

Measurement Guide

Cable and Antenna Analyzer

MS2090A Field Master Pro™

MS2080A Field Master™

Cable and Antenna Analyzer

Option 331

Notes

Cable and Antenna measurements require the Anritsu Site Master S331P that is sold separately. 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.



Unauthorized Use or Disclosure

Anritsu Company has prepared the product user documentation for use by Anritsu Company personnel and customers as a guide for the proper installation, operation, and maintenance of Anritsu Company equipment and software programs. The drawings, specifications, and information contained therein are the property of Anritsu Company, and any unauthorized use of these drawings, specifications, and information is prohibited; they shall not be reproduced, copied, or used in whole or in part as the basis for manufacture or sale of the equipment or software programs without the prior written consent of Anritsu Company.

Export Management

The Anritsu products identified herein and their respective manuals may require an Export License or approval by the government of the product country of origin for re-export from your country. Before you export these products or any of their manuals, please contact Anritsu Company to confirm whether or not these items are export-controlled. When disposing of export-controlled items, the products and manuals must be broken or shredded to such a degree that they cannot be unlawfully used for military purposes.

Contacting Anritsu for Sales and Service

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

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

Table of Contents

Chapter 1—General Information

1-1	Introduction	1-1
	Related Manuals	1-1
1-2	Option Description	1-2
1-3	Document Conventions	1-2
	User Interface Navigation	1-2
	Illustrations	1-2
1-4	Calibration and Verification.	1-2
1-5	Contacting Anritsu for Sales and Service	1-2

Chapter 2—Cable and Antenna Analyzer Measurements (Option 331)

2-1	Introduction	2-1
	S331P Instrument Description	2-1
2-2	Initial Setup	2-2
2-3	Cable and Antenna Analyzer GUI Overview.	2-3
	Display Layout	2-4
	Main Menu	2-6
	Using Menus	2-6
	Status Panel	2-7
2-4	Measurement Overview	2-8
	Line Sweep Measurements	2-8
	Common RF Terms	2-9
2-5	Setting Frequency and Distance Parameters	2-10
	Setting Frequency	2-10
	Setting Distance	2-11
	FREQ/DIST Menu	2-12
	DISTANCE Menu	2-12
	DTF AID Menu	2-13
	DTF SETUP Menu	2-14
2-6	Setting Amplitude Parameters	2-15
	Setting the Amplitude using Top and Bottom Keys	2-15
	Setting the Amplitude using Auto Scale	2-15
	Setting the Amplitude using Full Scale	2-15
	Amplitude Menu	2-16
2-7	Setting up a Measurement	2-17
	Return Loss Measurement	2-17
	VSWR Measurement	2-18
	Cable Loss Measurement	2-19
	DTF Return Loss and DTF VSWR Measurement	2-20
	Smith Chart Measurement	2-27
	1-Port Phase Measurement	2-28
	Transmission (Ext. Sensor) Measurement	2-29
	MEASURE Menu	2-31

Table of Contents (Continued)

2-8	Setting Sweep Parameters	2-32
	Data Points	2-32
	Run/Hold	2-32
	Sweep Type	2-32
	RF Immunity	2-32
	SWEEP Menu	2-33
2-9	Setting Up Markers	2-34
	Overview of Markers	2-34
	Select, Activate, and Place a Marker / Delta Marker	2-35
	Marker Table	2-36
	Marker Search	2-36
	Tracking Markers	2-36
	Marker to Memory	2-37
	MARKER Menu	2-38
	MARKER SEARCH Menu	2-39
2-10	Setting Up Limit Lines	2-40
	Single Limit Lines	2-40
	Segmented Limit Lines	2-41
	Limit Table	2-43
	Limit Alarm	2-43
	LIMIT Menu (Single)	2-44
	LIMIT Menu (Segmented)	2-45
2-11	Calibration	2-46
	Factory Calibration	2-46
	Calibration Methods	2-47
	Calibration Types	2-47
	Calibration Status Displays	2-48
	Calibration Procedure	2-49
	Cal Info	2-57
	USB CAA Info	2-58
	Power Sensor	2-59
	Temperature Window	2-59
	Save and Recall Calibration Coefficients	2-59
	CALIBRATION Menu	2-60
2-12	Setting Trace Parameters	2-61
	Trace Overlay	2-62
	Trace Math Example	2-63
	TRACE Menu	2-65
2-13	Presetting the Analyzer	2-66
	PRESET Menu	2-66
2-14	Saving and Recalling Measurements	2-67
	Saving a Measurement	2-67
	Recalling a Measurement	2-68
	FILE Menu	2-69

Chapter 1 — General Information

1-1 Introduction

This measurement guide describes the cable and antenna analyzer (CAA) measurement functions of the Anritsu Field Master Series handheld instruments. Advanced functions are available only when a related option is installed and activated. Refer to [Section 1-2 “Option Description”](#) for references to discussion of the supported option. Refer to [Chapter 2, “Cable and Antenna Analyzer Measurements \(Option 331\)”](#) for an overview of an initial setup, GUI overview 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>

Product Information, Compliance, and Safety

Read the Product Information, Compliance, and Safety Guide for important safety, legal, and regulatory notices before operating the equipment, PN: 10100-00069.

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 Option 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, Cable and antenna analyzer option is offered as a 90-day time-limited option by ordering Option 9331. 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 purchasing and activating time-limited options.

The cable and antenna analyzer Option 331 uses an external Site Master™ S331P instrument (sold separately) to facilitate cable and antenna measurements using Field Master Series as the host controller.

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.

1-4 Calibration and Verification

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

1-5 Contacting Anritsu for Sales and Service

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

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

Chapter 2 — Cable and Antenna Analyzer Measurements (Option 331)

2-1 Introduction

The cable and antenna analyzer (CAA) uses an external Site Master™ S331P instrument (sold separately) to facilitate cable and antenna measurements using Field Master Series as the host controller. This chapter is intended to assist you in setting up some common cable and antenna measurements, including selecting the analyzer and setting up frequency, bandwidth, and amplitude, and performing measurement calibrations. For an introduction to cable and antenna measurements, refer to [Section 2-4 “Measurement Overview” on page 2-8](#). After measurements are taken, refer to the “File Management” section in the Instrument overview chapter of the user guide, and [Section 2-14 “Saving and Recalling Measurements”](#) for descriptions of saving, recalling, and managing measurement files.

S331P Instrument Description

The S331P is a one-port, 150 kHz to 4 GHz (Option 704) or 150 kHz to 6 GHz (Option 706) ultra-portable cable and antenna analyzer designed to make return loss, VSWR, cable loss, and distance-to-fault (DTF) measurements in the field. The S331P has no external power supply. It is powered via USB and controlled from the Field Master Series with the appropriate firmware and option installed.

Measurement files, setup files, and interface screen captures can be saved to and recalled from the Cable and Antenna Analyzer or removable disk. Anritsu Line Sweep Tools (LST) can be used with these files to create reports, view and organize data, edit markers and limit lines, and perform trace analysis. LST is available for download on the Anritsu website: <http://www.anritsu.com/test-measurement/products/lst>

More details on the Site Master S331P cable and antenna analyzer can be found in the Site Master S331P Technical Data Sheet (11410-00964) and Site Master S331P User Guide (10580-00426), and related literature on the S331P product page: <http://www.anritsu.com/test-measurement/products/s331p>

2-2 Initial Setup

Connect the S331P to the Cable and Antenna Analyzer controller using a USB-A to Micro-B cable. The cable included with the S331P has a secure latching screw to maintain connection to the S331P.



Figure 2-1. Field Master Series Setup

The Cable and Antenna Analyzer instrument analyzers are then selected from the 9-dot icon or from the current measurement icon. To select an analyzer, touch the 9-dot icon in the title bar or touch the current measurement icon to display the available analyzers (see [Figure 2-2](#)). Select the CAAUSB application, then touch the desired analyzer icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via measurement setup menus.

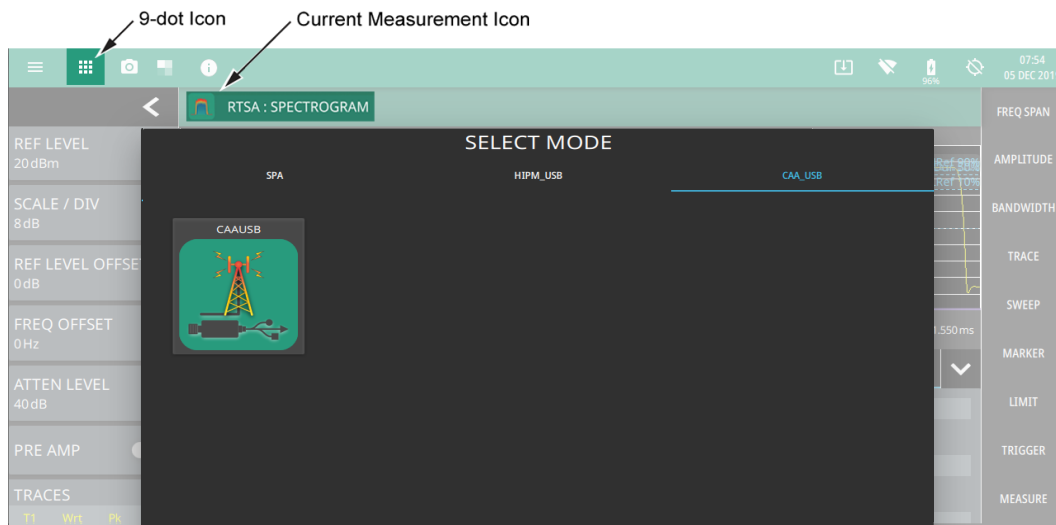
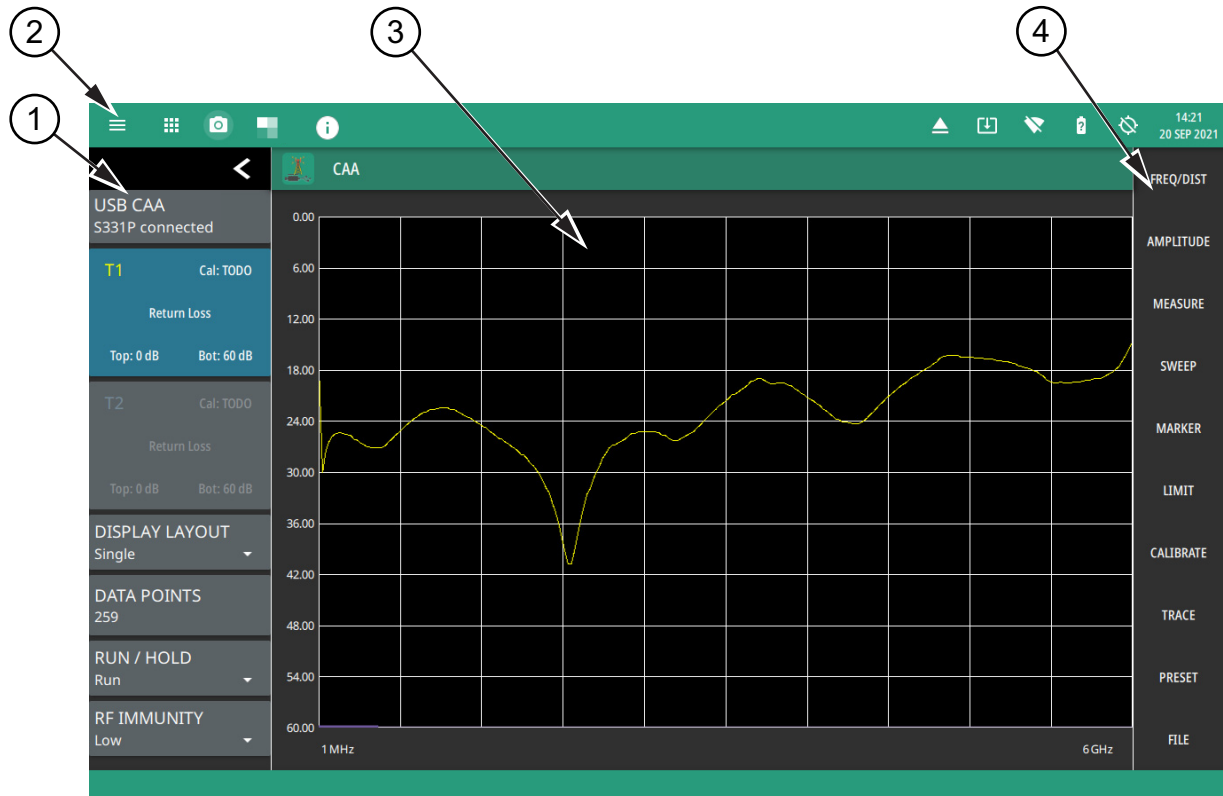


Figure 2-2. Selecting the CAAUSB Analyzer

2-3 Cable and Antenna Analyzer GUI Overview

This section illustrates the main graphical displays presented for the cable and antenna analyzer. For an introduction to cable and antenna measurements, refer to [Section 2-4 “Measurement Overview”](#) on page 2-8. For a general overview of the instrument and its user interface, refer to Instrument Overview chapter of the user guide.

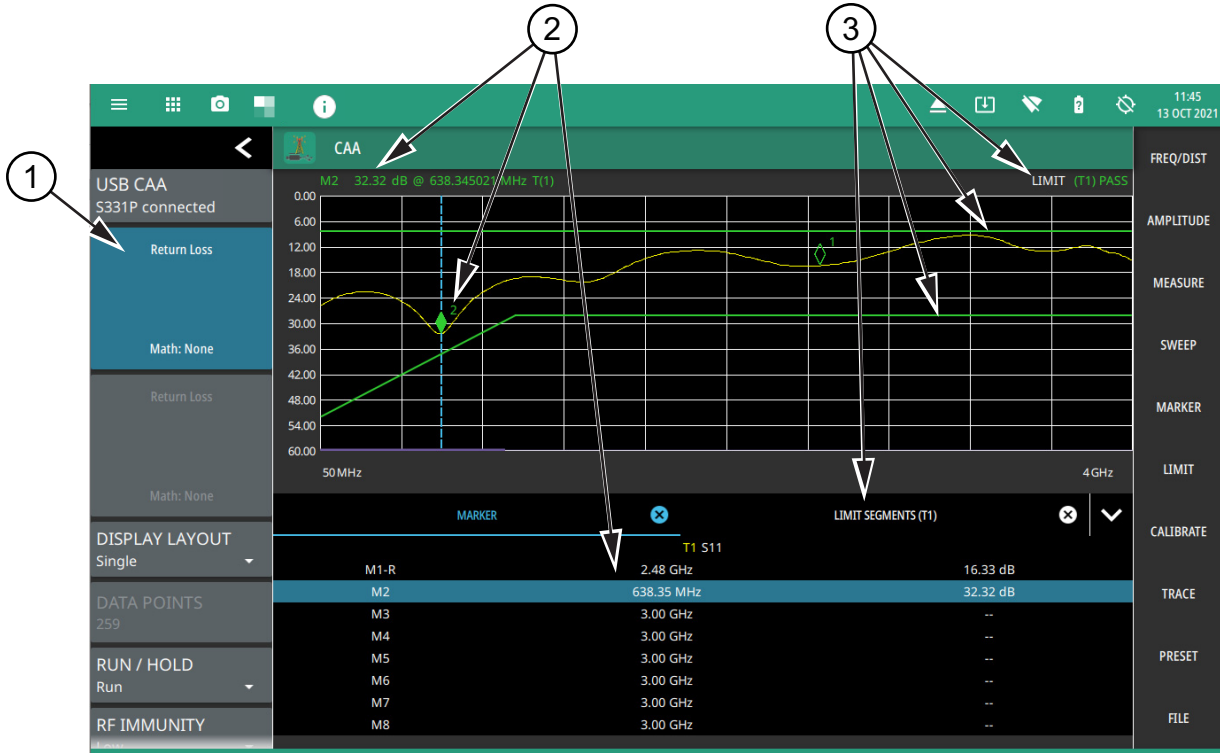


1. **Status Panel:** The cable and antenna analyzer status panel displays general settings for the current measurement. Refer to [“Status Panel”](#) on page 2-7.
2. **Title Bar:** The title bar provides quick access to system settings, measurement mode selection, informational dialogs, and screen capture. Refer to [Section 2-2 “Initial Setup”](#) on page 2-2.
3. **Main Measurement Display:** This area shows trace data and the marker table. Refer to [“Display Layout”](#) on page 2-4.
4. **Main Menu:** Access all setup and measurement configuration menus from here. Refer to [“Main Menu”](#) on page 2-6.

Figure 2-3. Cable Antenna Analyzer GUI Overview

Display Layout

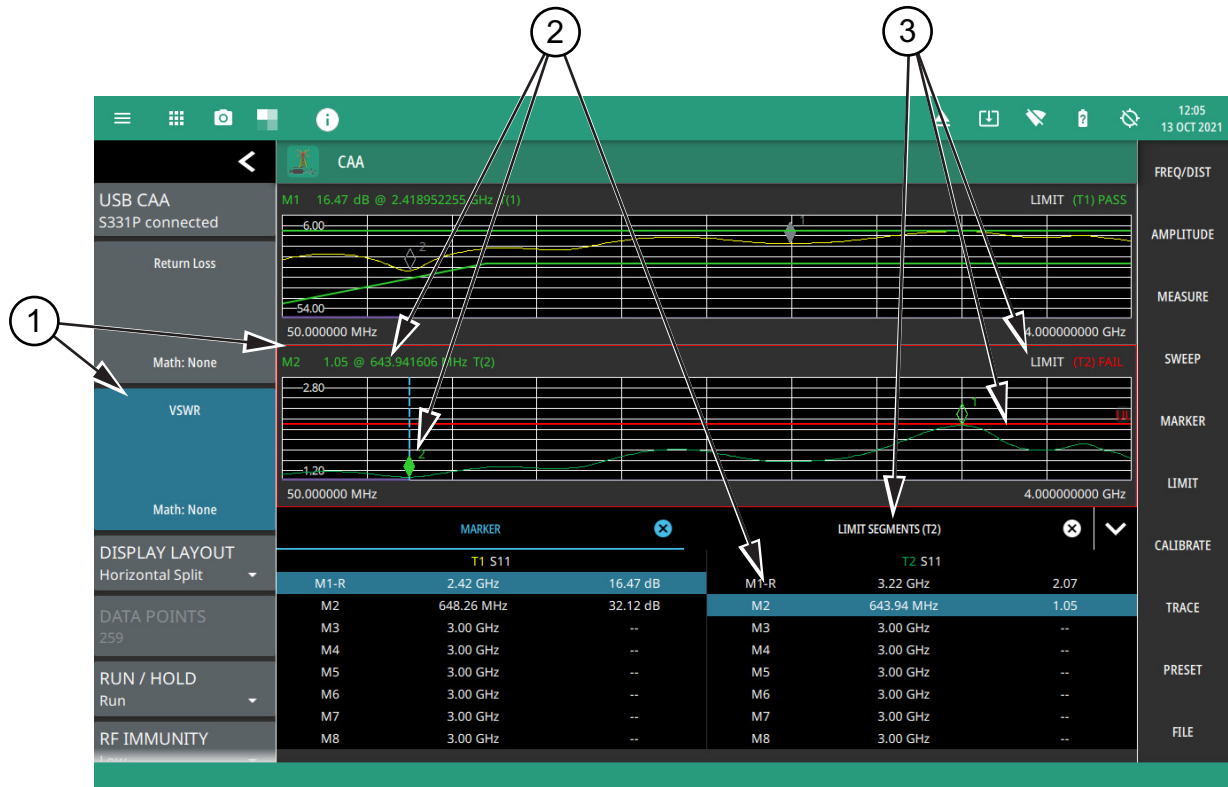
The Cable and Antenna Analyzer CAA can display a single measurement or two different measurements simultaneously (Horizontal Split). Different amplitudes, limit lines, and markers can be set for each display; the frequency range and calibration parameters are common to both displays. Marker and limit line tables can be toggled on and off, showing all marker and limit line values for either the single measurement or both measurements. Figure 2-4, “Single Measurement Display” shows an overview of the measurement display area for a single measurement display layout.



- Trace Card:** In single display layout, the upper trace card identifies the measurement type and related details. See “Status Panel” on page 2-7 for a description of trace cards.
- Markers:** Marker data is displayed at the top of the measurement scale and in the marker table below the measurement. The active marker has a solid fill and is highlighted in the marker table. The vertical blue line is also placed on the active marker and can be used to drag the markers position. Refer to Section 2-9 “Setting Up Markers” on page 2-34.
- Limits:** When enabled, limit lines appear on the display as green (passing) or red (failing). The pass/fail condition is indicated at the top of the scale. Additionally, when segmented limit lines are enabled, a limit table can be toggled on. Refer to Section 2-10 “Setting Up Limit Lines” on page 2-40.

Figure 2-4. Single Measurement Display

Figure 2-5, “Split Measurement Display” shows an overview of the measurement display area for a horizontal split measurement display layout.



1. **Trace Card and Active Trace:** In horizontal split (dual) display layout, the active trace card is highlighted in blue and identifies the measurement type and related details. In addition, the active trace measurement area is outlined in a red box. See “Status Panel” on page 2-7 for a description of trace cards. The settings for amplitude, measurements, markers and limits, and trace memory apply only to the active trace measurement.
2. **Markers:** Marker data is displayed at the top of the measurement scale and in the marker table below the measurements. The active marker has a solid fill and is highlighted in the marker table. The vertical blue line is also placed on the active marker and can be used to drag the marker position. The marker table applies to the active trace measurement only. Refer to Section 2-9 “Setting Up Markers” on page 2-34.
3. **Limits:** When enabled, limit lines appear on the display as green (passing) or red (failing). The pass/fail condition is indicated at the top of the scale. Additionally, when segmented limit lines are enabled, a limit table can be toggled on. The limit table applies to the active trace measurement only. Refer to Section 2-10 “Setting Up Limit Lines” on page 2-40.

Figure 2-5. Split Measurement Display

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/DIST	FREQ/DIST: Contains all frequency and distance settings including start and stop frequency, measurement distance, distance-to-fault (DTF), and cable parameters. Refer to Section 2-5 “Setting Frequency and Distance Parameters” .
AMPLITUDE	AMPLITUDE: Provides access to all amplitude-related settings such as top and bottom of the graticule and scale settings. Refer to Section 2-6 “Setting Amplitude Parameters” .
MEASURE	MEASURE: Used to select the measurement trace and measurement type such as return loss, VSWR, DTF, cable loss, smith chart, and one-port phase, and for setting the display layout. Refer to Section 2-7 “Setting up a Measurement” .
SWEEP	SWEEP: Provides controls for sweep behaviors, number of measurement points, and RF immunity settings. Refer to Section 2-8 “Setting Sweep Parameters” .
MARKER	MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 2-9 “Setting Up Markers” .
LIMIT	LIMIT: Provides controls for setting up limit lines and limit alarms. Refer to Section 2-10 “Setting Up Limit Lines” .
CALIBRATE	CALIBRATE: Sets the calibration type and method and begins the calibration. Refer to Section 2-11 “Calibration” .
TRACE	TRACE: Provides trace memory controls and trace math settings. Refer to Section 2-12 “Setting Trace Parameters” .
PRESET	PRESET: Opens the PRESET menu with selective trace, marker, and setup preset commands, or an all inclusive analyzer preset command. Refer to Section 2-13 “Presetting the Analyzer” .
FILE	FILE: Used to save and recall instrument setups and measurements, and screen images. Also provides access to save on event controls. Refer to “FILE Menu” on page 2-69 and the “File Management” section in the Instrument overview chapter of the user guide.

Figure 2-6. Main Menu

Using Menus

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

- Selecting a main menu button opens the associated menu.
- The name of the button selected 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.
- Selecting 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.
- Selecting Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

Status Panel

The status panel with the corresponding minimized status panel icons illustrated in this section are unique to the CAAUSB and to the particular measurement and view that is selected. Below is the CAAUSB status panel that covers all cable and antenna analyzer measurements, including return loss, voltage standing wave ratio, distance-to-fault, smith chart, and 1-port phase, and transmission measurements (selected via MEASURE > MEASUREMENT menu).

	<p>Selecting any of these parameters opens the associated menu or quick access pop-up that allows you to conveniently change the parameter value. These are the same settings found in the right side menus.</p> <p>USB CAA: Indicates the model of the connected sensor. This does not apply to the transmission measurement.</p> <p>Top and Bottom Trace Cards: The trace cards are divided into three separate areas that display information relevant to the selected measurement:</p> <ul style="list-style-type: none"> • The top area displays the selected measurement. • When the measurement type is DTF or cable loss, the middle area displays cable information (cable list selection, propagation velocity, and/or cable loss information). When the measurement type is transmission, it displays the connected sensor information. • The bottom area displays the trace math setting. Each of these areas are touchable and will access the relevant settings. <p>Note that the top trace card applies to CAA measurement and the bottom trace card applies to HIPM measurement.</p> <p>DISPLAY LAYOUT: Selects between a single, full-size measurement layout or horizontal split layout.</p> <p>DATA POINTS: Opens the data points selection menu. Data points can be set to 130, 259, 517, 1033, or 2065 points per sweep.</p> <p>RUN/HOLD: Sets the sweep to either run or hold mode.</p> <p>RF IMMUNITY: Sets the reflection RF measurement to High or Low.</p>
--	---

Figure 2-7. Cable and Antenna Analyzer Status Panel with Mini Status Panel Icons

2-4 Measurement Overview

Line Sweep Measurements

System performance issues are seen in two ways: excessive reflections (more common) caused by impedance mismatches or excessive insertion losses (less common) caused by energy dissipated in the connectors or cables.

