COPPER MOUNTAIN®
TECHNOLOGIES

Automatic Fixture Removal
Operating and Programming Manual

Revision 22.2.1 12.10.2022

Contents

Contents

Contents

Contents

Contents

Contents

Introduction

This help system is intended to provide you with all information that is necessary for setup, manual, and remote control of the Copper Mountain Technologies Vector Network Analyzer. Please use navigation tools on the left of the window to access the sections.

If you have any questions or comments please contact us.

This manual is compatible with version 1.4.1 of the AFR plug-in and versions of the Vector Network Analyzer software not lower than 22.0.0.

Automatic Fixture Removal (AFR) is a progressive de-embedding Vector Network Analyzer (VNA) software option used to characterize RF components, devices and interconnects in an arbitrary media.

| NOTE | Automatic Fixture Removal is a VNA software plug-in. The plug-in requires purchase of a license. |

Web Sites

Copper Mountain Technologies

Safety Requirements

Safety requirements are applied when working with the VNA, PC, and microwave circuits.

All precautions and warnings provided in this Manual for all the phases of operation, service, and repair of the Analyzer should be observed. The Analyzer should be used only by skilled and thoroughly trained personnel with the required knowledge of safety precautions. The Analyzer complies with INSTALLATION CATEGORY II as well as POLLUTION DEGREE 2 as defined in IEC61010-1. The Analyzer is a MEASUREMENT CATEGORY I (CAT I) device. Do not use the Analyzer as a CAT II, III, or IV device. The Analyzer is for INDOOR USE only. The Analyzer has been tested as a stand-alone device and in combination with the accessories supplied by Copper Mountain Technologies, in accordance with the requirements of the standards described in the Declaration of Conformity. If the Analyzer is integrated with another system, compliance with related regulations and safety requirements are to be confirmed by the builder of the system. Never operate the Analyzer in an environment containing flammable gasses or fumes. Operators must not remove the cover or any other part of the housing. The Analyzer must not be repaired by the operator. Component replacement or internal adjustment must be performed by qualified maintenance personnel only. Never operate the Analyzer if the power cable is damaged. Never connect the test ports to AC power mains.

Operation of the analyzer should be performed by qualified personnel with experience in operating of microwave circuits and PC.

Exceeding the maximum input power of the RF signal or the maximum DC peak voltage as indicated on the devices' housing may damage the devices. Exceeding the maximum input power of the RF signal or the maximum DC peak voltage as indicated on housing of the analyzer and used devices may damage them.

The analyzer connected to the mains must be grounded.

WARNING	DAMAGE OF THE GROUND WIRE MAKES WORK DANGEROUS.
	NEVER CONNECT OR DISCONNECT POWER CABLES WHEN THE EQUIPMENT IS POWERED ON.

