Measurement Guide

Cable and Antenna Analyzer

MS2090A Field Master Pro™
MS2080A Field Master™
MS2085A Site Master™
MS2089A Site Master™

Time Domain Reflectometry (TDR) Measurement	**Option 3**
2-port Transmission Measurement	**Option 21 (MS2085A/89A)**
Cable and Antenna Analyzer Measurements	**Option 331 (MS2090A) or MS208xA**

Note	Field Master Series requires the Anritsu Site Master™ S331P that is sold separately. 2-Port Transmission measurement, Option 21 is only available with Site Master instruments. Not all instrument models offer every option or every measurement within a given option. Refer to the Technical Data Sheet of your instrument for available options and supported measurements.

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Part Number: 10580-00493
Revision: F
Published: March 2025

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Chapter 4—Cable and Antenna Analyzer Measurements

Chapter 1 — General Information

1-1 Introduction

This measurement guide describes the cable and antenna analyzer (CAA) measurement functions of the Anritsu Field Master and Site 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 options. Refer to Chapter 4, "Cable and Antenna Analyzer Measurements" 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

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

Product Information, Compliance, and Safety

Read the Product Information, Compliance, and Safety Guide for important safety, legal, and regulatory notices before operating the equipment, 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 (MS2090A)
- 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, 2-Port Transmission measurement (Option 21) option is offered as a 90-day time-limited option by ordering Option 9021. 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 mode uses an external Site Master™ S331P instrument (sold separately) to facilitate cable and antenna measurements using Field Master Series as the host controller. MS2085A/89A

Site Master instruments do not require S331P to make cable and antenna measurements, because they are built with an internal cable and antenna analyzer.

Time Domain Reflectometry (TDR) Measurement (Option 3)

The TDR option complements the Distance-to-Fault (DTF) measurement by providing additional information about reflections in a transmission line. The resistive, capacitive and inductive component of individual reflections can be identified which provides an additional insight about the nature of the reflection. Refer to "Time Domain Reflectometry (TDR) Measurements (Option 3)" on page 4-29, for more information.

2-Port Transmission Measurement (Option 21)(MS2085A/89A)

The 2-port transmission measurement is used to verify the performance of tower-mounted amplifiers, and duplexers, and to verify antenna isolation between two sectors. The excellent dynamic range makes it suitable for repeaters as well. The second port is a selective receiver which provides up to 100 dB dynamic range which makes it possible to test the band pass filters common on many networks. For information refer to "2-Port Transmission Measurement (Option 21)" on page 4-28.

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

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Chapter 2 — Overview

2-1 Introduction

This chapter provides an overview of the cable and antenna analyzer (CAA) user interface and describes the main graphical displays and menus presented in the CAA measurement mode.

2-2 Cable and Antenna Analyzer Setup

The cable and antenna analyzer mode is utilized in two ways:

- Field Master MS2080A/MS2090A instruments use an external Site Master™ S331P instrument (sold separately) to facilitate cable and antenna measurements using Field Master as the host controller.
- MS2085A/89A Site Master instruments do not require S331P to make cable and antenna measurements, because they are built with an internal cable and antenna analyzer.

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.

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 related literature on the S331P product page: http://www.anritsu.com/test-measurement/products/s331p.

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 related literature on the S331P product page: http://www.anritsu.com/test-measurement/products/s331p.

The cable and antenna analyzer mode in Site Master instruments operates in an exactly same fashion but without the need for an external S331P.

Field Master Series 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 CAAUSB Setup

Selecting the Analyzer - Field Master

The Cable and Antenna Analyzer instrument analyzer is 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 and then select CAAUSB icon to load cable and antenna 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. Get yout test port cable, calibration components and device under test ready to start making cable and antenna measurements.

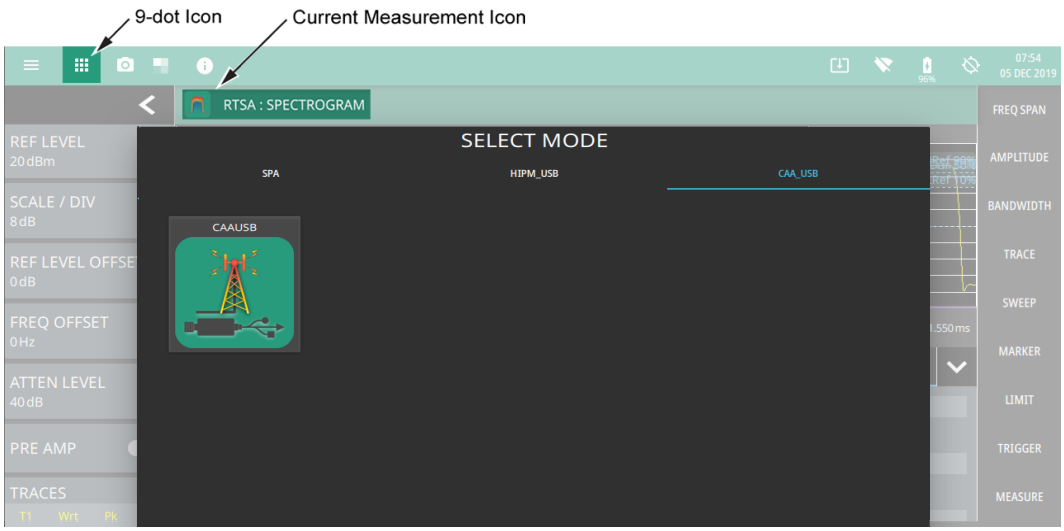


Figure 2-2. Selecting the CAAUSB Analyzer

Site Master Series Setup

The Site Master MS2085A/MS2089A instruments do not require an external S331P so, power on your instrument, keep the test port cable, calibration components and device under test to start making cable and antenna measurements.

Selecting the Analyzer - Site Master

From the instrument's title bar, either touch the 9-dot icon or the current measurement icon to view the available analyzers (see Figure 2-3). Select the CAA application and then select CAA icon to load the cable and antenna 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.

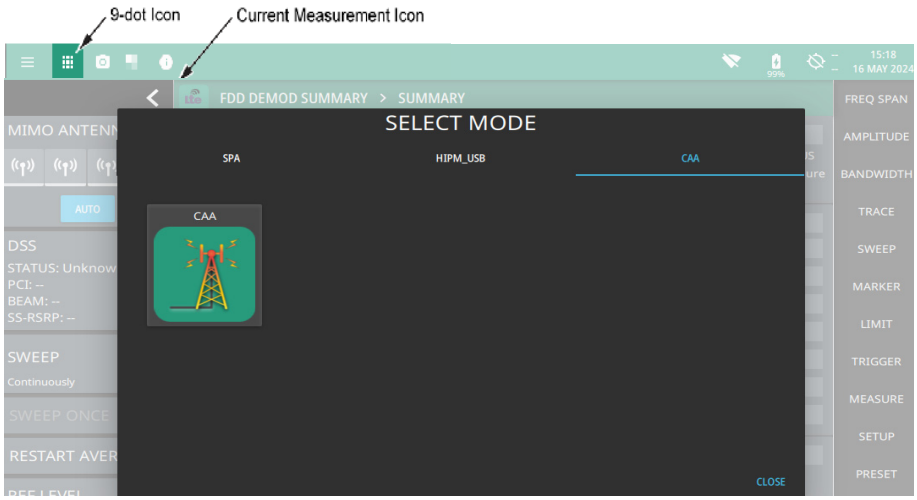
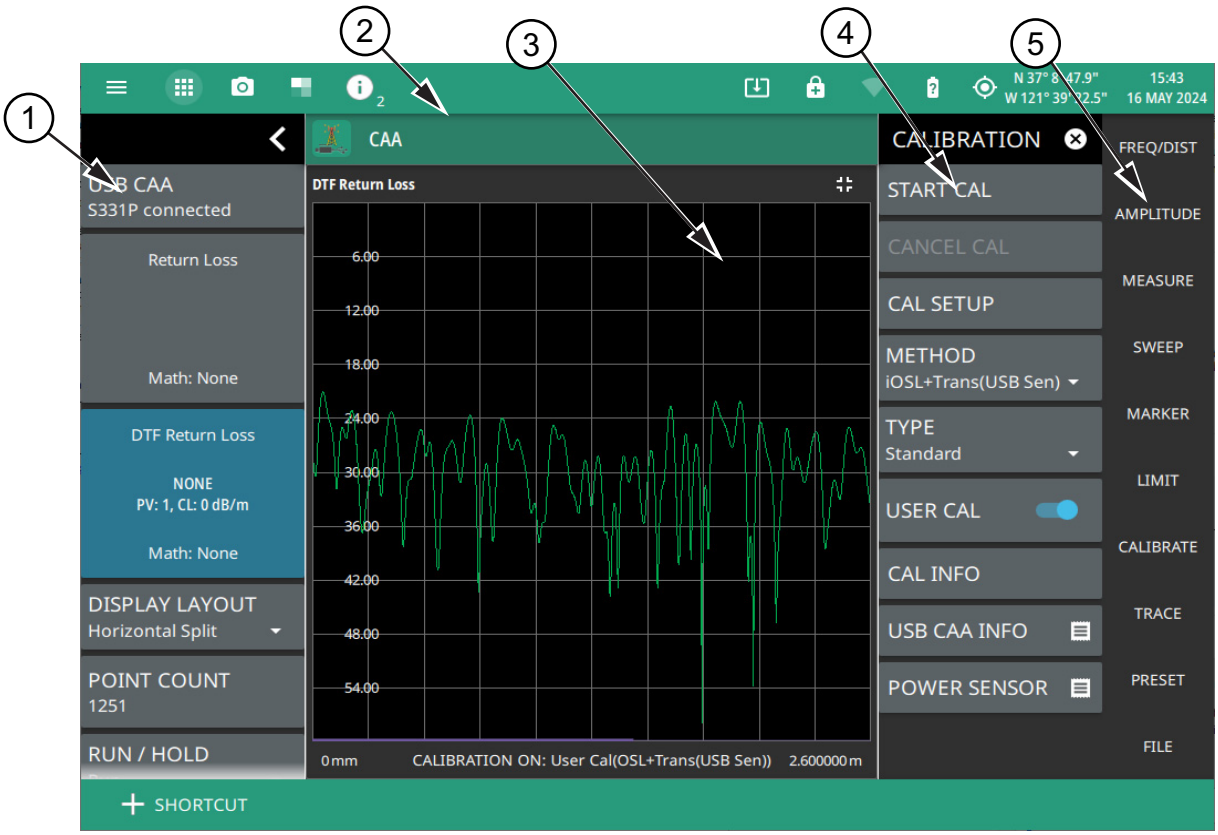


Figure 2-3. Selecting the CAA Analyzer

2-3 Cable and Antenna Analyzer GUI Overview

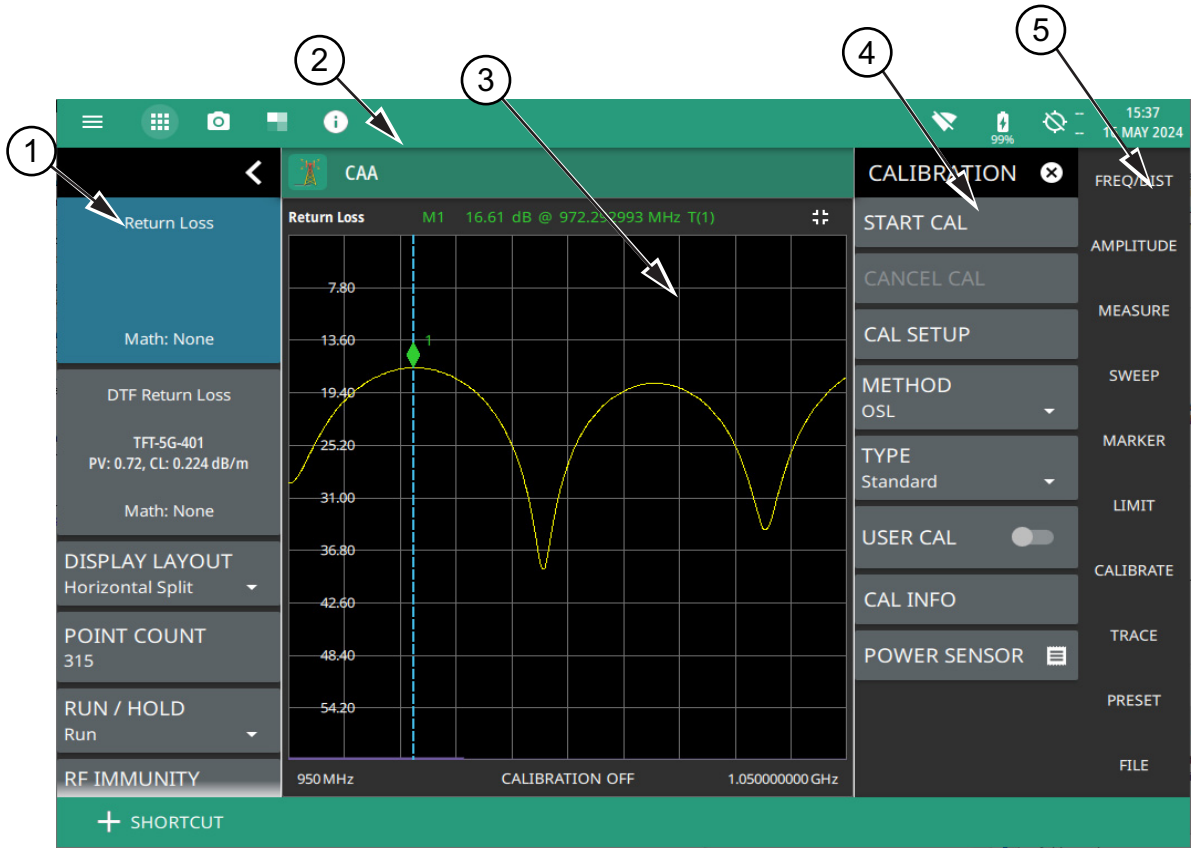
This section illustrates the main graphical displays presented for the cable and antenna analyzer of Field Master and Site Master series instruments. For an introduction to cable and antenna measurements, refer to Section 4-2 “Measurement Overview” on page 4-2. For a general overview of the instrument and its user interface, refer to Instrument Overview chapter of the product user guide.

Note	The instrument software user interface for Field Master and Site Master instruments is almost the same except with a few differences in the calibration menu, status panel and sweep menu.



1. **Status Panel:** The cable and antenna analyzer status panel displays general settings for the current measurement. Refer to “Status Panel” on page 2-9.
2. **Title Bar:** The title bar provides quick access to system settings, measurement mode selection, informational dialogs, and screen capture. Refer to “Selecting the Analyzer - Field Master” on page 2-2.
3. **Main Measurement Display:** This area shows active measurement either in single or dual display. Refer to “Display Layout” on page 2-6.
4. **Calibration Menu:** Access all the calibration settings and methods from here. Refer to “CALIBRATION Menu” on page 3-4.
5. **Main Menu:** Access all setup and measurement configuration menus from here. Refer to “Main Menu” on page 2-8.

Figure 2-4. Field Master Series Cable Antenna Analyzer GUI Overview

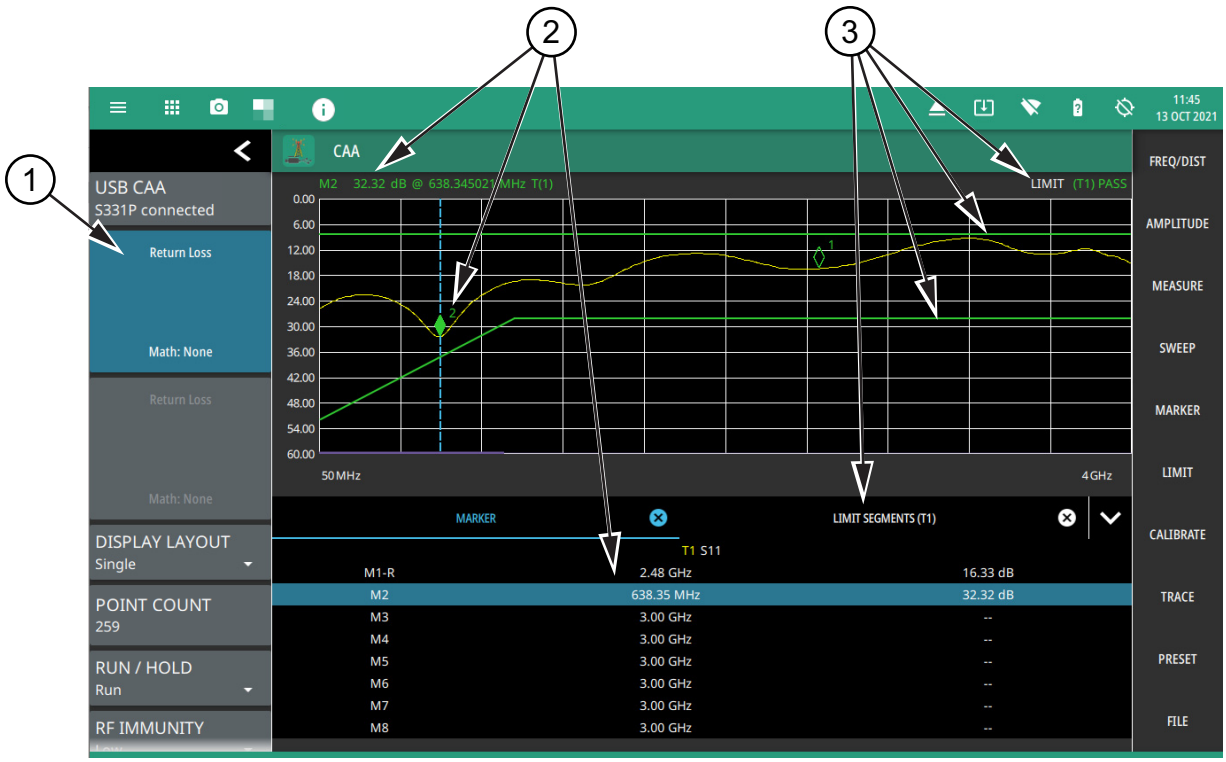


1. **Status Panel:** The cable and antenna analyzer status panel displays general settings for the current measurement. Refer to “Status Panel” on page 2-9.
2. **Title Bar:** The title bar provides quick access to system settings, measurement mode selection, informational dialogs, and screen capture. Refer to “Selecting the Analyzer - Site Master” on page 2-3.
3. **Main Measurement Display:** This area shows trace data and the marker table. Refer to “Display Layout” on page 2-6.
4. **Calibration Menu:** Access all the calibration settings and methods from here. Refer to “CALIBRATION Menu” on page 3-4.
5. **Main Menu:** Access all setup and measurement configuration menus from here. Refer to “Main Menu” on page 2-8.

Figure 2-5. Site Master Cable Antenna Analyzer GUI Overview

Display Layout

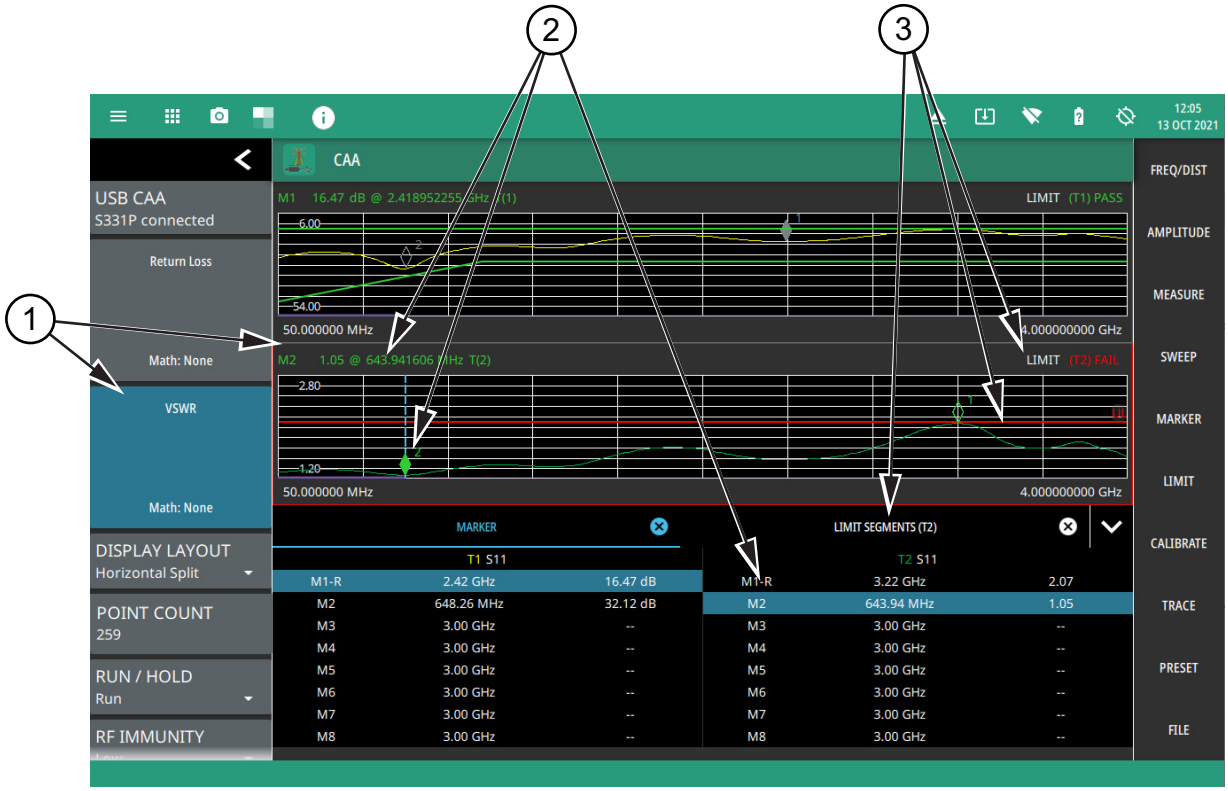
The Cable and Antenna Analyzer CAA can display a single measurement or two different measurements simultaneously (Horizontal Split). Different amplitudes, limit lines, and markers can be set for each display; the frequency range and calibration parameters are common to both displays. Marker and limit line tables can be toggled on and off, showing all marker and limit line values for either the single measurement or both measurements. Figure 2-6 shows an overview of the measurement display area for a single measurement display layout.



1. **Trace Card:** In single display layout, the upper trace card identifies the measurement type and related details. See “Status Panel” on page 2-9 for a description of trace cards.
2. **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 4-7 “Setting Up Markers” on page 4-33.
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. Refer to Section 4-8 “Setting Up Limit Lines” on page 4-40.

Figure 2-6. Single Measurement Display (Field Master Series)

Figure 2-7, “Split Measurement Display (Field Master Series)”shows an overview of the measurement display area for a horizontal split measurement display layout.

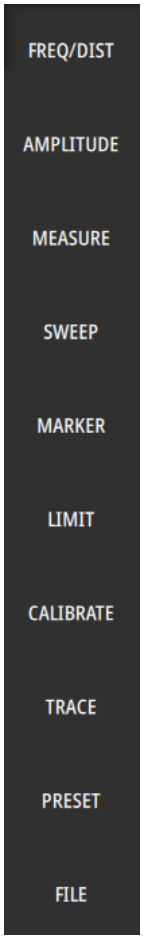


1. **Trace Card and Active Trace:** In horizontal split (dual) display layout, the active trace card is highlighted in blue and identifies the measurement type and related details. In addition, the active trace measurement area is outlined in a red box. See “Status Panel” on page 2-9 for a description 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 4-7 “Setting Up Markers” on page 4-33.
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 4-7 “Setting Up Markers” on page 4-33.

Figure 2-7. Split Measurement Display (Field Master Series)

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: Contains all frequency and distance settings including start and stop frequency, measurement distance, distance-to-fault (DTF), and cable parameters. Refer to Section 4-3 “Setting Frequency and Distance Parameters”.

AMPLITUDE: Provides access to all amplitude-related settings such as top and bottom of the graticule and scale settings. Refer to Section 4-4 “Setting Amplitude Parameters”.

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 4-5 “Setting up a Measurement”.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and RF immunity settings. Refer to Section 4-6 “Setting Sweep Parameters”.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 4-7 “Setting Up Markers”.

LIMIT: Provides controls for setting up limit lines and limit alarms. Refer to Section 4-8 “Setting Up Limit Lines”.

CALIBRATE: Sets the calibration type and method and begins the calibration. Refer to Section 3-2 “CALIBRATION Menu”.

TRACE: Provides trace memory controls and trace math settings. Refer to Section 4-9 “Setting Trace Parameters”.

PRESET: Opens the PRESET menu with selective trace, marker, and setup preset commands, or an all inclusive analyzer preset command. Refer to Section 4-10 “Presetting the Analyzer”.

FILE: Used to save and recall instrument setups and measurements, and screen images. Also provides access to save on event controls. Refer to “FILE Menu” on page 4-54 and the “File Management” section in the Instrument overview chapter of the user guide.

Figure 2-8. Main Menu

Using Menus

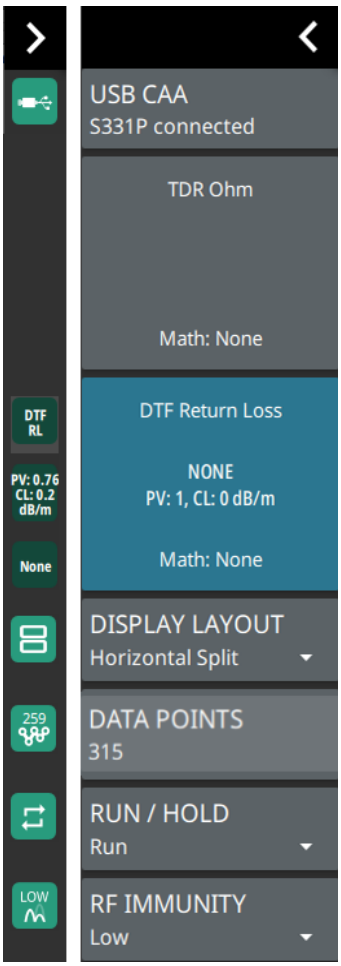
Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- 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).

Note	The MS2085A/89A instrument status panel does not include “USB CAA S331P connected” tile, as it does not require an external S331P instrument to make cable and antenna measurements.



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.

USB CAA: Indicates the model of the connected sensor. Only included in Field Master instruments.

Top and Bottom Trace Cards: Each trace card is divided into three separate sections that display information relevant to the selected measurement:

- 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.

DISPLAY LAYOUT: Selects between a single, full-size measurement layout or horizontal split layout.

DATA POINTS: Sets the number of display points currently measured by the instrument. Note that increasing the number of display points can improve the resolution of measurements in addition to increase in sweep time. Refer to “DATA POINTS” on page 4-31.

RUN/HOLD: Sets the sweep to either run or hold mode. Refer to “RUN/HOLD” on page 4-31.

RF IMMUNITY: Sets the reflection RF measurement to High or Low. Refer to “RF Immunity” on page 4-32.

Figure 2-9. Cable and Antenna Analyzer Status Panel with Mini Status Panel Icons (Field Master Series)

Chapter 3 — Calibration

3-1 Introduction

This chapter provides details and procedures about the following calibration methods:
InstaCal (ICN51A), Transmission (2-Port, Option 21), Transmission (USB Sensor), Open-Short-Load, Standard Cal and Flex Cal.

Chapter Overview

Refer to the following sections for a better understanding of the calibration:

- "Common RF Terms" on page 3-2
- "CALIBRATION Menu" on page 3-4
- "CALIBRATION METHODS" on page 3-9

For the most accurate results possible, the instrument should be calibrated before making any measurements.

OSL calibration components are used with cable and antenna analyzer measurements and are available from Anritsu as optional accessories, refer to your product's technical data sheet. For transmission measurements, an external USB power sensor is used in the calibration setup and is connected to the instrument with a through test port cable or adapter.

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.

Factory Calibration

The instrument 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 (USB 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 Menu” on page 3-4.

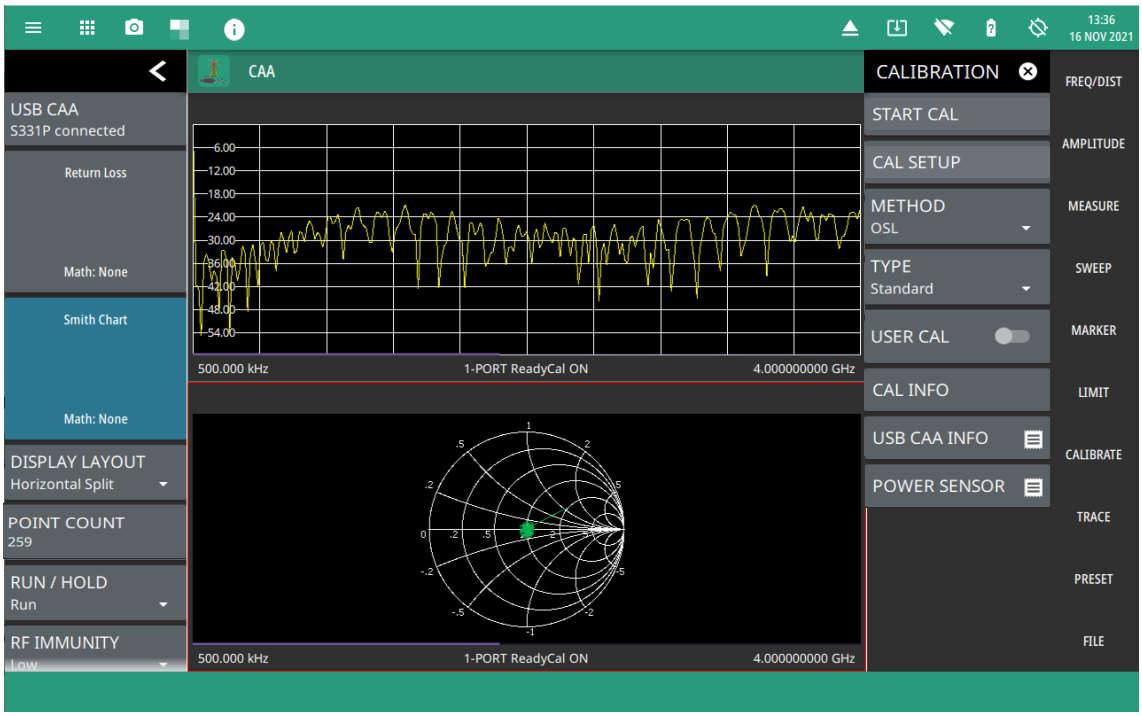
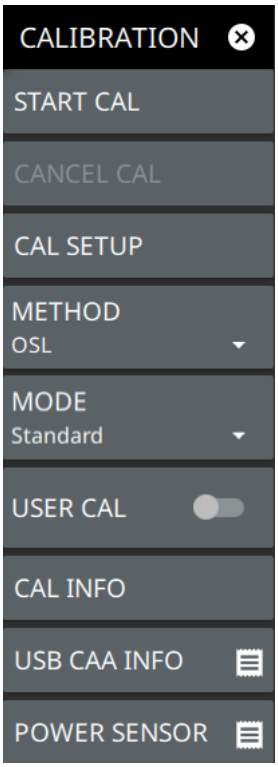


Figure 3-1. ReadyCal ON (All Measurements Except Transmission); User Cal Off (Transmission)

3-2 CALIBRATION Menu

Select CALIBRATION menu from the main menu to choose many options such as start/cancel calibration, cal setup, calibration methods, Mode and so on.