The two measurements used to determine communication system performance are:

- Return Loss or Voltage Standing Wave Ratio (VSWR) for reflections
- Cable Loss (Insertion Loss) for insertion losses

It is important to remember that return loss and VSWR are typically Pass/Fail tests. They both measure reflection but display the results in different ways. For either measurement, set a limit line to the specification determined by the carrier and make the measurement. If the *entire* frequency range swept is below the line, the test passes. If *any* part of the sweep is at or above the limit line, the test fails. With a failed test, one or more components is at fault. Distance-to-fault mode is used to find the problem.

The second common line sweeping measurement is cable loss. This is a measure of how much smaller the output power of a signal is, compared to the input power. The loss comes from heat and leakage. Cable manufacturers will specify the loss per foot or meter at different frequencies and may call it attenuation. The Field Master Series has pre-installed loss specifications for several cable types.

The cable loss measurement is also typically a Pass/Fail measurement and requires a short or open at the cable end. This is a typical measurement specified on new installations or main transmission line replacement but is not typically tested on existing systems.

Note

Anritsu recommends connecting directly to the S331P RF port. If this is not possible, using a phase-stable test port cable attached to the S331P RF port can extend the range. When using an extension cable, calibrate at the open end of the cable.

Refer to [Section 2-7 “Setting up a Measurement”](#) for detailed discussion of each measurement.

Common RF Terms

- 3 dB Rule:** A 3 dB gain means twice (x2) the power. A 3 dB loss means half the power. For example, a system with 40 watts of input power and a 6 dB insertion loss will only have 10 watts of output power.
- dB:** Decibel, a logarithm (equal to 10 times) ratio of the difference between two values. The Field Master Series uses dB to measure the ratio of sent signal energy to reflected signal energy. Common values of dB to ratios:
0 dB = 1:1, 10 dB = 10:1, 20 dB = 100:1, 30 dB = 1,000:1, -30 dB = 0.001:1. or (1/1000):1.
- dBm:** An absolute measurement of power relative to 1 milliwatt.
0 dBm = 1.0 milliwatt, 10 dBm = 10 milliwatt, 30 dBm = (1 mW x 1,000) = 1 watt.
- DTF:** (Distance to Fault) Measures the location and reflection size of impedance mismatches. This is typically a diagnostic measurement, not a pass/fail judgment measurement. DTF is used to identify and locate faults within an antenna system when the system is failing to meet the specified return loss/VSWR limits. DTF is also useful to verify the total length of a coaxial cable assembly.
- Impedance:** A measure of an RF components electrical resistance. Measured in ohms (W). In most cable and antenna systems the standard impedance is 50 W.
- Insertion Loss:** (Cable Loss) Measures the total amount of signal energy absorbed (lost) by the cable assembly. Measured in dB. S21 is another name for this measurement. This is often a pass/fail measurement.
- Return Loss:** Measurement in dB of reflected energy caused by impedance mismatch. May also be referred to as S11. S11 values are expressed as negative numbers, but Return Loss values are expressed as positive numbers since by definition the “Loss” expression implies a negative sign. The higher the value, the better the impedance match (think of a large negative number being less than a smaller negative number). 40 dB is nearly ideal. Only 0.01% of the total transmitted power is reflected if the Return Loss measurement value is 40 dB. 0 dB would be a complete reflection, or stated another way, 100% of the transmitted power is reflected back. Return Loss is typically a pass/fail measurement.
- RF:** (Radio Frequency) Frequency of radio sine waves. RF range is 3 kHz to 300 GHz.
- VSWR:** (Voltage Standing Wave Ratio) Another method to measure reflected energy caused by impedance mismatch. Expressed as a ratio of X:1. VSWR measures the voltage peaks and valleys. 1:1 would be a perfect match. A typical cable and antenna system would be around 1.43:1 or 15 dB Return Loss. The Field Master Series can measure either Return Loss or VSWR. Some carriers require that Return Loss is measured in VSWR. This is typically a pass/fail measurement.
- Watt:** Unit of measure for power.

2-5 Setting Frequency and Distance Parameters

The frequency and distance menu provides access to start and stop settings, and related settings for cable parameters and windowing. The start and stop settings must be made prior to a user calibration. Changing these settings after a calibration will disable the current user calibration and a new calibration will need to be performed.

Setting Frequency

1. Select **FREQ/DIST** on the main menu to open the “[FREQ/DIST Menu](#)” on page 2-12.
2. Select **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 right edge of the menu.
4. Select the appropriate frequency unit to terminate the entry or select **ACCEPT** to terminate the entry with the current frequency unit.
5. Select **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 right edge of the menu.
7. Select the appropriate frequency unit to terminate the entry or select **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 display graph.

Setting Distance

1. Select **FREQ/DIST** on the main menu to open the [“DISTANCE Menu” on page 2-12](#).
2. Select **DISTANCE** to access the **DISTANCE** menu.
3. Select **START DISTANCE** to open the start distance parameter entry keypad.
4. Enter the desired start distance in meters or feet.
5. Select the appropriate distance unit to terminate the entry or press **ACCEPT** to terminate the entry with the current distance unit.
6. Select **STOP DISTANCE** to open the stop distance parameter entry keypad.
7. Enter the desired stop distance in meters or feet.
8. Select the appropriate distance 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 distance value up or down, press the + or – slider controls to increment the distance in steps. You can also drag the distance using the slider.

The center distance will be set to exactly the middle of the start and stop distance. The current settings are shown along the bottom of the display graph.

9. To access and change other **DTF** parameters, press **DTF AID** or **DTF SETUP**, then select a parameter in the menu to edit.

The **DTF AID** displays **DTF** info relevant to the current instrument setup and provides dynamic, on-screen guidance for the settings that you access. **DTF AID** provides most of the distance related parameter settings. The **DTF SETUP** menu is more condensed and does not display the on-screen guidance.

Refer to [“DTF Return Loss and DTF VSWR Measurement” on page 2-20](#).

FREQ/DIST Menu

FREQ/DIST ✕	<p>Changing the start or the stop frequency requires turning off User Cal if the active Cal Type is Standard. Use Flex Cal to allow frequency range adjustments with User Cal on. Refer to “Calibration Types” on page 2-47.</p>
START FREQUENCY 500 kHz	<p>START FREQUENCY: Sets the start frequency of the sweep range. Selecting the plus (+) or minus (-) control moves the start frequency in discrete steps.</p>
STOP FREQUENCY 6 GHz	<p>STOP FREQUENCY: Sets the stop frequency of the sweep range. Selecting the plus (+) or minus (-) control moves the start frequency in discrete steps.</p>
DISTANCE ↵	<p>DISTANCE: Opens the “DISTANCE Menu” on page 2-12.</p>
DTF SETUP ↵	<p>DTF SETUP: Opens the “DTF SETUP Menu” on page 2-14.</p>

Figure 2-8. FREQ/DIST Menu

DISTANCE Menu

FREQ/DIST ✕	<p>START DISTANCE: Enters a start distance value for the measurement. The start distance must be shorter than the stop distance.</p>
DISTANCE ←	<p>STOP DISTANCE: Enters the stop distance for the measurement. The maximum stop distance is 1500 m (~4921 ft).</p>
START DISTANCE 0 m	<p>Note that the maximum distance measurement (from start to stop) is dependent on frequency span and the number of sweep points.</p>
STOP DISTANCE 2.600000 m	<p>UNITS: Selects distance units of meters or feet.</p>
UNITS Meters ▼	<p>DTF AID: Opens the “DTF AID Menu” on page 2-13, providing on-screen guidance and access to multiple measurement settings. Also displays current measurement setup information and maximum testing distance and resolution.</p>
DTF AID ↵	<p>DTF SETUP: Opens the “DTF SETUP Menu” on page 2-14.</p>
DTF SETUP ↵	

Figure 2-9. DISTANCE Menu

DTF AID Menu

DISTANCE ✕	START DISTANCE: Enters a start distance value for the measurement. The start distance must be shorter than the stop distance.
DTF AID ←	STOP DISTANCE: Enters the stop distance for the measurement. The maximum stop distance is 1500 m.
START DISTANCE 0 mm	Note that the maximum distance measurement (from start to stop) is dependent on frequency span and the number of sweep points.
STOP DISTANCE 2.600000 m	UNITS: Selects distance units of meters or feet.
UNITS Meters ▼	START FREQUENCY: Sets the start frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.
START FREQUENCY 1 MHz	STOP FREQUENCY: Sets the stop frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.
STOP FREQUENCY 6 GHz	DATA POINTS: Selects the number of data points for the sweep: 130, 259, 517, 1033 or 2065.
DATA POINTS 259	CABLE LIST: Opens a list of available cable specifications (see Figure 2-17 on page 2-21).
CABLE LIST NONE	When a cable is selected from this list, propagation velocity and cable loss are automatically set by the instrument. If the preselected values for propagation velocity or cable loss are changed, the analyzer will use “NONE” as the cable type.
CABLE LOSS 0 dB/mm	CABLE LOSS: Manually enters a cable loss value.
PROP VEL 1	PROP VEL: Manually enters a propagation velocity value.
WINDOWING Nominal Side Lobe ▼	WINDOWING: Selects the windowing for the measurement: <ul style="list-style-type: none"> • Rectangular: Rectangular windowing shows the highest side lobe levels (worst) and the greatest main lobe resolution (best). • Nominal Side Lobe: Nominal side lobe windowing shows less side lobe levels than rectangular windowing (good) but lower main lobe resolution (very good). • Low Side Lobe: Low side lobe windowing shows less side lobe levels than nominal windowing (very good) but lower main lobe resolution (good). • Minimum Side Lobe: Minimum side lobe windowing shows the lowest side lobe levels (best) but the least main lobe resolution (worst).

Figure 2-10. DTF AID Menu

DTF SETUP Menu

<p>FREQ/DIST ⊗</p>	<p>CABLE LIST: Opens a list of available cable specifications (see “Cable List” on page 2-21).</p>
<p>DTF SETUP ←</p>	<p>When a cable is selected from this list, propagation velocity and cable loss are automatically set by the instrument. If the preselected values for propagation velocity or cable loss are changed, the analyzer will use “NONE” as the cable type.</p>
<p>CABLE LIST RG-8 (9913)</p>	<p>CABLE LOSS: Manually enters a cable loss value.</p>
<p>CABLE LOSS 0.144000 dB/m</p>	<p>PROP VEL: Manually enters a propagation velocity value.</p>
<p>PROP VEL 0.84</p>	<p>WINDOWING: Selects the windowing for the measurement:</p> <ul style="list-style-type: none"> • Rectangular: Rectangular windowing shows the highest side lobe levels (worst) and the greatest main lobe resolution (best). • Nominal Side Lobe: Nominal side lobe windowing shows less side lobe levels than rectangular windowing (good) but lower main lobe resolution (very good). • Low Side Lobe: Low side lobe windowing shows less side lobe levels than nominal windowing (very good) but lower main lobe resolution (good). • Minimum Side Lobe: Minimum side lobe windowing shows the lowest side lobe levels (best) but the least main lobe resolution (worst).
<p>WINDOWING Low Side Lobe ▾</p>	

Figure 2-11. DTF SETUP Menu

2-6 Setting Amplitude Parameters

The amplitude menu includes settings for the vertical measurement scale. These parameters can be changed without affecting the current user calibration.

Setting the Amplitude using Top and Bottom Keys

To manually set the amplitude scale of the measurement display:

1. Select AMPLITUDE on the main menu to open the [“Amplitude Menu” on page 2-16](#).
2. Select TOP and use the keypad to enter the top level value.
3. Select ACCEPT to apply the new power level. To exit without making a change, press CANCEL.
4. Select BOTTOM and use the keypad to enter the bottom level value.
5. Select ACCEPT to apply the new power level. To exit without making a change, press CANCEL.

Setting the Amplitude using Auto Scale

With Auto scale, the instrument will automatically set the top and bottom scales to display the current measurement.

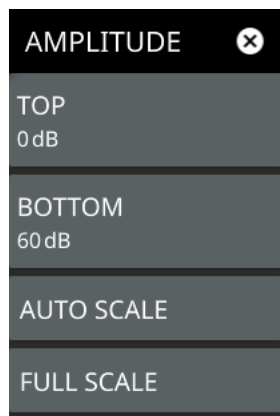
1. Select AMPLITUDE on the main menu to open the [“Amplitude Menu” on page 2-16](#).
2. Select AUTO SCALE.

Setting the Amplitude using Full Scale

With Full scale, the instrument will automatically set the top and bottom scales to the default values based on the measurement type.

1. Select AMPLITUDE on the main menu to open the [“Amplitude Menu” on page 2-16](#).
2. Select FULL SCALE.

Amplitude Menu

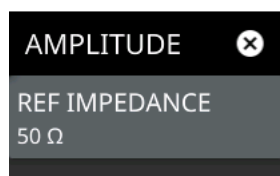


TOP: Sets the top amplitude value of the trace scale.

BOTTOM: Sets the bottom amplitude value of the trace scale.

AUTOSCALE: Automatically sets the top and bottom scales to the minimum and maximum values of the measurement with some margin on the y-axis of the display.

FULLSCALE: Automatically sets the scale to the default setting. 0 dB to 60 dB for return loss measurements, 0 to 30 dB for cable loss, 1 to 65 for VSWR measurements, 450° to -450° for phase measurements.



When measurement results are displayed in a Smith chart, the amplitude menu consists of a single key:

REF IMPEDANCE: Indicates that the reference impedance used for Smith chart calculations is 50 Ω. The reference impedance determines the value of impedance at the center of the Smith Chart. [Figure 2-25](#) illustrates a Smith Chart measurement.

Figure 2-12. AMPLITUDE Menu

2-7 Setting up a Measurement

This section describes how to set up the Cable and Antenna parameters, markers, and limit lines.

Return Loss Measurement

This is a measurement made when the antenna is connected at the end of the transmission line. It provides an analysis of how the various components of the system are interacting.

Return Loss is used to characterize RF components and systems. The Return Loss indicates how well the system is matched by taking the ratio of the reflected signal to the incident signal, and measuring the reflected power in dB.

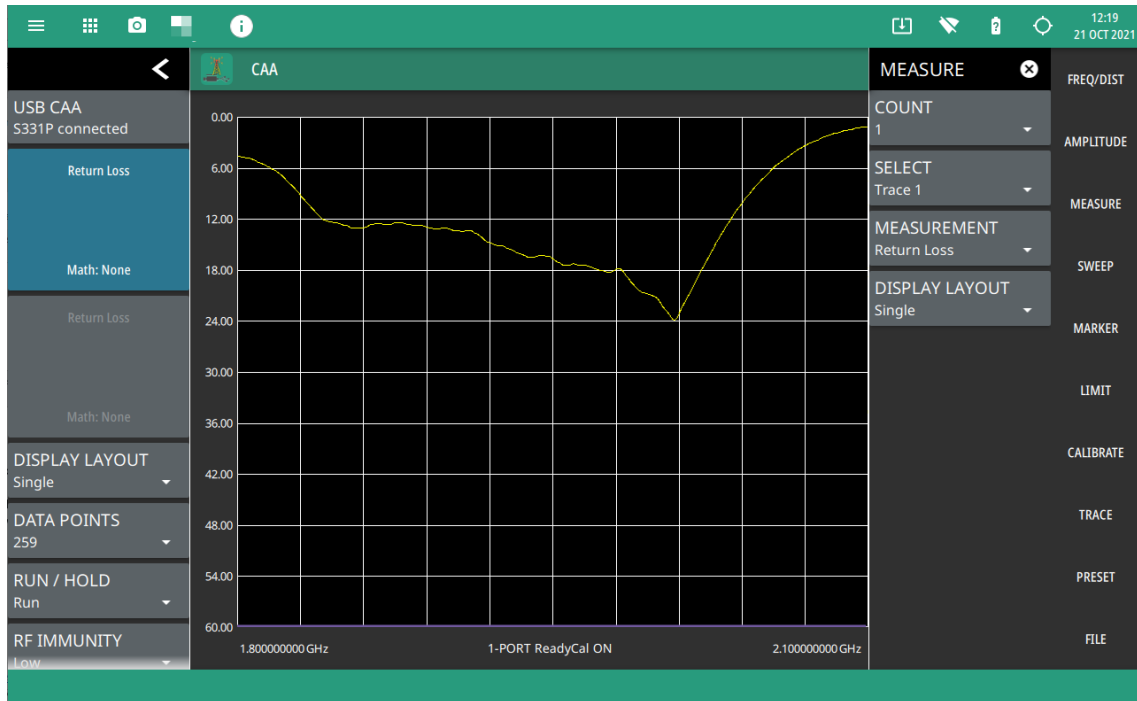


Figure 2-13. Antenna Return Loss Trace

VSWR Measurement

This is a measurement made when the antenna is connected at the end of the transmission line. It provides an analysis of how the various components of the system are interacting.

VSWR is a ratio of voltage peaks to voltage valleys and allows you to view the impedance match. This measurement is similar to return loss, but is the ratio of voltage peaks to voltage valleys caused by reflections.

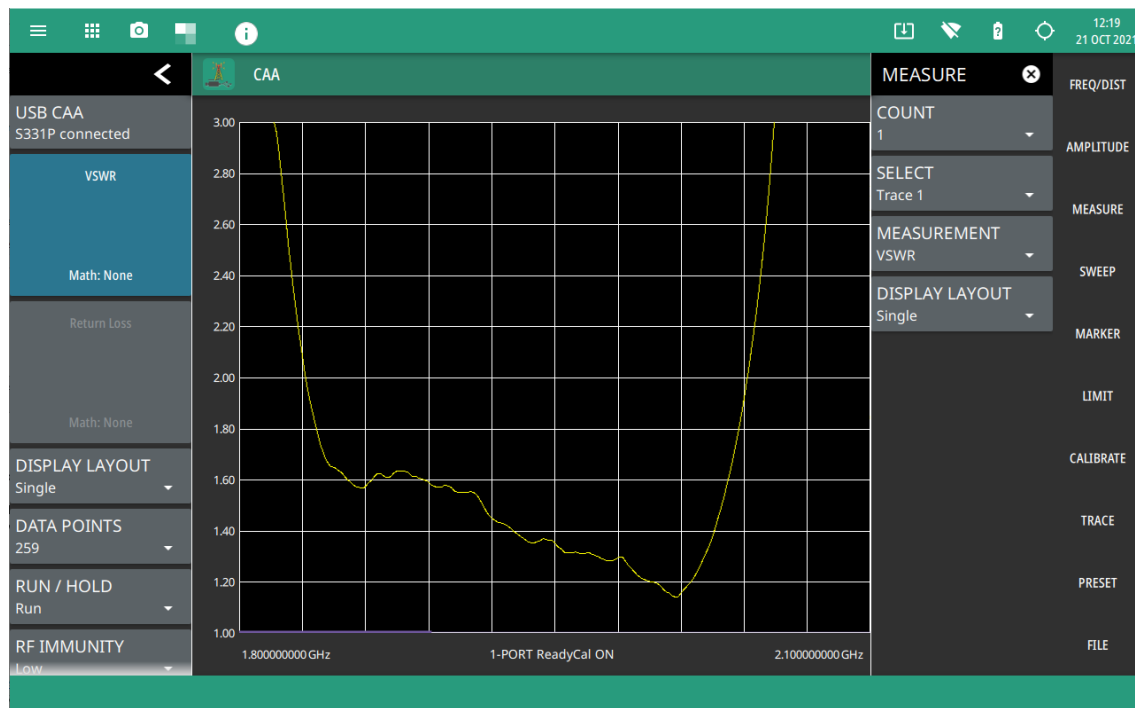


Figure 2-14. Same Antenna Trace in VSWR

To make return loss or VSWR measurements:

1. Select MEASURE on the main menu and then select MEASUREMENT > Return Loss or VSWR.
2. Select FREQ/DIST on the main menu, then enter the start and stop frequencies.
3. Select AMPLITUDE on the main menu, then enter the top and bottom power levels for the display, or press FULL SCALE.
4. For the most accurate results, press CALIBRATION on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).

Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-Port ReadyCal ON).

5. Connect the S331P to the device under test.
6. Select MARKER on the main menu and then set the appropriate markers as described in [“Setting Up Markers” on page 2-34](#).
7. Select LIMIT on the main menu and then set up limit lines as described in [“Setting Up Limit Lines” on page 2-40](#).
8. To save the measurement data or setup to a file, press FILE > SAVE AS..., and then select the location and file type you want to save. Refer to [“Saving a Measurement” on page 2-67](#) for details on saving measurement data or setups to a file.

Cable Loss Measurement

The cable loss measurement verifies the signal attenuation level of a cable. Cable loss sweep is made when a short is connected at the end of the transmission line. This insertion loss test allows analysis of the signal loss through the transmission line and identifies problems in the system. High insertion loss in the feed line or jumpers can contribute to poor system performance and loss of coverage.

Different transmission lines have different losses, depending on frequency and distance. The higher the frequency or longer the distance, the greater the loss. This measurement returns the energy absorbed, or lost, by the transmission line in dB/meter or dB/ft. The average cable loss of the frequency range is displayed on the trace card. [Figure 2-15](#) is a cable loss measurement example.

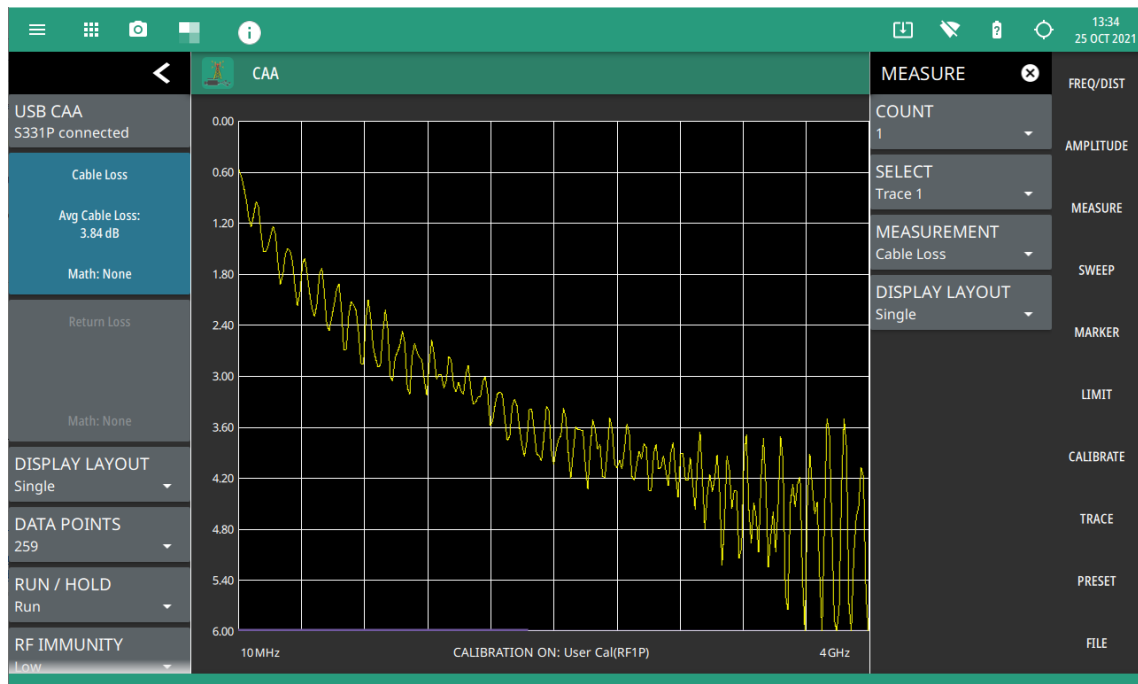


Figure 2-15. Cable Loss Measurement

To make a cable loss measurement:

1. Select **MEASURE** on the main menu and then select **MEASUREMENT > Cable Loss**.
2. Select **FREQ/DIST** and enter the start and stop frequencies.
3. Select **AMPLITUDE**, then enter the top and bottom power levels for the display or press **FULL SCALE**.
4. For the most accurate results, press **CALIBRATION** on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).
Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Connect the S331P to one end of the cable under test, then connect a short to the other end of the cable under test.
6. Select **MARKER** on the main menu and then set the appropriate markers as described in [“Setting Up Markers” on page 2-34](#).
7. Select **LIMIT** on the main menu and set the limit line as described in [“Setting Up Limit Lines” on page 2-40](#). This limit line is used only for visual reference and not a pass/fail guide. The pass/fail determination is based on the average cable loss shown in the trace card.
8. To save the measurement data or setup to a file, press **FILE > SAVE AS...**, and then select the location and file type you want to save. Refer to [“Saving a Measurement” on page 2-67](#) for details on saving measurement data or setups to a file.

DTF Return Loss and DTF VSWR Measurement

Distance-to-Fault (DTF) measurements are made with the antenna disconnected and replaced with a 50 Ω precision load at the end of the transmission line. This measurement allows analysis of the various components of the transmission feed line system in the DTF mode.

This measurement reveals the precise fault location of components in the transmission line system. This test helps to identify specific problems in the system, such as connector transitions, jumpers, kinks in the cable or moisture intrusion.

The first step is to measure the distance of a cable. This measurement can be made with an open or a short connected at the end of the cable. The peak indicating the end of the cable should be between 0 dB and 5 dB. An open or short should not be used when DTF is used for troubleshooting the system because the open/short will reflect most of the RF energy from the S331P and the true value of a connector might be misinterpreted or a good connector may look like a failing connector.

A 50 Ω load is the best termination for troubleshooting DTF problems because it will be 50 Ω over the entire frequency range. The antenna can also be used as a terminating device, but the impedance of the antenna will change over different frequencies since the antenna is typically only designed to have 15 dB or better return loss in the passband of the antenna.