Electrostatic discharge protection
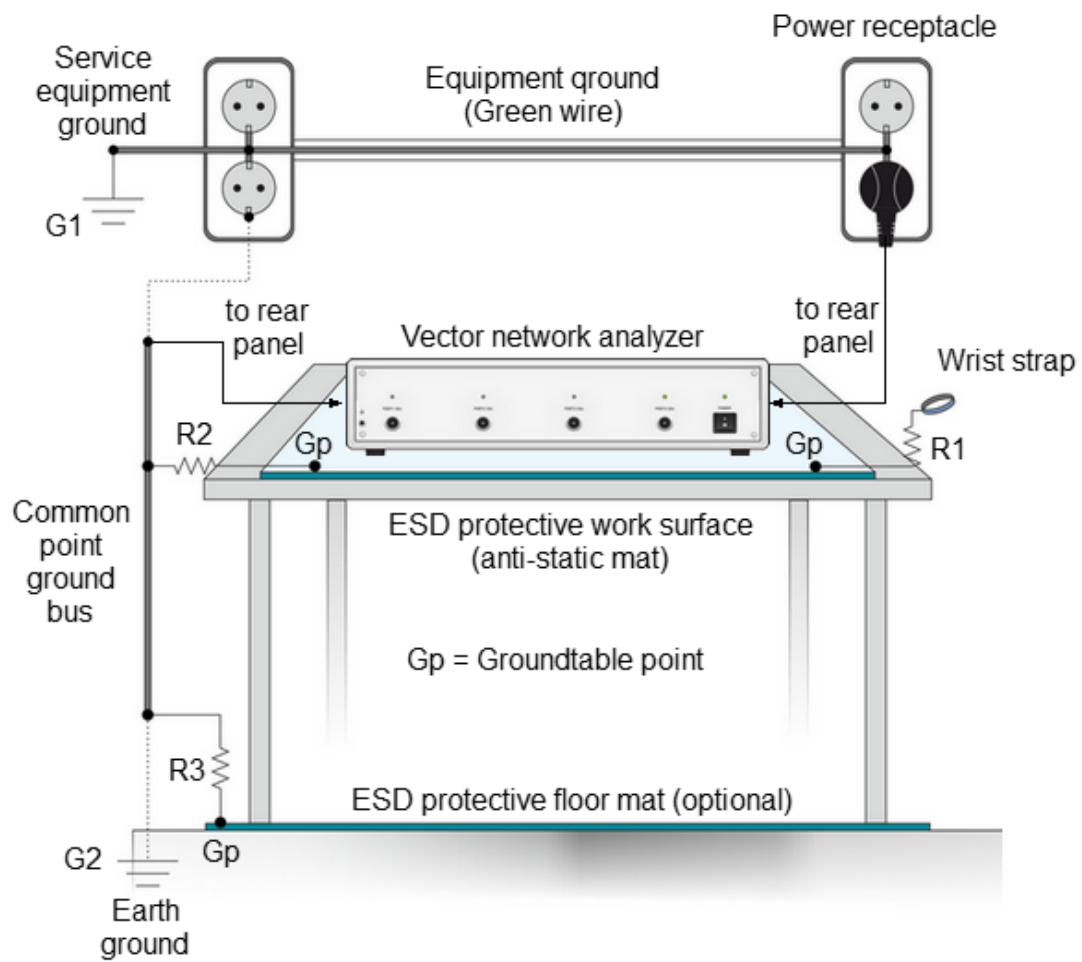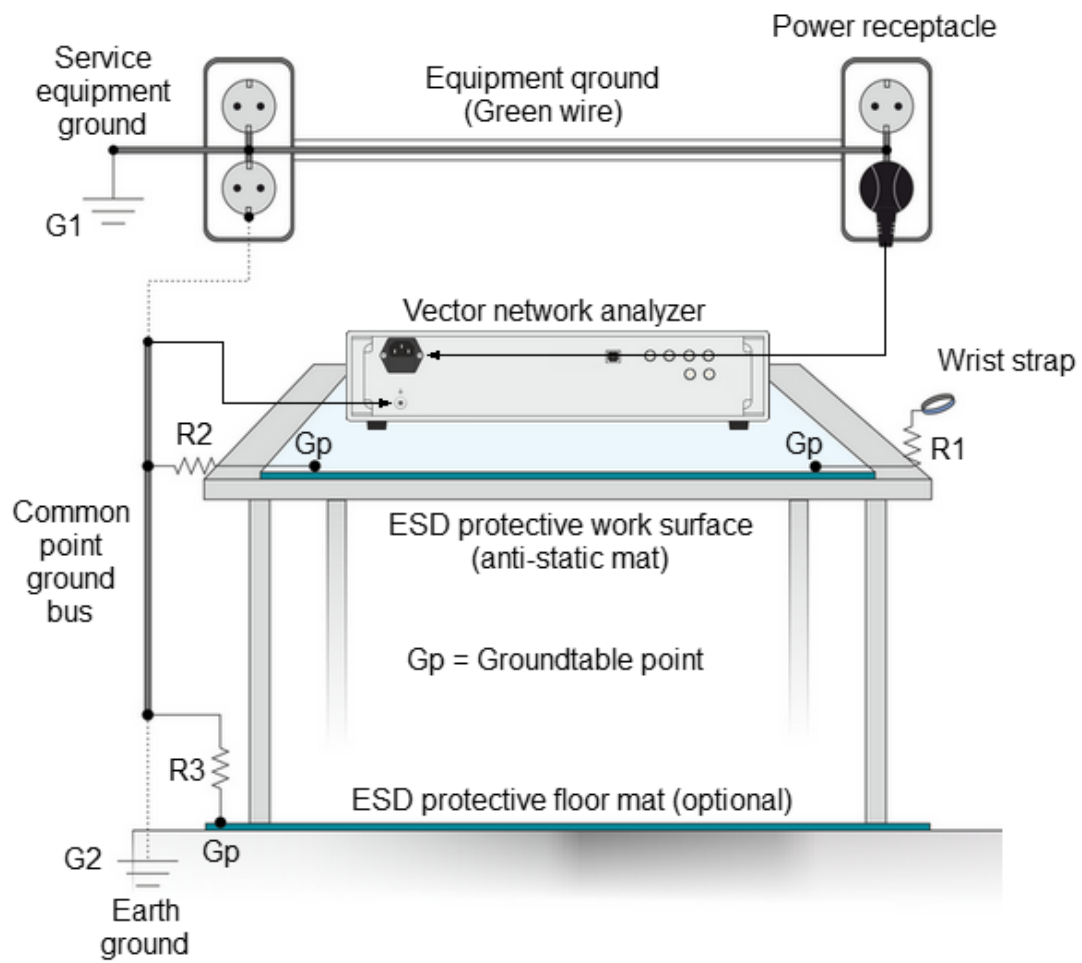
Electrostatic Discharge Protection for Workplace

