheet.

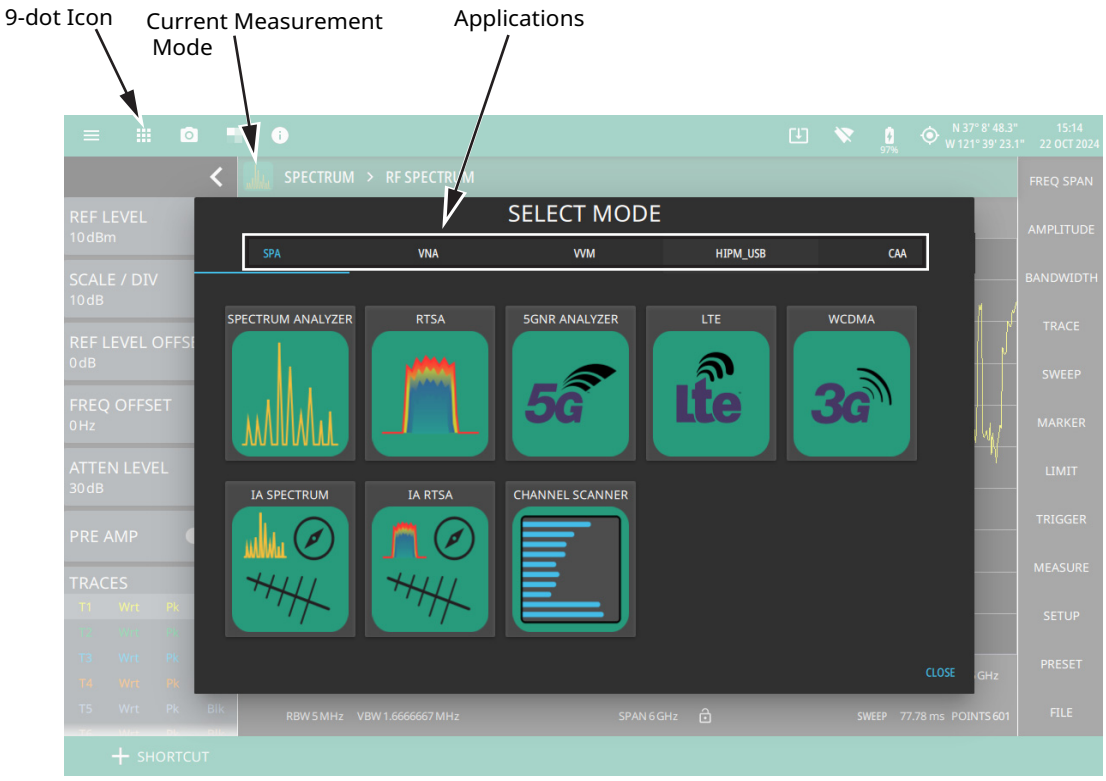


Figure 2-1. Instrument Applications and Modes

2-3 RTSA GUI Overview

This section illustrates the main graphical displays and menus available in RTSA.

RF Spectrum View

RF 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 RF Spectrum view from MEASURE > VIEW > RF Spectrum. The sample display below is set up with a single trace enabled and with a marker and the upper limit line envelope set.

Figure 2-2. RTSA – RF Spectrum View (1 of 2)

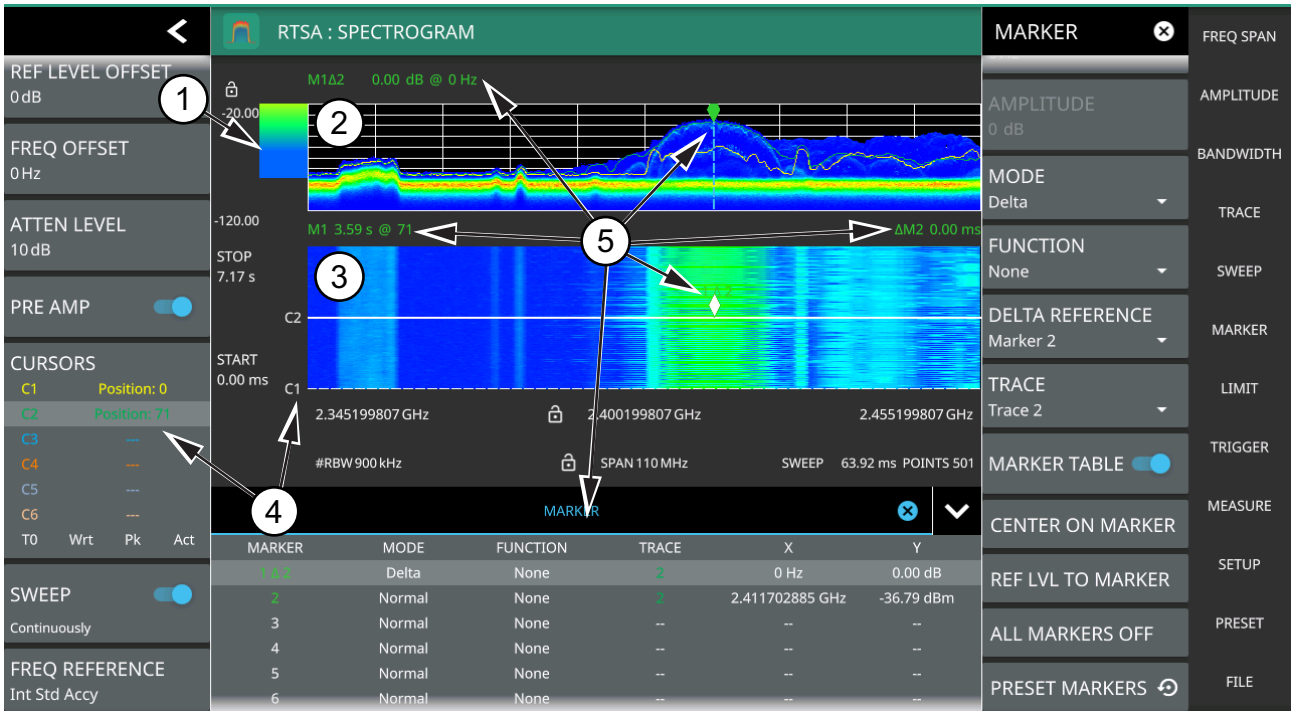
1. **Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings.
2. **Markers:** Markers are displayed as green diamonds on the trace to which they are assigned. The active marker is shown as a solid green 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 3-6 “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 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, Rolling Min or Max Hold, T1-T2 or T2-T1. Each trace can have Peak, Negative, Sample and Normal detectors. Traces can be set to Active, Hold/View, or Blank.

Figure 2-2. RTSA – RF 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 3-11 "Setting Up Advanced Measurements" on page 3-41 for more information on setting up the Spectrogram view.

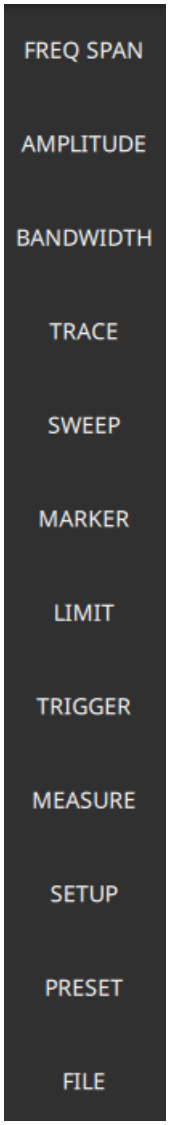


1. **Color Bar:** The color bar is used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, 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 (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 3-18.
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 3-33.

Figure 2-3. RTSA Spectrogram View

2-4 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 3-3 “Setting Frequency Parameters”.

AMPLITUDE: Provides access to amplitude-related settings, reference level, graticule scale, and attenuator/preamp settings. Refer to Section 3-4 “Setting Amplitude Parameters”.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 3-5 “Setting Bandwidth Parameters”.

TRACE: Provides trace/cursor and detection-related controls to set trace/cursor behaviors, presets, and access to the trace/detector settings table. Refer to Section 3-6 “Setting Trace and Cursor Parameters”.

SWEEP: Provides controls for sweep behaviors. Refer to Section 3-7 “Setting Sweep Parameters”.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 3-8 “Setting Up Markers”.

LIMIT: Provides controls for setting up limit lines and limit alarms. Refer to Section 3-9 “Setting Up Limit Lines”.

TRIGGER: Controls the trigger source, delay and holdoff, and trigger slope settings. Refer to Section 3-10 “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 3-11 “Setting Up Advanced Measurements”.

SETUP: Measurement controls for setting up advanced measurements. Refer to “SETUP Menu” on page 3-47).

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 3-17 “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 “Saving and Recalling Measurements” on page 3-64.

Figure 2-4. Main Menu

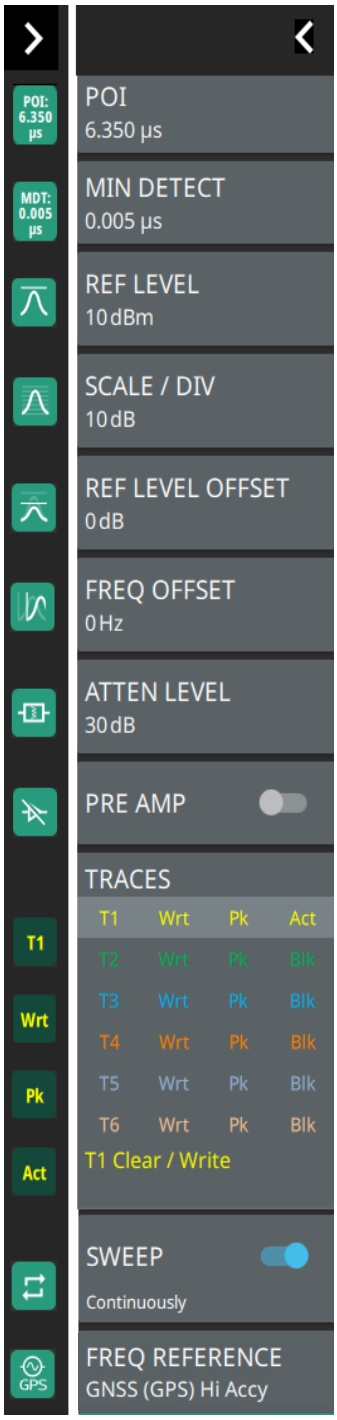
Using Menus

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.

2-5 Status Panel (RTSA)

The status panels and features illustrated in this section are unique to the real-time spectrum analyzer and to the selected measurement and view. Below is the RTSA status panel that covers RF Spectrum and spectrogram views, in addition to audio AM/FM and interference measurements (selected via MEASURE > MEASUREMENT 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.

Refer to Section 3-4 “Setting Amplitude Parameters” on page 3-5.

SCALE/DIV: Sets the graticule scale/division for log-based units.

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

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 3-3 “Setting Frequency Parameters” on page 3-1.

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 3-4 “Setting Amplitude Parameters” on page 3-5.

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 RF 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 RTSA 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 3-6 “Setting Trace and Cursor Parameters” on page 3-12.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 3-7 “Setting Sweep Parameters” on page 3-27.

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 GNSS (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 2-5. RTSA Status Panel with minimized icons

Chapter 3 — RTSA Measurements

3-1 Introduction

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 "File Management" section of Instrument Overview chapter of the user guide, and Section 3-18 "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 chapter includes sections that describe resolution bandwidth and attenuator functions. For example, in the resolution bandwidth (RBW) 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.

3-2 Making RTSA Measurements

The following sections of this chapter provide a detailed information of the RTSA measurements and the setup parameters.

Connecting a Signal Source

The basic setup starts with connecting a signal source to the RF In port of the instrument. For over-the-air (OTA) measurements, connect an antenna that is appropriate for the frequency range to be measured. For direct conducted measurements, ensure the RF source does not over power the input of the analyzer.

Note	For connector panels descriptions and torque specifications, refer to the product user guide. For RF input power limitations, refer to the product technical data sheet.

After an RF source is connected to the input connector, follow the sections below for setting up the measurement parameters.

3-3 Setting Frequency Parameters

Frequency-related parameters are set using the "FREQ / SPAN Menu" on page 3-4. 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 3-1 on page 3-4).

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 and right 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 3-1 on page 3-4).

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 2-5 “Status Panel (RTSA)”). 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).

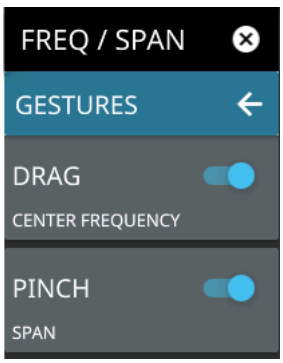
FREQUENCY STEP: Sets the frequency step value used for the plus (+) or minus (–) control.

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 3-4.

Figure 3-1. 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 3-2. GESTURES Menu

3-4 Setting Amplitude Parameters

The amplitude scale corresponds to the y-axis display. The Real-time spectrum Analyzer supports log units such as dBm and dBV. Amplitude-related parameters are set using the "AMPLITUDE Menu" on page 3-9.

Setting Amplitude Units

This setting allows you to set the y-axis graticule units and applies to most of the spectrum analyzer measurements, including markers, traces, and limit lines.

1. Press AMPLITUDE > Y AXIS UNIT
2. Select the desired y-axis amplitude units from the following: dBm (default), dBV, dBW dBmV, dBµV, or dBA.

When switching amplitude units, the following parameters are affected as described below:

- Reference level is converted directly from the current unit into the new unit and scaled appropriately.
- The reference level offset is always entered in dB.
- When changing from log units to log units, scaling (dB/div) remains unchanged.
- Trace in a "HOLD / VIEW" mode will be scaled to match the newly selected units.
- Marker amplitudes will be scaled to match the newly selected units.
- Limit line points will be directly converted and displayed in the newly selected amplitude units.
- Trigger levels will be converted to the newly selected units.
- Measurements and setups will be converted to the newly selected units.
- Save and recall will retain the units configuration.
- Power cycle will retain the current units configuration.

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 3-8). 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.

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 operation and allows you to set the y-axis graticule scale for log-based units only.

1. Press AMPLITUDE > SCALE/DIV.
2. Enter the desired number of units per division.

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 always in dB, even if linear amplitude units are selected. 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 3-9.
- Turn on the preamplifier.
- Reduce RBW. Refer to "Setting Bandwidth Parameters" on page 3-10.

Preamplifier

The preamplifier can be turned on and off by toggling PRE AMP via the status panel or the AMPLITUDE menu. Figure 3-3 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.

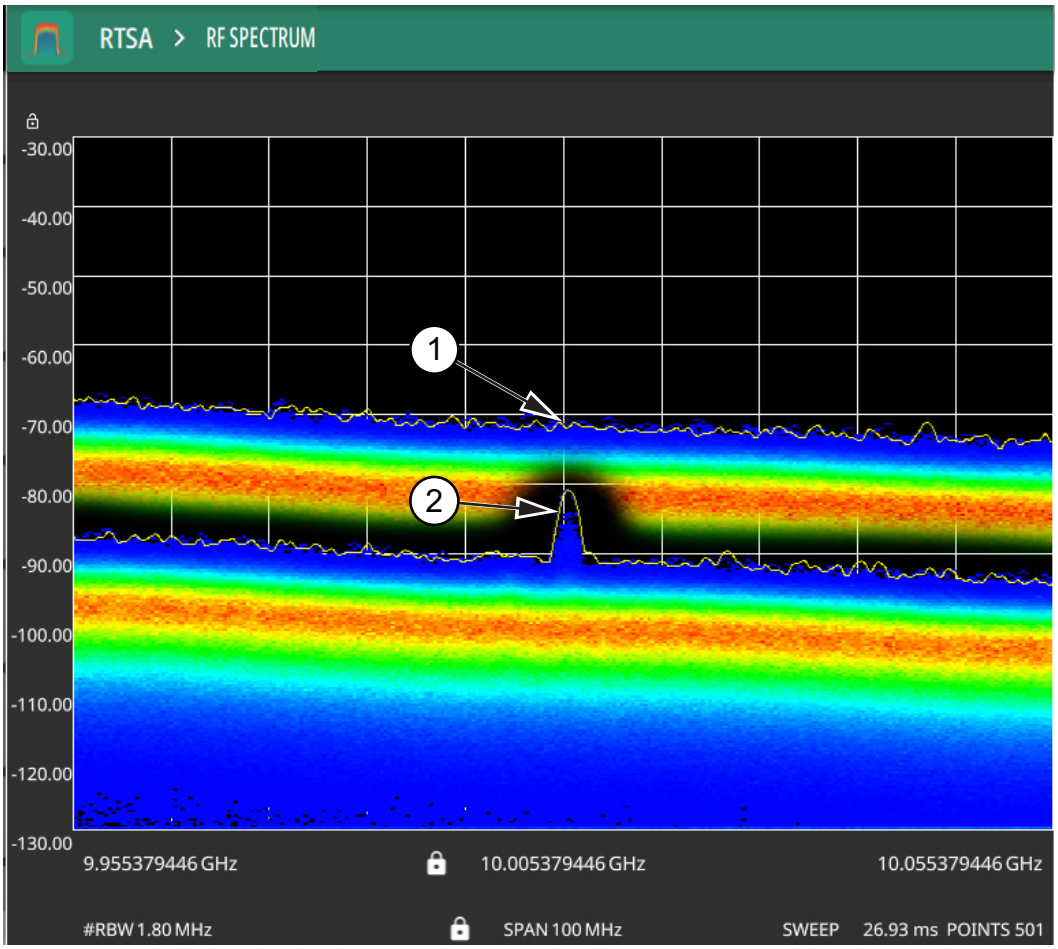


Figure 3-3. 1. Preamplifier Off
2. Preamplifier On

Indications of Excessive Signal Level

The instrument 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 3-4). 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 3-4. ADC Overrange

Overpower Warning

The Field Master Series MS2080A/MS2070A and Site Master MS2089A instruments are equipped with an in-built overpower protection hardware in order to manage considerably high range of input power. If the input power range exceeds beyond 5 watts, the protection relay gets activated and a notification alert is displayed as shown in the Figure 3-5. Proceed by removing the high power input source to avoid to damaging the RF circuitry.

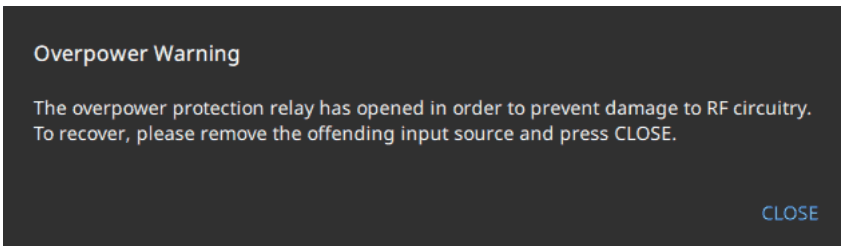
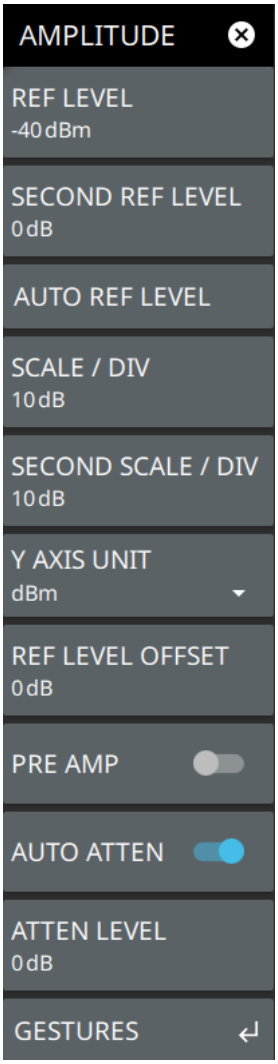


Figure 3-5. Overpower Warning

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.