DTF measurement is a frequency domain measurement and the data is transformed to the time domain. The distance information is obtained by analyzing how much the phase is changing when the system is swept in the frequency domain. Frequency selective devices such as TMAs (tower mounted amplifiers), duplexers, filters, and quarter wave lightning arrestors change the phase information (distance information) if they are not swept over the correct frequencies. Care needs to be taken when setting up the frequency range whenever a TMA is present in the path.

DTF Aid

Because of the nature of the measurement, maximum distance range and distance resolution are dependent upon the frequency range and number of data points. DTF Aid (FREQ/DIST > DISTANCE > DTF AID) shown in [Figure 2-16](#) explains how the parameters are related.

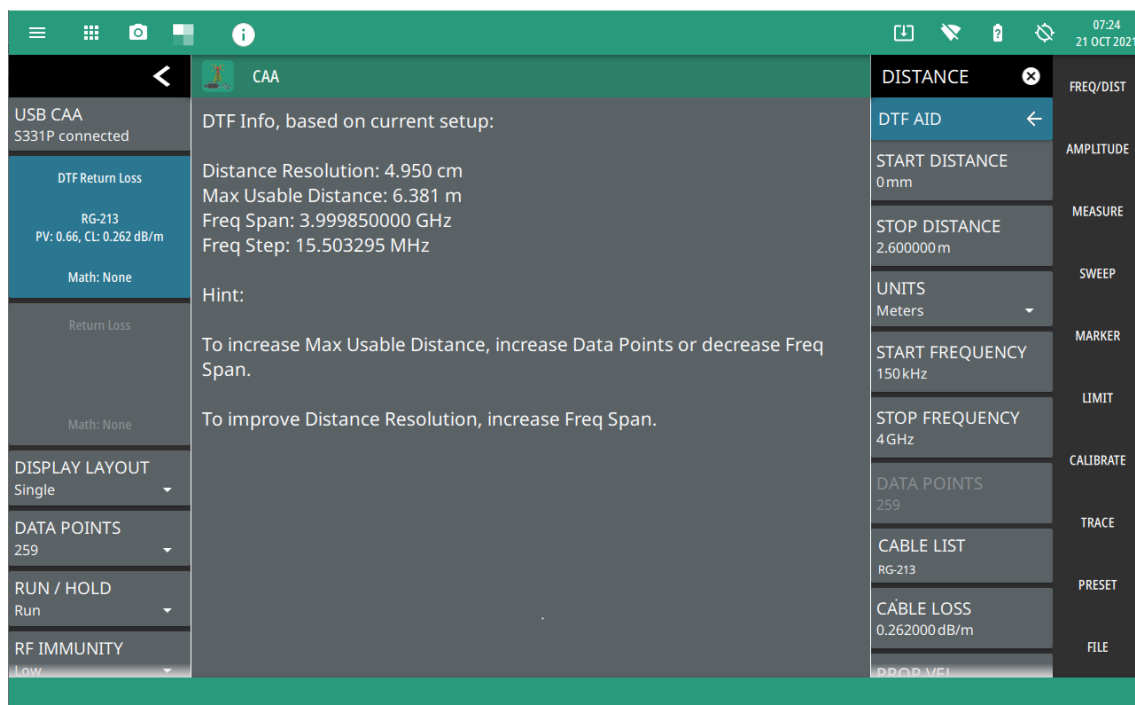


Figure 2-16. DTF Aid

The maximum usable distance may be extended by either increasing the number of sweep data points or by reducing the current frequency span. Distance resolution is inversely proportional to the frequency span and may be increased by setting a wider frequency span. Windowing can also affect distance resolution. For the best distance resolution, select Rectangular Windowing.

Note When determining the frequency range, consider all in-line frequency selective devices.

Cable List

Selecting the cable type is critical for accurate DTF measurements. Incorrect propagation velocity values (PV) affect the distance accuracy, and inaccurate cable attenuation values affect the accuracy of the amplitude values. The Field Master Series Cable and Antenna Analyzer is equipped with a cable list (FREQ/DIST > DTF SETUP > CABLE LIST) including most of the common cables currently used. Once the correct cable has been selected, the instrument will update the propagation velocity and the cable attenuation values to correspond with the cable. For setups with several different cable types, choose the main feeder cable.

For cables not on the list, select **NONE** and manually enter the propagation velocity (PROP VEL) and cable loss in DTF AID or the DTF SETUP menu.

The name, propagation velocity, and cable loss of the selected cable are displayed in the trace card during distance measurements (MEASURE > MEASUREMENT > DTF Return Loss or DTF VSWR) as shown in [Figure 2-17](#).

Select **EXPORT** button on the top right of the cable list window to save the cable list to the instrument's internal memory.

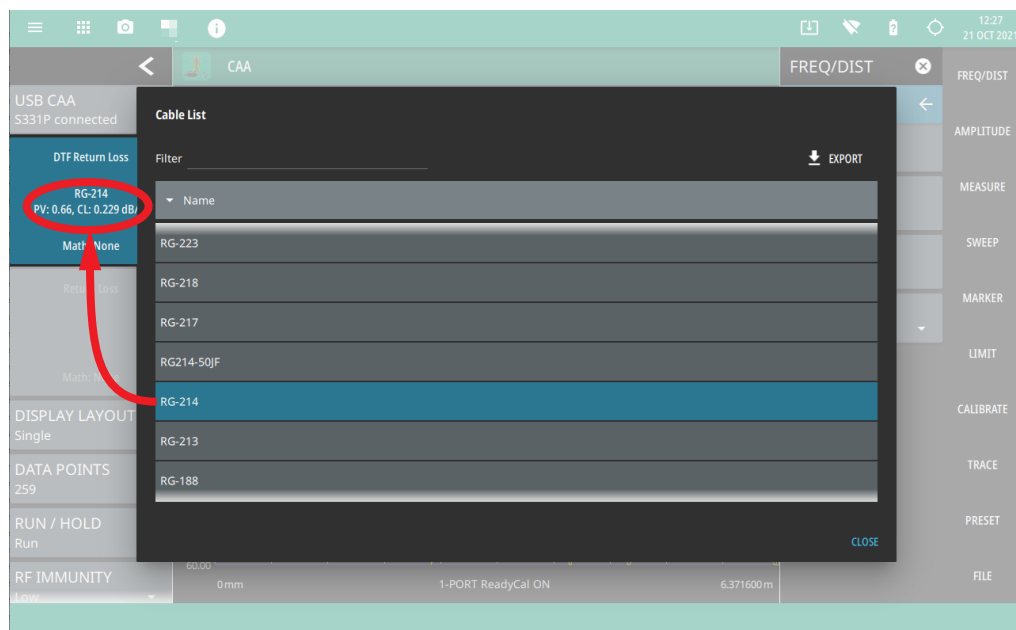


Figure 2-17. Cable List Selection

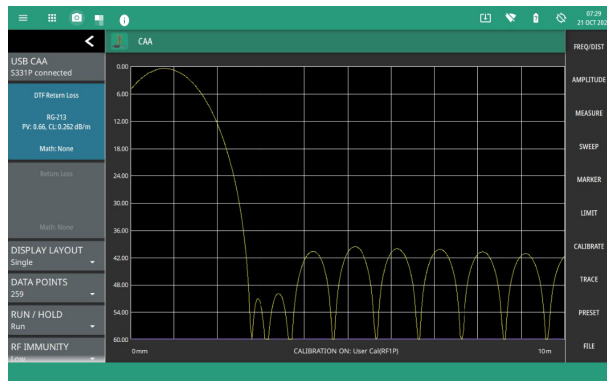
Distance Resolution

Distance resolution is the Field Master Series's ability to separate two closely spaced discontinuities. If the resolution is 5 meters and there are two faults 3 meters apart, the Field Master Series will not be able to show both faults until the resolution is improved by widening the frequency span.

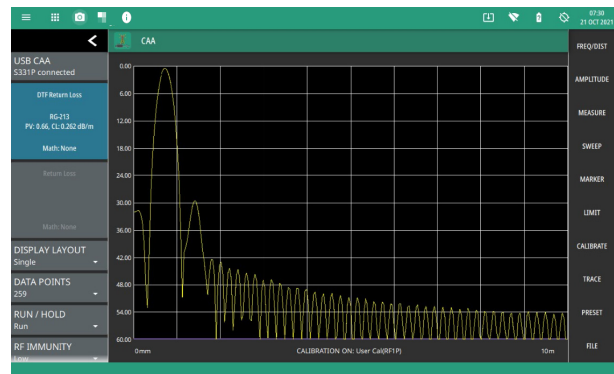
$$\text{Distance Resolution (m)} = 1.5 \times 10^8 \times \text{PV} / \Delta F \text{ (in Hz)}$$

with Rectangular Windowing applied.

Figure 2-18 is an example of the same DTF measurement with a 100 MHz span vs. a 500 MHz span. The increased span provides additional detail that there may be several unique issues with the first 10 meters of the cable. This detail was not available in the narrower span.



100 MHz Span



500 MHz Span

Figure 2-18. DTF Measurements at 100 MHz vs. 500 MHz

Windowing

The theoretical requirement for inverse FFT is for the data to extend from zero frequency to infinity. Side lobes appear around a discontinuity because the spectrum is cut off at a finite frequency. Windowing reduces the side lobes by smoothing out the sharp transitions at the beginning and end of the frequency sweep. The main lobe widens as the side lobes are reduced, thus reducing the resolution.

In situations where a small discontinuity may be close to a large one, side lobe reduction windowing helps to reveal the discrete discontinuities. If distance resolution is critical, then reduce the windowing for greater signal resolution.

If two or more signals are very close to each other, then spectral resolution is important. In this case, use Rectangular Windowing for the sharpest main lobe (the best resolution).

To select the windowing type, follow this key sequence:

FREQ/DIST > DISTANCE > DTF AID > WINDOWING >

- Rectangular windowing provides best spatial distance resolution for revealing closely spaced events, but the side lobes close to any major event (large reflection) may mask smaller events which are close to the major event. Excellent choice if multiple faults of similar amplitudes close together are suspected.

- Nominal Side Lobe windowing provides very good suppression of close-in side lobes, but compromises spatial distance resolution compared to Rectangular. Closely spaced events may appear as a single event, often non-symmetrical in shape. Excellent overall choice for most typical antenna system sweeps.
- Low Side Lobe windowing provides excellent suppression of close-in side lobes, but spatial distance resolution is worse than Nominal Side Lobe. The additional suppression of side lobes may be useful in locating very small reflection events further away from large events. It is not often used for field measurements.
- Minimum Side Lobe windowing provides highest suppression of side lobes but worst spatial distance resolution. Can be useful for finding extremely small events spaced further apart than the distance resolution. *Again, not typically used for field measurements.*

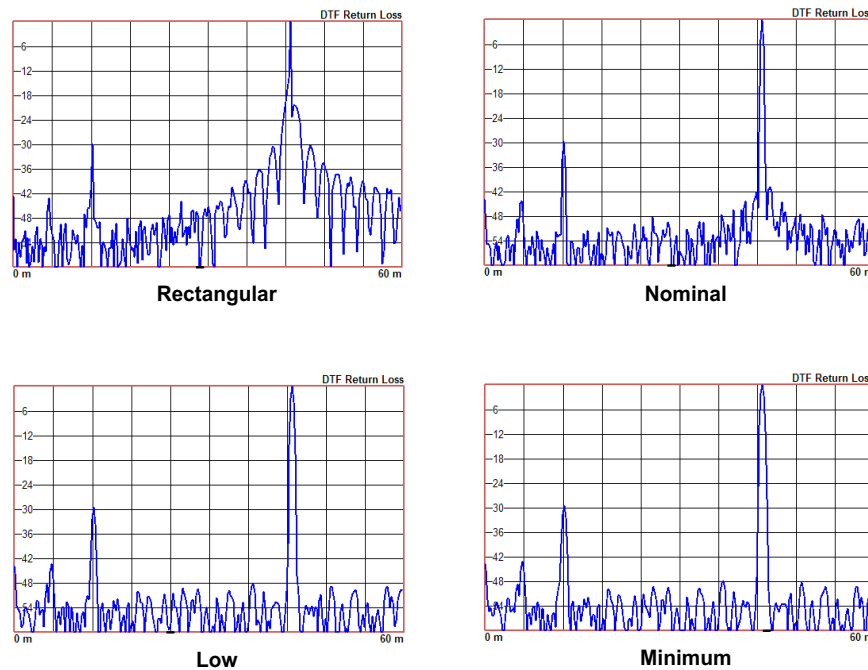


Figure 2-19. Effects of Windowing on a Sample Trace

Maximum Usable Distance

The maximum horizontal distance that can be analyzed is displayed in the DTF Aid Info dialog, of which the stop distance cannot exceed. If the cable is longer than this max distance, the setup needs to be improved by increasing the number of data points or lowering the frequency span. Note that the data points can be set to 130, 259, 517, 1033, or 2065 (SWEEP > DATA POINTS).

$$\text{Max Distance} = (\text{Datapoints} - 1) \times \text{Distance Resolution}$$

To make DTF Return Loss or DTF VSWR measurements:

1. Select MEASURE > MEASUREMENT and select DTF Return Loss or DTF VSWR.
2. Select the FREQ/DIST > DISTANCE > DTF AID, then select a setup parameter and follow the on-screen guidance in the DTF Aid Info dialog.
3. Repeat the above step above to edit more parameters until the setup is complete.
4. For the most accurate results, press CALIBRATION on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).

Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-Port ReadyCal ON).

5. Connect the S331P to the device under test.

Example 1 – DTF with a Short to Measure Cable Length

To measure the length of a cable, DTF measurements can be made with an open or a short connected at the end of the cable. Provided you have selected the appropriate cable type from the “Cable List”, the peak indicating the end of the cable should be 0 dB or a value close to zero. In [Figure 2-20 on page 2-24](#), the cable end is at 20.5 meters.

The cable end was found by selecting Marker 1, then searching for the trace peak. (MARKER > MARKER SEARCH > Peak)

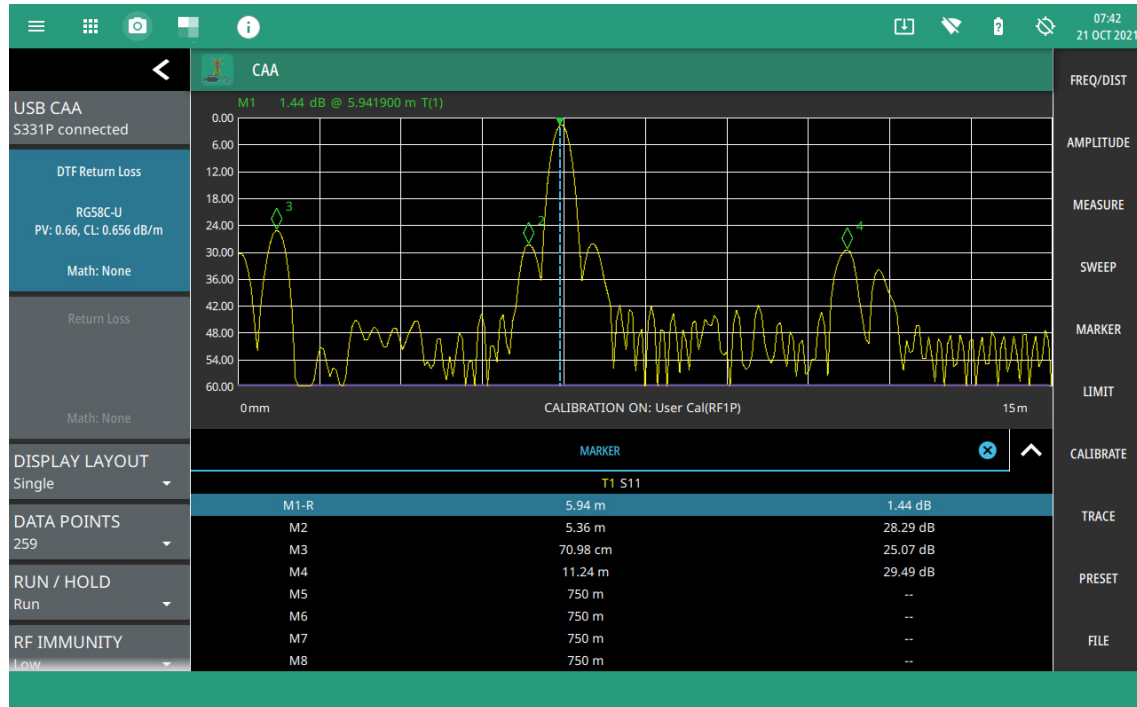


Figure 2-20. DTF Return Loss with a Short at the End of the Cable

Note

In [Figure 2-20](#), M2 and M3 are jumper cable connections at each end of the main cable. The peak beyond the end of the cable at M4 is the return reflection of the M3 peak.

Example 2 – DTF Transmission Line Test

The Distance-to-Fault transmission line test verifies the performance of the transmission line assembly and its components and identifies the fault locations in the transmission line system. This test determines the return loss value of each connector pair, cable component and cable to identify the problem location. This test can be performed in the DTF Return Loss or DTF VSWR mode. Typically, for field applications, the DTF Return Loss mode is used. [Figure 2-21 on page 2-25](#) shows the failure with the antenna still attached.

To perform this test, disconnect the antenna and connect the load at the end of the transmission line ([Figure 2-22 on page 2-25](#)).

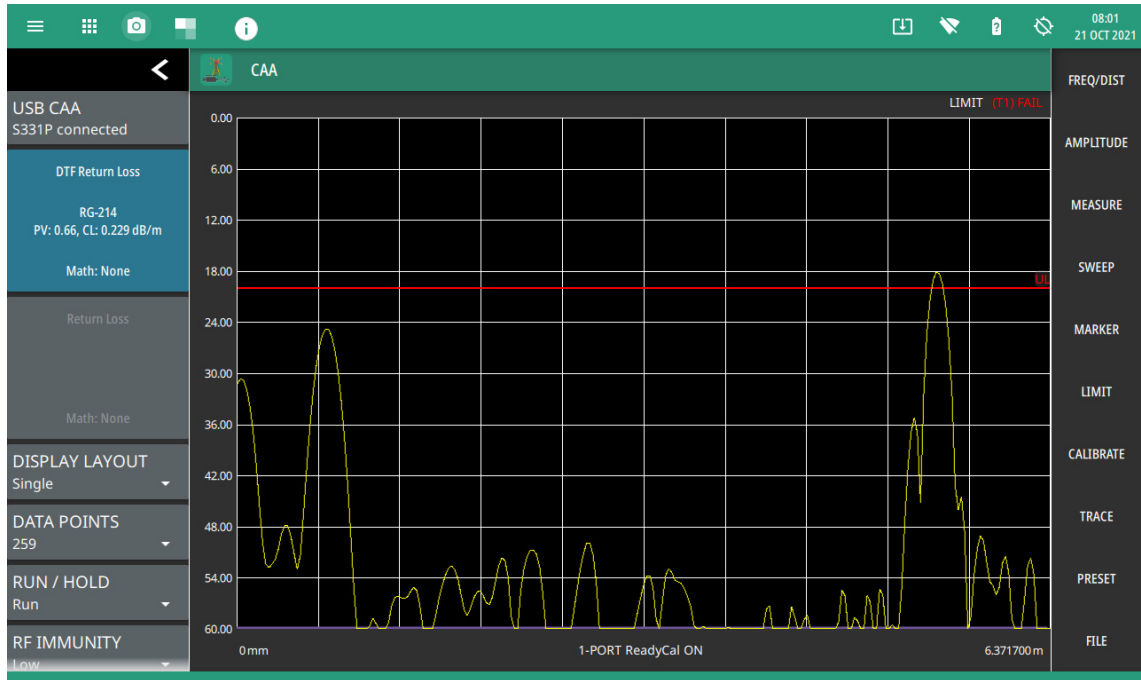


Figure 2-21. Failing DTF Return Loss Measurement (Antenna)

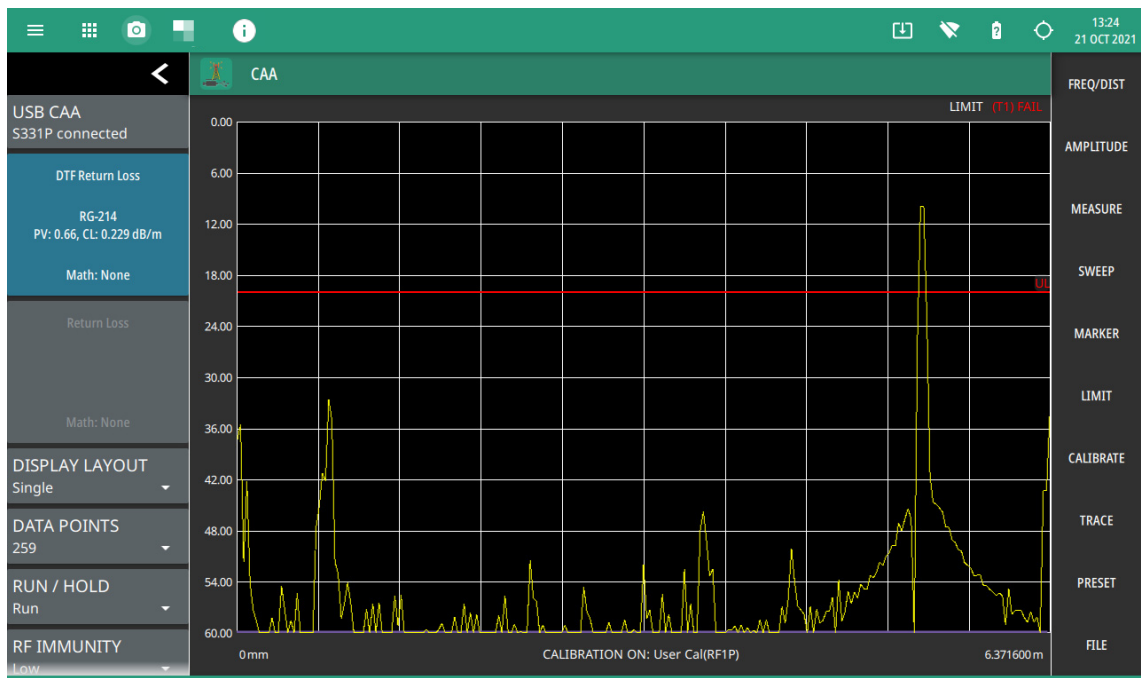


Figure 2-22. Failing DTF Return Loss Measurement (Load)

The jumper connector at the antenna end of the cable was found to be loose and dirty. After cleaning and tightening to specification, another DTF measurement showed that the connector now passed the carrier 20 dB specification, indicated by the limit line (Figure 2-23).

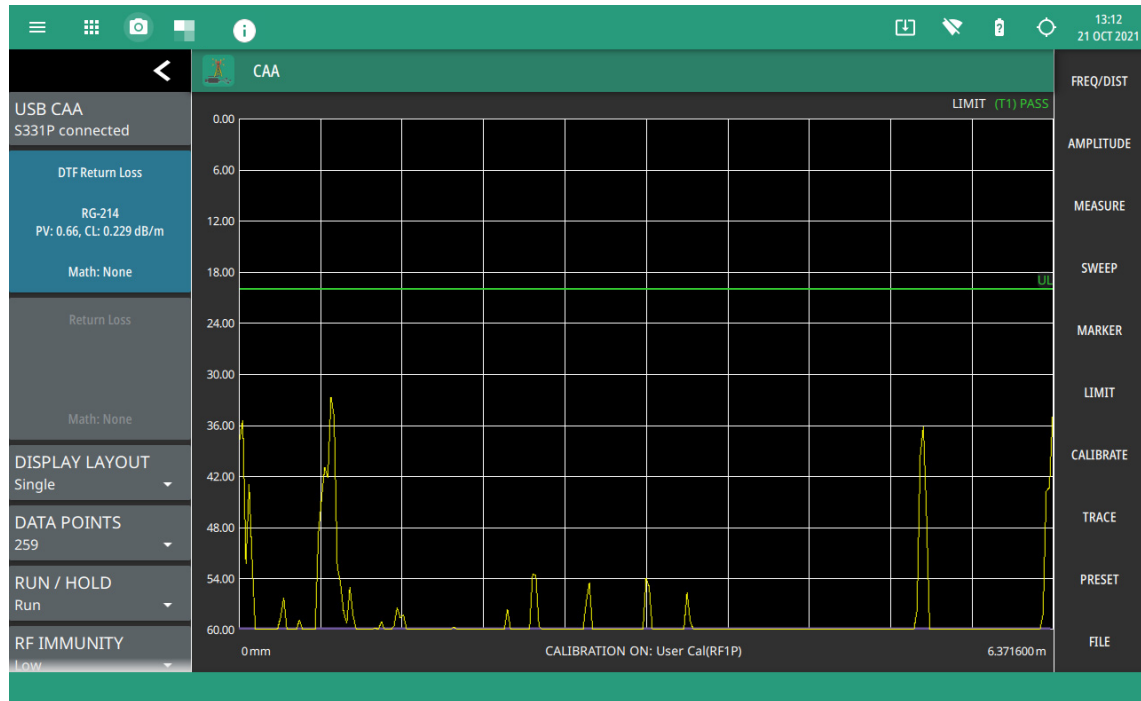


Figure 2-23. Passing DTF Return Loss Measurement (Load)

Figure 2-24 shows the same system with the antenna re-attached. The reflection of the jumper connector is now reduced to 22 dB.