START CAL: Starts a manual measurement calibration. The CAL WIZARD window will open and provide on-screen instructions. Refer to "" on page 3-13. The basic calibration sequence is as follows:

- **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 + Trans (USB Sen). 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.

CANCEL CAL: Cancels the active calibration.

CAL SETUP: Provides the predefined set of parameters needed to start calibration.

METHOD: The Cable and Antenna Analyzer supports various calibration methods. Refer to "CALIBRATION METHODS" on page 3-9.

MODE: Selects either Standard calibration or Flex calibration. Refer to "Calibration Mode" on page 3-10.

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 3-6.

CAL INFO: Displays the active cal settings and current instrument settings. Refer to "CAL INFO" on page 3-6.

USB CAA INFO: Displays the cable antenna analyzer settings such as serial number, frequency range, etc. Refer to "USB CAA Info (Field Master Series Only)" on page 3-7. Note that this option does not apply to Site Master instruments.

POWER SENSOR: Displays the power sensor settings. Refer to "Power Sensor" on page 3-8.

Figure 3-2. CALIBRATION Menu

CALIBRATION SETUP

From the main menu select CALIBRATE > CAL SETUP to choose predefined calibration parameters. The cal setup menu consists of all the essential parameters to start an active calibration. You can choose the desired calibration method, MODE, DUT and cal kit. The list of cal kit components tend to differ based on the selected DUT.

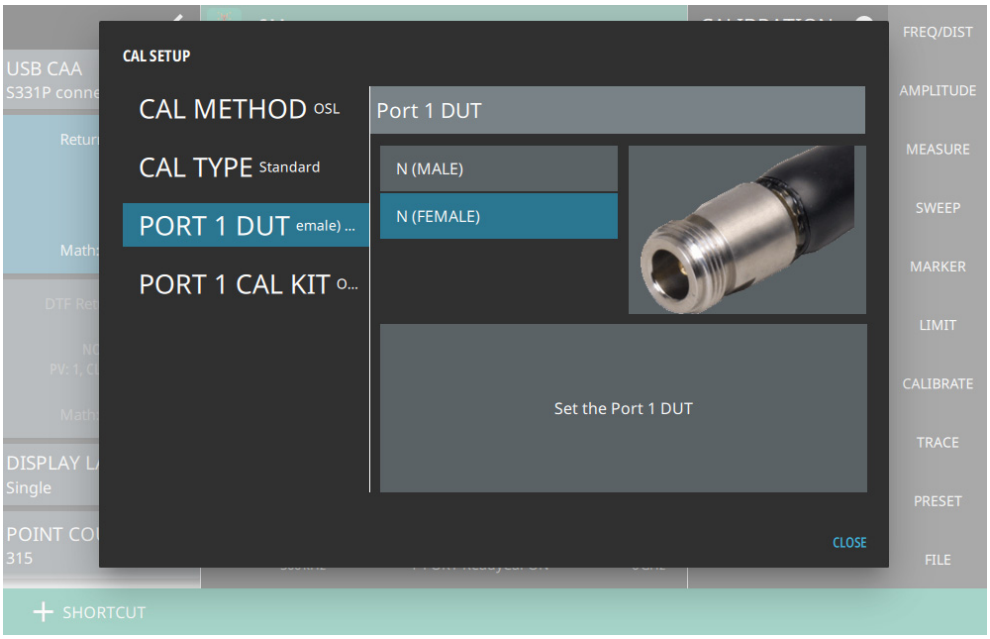


Figure 3-3. Cal Setup Menu

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 3-4). Active calibration settings are the settings saved following the last completed calibration. Current settings are values currently set on the instrument.

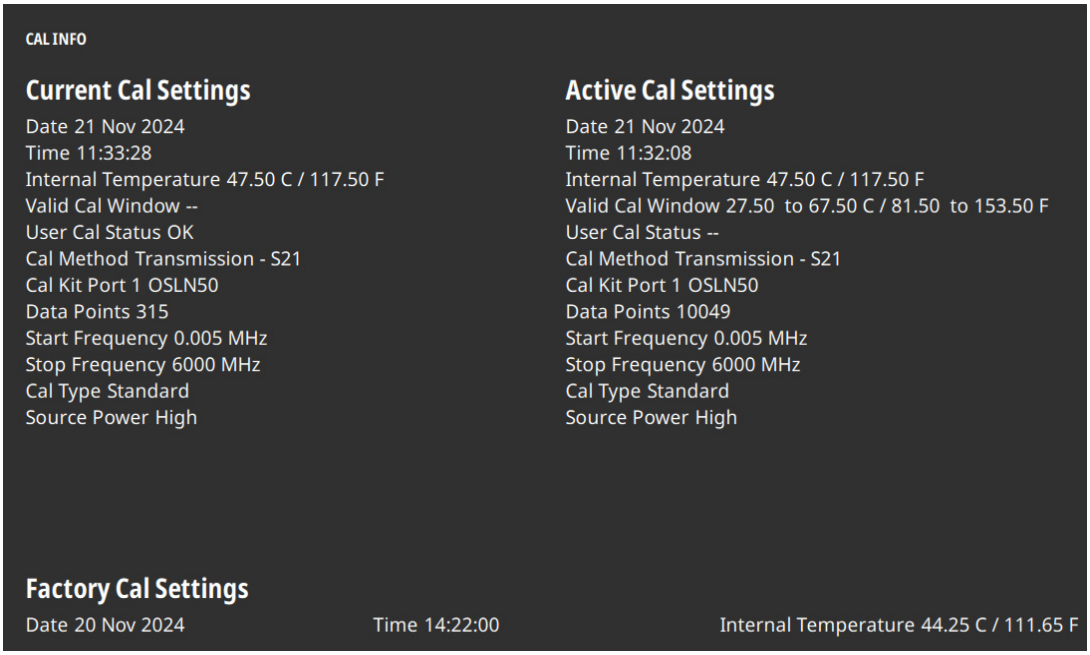


Figure 3-4. Cal Info Window

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 (USB Sensor) measurements, whether USER CAL is on or off. Conversely, if the instrument is calibrated using Transmission (USB 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 (Field Master Series Only)

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. Note that USB CAA Info option only applies to instruments with CAAUSB application.

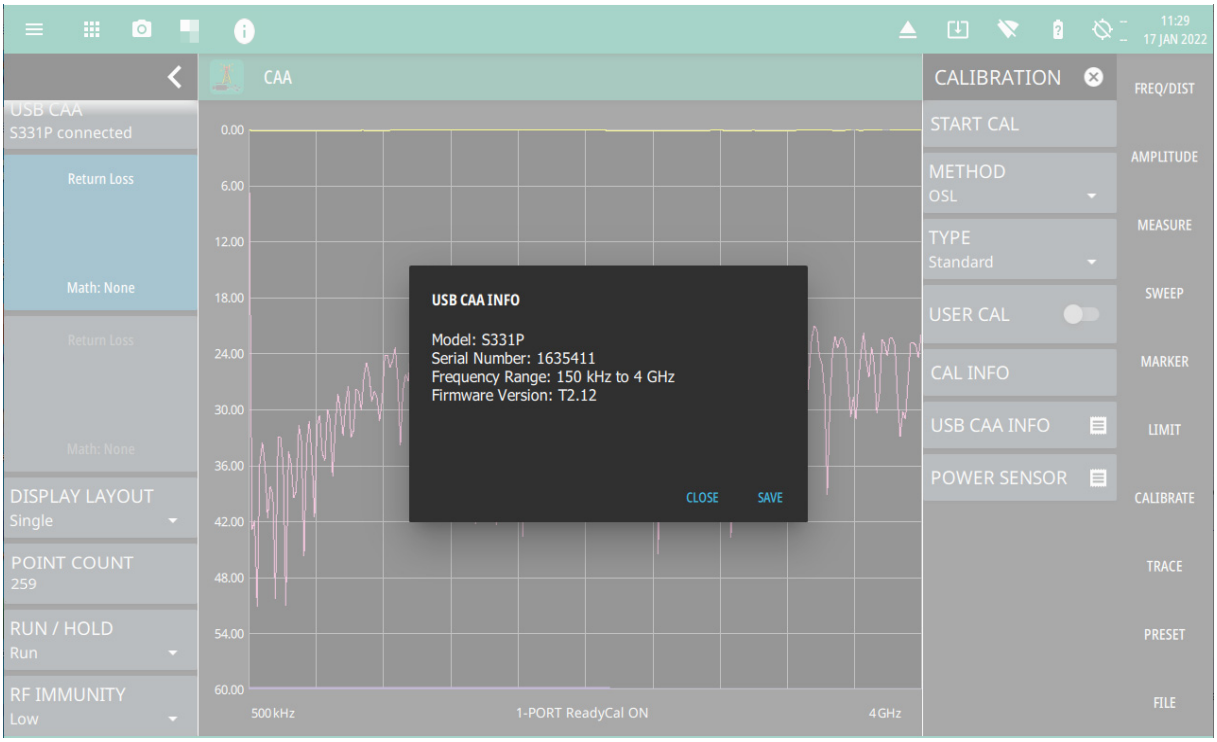


Figure 3-5. USB CAA Information

Power Sensor

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

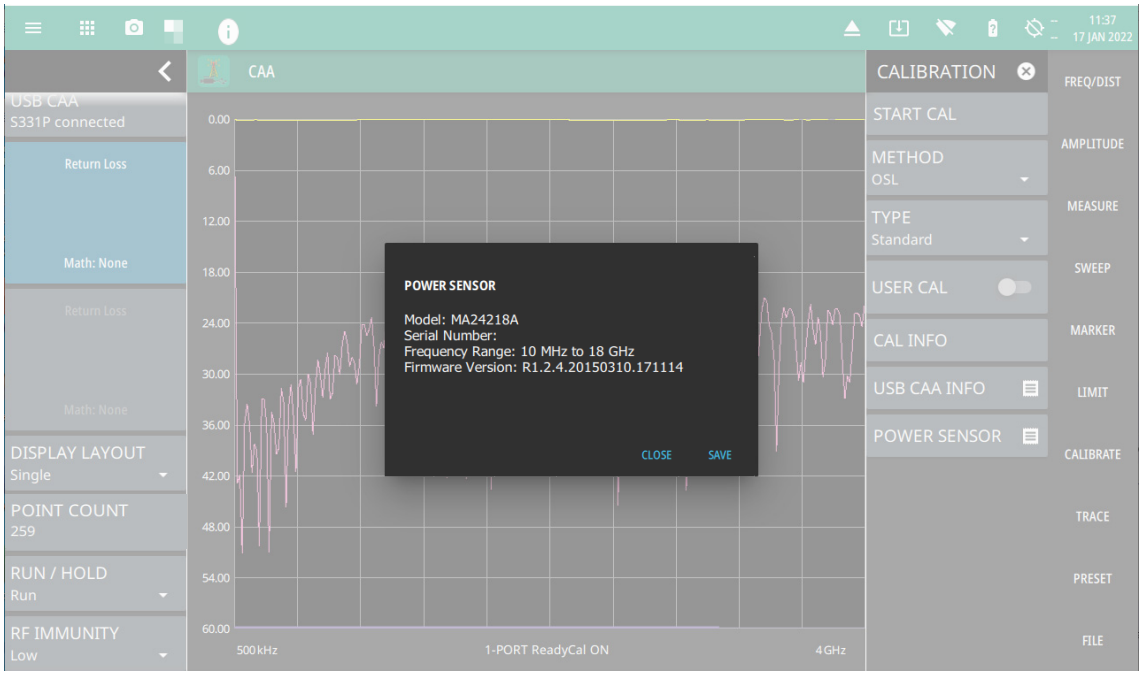


Figure 3-6. Power Sensor Information

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 (.fmcaausb) 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.

3-3 CALIBRATION METHODS

Not all instruments support all of the following user calibration methods for cable and antenna analyzer measurements. Some of the calibration methods are option dependent, please refer to your instrument's technical data sheet for the list of available options.

OSL (Open-Short-Load): For all measurement except Transmission (USB Sensor), you can manually calibrate the S331P using an external precision OSL calibration kit. Refer to "OSL Calibration" on page 3-13 for calibration instructions.

OSL + Trans (USB Sen): The combined calibration method OSL + Trans (USB Sen) allows the instrument to be calibrated once for all the supported measurement methods, eliminating the need to re-calibrate when switching from one type of measurement to another, such as return loss to transmission. Refer to "OSL + Transmission (USB Sen) Calibration" on page 3-16 for the calibration procedure.

Trans (USB Sen): Select the Transmission (USB 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 instrument's RF test port or through a test port cable.

When this calibration method is active and not combined with OSL, the S331P or Site Master automatically applies the default ReadyCal to all measurements other than Transmission. Refer to "Transmission (USB Sensor) Calibration" on page 3-20 for the calibration procedure.

OSL + Trans (2-port) (Option 21): OSL + Transmission (2-Port) method involves calibrating the port one with OSL and then calibrating the transmission from port 1 to port 2. The cable used to connect the two ports would be normalized.
Refer to"OSL + 2-Port Transmission Calibration (Option 21)" on page 3-22 for the calibration procedure.

Transmission (2-port) (Option 21): The 2-port transmission measurement is used to verify the performance of tower-mounted amplifiers, and duplexers, and to verify antenna isolation between two sectors. The excellent dynamic range makes it suitable for repeaters as well. The second port is a selective receiver which provides up to 100 dB dynamic range which makes it possible to test the band pass filters common on many networks. Refer to "2-port Transmission Calibration (Option 21)" on page 3-26 for the calibration procedure.

Note	OSL + Trans (2-port), Transmission (2-port) and OSL + Trans (2-port) calibration methods are only available if Option 21 is installed and are applicable to Site Master MS2085A/89A instruments only.

iOSL : The system will automatically switch between open, short and load during the calibration process. Note that this calibration method is only available when InstaCal ICN51A is used. Refer to "iOSL Calibration" on page 3-28 for the calibration procedure.

iOSL + Trans (USB Sen) : The system will automatically switch between and open, short and load. ICN51A InstaCal is used in this method instead of traditional OSL. External USB power senor is necessary to carry out this calibration method. Refer to "iOSL + Transmission (USB Sensor) Calibration" on page 3-30 for the calibration procedure.

iOSL + Trans (2-port) (Option 21): Just like OSL+ Trans (USB Sen) the iOSL + Trans (2-Port) uses the ICN51A instead of a traditional OSL. The system will automatically switch between and open, short and load. Refer to "iOSL + 2-Port Transmission Calibration (Option 21)" on page 3-33 for the calibration procedure.

Calibration Mode

The available calibration modes 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 (USB 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 3-1 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 3-1. Summary of Calibration Types

Calibration Mode	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 Mode" on page 3-10.

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 instrument 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 (USB 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 instrument:

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 for example, OSL or OSL + Trans (USB Sen)).
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 Calibration

Follow the steps below to perform OSL calibration method:

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.
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.

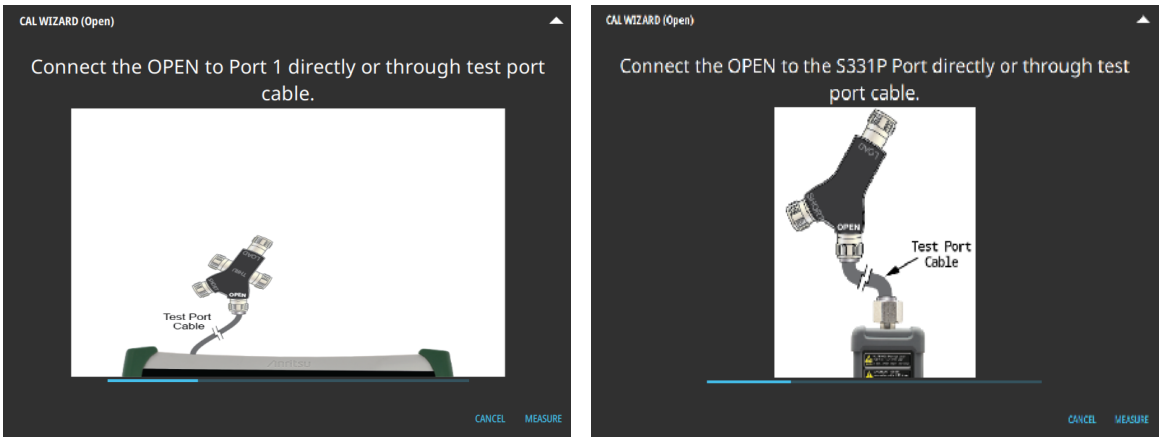


Figure 3-7. OSL Calibration - OPEN (Left: Site Master Instruments, Right: Field Master Instruments)

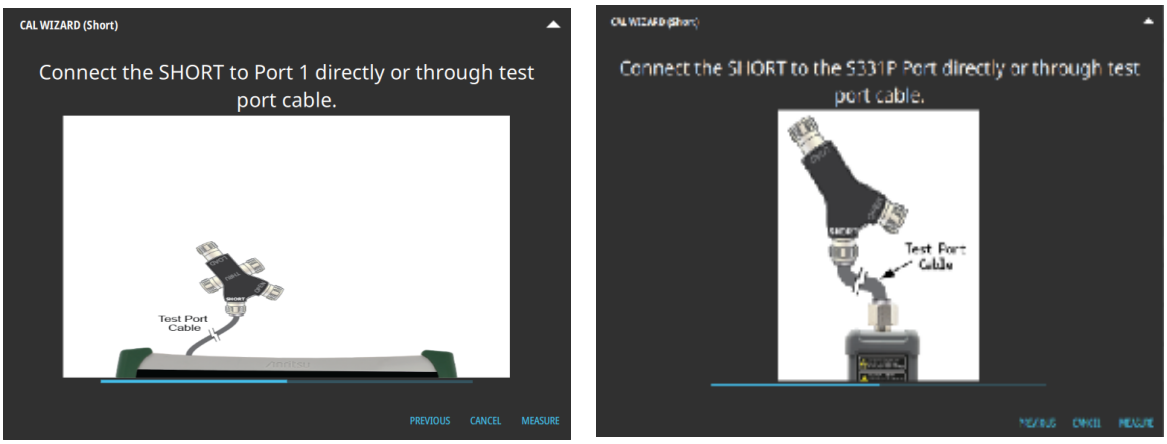


Figure 3-8. OSL Calibration - SHORT (Left: Site Master Instruments, Right: Field Master Instruments)

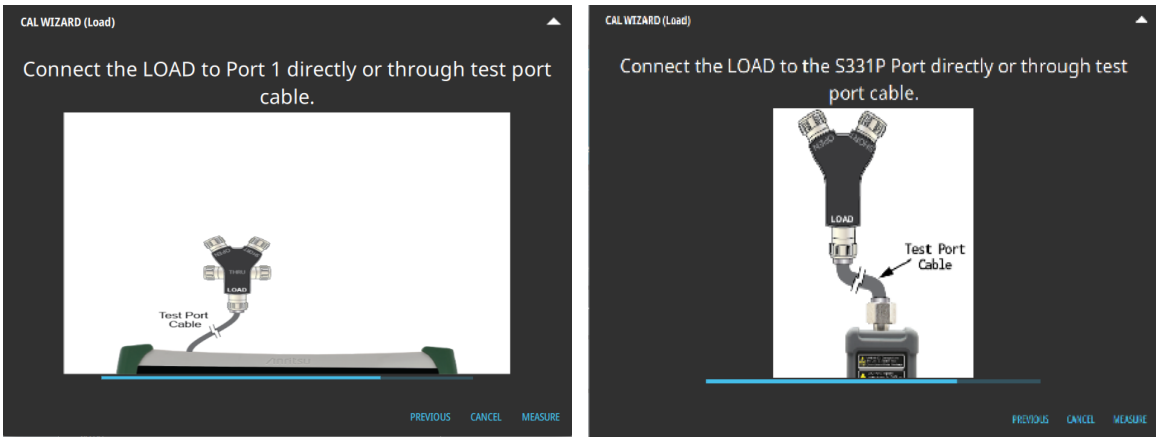


Figure 3-9. OSL Calibration - LOAD ((Left: Site Master Instruments, Right: Field Master Instruments)

7. When done, select APPLY.

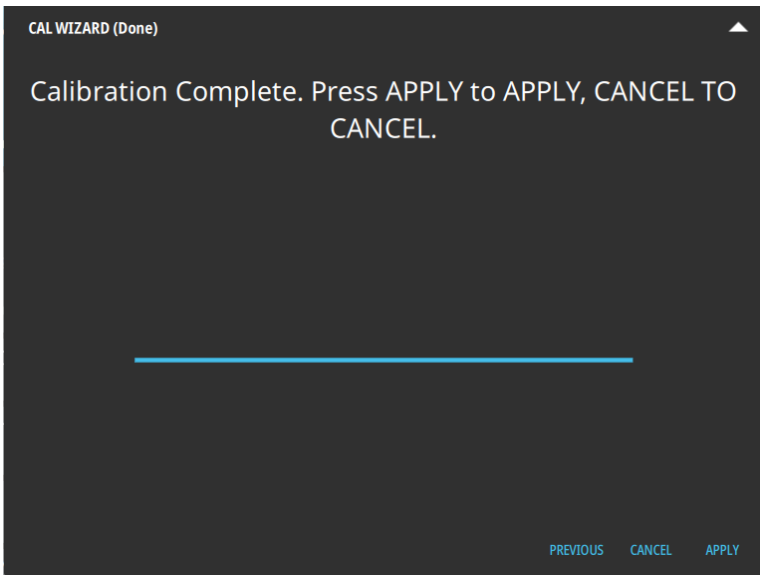


Figure 3-10. OSL Calibration - APPLY

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

   CALIBRATION ON: User Cal (OSL) for Standard calibration type
   CALIBRATION ON: iUser Cal (OSL) for Flex calibration type

Figure 3-11 illustrates both return loss measurement after a standard OSL calibration. The calibration is not applied to Transmission measurement.

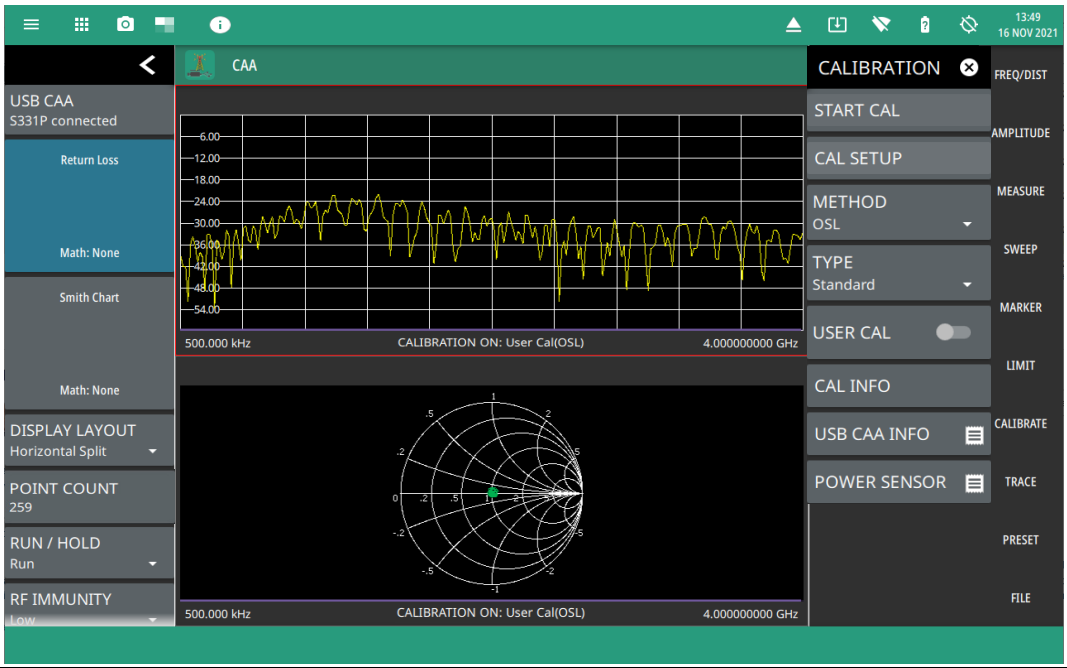


Figure 3-11. OSL Calibration, Standard (Field Master Series)

OSL + Transmission (USB Sen) Calibration

Follow the steps below to perform OSL + Transmission (USB Sensor) calibration method:

1. Ensure that an external USB power sensor is 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 + Trans (USB Sen).
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 + Trans (USB Sen) calibration method. The Transmission (USB Sen) calibration method begins with (Figure 3-15, “OSL +Trans (USB Sen) Calibration - ZERO (ensure nothing is connected to sensors) (Left: Site Master Instruments, Right: Field Master Instruments)” on page 3-17.