SECOND REF LEVEL: The reference level is the top graticule line to the right on the measurement display. Its functionality is exactly same as reference level, but it is only available when trace math is enabled.

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. SCALE/DIV is not available when linear y-axis amplitude units are selected.

SECOND SCALE/DIV: It applies to second reference level and is available only when trace math is enabled.

Y AXIS UNIT: Selects the y-axis amplitude units. Available units are: dBm, dBW, or dBV, dBmV, dBµV, dBA.

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 and will always be presented in dB units. 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 3-6.

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 3-7.

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.

GESTURES: Press GESTURES to lock the reference level by toggling the DRAG button on/off.

Figure 3-6. AMPLITUDE Menu

3-5 Setting Bandwidth Parameters

Bandwidth parameters are set using the "BANDWIDTH Menu" on page 3-11.

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

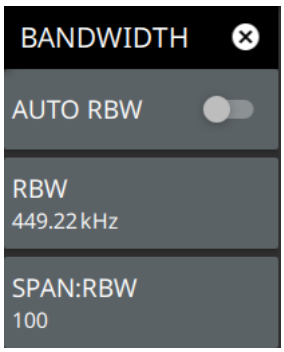
Both resolution bandwidth and video bandwidth can be coupled to the frequency span automatically, or set manually. When set to Auto RBW, the instrument automatically adjusts the RBW in proportion to the frequency span. The default ratio of the span width to the resolution bandwidth is 100:1 and can be 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 3-11 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 3-7. BANDWIDTH Menu

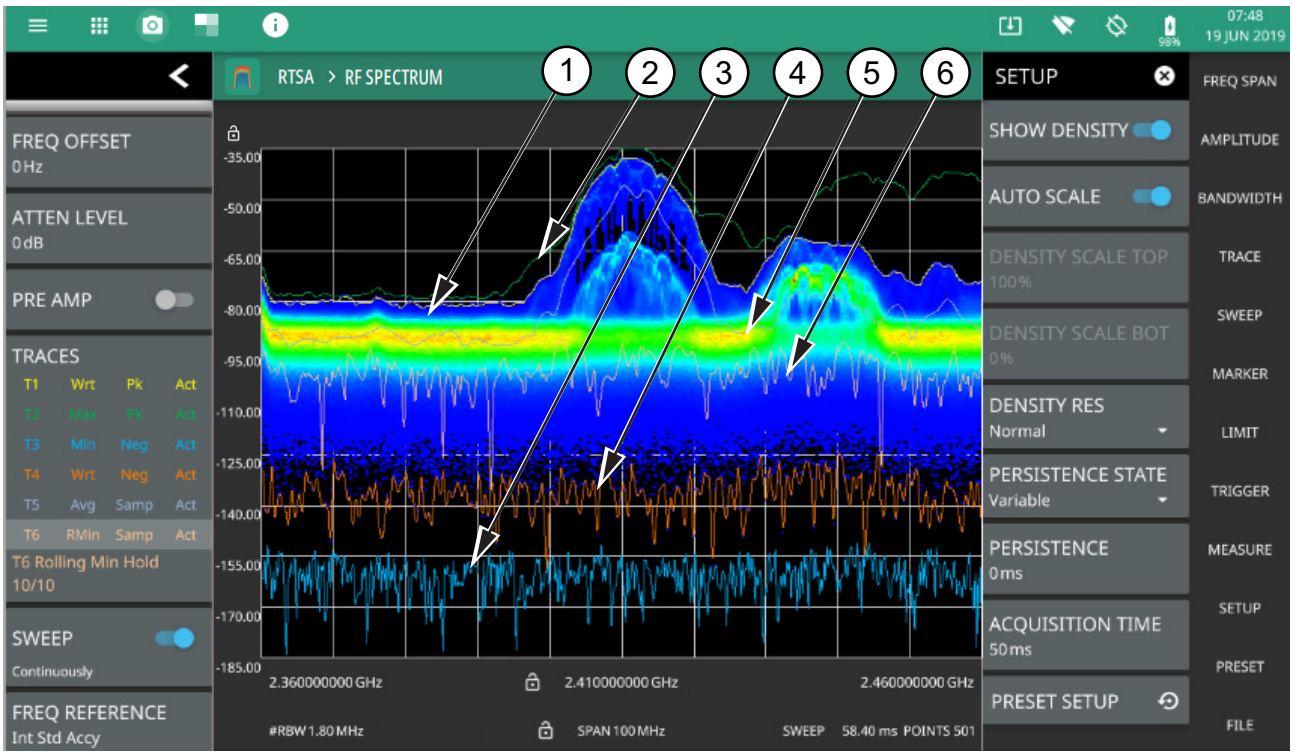
3-6 Setting Trace and Cursor Parameters

Field Master Series 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 RF Spectrum view, refer to "TRACE Menu (RF Spectrum View)" on page 3-13.

When working with traces and cursors in Spectrogram view, refer to "TRACE Menu (Spectrogram View)" on page 3-19 and "TRACE CURSOR Menu" on page 3-20.

Traces in RF Spectrum View

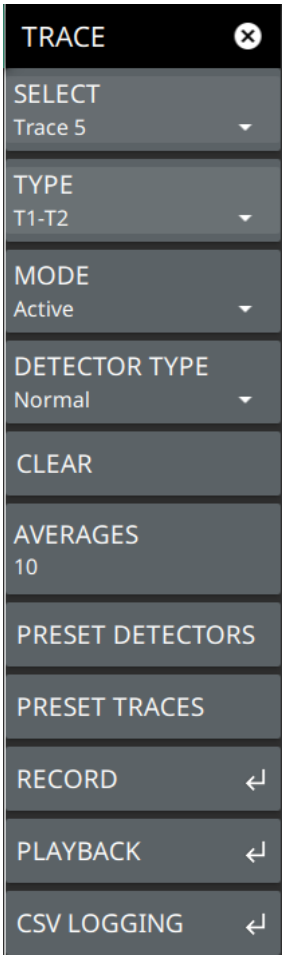
The screenshot below shows the real-time spectrum analyzer with all six traces enabled on a signal, each with a different trace or detector type setting. The left side status panel shows a trace setup summary table. Touching one of the trace rows in the table will enable the trace and open the TRACE 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.
7. T1-T2 or T2-T1: Appears only when Trace 5 or 6 are enabled. When selected displays the difference between T1 and T2, in addition to the second Y axis on the right hand side.

Figure 3-8. Traces in Spectrum View

TRACE Menu (RF 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.
- **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.
- **T1-T2:** This option appears only when Trace 5 is enabled.
- **T2-T1:** This option appears only when Trace 6 is enabled.

In trace math the T2-T1 or T1-T2 operation performs a division of the linear powers (Watts) of trace 2 divided by trace 1 and vice versa, this is equivalent to the subtraction of the log powers (dBm). The operation does not change depending on the amplitude units and the resulting math trace is always in dB. When a math trace enabled, a secondary Y axis appears on the right side of the trace window. Most measurements are incompatible with dB values and will stop updating when a math trace is the active trace. Limit lines on math traces interpret their values as (dB).

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 3-9. 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 3-15). • **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. • **Normal:** Shows random noise and signal data depending on the nature of the sampled data. If the signal both rises and falls during the sampling interval (random noise), then odd-numbered sampling intervals display the maximum value and even-numbered sampling intervals display the minimum value. Odd-numbered sampling intervals will display the peak value of the previous even-numbered sampling interval when the peak there is higher. If the signal only rises or only falls during the sampling interval (signal), then only the peak value is displayed, and Normal detection is then equivalent to Peak detection. **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 trace setup to Clear/Write, Active, with Peak Detector. **RECORD:** Opens the "TRACE RECORD Menu" on page 3-24. **PLAYBACK:** Opens the "TRACE PLAYBACK Menu" on page 3-25. **CSV LOGGING:** Opens the "TRACE CSV LOGGING Menu" on page 3-26.

Figure 3-9. TRACE Menu (2 of 2)

Trace Detector Types

The figures below illustrate how the selected detector type determine a trace data point from the sampled data.

Peak

Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed.

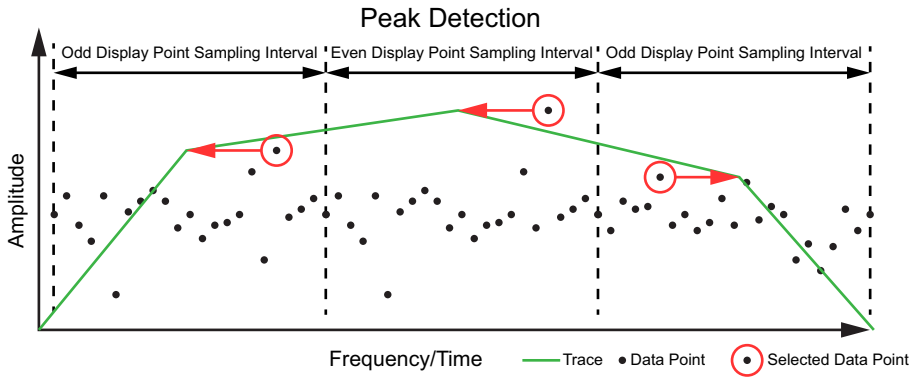


Figure 3-10. Peak Detector Type

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.

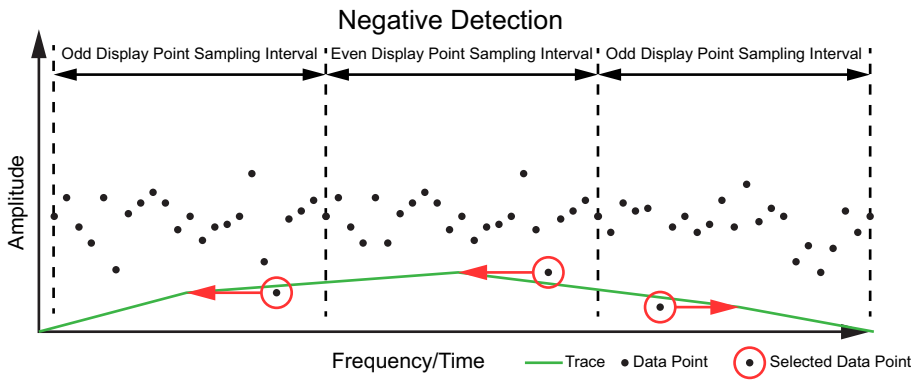


Figure 3-11. Negative Detector Type

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. Only available in zero span and RSSI measurements.

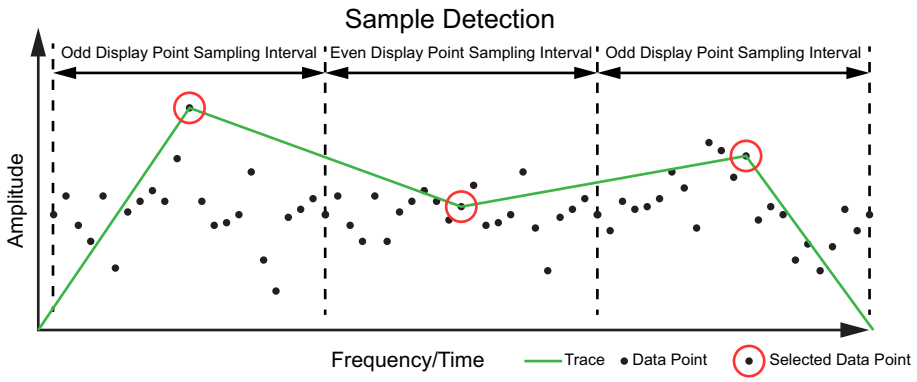


Figure 3-12. Sample Detector Type

Normal

Shows random noise and signal data depending on the nature of the sampled data. If the signal both rises and falls during the sampling interval (random noise), then odd-numbered sampling intervals display the maximum value and even-numbered sampling intervals display the minimum value. Odd-numbered sampling intervals will display the peak value of the previous even-numbered sampling interval when the peak there is higher. If the signal only rises or only falls during the sampling interval (signal), then only the peak value is displayed, and Normal detection is then equivalent to Peak detection.

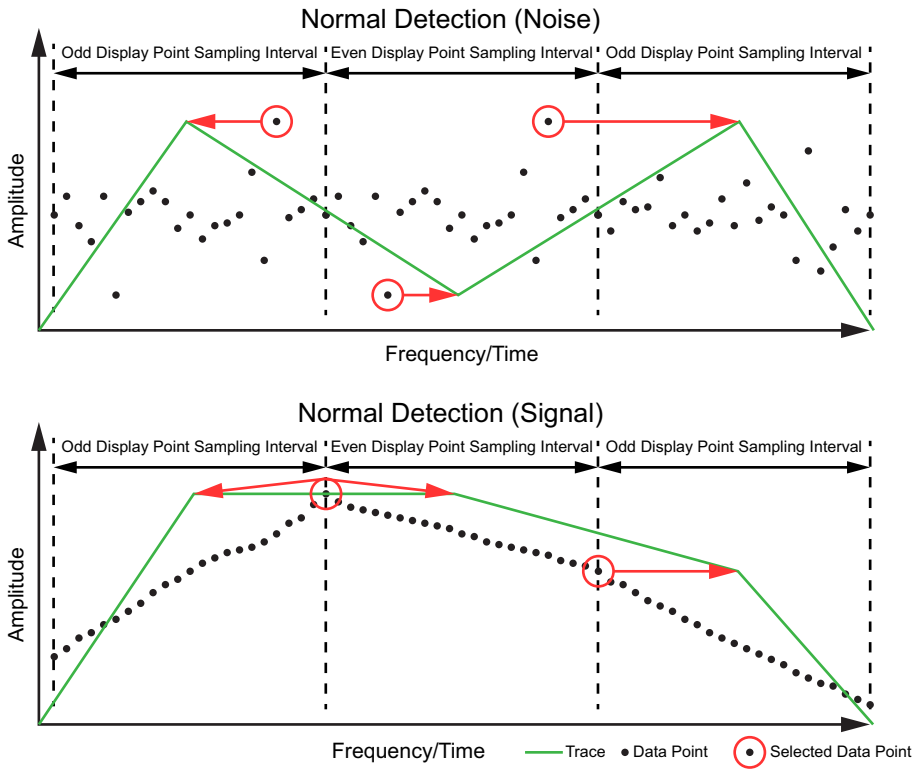
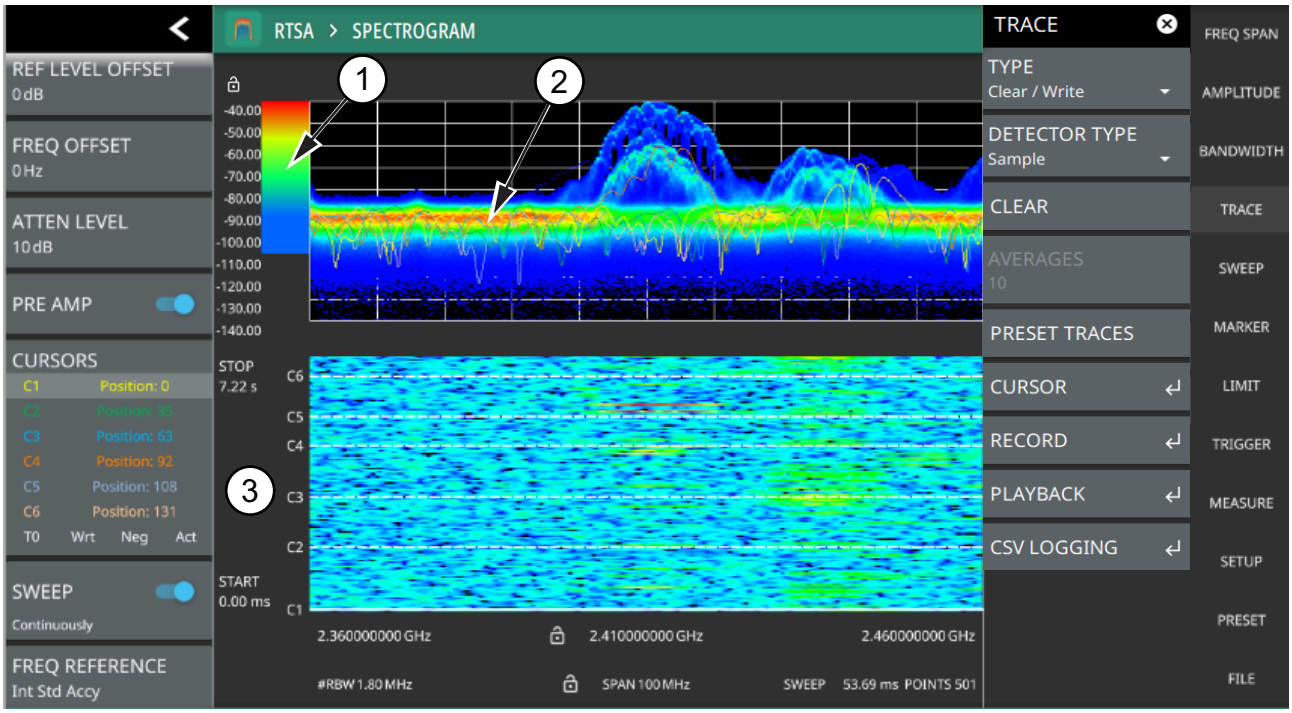


Figure 3-13. Normal Detector Type

Cursors in Spectrogram View

The screenshot below shows the Real-time spectrum Analyzer 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.

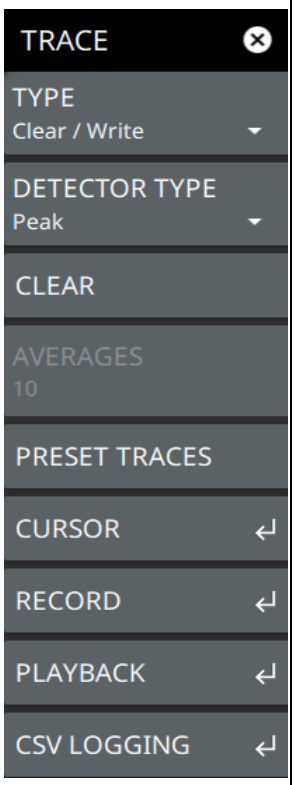


1. Color Bar settings are used to adjust the colors displayed at different amplitude levels. The color bar shown here represents the range of colors that will be displayed. This bar can be dragged up or down to adjust the coverage area. If signals or noise is outside of the color bar range, then black 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 3-47.
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 3-20. 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 3-14. RTSA – Spectrogram View

TRACE Menu (Spectrogram View)

When the combined Spectrogram view is selected (MEASURE > VIEW > SPECTROGRAM), 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 3-15).