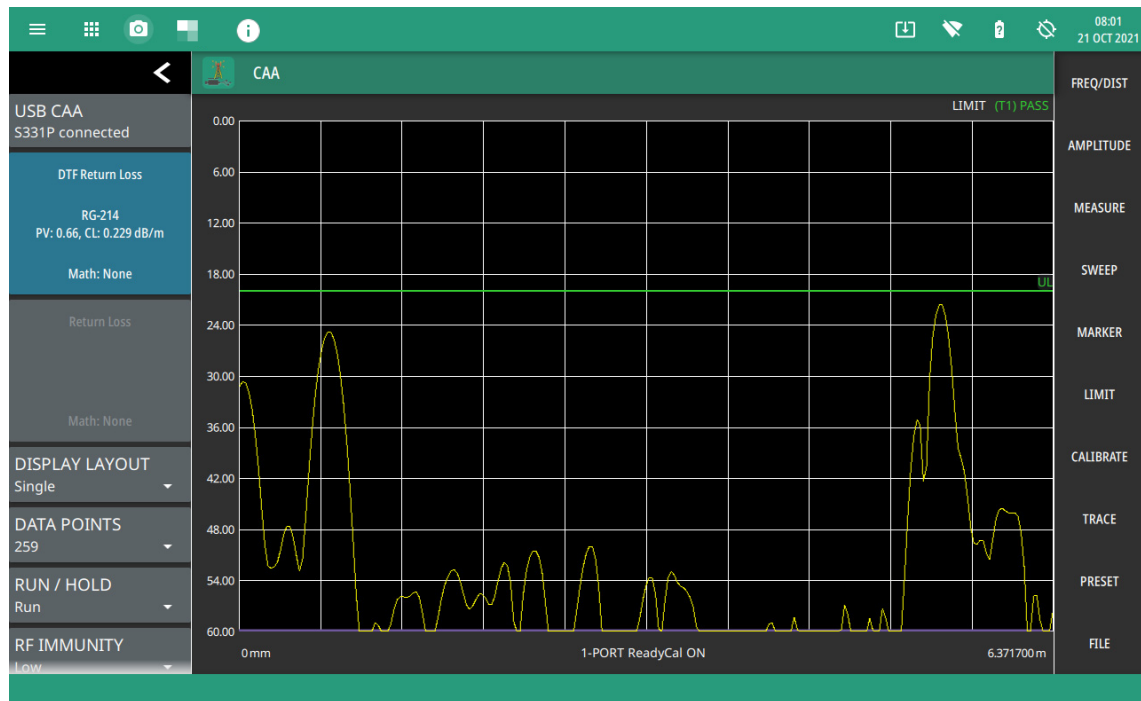


Figure 2-24. DTF Return Loss Measurement (Antenna)

Smith Chart Measurement

The Smith Chart is a graphical tool for plotting impedance data versus frequency. It converts the measured reflection coefficient data into complex impedance data and displays it in a manner that makes the Smith Chart a useful tool for determining and tuning input match. Markers can be used to read the real and imaginary parts of the complex impedance. See the example in [Figure 2-25](#). This impedance plot reveals which matching elements (capacitance, inductance) are necessary to match a device under test to the reference impedance (50 ohms).

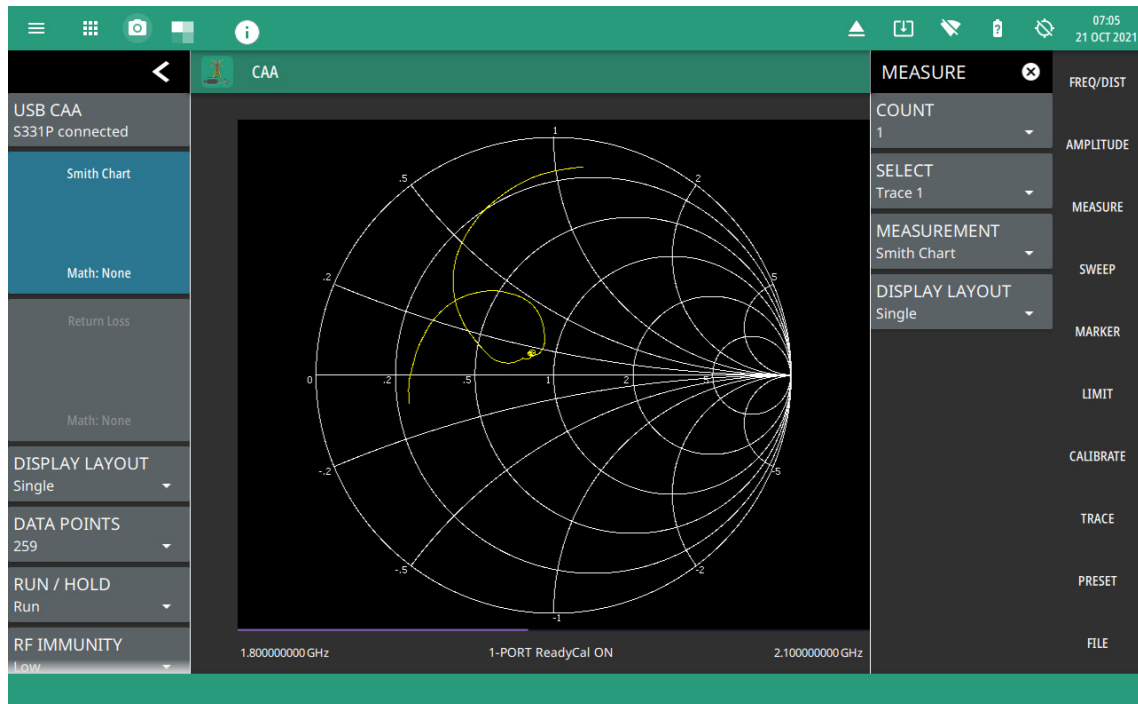


Figure 2-25. Smith Chart Measurement

To make a smith chart measurement:

1. Select **MEASURE** on the main menu and then select **MEASUREMENT > Smith Chart**.
2. Select **FREQ/DIST** and enter the start and stop frequencies.
3. For the most accurate results, press **CALIBRATION** on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).

Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).

4. Connect the S331P to the device under test.
5. Select **MARKER** on the main menu and then set the appropriate markers as described in [“Setting Up Markers” on page 2-34](#).
6. To save the measurement data or setup to a file, press **FILE > SAVE AS...**, and then select the location and file type you want to save. Refer to [“Saving a Measurement” on page 2-67](#) for details on saving measurement data or setups to a file.

1-Port Phase Measurement

The Cable and Antenna Analyzer can display the phase of the reflection measurements at the RF port. The Phase display range is from -450 degrees to $+450$ degrees. The 1-port phase measurement is most useful when making relative measurements (comparing the phase of one device to the phase of another) by utilizing the Trace Math function (Trace – Memory).

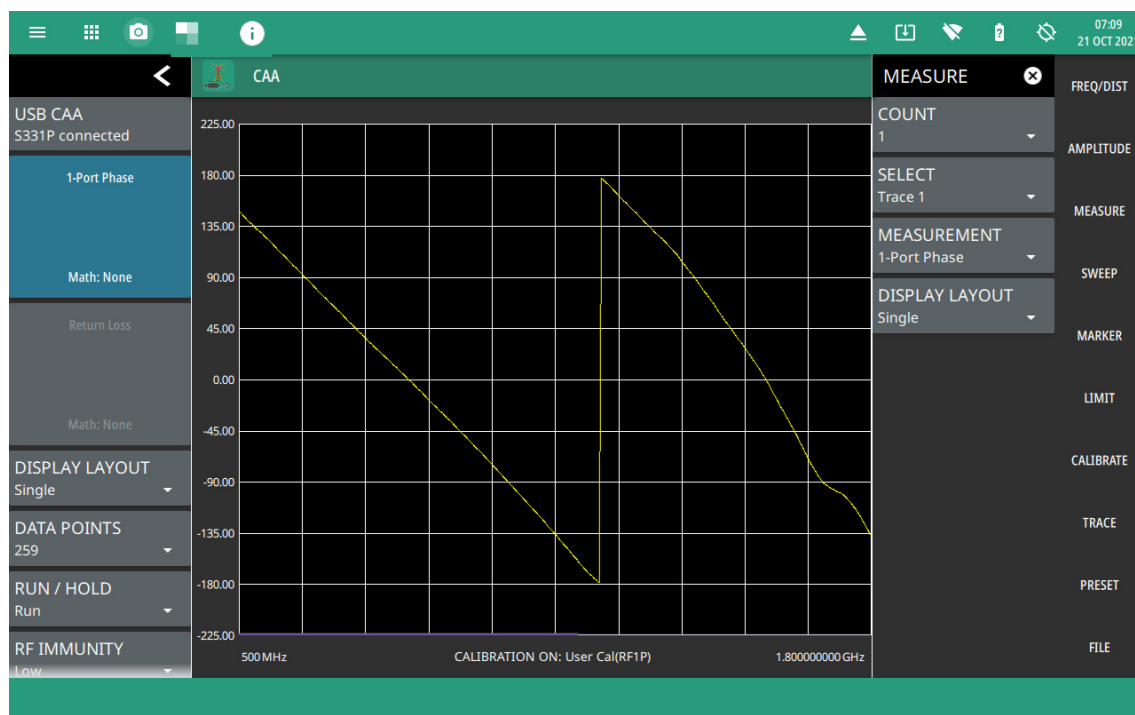


Figure 2-26. 1-Port Phase Measurement

1. Select MEASURE on the main menu and then select MEASUREMENT > 1-Port Phase.
2. Select FREQ/DIST and enter the start and stop frequencies.
3. Select AMPLITUDE, then enter the maximum and minimum angles for the display or press FULL SCALE.
4. For the most accurate results, press CALIBRATION on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).

Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).

5. Connect the S331P to the device under test.
6. Select MARKER on the main menu and then set the appropriate markers as described in [“Setting Up Markers” on page 2-34](#).
7. Select LIMIT on the main menu and set the limit line as described in [“Setting Up Limit Lines” on page 2-40](#). This limit line is used only for visual reference and not a pass/fail guide. The pass/fail determination is based on the average cable loss shown in the trace card.
8. To save the measurement data or setup to a file, press FILE > SAVE AS..., and then select the location and file type you want to save. Refer to [“Saving a Measurement” on page 2-67](#) for details on saving measurement data or setups to a file.

Transmission (Ext. Sensor) Measurement

The Transmission measurement is used to measure the loss (or gain) in dB of a device. This measurement requires that one port of the device be connected directly (or through a test port cable) to the RF port of the S331P. The second port of the device connects to an external USB sensor. To make more accurate cable loss measurements, especially for cables with more than 10 dB of loss, you can use the transmission measurement with an external sensor. For this measurement, connect the cable under test to the RF port of the S331P and connect a USB power sensor to the other end of the cable. USB extenders can be used for long cable runs.

This measurement gives accurate results of cable loss up to 30 dB. This is a scalar measurement, providing only magnitude data (no phase) and, therefore, does not use vector error correction for its calibration steps. Instead, it uses a sensor reference calibration. [Figure 2-27](#) is a cable loss transmission measurement example with an external power sensor, which can be compared to the example shown in [Figure 2-15, “Cable Loss Measurement”](#) on page 2-19.

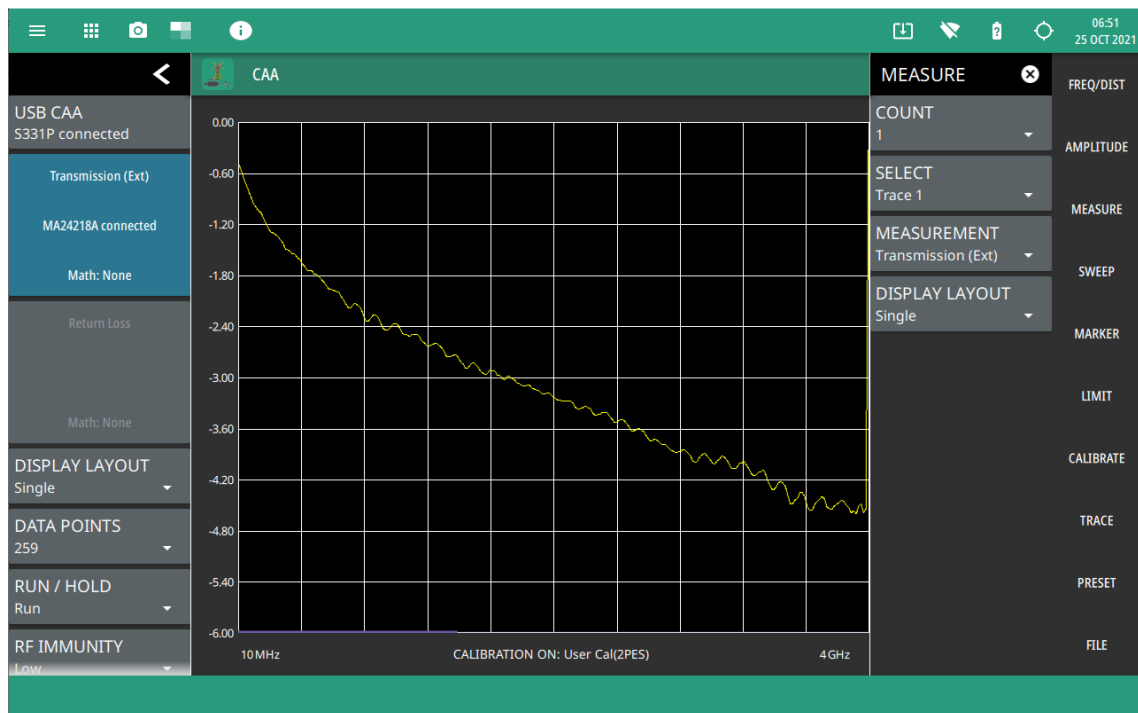


Figure 2-27. External Sensor Transmission Measurement

For best results when performing both transmission and return loss measurements on the same cable, the return loss should be measured with a good-quality termination at the end of the cable.

Note For a list of external USB sensors that are supported by the Cable and Antenna Analyzer for transmission measurements, see the Cable and Antenna Analyzer Technical Data Sheet.

Table 2-1 presents a summary of the typical measurements and required cable end tool. The typical values are for general information purposes. The carriers will provide final values in the acceptance testing specification.

Table 2-1. Cable and Antenna Measurement Overview

Measurement	Mode	End Tool	Marker
TYPICAL PASS/FAIL MEASUREMENTS			
Pass/Fail Test of Cable & Connectors	Freq Return Loss or Freq, SWR	Load	Peak
Pass/Fail Test of System Including Antenna	Freq Return Loss or Freq, SWR	Antenna	Peak
Frequency Range of Antenna	Freq Return Loss or Freq, SWR	Antenna	Valley
Cable Loss	Freq Cable Loss	Short or Open	Peak & Valley
Cable Loss (High Accuracy)	Freq Cable Loss (Open and Short) / 2 using trace memory function	Short and Open	Peak
Return Loss	Freq Return Loss	Load	Peak
TROUBLESHOOTING MEASUREMENTS			
Cable Length	DTF Return Loss or DTF SWR	Short or Open	Peak
Good Cable & Connectors	DTF Return Loss or DTF SWR	Load	Peak
Good System Including Antenna	DTF Return Loss or DTF SWR	Antenna	Peak

To set up a 2-port transmission measurement:

1. Select MEASURE on the main menu and then select MEASUREMENT > Transmission (Ext).
2. Select FREQ/DIST and enter the start and stop frequencies.
3. Select AMPLITUDE, then enter the top and bottom power levels for the display or press FULL SCALE.
4. For the most accurate results, press CALIBRATION on the main menu and perform a manual calibration of the instrument. Refer to [“Calibration Procedure” on page 2-49](#).
Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Connect the S331P and power sensor to the device or cable under test.
6. Select MARKER on the main menu and then set the appropriate markers as described in [“Setting Up Markers” on page 2-34](#).
7. Select LIMIT on the main menu and set the limit line as described in [“Setting Up Limit Lines” on page 2-40](#). This limit line is used only for visual reference and not a pass/fail guide. The pass/fail determination is based on the average cable loss shown in the trace card.
8. To save the measurement data or setup to a file, press FILE > SAVE AS..., and then select the location and file type you want to save. Refer to [“Save File” on page 6-2](#) for details on saving measurement data or setups to a file.

MEASURE Menu

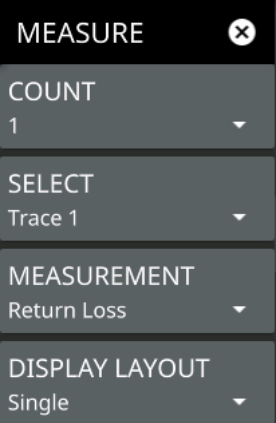
	<p>COUNT: Selects the display format of single (1) or horizontal split (2).</p> <p>SELECT: Used to select which measurement trace is active for setting up measurement parameters.</p> <p>MEASUREMENT: Selects which measurement type is applied to the active measurement trace. The following measurements are supported:</p> <ul style="list-style-type: none"> • “Return Loss Measurement” on page 2-17 • “VSWR Measurement” on page 2-18 • “Cable Loss Measurement” on page 2-19 • “DTF Return Loss and DTF VSWR Measurement” on page 2-20 • “Smith Chart Measurement” on page 2-27 • “1-Port Phase Measurement” on page 2-28 • “Transmission (Ext. Sensor) Measurement” on page 2-29 <p>DISPLAY LAYOUT: Selects either one measurement trace (Single) or two measurement traces (Horizontal Split). In horizontal split display format, the active measurement trace is framed with a red border and the measurement trace card in the status panel will have a blue background. You can touch either trace to make it the active trace.</p>
---	---

Figure 2-28. MEASURE Menu

2-8 Setting Sweep Parameters

The sweep menu includes settings for the number of trace data points, run/hold mode, sweep type, and RF immunity. With the exception of changing the number of trace data points, these settings can be changed without affecting the current user calibration.

Data Points

The number of data points can be set to 130, 259, 517, 1033, or 2065 data points. This can be changed before or after calibration, with one exception (see note below). The default setting is 259. This is recommended for most measurements. Additional data points slow down the sweep speed but are helpful in DTF, as it enables increased distance coverage for the same distance resolution.

Note	Setting data points to 2065 will invalidate the current user calibration that was performed with a lower number of data points. A new calibration is required before making measurements.
-------------	---

1. Select SWEEP on the main menu to open the [“SWEEP Menu” on page 2-33](#).
2. Select DATA POINTS and select 130, 259, 517, 1033, or 2065 data points.

Run/Hold

RUN/HOLD is used to start and stop line sweeping. When in hold mode, the RF output can be set on or off.

1. Select SWEEP on the main menu to open the [“SWEEP Menu” on page 2-33](#).
2. Select RUN/HOLD to and select Run or Hold.
3. When in hold mode, toggle the RF IN HOLD button to enable or disable the RF output.

Sweep Type

This button sets single or continuous sweep mode. In single sweep mode, each sweep is initiated SWEEP ONCE button.

1. Select SWEEP on the main menu to open the [“SWEEP Menu” on page 2-33](#).
2. Select SWEEP TYPE to and select Single or Continuous.
3. When in single sweep mode, press SWEEP ONCE to start one line sweep.

RF Immunity

The RF Immunity setting provides a way to protect the instrument from stray signals generated by nearby or co-located transmitters that can affect measurements. Interfering signals can make the measurement look better or worse than it is. To improve the instrument's ability to reject unwanted signals, you can set the RF immunity to high. However, sweep speed may be slowed as a result.

The RF immunity default setting is low, which makes the instrument more susceptible to interfering signals during a measurement, but optimizes sweep speed. This is appropriate when the instrument is used in an environment where RF noise is not of great concern.

1. Select SWEEP on the main menu to open the [“SWEEP Menu” on page 2-33](#).
2. Select RF IMMUNITY and select either High or Low.

SWEEP Menu

SWEEP ✕	DATA POINTS: Selects the number of data points for the sweep: 130, 259, 517, 1033 or 2065.
DATA POINTS 259	RUN/HOLD: Toggles between Run and Hold. When in hold mode, pressing this key starts the sweeping and provides a trigger. When in the run mode, pressing this key pauses the sweep.
RUN / HOLD Run	SWEEP TYPE: Toggles between single sweep and continuous sweep. In single sweep mode, each sweep must be activated by pressing SWEEP ONCE.
SWEEP TYPE Continuous	SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.
SWEEP ONCE	RF IMMUNITY: Select this key to toggle between RF immunity High or Low. The default setting is Low. Refer to “RF Immunity” on page 2-32 for details.
RF IMMUNITY Low	RF IN HOLD: Select this toggle, to enable or disable RF output, when in hold mode.
RF IN HOLD <input checked="" type="checkbox"/> Output RF when in hold	

Figure 2-29. SWEEP Menu

2-9 Setting Up Markers

Markers can be applied to active or recalled measurements. The instrument supports eight markers. Marker information is stored in measurement and setup files and is displayed when either file type is recalled. Selecting MARKER on the main menu will bring up the marker functions.

Overview of Markers

- Frequency measurements (Return Loss, Cable Loss, VSWR, and Smith Chart, and Transmission (Ext)) have common markers. Distance measurements (DTF Return Loss and DTF VSWR) also have common markers.
- The active marker data is displayed at the top of the measurement scale and indicates the trace to which the marker is attached (i.e., T(1) for trace 1).
- The active marker has a solid fill and is highlighted in the marker table. The vertical blue line is also placed on the active marker (excluding Smith Chart) and can be used to drag the markers position.
- To move a marker, press the marker line and drag. For Smith Chart, use the **+** and **-** buttons below the chart to increment the marker location up or down. To set a more exact location, use the MARKER menu to set a specific frequency or distance value.
- Markers set beyond the current frequency or distance range are displayed at either the left or right of the trace window with an arrow.
- Marker location and type are stored after the marker is turned off.
- PRESET MARKERS restores the markers to their default state. All markers are turned off and previous marker information is not saved.

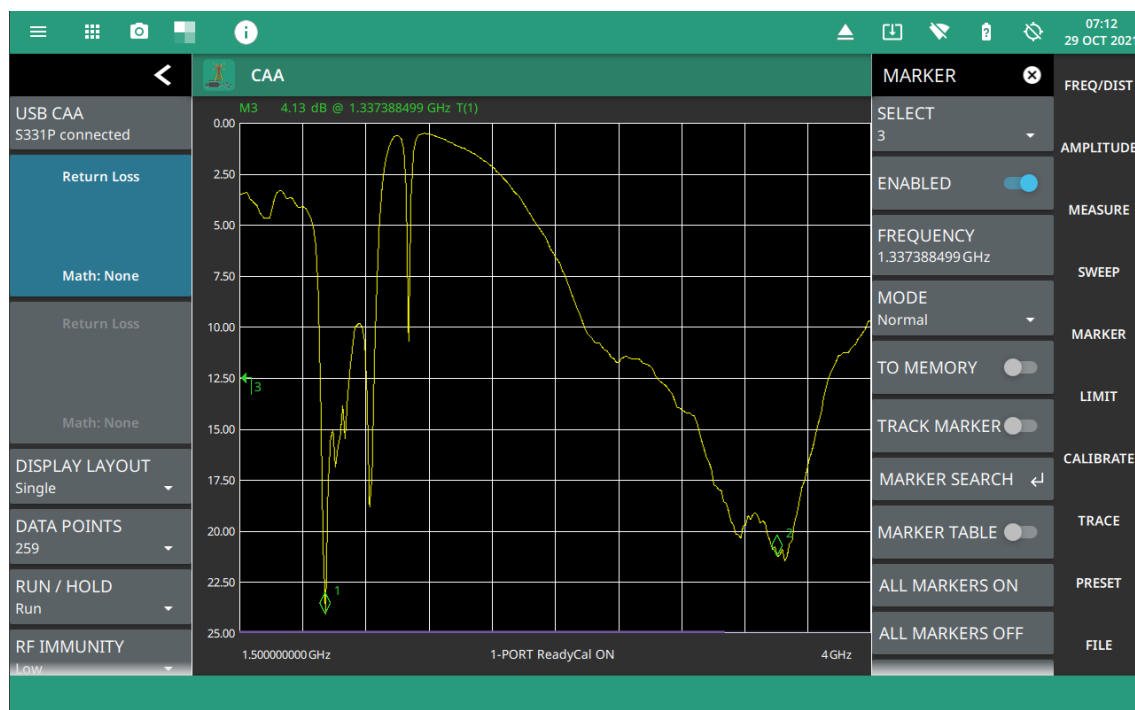


Figure 2-30. Markers 1, 2, and 3 (Marker 3 is Out of Range)

Select, Activate, and Place a Marker / Delta Marker

1. Select MARKER on the main menu. Select a marker by pressing SELECT, then press one of the marker numbers to make it active.
2. Select ENABLED to toggle the marker on or off.
3. Select FREQUENCY or DISTANCE to edit the marker location, or drag the marker on the display. [Figure 2-32](#) shows a marker on the Smith chart, where the location can be changed by using the + or - buttons, or by editing the frequency value.
4. Markers 2 through 8 can be set as a delta marker to the reference marker 1. Select MODE to select the active marker type as a Delta marker. [Figure 2-32](#) illustrates a delta marker between two return loss valleys.