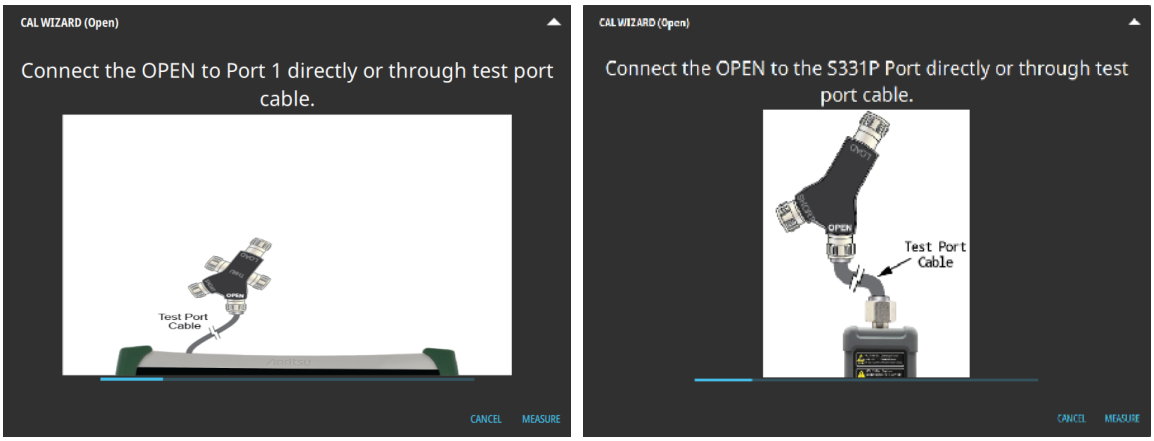


Figure 3-12. OSL +Trans (USB Sen) Calibration - OPEN (Left: Site Master Instruments, Right: Field Master Instruments)

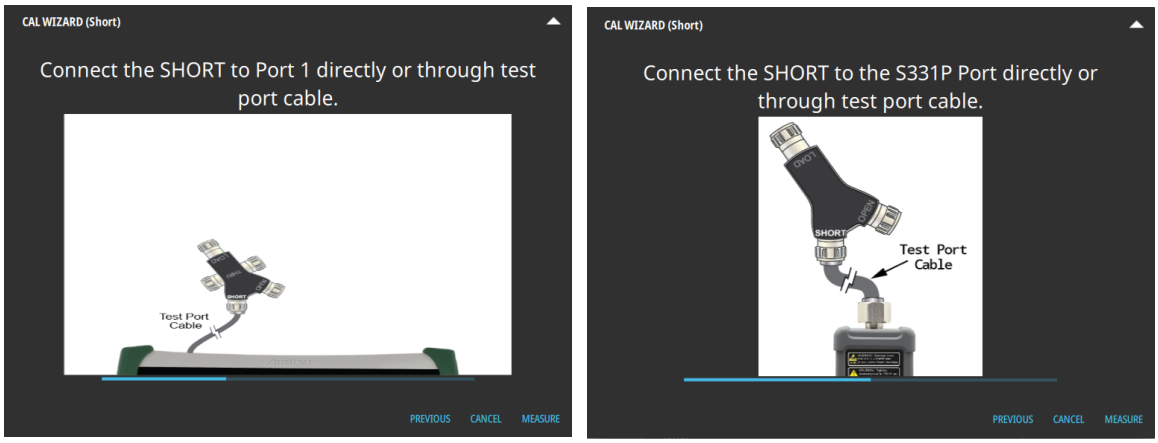


Figure 3-13. OSL +Trans (USB Sen) Calibration - SHORT (Left: Site Master Instruments, Right: Field Master Instruments)

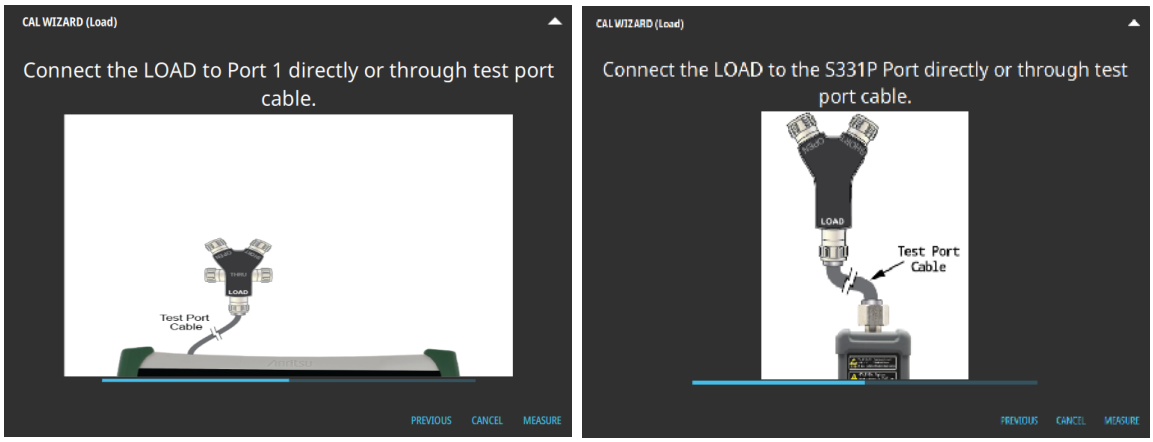


Figure 3-14. OSL +Trans (USB Sen) Calibration - LOAD (Left: Site Master Instruments, Right: Field Master Instruments)

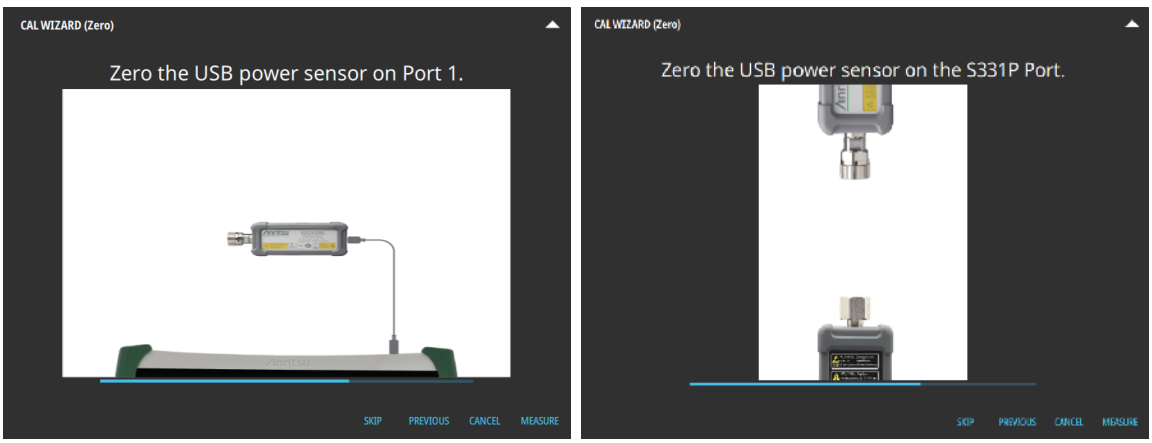


Figure 3-15. OSL +Trans (USB Sen) Calibration - ZERO (ensure nothing is connected to sensors) (Left: Site Master Instruments, Right: Field Master Instruments)

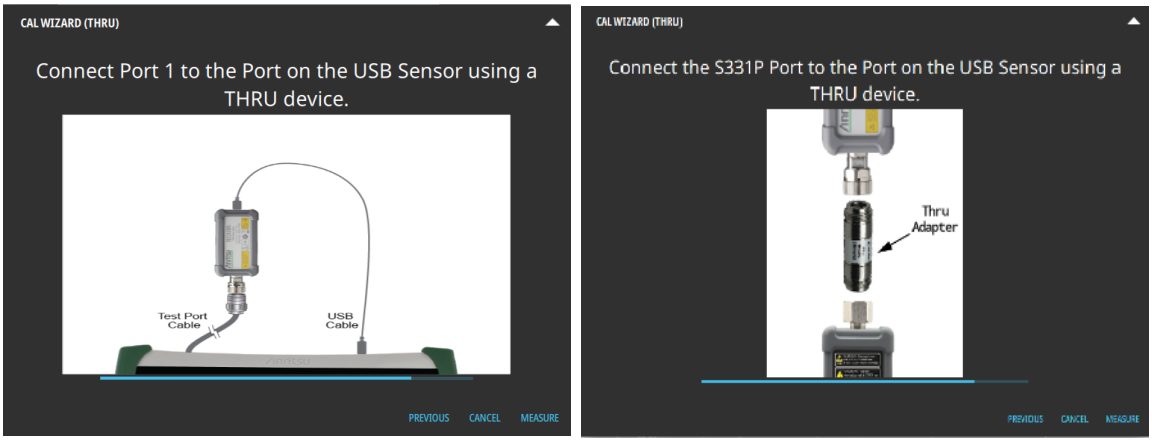


Figure 3-16. OSL +Trans (USB Sen) Calibration - THRU (Left: Site Master Instruments, Right: Field Master Instruments)

8. When done, select APPLY.

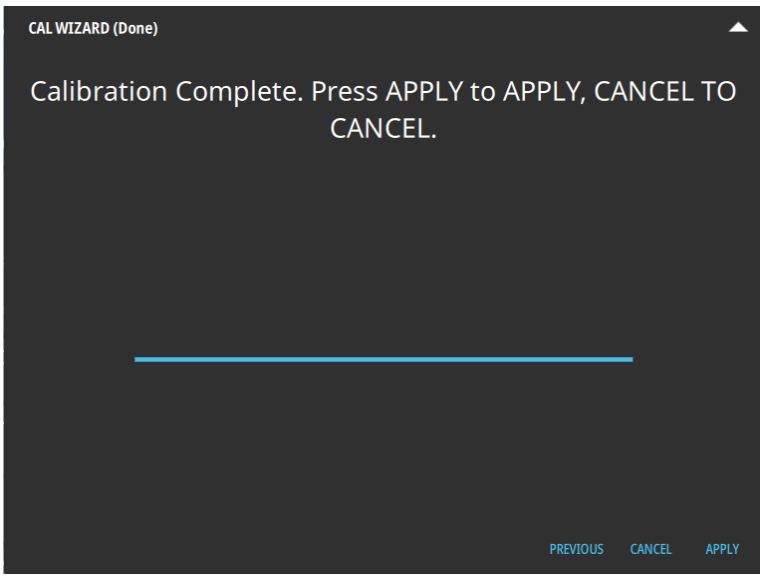


Figure 3-17. OSL +Trans (USB Sen) Calibration - APPLY

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

   CALIBRATION ON: User Cal (OSL+Trans (USB Sen)) for Standard calibration type
   CALIBRATION ON: iUser Cal (OSL+Trans (USB Sen)) for Flex calibration type

Figure 3-18 illustrates both Return Loss and Transmission (USB Sen) measurements after a standard OSL + Trans (USB Sen) calibration.

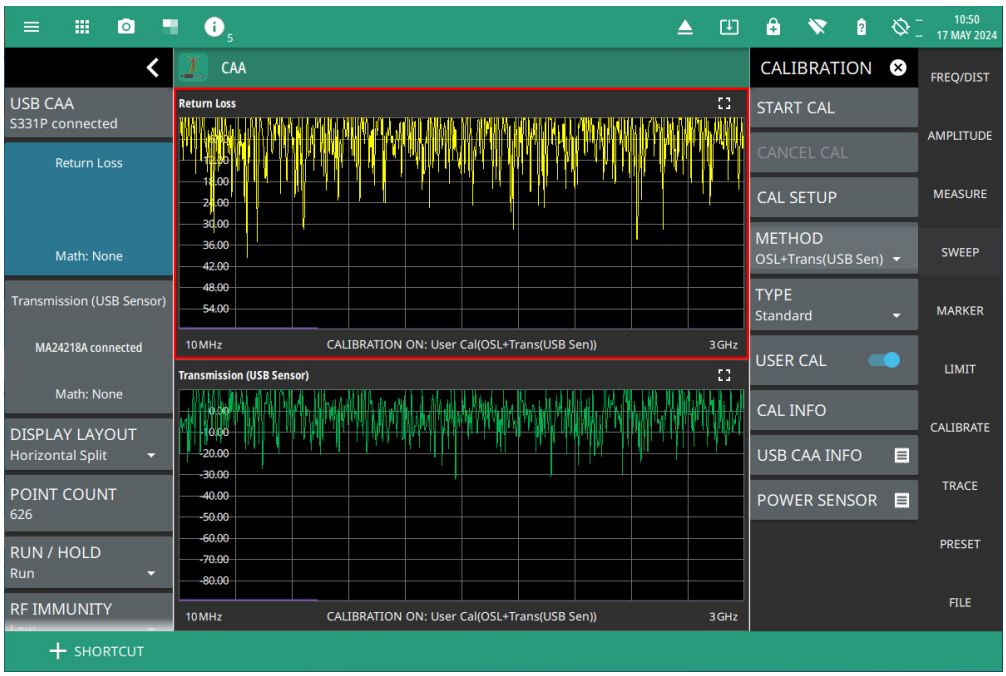


Figure 3-18. OSL +Trans (USB Sen) Calibration, Standard (Site Master Series)

Transmission (USB Sensor) Calibration

Follow the steps below to perform Transmission (USB Sensor) calibration method:

1. Ensure that an external USB power sensor is 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 Transmission (USB Sen).
5. Select TYPE and select either Standard or Flex for the calibration type.
6. Select START CAL and follow the on-screen CAL WIZARD prompts.
7. Select MEASURE at the end of each step to proceed to the next step in the sequence.

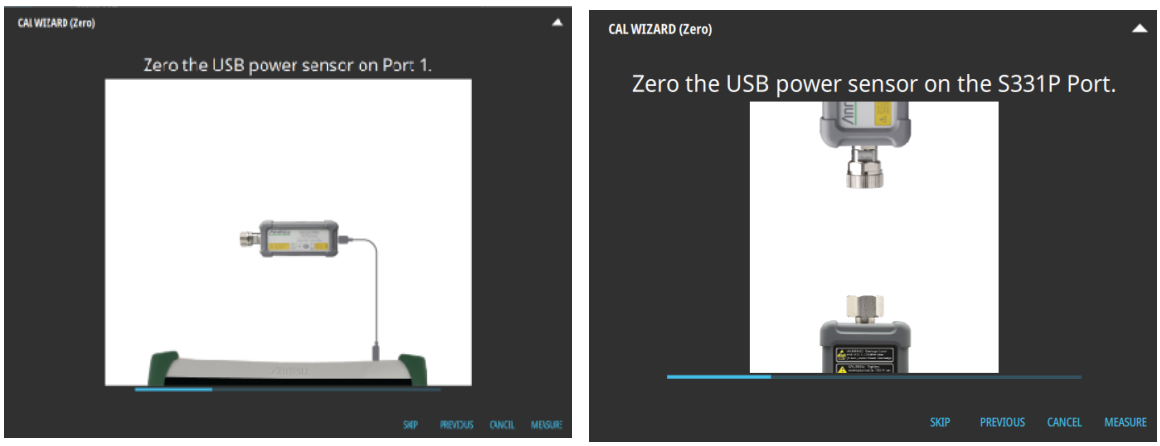


Figure 3-19. Transmission (USB Sen) Calibration - ZERO (ensure nothing is connected to sensor) (Left: Site Master Instruments, Right: Field Master Instruments)

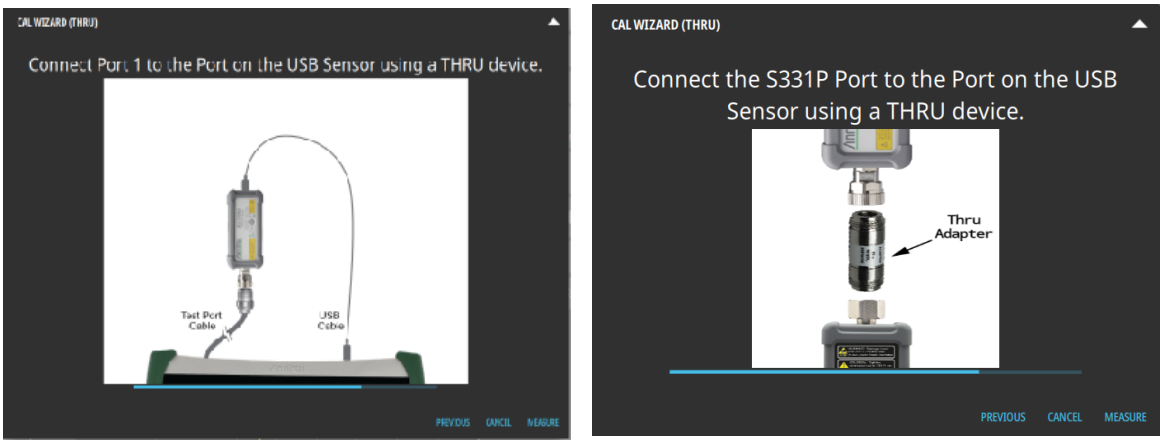


Figure 3-20. Transmission (USB Sen) Calibration- THRU

8. When done, select APPLY.

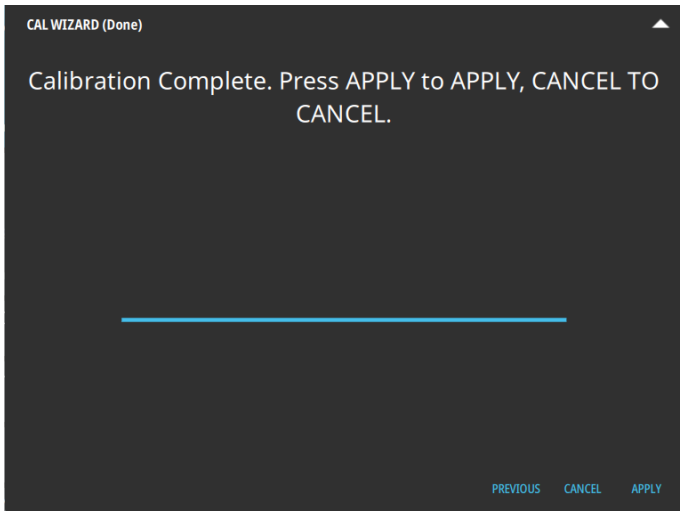


Figure 3-21. Transmission (USB Sen) Calibration - APPLY

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

   CALIBRATION ON: User Cal (Trans (USB Sen)) for Standard calibration type
   CALIBRATION ON: iUser Cal (Trans (USB Sen)) for Flex calibration type

Figure 3-22 illustrates both Return Loss and Transmission (USB Sen) measurements after a standard Transmission (USB Sen) calibration.

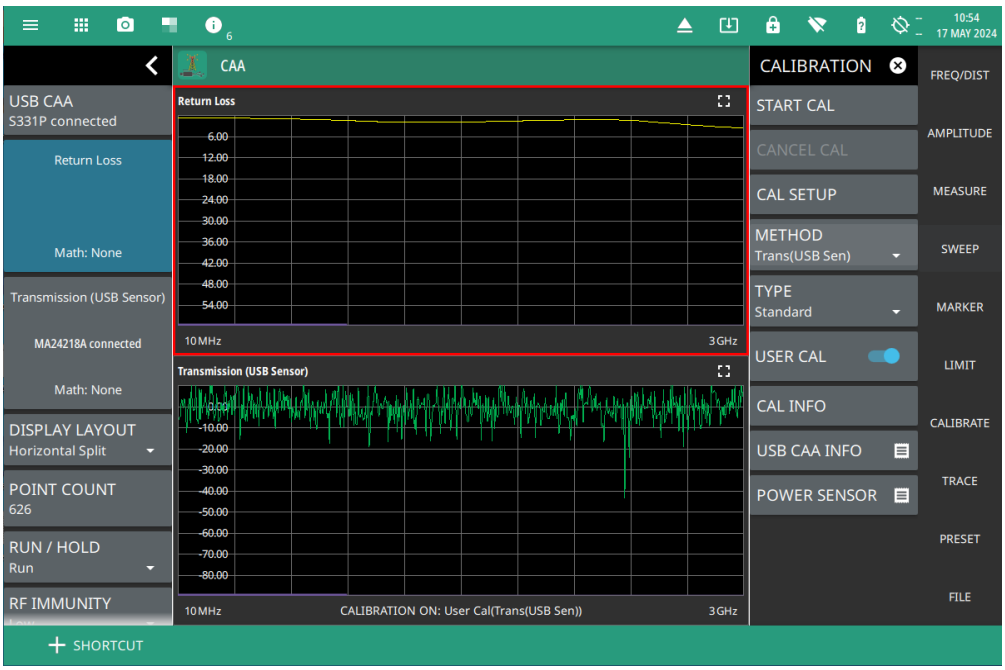


Figure 3-22. Transmission (USB Sen) Calibration, Standard

OSL + 2-Port Transmission Calibration (Option 21)

Follow the steps below to perform OSL + 2-Port Transmission calibration method:

Note	OSL + 2-Port Transmission calibration method is only available when Option 21 is installed which applies to Site Master instruments, only.

1. Ensure that an external USB 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 + Trans (2-Port).
5. Select TYPE and select either Standard or Flex for the calibration type.
6. Select START CAL and follow the on-screen CAL WIZARD prompts.
7. Select MEASURE at the end of each step to proceed to the next step in the sequence.

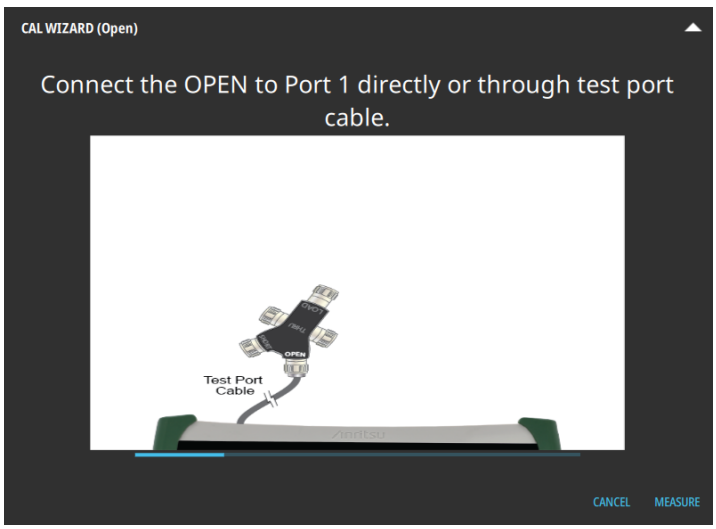


Figure 3-23. OSL + 2-port Transmission Calibration - OPEN

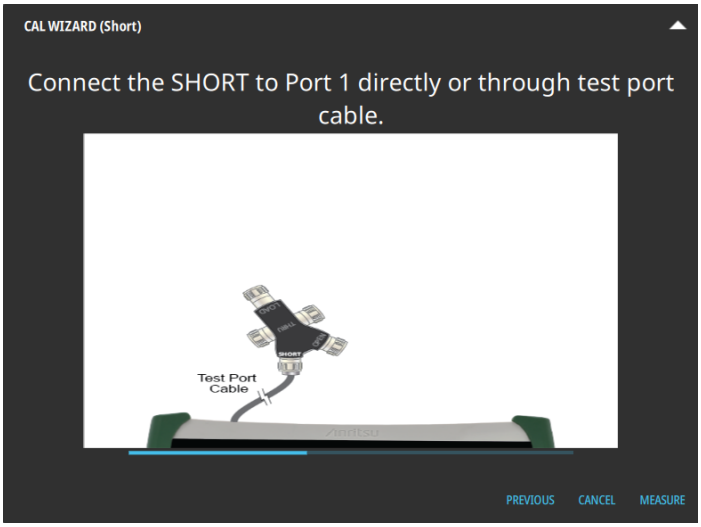


Figure 3-24. OSL + 2-port Transmission Calibration - SHORT

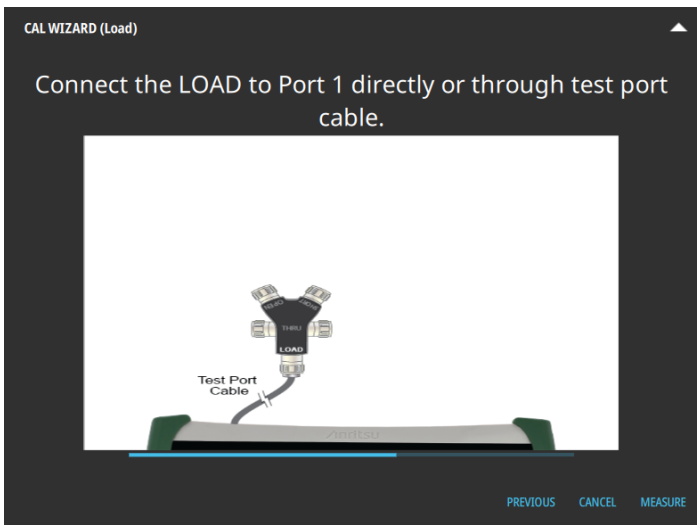


Figure 3-25. OSL + 2-port Transmission Calibration - LOAD

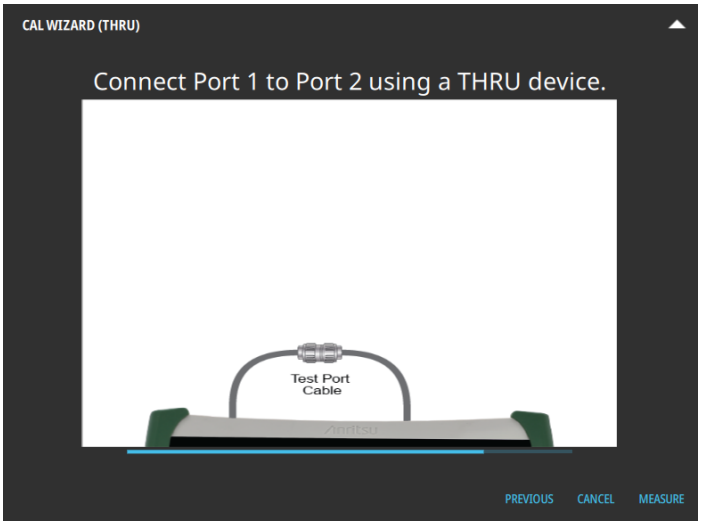


Figure 3-26. OSL + 2-port Transmission Calibration - THRU

8. When done, select APPLY.

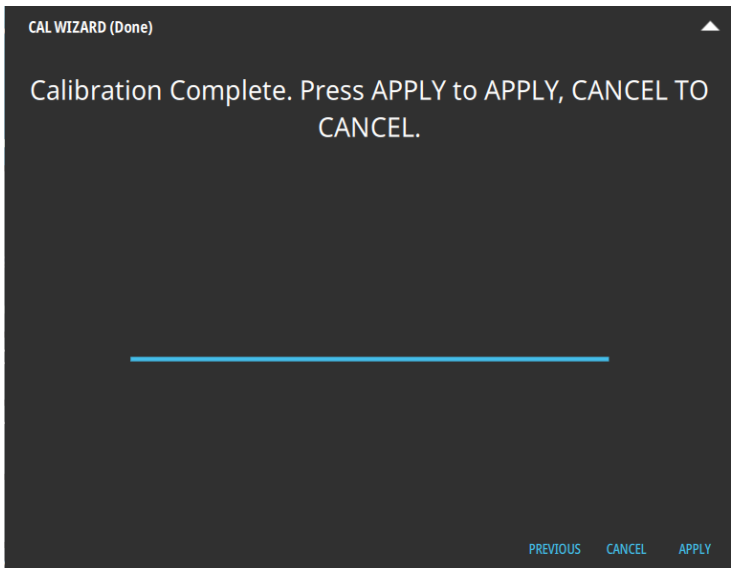


Figure 3-27. OSL + Transmission (2-port) Calibration - APPLY

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

   CALIBRATION ON: User Cal (OSL+Trans (Port 2) for Standard calibration type
   CALIBRATION ON: iUser Cal (OSL+Trans (Port 2) for Flex calibration type

Figure 3-28 illustrates both return loss and DTF return loss measurements after a standard OSL + 2-Port Transmission calibration.

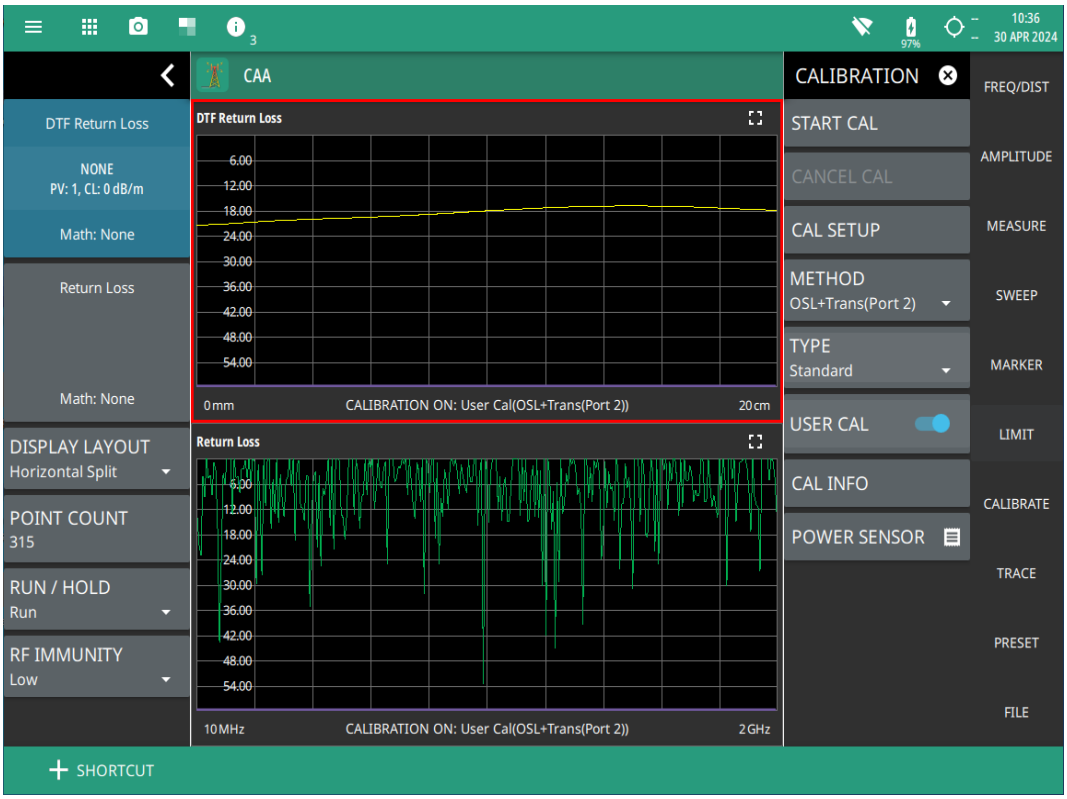


Figure 3-28. OSL + Transmission (2-port) Calibration, Standard

2-port Transmission Calibration (Option 21)

Follow the steps below to perform 2-Port Transmission calibration method:

Note	2-Port Transmission method is only available when Option 21 is installed which applies to Site Master instruments, only.

1. Ensure that an external USB 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 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.

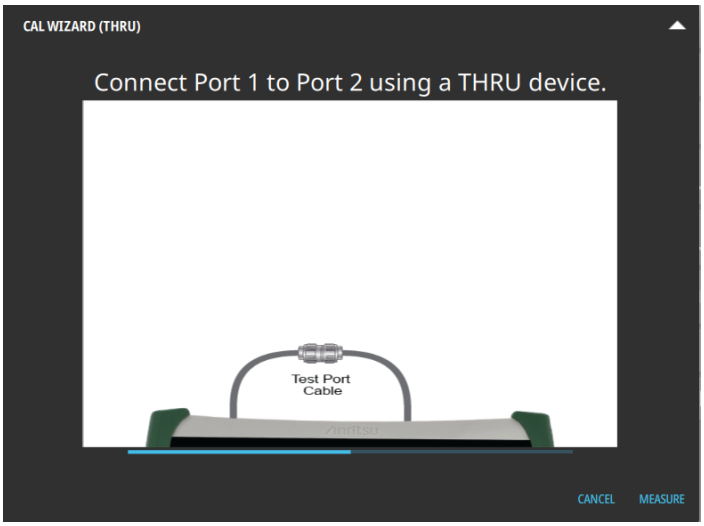


Figure 3-29. 2-port Transmission Calibration - THRU

8. When done, select APPLY.

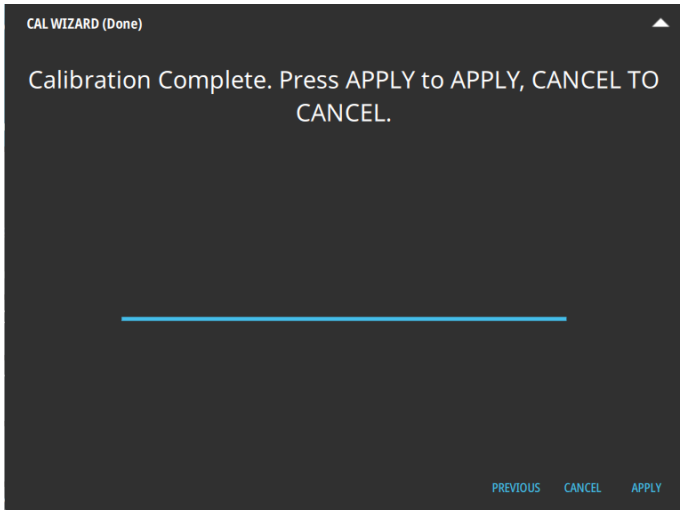


Figure 3-30. (2-port Transmission Calibration - APPLY

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

   CALIBRATION ON: User Cal (Trans (Port 2) for Standard calibration type
   CALIBRATION ON: iUser Cal (Trans (Port 2) for Flex calibration type

Figure 3-31 illustrates both DTF return loss and transmission measurements after a standard Transmission (2-port) calibration.