WARNING	Ensure the workplace is protected against electrostatic charges.
	Static charge can build up on a user's body and damage sensitive internal components. To avoid damage from electric discharge, follow the rules below:

- Always discharge the static charge accumulated on your body before touching any device.

- Always use a desktop grounded conductive anti-static mat on your stationary workplace.

- Always wear a grounding wrist strap connected to the desktop grounded conductive anti-static mat via daisy-chained 1 MΩ resistor.

General Overview

AFR serves to simplify the measurement of a device under test (DUT) when the appropriate calibration standards are not available or there are difficulties in accessing the DUT directly (See figure below).

Automatic Fixture Removal
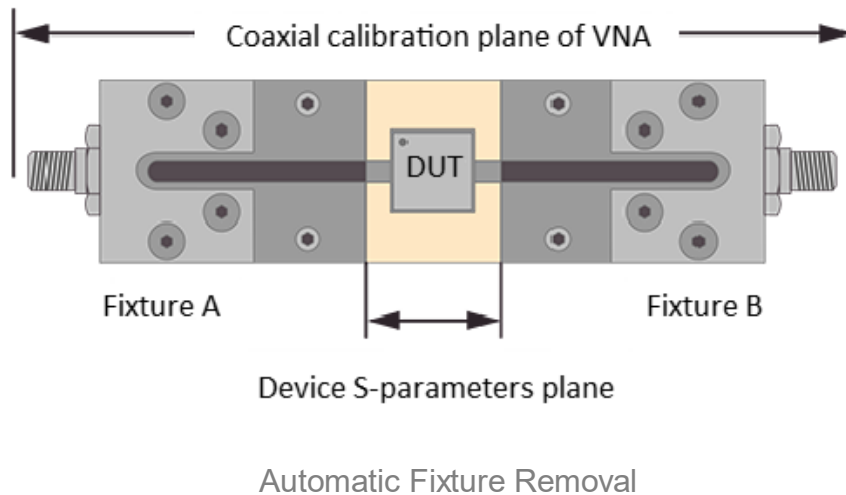
A principal challenge in making these measurements is how to correctly separate the effects of the transmission medium from parameters of the device. The AFR function removes fixture' characteristics mathematically leaving only the DUT behavior over the required frequency range. AFR is an alternative way of re-calibrating the VNA to compensate for the influence of a fixture. It helps when performing de-embedding or selecting transmission paths going up to the DUT connectors. Moreover, results obtained after AFR is applied can be also processed to investigate properties of the fixture.

Automatic Fixture Removal can be used for determining the S-parameters of:

- RF Components Installed in Non-Coaxial Fixture.

- Transmission Lines in Circuit Boards and Substrates.

- Interconnects.