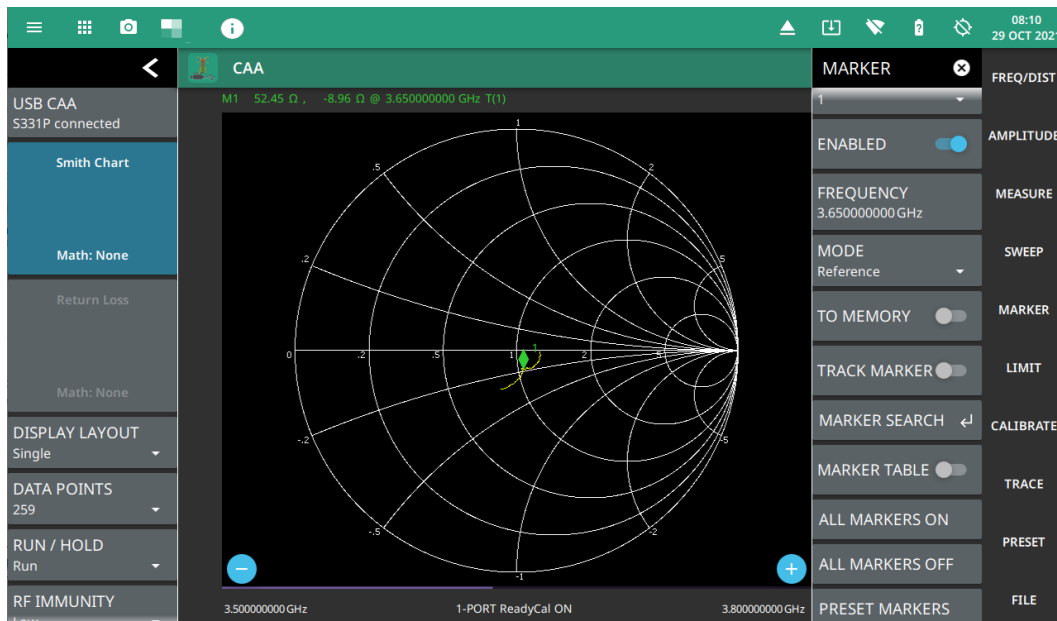


Figure 2-31. Markers on Smith Chart (use the + or - buttons to move the marker location in increments)

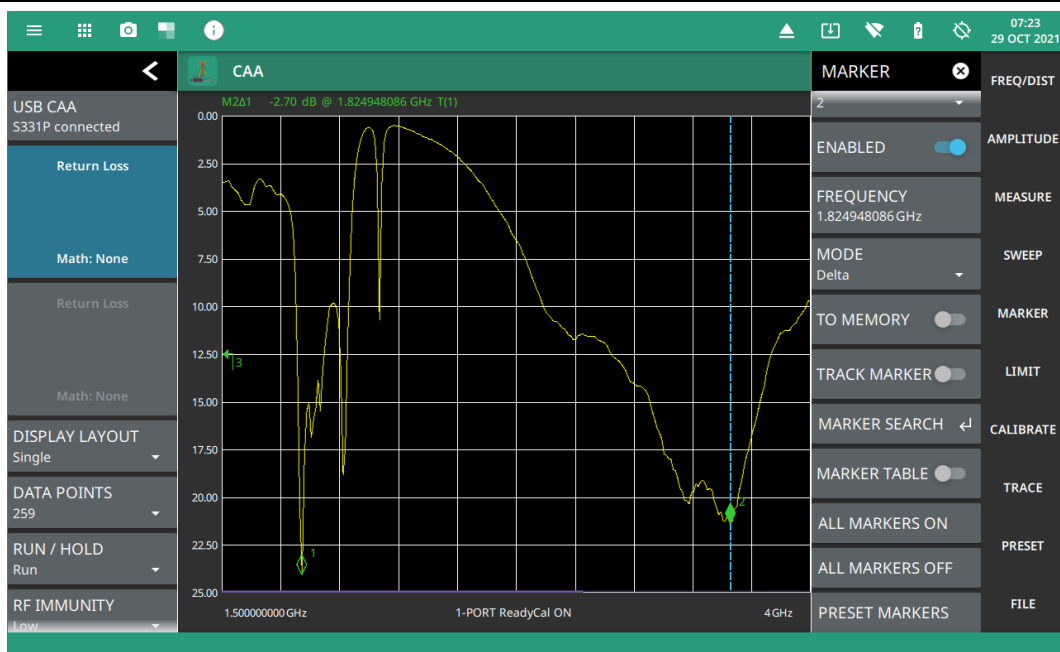


Figure 2-32. Delta Markers 1 and 2

Marker Table

The Marker Table displays at the bottom of the measurement area. The table lists marker frequency/distance and amplitude information for all currently active markers.

To display the marker table, press **MARKER** on the main menu, then toggle **MARKER TABLE** on or off. The active marker is indicated with a blue background as shown in [Figure 2-33](#).

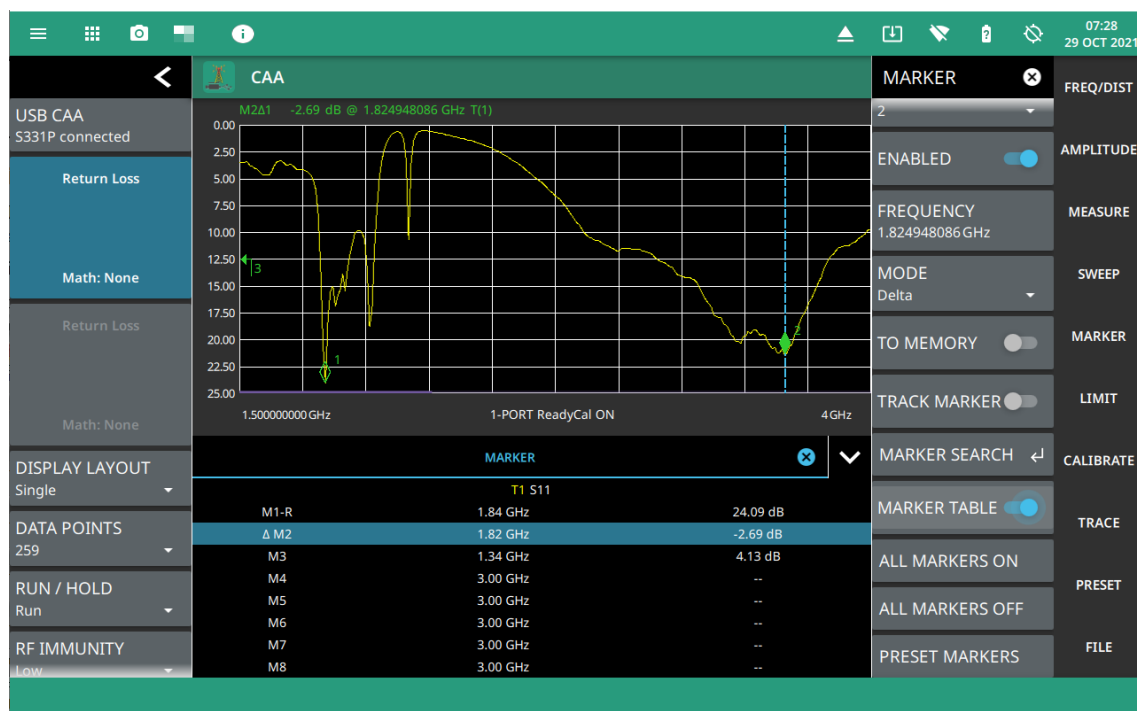


Figure 2-33. Delta Marker 2 and Marker Table

Marker Search

All the cable & antenna measurements include markers that will find trace peak or trace valley automatically. Marker search in Smith Chart finds the lowest or highest j magnitude when searching for valley or peak, respectively.

1. Select **MARKER** on the main menu, then press **SELECT** and press a desired marker number.
2. Select **MARKER SEARCH** to open the **MARKER SEARCH** menu.
3. Select **PEAK** to set the marker to the peak of the measurement or press **VALLEY** to set the marker to the valley of the measurement.

Tracking Markers

A tracking marker is set to a peak or to a valley. As the peak (or valley) varies in the measurement trace, the tracking marker stays at the peak (or valley).

Any marker can be set to tracking from the **MARKER** main menu by toggling **TRACK MARKER** on, then use the **MARKER SEARCH** and select **PEAK** or **VALLEY**.

Marker to Memory

The marker to memory requires a trace first be saved to memory. Toggling marker to memory on places the active marker on the trace memory at the current location. Refer to [Section 2-12 “Setting Trace Parameters”](#) on page 2-61 for more details about setting up traces and trace memory functions.

[Figure 2-34](#) shows a return loss antenna measurement with an earlier trace saved to memory shown with the active trace. Markers 1 and 2 are enabled with Marker 2 set as a delta marker and toggled to memory. Both markers were set to search for the valley.

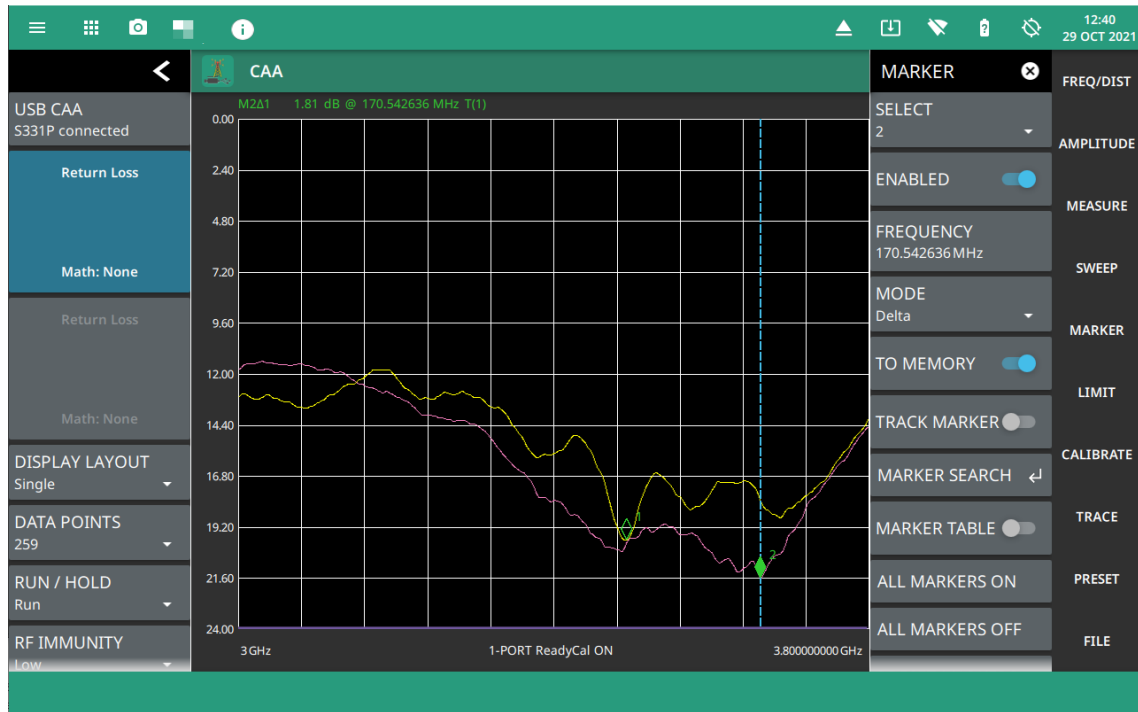


Figure 2-34. Delta Marker 2 with Marker to Memory

MARKER Menu









MARKER 	SELECT: Selects one of eight potential markers and makes it the active marker. You can also make a marker active by touching the vertical marker line.
SELECT 1 	ENABLED: Toggles the display of the currently active marker on and off. When off, the location of the marker is stored.
ENABLED 	FREQUENCY or DISTANCE: Displays the marker frequency (or distance for a DTF measurement). For delta markers, the frequency/distance is relative to the reference marker (Marker 1). Change the marker frequency by dragging it to the desired location (or use the +/- buttons for smith chart). You can also change the marker frequency or distance from the FREQ/DIST menu and change it manually using the keypad.
FREQUENCY 3.000075000 GHz	MODE: Sets the current active marker as a normal marker or a delta marker to Marker 1. Marker 1 is always the reference marker.
MODE Reference 	TO MEMORY: Toggles the marker to memory on or off. This sends the marker to the trace memory, so a trace must be saved to memory before toggling this on.
TO MEMORY 	TRACK MARKER: When toggled on, the active marker becomes a tracking marker and defaults to tracking the valleys or peaks. The search settings cannot all be applied to a marker with tracking either on or off.
TRACK MARKER 	MARKER SEARCH: Opens the “MARKER SEARCH Menu” on page 2-39.
MARKER SEARCH 	MARKER TABLE: Toggles on or off the marker table displayed below the measurement. Refer to
MARKER TABLE 	ALL MARKERS ON: Turns all markers on with either default values or previously set values if the markers have not been preset.
ALL MARKERS ON	ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.
ALL MARKERS OFF	PRESET MARKERS: Presets marker selections to default values.
PRESET MARKERS	

Figure 2-35. MARKER Menu

MARKER SEARCH Menu

MARKER ✕	PEAK: Places the currently active marker on the highest signal amplitude currently displayed on screen.
MARKER SEARCH ←	VALLEY: Places the currently active marker on the lowest signal amplitude currently displayed on screen.
PEAK	<i>Markers 5, 6, 7, and 8 can perform a special Marker search to find the Peak or Valley between two other markers.</i>
PEAK: M1 <-> M2	<i>When Marker 5 or Marker 7 is Active</i>
PEAK: M3 <-> M4	
VALLEY	Peak Between M1 & M2: Places Marker 5 or 7 on the highest signal amplitude between Marker 1 and Marker 2.
VALLEY: M1 <-> M2	Valley Between M1 & M2: Places Marker 5 or 7 on the lowest signal amplitude between Marker 1 and Marker 2.
VALLEY: M3 <-> M4	<i>When Marker 6 or Marker 8 is Active</i>
	Peak Between M3 & M4: Places Marker 6 or 8 on the highest signal amplitude between Marker 3 and Marker 4.
	Valley Between M3 & M4: Places Marker 6 or 8 on the lowest signal amplitude between Marker 3 and Marker 4.

Figure 2-36. MARKER SEARCH Menu

2-10 Setting Up Limit Lines

Limit lines are used for visual reference or for pass/fail criteria using the limit alarm and pass/fail message settings. Selecting the LIMIT on the main menu displays the LIMIT menu.

Overview of limit lines:

- Each measurement has a unique limit line.
- The color of the limit line changes to red when a measurement trace exceeds a limit and when LIMIT TEST is enabled, the limit pass/fail result is displayed in the upper right of the measurement data.
- Limits set beyond the current amplitude range are displayed at either the top or bottom of the graticule.
- The limit line amplitude is stored when a limit line is turned off.
- Limit lines must either be all single limit lines or all segmented limit lines. They cannot be mixed, but you can have a single segment as upper or lower limit lines.
- PRESET LIMITS will turn off the limit line display, limit alarm and Pass/Fail message, and reset upper and lower limits to their default values.

Single Limit Lines

To enable a simple upper or lower limit lines:

1. Select LIMIT on the main menu.
2. Toggle UPPER LIMIT or LOWER LIMIT on or off.
3. Select UPPER LEVEL or LOWER LEVEL to edit the limit line amplitude, or use the touch screen to drag the limit line up or down.

A single limit line extends over the entire displayed range of the sweep, independent of the start/stop settings of the sweep. For a single limit line, the amplitude for the start/stop points is the same. Upper limit lines are labeled with a “UL”, and lower limit lines are labeled with an “LL”. Limit lines are displayed in green so long as the limits are not reached or exceeded. When a limit is exceeded (upper or lower), the limit line or segment turns red. Any portion of the measurement trace touching or exceeding a limit also turns red, while portions of the trace within limits remain in the default yellow color.

Figure 2-37 shows single upper and lower limit lines with the lower limit failing the limit test.

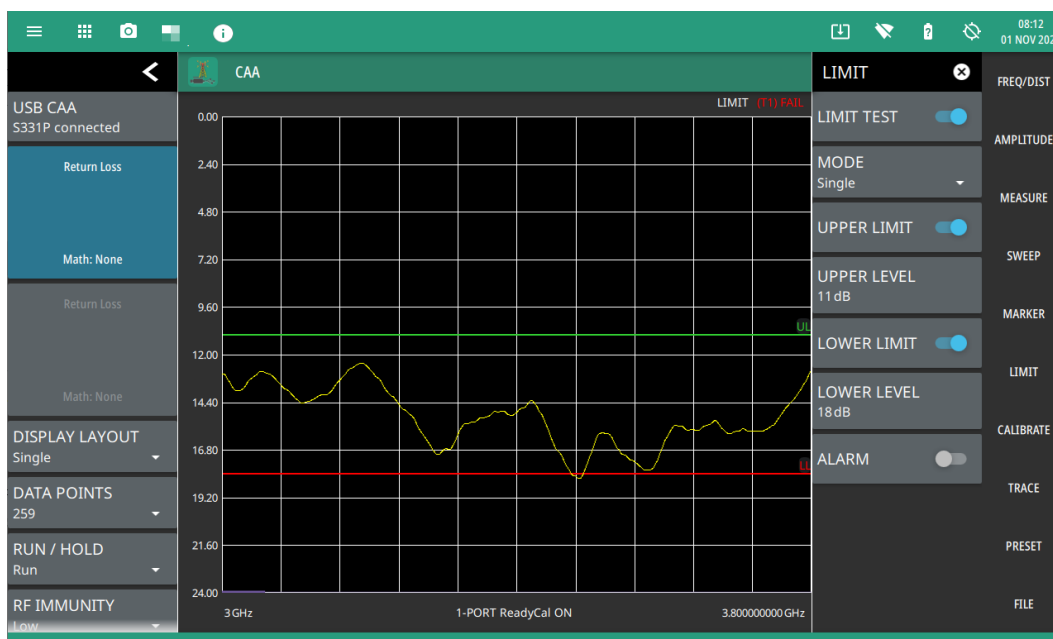


Figure 2-37. Single Limit Lines

Segmented Limit Lines

Segmented limit lines need not be continuous or connected as a single limit line. If any of the segments fail the limit test, the entire upper or lower limit fails the test. Additionally, segments can be added in any order and are not necessarily sequential from left to right or as all upper or all lower in sequence (i.e., segment 1 and 10 can be upper limits).

To enable segmented limit lines:

1. Select LIMIT on the main menu.
2. Select MODE and select Segmented. The segmented LIMIT menu will be shown (use the MODE selection to change between single or segmented limits).
3. Select SEGMENT TYPE and select Upper or Lower.
4. Toggle UPPER LIMIT or LOWER LIMIT on or off.

A single limit line segment is placed over the entire displayed range of the sweep, independent of the start/stop settings of the sweep. A segmented limit line can be divided into connected or disconnected segments with different start/stop frequency values (X1/X2) and corresponding start/stop amplitude values (Y1/Y2).

5. Select SEGMENT and select a segment number and make it the active segment. The active segment is shown in blue color.
6. Select X1 to set the start frequency of the active segment.
7. Select Y1 to set the start amplitude of the active segment.
8. Select X2 to set the stop frequency of the active segment.
9. Select Y2 to set the stop amplitude of the active segment.

Note Limit lines segments cannot be moved by using the touch screen.

Figure 2-38 shows a single segment limit line.

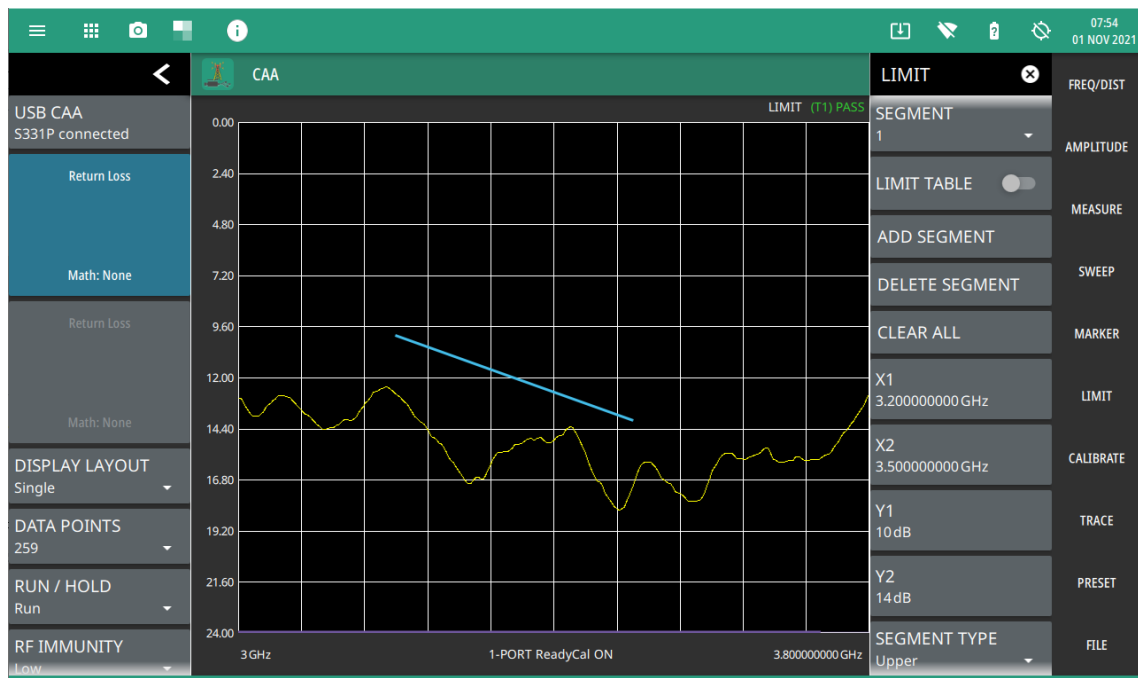


Figure 2-38. Single Segment Limit Line

10. Select ADD SEGMENT to add a new segment, then press SEGMENT TYPE to set it as an Upper or Lower segment.

A new segment is added after the currently set active segment and existing segment numbers are incremented by 1. The new segment starts from the stop point of the previous segment and ends at the start point of the next segment of the same type (upper or lower), or to the end of the sweep range if there are no following segments. Figure 2-38 shows three upper segments where the active segment 2 was added by making segment 1 active, then pressing ADD SEGMENT. The new segment was added and connects the end point of segment 1 and start point of segment 3.

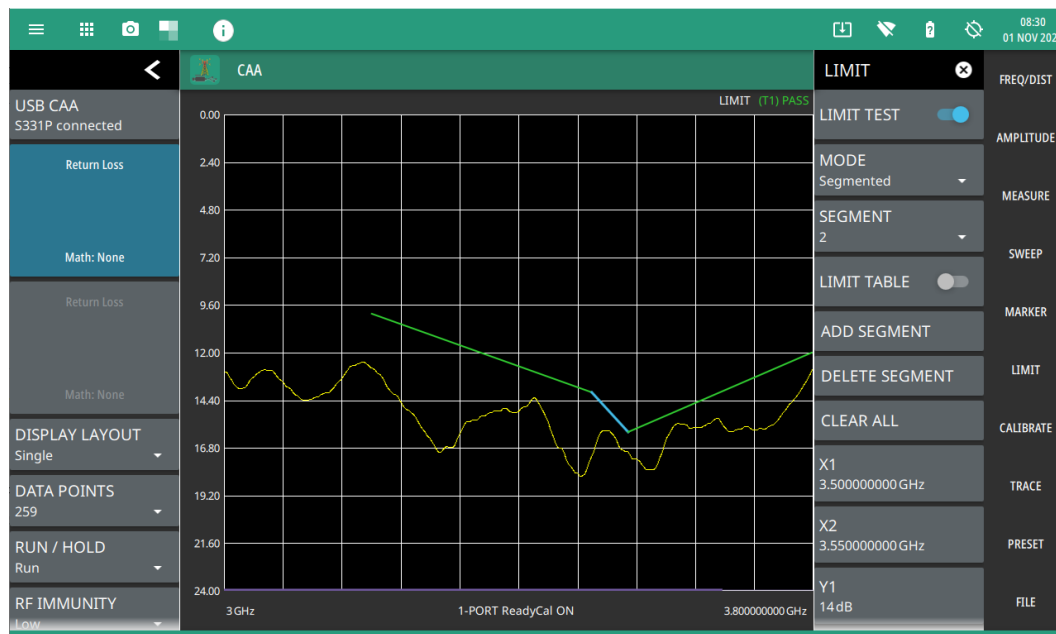


Figure 2-39. Single Segment Limit Line

Segments are added, set as upper and lower, and their start and stop points are edited to create a complex pass/fail limit test. Figure 2-38 shows several upper and lower segmented limit lines with the lower limit failing.

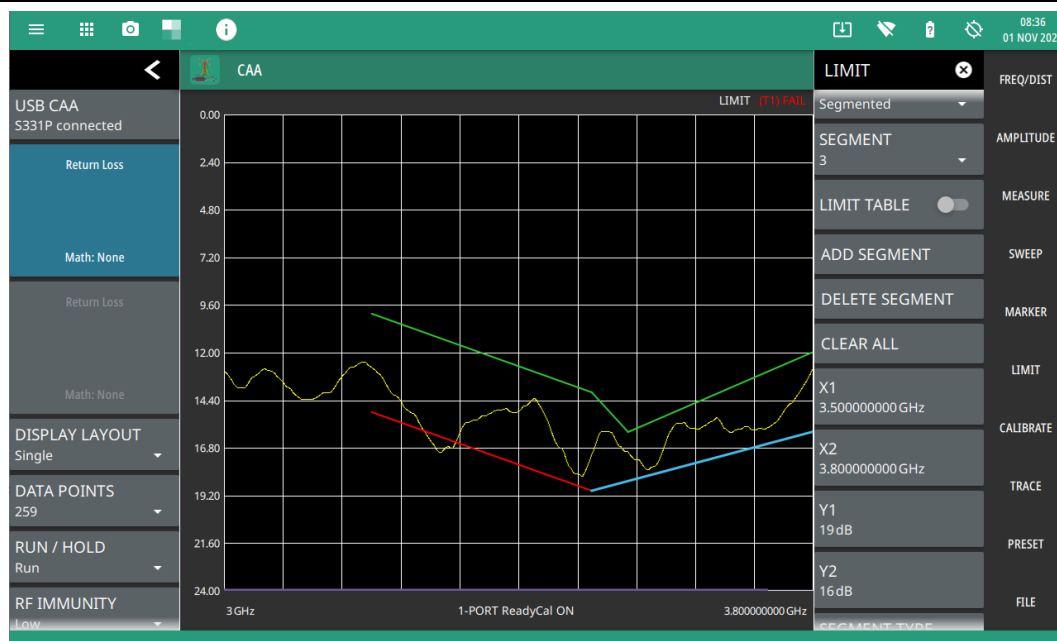


Figure 2-40. Complex Segmented Limit Lines

Limit Table

A limit table can be displayed for segmented limit lines by toggling LIMIT TABLE on or off. The limit table is useful when creating very complex limit lines as you can directly select the limit segment to make it active and edit any of its parameters (start and stop points and its type) right from the table. Figure 2-41 shows segmented limit lines with the limit table enabled. The lower segment is failing the limit test.