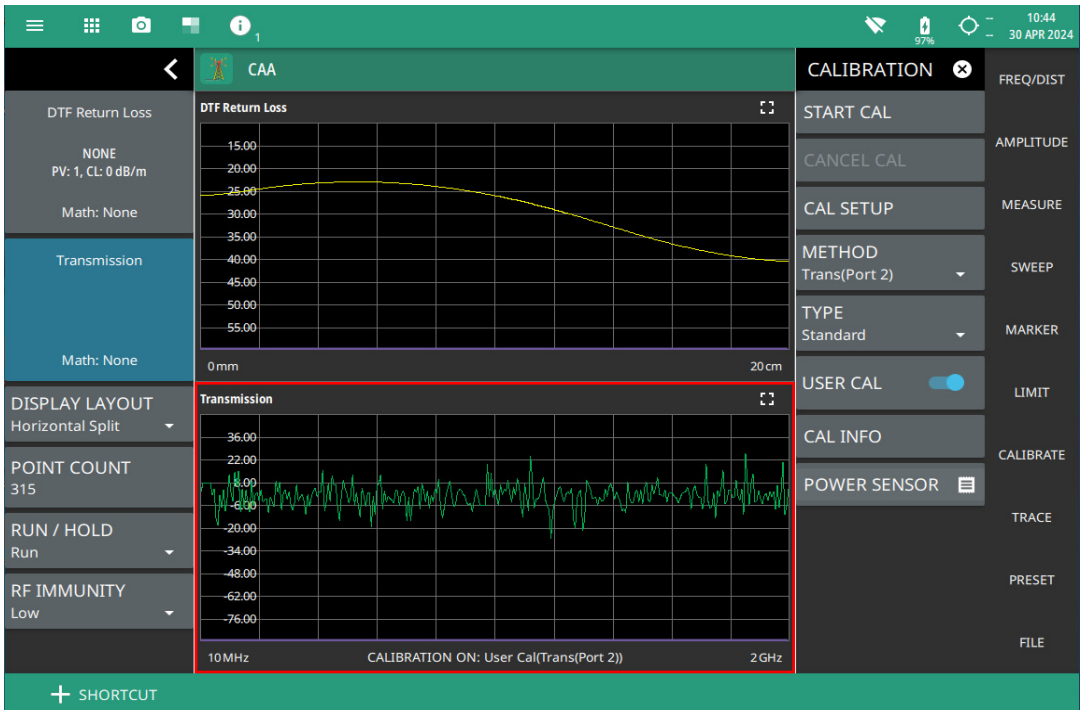


Figure 3-31. 2-port Transmission Calibration, Standard

iOSL Calibration

Follow the steps below to perform iOSL calibration method:

1. Ensure that an InstaCal ICN51A is 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 iOSL.
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.

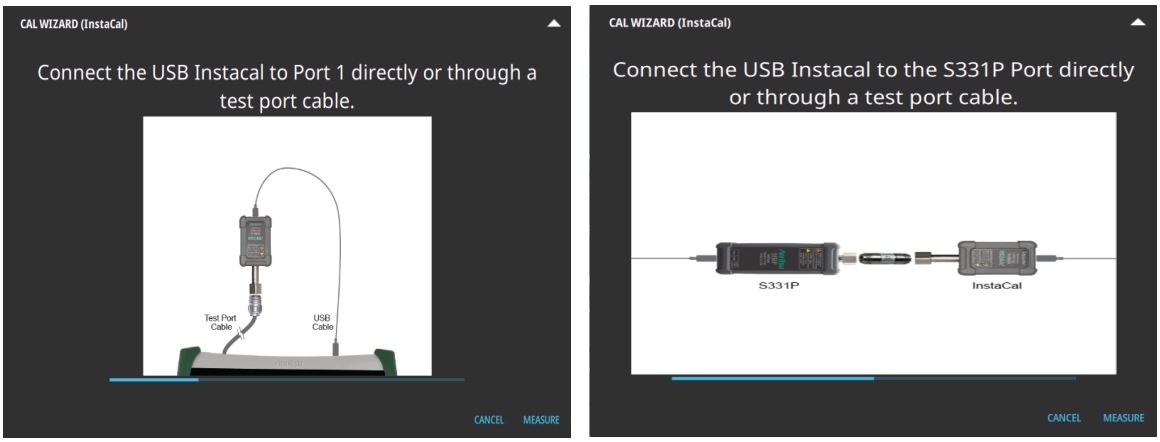


Figure 3-32. iOSL Calibration - MEASURE (Left: Site Master Instruments, Right: Field Master Instruments)

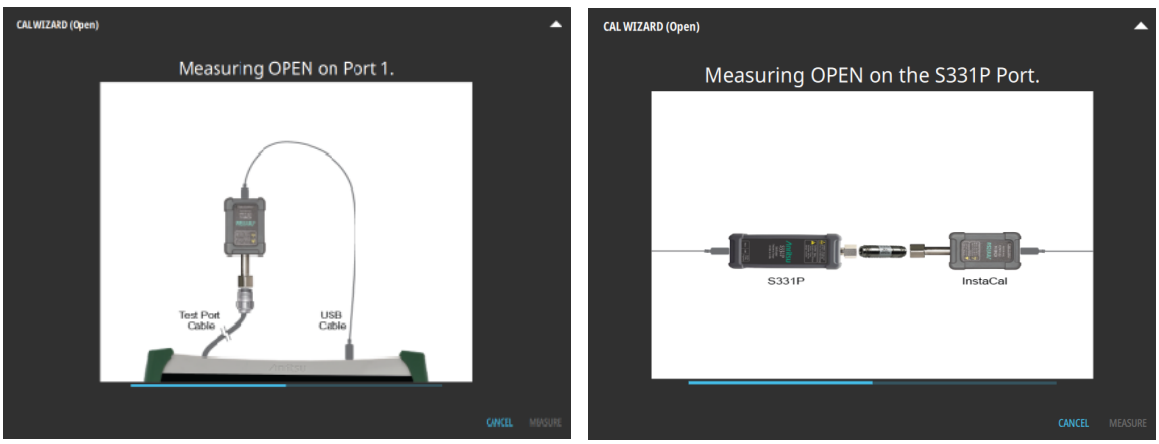


Figure 3-33. iOSL Calibration - MEASURE (Left: Site Master Instruments, Right: Field Master Instruments)

8. When done, select APPLY.

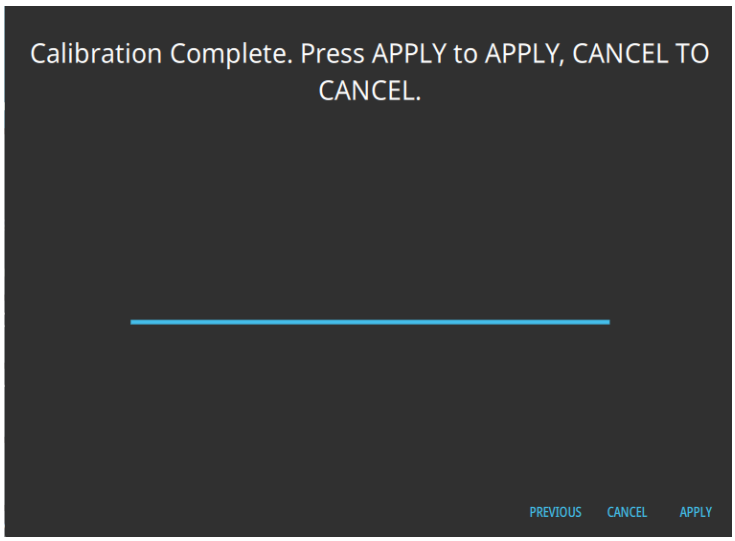


Figure 3-34. iOSL Calibration - APPLY

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

   CALIBRATION ON: User Cal (iOSL) for Standard calibration type
   CALIBRATION ON: iUser Cal (iOSL) for Flex calibration type

Figure 3-35 illustrates a return loss and DTF Return loss measurements after a standard iOSL calibration.

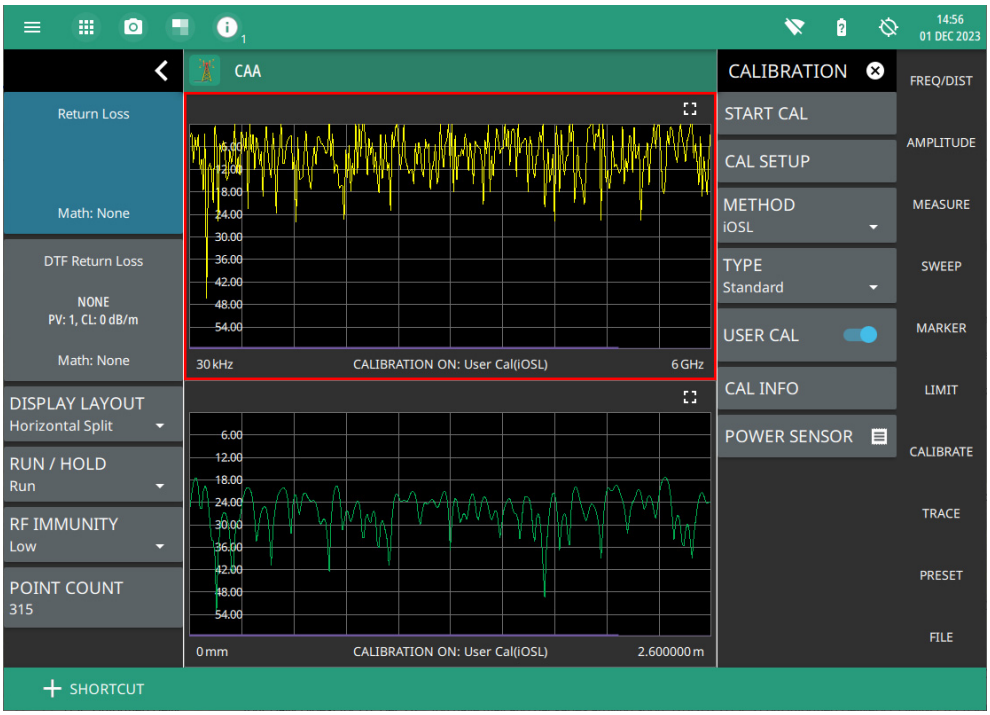


Figure 3-35. iOSL Calibration, Standard

iOSL + Transmission (USB Sensor) Calibration

Follow the steps below to perform iOSL + Transmission (USB sensor) calibration method:

1. Ensure that an external USB power sensor and InstaCal ICN51A 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 iOSL + Trans(USB Sen).
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.

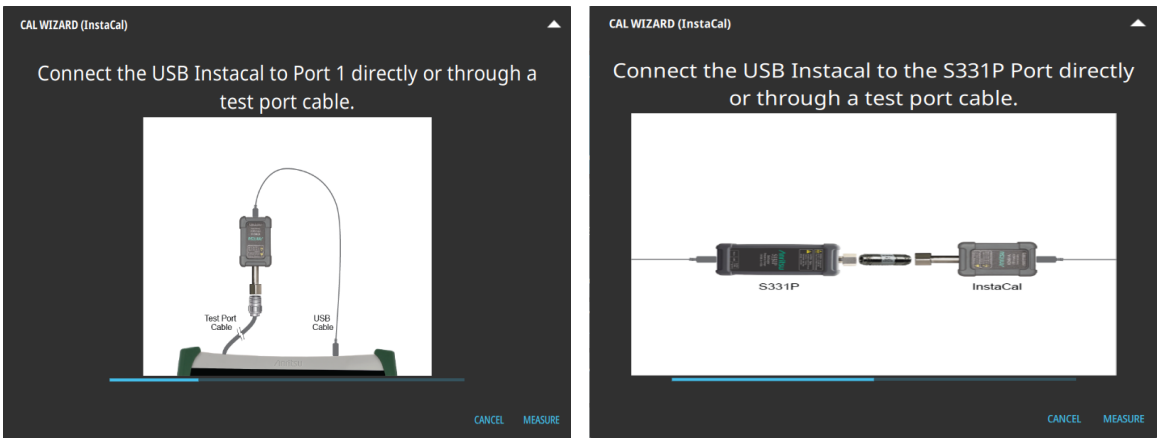


Figure 3-36. iOSL + Transmission (USB Sensor) Calibration - MEASURE (Left: Site Master Instruments, Right: Field Master Instruments)

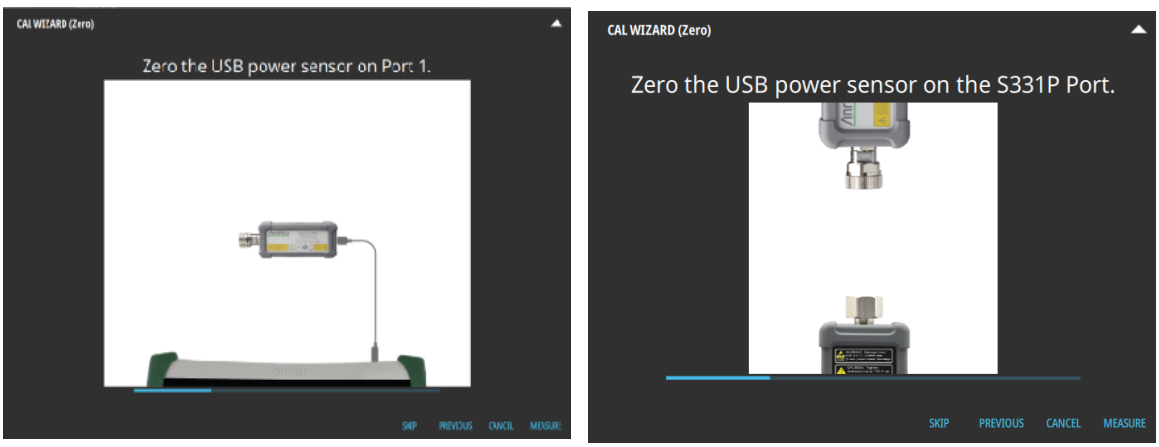


Figure 3-37. iOSL + Transmission (USB Sensor) Calibration - ZERO (ensure nothing is connected to sensors) (Left: Site Master Instruments, Right: Field Master Instruments)

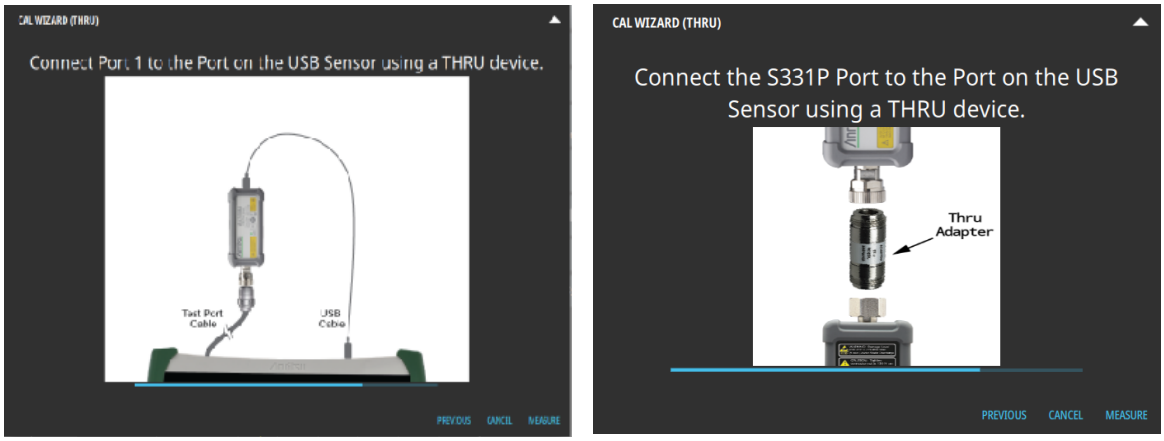
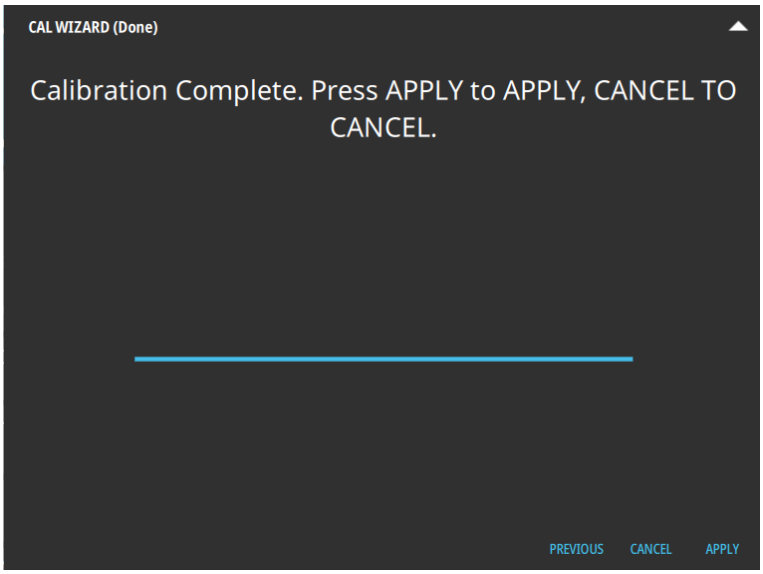


Figure 3-38. iOSL +Transmission (USB Sensor) Calibration - THRU

8. When done, select APPLY.



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

CALIBRATION ON: User Cal (iOSL + Trans (USB Sen)) for Standard calibration type
CALIBRATION ON: iUser Cal (iOSL + Trans (USB Sen)) for Flex calibration type

Figure 3-39 illustrates both return loss and DTF return loss measurements after a standard iOSL +Transmission (USB Sensor) calibration. The calibration is not applied to Transmission measurement.

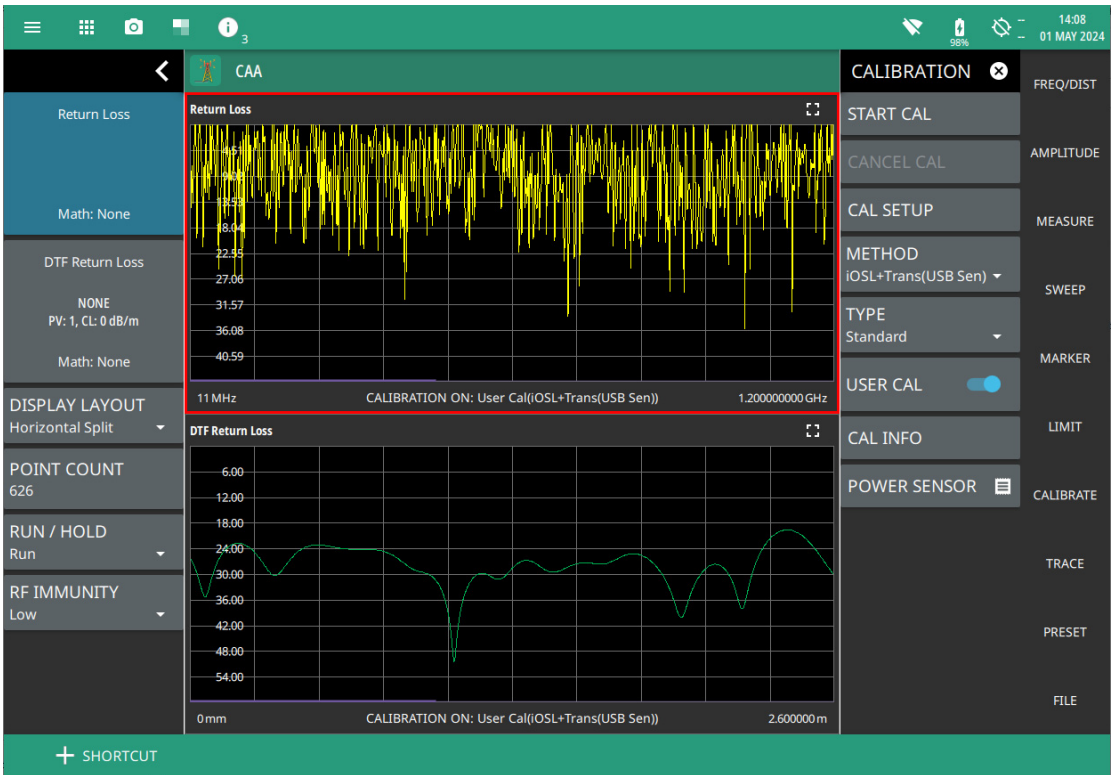


Figure 3-39. iOSL + Trans (USB Sen) Calibration, Standard

iOSL + 2-Port Transmission Calibration (Option 21)

Follow the steps below to perform iOSL + 2-Port Transmission calibration method:

Note	OSL + 2-Port Transmission Calibration method is only available when Option 21 is installed which applies to Site Master instruments, only.

1. Ensure that an InstaCal ICN51A is 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 iOSL + Trans (2-Port).
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.

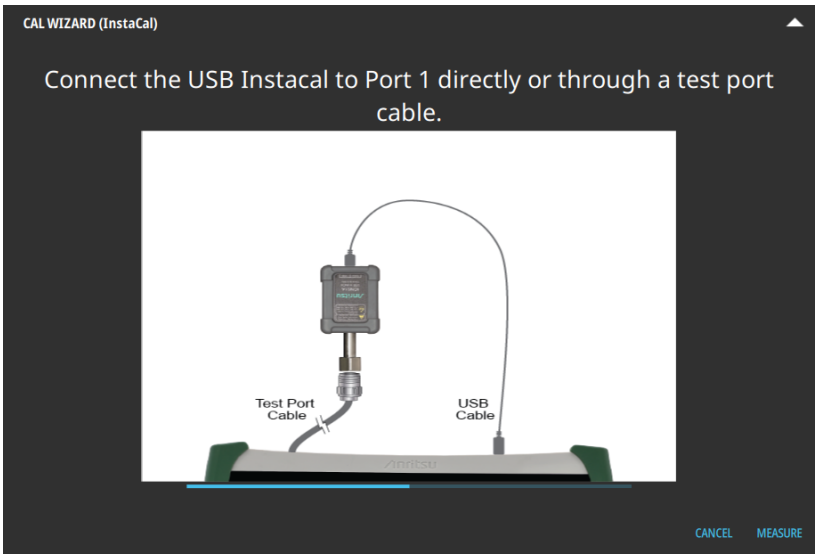
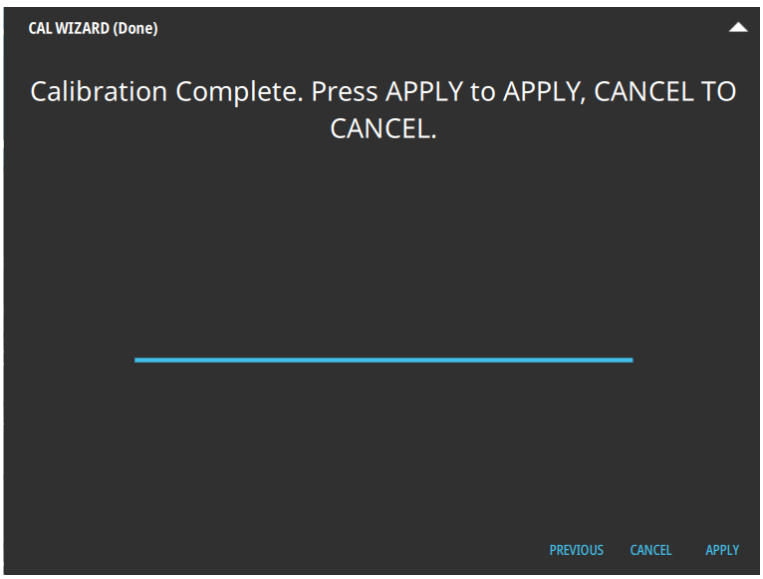


Figure 3-40. iOSL + Trans (2-Port) Calibration - MEASURE

Figure 3-41. iOSL + Trans (2-Port) Calibration - THRU

8. When done, select APPLY.



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

   CALIBRATION ON: User Cal (iOSL + Trans (2-Port) for Standard calibration type
   CALIBRATION ON: iUser Cal (iOSL + Trans (2-Port)) for Flex calibration type

Figure 3-42 illustrates a return loss and DTF return loss measurements after a standard iOSL + 2-Port Transmission calibration.

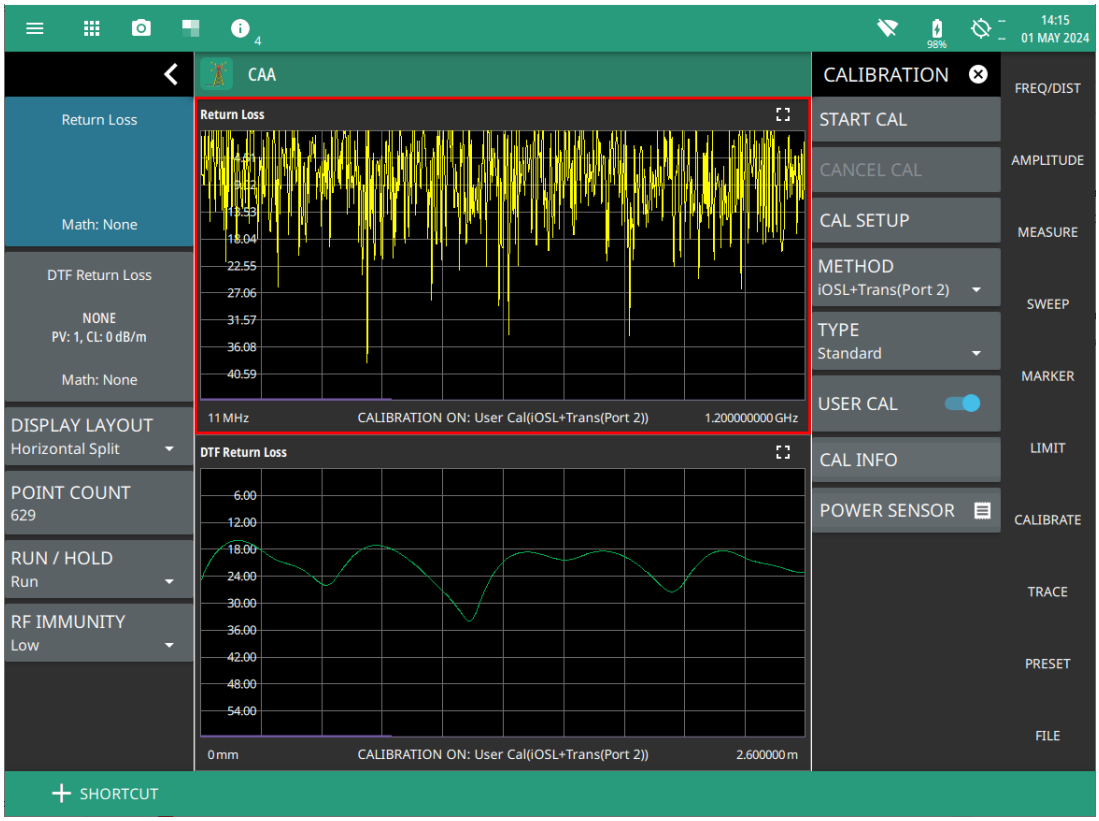


Figure 3-42. iOSL + Trans (2-Port) Calibration, Standard

Chapter 4 — Cable and Antenna Analyzer Measurements

4-1 Introduction

Anritsu supports two methods for making cable and antenna analyzer measurements. Field Master MS2080A and MS2090A instruments require an external Site Master S331P instrument, sold separately). Site Master MS2085A/MS2089A instruments are built with an internal cable and antenna analyzer.

This chapter is intended to assist you in setting up some common cable and antenna measurements, including setting up frequency, amplitude, sweep, marker, and trace parameters. Refer to Chapter 4 for the detailed information on measurement calibrations.

For an introduction to cable and antenna measurements, refer to Section 4-2 “Measurement Overview” on page 4-2. After performing measurements, refer to Section 4-11 “Saving and Recalling Measurements” for descriptions of saving, recalling, and managing measurement files.

4-2 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. Generally, cable loss measurements determine how less the output signal power 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 and Site Master Series instruments have 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 RF port. If this is not possible, using a phase-stable test port cable attached to the RF port to extend the range. When using an extension cable, calibrate at the open end of the cable. Refer to Chapter 3, “Calibration”.

Refer to Section 4-5 “Setting up a Measurement” for detailed description of each measurement.

4-3 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 "DISTANCE Menu" on page 4-4.
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.

FREQ/DIST Menu

Access FREQ/DIST menu from the main menu.

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 "" on page 3-12.

START FREQUENCY: Sets the start frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.

STOP FREQUENCY: Sets the stop frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.

DISTANCE: Opens the "DISTANCE Menu" on page 4-4.

DTF SETUP: Opens the "DTF SETUP Menu" on page 4-6.

Figure 4-1. FREQ/DIST Menu

Setting Distance

1. Select FREQ/DIST on the main menu to open the "DISTANCE Menu" on page 4-4.
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.

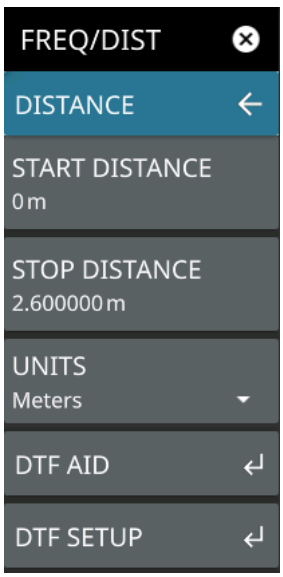
9. To access and change other DTF parameters, press DTF AID or DTF SETUP, then select a parameter in the menu to edit.

   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 4-13.

DISTANCE Menu

Access Distance submenu from FREQ/DIST > DISTANCE.



START DISTANCE: Enters a start distance value for the measurement. The start distance must be shorter than the stop distance.

STOP DISTANCE: Enters the stop distance for the measurement. The maximum stop distance is 1500 m (~4921 ft).

Note that the maximum distance measurement (from start to stop) is dependent on frequency span and the number of sweep points.

UNITS: Selects distance units of meters or feet.