There are three Automatic Fixture Removal methods:

- Filtering approach

- Time-gate approach

- Bisect algorithm

Software Installation

The "Automatic Fixture Removal" setup file has the following structure:

AutomaticFixtureRemovalSetup SXVNA - X.X.XX.X -Realease- xXX

Analyzer software version (S2VNA or S4VNA)   Plugin version   CPU register (x86 or x64)

System Requirements

Parameter	Requirements
Operating system	Windows 10 and above
Processor	1 GHz
System memory	1 GB RAM
Interface	USB 2.0
Hardware	Keyboard and mouse
Main software	Vector Network Analyzer Software (S2VNA or S4VNA)

Installation Procedure

1. Double-click the setup file to run the Setup Wizard. Run the setup file, the Setup Wizard will appear on the screen. Start the AFR plug-in installation.

Verify the folder where the plug-in will be installed. By default, the plug-in will be installed in the VNA folder where the VNA software is installed.

NOTE	The destination folder can be anywhere else.

Click **Browse...** button to change installation location.

Click **Next** button to continue the installation (See figure below).
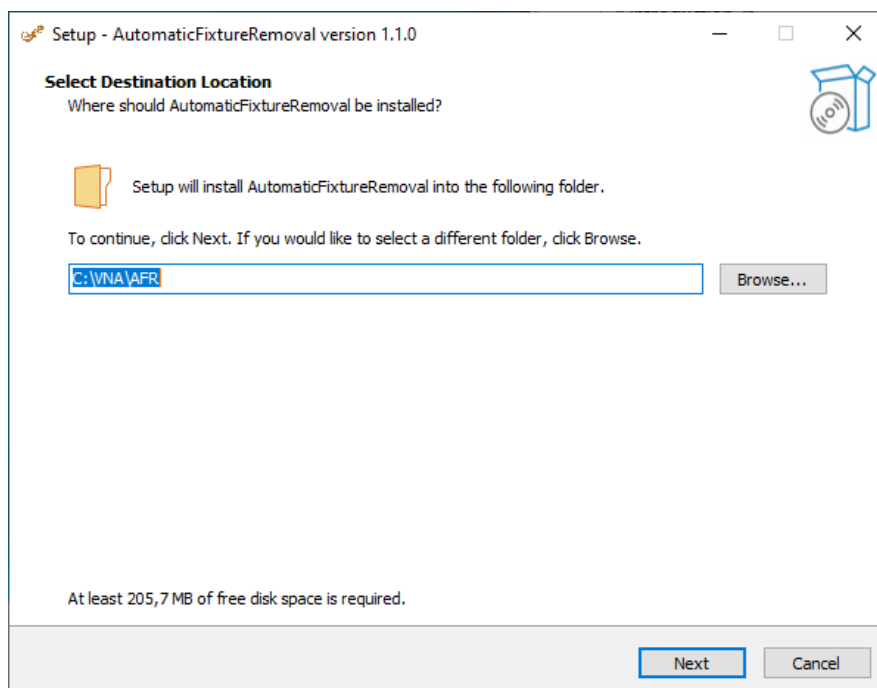