- **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.
- **Normal:** Normal detector type also referred to as Rosenfell, shows the random noise than positive peak and avoids the missed-signal problem of the Sample Mode. Should the signal both rise and fall within the bucket interval, then the algorithm classifies the signal as noise. An odd-numbered data point displays the maximum value encountered during its bucket. An even-numbered data point displays the minimum value encountered during its bucket. If the signal is NOT classified as noise (does NOT rise and fall) then Normal is equivalent to positive peak.

Figure 3-15. TRACE Menu (1 of 2)

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 3-20.

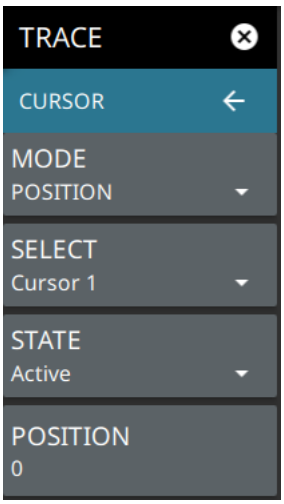
RECORD: Opens the "TRACE RECORD Menu" on page 3-24.

PLAYBACK: Opens the "TRACE PLAYBACK Menu" on page 3-25.

CSV LOGGING: Opens the "TRACE CSV LOGGING Menu" on page 3-26.

Figure 3-15. TRACE Menu (2 of 2)

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 3-33.

STATE: Selects one of the following cursor states:

- **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.

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 3-16. TRACE / CURSOR Menu (Spectrogram View)

Trace Recording, Playback, and CSV Logging

The real-time spectrum analyzer supports recording and playing back of trace data. Recordings are actually made on sample data (not just trace points) so during playback, users can set different trace types or detectors for deeper analysis of the data. Trace recording and playback is accomplished by sequentially recording, then drawing, an entire trace through a recording session. In RTSA, only trace data is recorded (no density data). Recordings can be initiated on both the instrument or from the PC software when connected to an instrument. The files are saved as .fmrec on the instrument internal memory and must be played back on the instrument. The recorded file contains instrument setup information so it can be recalled from any mode and automatically configure the instrument settings for playback. The recorded trace data includes time and GPS information. If recording starts while the instrument is in spectrogram, recording starts with the next available sample and excludes all of the traces previously captured traces in the waterfall. During playback, the spectrogram is built from the replayed traces and an indication of the current trace count and total session trace count (i.e., 33/85) is shown at the right side of the trace display. This count increments during trace playback.

Figure 3-17 shows a recorded trace session during playback. When the playback menu is opened, playback controls are shown at the bottom of the screen.

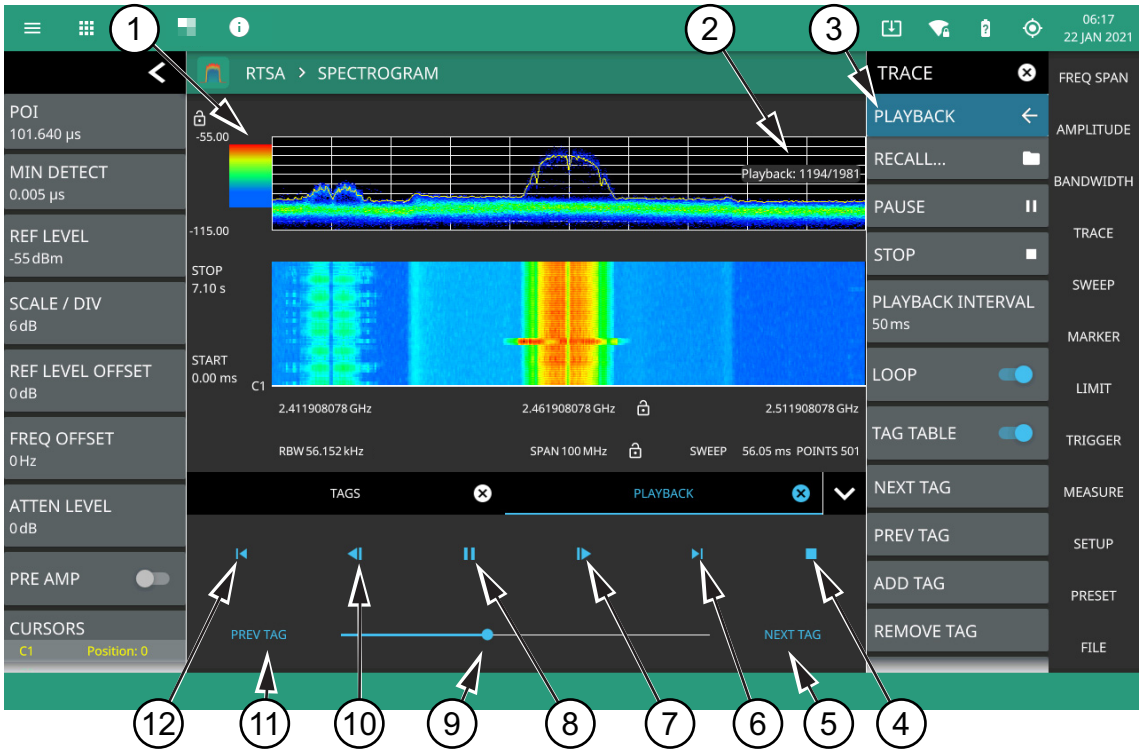
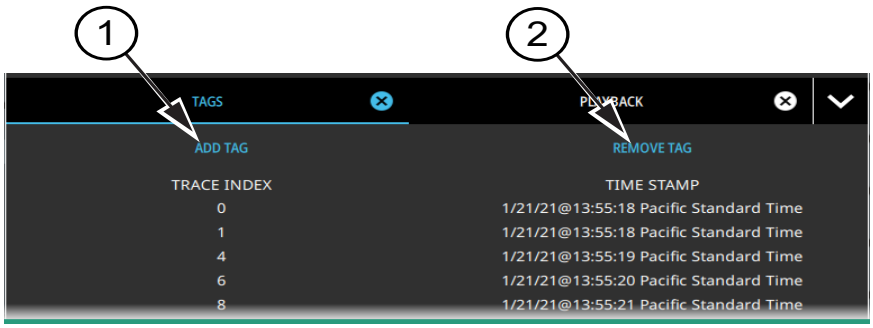


Figure 3-17. Trace – Record and Playback (1 of 2)

1. Recorded trace and spectrum waterfall. 2. Shows either the Recording or Playback indicator. 3. Trace playback menu.TRACE RECORD Menu, TRACE PLAYBACK Menu, or TRACE CSV LOGGING Menu. 4. Stops the current trace playback session and restores live data display from the RF input. 5. Steps to the next tagged trace in the recorded session. Untagged traces will be skipped. 6. Increments the trace index by 142 to the next set of spectrogram traces. 7. Increments the trace index by 1 to the next trace in the sequence.	8. Starts playback of the selected trace recording. During playback, the button changes to the PAUSE button, allowing pausing of the playback. 9. Playback location indicator/slider - can be used to drag playback forward and backward. 10. Decrements the trace index by 1 to the previous trace in the sequence. 11. Steps to the previous tagged trace in the recorded session. Untagged traces will be skipped. 12. Decrements the trace index by 142 to the previous set of spectrogram traces.

Figure 3-17. Trace – Record and Playback (2 of 2)

Tags are associated with individual traces, allowing scrolling through a sequence of tags and skipping forward or backward past untagged traces. All tagged traces can be viewed in a TAGS table (Figure 3-18), similar to a marker table. Users can add or remove tags from traces. To know which tag is being removed, look at the trace index in the display panel and correlate it to the trace index in the tag table.



1. Add tag button.	2. Remove tag button.

Figure 3-18. Tags Table

Other features with trace recording and playback:

- If settings that would invalidate the record or playback state are changed (i.e., frequency and amplitude settings, or changing analyzer modes), the current recording/playback session will end and the current recording will be saved.
- Markers and limits can be enabled on playback traces, just as with live data.
- Measurements such as channel power, OBW, ACP, or interference finder can be enabled on playback traces; all other measurements are blocked.
- New recordings can be made during playback to capture smaller segments of the previous recording.
- To save a .fmspa or .fmrtsa file at any point, it must be done in playback and while paused.

CSV Logging

CSV logging provides much of the same functionality as trace recording described above, but a CSV log cannot be replayed. CSV logging allows continuous recording of either live trace data or playback trace data to a CSV file with frequency and amplitude information for all traces captured during the logging period. When the log recording is stopped, a csv file is automatically created and saved. CSV logging can also be set to automatically record a recording or playback session. When AUTO LOG is set to either Record or Playback, a CSV log is simultaneously recorded with the record or playback session. When the session is paused, CSV logging is paused. When the session is stopped, CSV logging is stopped and saved.

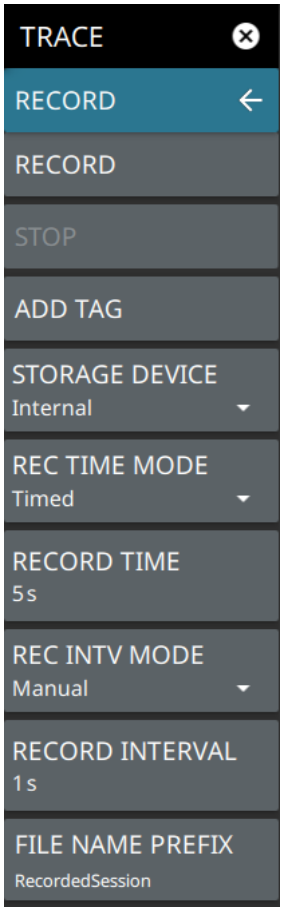
CSV file format:

Header then trace data horizontally with time and GPS stamps. The header includes:

```
Model
Serial
Firmware version
Application
Points
Center frequency
Span
RBW
Preamp on/off
Attenuation
Detector
Ref level offset
```

TRACE RECORD Menu

The trace recording feature is accessed via the TRACE > RECORD menus. This feature allows you to record a trace for future playback on the instrument or PC application.



RECORD: Starts a trace recording session and saves traces and setup data to a record file (.fmrec). Files will be saved to the "Playback" folder on the selected storage device (below). When recording is initiated, this button changes to PAUSE so you can temporarily stop the recording while leaving the recording session open.

STOP: Stops the active trace recording session. When pressed, a dialog will ask to either keep or discard the recording data.

ADD TAG: Tags the currently recorded trace. This marks the trace for easy searching in the playback tag table. Tags can be added during recording, when the recording is paused, and during playback.

STORAGE DEVICE: Selects the target location for the trace recording. This will be to internal storage or to a connected external USB storage device.

REC TIME MODE: Sets the recording time mode to Auto or Timed. Automatic recording continues until the STOP button is pressed or until memory is full. Manual recording uses a set RECORD TIME. The recording session ends after that time is complete or the stop button is pressed, whichever comes first.

RECORD TIME: Sets the recording time session when the record time mode is set to manual.

REC INTV MODE: Sets the time interval mode (time between recording a trace) to automatic or manual. Automatic will record every trace the analyzer captures. Manual will record one trace every x seconds, where x is the RECORD INTERVAL set below. If the interval time is lower than the sweep time, every trace will be recorded.

RECORD INTERVAL: Sets the recording time interval when the record interval mode is set to manual. Recording stops at the end of the record time or when manually stopped.

FILE NAME PREFIX: Adds a custom file name prefix to the record file (.fmrec). The default prefix is "RecordedSession" and will be appended with a date and time stamp, such as: "Traces_20201216T062419.135.fmrec."

Figure 3-19. TRACE – RECORD Menu

TRACE PLAYBACK Menu

The trace playback feature is accessed via the TRACE > PLAYBACK menus. This feature allows you to play back a recorded trace (.fmrec) file on the instrument or PC application.

A playback session must be started by first recalling a previously recorded session.

RECALL: Opens the file manager so you can select a recorded trace file for playback. The recorded files are typically stored in the Playback folder on the internal or external storage device. Once a trace is recalled, the instrument is set up to match the settings from when the trace was recorded and the PLAYBACK menu will need to be accessed to play the recalled file.

PLAY/PAUSE: Starts playback of the selected trace recording. During playback, the button changes to the PAUSE button, allowing pausing of the playback.

STOP: Stops the current trace playback session and restores live data display from the RF input.

PLAYBACK INTERVAL: Sets the trace playback interval. The playback interval is the sequential trace playback rate, which is the time a trace is displayed before sequencing to the next trace in the recording.

LOOP: When toggled on, the playback plays the trace samples in a loop until stopped. When toggled off, playback pauses at the end of the session. Press STOP to return to live traces or drag the slider back to the beginning and press PLAY to play the session again.

TAG TABLE: Toggles the tag table at the bottom of the screen.

NEXT TAG: Steps to the next tagged trace in the recorded session. Untagged traces will be skipped.

PREV TAG: Steps to the previous tagged trace in the recorded session. Untagged traces will be skipped.

ADD TAG: Adds a tag to the current trace. Tags are automatically saved to the file.

REMOVE TAG: Removes the tag from the current trace. Tags are automatically removed from the saved file.

SKIP FWD: Increments the trace index by 142 to the next set of spectrogram traces.

SKIP BACK: Decrements the trace index by 142 to the previous set of spectrogram traces.

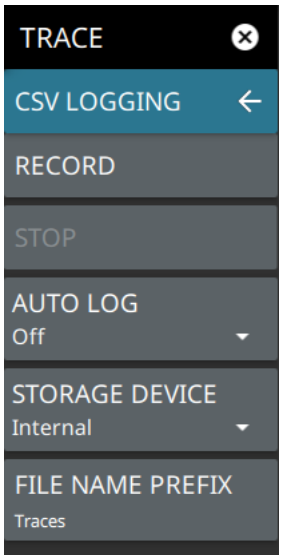
NEXT TRACE: Increments the trace index by 1 to the next trace in the sequence.

PREV TRACE: Decrements the trace index by 1 to the previous trace in the sequence.

Figure 3-20. TRACE – PLAYBACK Menu

TRACE CSV LOGGING Menu

The trace CSV capture feature is accessed via the TRACE > CSV CAPTURE menus. This feature allows you to capture trace data in comma separated value (.csv) format.



RECORD: Starts a recording session and saves trace and setup data to a CSV file (.csv). Files will be saved to the "PlaybackCsv" folder on the selected storage device (below). When recording is initiated, this button changes to PAUSE so you can temporarily stop the recording while leaving the recording session open.

STOP: Stops the active trace recording session. When pressed, a dialog will ask to either keep or discard the recording data.

AUTO LOG: Select one of the following automatic recording options (CSV recording will start automatically with Record or Playback selected – no need to press RECORD in the CSV menu. Manual CSV logging can be done independent of this setting.):

- Record: Simultaneously saves CSV log data during a trace recording.
- Playback: Simultaneously saves CSV log data during a recorded trace playback.
- Off: No auto logging selected.

STORAGE DEVICE: Selects the target location for the trace logging. This will be to internal storage or to a connected external USB storage device.

FILE NAME PREFIX: Adds a custom file name prefix. The default prefix is "Traces" and will be appended with a date and time stamp, such as: "Traces_20201216T062419.135.csv."

Figure 3-21. TRACE – CSV LOGGING Menu

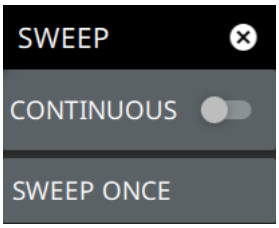
3-7 Setting Sweep Parameters

Sweep parameters are set using the "SWEEP Menu" on page 3-27.

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 3-47.

SWEEP Menu



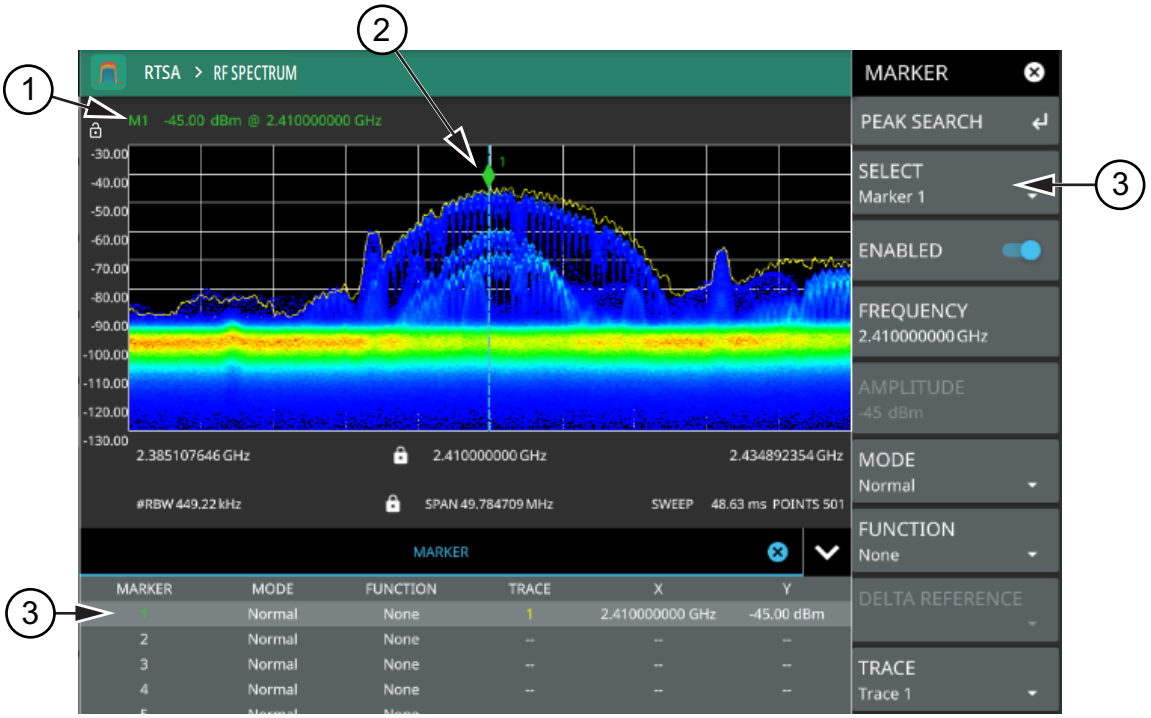
CONTINUOUS: Toggles between continuous sweep and single sweep. When the toggle is off, the instrument is in single sweep. In single sweep, the trace results of a sweep are displayed on the screen while the instrument awaits a trigger event to update the trace data. The current state of the instrument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

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

Figure 3-22. SWEEP Menu

3-8 Setting Up Markers

Marker parameters are set using the "MARKER Menu" on page 3-30. Refer to the figure below when using markers to make RTSA measurements.



1. RF 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 3-23. Marker Table and Marker Settings Panel

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 3-31). 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.