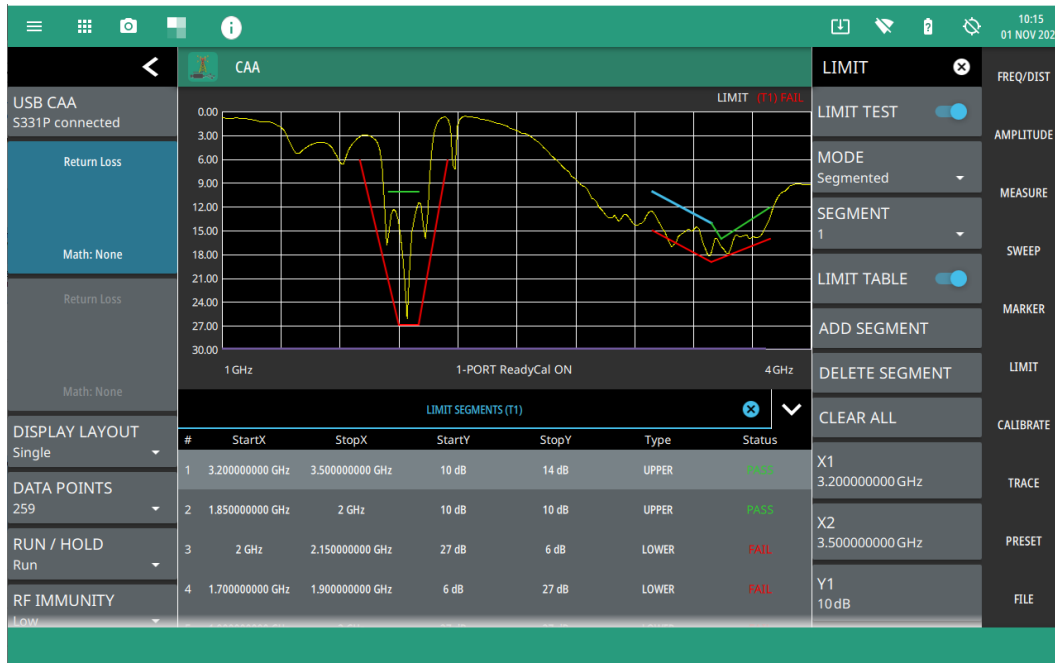


Figure 2-41. Limit Table

Limit Alarm

Select the LIMIT > ALARM to toggle the audible limit test alarm on or off.

LIMIT Menu (Single)

LIMIT ✕	LIMIT TEST: When toggled on, a Pass or Fail message is displayed to indicate whether the trace touches or exceeds the limit line (Fail).
LIMIT TEST <input checked="" type="checkbox"/>	MODE: Sets the limit line to single or segmented. A single limit line will be set to a single threshold level. If using segmented limit lines, See “LIMIT Menu (Segmented)” on page 2-45.
MODE Single ▼	UPPER LIMIT: Toggles the upper limit line on or off.
UPPER LIMIT <input checked="" type="checkbox"/>	UPPER LEVEL: Sets the amplitude of the upper limit line.
UPPER LEVEL 18 dB	LOWER LIMIT: Toggles the lower limit line on or off.
LOWER LIMIT <input checked="" type="checkbox"/>	LOWER LEVEL: Sets the amplitude of the lower limit line.
LOWER LEVEL 42 dB	ALARM: When toggled on, an audible alarm sounds a repeating beep when the trace touches the limit line.
ALARM <input checked="" type="checkbox"/>	

Figure 2-42. LIMIT Menu (Single)

LIMIT Menu (Segmented)

LIMIT ✕	
LIMIT TEST <input checked="" type="checkbox"/>	LIMIT TEST: When toggled on, a PASS or FAIL message is displayed at the top of the scale to indicate whether the trace touches or exceeds the limit line (FAIL).
MODE Segmented ▾	MODE: Sets the limit line to single or segmented. Limit line segments are independent of each other and are defined by a start point and an end point. A maximum of 42 limit line segments can be defined. Both the upper and lower limit line segments for a measurement trace must be of the same type: either both are single, or both are segmented; however, you can create just one limit line segment as upper or lower to cover the entire measurement. If using single limit lines, see "LIMIT Menu (Single)" on page 2-44.
SEGMENT 6 ▾	SEGMENT: Selects one of the limit line segments and makes it active. An active segment appears blue in color.
LIMIT TABLE <input checked="" type="checkbox"/>	LIMIT TABLE: Toggle on or off the limit table displayed below the screen. The limit table is only available when segmented limit lines are used. The limit table provides an easy to use interface for editing limit line segments. You can touch any segments X1, X2, Y1, Y1, or Refer to
ADD SEGMENT	ADD SEGMENT: Adds a limit line segment after the current active segment. All segment numbers after the current active segment will be incremented.
DELETE SEGMENT	DELETE SEGMENT: Deletes the currently active segment. All segment numbers after the current active segment will be decremented.
CLEAR ALL	CLEAR ALL: Removes all segments and does not store any segment information.
X1 500 kHz	X1: Edits the start X value (frequency or distance) of the active limit line segment.
X2 6 GHz	X2: Edits the stop X value (frequency or distance) of the active limit line segment.
Y1 44 dB	Y1: Edits the start Y value (amplitude or phase) of the active limit line segment.
Y2 44 dB	Y2: Edits the stop Y value (amplitude or phase) of the active limit line segment.
SEGMENT TYPE Upper ▾	SEGMENT TYPE: Toggles the active limit line segment to upper or lower limit.
Y OFFSET 0	Y OFFSET: Applies an amplitude offset to all upper limit line segments. The offset value must not offset any upper limit line segments outside of the full scale amplitude for the measurement.
UPPER LIMIT <input checked="" type="checkbox"/>	UPPER LIMIT: Toggles all of the upper limit line segments on or off.
LOWER LIMIT <input checked="" type="checkbox"/>	LOWER LIMIT: Toggles all of the lower limit line segments on or off.
ALARM <input checked="" type="checkbox"/>	ALARM: When toggled on, an audible alarm sounds a repeating beep when the trace touches the limit line.

Figure 2-43. LIMIT Menu (Segmented)

2-11 Calibration

For the most accurate results possible, the instrument should be calibrated before making any measurements. If you want to perform a quick measurement without going through manual calibration, you may turn off User Cal and the instrument will apply the factory default calibration automatically (except for Transmission measurements).

OSL calibration components are used with cable and antenna analyzer measurements and are available from Anritsu as optional accessories. For transmission measurements, an external USB power sensor is used in the calibration setup and is connected to the S331P with a through test port cable or adapter. The S331P Technical Data Sheet (part 11410-00964) contains a list of supported calibration components, adapters, and power sensors.

Factory Calibration

The S331P is calibrated at the factory at room temperature. This default calibration, named 1-Port ReadyCal is automatically applied to all cable and antenna measurements – except transmission (Ext Sensor) measurements – when the instrument has not been manually calibrated or user calibration (User Cal) is turned off.

ReadyCal simplifies the measurement process and can reduce overall test time while maintaining measurement integrity. Anritsu recommends an annual re-calibration at the factory if you routinely apply ReadyCal when making measurements.

When the best possible accuracy is required or the ambient temperature is greatly different from normal room temperature, you should perform a user calibration to override the default ReadyCal. Refer to “[Calibration Methods](#)” on page 2-47.

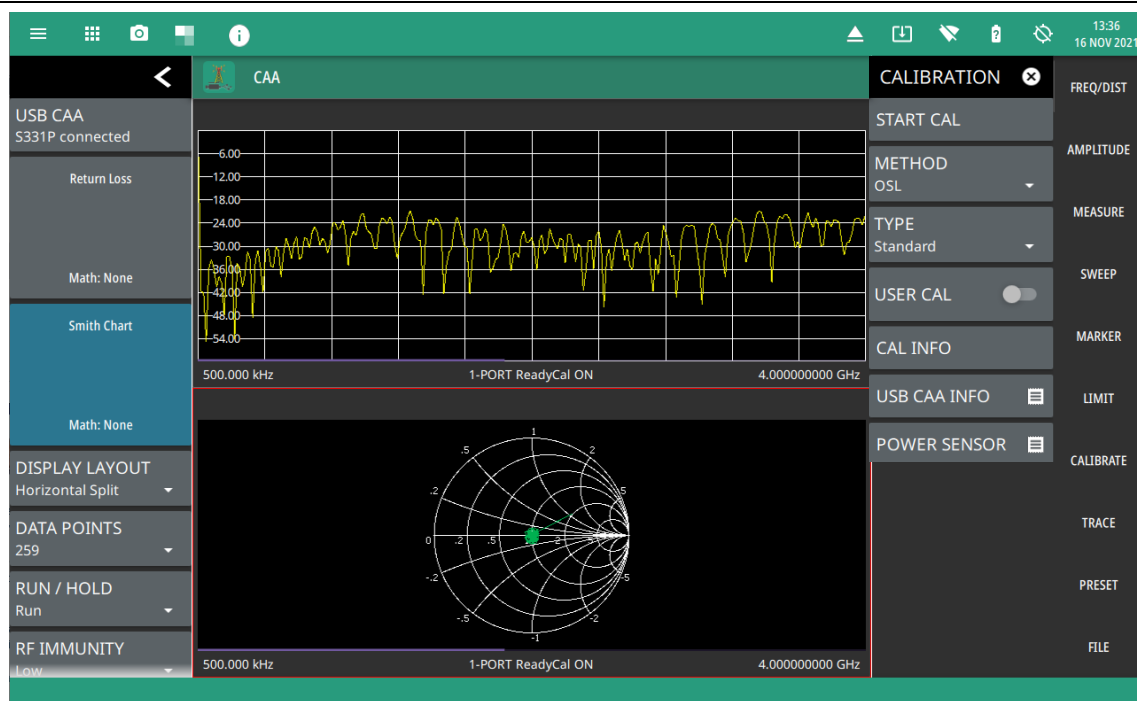


Figure 2-44. ReadyCal ON (All Measurements Except Transmission); User Cal Off (Transmission)

Calibration Methods

The S331P supports the following user calibration methods for cable and antenna measurements.

OSL (Open-Short-Load)

For all measurement types except Transmission (Ext Sensor), you can manually calibrate the S331P using an external precision OSL calibration kit. Refer to [“OSL Calibration” on page 2-49](#) for calibration instructions.

Ext Transmission (Ext Sensor)

Select the Transmission (Ext Sensor) calibration method for transmission measurements with an external power sensor. A normalization process is used to calibrate the frequency response of the sensor and any test port cables/adapters used. An optional zeroing step is performed to remove any residual noise in the sensor, followed by a normalization step performed with the sensor connected directly to the S331P RF test port or through a test port cable.

When this calibration method is active and not combined with OSL, the S331P automatically applies the default ReadyCal to all measurements other than Transmission.

OSL + Ext Trans

The combined calibration method OSL + Ext Transmission allows the instrument to be calibrated once for all the supported measurement types, eliminating the need to re-calibrate when switching from one type of measurement to another, such as return loss to transmission. Refer to [“OSL + Ext Trans” on page 2-53](#) for the calibration procedure.

Calibration Types

The available calibration types are Standard Cal and Flex Cal. Standard Cal applies to the currently set frequency range. Changing either the Start or Stop Frequency setting requires turning off User Cal, in which case the factory default 1-Port ReadyCal will apply to all measurement types except Transmission (Ext Sensor). You may subsequently re-calibrate the instrument as appropriate.

Flex Cal calibrates the instrument over the entire frequency range and interpolates data points if the frequency range is changed. This method saves time as it does not require the user to re-calibrate the system for frequency changes. The trade-off is fewer data points and less accuracy when compared to Standard Cal.

[Table 2-2](#) lists the main characteristics of the Standard and Flex calibration types. If you do not expect to change the frequency range often, Standard Cal is recommended for best accuracy.

Table 2-2. Summary of Calibration Types

Calibration Type	Characteristics
Standard Cal	Need to re-calibrate if frequency changes. This will provide the best accuracy. Recommended for reporting.
Flex Cal	No need to recalibrate if frequency changes. Recommended for troubleshooting.

Calibration Status Displays

The instrument calibration status and type are displayed below the measurement scale. When User Cal is on, the calibration method is shown in parentheses:

RFP1 - OSL Reflection (1-port)

TRES - Transmission (using an External Sensor) 2PES - OSL + External Transmission

The following status descriptions are representative of the indicators and messages you may see on the interface screen. They are not a complete list of all possible combinations of measurement types and calibration methods. Refer to “[Calibration Types](#)” on page 2-47.

1-Port ReadyCal ON

USER CAL is off and the factory default 1-Port ReadyCal is applied to all measurement types except Transmission (Ext Sensor).

CALIBRATION ON: User Cal (RFP1)

The instrument has been calibrated for an OSL measurement (RFP1) and USER CAL is on. The *User Cal* status indicates the active calibration type is Standard, meaning that frequency adjustments require user calibration to be turned off.

CALIBRATION ON: iUser Cal (RFP1)

The instrument has been calibrated for an OSL measurement (RFP1) and USER CAL is on. The *iUser Cal* status indicates the active calibration type is Flex, meaning that frequency adjustments are allowed while user calibration is on.

CALIBRATION ON: User Cal (TRES)

The instrument has been calibrated for a Transmission measurement (TRES) and USER CAL is on. The factory default 1-Port ReadyCal is automatically applied to all other measurement types. The *User Cal* status indicates the active calibration type is Standard, meaning that frequency adjustments require user calibration to be turned off.

CALIBRATION ON: User Cal (2PES)

The instrument has been calibrated for an OSL + External Transmission measurement (2PES) and USER CAL is on. The User Cal (RFP1) is automatically applied to all other measurement types. The *User Cal* status indicates the active calibration type is Standard, meaning that frequency adjustments require user calibration to be turned off.

CALIBRATION ON: iUser Cal (2PES)

The instrument has been calibrated for an OSL + Transmission measurement (2PES) and USER CAL is on. The iUser Cal (RFP1) is automatically applied to all other measurement types. The *iUser Cal* status indicates the active calibration type is Flex, meaning that frequency adjustments are allowed while user calibration is on, except for the transmission measurement.

CALIBRATION OFF

The instrument is set to Transmission (Ext) measurement and has not been calibrated, or USER CAL is off.

Calibration Procedure

You can manually calibrate the S331P or use the ReadyCal factory calibration for quick measurements. The instrument automatically applies the default ReadyCal to all cable and antenna analyzer measurement types, except transmission, when the USER CAL setting is toggled off or the Transmission (Ext Sensor) calibration method is used.

The instrument needs to be manually re-calibrated if a test port cable is used and has been replaced, or when changing frequency in Standard Cal (not in Flex Cal).

To manually calibrate the S331P:

1. Select **FREQ/DIST** on the main menu and adjust the start and stop frequency values if needed.
If the active calibration type is Standard and **USER CAL** is on, a warning message is displayed informing you that **USER CAL** must be turned off. You can use the Flex calibration type to allow frequency changes with **USER CAL** on.
2. Select **CALIBRATION** on the main menu and ensure **USER CAL** is off.
3. Select **METHOD** and select the desired calibration method (OSL or OSL + Ext Trans).
4. Select **TYPE** and select either Standard or Flex for the calibration type.
5. Select **START CAL**. Depending on the selected calibration method, proceed with the appropriate set of instructions for calibration setup shown in the on-screen **CAL WIZARD**:

OSL

OSL + Ext Trans

Refer to the S331P Technical Data Sheet (part number 11410-00964) for a list of supported calibration components, adapters, and power sensors.

OSL Calibration

1. Select **FREQ/DIST** on the main menu and adjust the start and stop frequency values if needed.
If the active calibration type is Standard and **USER CAL** is on, a warning message is displayed informing you that **USER CAL** must be turned off. You can use the Flex calibration type to allow frequency changes with **USER CAL** on.
2. Select **CALIBRATION** on the main menu and ensure **USER CAL** is off.
3. Select **METHOD** and select **OSL**.
4. Select **TYPE** and select either Standard or Flex for the calibration type.
5. Select **START CAL** and follow the on-screen **CAL WIZARD**.

6. Select MEASURE at the end of each step to proceed to the next step in the sequence.

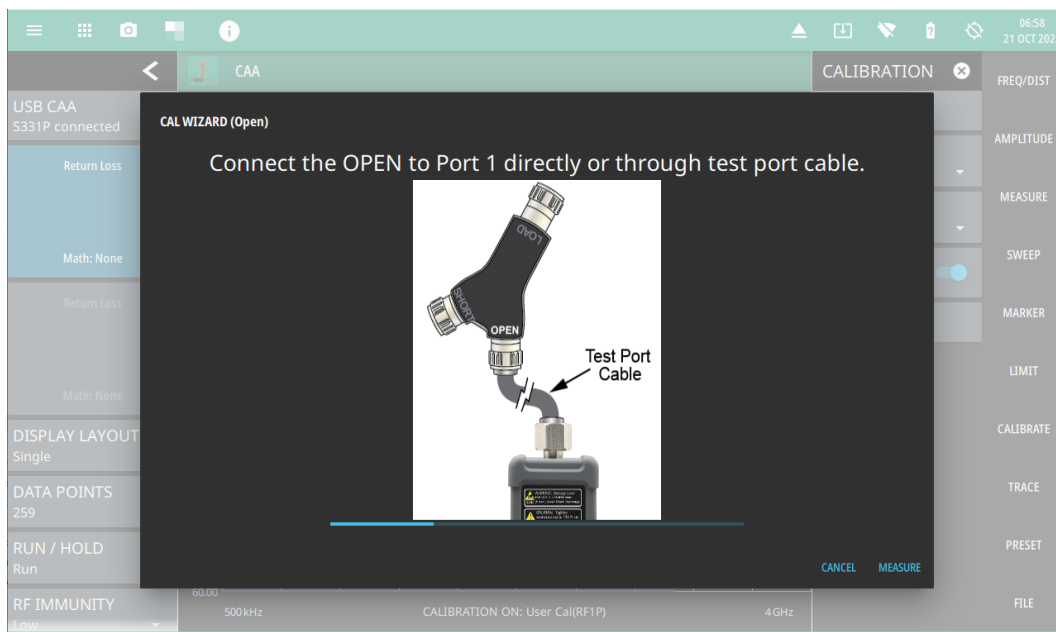


Figure 2-45. OSL Calibration - OPEN

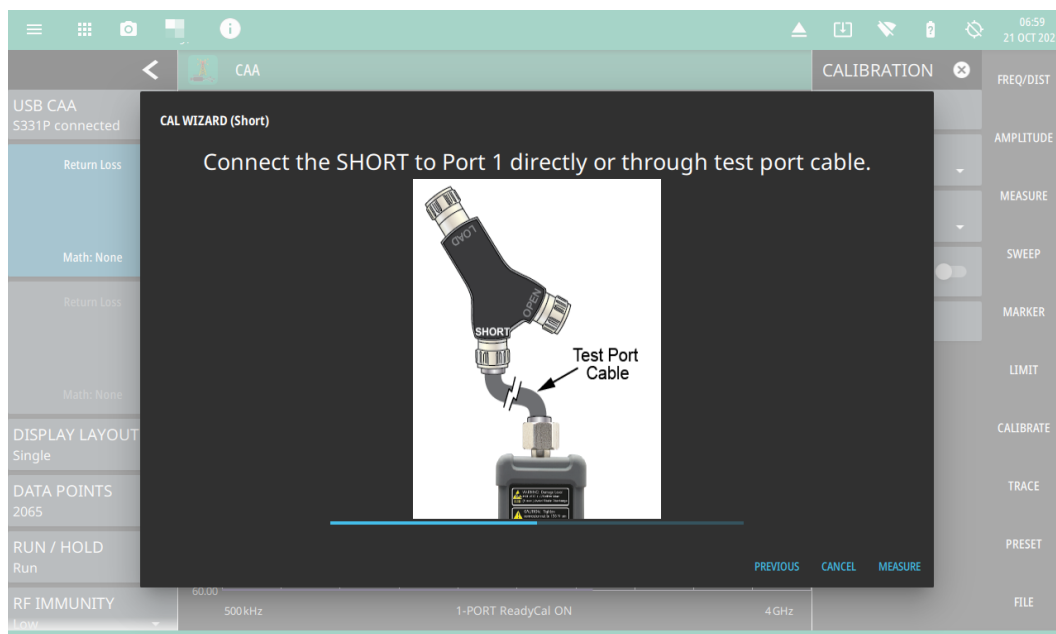


Figure 2-46. OSL Calibration - SHORT

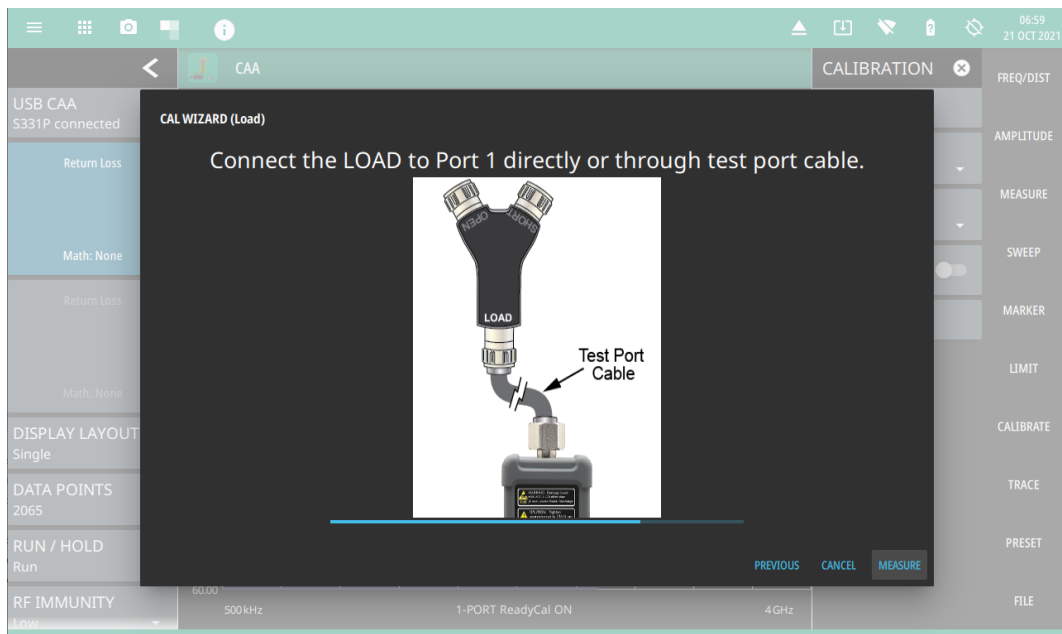


Figure 2-47. OSL Calibration - LOAD

7. When done, select Apply.

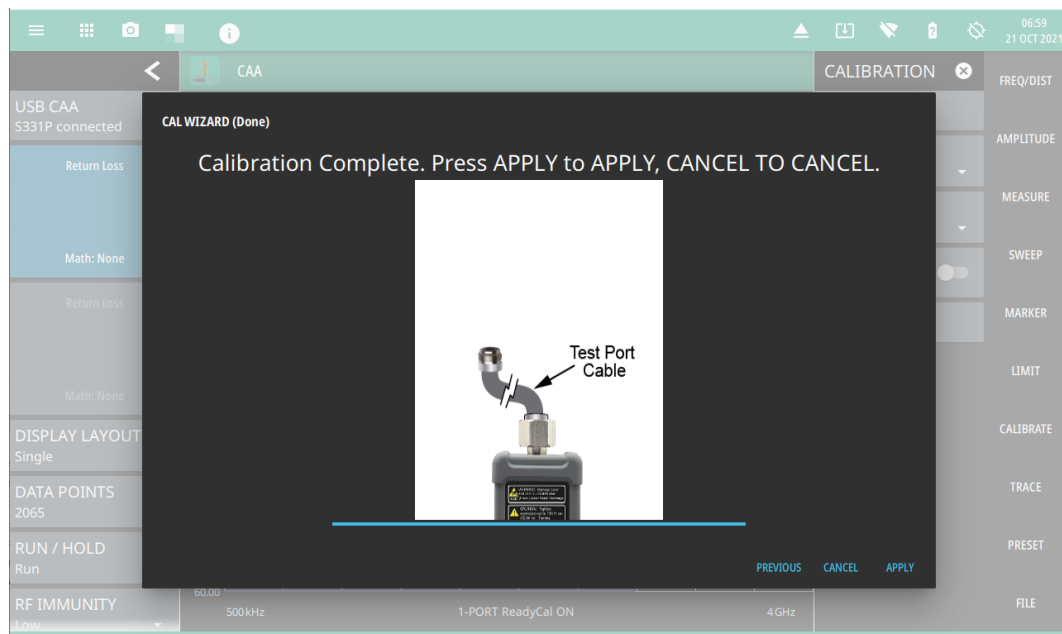


Figure 2-48. OSL Calibration - APPLY

8. When calibration has completed, the user cal status message will display as follows:
 CALIBRATION ON: User Cal (RFP1) for Standard calibration type
 iCALIBRATION ON: User Cal (RFP1) for Flex calibration type

Figure 2-49 illustrates a return loss measurement after a standard OSL calibration. The calibration is not applied to Transmission measurement.