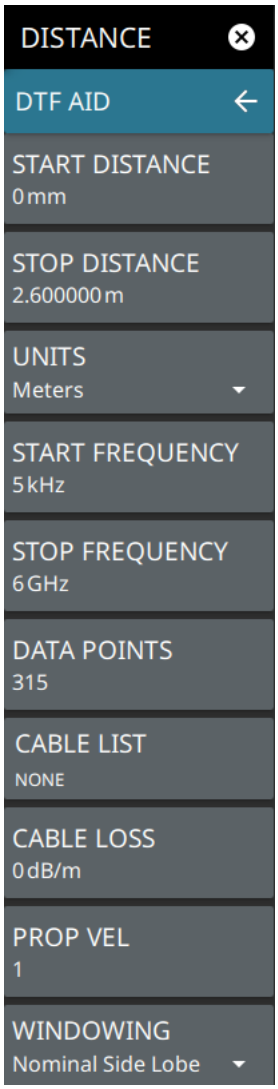
DTF AID: Opens the "DTF AID Menu" on page 4-5, providing on-screen guidance and access to multiple measurement settings. Also displays current measurement setup information and maximum testing distance and resolution.

DTF SETUP: Opens the "DTF SETUP Menu" on page 4-6.

Figure 4-2. DISTANCE Menu

DTF AID Menu

Access DTF AID submenu from FREQ/DIST > DISTANCE > DTF AID.



START DISTANCE: Enters a start distance value for the measurement. The start distance must be shorter than the stop distance.

STOP DISTANCE: Enters the stop distance for the measurement. The maximum stop distance is 1500 m.

Note that the maximum distance measurement (from start to stop) is dependent on frequency span and the number of sweep points.

UNITS: Selects distance units of meters or feet.

START FREQUENCY: Sets the start frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.

STOP FREQUENCY: Sets the stop frequency of the sweep range. Selecting the plus (+) or minus (–) control moves the start frequency in discrete steps.

DATA POINTS: Sets the number of display point currently measured by the instrument. Note that increasing the number of display points can improve the resolution of measurements in addition to increase in sweep time.

CABLE LIST: Opens a list of available cable specifications (see Figure 4-11 on page 4-15).

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: Manually enters a cable loss value.

PROP VEL: Manually enters a propagation velocity value.

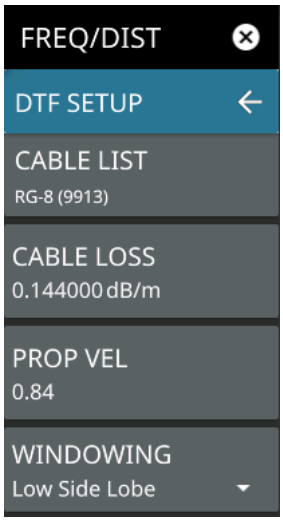
WINDOWING: Selects the windowing for the measurement:

- **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 4-3. DTF AID Menu

DTF SETUP Menu

Access DTF SETUP submenu from FREQ/DIST > DISTANCE > DTF SETUP.



CABLE LIST: Opens a list of available cable specifications (see "Cable List" on page 4-14).

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: Manually enters a cable loss value.

PROP VEL: Manually enters a propagation velocity value.

WINDOWING: Selects the windowing for the measurement:

- **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 4-4. DTF SETUP Menu

4-4 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 4-8.
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 4-8.
2. Select AUTO SCALE.

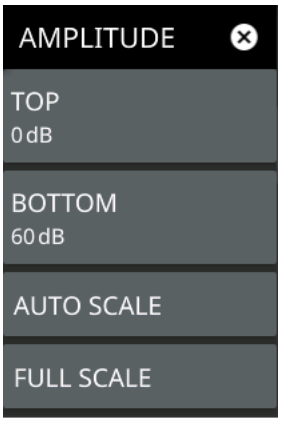
Setting the Amplitude using Full Scale

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 4-8.
2. Select FULL SCALE.

Amplitude Menu

Access AMPLITUDE menu from the main menu.

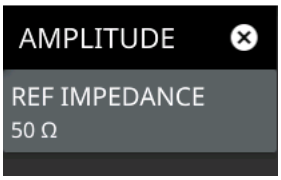


TOP: Sets the top amplitude value of the trace scale.

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 4-24 illustrates a Smith Chart measurement.

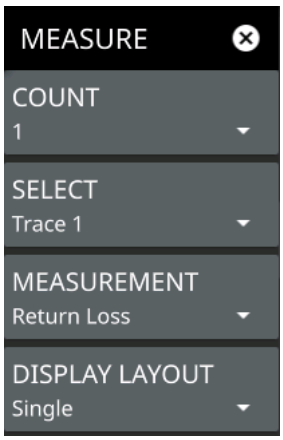
Figure 4-5. AMPLITUDE Menu

4-5 Setting up a Measurement

This section describes the various Cable and Antenna Analyzer measurements. Note that not all measurements are supported in all instruments. Some of the measurements are option dependent. Please refer to your product's technical data sheet for the list of supported options.

MEASURE Menu

From the main menu select MEASURE > MEASUREMENT menu to select one of the desired measurements.



COUNT: Select the display format of single (1) or horizontal split (2).

SELECT: Select the desired active trace for setting up measurement parameters.

MEASUREMENT: Select one of the desired measurement type from the following list:

- **Return Loss:** Measures the reflected power in dB. Refer to "Return Loss Measurement" on page 4-10.
- **VSWR:** Measures the ratio of voltage peaks to voltage valleys. Refer to "VSWR Measurement" on page 4-11.
- **Cable Loss:** Measures the signal loss in the transmission line in dB/meter or dB/ft. Refer to "Cable Loss Measurement" on page 4-12.
- **DTF Return Loss and DTF VSWR:** Measures the distance-to-fault (DTF) return loss and DTF VSWR. Refer to "DTF Return Loss and DTF VSWR Measurement" on page 4-13.
- **Smith Chart:** Measures the reflection coefficient data to determine and tune input match. Refer to "Smith Chart Measurement" on page 4-24.
- **1-Port Phase:** Measures the phase of the reflection measurements at RF port. Refer to "1-Port Phase Measurement" on page 4-25.
- **Transmission (USB Sensor):** Measures the loss or gain of a device in dB. Refer to "Transmission (USB Sensor) Measurement" on page 4-26.
- **Transmission (2-Port):** Verifies the performance of tower-mounted amplifiers, and duplexers, and antenna isolation between two sectors. Refer to "2-Port Transmission Measurement (Option 21)" on page 4-28.
- **TDR Ohm:** Measures the mismatch of the transmission line impedance against distance. Refer to "TDR OHM (Option 3) Measurement" on page 4-29.
- **TDR Lin:** Measures the return loss in time domain. Refer to "TDR Linear (Option 3) Measurement" on page 4-30

DISPLAY LAYOUT: Select 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.

Figure 4-6. MEASURE Menu

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.

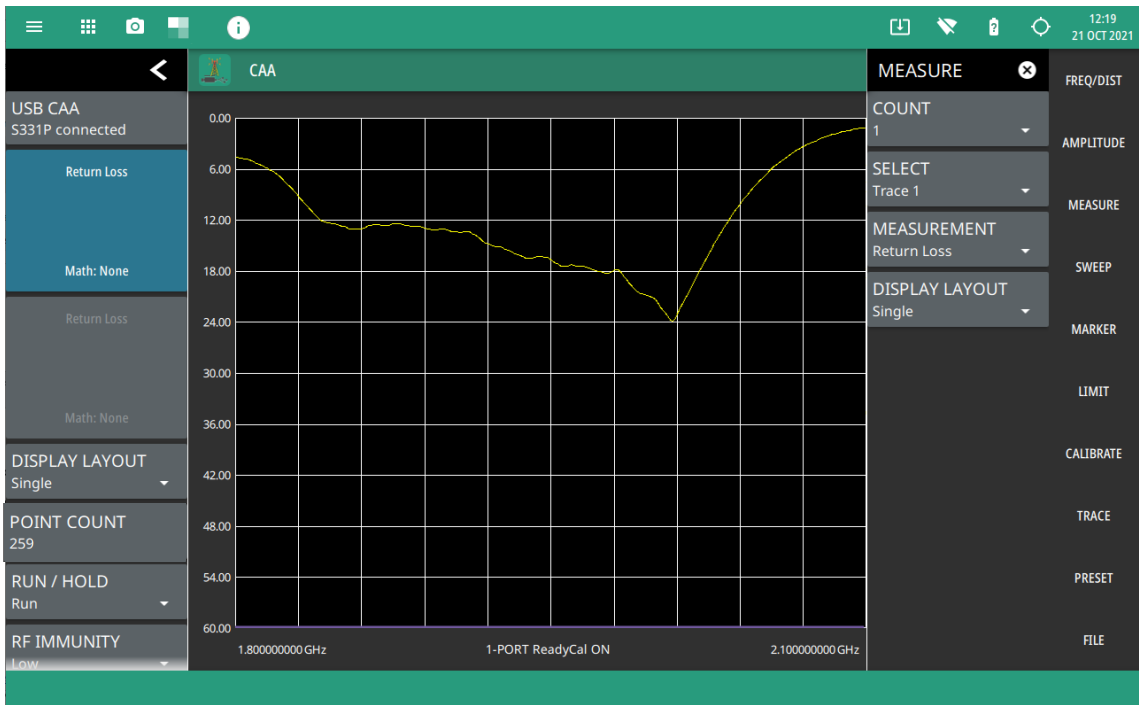


Figure 4-7. Return Loss Measurement

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.

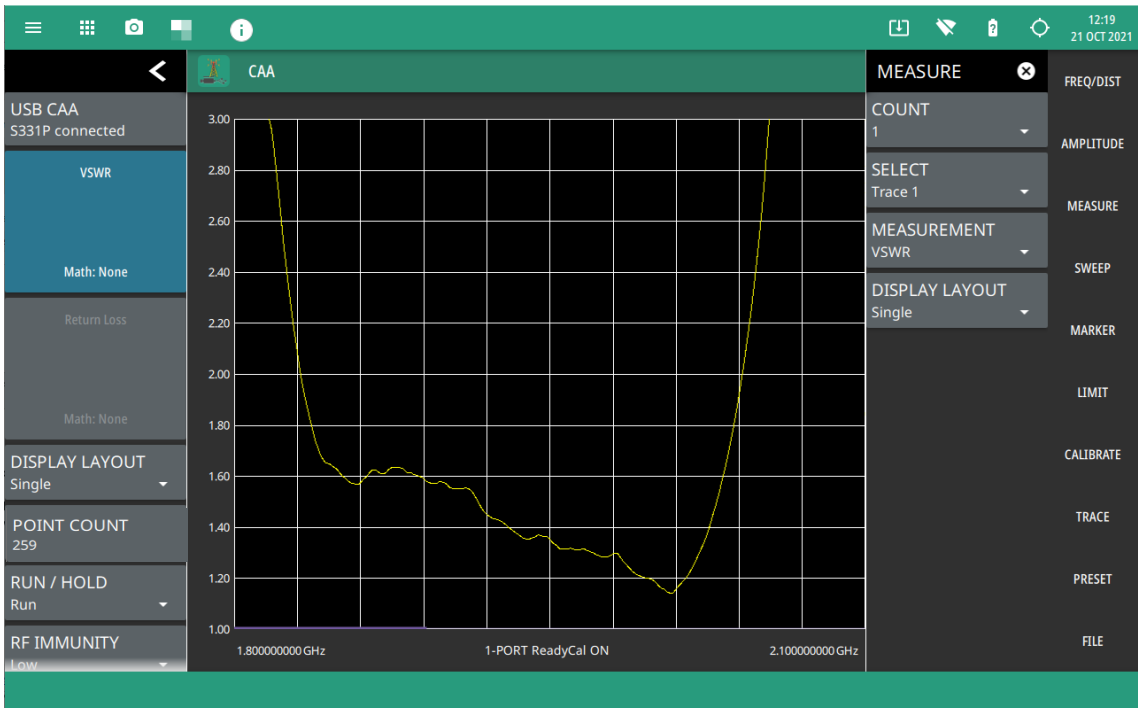


Figure 4-8. VSWR Measurement

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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-Port ReadyCal ON).
5. Connect the instrument/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 4-33.
7. Select LIMIT on the main menu and then set up limit lines as described in "Setting Up Limit Lines" on page 4-40.
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 4-52 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 4-9 is a cable loss measurement example.

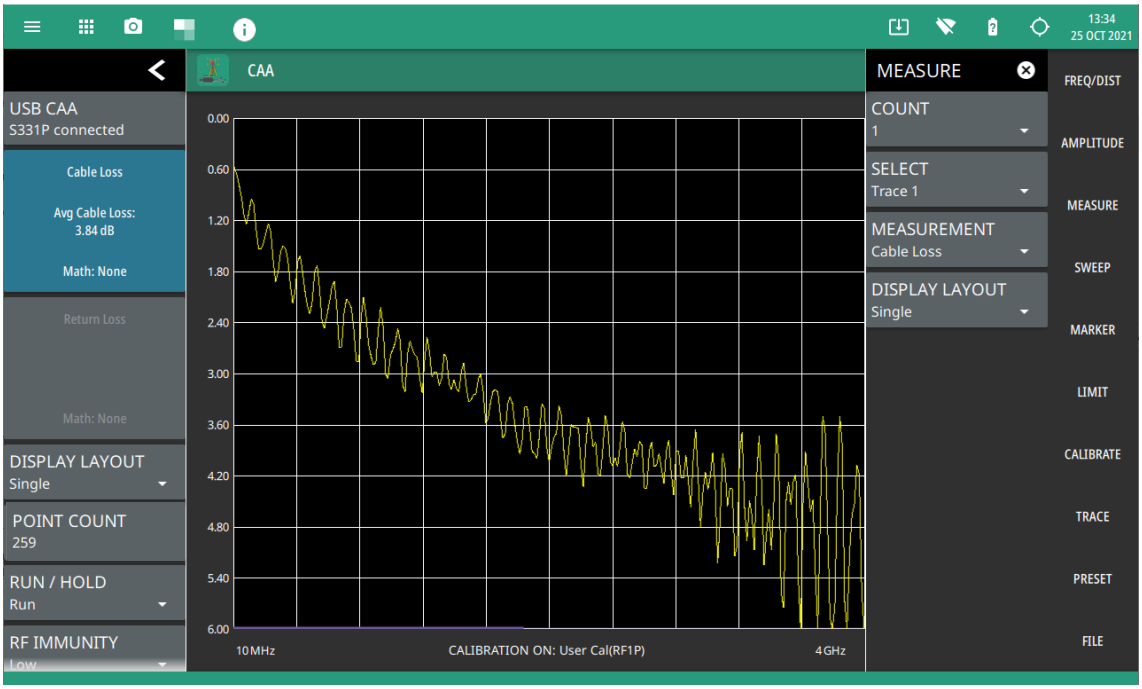


Figure 4-9. Cable Loss Measurement

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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Connect the instrument/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 4-33.
7. Select LIMIT on the main menu and set the limit line as described in "Setting Up Limit Lines" on page 4-40. 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 4-52 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 RF test port 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 4-10 explains how the parameters are related.

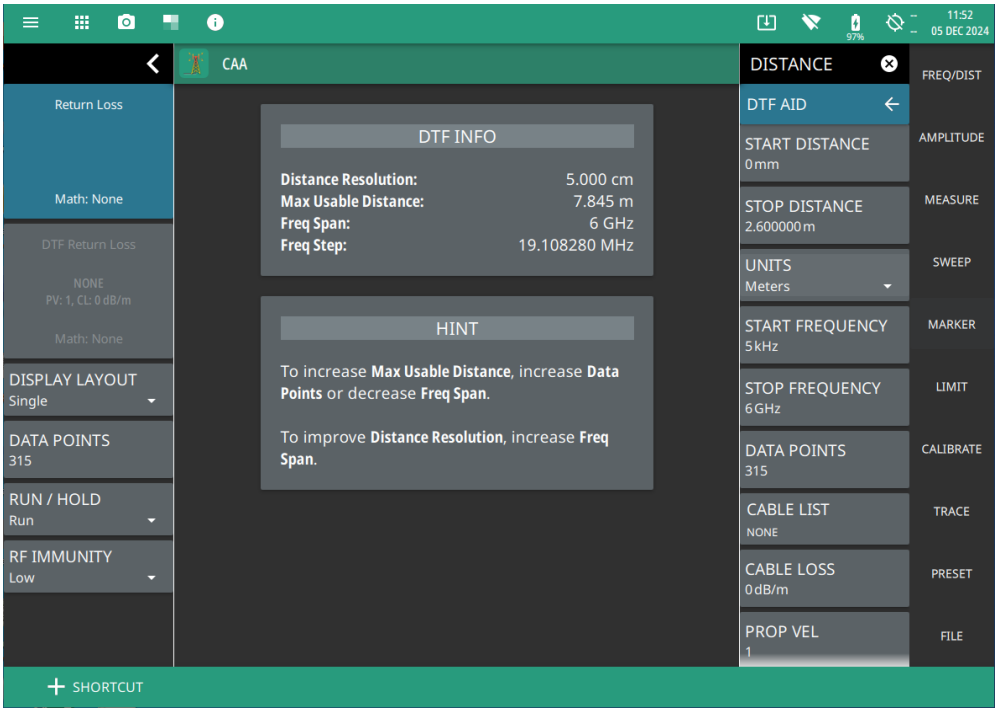


Figure 4-10. DTF Aid

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 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 status panel's trace card during distance measurements (MEASURE > MEASUREMENT > DTF Return Loss or DTF VSWR) as shown in Figure 4-11.

The cable list window has the following options:

- Enter a keyword in FILTER field found in the top of the list to search for a specific cable of interest, for e.g. coaxial.
- Select copy icon to add a copy of the selected cable to the USER CABLE LIST.

- Select EXPORT button on the top right corner of the cable list window to save the cable to the instrument's internal memory.
- Select refresh icon to refresh the cable list.

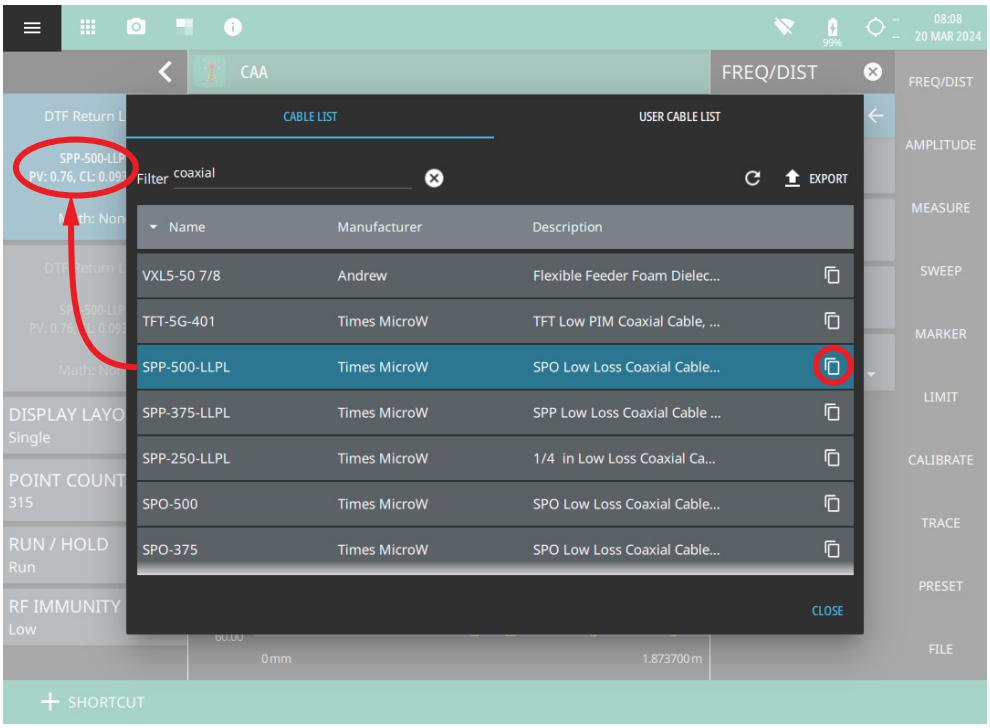


Figure 4-11. Cable List Selection

User Cable List

To add a custom user cable to the user cable list follow the instructions below:

1. Select the copy icon (see Figure 4-11) from CABLE LIST as shown in Figure 4-12. Select APPLY button located at the bottom of the window.

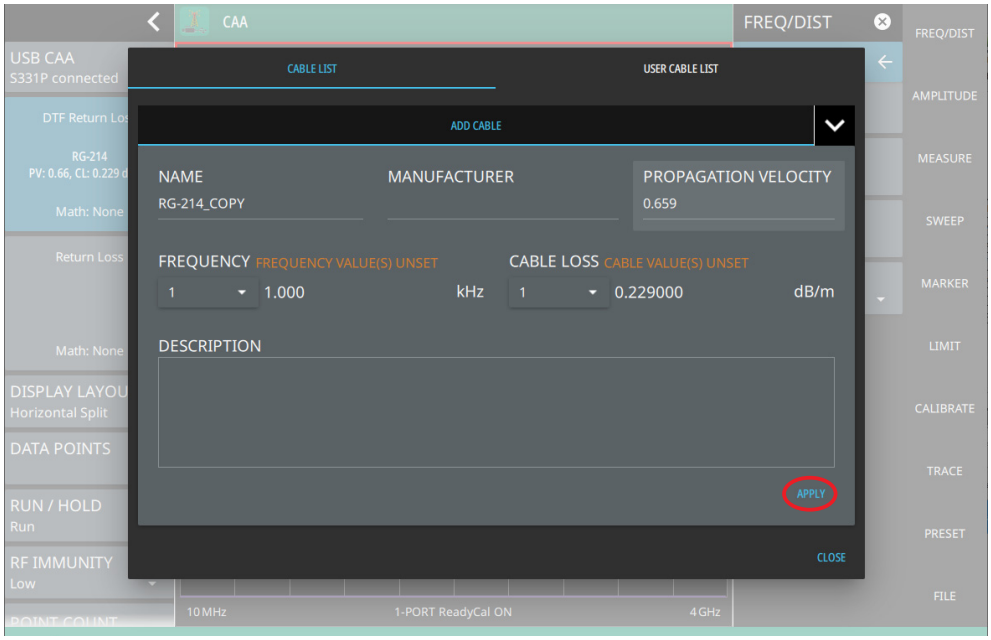


Figure 4-12. Add Cable Window

2. Go to USER CABLE LIST to view the newly added cable. If required select the edit icon to change the name of the cable as shown in as shown in Figure 4-13.

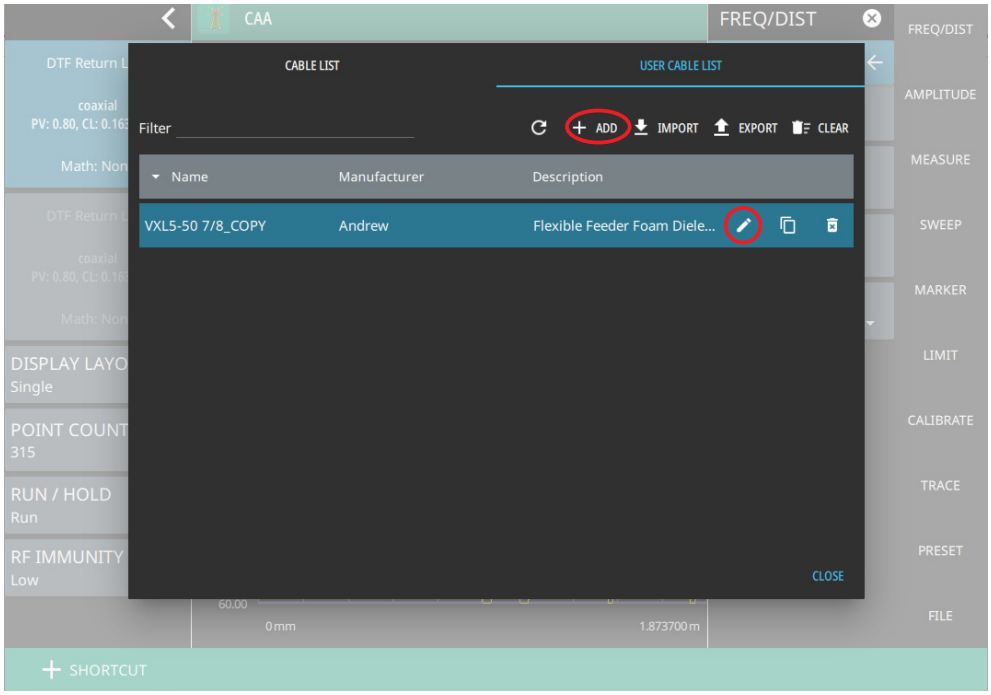


Figure 4-13. User Cable List - Edit

3. Enter the name of the cable and select RENAME button at the bottom of the window. Note that you can only rename the cable from this window.

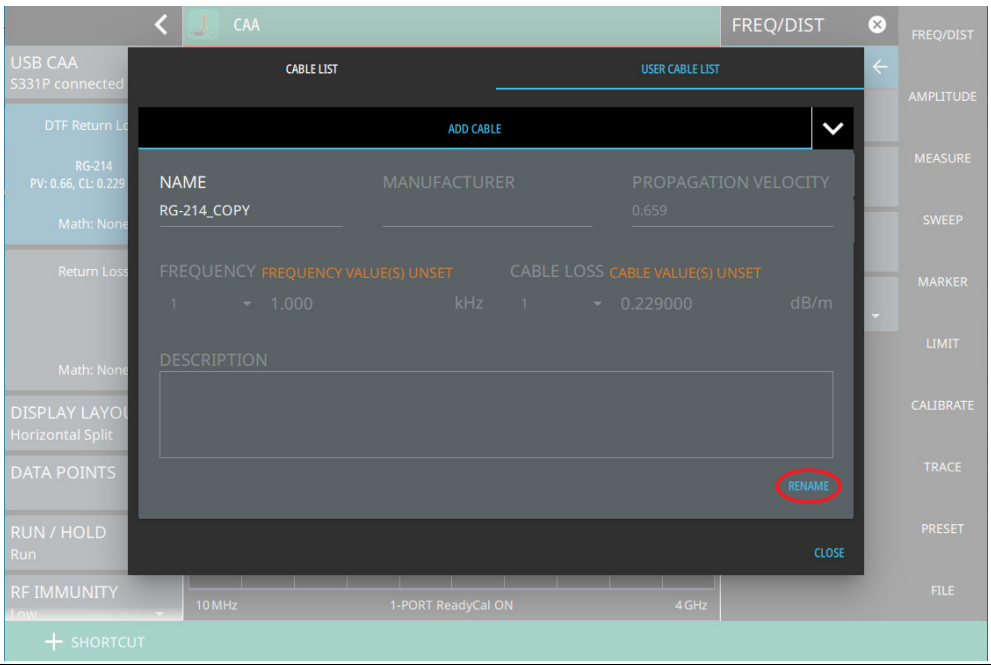


Figure 4-14. User Cable List - Rename

4. Alternatively, select +ADD button (see Figure 4-13) on the top right corner of the USER CABLE LIST to add a custom cable to the list and click APPLY at the bottom of the window, as shown in the Figure 4-15.

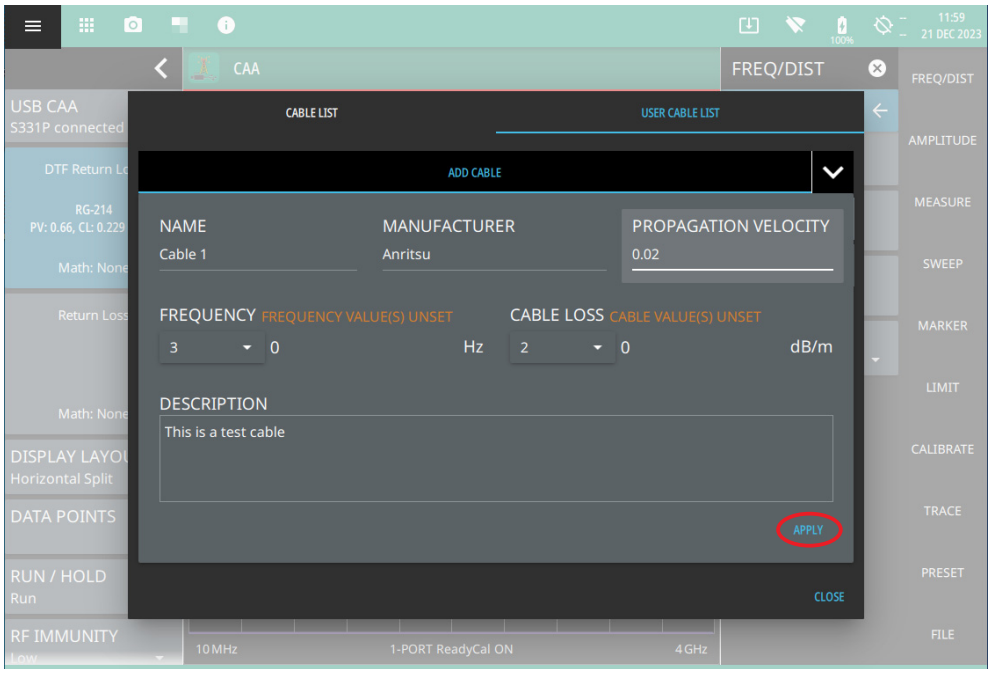


Figure 4-15. User Cable List - Add Cable

Figure 4-16 is an example of the custom user cable.