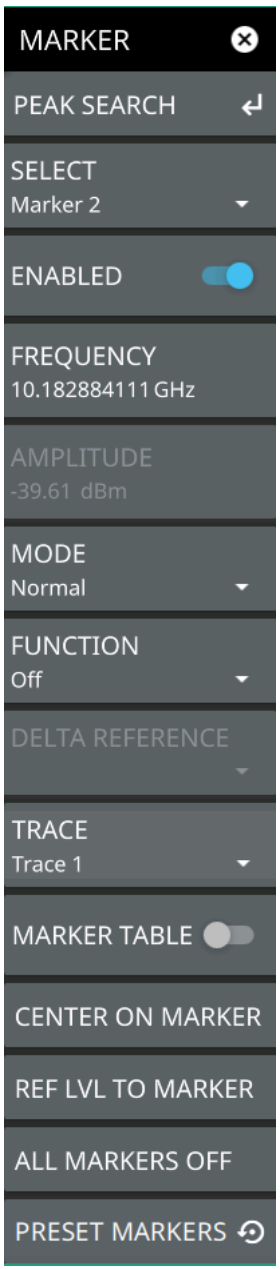
Placing a Delta Marker

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 3-31). 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 3-31).

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 3-31.

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 or Noise. For more information about using marker functions, refer to "Marker Functions" on page 3-32.

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 3-34.

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.

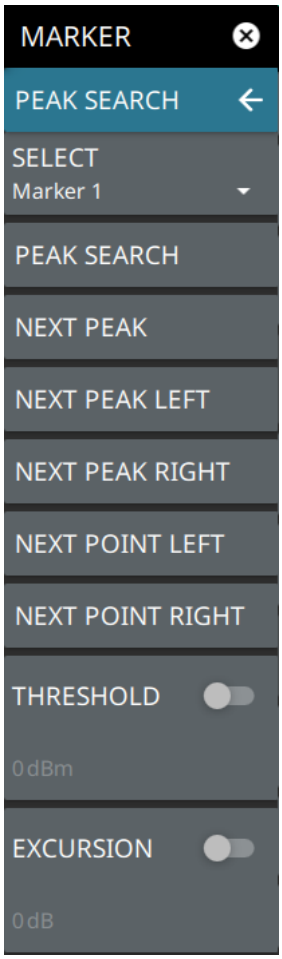
ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 3-24. 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 3-25. PEAK SEARCH Menu

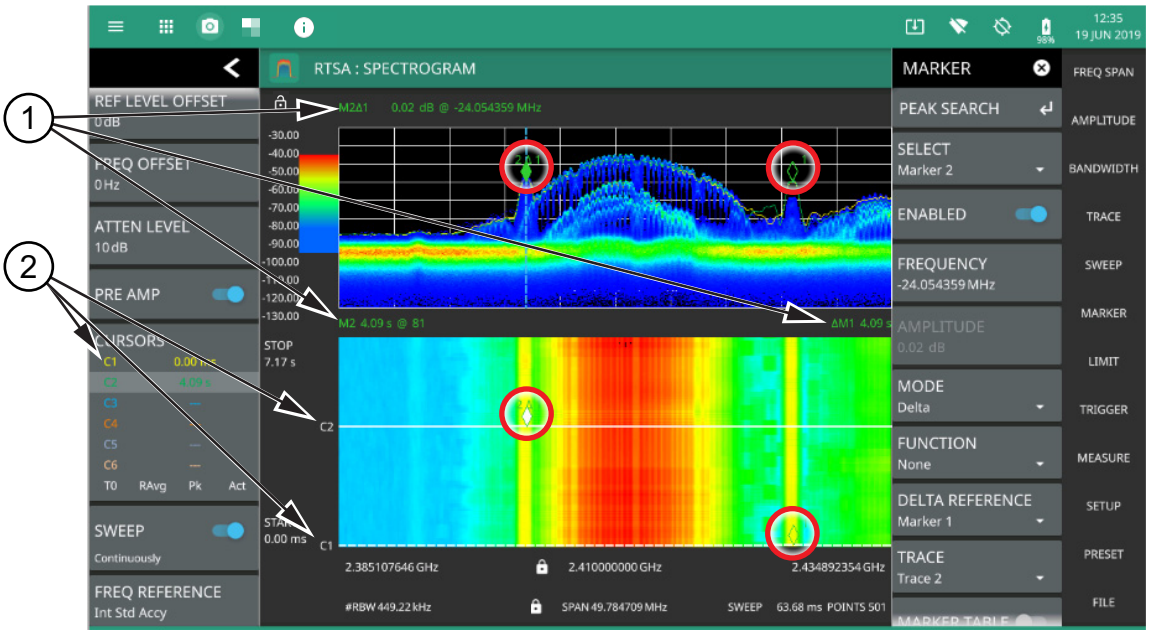
Marker Functions

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 amplitude units/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.

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

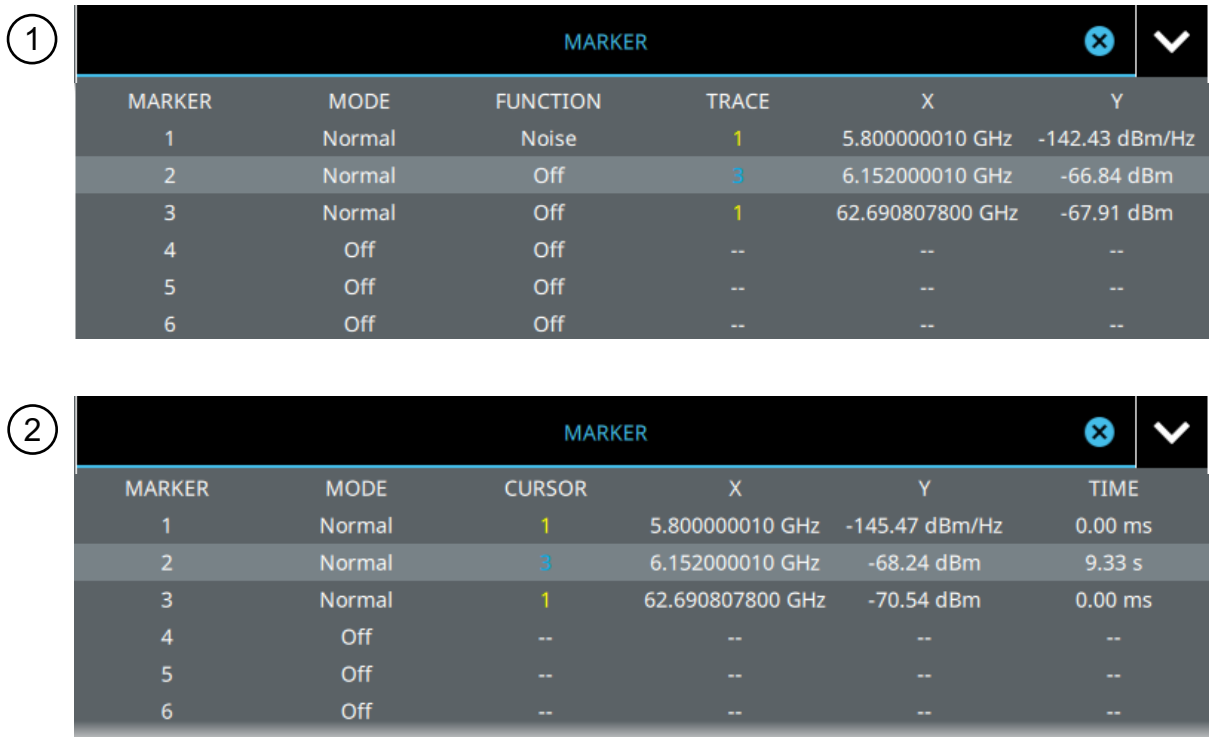


1. **Markers:** Displays the selected marker value. Marker values at the top of the spectrum display will show the current frequency and amplitude values of the active marker and its type. In this case, marker 2 is set to a delta marker relative to Marker 1. Marker values at the top of the spectrogram 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 3-26. 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	3	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	3	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 3-27. Marker Table

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

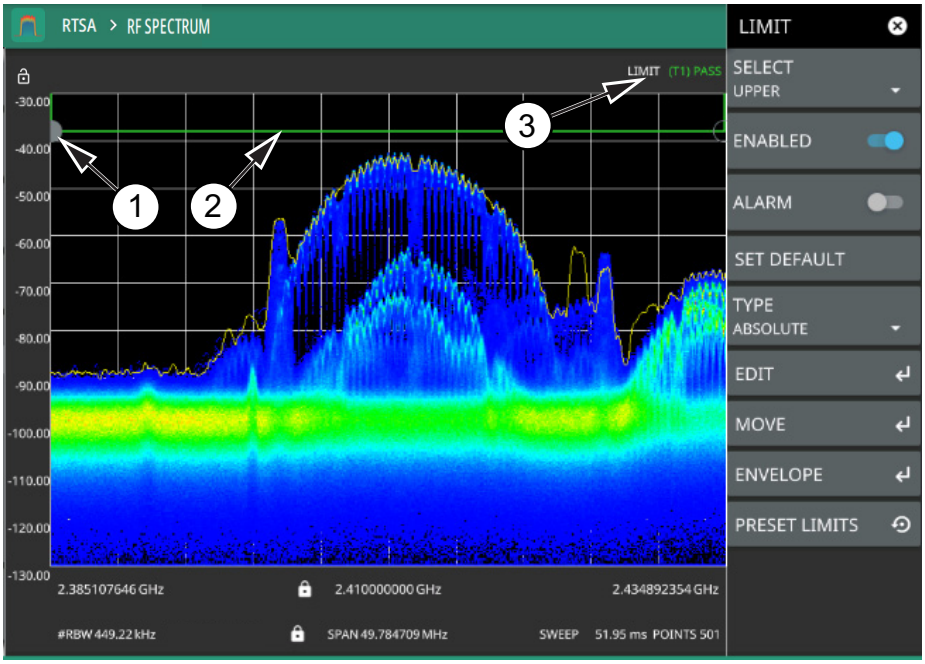
The currently selected marker's value is shown at the top left of the spectrum window with its current amplitude and frequency values.

The selected marker is highlighted on the trace display.

3-9 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 3-18 “Saving and Recalling Measurements” on page 3-64).

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 3-37.



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 3-28. Simple Limit Line

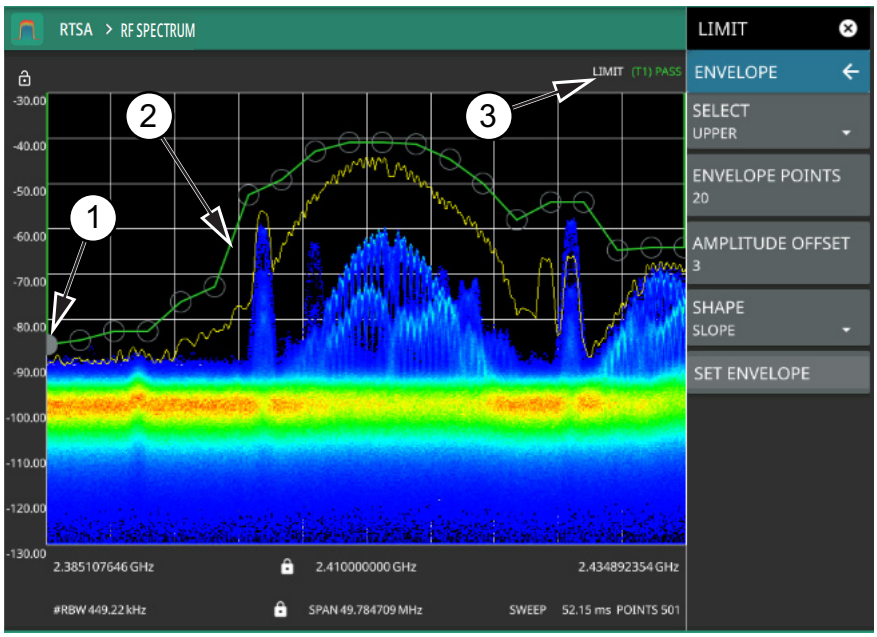
Simple Limit Line

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 3-40. 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 3-29. 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.
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.

FREQ MODE: Sets frequency mode of 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.

AMP MODE: Sets amplitude mode of 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 3-38.

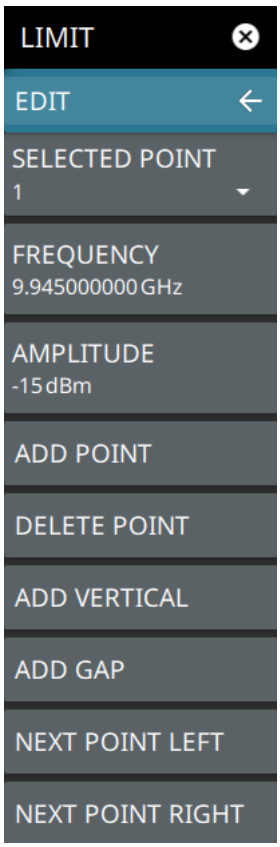
MOVE: Opens the “LIMIT MOVE Menu” on page 3-39.

ENVELOPE: Opens the “LIMIT ENVELOPE Menu” on page 3-40.

PRESET LIMITS: Presets the limit lines to default values.

Figure 3-30. 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.

ADD GAP: Select this button to disconnect the continuous limit line. It can be used when you don't want to apply limit to a specific portion of the trace.

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 3-31. 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.

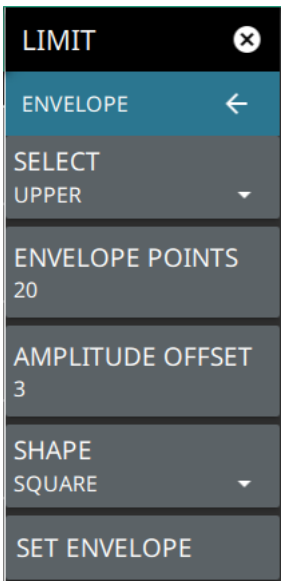
DOWN: Pressing this button moves all inflection points down by the Y-OFFSET value.

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 amplitude 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 3-32. 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. 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.

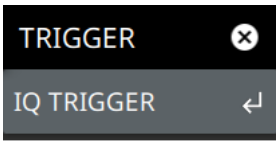
SHAPE: Use to choose whether the upper or lower envelope will be with flat tops (SQUARE setting) and vertical lines, or whether the envelope will have sloped lines (SLOPE setting) between adjacent inflection points. When the square envelope type is selected, two inflection points are used for each horizontal 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 3-33. LIMIT ENVELOPE Menu

3-10 Setting Up Triggering

TRIGGER Menu



IQ TRIGGER: Opens the “IQ TRIGGER Menu” on page 3-45.

Refer to the IQ Capture/Streaming Measurement Guide for discussion of IQ Capture and Streaming, PN: 10580-00490.

Figure 3-34. TRIGGER Menu

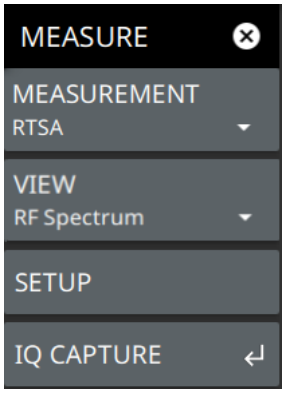
3-11 Setting Up Advanced Measurements

Refer to "Making RTSA Measurements" on page 3-1 for basic information on setting up a spectrum measurement. This section provides setup information for making real-time spectrum measurements. The Field Master Series and Site Master instruments feature smart measurements that make setup easy. The following sections present brief examples demonstrating the use of these measurements.

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

MEASURE Menu (RTSA)

Access MEASURE menu from main menu on the left side of the display screen.



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

- **RTSA:** Displays the frequency domain spectrum measurement.
- **AM/FM Audio:** Available when Option 24 is installed. The AM/FM Audio provides audio demodulation capability. Refer to Section 3-15 "AM/FM Audio (Requires Option 24 or Option 509)" on page 3-53.
- **PIM/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 3-14 "Interference Finder (Option 24)" on page 3-49.

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

- **RF Spectrum**: Selects RF spectrum view. Refer to "RF Spectrum View" on page 2-2
- **Spectrogram**: Selects Spectrogram view. When selected, a Spectrogram view is added to the display. Refer to "Spectrogram View" on page 2-4.

SETUP: Opens the SETUP menu for the measurement and view selected above.

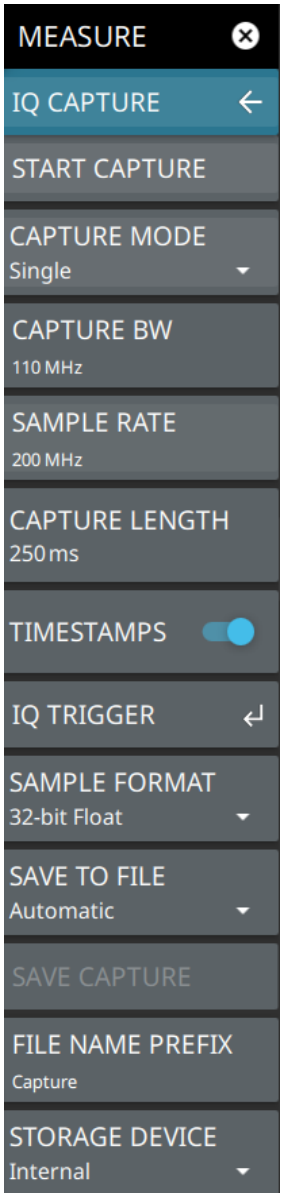
IQ CAPTURE: Opens the "IQ CAPTURE Menu" on page 3-42.

Refer to the IQ Capture/Streaming Measurement Guide for discussion of IQ Capture and Streaming, PN: 10580-00490.

Figure 3-35. MEASURE Menu

IQ CAPTURE Menu

Access IQ Capture submenu from MEASURE > IQ CAPTURE.



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 3-43).

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.

IQ TRIGGER: Opens the "IQ TRIGGER Menu" on page 3-45.

SAMPLE FORMAT: Sets the sampling bit format to one of the following options:

- 32-bit Float (IQ)
- 32-bit Int (IQ)
- 16-bit Int (IIQQ)
- 16-bit Int (IQIQ)
- 10-bit Int (IIIQQQ)
- 8-bit Int (IIIIQQQQ).

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.

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:

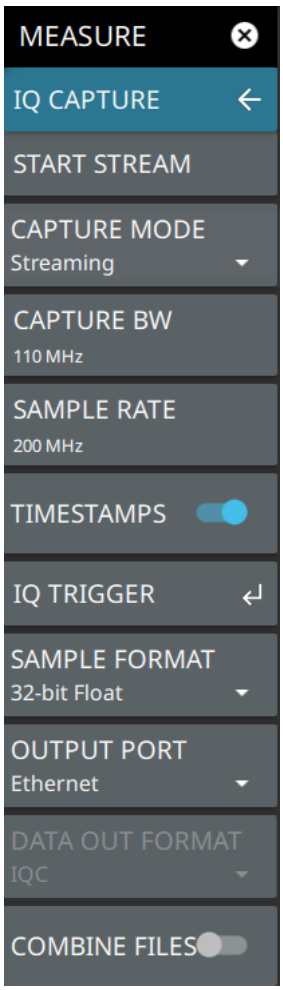
prefix_year-month-day-time-##_capturetime in ns_number in scientific notation.dgz or .dgzm.