2. To create a shortcut on the desktop, set the flag in the additional tasks window. Click **Next** button to continue with the installation (See figure below).
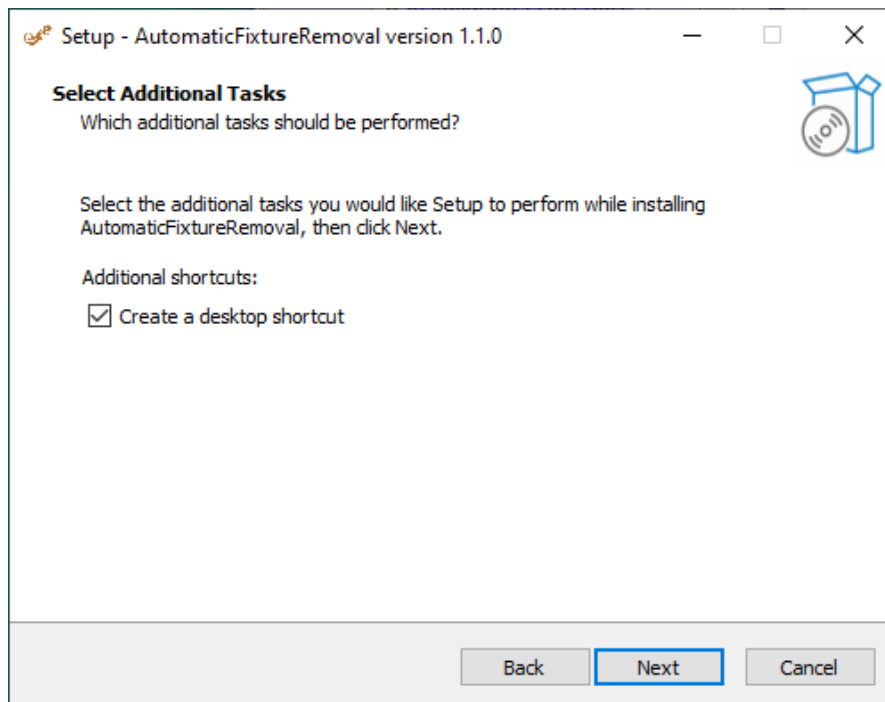
3. Click the **Install** button to start installing the plug-in (See figure below).
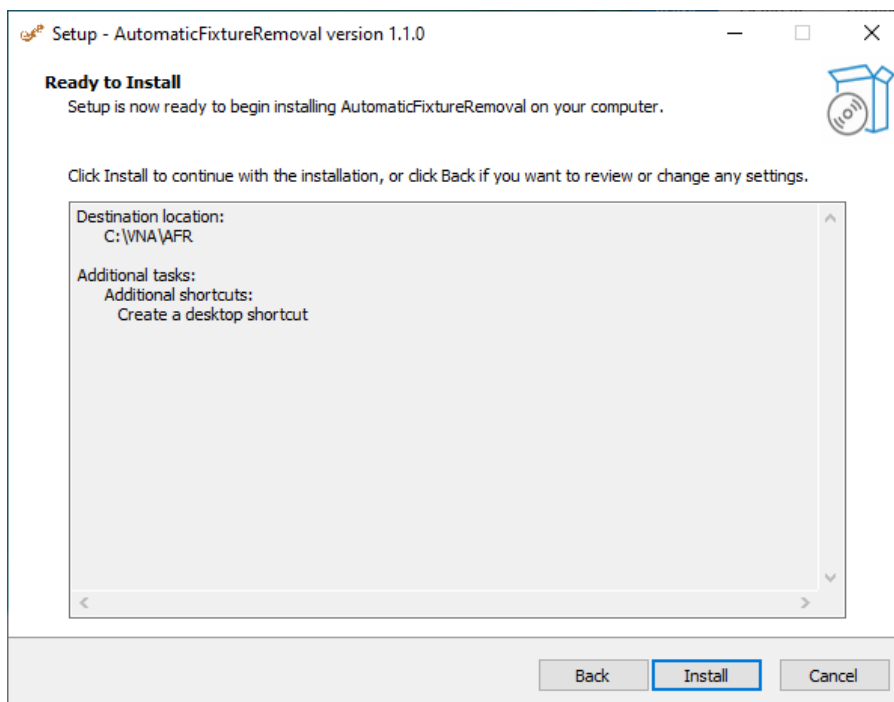
Installation takes only a few seconds (See figure below).
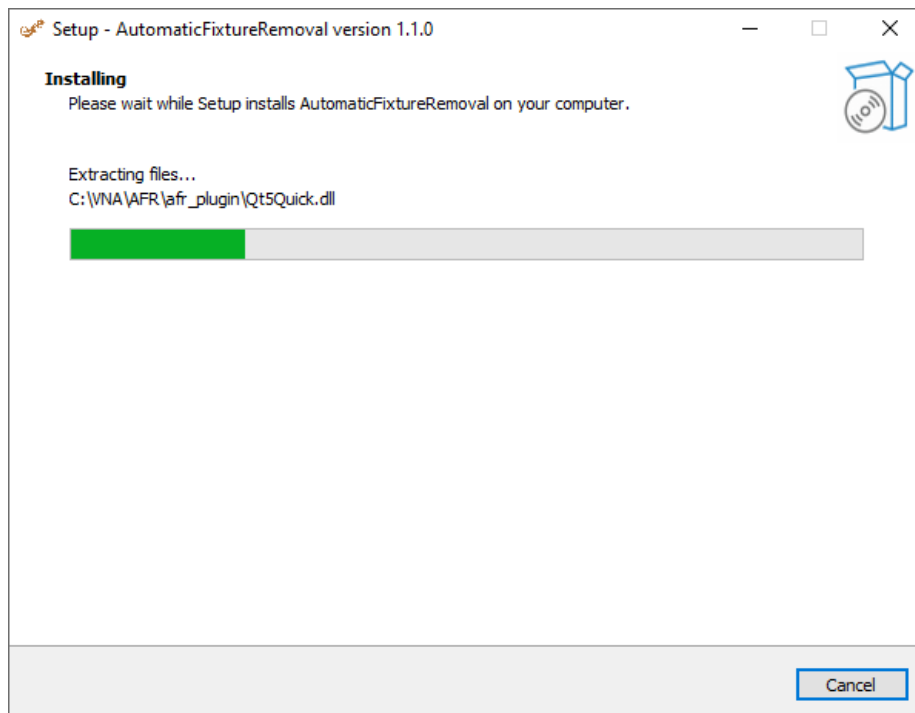
4. After successful installation the setup wizard may be closed (See figure below).
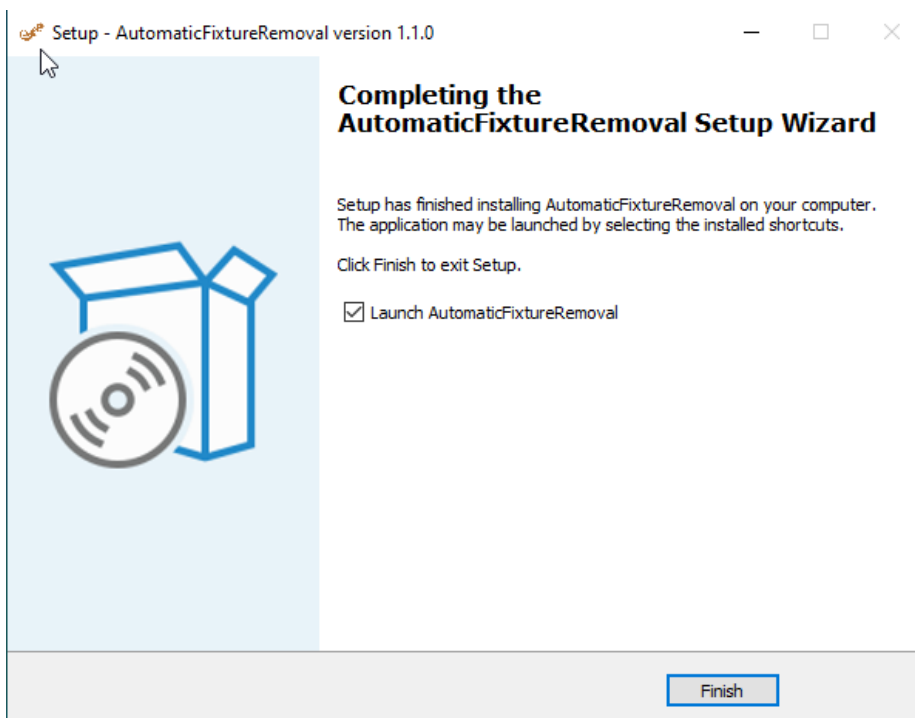
Click **Finish** button to close the Setup Wizard.