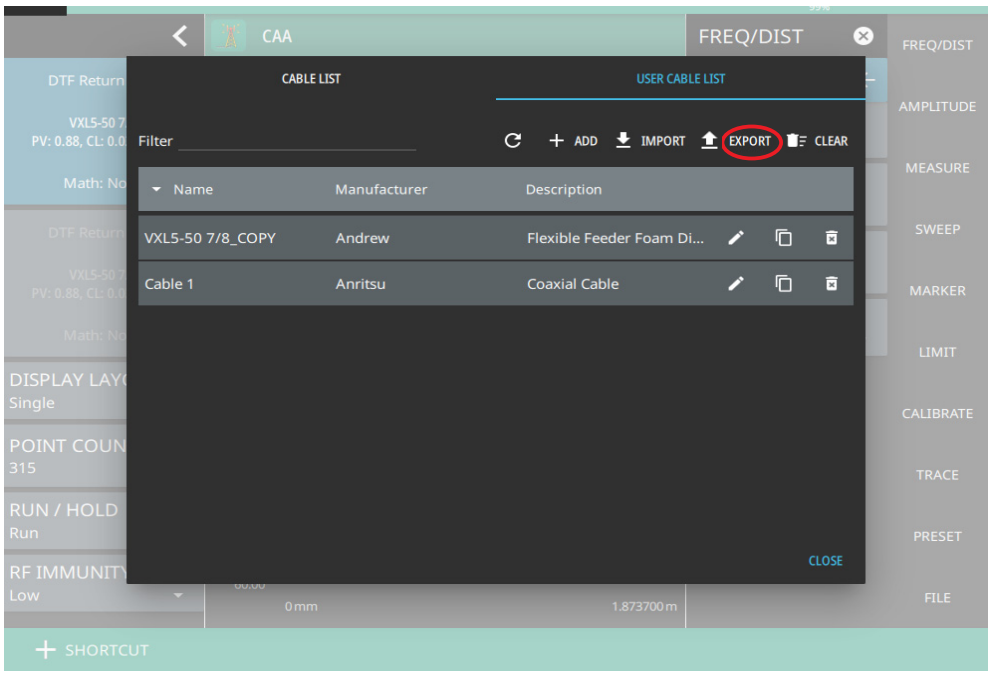


Figure 4-16. User Cable List - Custom Cable List

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.

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

with Rectangular Windowing applied.

Figure 4-17 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.

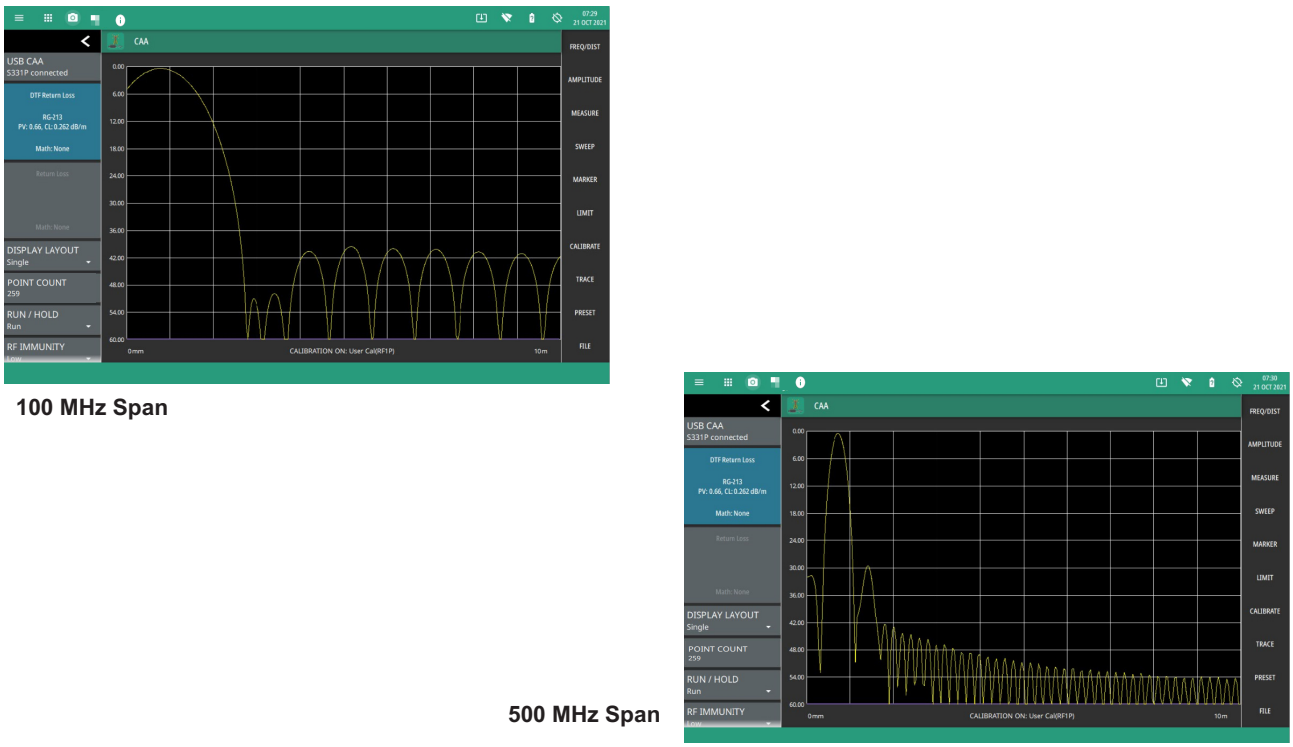


Figure 4-17. DTF Measurements at 100 MHz vs. 500 MHz (Field Master Series)