STORAGE DEVICE: Sets the capture file save location. You can select Internal or one of the available USB ports when storage media is detected.

Figure 3-36. IQ CAPTURE Menu

IQ STREAMING Menu

To access IQ Streaming menu, go to main menu, MEASURE > IQ CAPTURE > CAPTURE MODE > Streaming.



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 3-42)
- **Continuous** for capture to internal or external (USB) storage (refer to "IQ CAPTURE Menu" on page 3-42)
- **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 (Refer to the IQ Capture/Streaming Measurement Guide, PN: 10580-00490).

IQ TRIGGER: Opens "IQ TRIGGER Menu" on page 3-45.

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.

DATA OUTPUT FORMAT: Selects the data out format of IQC or PCIe. IQC is the default format and is intended for use with the MA25424A IQ Data Converter (Refer to the IQ Capture/Streaming Measurement Guide, PN: 10580-00490). PCIe is intended for use with the MA25101A IQ Streaming PCIe kit (refer to the MA25101A User Guide, PN: 10580-00476). Note that changing to PCIe will require the application to reload and the analyzer will be unresponsive during that time.

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 3-46 to combine the files.

Figure 3-37. IQ STREAMING Menu

Once the IQ Capture menu is accessed, the IQ CAPTURE table is displayed at the bottom of the screen.

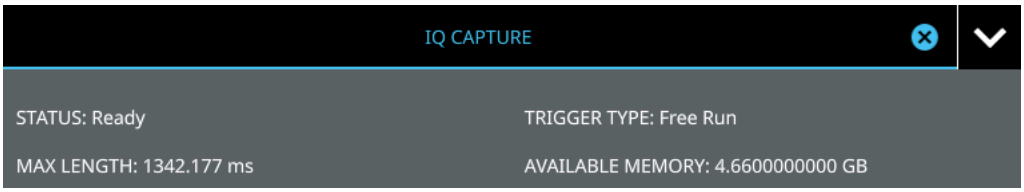


Figure 3-38. IQ CAPTURE Table

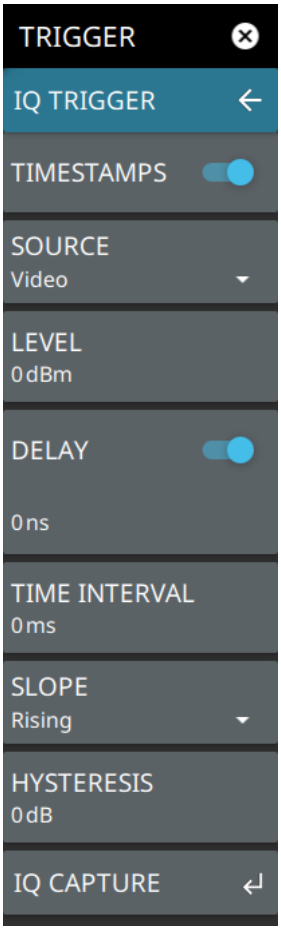
The IQ CAPTURE table provides the following:

- 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

To access IQ Trigger menu, go to main menu, TRIGGER > IQ TRIGGER.

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 (Refer to the IQ Capture/Streaming Measurement Guide, PN: 10580-00490).

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 3-40). 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" on page 3-42.

Figure 3-39. IQ TRIGGER Menu

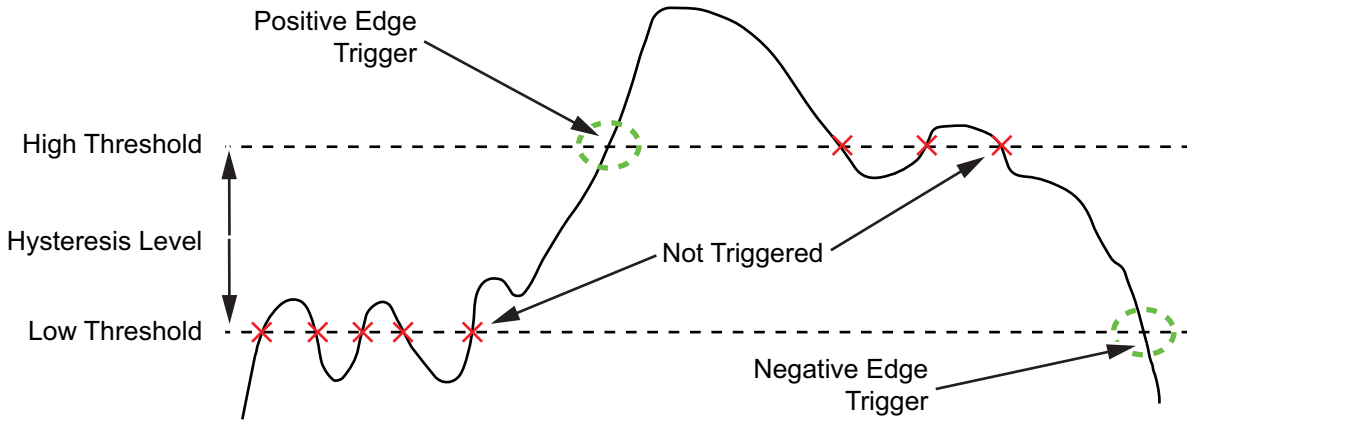


Figure 3-40. Trigger Levels and Hysteresis

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.

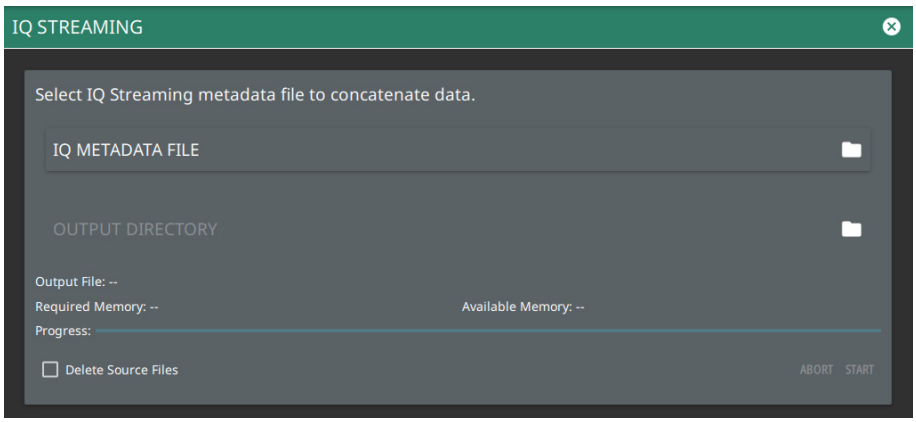


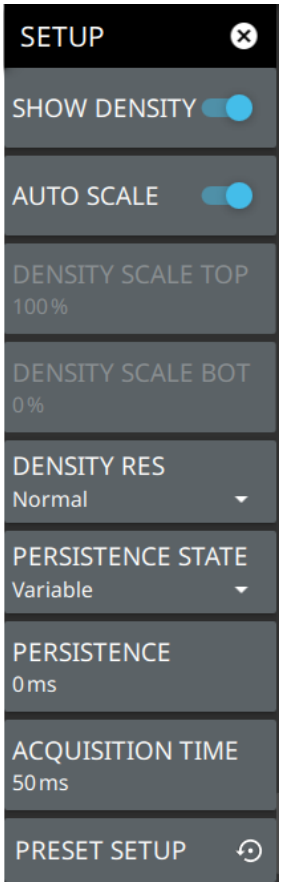
Figure 3-41. IQ Streaming

3. 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.
4. Touch the OUTPUT DIRECTORY and select the destination for the concatenated files. If desired, select Delete Source Files.
5. 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 your instrument PC application. Refer to the PC software chapter of the product's user guide for details on using this application.

3-12 SETUP Menu

Access the SETUP menu from the main menu on the left side of the display screen



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.

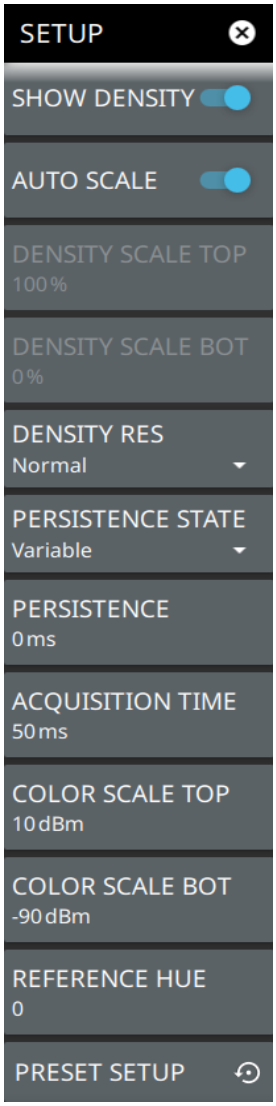
PERSISTENCE: Sets the decay time of the density display.

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.

PRESET SETUP: Presets the color setup settings.

Figure 3-42. SETUP Menu (RF Spectrum View)

3-13 SETUP Menu (Spectrogram View)



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.

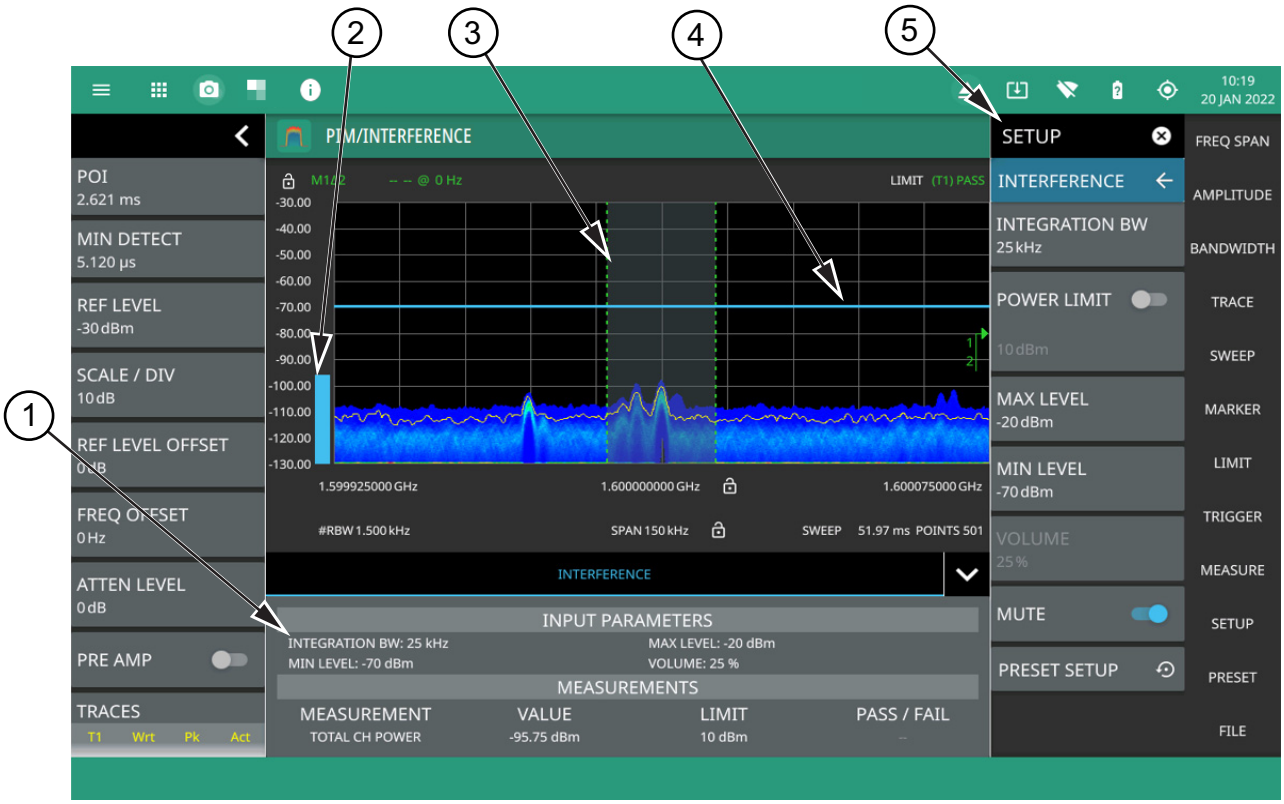
Figure 3-43. SETUP Menu (Spectrogram View)

Refer to the sections below for additional setup menus when using advanced measurements:

- "SETUP Menu (AM/FM Audio - RF Spectrum)" on page 3-55
- "SETUP Menu (PIM/Interference)" on page 3-50

3-14 Interference Finder (Option 24)

The interference finder measurement is set up using the "To access Interference menu go to main menu and press SETUP > INTERFERENCE." on page 3-51. 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 3-44. Interference Finder Measurement

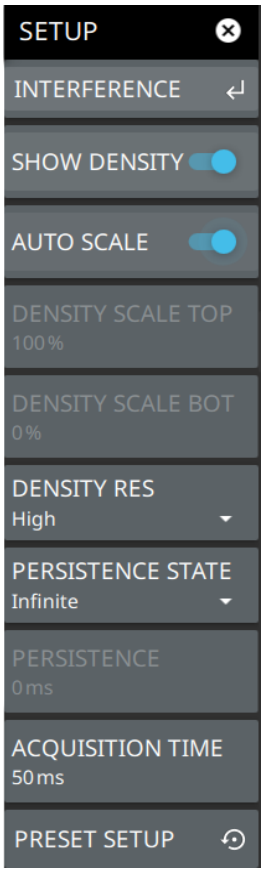
Frequency and level settings for many interfering signals can be set as follows:

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.

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 (PIM/Interference)



INTERFERENCE: Opens up "To access Interference menu go to main menu and press SETUP > INTERFERENCE.".

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.

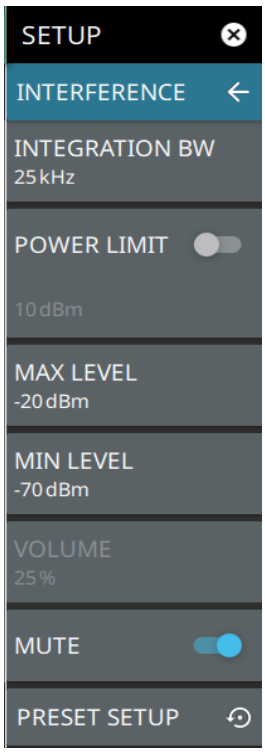
ACQUISITION TIME: The acquisition time sets the update interval for each spectrum trace, spectrogram line, and density display. During the acquisition interval, spectral data from multiple FFTs of the input signal are taken and combined. The acquisition time is adjustable to allow resolving multiple, brief signal events in time and to observe longer term behaviors.

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

Figure 3-45. SETUP Menu (Interference Finder)

Interference Menu

To access Interference menu go to main menu and press SETUP > INTERFERENCE.



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 system volume can affect the range of this setting. Refer to Section 3-14 “Interference Finder (Option 24)” on page 3-49.

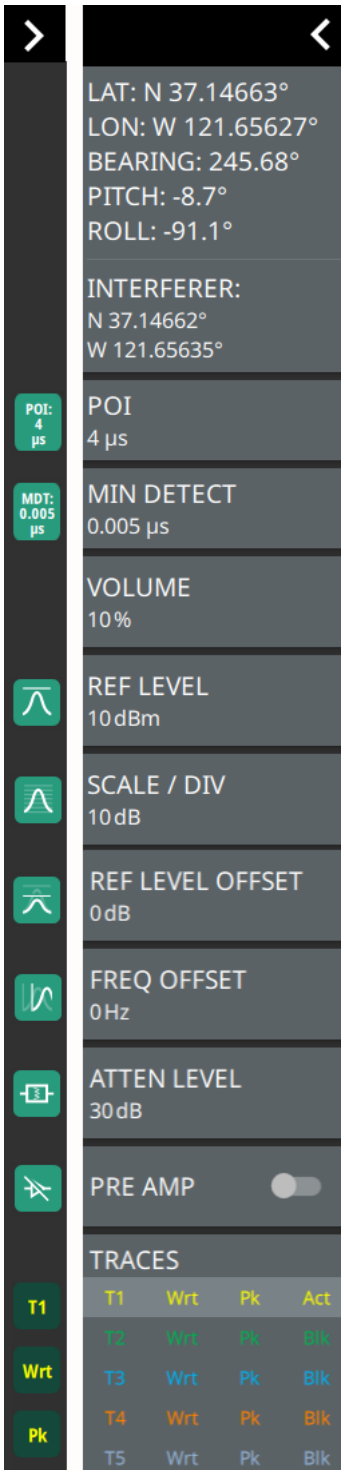
MUTE ALL: Mutes the volume of the instrument.

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

Figure 3-46. Interference Menu

Status Panel (PIM/Interference)

The status panels and features illustrated in this section are unique to the real-time spectrum analyzer and to the selected measurement and view. Below is the Interference status panel that covers RF Spectrum and spectrogram views, in addition to audio AM/FM and interference measurements (selected via MEASURE > MEASUREMENT 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.

VOLUME: Sets the volume level for the audio response of the measurement. Note that the system volume can affect the range of this setting. Refer to Section 3-14 “Interference Finder (Option 24)” on page 3-49.

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.

Refer to Section 3-4 “Setting Amplitude Parameters” on page 3-5.

SCALE/DIV: Sets the graticule scale/division for log-based units.

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

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 3-3 “Setting Frequency Parameters” on page 3-1.

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 3-4 “Setting Amplitude Parameters” on page 3-5.

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 RF 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 RTSA 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 3-6 “Setting Trace and Cursor Parameters” on page 3-12.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 3-7 “Setting Sweep Parameters” on page 3-27.