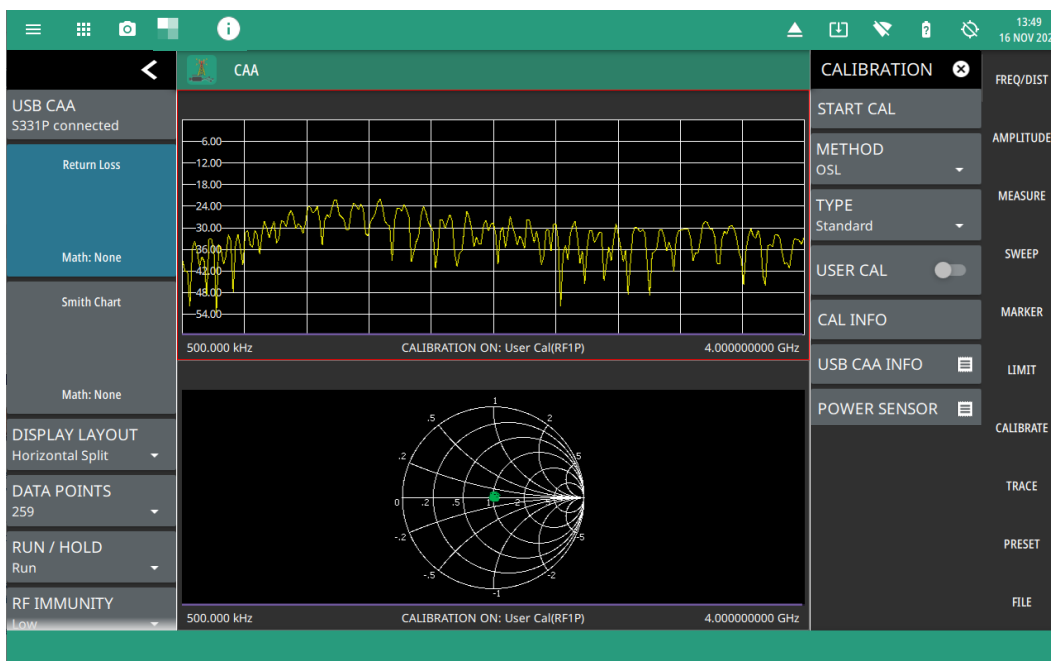


Figure 2-49. OSL Calibration, Standard

OSL + Ext Trans

1. Ensure both the S331P and an external power sensor are connected to the instrument.
2. Select FREQ/DIST on the main menu and adjust the start and stop frequency values if needed.

If the active calibration type is Standard and USER CAL is on, a warning message is displayed informing you that USER CAL must be turned off. You can use the Flex calibration type to allow frequency changes with USER CAL on.

3. Select CALIBRATE on the main menu and ensure USER CAL is off.
4. Select METHOD and select OSL + Ext Trans or Ext Transmission.
5. Select TYPE and select either Standard or Flex for the calibration type.
6. Select START CAL and follow the on-screen CAL WIZARD.
7. Select MEASURE at the end of each step to proceed to the next step in the sequence.

Note

The first three sequences below (OPEN, SHORT, and LOAD) only apply to the OSL + Ext Trans calibration method. The Ext Transmission calibration method begins with (Figure 2-53, "OSL + Ext Trans Calibration - ZERO (ensure nothing is connected to sensors)" on page 2-55.

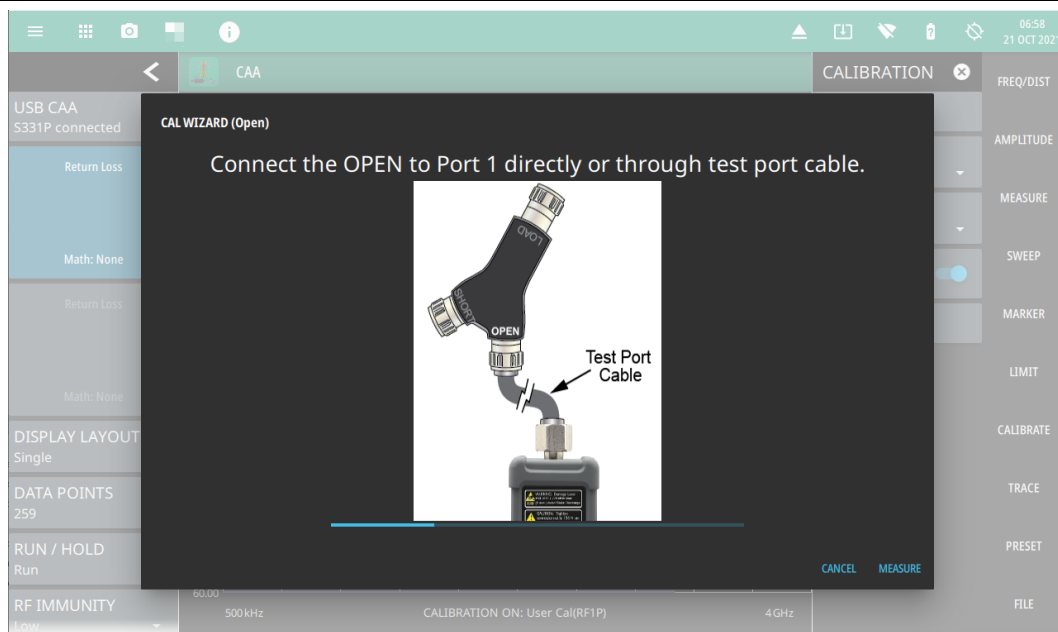


Figure 2-50. OSL + Ext Trans Calibration - OPEN

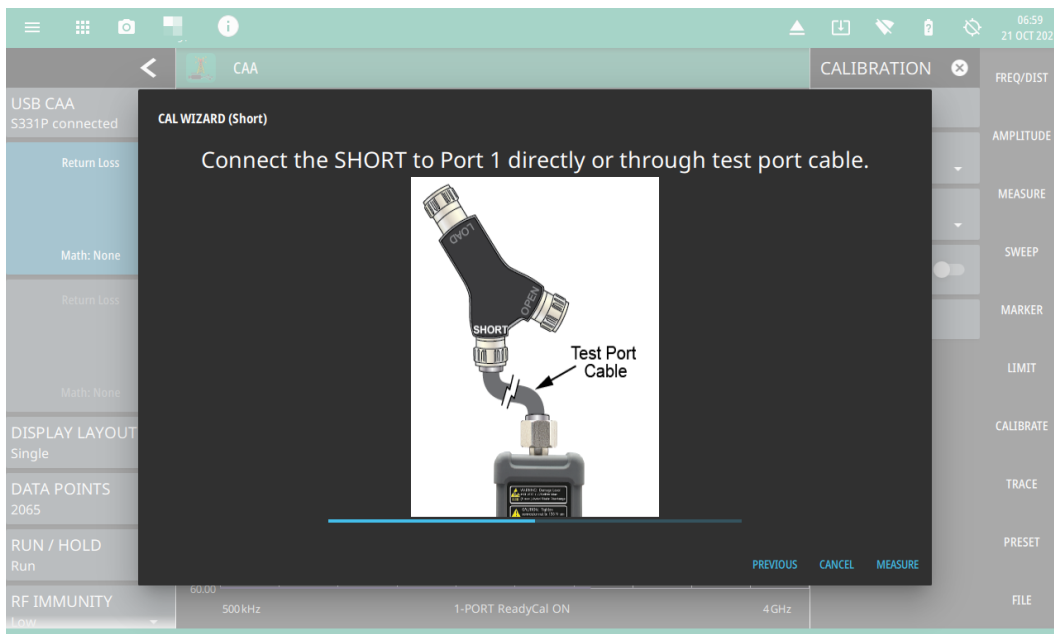


Figure 2-51. OSL + Ext Trans Calibration - SHORT

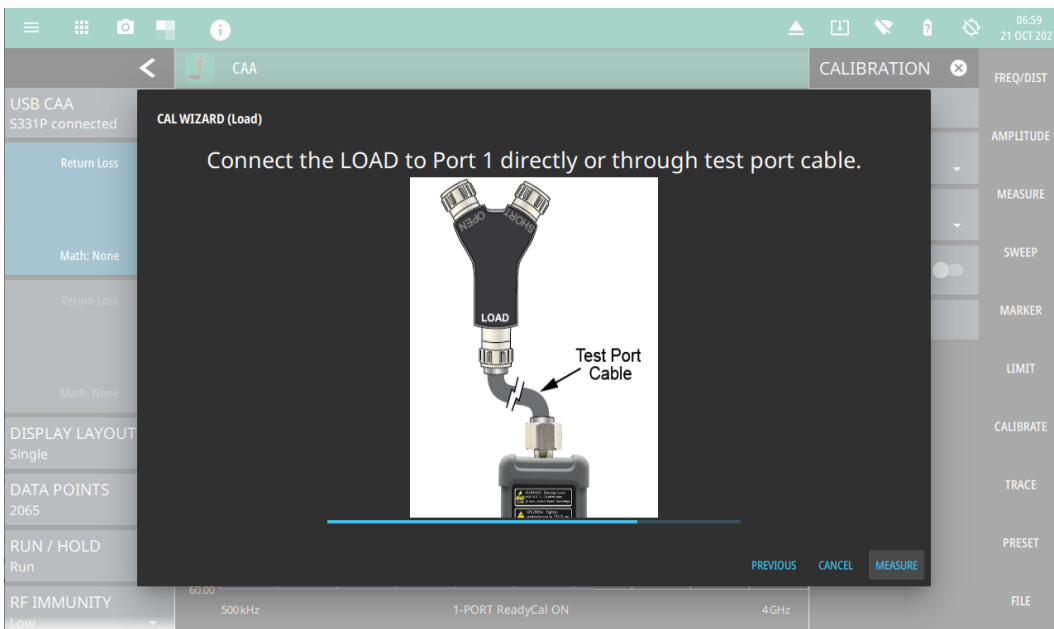


Figure 2-52. OSL + Ext Trans Calibration - LOAD

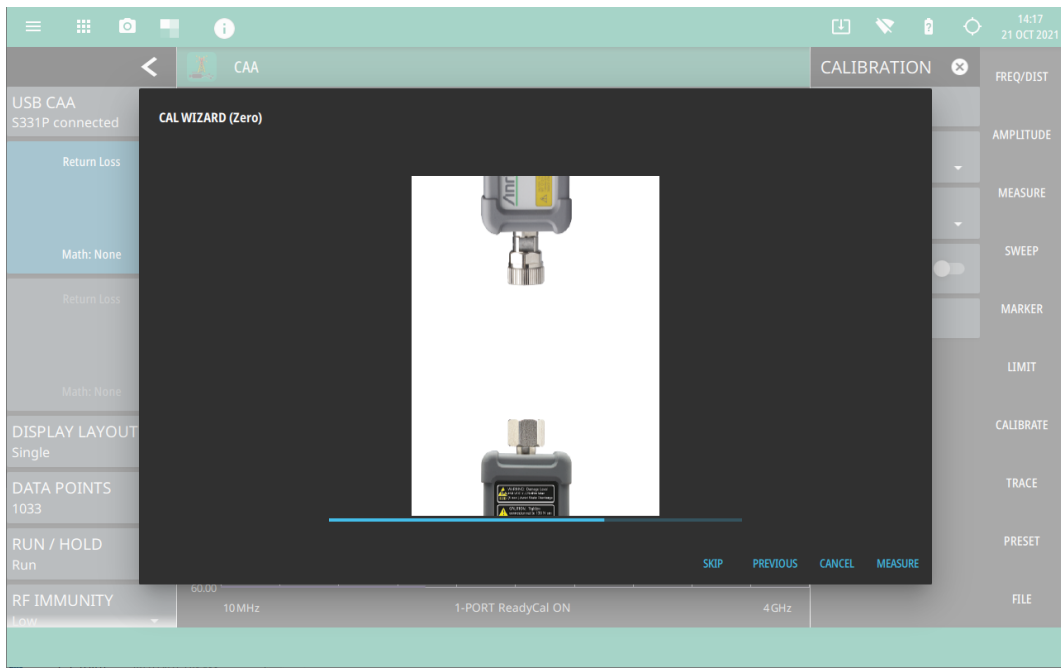


Figure 2-53. OSL + Ext Trans Calibration - ZERO (ensure nothing is connected to sensors)

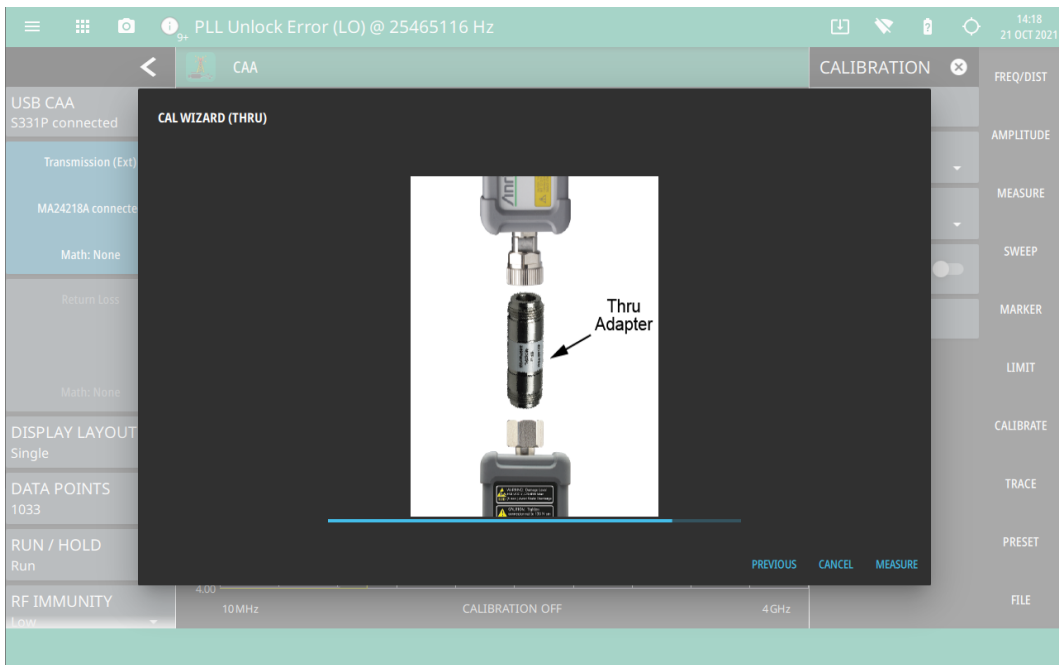


Figure 2-54. OSL + Ext Trans Calibration - THRU

- When done, select Apply.

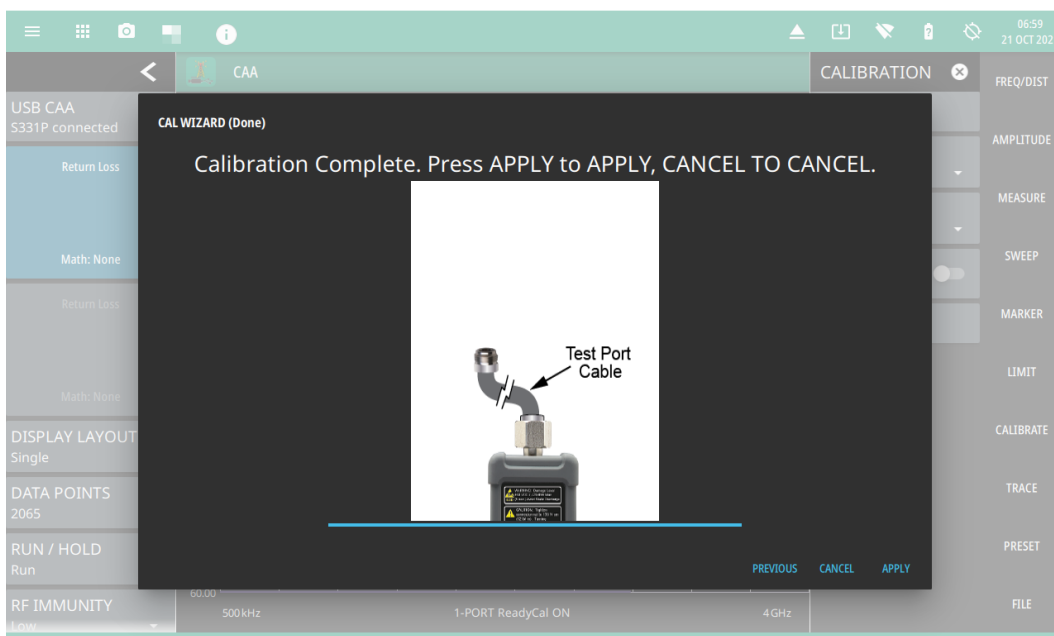


Figure 2-55. OSL Calibration - APPLY

- When the calibration has completed, the user cal status message will display as follows:

CALIBRATION ON: User Cal (2PES) or CALIBRATION ON: User Cal (TRES) for Standard calibration type
 iCALIBRATION ON: User Cal (2PES) or iCALIBRATION ON: User Cal (TRES) for Flex calibration type

Figure 2-56 illustrates both Return Loss and Transmission (Ext) measurements after a standard OSL + Ext Trans calibration.

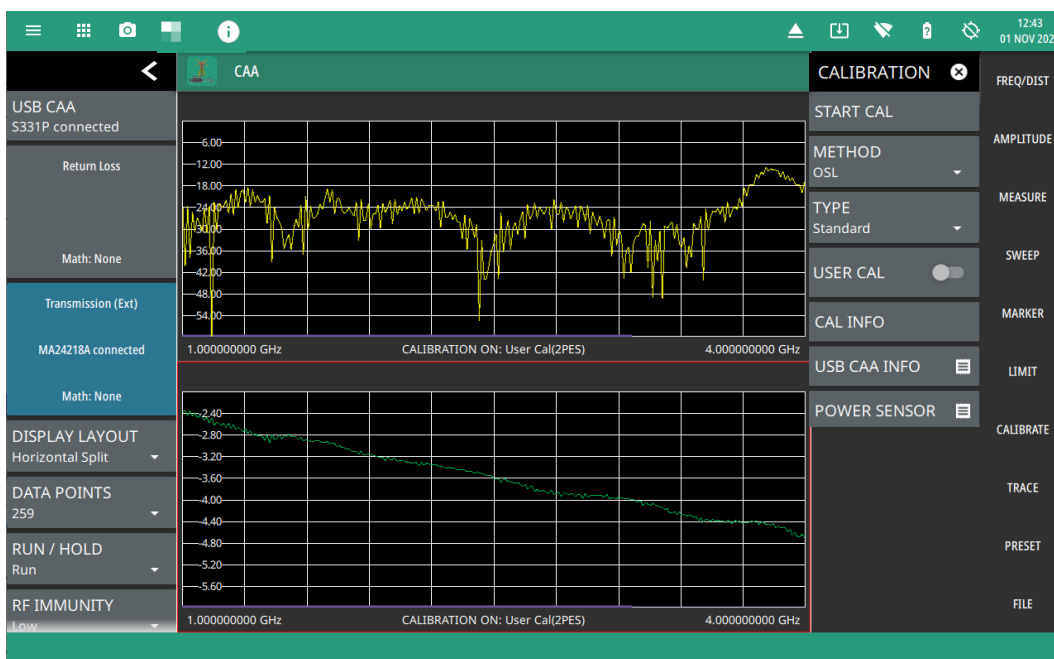


Figure 2-56. OSL + Ext Trans Calibration, Standard

Cal Info

From the CALIBRATION main menu, press CAL INFO to view the active calibration settings and a summary of the current instrument settings (see [Figure 2-57](#)). Active calibration settings are the settings saved following the last completed calibration. Current settings are values currently set on the instrument.

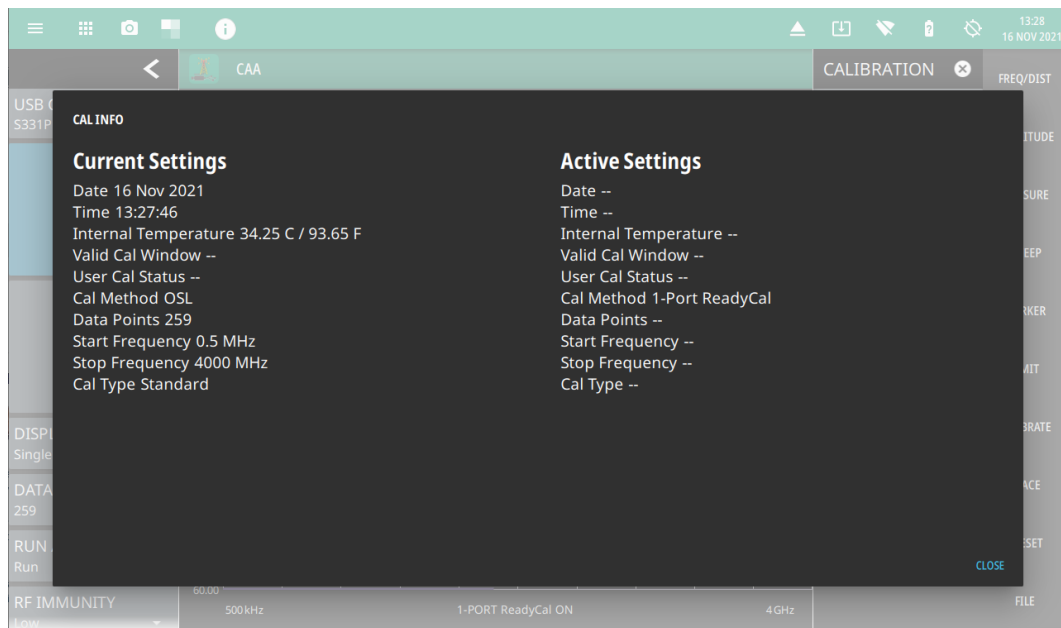


Figure 2-57. Calibration Information

The calibration factor can be toggled off with the USER CAL button. The calibration coefficients are saved and can be reapplied, along with the active calibration settings, by toggling USER CAL back on.

Note

toggling USER CAL on and off only impacts measurement types associated with the calibration method in the active settings. For example, if the instrument has been calibrated for OSL, calibration will remain off for Transmission (Ext Sensor) measurements, whether USER CAL is on or off. Conversely, if the instrument is calibrated using Transmission (Ext Sensor) method, the default 1-Port ReadyCal is applied to all measurement types other than Transmission, independently of USER CAL being toggled on or off.

USB CAA Info

From the CALIBRATION main menu, press USB CAA INFO to view the S331P cable antenna analyzer details. This pop-up menu displays CAA model number, serial number, frequency range and firmware version.

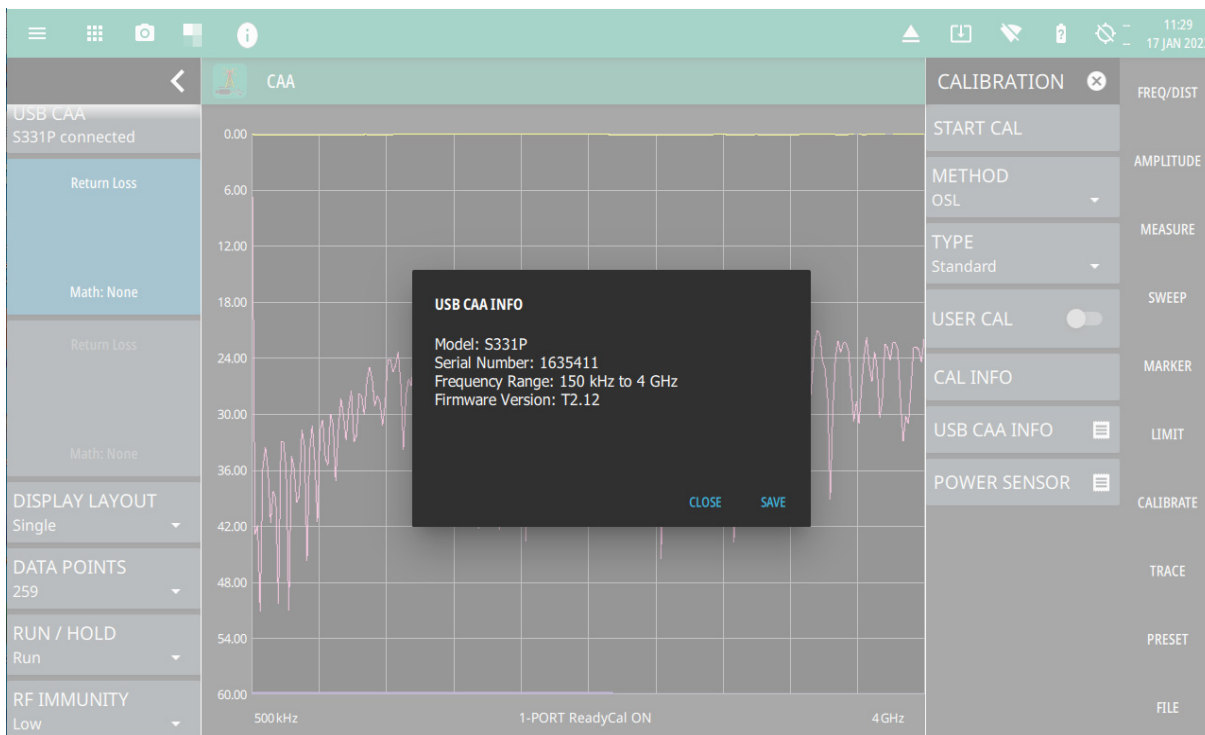


Figure 2-58. USB CAA Information

Power Sensor

From the CALIBRATION main menu, press POWER SENSOR to view the details of the power sensor connected to the instrument.