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.*

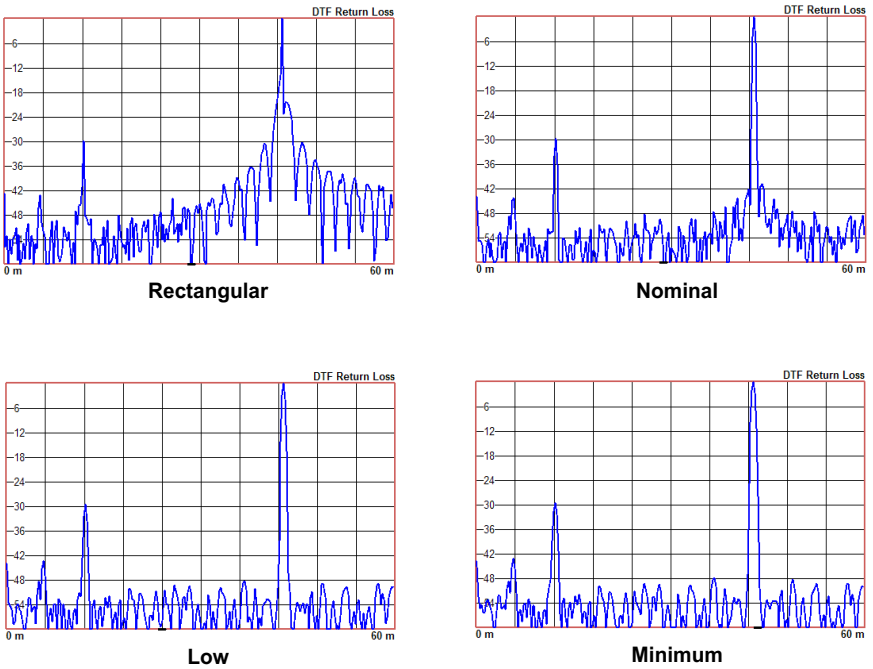


Figure 4-18. Effects of Windowing on a Sample Trace

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).

```
Max Distance = (Datapoints – 1) x 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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-Port ReadyCal ON).
5. Connect the instrument 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 4-19 on page 4-21, 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)

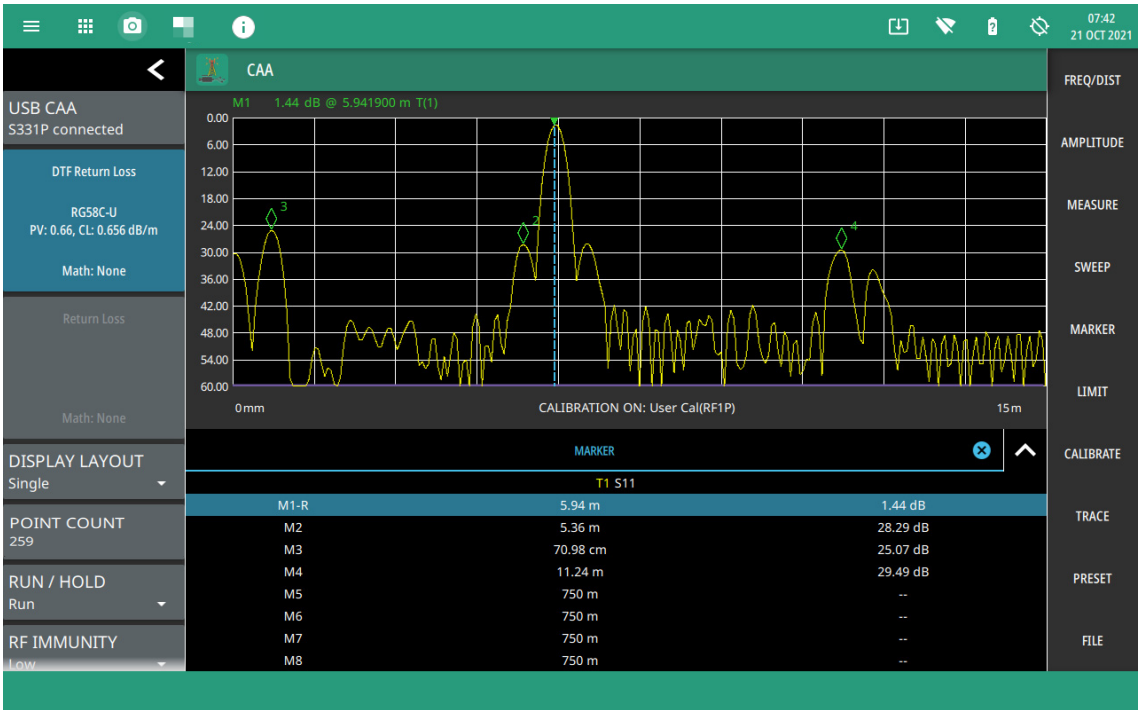


Figure 4-19. DTF Return Loss with a Short at the End of the Cable

Note	In Figure 4-19, 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 4-20 on page 4-22 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 4-21 on page 4-22).

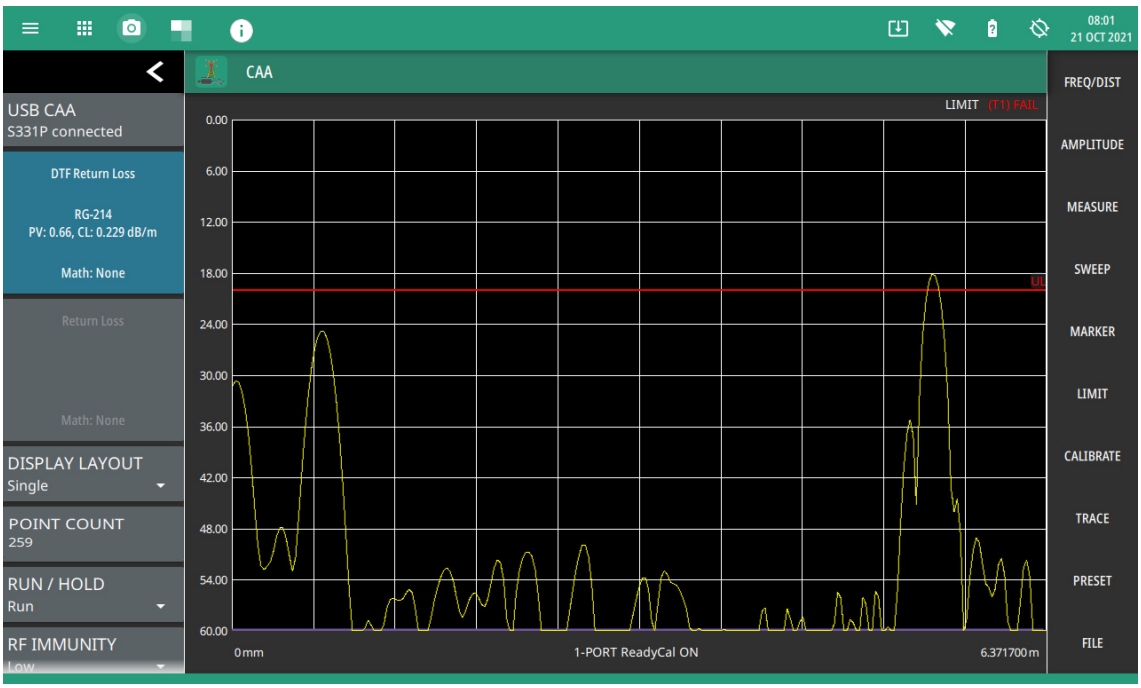


Figure 4-20. Failing DTF Return Loss Measurement (Antenna)

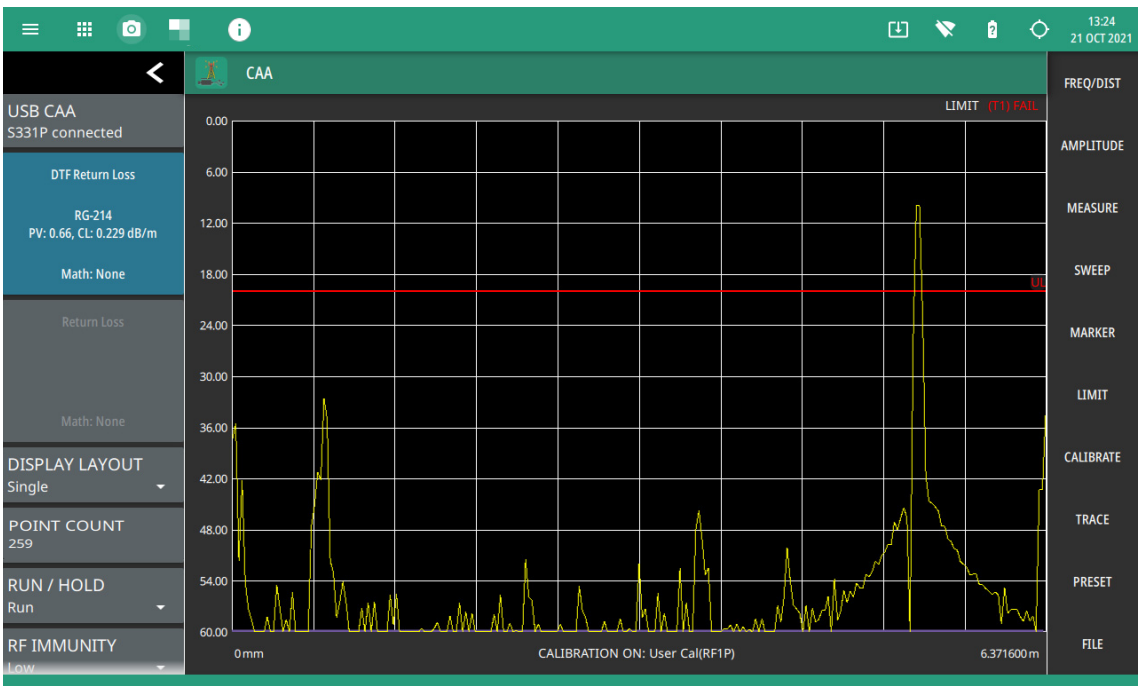


Figure 4-21. Failing DTF Return Loss Measurement (Load)

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 4-22).

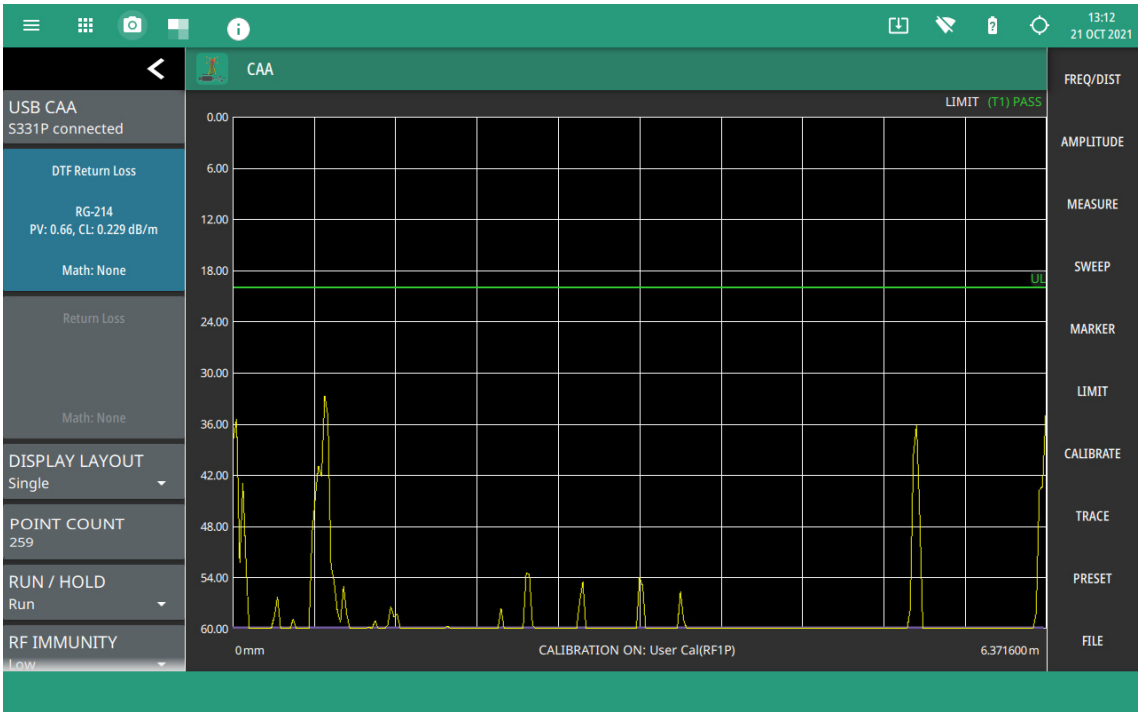


Figure 4-22. Passing DTF Return Loss Measurement (Load)

Figure 4-23 shows the same system with the antenna re-attached. The reflection of the jumper connector is now reduced to 22 dB.

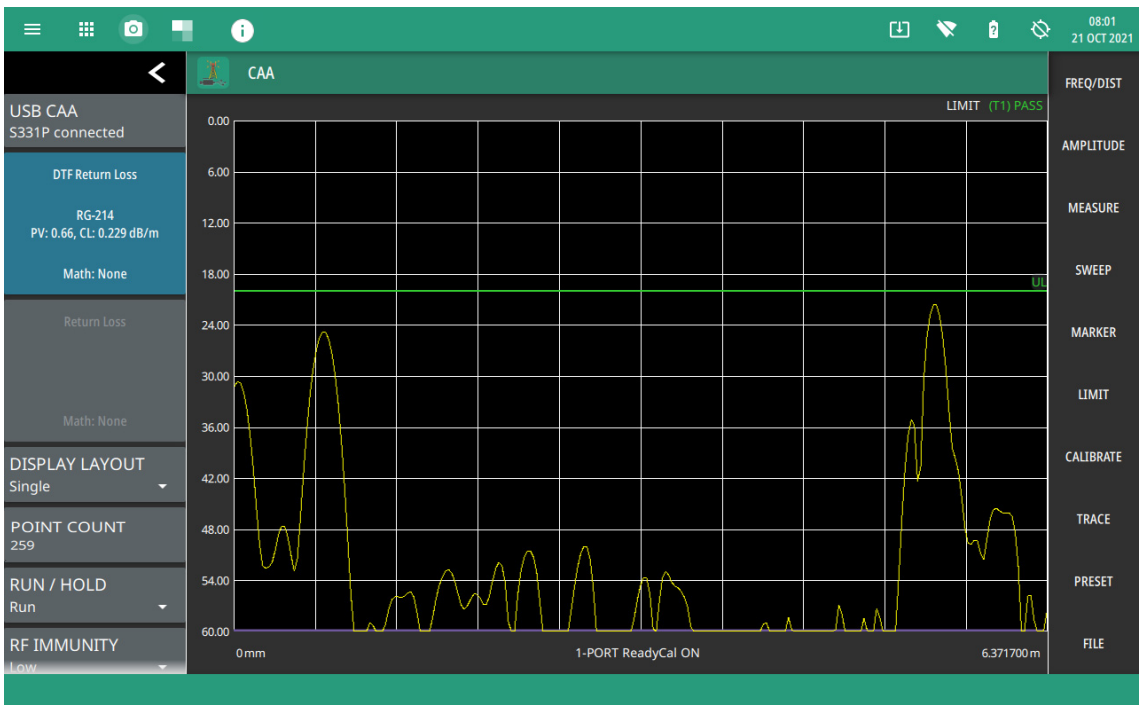


Figure 4-23. DTF Return Loss Measurement (Antenna)

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 4-24. This impedance plot reveals which matching elements (capacitance, inductance) are necessary to match a device under test to the reference impedance (50 ohms).

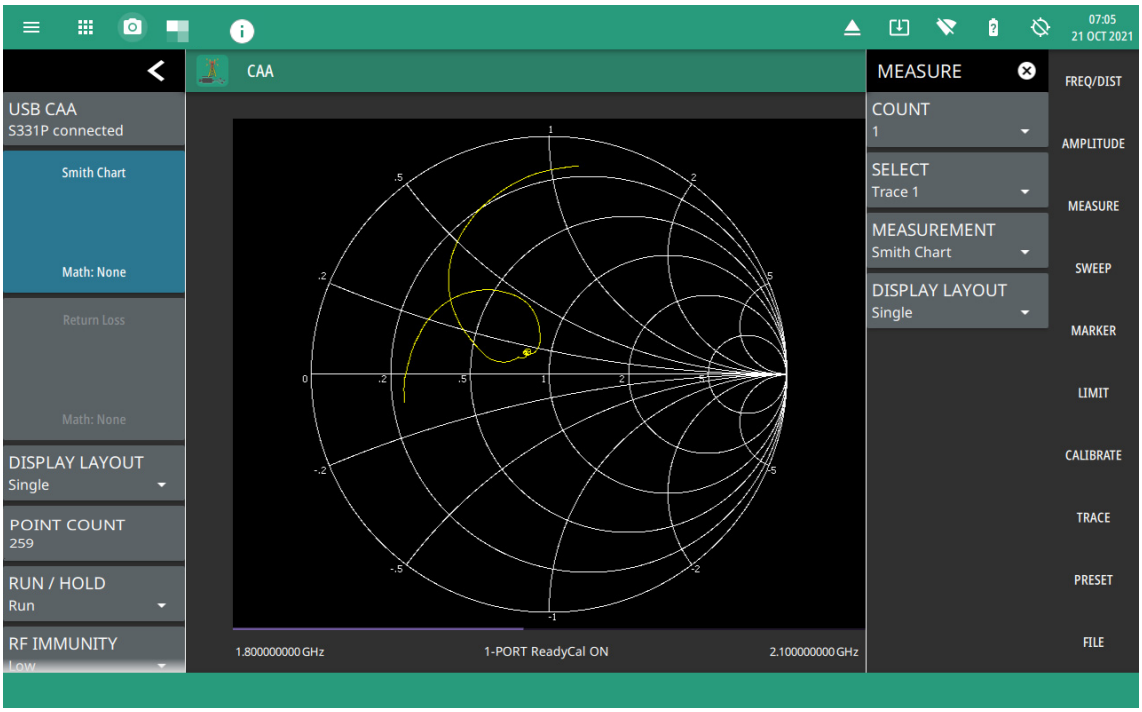


Figure 4-24. Smith Chart Measurement

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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
4. Connect the RF test port of the instrument 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 4-33.
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 4-52 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).

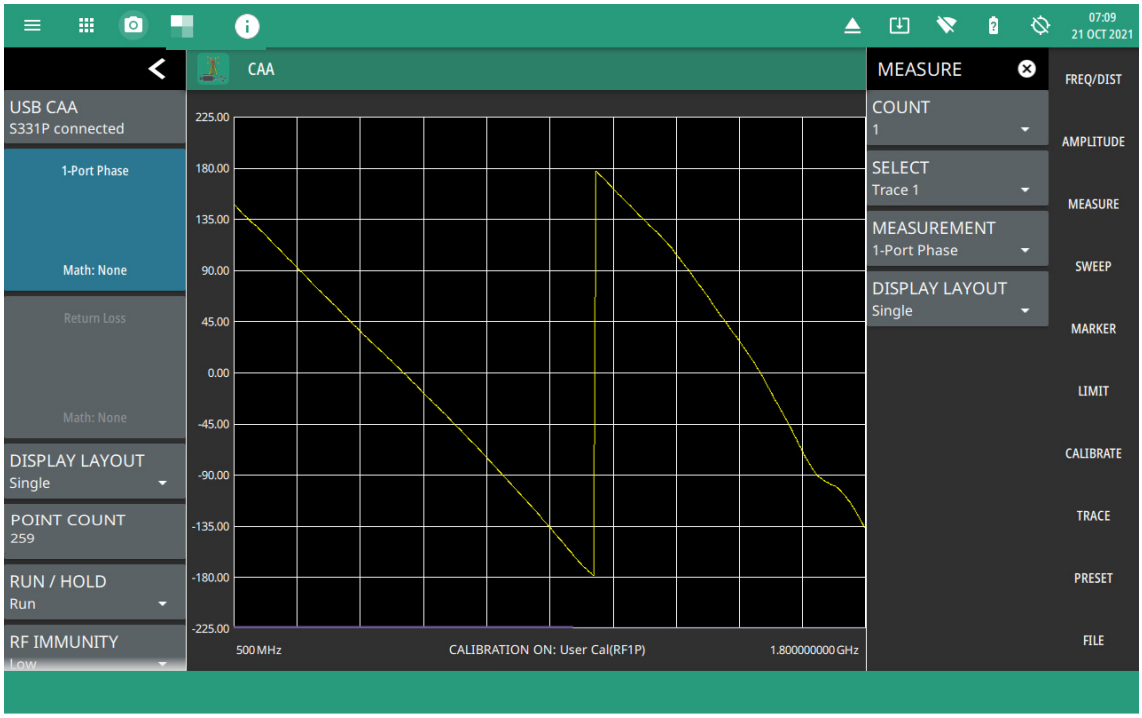


Figure 4-25. 1-Port Phase Measurement

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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Connect the instrument/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 4-33.
7. Select LIMIT on the main menu and set the limit line as described in "Setting Up Limit Lines" on page 4-40. 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 4-52 for details on saving measurement data or setups to a file.

Transmission (USB Sensor) Measurement

Note	To carry out Transmission (USB Sensor) measurement, USB Power Sensor and external Site Master S331P are required for MS2080A. For MS2090A, USB Power Sensor, external Site Master S331P and CAA Option 331 are required. For MS2085A and MS2089A Site Master Series instruments, only USB Power Sensor is required.

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 4-26 is a cable loss transmission measurement example with an external power sensor, which can be compared to the example shown in Figure 4-9, “Cable Loss Measurement” on page 4-12.

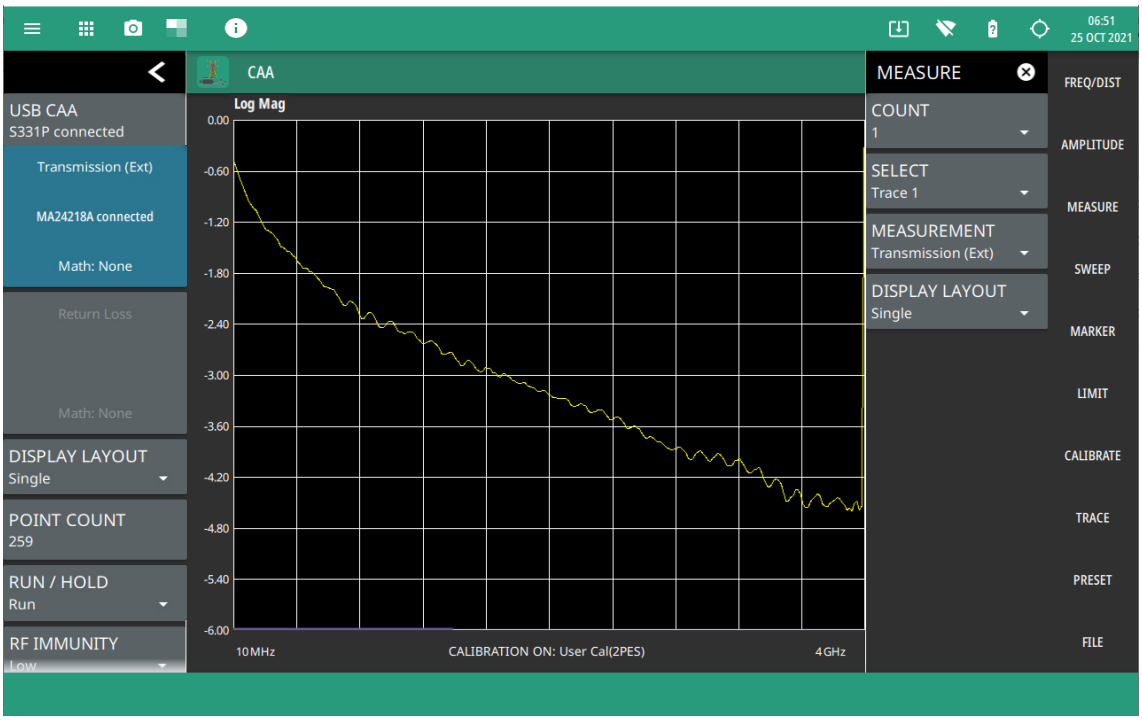


Figure 4-26. External Sensor Transmission Measurement

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 your instrument’s Technical Data Sheet. Only a supported USB power sensor is necessary to make Transmission (USB sensor) measurements, the purchase of Option 19, High Accuracy Power Meter (HIPM) is not required.

Table 4-1 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 4-1. 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, external USB sensor transmission measurement:

1. Select MEASURE on the main menu and then select MEASUREMENT > Transmission (USB Sen).
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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Connect the instrument/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 4-33.
7. Select LIMIT on the main menu and set the limit line as described in “Setting Up Limit Lines” on page 4-40. 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.

2-Port Transmission Measurement (Option 21)

Note	2-Port Transmission measurement is applicable only to MS2085A, MS2089A Site Master instruments.

The 2-port transmission measurement is used to verify the performance of tower-mounted amplifiers, and duplexers, and to verify antenna isolation between two sectors. The excellent dynamic range makes it suitable for repeaters as well. The second port is a selective receiver which provides up to 100 dB dynamic range which makes it possible to test the band pass filters common on many networks.

Both high and low power settings are available. The high-power setting delivers approximately 0 dBm power at the RF out port, ideal for antenna isolation measurements and duplexers. When making measurements of a Tower Mounted Amplifier, Anritsu recommends to use the low-power setting (approximately –40 dBm). This will ensure that the RF In port is not over-powered and that the measurements are made in the linear region of the amplifier.

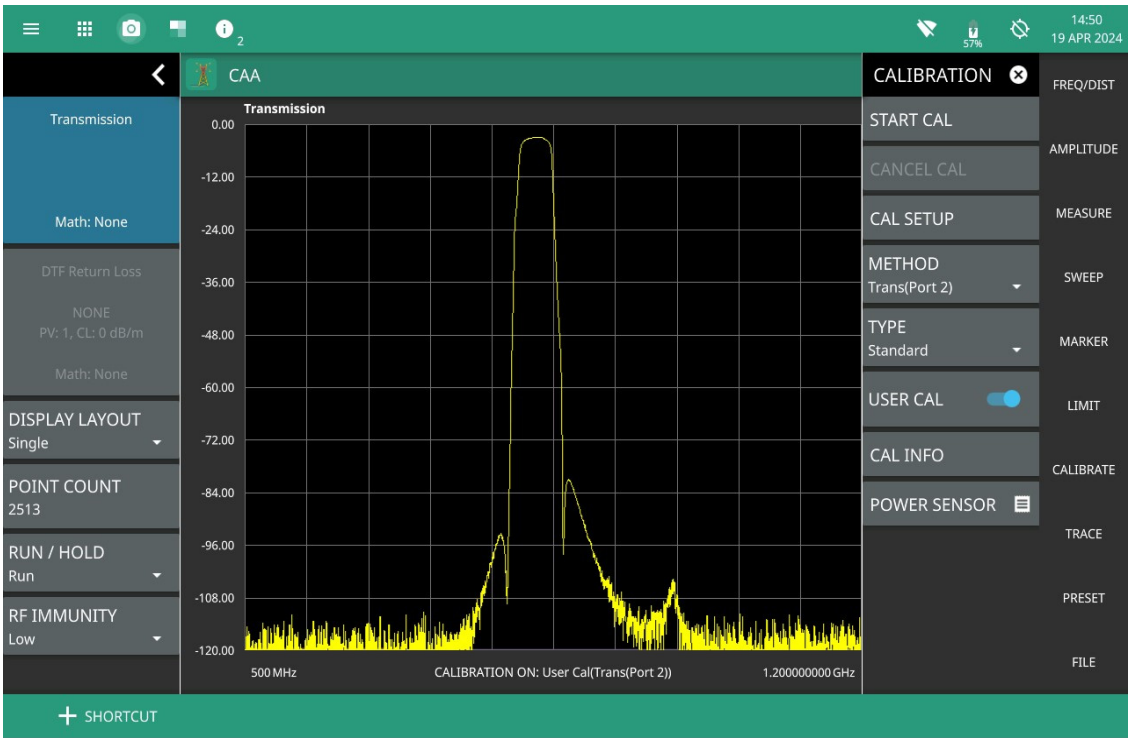


Figure 4-27. 2-PortTransmission Measurement (Option 21)

To set up a, 2-port transmission measurement:

1. Select MEASURE on the main menu and then select MEASUREMENT > Transmission.
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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Select MARKER on the main menu and then set the appropriate markers as described in “Setting Up Markers” on page 4-33.

6. Select LIMIT on the main menu and set the limit line as described in "Setting Up Limit Lines" on page 4-40. 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.
7. 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 4-52 for details on saving measurement data or setups to a file.

Time Domain Reflectometry (TDR) Measurements (Option 3)

Time Domain Reflectometry is a technique that measures and displays the impedance of a network (cable, filter etc) over time.

A TDR measurement shows impedance against distance, with a normal 50 ohm line running across the center of the display. Different causes of reflections such as open circuits, short circuits, kinks to the outer cable conductor and water ingress will cause characteristic changes to the transmission line impedance. This in turn helps identify the cause of the fault and accelerates the repair process.

TDR OHM (Option 3) Measurement

TDR Ohm measurement involves using TDR to analyze the impedance or characteristic impedance of a transmission line or cable. TDR instruments provide valuable information about impedance mismatches, cable faults, and variations in characteristic impedance.

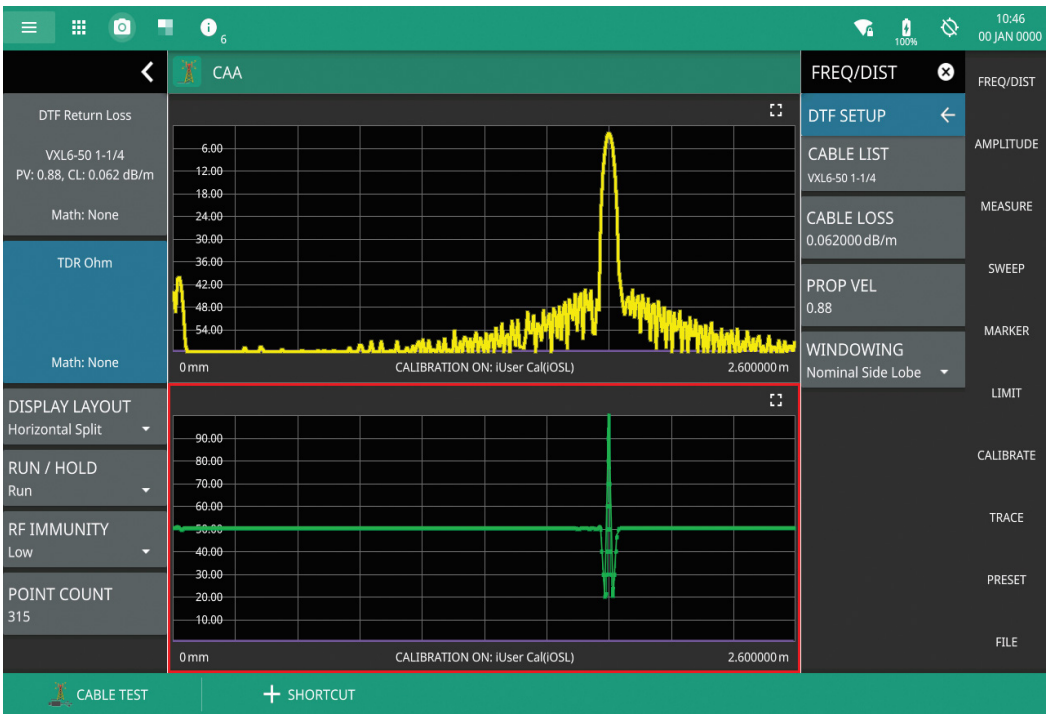


Figure 4-28. TDR OHM Measurement

TDR Linear (Option 3) Measurement

The TDR Linear measurement is a linear representation of the return loss (or gain) in dB of a device in time domain. The time domain transform of the underlying s-parameter is integrated into a step response (and presumably plotted on a linear scale).

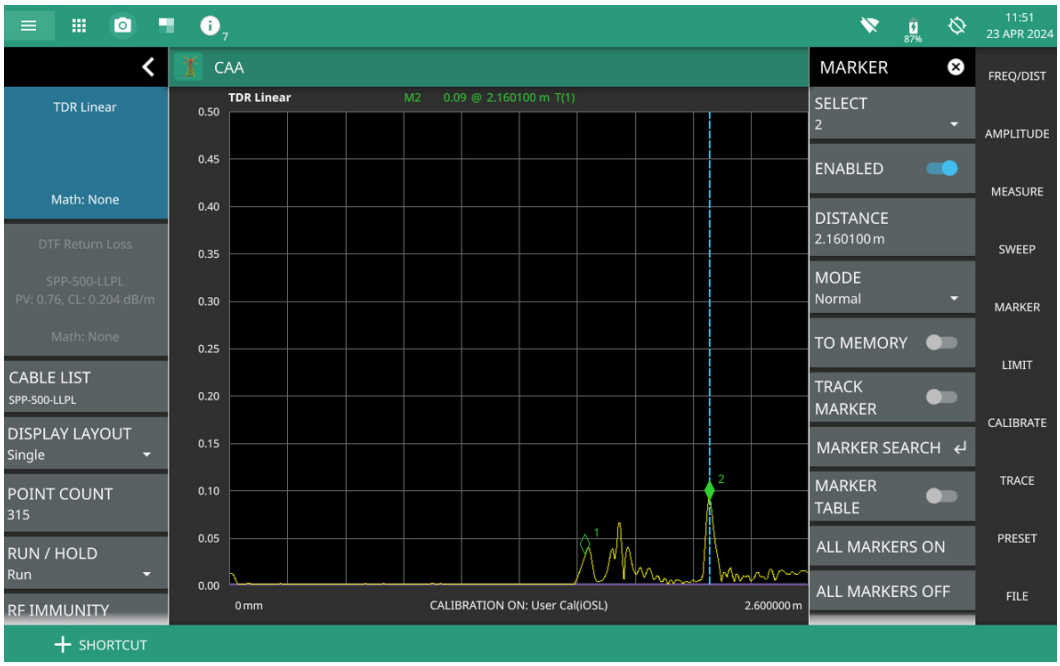


Figure 4-29. TDR Linear Measurement

To set up TDR measurements:

1. Select MEASURE on the main menu and then select MEASUREMENT > TDR Ohm/TDR Linear.
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 3-12.

   Alternatively, you can skip this step and the instrument will automatically apply the factory calibration (1-PORT ReadyCal ON).
5. Select MARKER on the main menu and then set the appropriate markers as described in "Setting Up Markers" on page 4-33.
6. Select LIMIT on the main menu and set the limit line as described in "Setting Up Limit Lines" on page 4-40. 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.

4-6 Setting Sweep Parameters

The sweep menu includes settings for the number of trace data points, run/hold mode, sweep trigger, sweep 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 data point can be user defined. The range is between 2 and 10,049 for both Standard and Flex calibrations.

When the standard calibration is applied to Site Master and Field Master instruments the data point snaps to the nearest calibration data points as follows:

- OSL Calibration: 10,049, 5025, 2513, 1257, 629, 315, 158, 65, 33, 17, 9, 5, 3 and 2
- OSL + Trans (USB Sen)/Trans (USB Sen) Calibration: 1251, 626, 251, 126, 51, 26, 11, 6, 3 and 2

The snap data points ensure that all points in the sweep are calibration measurement points rather than interpolated points. The data point can be changed with the calibration enabled, but it will always snap to the nearest calibrated data point. The Start/Stop frequencies cannot be changed when the calibration is started.

Once the calibration is complete, the unit will return to the data point and Start/Stop frequencies that were in place at the start of the cal. The number of points and Start/Stop frequencies can be changed with the calibration enabled, with each frequency point being interpolated from the flex cal.

The default data point setting is 315. This is recommended for most measurements. Increasing the data point increases the resolution of the measurement but slows down the sweep speed. The increased resolution can be helpful in DTF, as it enables increased distance coverage for the same distance resolution.

1. Select SWEEP on the main menu to open the "SWEEP Menu" on page 4-32.
2. Select DATA POINTS and enter the desired number using the numeric keypad.

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 4-32.
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 TRIGGER

Sweep Trigger sets the sweep mode to single or continuous. In single sweep mode, each sweep is initiated by SWEEP ONCE submenu.

1. Select SWEEP on the main menu to open the "SWEEP Menu" on page 4-32.
2. Select SWEEP TRIGGER to and select Single or Continuous.
3. When in single sweep mode, press SWEEP ONCE to start one line sweep.

RF Immunity

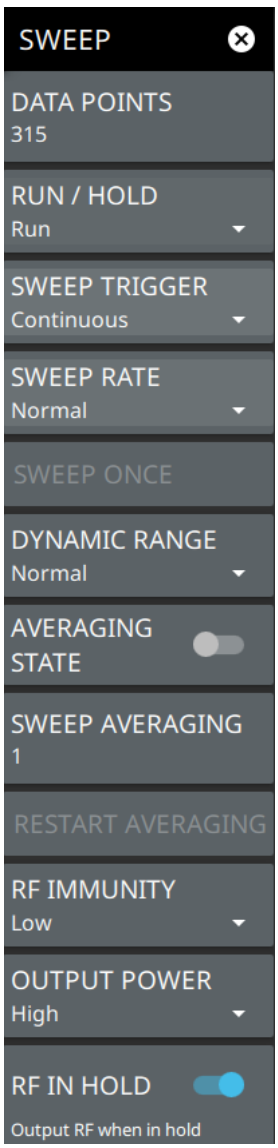
The RF Immunity setting provides a way to protect the instrument from stray signals generated by nearby or co-located transmitters that can affect measurements. Interfering signals can make the measurement look better or worse than it is. To improve the instrument's ability to reject unwanted signals, 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 4-32.
2. Select RF IMMUNITY and select either High or Low.

SWEEP Menu

Access SWEEP menu from the main menu.



DATA POINTS: Enters the number of data points for the sweep.

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.

SWEEP TRIGGER: Toggles between single sweep and continuous sweep. In single sweep mode, each sweep must be activated by pressing SWEEP ONCE.

SWEEP RATE: Selects the sweep rate as either normal or fast.

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

DYNAMIC RANGE: Toggles the dynamic range between Low and High. The high dynamic range mode can be used for applications where additional dynamic range is required. Note that the sweep speed slows down in high dynamic range mode. Only available in MS2085A/89A instruments.

AVERAGING STATE: Toggles averaging state on or off. When the averaging state is turned on the trace is swept the number of times equal to the set value of sweep averaging.

SWEEP AVERAGING: Sets the number of sweeps to be averaged, with a minimum value as 1 and maximum value is 1000.

RF IMMUNITY: Select this key to toggle between RF immunity High or Low. The default setting is Low. Refer to "RF Immunity" on page 4-32 for details.

OUTPUT POWER: Toggles the Output Power between Low and High. The power level defaults to Low (~ –30 dBm) for all 2-port measurements. This is ideal if you are measuring active devices such as Tower Mounted Amplifiers. The low power setting will ensure the measurement is made in the linear region and that the instrument is not over powered. Output power set to High (~ 0 dBm) should only be used when making loss measurements. Please note that calibration is only valid for the selected output power level. Only available in MS2085A/89A instruments.