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 GNSS (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 3-47. Interference Status Panel with minimized Status Panel Icons

3-15 AM/FM Audio (Requires Option 24 or Option 509)

This section describes the AM/FM audio demodulation capability (available with Option 24) and key characteristics of analog amplitude modulation (AM) and frequency modulation (FM). The AM/FM audio measurement provides the following features:

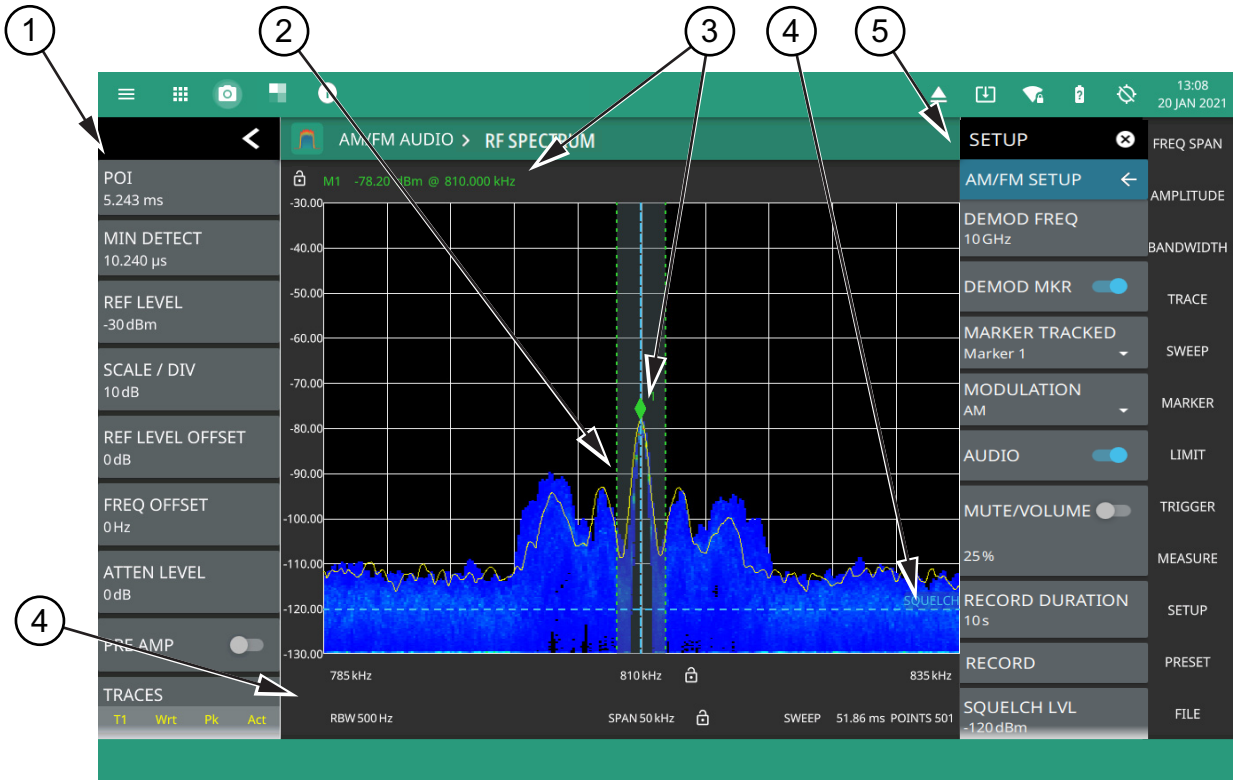
- Ability to listen to audio and sweep trace data simultaneously with built-in speaker or headphone. See Figure 3-48, "AM/FM Audio (RF Spectrum)".
- Selectable demodulation frequency with ability to tie frequency to markers.
- Record audio to WAV file
- Selectable modulation modes such as:
  - AM
  - Upper sideband (US Band)
  - Lower sideband (LS Band)
  - Narrowband FM
    - 6.25 kHz
    - 12.5 kHz
    - 25 kHz
  - FM Wideband

Refer to the previous sections in this chapter for details and menu overviews of general spectrum analysis measurements including setting up frequency and bandwidth parameters, sweep settings, trigger types, attenuator options, and preamp settings. Once the basic measurement is set up, select the AM/FM Audio measurement via MEASURE > MEASUREMENT > AM/FM AUDIO. Select a desired measurement view via MEASURE > VIEW.

Note	The AM/FM Audio measurement (Option 24 or Option 509) remains unresponsive when PCIe is selected as Data Out Format in IQ streaming mode. Refer to "IQ STREAMING Menu" on page 3-43.

AM/FM Audio – RF Spectrum View

The RF spectrum view displays the carrier signal power of the demodulated AM/FM audio signal in frequency domain.Toggle DEMOD MARKER button to identify the peak value of the carrier power. You can also record the audio signal by setting the duration time. Make sure to toggle on the Audio button to listen to the signal by adjusting the volume accordingly.

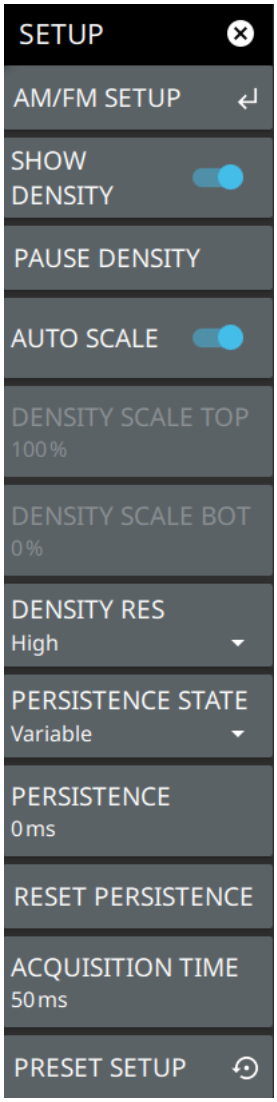


1. The status panel provides quick access to common spectrum analyzer settings. See “AM/FM SETUP Menu - RF Spectrum” on page 3-56.
2. The trace display area can show multiple traces, each with a unique color. Each trace can be set to Clear/Write, Average, Min or Max Hold, Rolling Average or Rolling Min, or Max Hold. Each trace can have Peak, RMS/Average, or Negative detectors. Traces can be set to Active, Hold/View, or Blank. Refer to “Setting Trace and Cursor Parameters” on page 3-12. The shaded vertical section marked with green dashed line illustrate the demodulation channel bandwidth.
3. The demodulation marker is the same as a regular marker and can be applied to any trace using the Marker Menu. Refer to “Setting Up Markers” on page 3-28.
4. Current frequency, bandwidth, and sweep settings. Refer to “Setting Frequency Parameters” on page 3-1, “Setting Amplitude Parameters” on page 3-5, “Setting Bandwidth Parameters” on page 3-10.
5. The SETUP menu is where the AM/FM demodulation settings are configured. See “SETUP Menu (AM/FM Audio - RF Spectrum)” on page 3-55.

Figure 3-48. AM/FM Audio (RF Spectrum)

SETUP Menu (AM/FM Audio - RF Spectrum)

The default view of AM/FM Audio measurement is RF spectrum view. The AM/FM audio demodulation SETUP menu is available in MEASURE > MEASUREMENT > AM/FM Audio > SETUP.



AM/FM SETUP: Opens "AM/FM SETUP Menu - RF Spectrum" on page 3-56.

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.

PAUSE DENSITY: Pauses the display density, press RESTART DENSITY to resume displaying density.

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.

RESET PERSISTENCE: Resets the decay time of the density display.

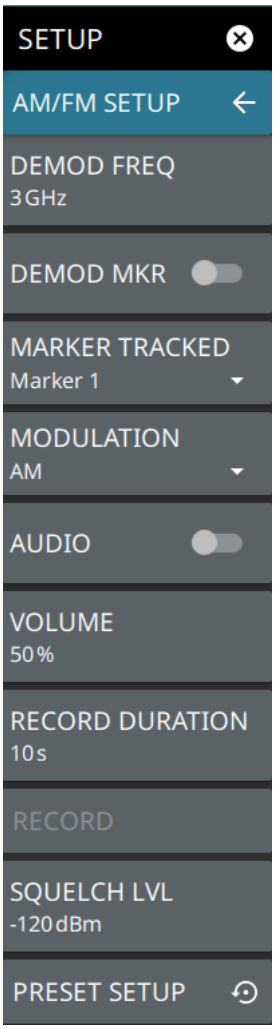
ACQUISITION TIME: The acquisition time sets the update interval for each spectrum trace, spectrogram line, and density display. During the acquisition interval, spectral data from multiple FFTs of the input signal are taken and combined. The acquisition time is adjustable to allow resolving multiple, brief signal events in time and to observe longer term behaviors.

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

Figure 3-49. SETUP Menu (AM/FM Audio – RF Spectrum)

Note	For simultaneous audio demodulation and trace sweep, the set span must not be greater than the maximum capture bandwidth based on the installed bandwidth option (No option: 20 MHz; Option 103: 55 MHz; Option 104: 110 MHz) and the tuning range must not cross more than one internal local oscillator tuning points. These conditions will be indicated by a transient status message at the top of the display.

AM/FM SETUP Menu - RF Spectrum



DEMOD FREQ: Sets the audio demodulation frequency.

DEMOD MKR: Toggles the tracked marker on and sets the demod frequency to track the marker frequency. Use the "MARKER Menu" on page 3-30 to adjust the marker parameters.

MARKER TRACKED: Selects which marker to track. When DEMOD MKR is enabled, the demodulated frequency tracks the indicated marker.

MODULATION: Selects the modulation type to demodulate the RF signal. Available modulation types are AM, US Band (upper sideband), LS Band (lower sideband), FM Narrowband (6.25 12.5 and 25 kHz), and FM Wideband.

AUDIO: Toggles the demodulated audio output (sound) on or off. The demodulation frequency must be within the current sweep for audio demodulation. Note that AM/FM audio demodulation cannot be used in conjunction with IQ Streaming or when the IQ streaming output port is set to Data Out.

VOLUME: Sets the percentage of audio output volume or mutes the audio.

RECORD DURATION: Sets the audio recording time. The maximum recording time is approximately 27 hours, depending on available storage.

RECORD: Starts audio recording. Recorded audio files (.wav) are saved to the Waves folder. Audio will be recorded for the recording duration or will stop when AUDIO is toggled off.

SQUELCH LVL: Sets the RF threshold level for audio playback. This is typically used with weak or intermittent signals to mute the static sound when the signal is below the squelch threshold.

PRESET SETUP: Presets all the AM/FM audio setup parameters.

Figure 3-50. AM/FM SETUP Menu (AM/FM Audio – RF Spectrum)

3-16 AM/FM Modulation Measurement (Option 509)

The AM/FM modulation measurement evaluates the quality of the baseband signal retrieved from the modulated signal. The graphical representation of the baseband signal indicates the pattern of modulation depth/deviation versus frequency and time.

The AM/FM audio provides quantitative measurements of analog radio transmitters using amplitude and frequency modulation. In addition to numeric results, AM/FM modulation measurement provides a new audio spectrum display and audio demodulated signal vs time (oscilloscope) display.

The ALL MEASUREMENTS view consists of the graphical representations of AUDIO SPECTRUM, AUDIO TIME DOMAIN, RF SPECTRUM in addition to AUDIO RESULTS table.

The audio spectrum displays the frequency spectrum of the demodulated audio signal.

The audio time domain provides an oscilloscope style display of the demodulated audio signal in amplitude versus time.

The RF spectrum display is the standard RF spectrum of the modulated carrier.

The audio results table consists of several numerical measurements such as SINAD (Signal-to-Noise and Distortion) ratio, THD (Total Harmonic Distortion), depth and deviation.

The ALL MEASUREMENTS view is available only if Option 509 is installed. See Figure 3-51.

To select All Measurements view navigate to MEASURE>MEASUREMENT>AM/FM AUDIO>VIEW>ALL MEASUREMENTS.

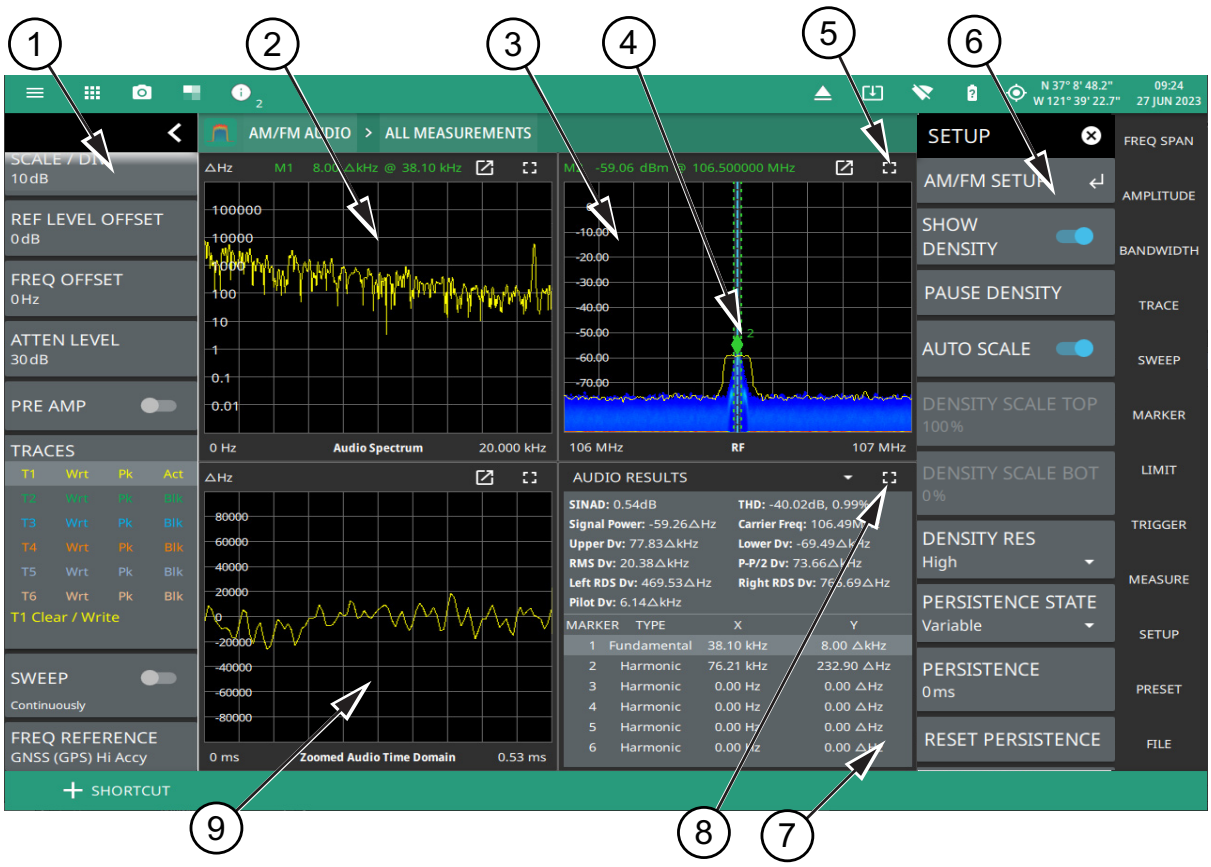


Figure 3-51. AM/FM Audio – All Measurements

1. The status panel provides quick access to common spectrum analyzer settings. See “AM/FM SETUP Menu - RF Spectrum” on page 3-56.
2. The audio spectrum displays the frequency spectrum of the demodulated audio signal. It displays depth (%) in amplitude modulation, and deviation (Hz) in frequency modulation.
3. The RF spectrum graph represents the minimized view of the RF spectrum view.
4. The demodulation marker is used to select the audio signal in the RF frequency domain. Toggle on DEMOD MKR button to analyze the audio signal.
5. The full screen icon displays the maximized view of the selected graph with audio results table displayed at the bottom. Touch exit full screen icon to exit the full screen view. Note that when the audio results table is viewed in full screen the corresponding graphs are not displayed at the bottom of the screen.
6. The SETUP menu is where the AM/FM demodulation settings are configured. See “SETUP Menu (AM/FM Audio – All Measurements)” on page 3-60.
7. The audio results displays several numerical measurements such as SINAD (Signal-to-Noise and Distortion), THD (Total Harmonic Distortion), Pilot Deviation, left/right RDS deviation, FM deviation etc. It also includes the fundamental and harmonic markers in addition to X and Y axes coordinates of the marker locations.
8. This drop-down menu allows you to switch between marker table and audio results display. Note that Marker Table is only visible when MARKER TABLE is toggled on in MARKER menu.
9. The audio time domain graph also referred as oscilloscope, represents the AM depth (%) or FM deviation (Hz) of the audio signal versus time.

Figure 3-51. AM/FM Audio – All Measurements

AM/FM Metrics

Field Master Series and Remote Spectrum Monitor instruments automatically detect the highest power audio tone which is used as the fundamental tone for the audio signal in Signal-to-noise and distortion (SINAD) measurement, therefore it is not required to define the frequency of the fundamental tone. SINAD is the ratio of the total channel power relative to the unwanted signal power. Higher the value of SINAD, the better the quality of the audio signal.

SINAD ratio measures AM/FM modulation distortion. It is calculated as the ratio of the channel power relative to the power of the fundamental tone using a notch filter.

SINAD ratio (dB) is expressed in logarithmic term as follows:

$$SINAD = \frac{S + D + N}{D + N}$$

Where, S = Signal Power, D = Distortion, N = Noise.

Distortion is defined as all signals in the demodulation bandwidth other than the wanted tone used to modulate the transmitter under test, including spurious and sidebands created by non linearity in the transmitter modulator.

Total harmonic distortion (THD) measurement extracts the total harmonic distortion component from the noise component in the total unwanted signal. The isolated distortion component is useful to troubleshoot the root causes of the modulation distortion.

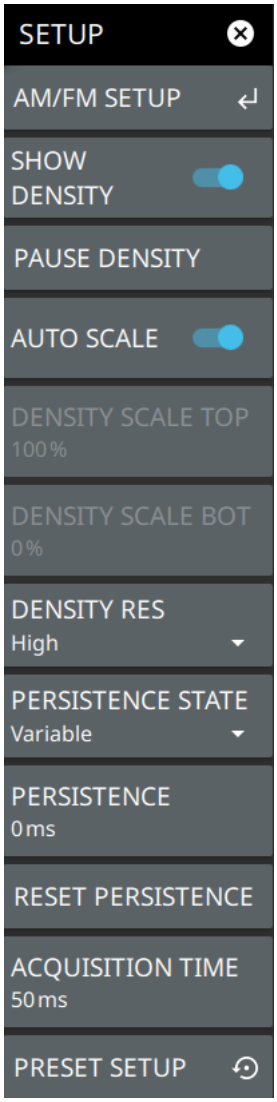
$$THD = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \ldots + V_n^2}}{V_1}$$

Where, V_n = RMS value of the nth harmonic voltage, n = 10, V_1 = RMS value of the fundamental component.

Note	Total harmonic distortion is calculated based on maximum of 10 harmonics. For the selected AM/FM modulation mode, the frequency of harmonics beyond the bandwidth of the audio signal is not measured.

SETUP Menu (AM/FM Audio – All Measurements)

The default view of AM/FM Audio measurement is RF spectrum view. The AM/FM audio demodulation SETUP menu is available in MEASURE > MEASUREMENT > AM/FM Audio > SETUP.



AM/FM SETUP: Opens "AM/FM SETUP Menu (All Measurements)" on page 3-61.

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.

PAUSE DENSITY: Pauses the display density, press RESTART DENSITY to resume displaying density.

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.

RESET PERSISTENCE: Resets the decay time of the density display.

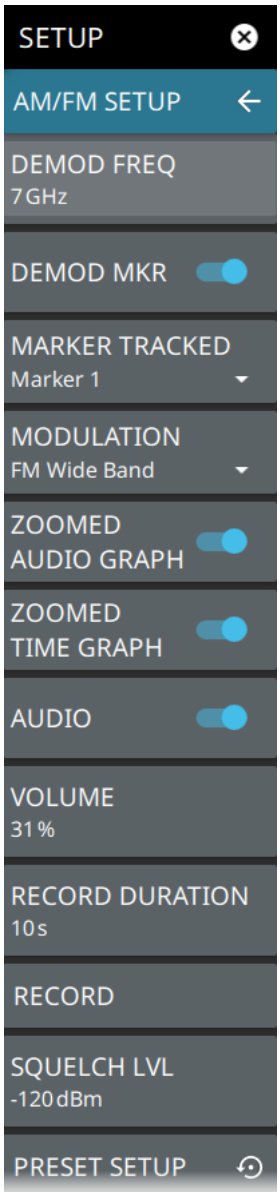
ACQUISITION TIME: The acquisition time sets the update interval for each spectrum trace, spectrogram line, and density display. During the acquisition interval, spectral data from multiple FFTs of the input signal are taken and combined. The acquisition time is adjustable to allow resolving multiple, brief signal events in time and to observe longer term behaviors.