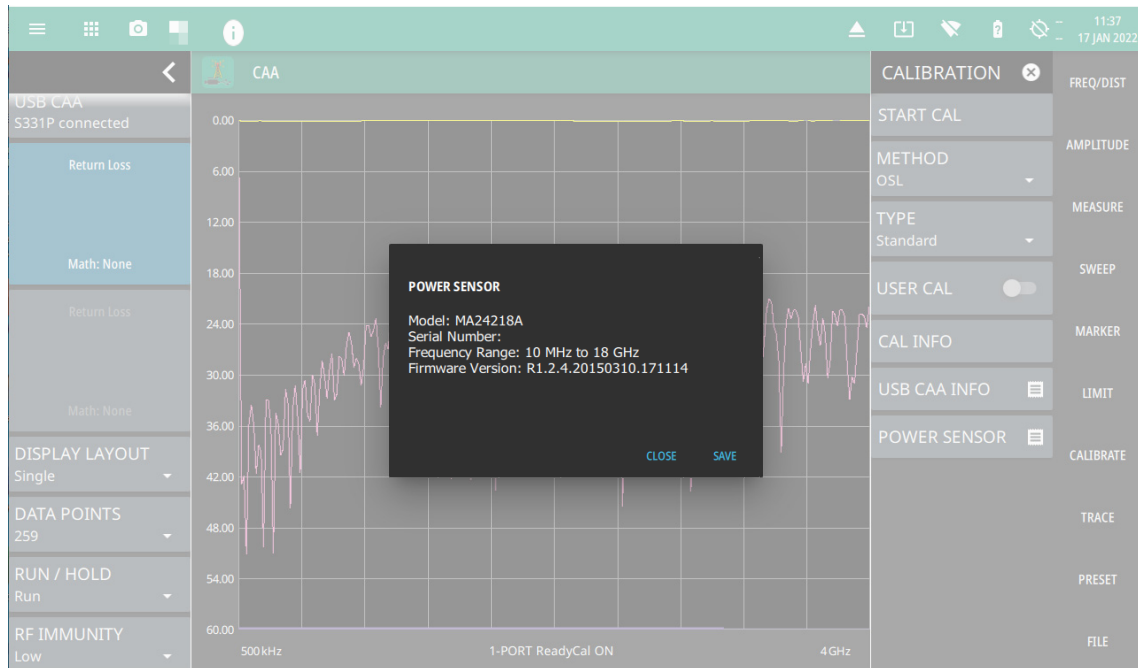


Figure 2-59. Power Sensor Information

Temperature Window

Anritsu recommends allowing the instrument to warm up for approximately 10 minutes to typical operating temperature before performing a user calibration.

During operation, if the internal temperature moves outside the valid cal window, any applied user calibration factor will automatically be toggled off – and the factory default 1-Port ReadyCal applied, when applicable. In this case, the instrument will display: 1-PORT ReadyCal (↓ °C) to indicate that the USER CAL has been toggled off due to a temperature change.

The USER CAL toggles back on automatically if the internal temperature moves back into the valid cal window. Alternatively, you can perform a new user calibration, which will then have a new cal temperature window based on the current ambient temperature ± 10 °C.

Save and Recall Calibration Coefficients

Calibration information is included when a setup (.stp) or trace (.fmcausb) file is saved (even when USER CAL is off). The calibration information is also recalled with these file types and can be toggled on if the current internal instrument temperature is within the saved cal window. Calibration information is not included when other file types are saved.

CALIBRATION Menu

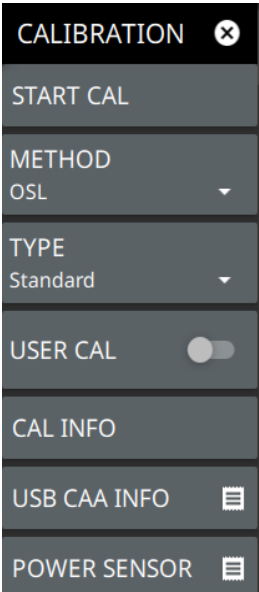
	<p>START CAL: Starts a manual measurement calibration. The CAL WIZARD window will open and provide on-screen instructions. Refer to “Calibration Procedure” on page 2-49. The basic calibration sequence is as follows:</p> <ul style="list-style-type: none"> • Measure: Performs a measurement at each calibration step, after making the connections as instructed by the CAL WIZARD. • Previous: Goes back to the previous calibration step. • Skip: Present only in calibration step 1 when the calibration method is OSL + Ext Transmission. This step (zero the sensor) is optional and may be skipped. • Apply: Displayed only in the final calibration step, applies the calibration and closes the CAL WIZARD. • Cancel: Aborts the calibration and closes the CAL Wizard dialog. <p>METHOD: The Cable and Antenna Analyzer supports OSL and OSL + External Transmission calibration methods. Refer to “Calibration Methods” on page 2-47.</p> <p>TYPE: Selects Standard calibration or Flex calibration. Refer to “Calibration Types” on page 2-47.</p> <p>USER CAL: Toggles whether the active cal settings are applied to the current measurement. With User Cal off, the factory default calibration (1-Port ReadyCal) is applied to all measurements except Transmission. Turning User Cal on restores the active cal settings, including frequency range. See the Note in “Cal Info” on page 2-57.</p> <p>CAL INFO: Displays the active cal settings and current instrument settings. Refer to “Cal Info” on page 2-57.</p> <p>USB CAA INFO: Displays the cable antenna analyzer settings such as serial number, frequency range, etc. Refer to “USB CAA Info” on page 2-58.</p> <p>POWER SENSOR: Displays the power sensor settings. Refer to “Power Sensor” on page 2-59.</p>
--	--

Figure 2-60. CALIBRATION Menu

2-12 Setting Trace Parameters

The Field Master Series Cable and Antenna Analyzer allows the user to concurrently view the live trace and a second trace that is stored in trace memory. The user can compare the two traces visually or by using trace math functions. Selecting TRACE on the main menu will bring up the trace menu.

Overview of traces:

- Recalled measurements (.fmcausb files) are automatically copied to trace memory and displayed.

Note Recalled measurements may change the current instrument settings.

- COPY TO MEM will replace whatever is in memory with the live (yellow) trace. The memory trace (purple) is displayed behind the live (yellow) trace.
- The default view is live Trace only. View options (MEMORY DISPLAY) include viewing only the trace in memory or both traces.
- Active markers can be applied to the purple trace memory by pressing MARKER > TO MEMORY (refer to [Section 2-9 “Setting Up Markers”](#) on page 2-34).

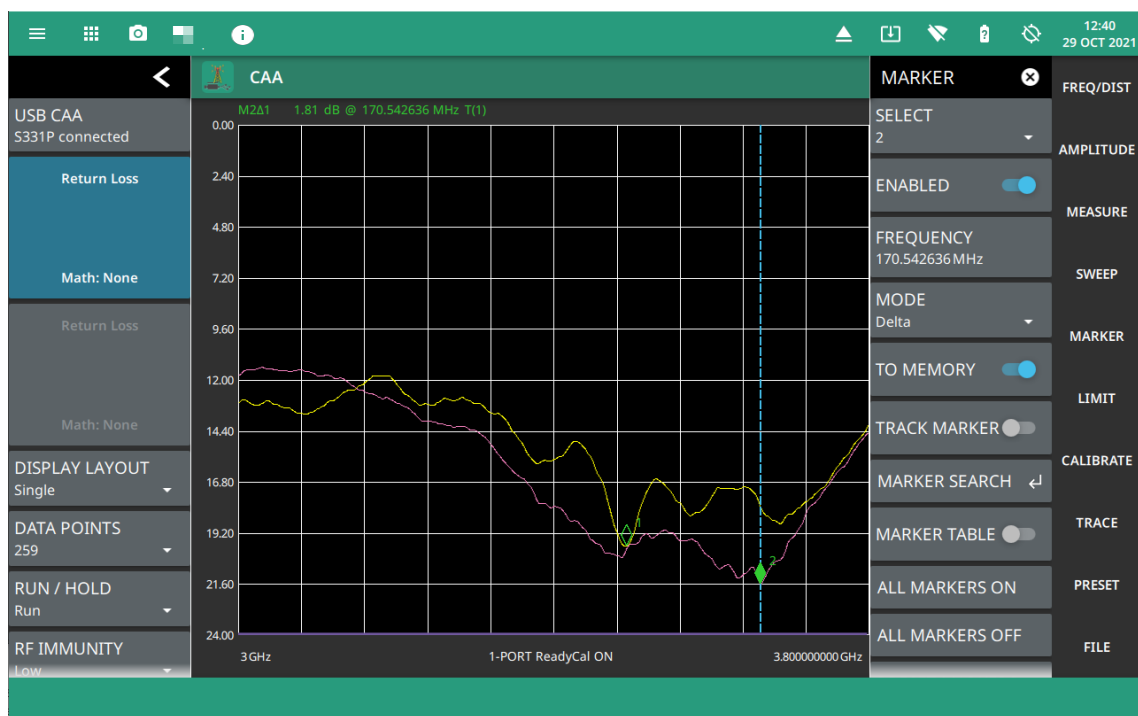


Figure 2-61. Displaying a Live Trace and a Static Trace from Trace Memory

MEMORY DISPLAY allows viewing of two traces to compare the trace stored in memory to the live trace. Trace MATH operations include Trace – Memory, Trace + Memory and (Trace + Memory) / 2. Saved traces can also be recalled and compared with the live trace.

Trace Overlay

The examples below illustrate how the trace overlay feature can be used to compare the return loss measurements between two antennas.

1. Connect the first antenna and set up the measurement. Refer to [“Setting up a Measurement” on page 2-17](#) for additional information.
2. Select TRACE > COPY TO MEM.
3. Remove the first antenna and connect the second antenna.
4. Select MEMORY DISPLAY and select Both. The purple trace from trace memory is displayed along with the live (yellow) trace.

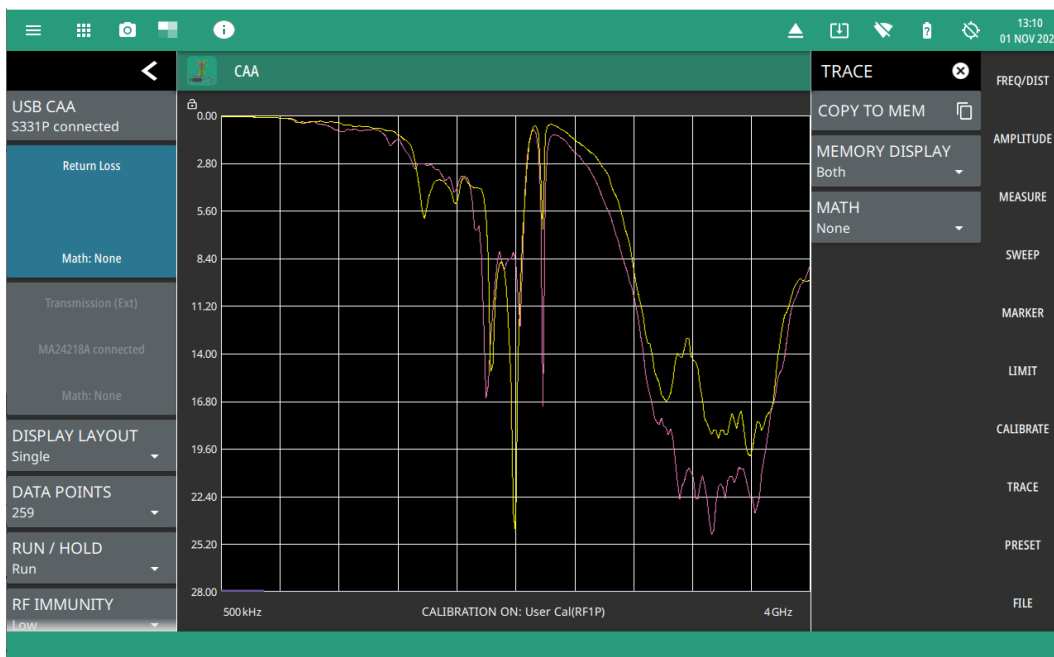


Figure 2-62. Trace Overlay of Two Antennas

Note

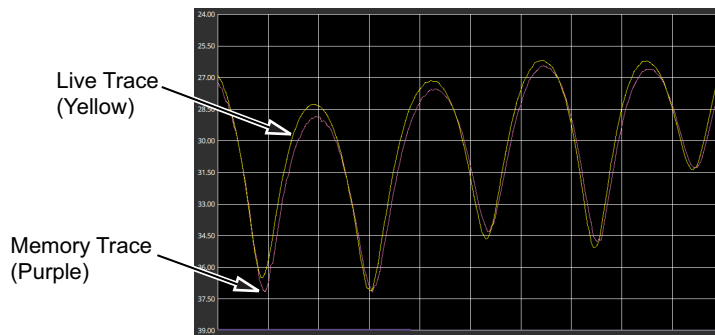
The trace from memory can only be displayed if the measurement settings (except for Amplitude) have not changed since the trace was copied to memory.

If one of the traces is cut off, pressing AMPLITUDE > FULLSCALE will adjust the reference level to display both traces.

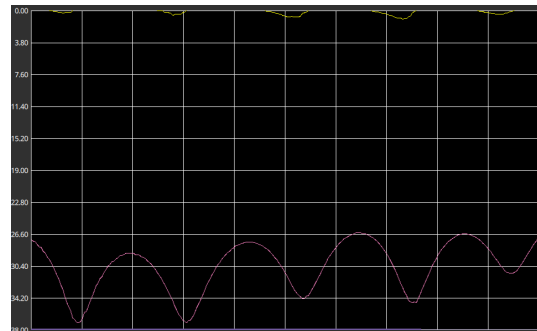
Trace Math Example

The example below illustrates how the trace math features can be used to compare the phase of two cables.

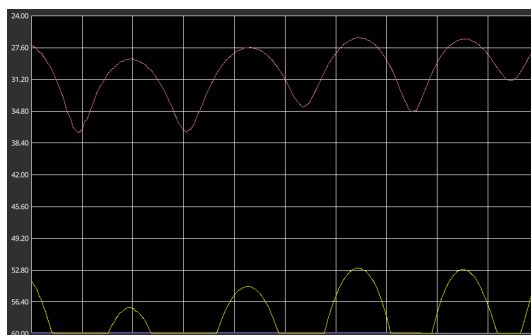
1. Connect the first cable and set up the measurement. Refer to “[Setting up a Measurement](#)” on page 2-17 for additional information.
2. Select TRACE > COPY TO MEM.
3. Remove the first cable and connect the second cable.
1. Select MEMORY DISPLAY and select Both. The purple trace from trace memory is displayed along with the live (yellow) trace.
2. Select MATH and select Trace - Mem, Trace + Mem, or $(\text{Trace} + \text{Mem}) / 2$ ([Figure 2-63](#)).



Example A. Sample Traces



Example B. Trace - Memory



Example C. Trace + Memory

Figure 2-63. Trace Memory Used to Compare the Phase of Two Cables (see [Table 2-3, “Trace Math Details”](#) on page 2-64)

Note

The trace math functions often seem backwards to new users. The points to remember with Trace – Mem, Trace + Mem, and $(\text{Trace} + \text{Mem}) / 2$ are:

The numbers on the y-axis are negative.

The purple trace is added to or subtracted from the live trace. The sum or difference of the live trace and memory trace is displayed in yellow.

Table 2-3. Trace Math Details

Example from Figure 2-63	Example Description
A. Sample Traces	Shows the live yellow trace and purple memory trace.
B. Trace – Memory	<p>In the Trace - Memory graph, the yellow trace is the result of subtracting the purple trace from the active trace (not displayed in Example B, Trace - Memory, but shown in Example A).</p> <p>Note that the yellow Trace - Memory is at 0 or above (and off the graticule) whenever the yellow trace is above (has a greater value than) the purple trace (refer to A).</p> <p>The two down sloping bumps in Example B are when the purple trace moves above the yellow trace. In Trace - Memory, this results in a negative value that is displayed.</p>
C. Trace + Memory	<p>In the Trace + Memory graph, the yellow trace is the result of adding the purple trace to the active trace (not displayed in Example C, Trace + Memory, but shown in Example A).</p> <p>Note that the yellow Trace + Memory is below 60 (and off the graticule) whenever adding the yellow trace value to the purple trace value is greater than 60 (refer to A).</p>
(Trace + Memory) / 2 (not shown)	<p>In the (Trace + Memory) / 2 graph, the yellow trace is the result of adding the purple trace to the active trace and then dividing the result by 2.</p> <p>This math function is most useful when measuring one-port Cable Loss (using the Cable Loss measurement).</p> <ol style="list-style-type: none"> 1. Connect a Short to the end of the cable and store the trace into memory. 2. Next, connect an Open to the end of the cable and apply (Trace + Mem) / 2 math function. <p>Because the ripple generated by the Short and Open are 180° out of phase, the effect of this math function will be to cancel out the ripple, resulting in a more accurate cable loss measurement.</p>

Refer to “TRACE Menu” on page 2-65 for additional information.

TRACE Menu

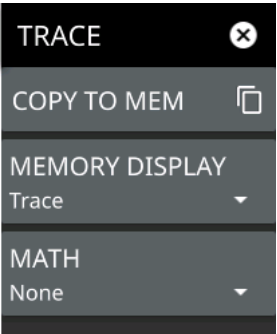
	<p>COPY TO MEM: Copies the currently active trace to memory for use in the display and math and options below.</p> <p>MEMORY DISPLAY: Selects the trace display options.</p> <ul style="list-style-type: none"> • Trace: The active trace is shown in yellow. • Memory: The trace stored in memory is displayed in purple. • Both: Displays both the stored trace (purple) if a trace is stored in memory and the current active trace (yellow). <p>MATH: Select to change the trace math options.</p> <ul style="list-style-type: none"> • None: The active trace is shown as is with no math functions. • Trace + Mem: Displays the difference between the active trace and the trace in memory. • Trace – Mem: Displays the results of logarithmic adding of the active trace and the trace in memory. • (Trace + Mem) / 2: Displays the results of the average of the active trace and trace in memory.
---	--

Figure 2-64. TRACE Menu

2-13 Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to “Reset settings” section in Instrument Overview chapter of user guide. To recover from system software faults, refer to Appendix A, “Instrument Messages and Troubleshooting” chapter of user guide.

PRESET Menu

PRESET ✕	PRESET TRACES: Presets all trace settings to default values.
PRESET TRACES	PRESET MARKERS: Presets all marker settings to default values. Turns off all markers.
PRESET MARKERS	PRESET LIMITS: Presets all limit settings to default values. Turns off all limits.
PRESET LIMITS	PRESET MODE: Presets all of the current analyzer settings to default values.
PRESET MODE	

Figure 2-65. PRESET Menu

2-14 Saving and Recalling Measurements

The Field Master Series can save measurement setups, native trace and CSV trace data, and screenshots. Setup and native trace files can be recalled. For other file operations such as copy, move, and directory management, refer to the “File Management” section in the Instrument overview chapter of the user guide.

Saving a Measurement

To save a measurement or setup, refer to [Figure 2-66](#):

1. Select 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. Select SAVE to save the file.

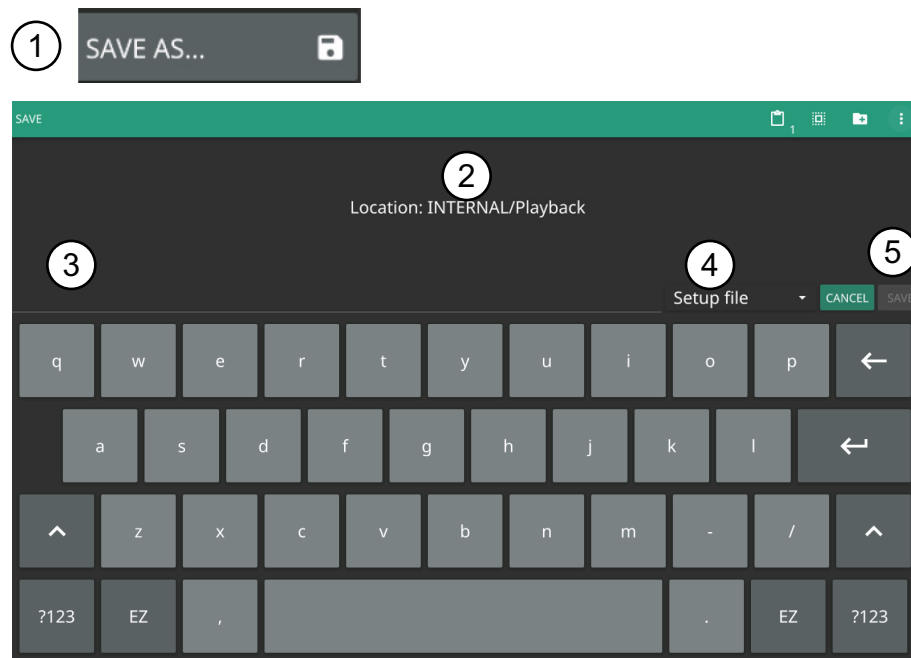


Figure 2-66. File Save Dialog

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

Saved setup and native trace measurements can be recalled. 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 2-67](#):

1. Select 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. Select OPEN to recall the file.

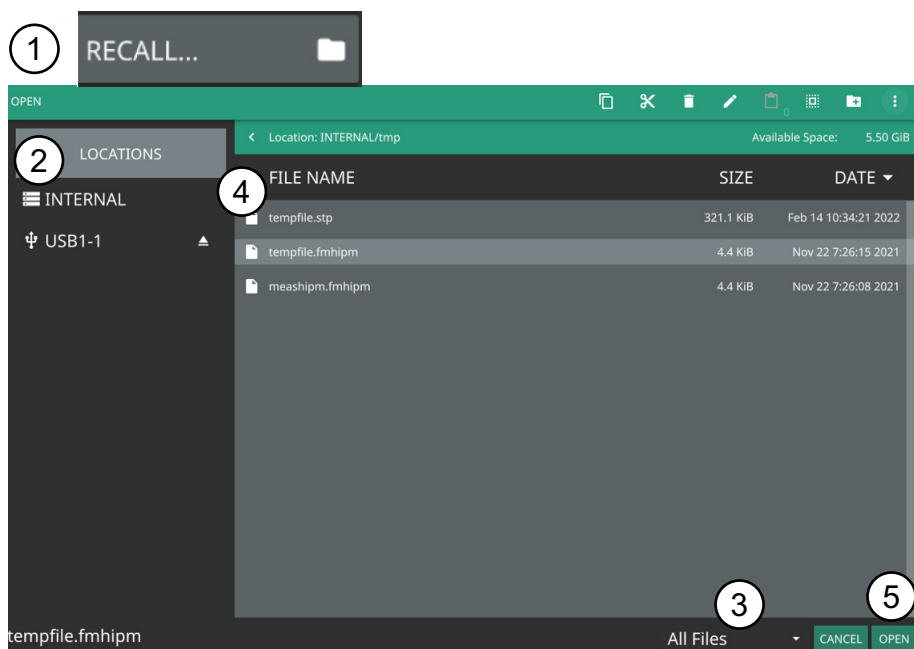


Figure 2-67. File Open Dialog

When a trace measurement is recalled, the trace will be recalled to memory and displayed along with the active trace. Toggle the trace display setting via TRACE > MEMORY DISPLAY and select Trace, Memory, or Both.

FILE Menu

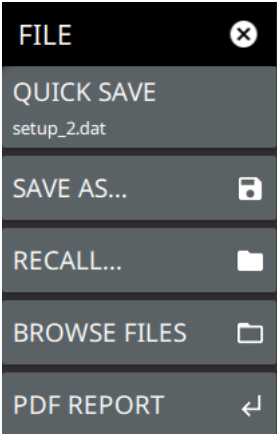
	<p>QUICK SAVE: Saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.</p> <p>SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:</p> <ul style="list-style-type: none"> • Setup: Saves the current instrument setup (stp file type). • Trace: Saves the measurement point (trace) data and the current instrument setup (fmcausb 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. • Trace TXT: Saves the instrument data and setup information, and the measurement point (trace) data (txt file format). • Screenshot: Saves a screenshot of the current measurement (png file type). • Measurement: Saves measurement data in a format that is compatible with Anritsu Line Sweep Tools (dat file format). <p>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 trace memory and will be displayed with the active trace. Toggle the trace display setting via TRACE > MEMORY DISPLAY and select Trace, Memory, or Both.</p> <p>BROWSE FILES: Refer to the “File Management” section of the instrument user guide.</p> <p>PDF REPORT: Opens “PDF Report Menu” on page 2-69. Refer to instrument user guide for detailed information.</p>
---	---

Figure 2-68. FILE Menu

PDF Report Menu

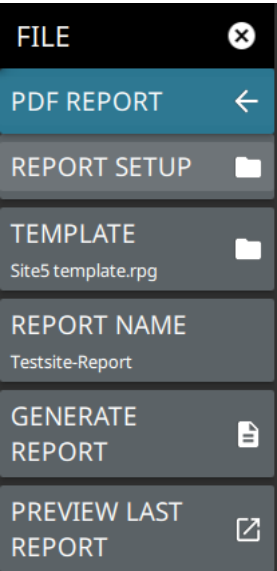
	<p>REPORT SETUP: Opens the PDF report generator screen.</p> <p>TEMPLATE: Loads the PDF report template saved in the instrument.</p> <p>REPORT NAME: Allows to name the PDF report.</p> <p>GENERATE REPORT: Generates the PDF report and saves in the REPORTS folder.</p> <p>PREVIEW LAST REPORT: Opens the previously generated report.</p>
---	--

Figure 2-69. PDF Report Menu

Anritsu



Anritsu utilizes recycled paper and environmentally conscious inks and toner.

Anritsu Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

<http://www.anritsu.com>

www.tehencom.com