RF IN HOLD: Select this toggle, to enable or disable RF output, when in hold mode.

Figure 4-30. SWEEP Menu

4-7 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 (USB Sen)) 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.

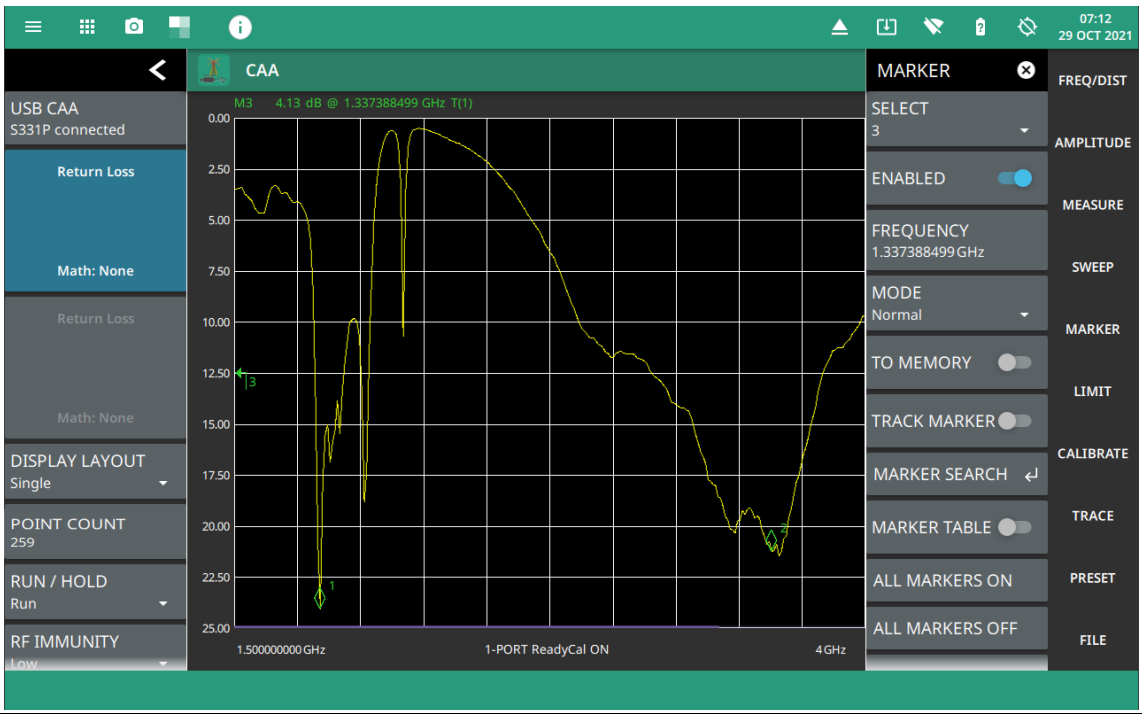


Figure 4-31. Markers 1, 2, and 3 (Marker 3 is Out of Range)

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 4-33 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 4-33 illustrates a delta marker between two return loss valleys.

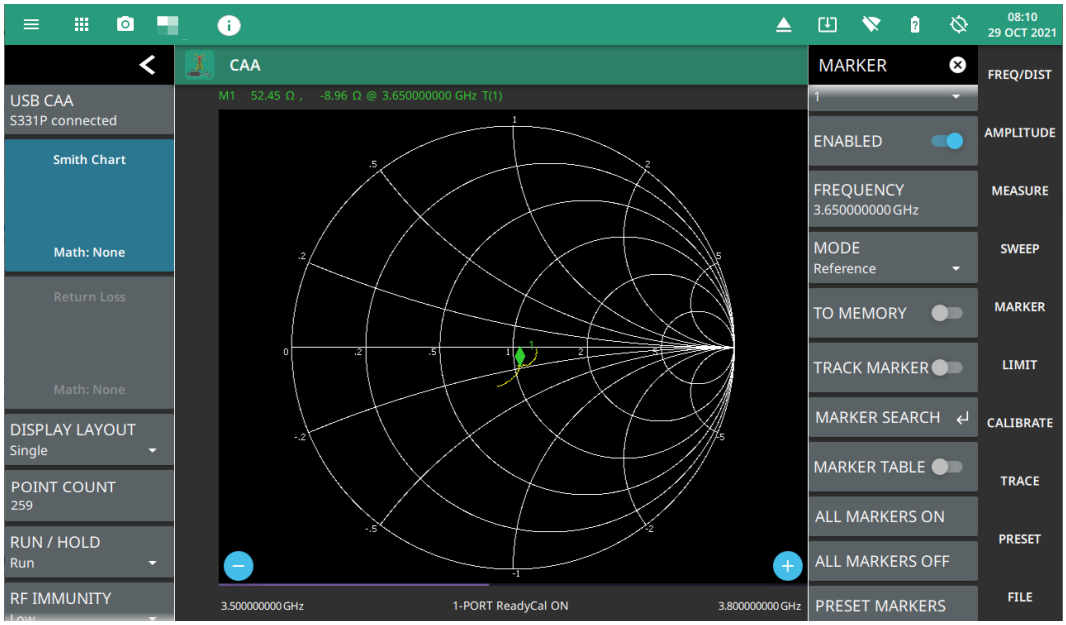


Figure 4-32. Markers on Smith Chart (use the + or – buttons to move the marker location in increments)

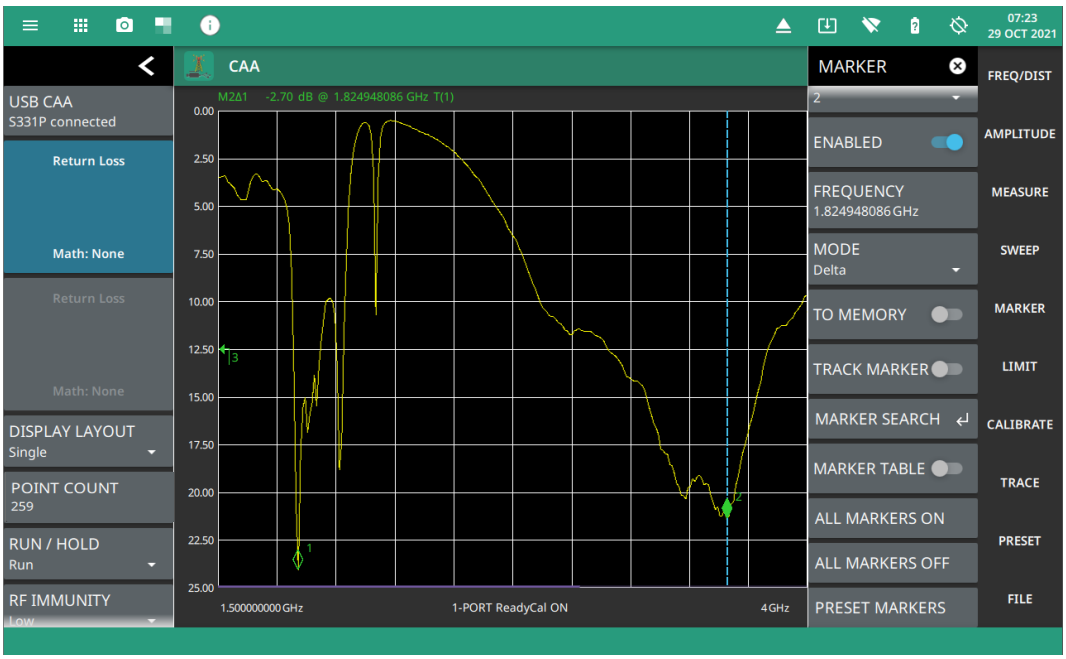


Figure 4-33. Delta Markers 1 and 2

Marker Table

The Marker Table is displayed at the bottom of the sweep window. The table lists all the 8 markers along with frequency/distance, time delay and amplitude information for the active markers.

To display the marker table, press MARKER on the main menu, then toggle MARKER TABLE on. The active marker is indicated with a blue background as shown in Figure 4-34.

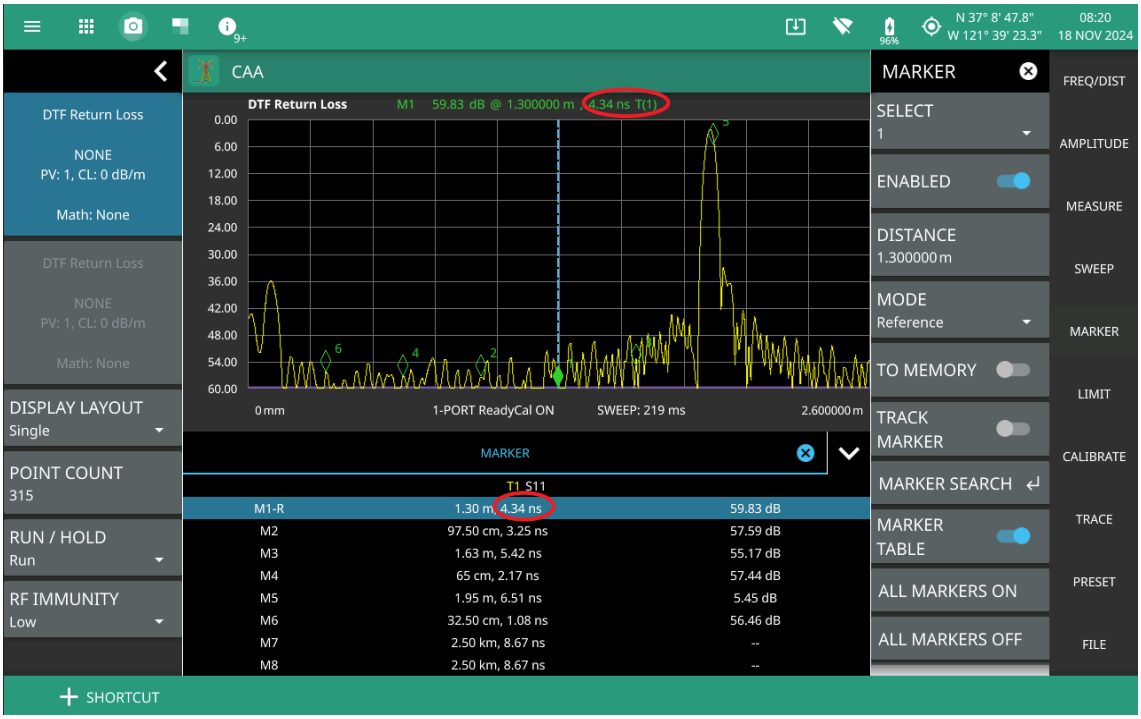


Figure 4-34. Delta Marker 2 and Marker Table with Time Delay

Note	Time delay is displayed in the Marker Table for DTF measurements (distance domain) only, such as DTF Return Loss, DTF VSWR, TDR Ohm and TDR Linear measurements.

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 4-9 “Setting Trace Parameters” on page 4-46 for more details about setting up traces and trace memory functions.

Figure 4-35 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.

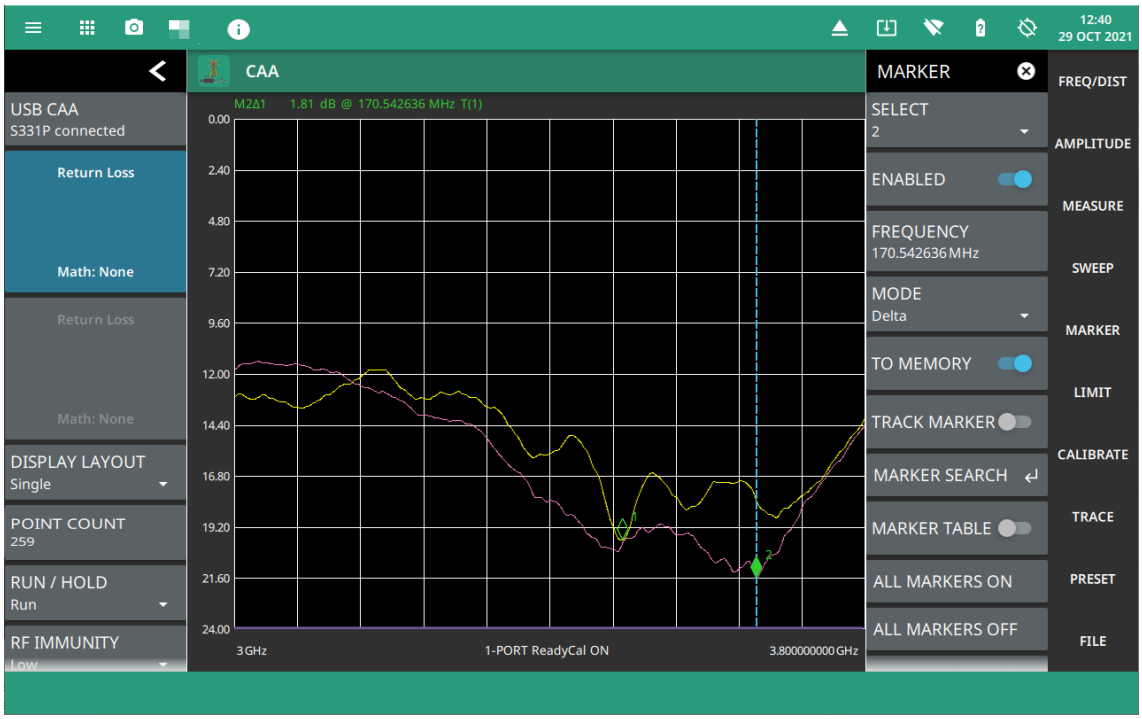
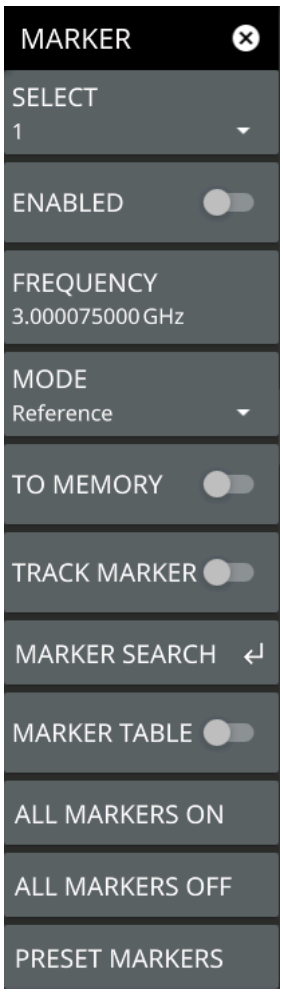


Figure 4-35. Delta Marker 2 with Marker to Memory

MARKER Menu

Access MARKER menu from the main menu.



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.

ENABLED: Toggles the display of the currently active marker on and off. When off, the location of the marker is stored.

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.

MODE: Sets the current active marker as a normal marker or a delta marker to Marker 1. Marker 1 is always the reference marker.

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.

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.

MARKER SEARCH: Opens the “MARKER SEARCH Menu” on page 4-39.

MARKER TABLE: Toggles on or off the marker table displayed below the measurement. Refer to

ALL MARKERS ON: Turns all markers on with either default values or previously set values if the markers have not been preset.

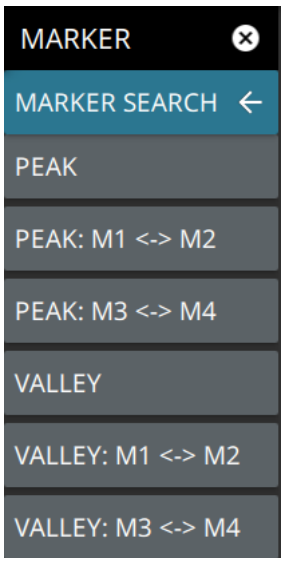
ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 4-36. MARKER Menu

MARKER SEARCH Menu

To access MARKER SEARCH from main menu press MARKER > MARKER SEARCH.



PEAK: Places the currently active marker on the highest signal amplitude currently displayed on screen.

VALLEY: Places the currently active marker on the lowest signal amplitude currently displayed on screen.

Markers 5, 6, 7, and 8 can perform a special Marker search to find the Peak or Valley between two other markers.

When Marker 5 or Marker 7 is Active

Peak Between M1 & M2: Places Marker 5 or 7 on the highest signal amplitude between Marker 1 and Marker 2.

Valley Between M1 & M2: Places Marker 5 or 7 on the lowest signal amplitude between Marker 1 and Marker 2.

When Marker 6 or Marker 8 is Active

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 4-37. MARKER SEARCH Menu

4-8 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 4-38 shows single upper and lower limit lines with the lower limit failing the limit test.

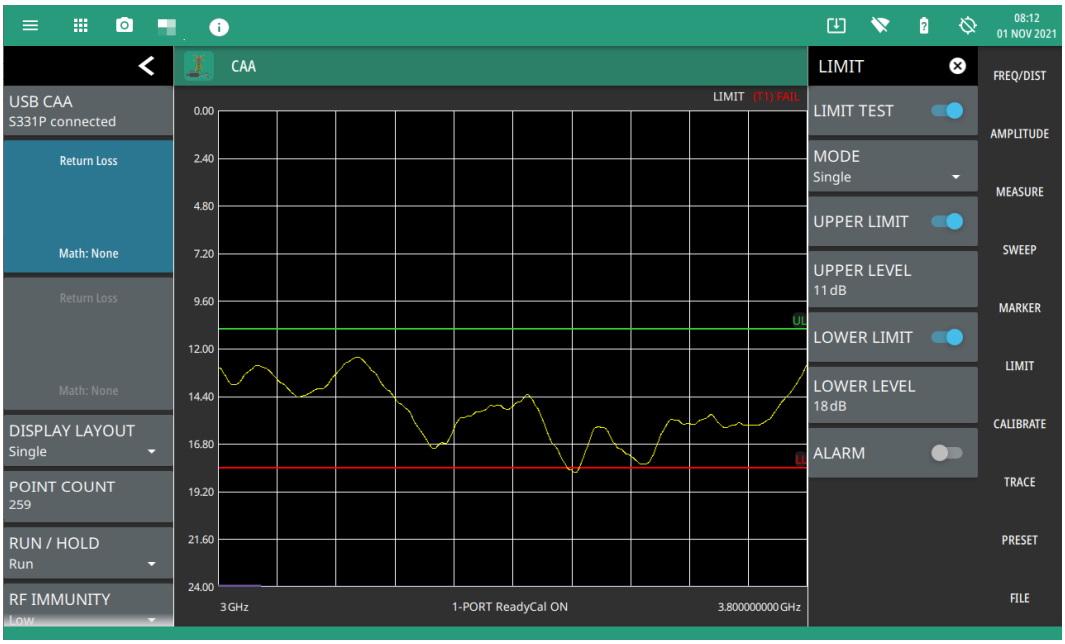


Figure 4-38. Single Limit Lines

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 4-39 shows a single segment limit line.

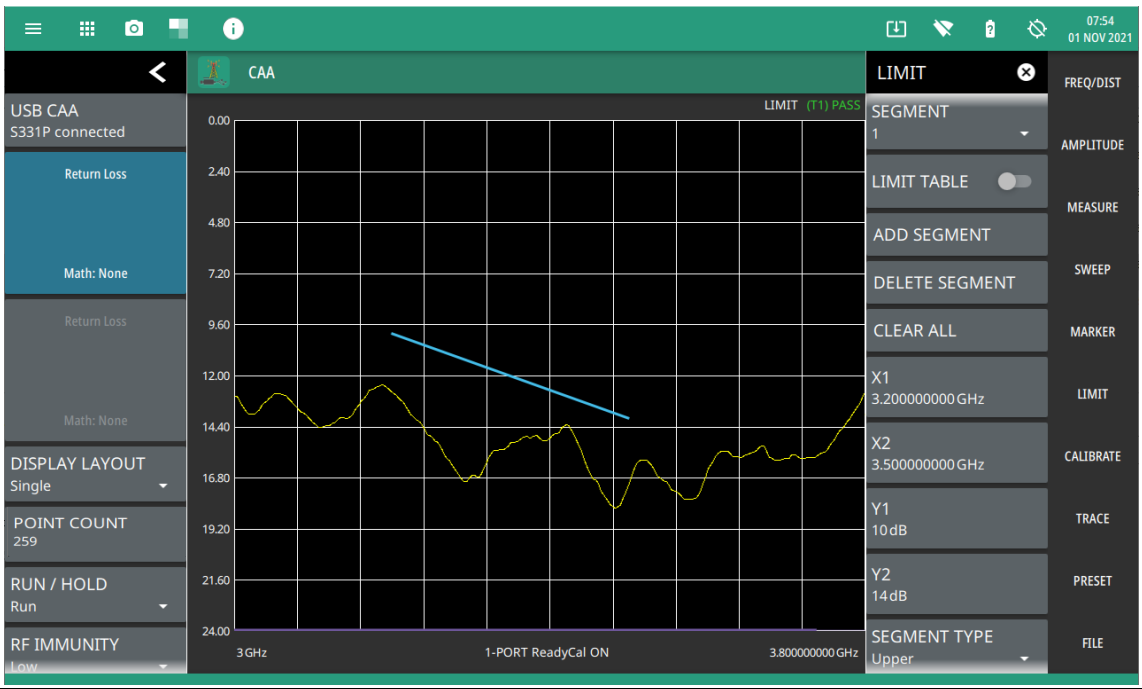


Figure 4-39. Single Segment Limit Line

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 4-39 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.

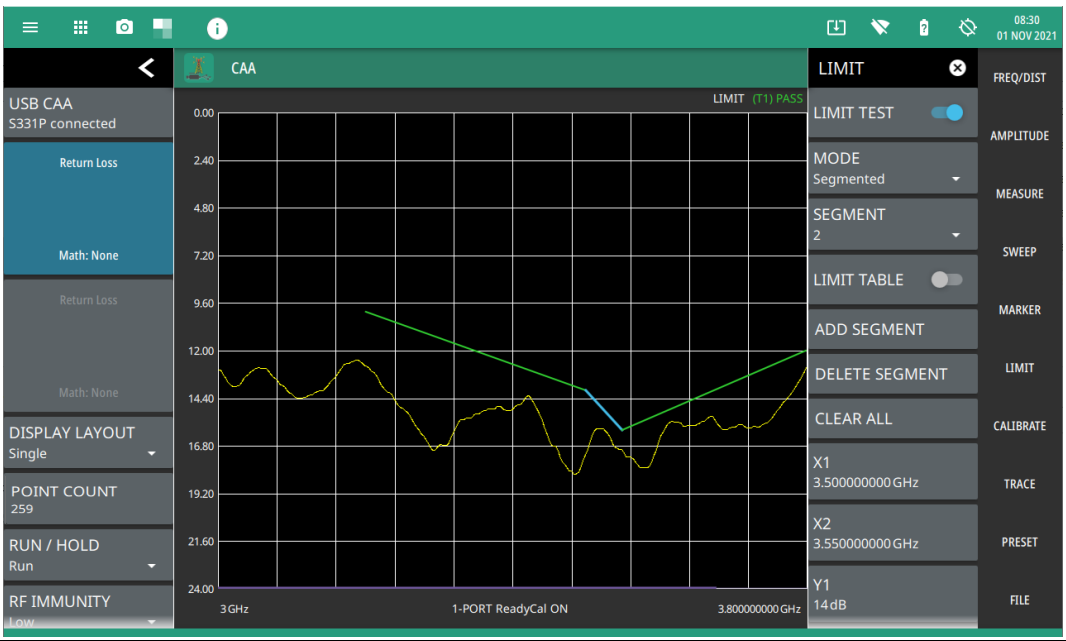


Figure 4-40. Single Segment Limit Line

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 4-39 shows several upper and lower segmented limit lines with the lower limit failing.

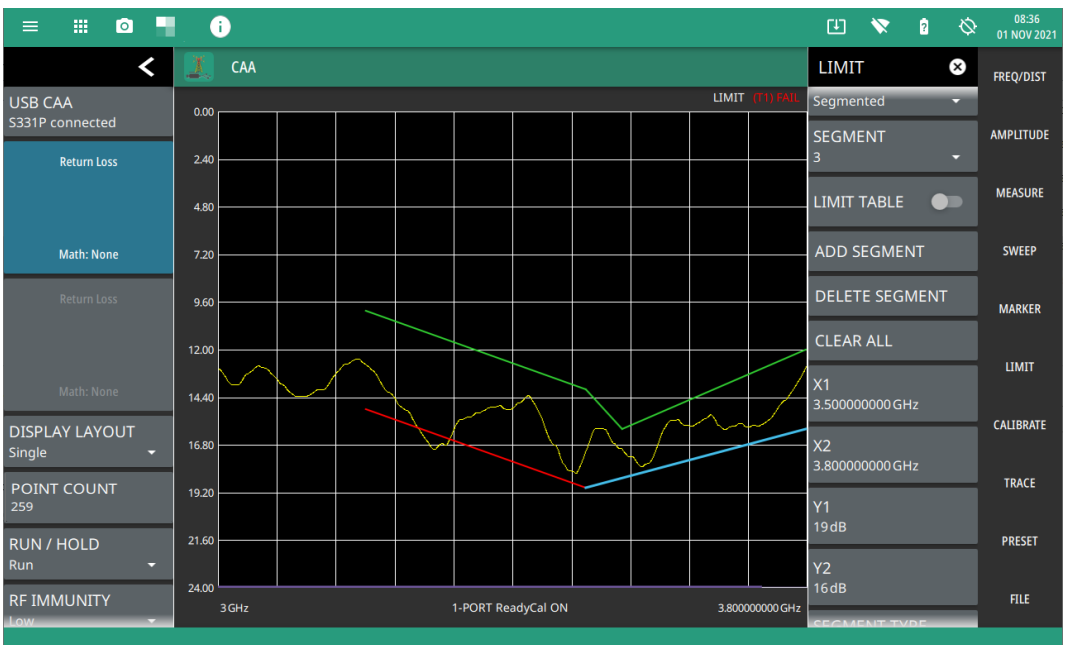


Figure 4-41. Complex Segmented Limit Lines

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 4-42 shows segmented limit lines with the limit table enabled. The lower segment is failing the limit test.

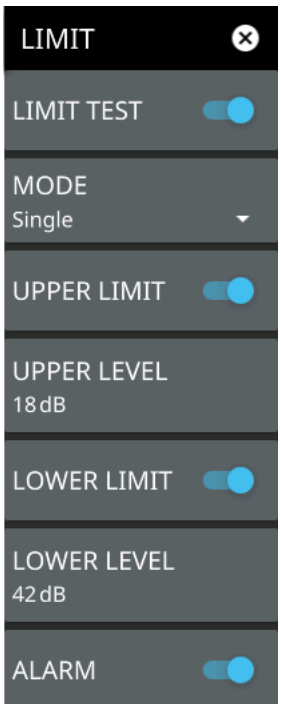
Figure 4-42. Limit Table

Limit Alarm

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

LIMIT Menu (Single)

Access LIMIT menu from the main menu.



LIMIT TEST: When toggled on, a Pass or Fail message is displayed to indicate whether the trace touches or exceeds the limit line (Fail).

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 4-45.

UPPER LIMIT: Toggles the upper limit line on or off.

UPPER LEVEL: Sets the amplitude of the upper limit line.

LOWER LIMIT: Toggles the lower limit line on or off.

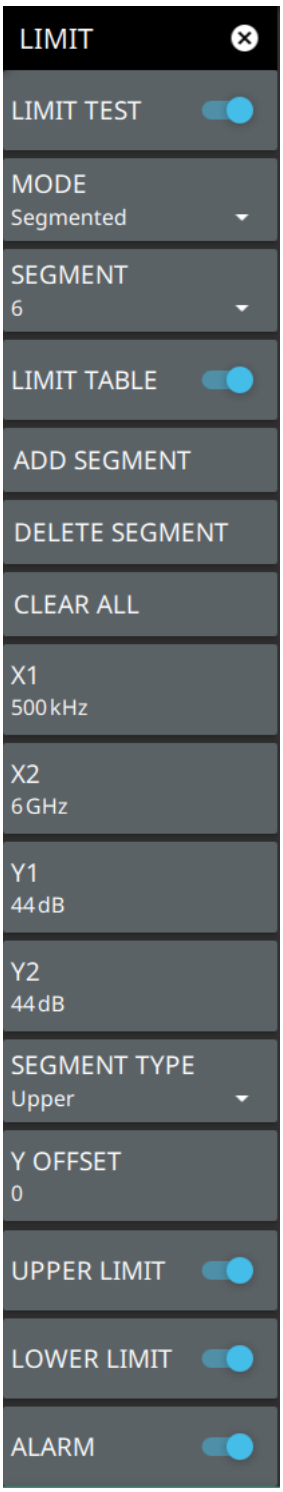
LOWER LEVEL: Sets the amplitude of the lower limit line.

ALARM: When toggled on, an audible alarm sounds a repeating beep when the trace touches the limit line.

Figure 4-43. LIMIT Menu (Single)

LIMIT Menu (Segmented)

To access segmented limit menu press LIMIT >MODE > SEGMENTED.



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: 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 4-44.

SEGMENT: Selects one of the limit line segments and makes it active. An active segment appears blue in color.

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: Adds a limit line segment after the current active segment. All segment numbers after the current active segment will be incremented.

DELETE SEGMENT: Deletes the currently active segment. All segment numbers after the current active segment will be decremented.

CLEAR ALL: Removes all segments and does not store any segment information.

X1: Edits the start X value (frequency or distance) of the active limit line segment.

X2: Edits the stop X value (frequency or distance) of the active limit line segment.

Y1: Edits the start Y value (amplitude or phase) of the active limit line segment.

Y2: Edits the stop Y value (amplitude or phase) of the active limit line segment.

SEGMENT TYPE: Toggles the active limit line segment to upper or lower limit.

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: Toggles all of the upper limit line segments on or off.

LOWER LIMIT: Toggles all of the lower limit line segments on or off.

ALARM: When toggled on, an audible alarm sounds a repeating beep when the trace touches the limit line.

Figure 4-44. LIMIT Menu (Segmented)

4-9 Setting Trace Parameters

The 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 (.fmcaausb/.smcaa 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 4-7 “Setting Up Markers” on page 4-33).

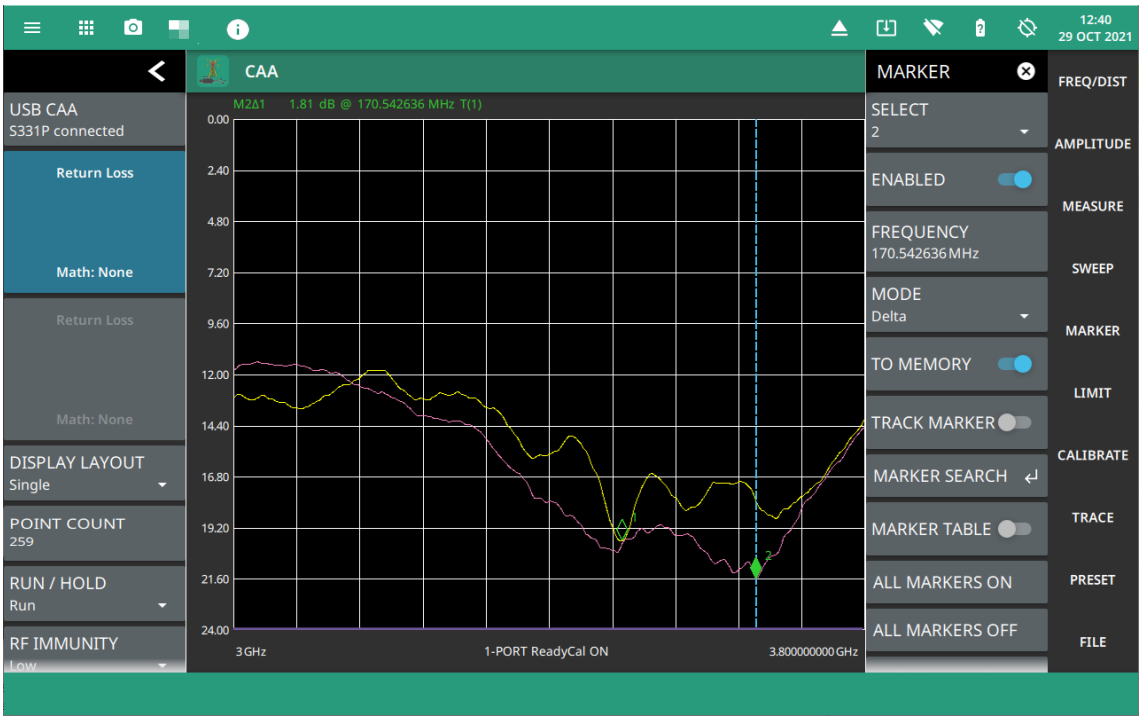


Figure 4-45. Displaying a Live Trace and a Static Trace from Trace Memory

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 4-9 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.

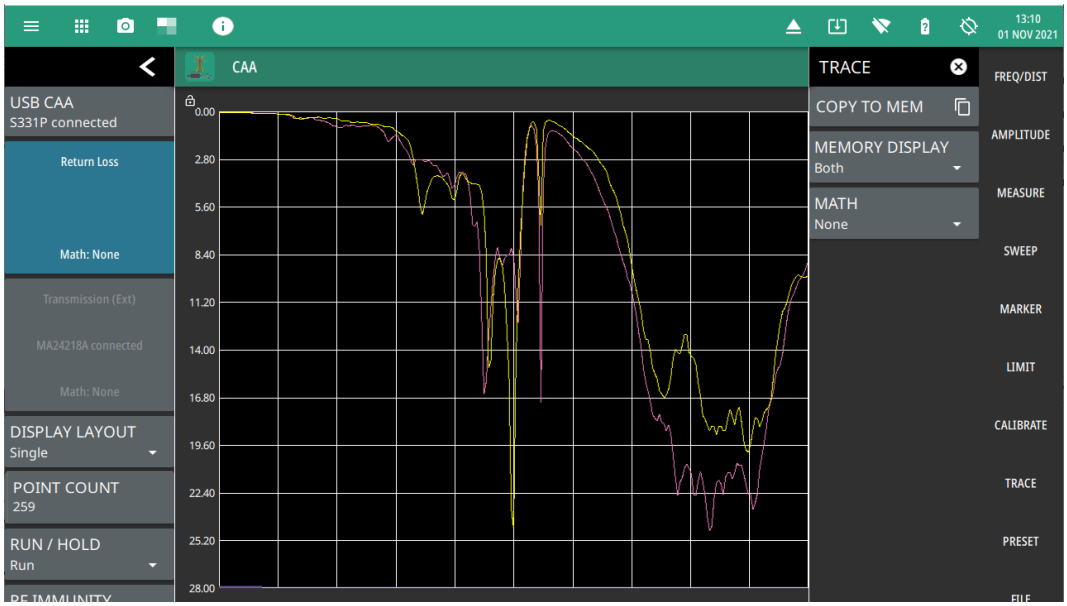


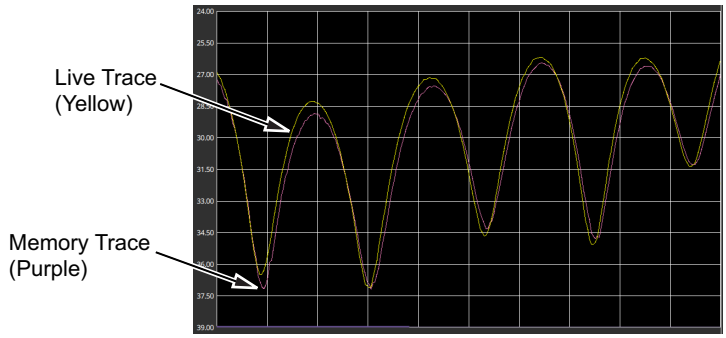
Figure 4-46. Trace Overlay of Two Antennas

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.

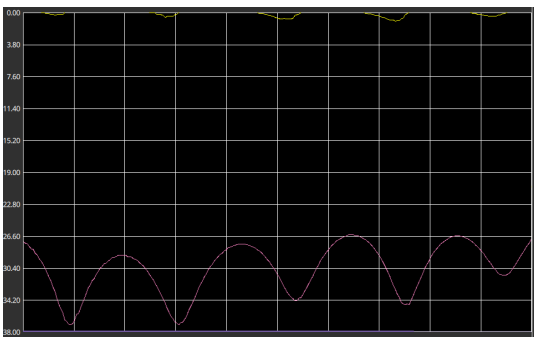
Trace Math Example

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

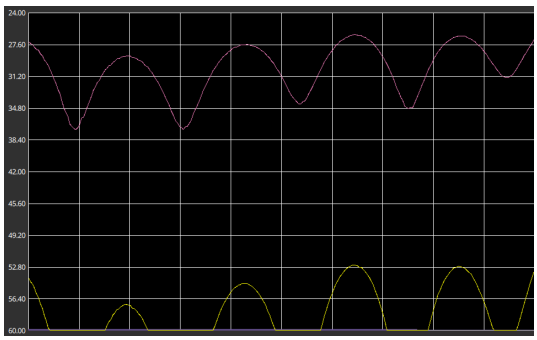
1. Connect the first cable and set up the measurement. Refer to "Setting up a Measurement" on page 4-9 for additional information.
2. Select TRACE > COPY TO MEM.
3. Remove the first cable and connect the second cable.
1. Select MEMORY DISPLAY and select Both. The purple trace from trace memory is displayed along with the live (yellow) trace.
2. Select MATH and select Trace - Mem, Trace + Mem, or (Trace + Mem) / 2 (Figure 4-47).



Example A. Sample Traces



Example B. Trace - Memory



Example C. Trace + Memory

Figure 4-47. Trace Memory Used to Compare the Phase of Two Cables (see Table 4-2, "Trace Math Details" on page 4-49)

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

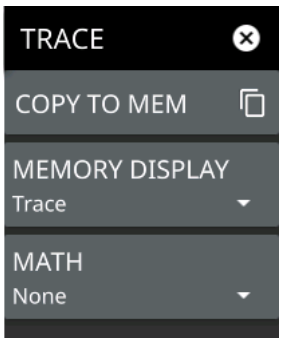
Table 4-2. Trace Math Details

Example from Figure 4-47	Example Description
A. Sample Traces	Shows the live yellow trace and purple memory trace.
B. Trace – Memory	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). 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). 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.
C. Trace + Memory	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). 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).
(Trace + Memory) / 2 *(not shown)*	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. This math function is most useful when measuring one-port Cable Loss (using the Cable Loss measurement). 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. 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.

Refer to "TRACE Menu" on page 4-50 for additional information.

TRACE Menu

Access TRACE menu from main menu.



COPY TO MEM: Copies the currently active trace to memory for use in the display and math and options below.

MEMORY DISPLAY: Selects the trace display options.

- **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).

MATH: Select to change the trace math options.

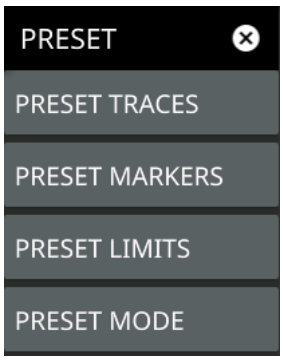
- **None:** The active trace is shown as is with no math functions.
- **Trace + Mem:** Displays the difference between the active trace and the trace in memory.
- **Trace – Mem:** Displays the results of logarithmic adding of the active trace and the trace in memory.
- **(Trace + Mem) / 2:** Displays the results of the average of the active trace and trace in memory.

Figure 4-48. TRACE Menu

4-10 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 CAA/CAA_USB. 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 instrument user guide.

PRESET Menu



PRESET TRACES: Presets all trace settings to default values.

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

PRESET LIMITS: Presets all limit settings to default values. Turns off all limits.

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

Figure 4-49. PRESET Menu

4-11 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 4-50:

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.

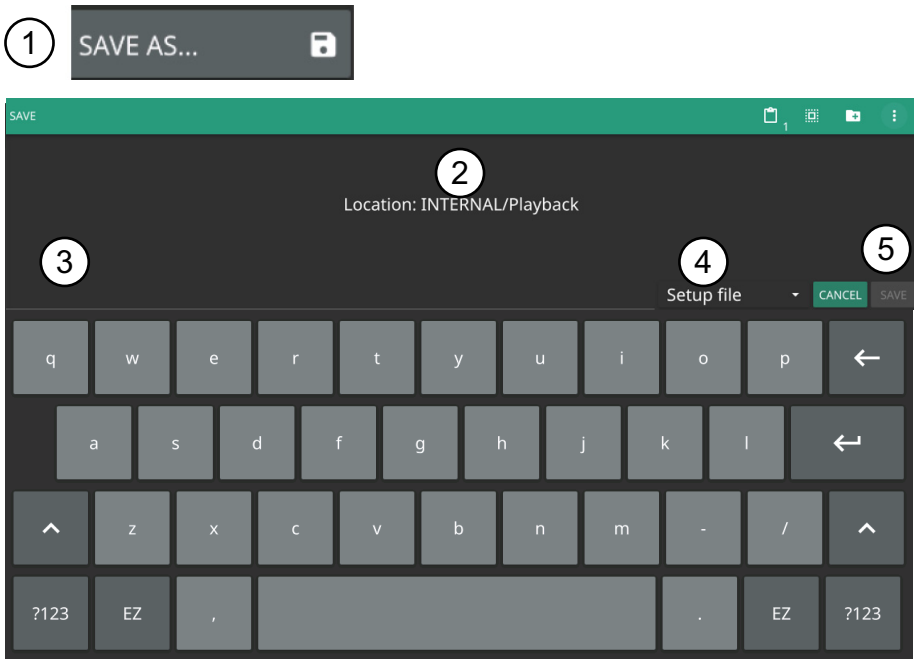


Figure 4-50. File Save Dialog

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 4-51:

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.

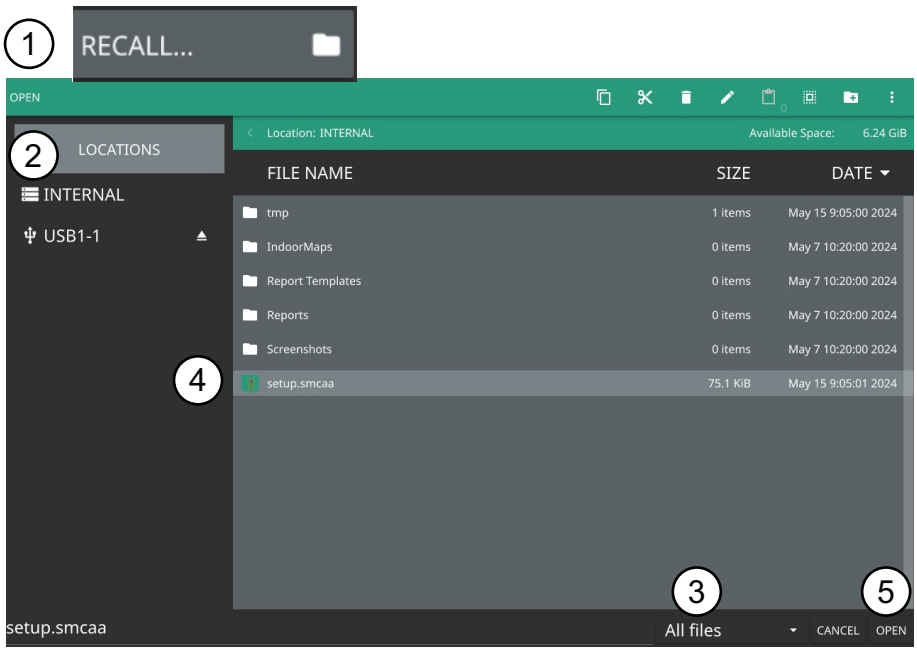
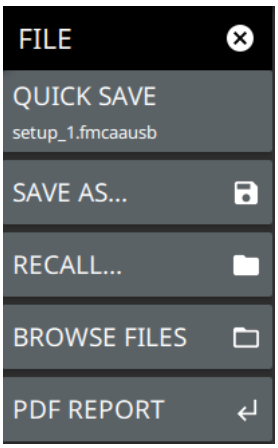


Figure 4-51. File Open Dialog

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

Access FILE menu from main menu.



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

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

- Setup: Saves the current instrument setup (stp file type).
- Limit: Saves the current limit line point data (limcaa file type)
- Trace: Saves the measurement point (trace) data and the current instrument setup (fmcaausb/smcaa file type).
- Trace + Screenhsot: Saves the measurement point (trace) data and the current instrument setup screenshot (fmcaausb/smcaa 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) (Field Master Series instruments only)

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.

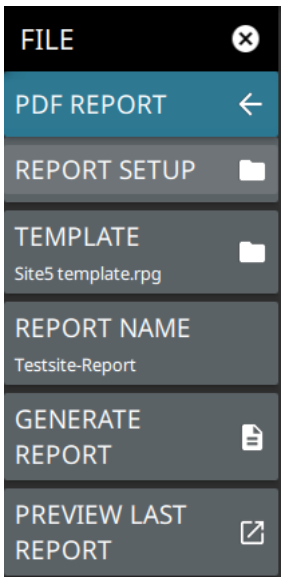
BROWSE FILES: Refer to the “File Management” section of the instrument user guide.

PDF REPORT: Opens “PDF REPORT Menu” on page 4-55. Refer to instrument user guide for detailed information.

Figure 4-52. FILE Menu

PDF REPORT Menu

Access PDF Report submenu from main menu, FILE > PDF REPORT.



REPORT SETUP: Opens the PDF report generator screen.

TEMPLATE: Loads the PDF report template saved in the instrument.

REPORT NAME: Allows to name the PDF report.

GENERATE REPORT: Generates the PDF report and saves in the REPORTS folder.

PREVIEW LAST REPORT: Opens the previously generated report.

Figure 4-53. PDF Report Menu

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