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

Figure 3-52. SETUP Menu (AM/FM Audio – All Measurements)

AM/FM SETUP Menu (All Measurements)

The AM/FM audio demodulation SETUP menu is available in MEASURE > MEASUREMENT > AM/FM Audio > SETUP. Make sure to select ALL MEASUREMENTS from VIEW drop-down.



DEMOD FREQ: Sets the audio demodulation frequency.

DEMOD MKR: Toggles the tracked marker on and sets the demod frequency to track the marker frequency. Use the "MARKER Menu" on page 3-30 to adjust the marker parameters.

MARKER TRACKED: Selects which marker to track. When DEMOD MKR is enabled, the demodulated frequency tracks the indicated marker.

MODULATION: Selects the modulation type to demodulate the RF signal. Available modulation types are AM, US Band (upper sideband), LS Band (lower sideband), FM Narrowband (6.25 12.5 and 25 kHz), and FM Wideband.

ZOOMED AUDIO GRAPH: Displays zoomed audio spectrum graph when toggled on, only available in FM modulation. Only available in Wideband FM mode. The full span audio spectrum shows 96 kHz of spectrum to include the mono audio, 19 kHz sub carrier, left and right stereo channels. The zoomed graph shows 20 kHz audio spectrum for closer analysis of the combined left/right channels.

ZOOMED TIME GRAPH: Displays zoomed audio time domain graph when toggled on. Zoomed time domain audio graph is used to view a signal modulated with an ideal sine wave to detect distortion.

AUDIO: Toggles the demodulated audio output (sound) on or off. The demodulation frequency must be within the current sweep for audio demodulation. Note that AM/FM audio demodulation cannot be used in conjunction with IQ Streaming or when the IQ streaming output port is set to Data Out.

VOLUME: Sets the percentage of audio output volume or mutes the audio.

RECORD DURATION: Sets the audio recording time. The maximum recording time is approximately 27 hours, depending on available storage.

RECORD: Starts audio recording. Recorded audio files (.wav) are saved to the Waves folder. Audio will be recorded for the recording duration or will stop when AUDIO is toggled off.

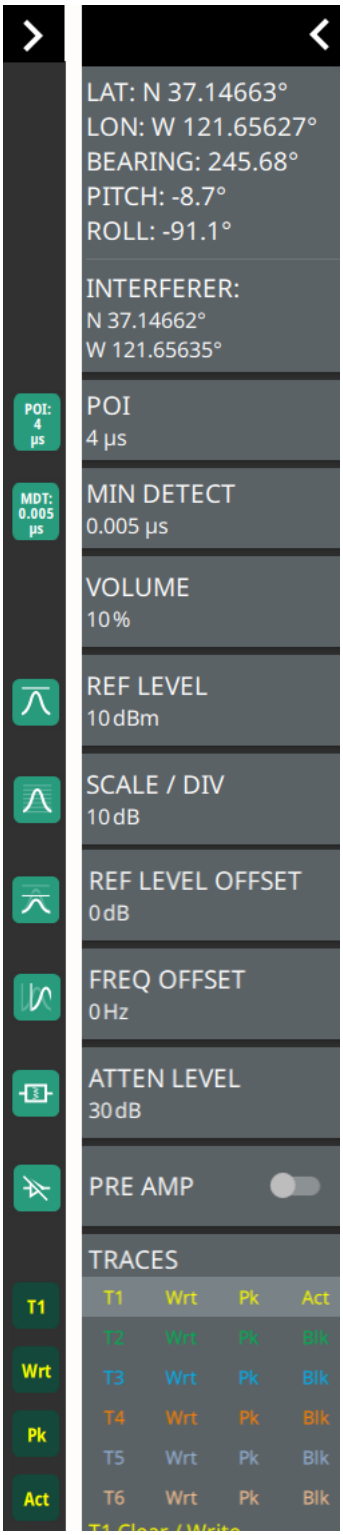
SQUELCH LVL: Sets the RF threshold level for audio playback. This is typically used with weak or intermittent signals to mute the static sound when the signal is below the squelch threshold.

PRESET SETUP: Presets all the AM/FM audio setup parameters.

Figure 3-53. AM/FM SETUP Menu (ALL MEASUREMENTS)

Status Panel (AM/FM Audio)

The status panels and features illustrated in this section are unique to the real-time spectrum analyzer and to the selected measurement and view. Below is the AM/FM audio status panel that covers RF Spectrum and spectrogram views, in addition to audio AM/FM and interference measurements (selected via MEASURE > MEASUREMENT 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.

VOLUME: Sets the volume level for the audio response of the measurement. Note that the system volume can affect the range of this setting. Refer to Section 3-14 “Interference Finder (Option 24)” on page 3-49.

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.

Refer to Section 3-4 “Setting Amplitude Parameters” on page 3-5.

SCALE/DIV: Sets the graticule scale/division for log-based units.

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

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 3-3 “Setting Frequency Parameters” on page 3-1.

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 3-4 “Setting Amplitude Parameters” on page 3-5.

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 RF 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 RTSA 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 3-6 “Setting Trace and Cursor Parameters” on page 3-12.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 3-7 “Setting Sweep Parameters” on page 3-27.

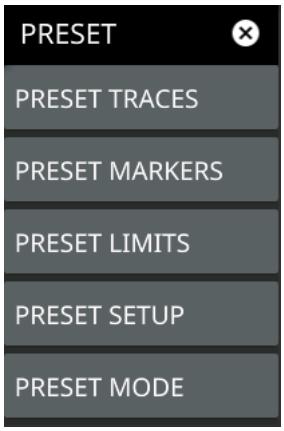
FREQ REFERENCE: Indicates the current frequency reference source of Internal High Accuracy (used after GPS has lost sync, but while the internal clock still has good GPS reference), Internal Standard Accuracy, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the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

Figure 3-54. AM/FM Audio Status Panel with minimized Status Panel Icons

3-17 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 RTSA 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 “Reset Settings” section of Instrument Overview chapter of user guide. To recover from system software faults, refer to Appendix A “Instrument Messages and Troubleshooting” chapter of the user guide.

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 3-55. PRESET Menu

3-18 Saving and Recalling Measurements

The Field Master Series 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 “File Management” section of Instrument Overview chapter of the corresponding user guide.

Saving a Measurement

To save a measurement or setup, refer to Figure 3-56:

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.

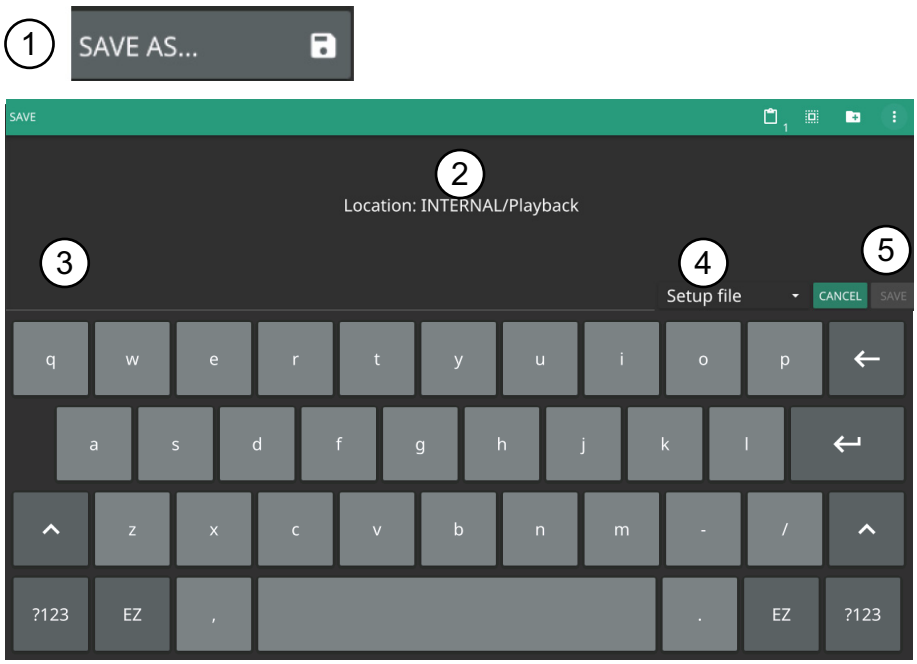


Figure 3-56. File Save Dialog

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 3-57:

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.

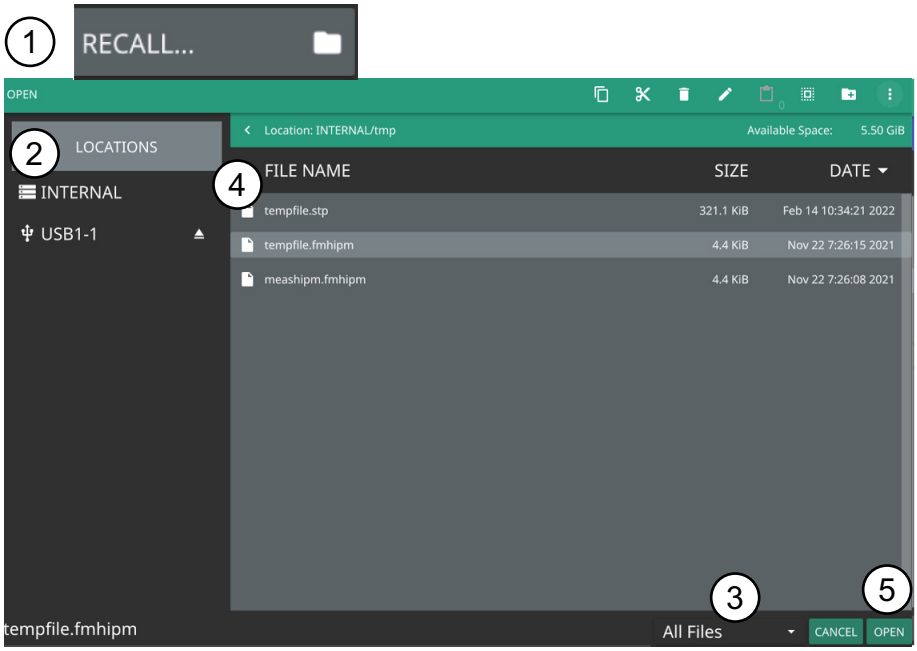


Figure 3-57. File Open Dialog

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).

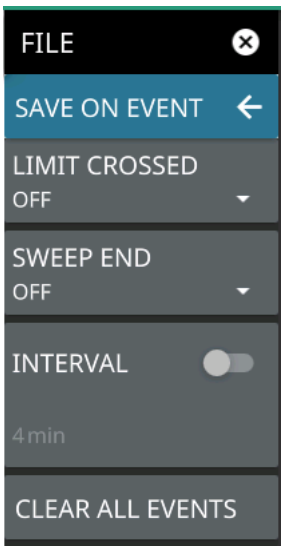
RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled 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.

SAVE ON EVENT: Opens the “SAVE ON EVENT Menu” on page 3-67. This feature is not available in the 5GNR/LTE analyzer.

BROWSE FILES: .Refer to “File Management” section in Instrument Overview chapter of the user guide.

Figure 3-58. 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 3-59. SAVE ON EVENT Menu

Chapter 4 — IA Real-Time Spectrum Analyzer (Option 24)

4-1 Introduction

The Interference Analyzer (IA) real-time spectrum analyzer (RTSA) and MA2700A handheld InterferenceHunter™ are the ideal solution for anyone conducting coverage testing of RF and microwave communications systems, including 5G and LTE networks.

The Interference Analyzer (IA) RTSA application assists you in finding the source of interfering signals with the use of MA2700A handheld InterferenceHunter, GPS receiver, and directional antenna. Note that it is required to enable the GNSS receiver in the GNSS (GPS) settings of the instrument. Refer to instrument user guide.

It is recommended to use the RTSA interference finder mode at all times to achieve better interference hunting, unless a frequency span wider than the RTSA option (up to 110 MHz) is required. This is because the measurement cycle time is faster in RTSA mode, resulting in increased possibility of locating the interfering signals. With the MA2700A, a vector line to an interfering signal can be added to a map in the instrument with a click of the trigger on the handle.

A basic understanding of the measurement concepts presented in Chapter 2, “RTSA (Option 199) Overview” is recommended before performing the procedures in this chapter. Refer to the following sections for a better understanding of the RTSA application:

- Section 2-2 “Selecting the Applications/Modes” on page 2-1
- Section 2-3 “RTSA GUI Overview” on page 2-2 (only applies to RF Spectrum RTSA view, no spectrogram view in IA RTSA measurement)
- Section 2-4 “Main Menu” on page 2-5
- Section 2-5 “Status Panel (RTSA)” on page 2-6
- Section 3-3 “Setting Frequency Parameters” on page 3-1
- Section 3-4 “Setting Amplitude Parameters” on page 3-5
- Section 3-5 “Setting Bandwidth Parameters” on page 3-10
- Section 3-6 “Setting Trace and Cursor Parameters” on page 3-12 (Cursor parameters don’t apply to IA RTSA measurement)
- Section 3-7 “Setting Sweep Parameters” on page 3-27
- Section 3-8 “Setting Up Markers” on page 3-28
- Section 3-9 “Setting Up Limit Lines” on page 3-35
- Section “IQ TRIGGER Menu” on page 3-45
- Section 3-14 “Interference Finder (Option 24)” on page 3-49
- Section 3-15 “AM/FM Audio (Requires Option 24 or Option 509)” on page 3-53
- Section 3-16 “AM/FM Modulation Measurement (Option 509)” on page 3-57

IA RTSA application includes the use of additional functions beyond frequency, span, amplitude, and marker functions. Refer to Section 4-3 and Section 4-5 to cover field measurements and additional smart measurements provided by these newly added modes such as interference map and interference polar.

4-2 Making IA RTSA Measurements

Initial Setup

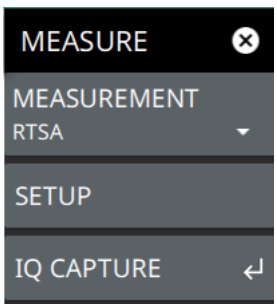
- Connect a signal source to the RF In test port of the instrument. For over-the-air measurements, connect an antenna that is appropriate for the frequency range to be measured. For connector descriptions, refer to instrument's user guide.
- Connect the MA2700A handheld InterferenceHunter, GPS receiver and a directional antenna (e.g. Yagi antenna) to the instrument. Enable GNSS/GPS toggle from GNSS (GPS) settings menu.
- Select the IA RTSA analyzer. Refer to "Selecting the Applications/Modes" on page 2-1.

4-3 Setting Up Advanced Measurements

Refer to "Making IA RTSA Measurements" on page 4-2 for basic information on setting up IA RTSA measurement. This section provides setup information for making real-time spectrum measurements. The Field Master Series analyzer features smart measurements that make setup easy. The following sections present brief examples demonstrating the use of these measurements.

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

MEASURE Menu



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

- **RTSA:** Displays the frequency domain spectrum measurement.
- **AM/FM Audio:** Available when Option 24 or Option 509 is installed. The AM/FM Audio provides audio demodulation capability. Refer to Section 3-15 "AM/FM Audio (Requires Option 24 or Option 509)" on page 3-53 and Section 3-16 "AM/FM Modulation Measurement (Option 509)" on page 3-57.
- **PIM/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 3-14 "Interference Finder (Option 24)" on page 3-49.
- **Interference Map:** This technique is used to geo-locate the interfering signals that may be from a few hundred yards to a few miles away, with respect to user's current location. Refer to Section 4-4 "Interference Map" on page 4-4.
- **Interference Polar:** This technique is used to geo-locate the polar plot of the interfering signals that may be from a few hundred yards to a few miles away, with respect to user's current location. Refer to Section 4-5 "Interference Polar" on page 4-8.

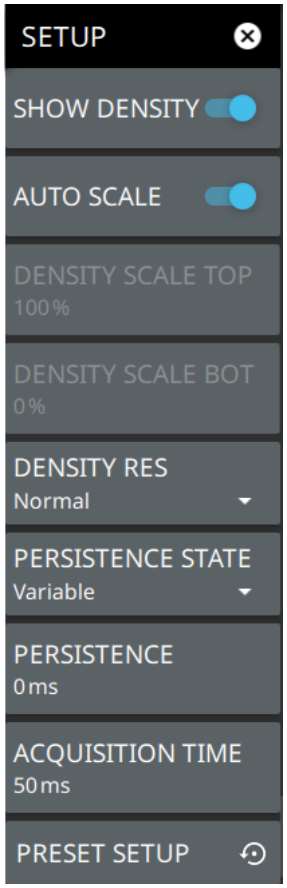
SETUP: Opens the "SETUP Menu (RTSA)" on page 4-3 for the measurement and view selected above.

IQ CAPTURE: Opens the "IQ CAPTURE Menu" on page 3-42.

Refer to the IQ Capture/Streaming Measurement Guide for discussion of IQ Capture and Streaming, PN: 10580-00490.

Figure 4-1. MEASURE Menu

SETUP Menu (RTSA)



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, 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.

PRESET SETUP: Presets the color setup settings.

Figure 4-2. SETUP Menu (RF Spectrum View)

Refer to the sections below for additional setup menus when using advanced measurements:

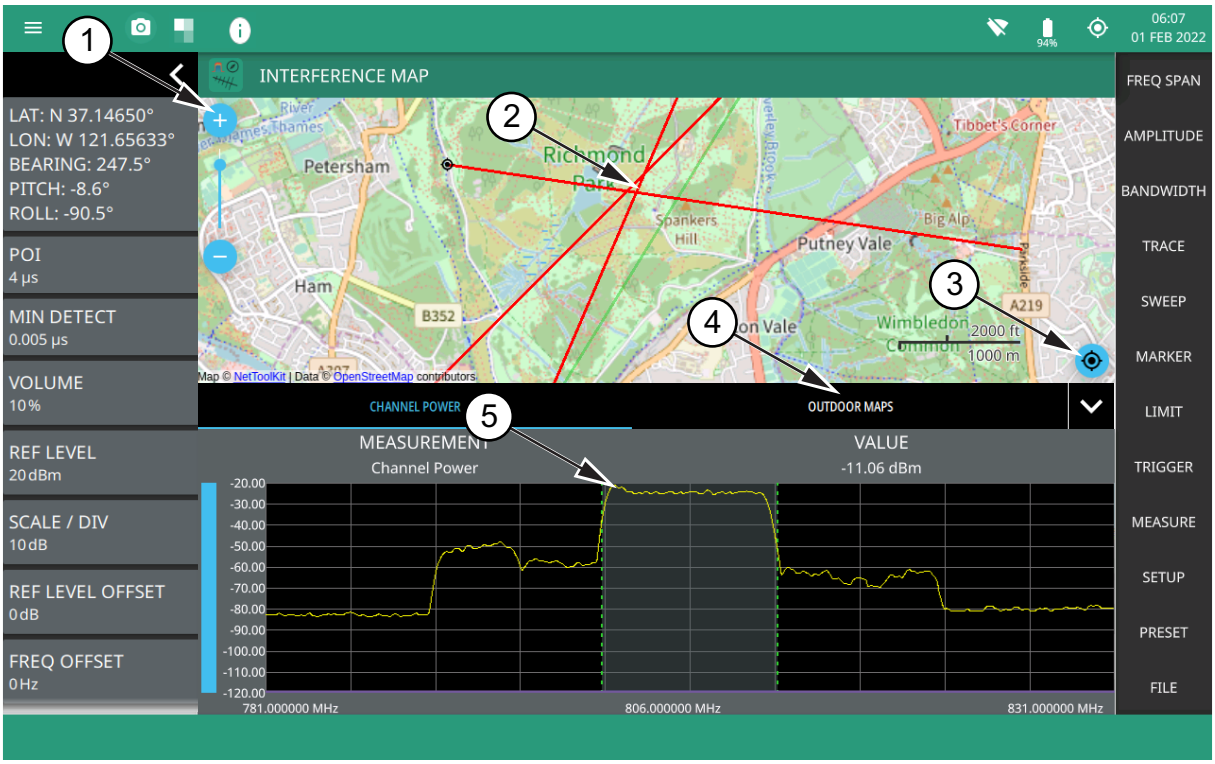
- "SETUP Menu (PIM/Interference)" on page 3-50
- "SETUP Menu (AM/FM Audio - RF Spectrum)" on page 3-55
- "SETUP Menu (AM/FM Audio – All Measurements)" on page 3-60
- "SETUP Menu (Interference Map)" on page 4-7
- "SETUP Menu (Interference Polar)" on page 4-10

4-4 Interference Map

This section describes the Interference Map capability and key characteristics of Interference map measurement mode. This section describes the Interference Map capability and key characteristics of Interference map measurement mode. This technique is used to geo-locate interfering signals with respect to the user's current location. The user is required to travel with the instrument connected with a GPS receiver, directional antenna and the MA2700A InterferenceHunter to more than one location to capture the triangulation of the interfering signals. The resulting geo-location of the intersecting signals will get captured in the map.

The interfering signal is located by following the steps below:

1. Press system menu (3-line icon in the upper left corner), go to SETTINGS > GPS, and toggle GPS/GNSS on.
2. Press System menu, go to TOOLS > MAP TOOL to download a digital map of the current location. Refer to "Map Tool" section of Instrument Overview chapter of the user guide. Note that Internet connection is required to download the map tiles of the selected location. Ensure to have either an Ethernet or a Wi-Fi connection.
3. Connect the GPS, handheld InterferenceHunter MA2700A and suitable directional antenna (for e.g. Yagi antenna) to instrument.
4. Press MEASURE > MEASUREMENT> Interference Map.
5. Set up the frequency and span in order to view the signal of interest on the spectrum display. Ensure not to make the span too wider, as this slows down the instrument's response in locating the interfering signal.
6. Press SETUP>INTEGRATION BW and set an appropriate integration bandwidth to measure the channel power of the signal of interest.
7. Press SETUP> VOLUME to increase the instrument's volume in order to listen for max channel power.
8. Slowly point the directional antenna in the direction leading to max channel power, either press the trigger on MA2700A when pointing in the direction of the maximum power, or press PLACE LINE in SETUP menu. Refer to Section "".
9. Notice that moving the directional antenna will mark a red line on the map, which signifies the direction of max power.
10. To view the interference signal, change the current location to another nearby different location (~1 mile/km).
11. Repeat Step 6 through Step 8 and drop a second red line on the map by clicking the trigger on the MA2700A.
12. Similarly, change the present location to another nearby location and repeat Step 6 through Step 8 to drop a third line on the map. The three lines should intersect at an approximate location of the signal of interest.
13. If needed you can also choose a desired bearing line by selecting an appropriate bearing line from SELECTED LINE drop-down. Refer to Section "".



1. The map zoom tool is used to increase (+) or decrease (-) zoom level. You can also drag the zoom level indicator up or down, or you can pinch to change zoom level.
2. Triangulation of all the three Interference signals.
3. Recentering tool to center map on current GPS position. A GPS is required for this icon to appears.
4. Select Outdoor Maps to view the list of saved maps or to create a new map using Map tool.
5. Max channel power.

Figure 4-3. Interference Map Overview

STATUS Panel (Interference Map and Interference Polar)

This status panel is unique to Interference Map and Interference Polar measurement modes (selected via MEASURE > MEASUREMENT menu) of IA RTSA Application.

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.

LATITUDE: Shows the latitude coordinate of the interferer

LONGITUDE: Shows the longitude coordinate of the interferer.

BEARING: Direction the MA2700A is pointing (shown in red).

PITCH (vertical level): Indicates the front-to-back orientation.

ROLL (horizontal level): Indicates the side-to-side orientation.

INTERFERER: Shows the latitude and longitude coordinates of the interferer.

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.

VOLUME: Sets the audio output volume.

REF LEVEL: Sets the reference level of the top graticule line in the selected units. If the reference level offset is not zero, OFFSET REF LEVEL is displayed at this location. Refer to Section 2-8 “Setting Amplitude Parameters” on page 2-10.

SCALE/DIV: Sets the graticule scale/division for log-based units. This setting does not apply to linear units.

REF LEVEL OFFSET: Sets the reference level offset in dB units. This setting can compensate for the presence of external input attenuation or gain.

FREQ OFFSET: Accounts for frequency conversions outside of the analyzer. Refer to Section 2-7 “Setting Frequency Parameters” on page 2-7.

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 2-8 “Setting Amplitude Parameters” on page 2-10.

TRACES: Displays the current status of up to six traces or cursors in a quick-view summary. When the measurement view is set to IA RTSA mode trace information is displayed in this area. 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 or cursor and opens the TRACE menu, allowing you to select and set up an individual trace or cursor as desired. Refer to Section 2-10 “Setting Trace and Cursor Parameters” on page 2-16. Note that cursor parameters don’t apply to IA RTSA application because there is not spectrogram view.

SWEEP: Toggles the current sweep setting between continuously or sweep once. Refer to Section 2-11 “Setting Sweep Parameters” on page 2-31.

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 GNSS (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 4-4. STATUS Panel with Mini Status Panel Icons (Interference Map and Interference Polar)

SETUP Menu (Interference Map)

The Interference Map SETUP menu is available in MEASURE > MEASUREMENT > Interference Map> SETUP.

BEARING SOURCE: Selects the bearing source either as antenna or manual. If antenna is selected the electronic compass from the MA2700A InterferenceHunter is used to find the direction of the peak signal. If MANUAL is selected an external compass must be used to find the direction of the power signal.

MANUAL BEARING: Allows the user to manually enter the number of degrees from true north direction of the peak signal. In this case a magnetic compass or a compass App installed in a smart phone can be used to find the direction of the peak signal.

Note that if an antenna that is less than 6 GHz range is used, then an external magnetic compass may be used to find the signal direction. The eCompass in MA2700A does not support in locating high frequency signals. Manual bearing feature is very useful when triangulating signals greater than 6 GHz, as the user is allowed to enter the bearing manually.

PLACE LINE: Places the bearing line data in red on the map, alternatively press the trigger on the MA2700A InterferenceHunter to place the red line on the map.

SELECTED LINE: Selects a desired bearing line of your choice.

CLEAR ALL LINES: Clears all the bearing line data from the map.

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: Adjusts the audio output volume.

MUTE: Mutes the instrument volume.

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).

Figure 4-5. SETUP Menu (Interference Map)

4-5 Interference Polar

This section describes the Interference Polar capability and key characteristics of Interference Polar measurement mode. This is an alternative technique to geo-locate a potentially interfering signal without having to go to multiple locations. The user stands at a fixed location and makes a full rotation along with the MA2700A InterferenceHunter and a directional antenna through 360º. A polar plot of the signal strength in all directions is displayed on the map.

The polar plot of the interfering signal is located by following the steps below:

1. Press system menu (3-line icon in the upper left corner), go to SETTINGS > GPS, and toggle GPS/GNSS on.
2. Press system menu, go to TOOLS > MAP TOOL to download a digital map of the current location. Note that Internet connection is required to download the map tiles of the selected location. Ensure to have either an Ethernet or a Wi-Fi connection.
3. Connect the GPS, MA2700A handheld InterferenceHunter and a suitable directional antenna (for e.g. Yagi antenna) to your instrument.
4. Press MEASURE > MEASUREMENT> Interference Polar.
5. Set up the frequency and span in order to view the signal of interest on the spectrum display. Ensure not to make the span too wider, as this slows down the instrument's response in locating the interfering signal.
6. Press SETUP>INTEGRATION BW and set an appropriate integration bandwidth to measure the channel power of the signal of interest.
7. Press SETUP> VOLUME to increase the instrument's volume in order to listen for max channel power.
8. Press SETUP menu and press START MEAS and slowly make a full rotation in clock-wise direction holding the directional antenna to complete 360º. Refer to Section "SETUP Menu (Interference Polar)".
9. Notice that the rotation of the antenna places series of red lines to create a polar plot of the signal in every direction. The direction of maximum signal strength indicates the transmitter that is the source of the interfering signal.

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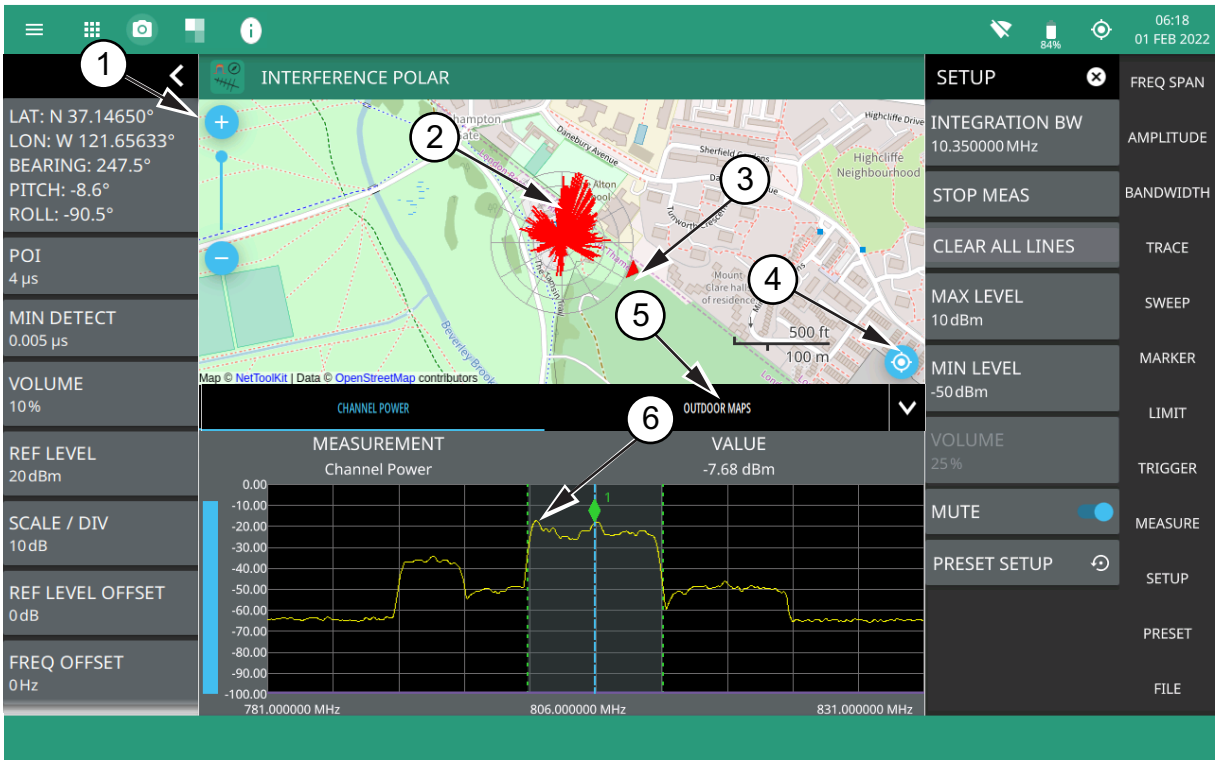
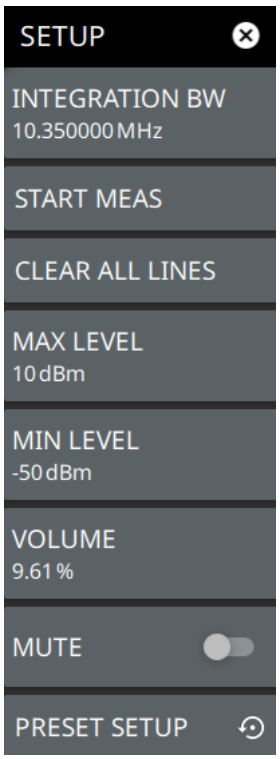


1. The map zoom tool is used to increase (+) or decrease (-) zoom level. You can also drag the zoom level indicator up or down, or you can pinch to change zoom level.
2. Interference signal.
3. Direction of bearing degrees.
4. Recentering tool to center map on current GPS position. A GPS is required for this icon to appear.
5. Select Outdoor Maps to view the list of saved maps or to create a new map using Map tool.
6. Max channel power.

Figure 4-6. Interference Polar Overview

SETUP Menu (Interference Polar)

The Interference Polar SETUP menu is available in MEASURE > MEASUREMENT > Interference Polar > SETUP.



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).

START MEAS/STOP MEAS: Stay in one location and slowly turn around holding the antenna in the front to complete a full 360º circle. This measures a plot of signal strength in every direction, called a polar plot. Press STOP MEAS to stop measuring the signal.

CLEAR ALL LINES: Clears all the red lines on the map.

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 audio output volume.

MUTE: Mutes the instrument volume.

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

Figure 4-7. SETUP Menu (Interference Polar)

4-6 Saving and Recalling Measurements

The Field Master Series 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 instrument user guide for detailed information on file management.

Saving a Measurement

To save a measurement or setup, refer to Figure 4-8:

1. Go to 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.

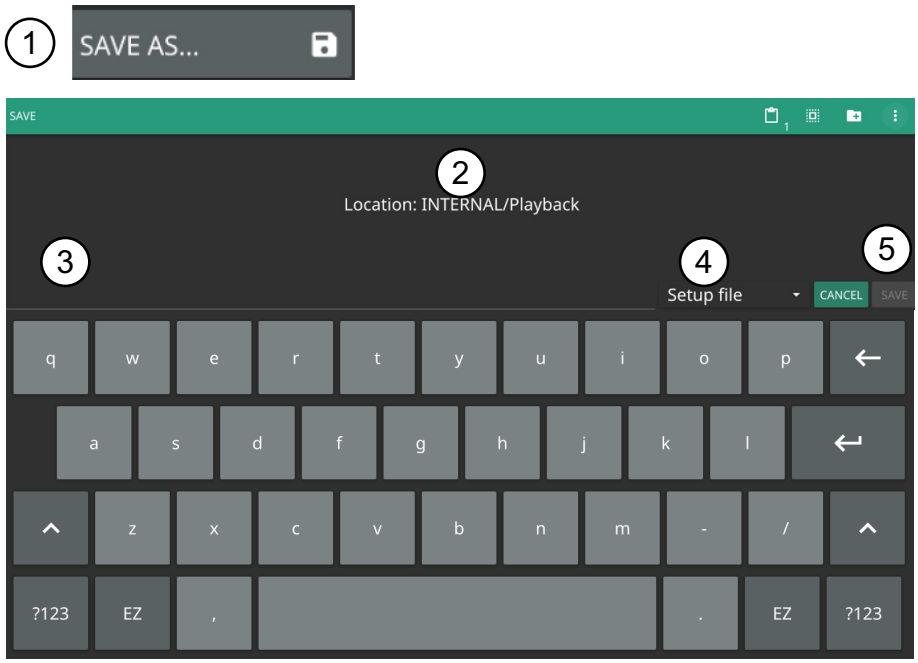


Figure 4-8. File Save Dialog

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 4-9:

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.

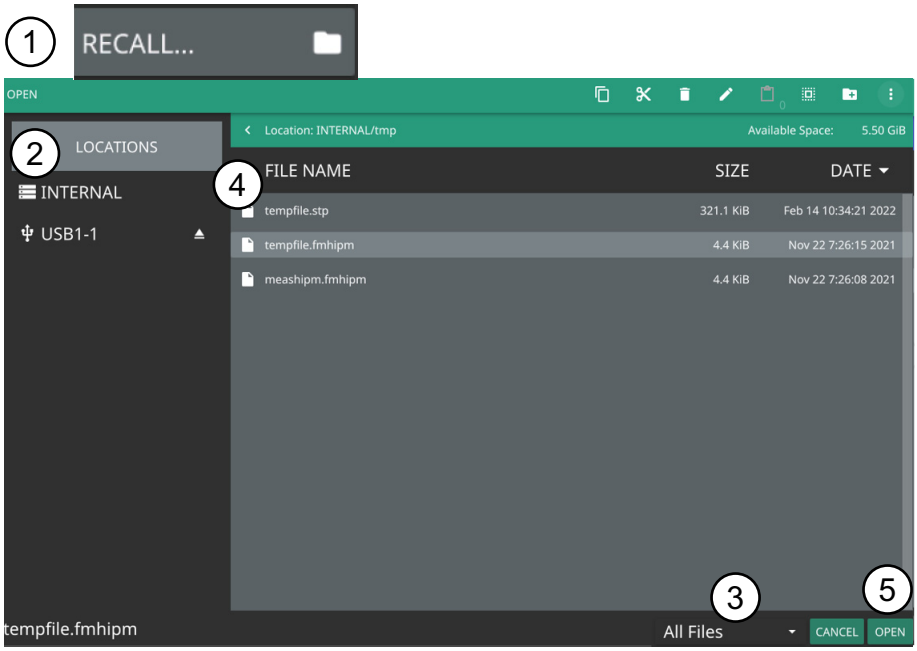


Figure 4-9. File Open Dialog

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 (fmiart 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 fmiart and png file types).

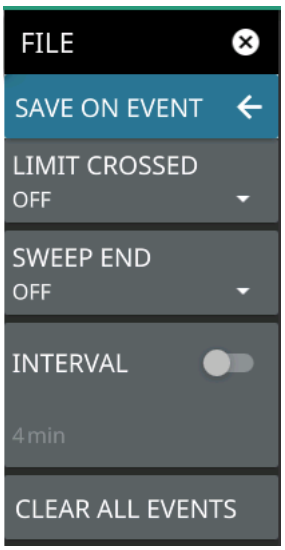
RECALL: Opens the Recall File dialog to retrieve a file from a desired location. Only supported files will be displayed depending on the currently set measurement. When trace data is recalled, the instrument will change the settings to match the settings of the saved trace. The data will be recalled 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 4-13. This feature is not available in the 5GNR/LTE analyzer.

BROWSE FILES: Opens File Management. Refer to instrument user guide for detailed information.

Figure 4-10. 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 4-11. SAVE ON EVENT Menu

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