5. Install the License File (See License File Installation).

License File Installation

The license file is generated by Copper Mountain Technologies and sent to the customer at the time of purchase. Please contact your local Copper Mountain Technologies representative to get a quote.
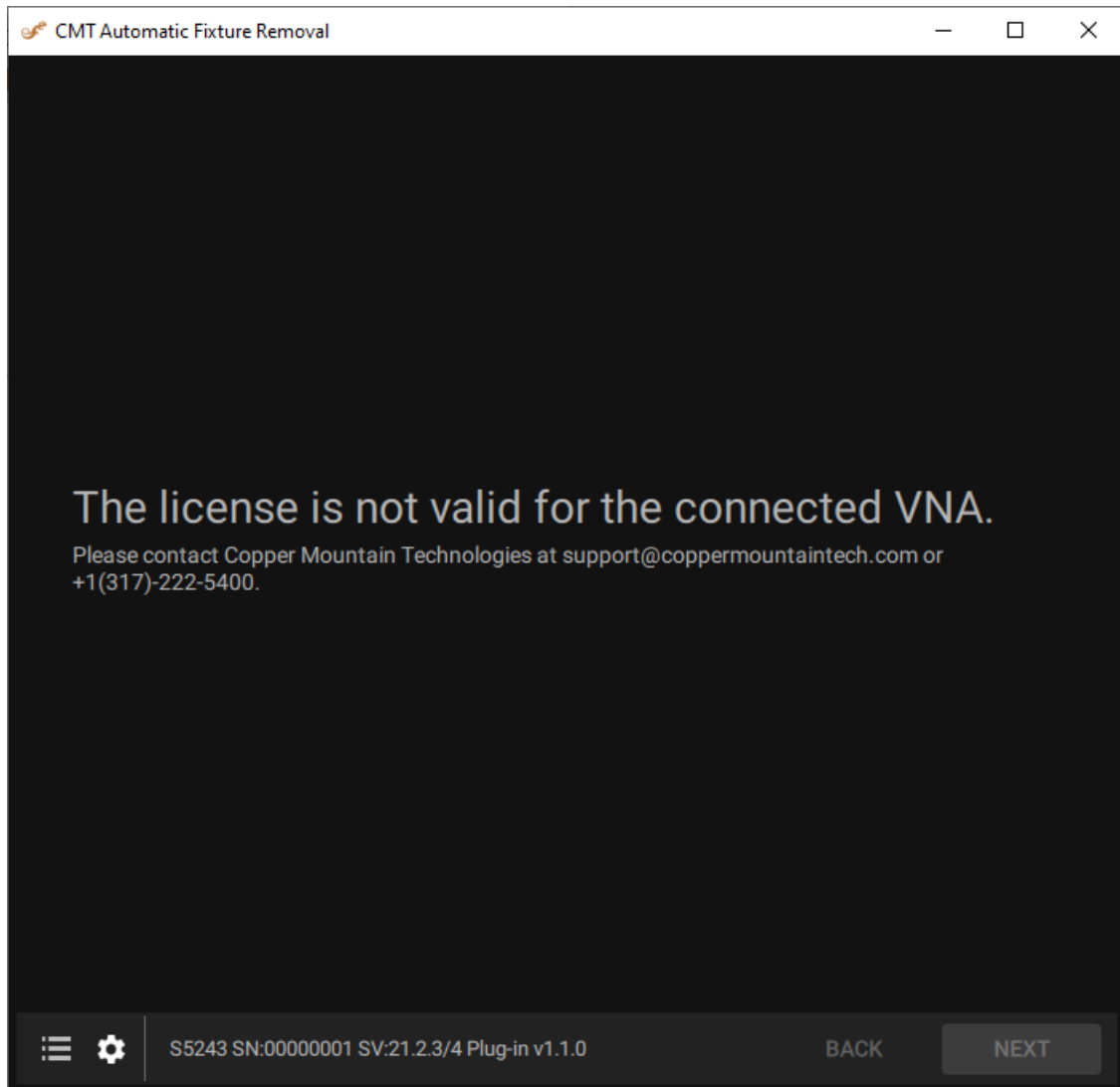
Invalid license message

The license file is generated by Copper Mountain Technologies and sent to the customer at the time of purchase.

- A license file can support one or more VNA serial numbers.

- The extension of the license file is *.LIC.

- The license file must be located in the same directory as the AFR plug-in executable.

- License verification occurs every time the plug-in is started.

- A network connection is not required for license verification except in the case of a timed demo where the expiration date must be determined from an internet-based time source.

- A new license is not required when installing an updated version of the plug-in.

- A new license is not required when the VNA software version changes or the VNA software is re-installed.

Copy the license file into the same folder as the AFR plug-in executable. This will be the folder directory of the VNA software.

NOTE	Contact your local Copper Mountain Technologies representative if a license file is lost or damaged.

Supported VNAs

Automatic Fixture Removal can be performed with two-directional VNAs. These include the Copper Mountain Technologies S2VNA and S4VNA software.

NOTE	The latest version of the VNA software can be downloaded from the [Copper Mountain Technologies](#) website.
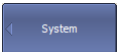
To view list of supported devices click the following VNA buttons: **System > Misc Setup > Analyzer Model**.
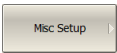
The list of supported instruments depends on the VNA software version.
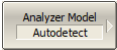
Demo mode

One of the easiest ways to get to know Copper Mountain Technologies' VNAs is to explore the instruments directly. That's made even easier when free demo VNA software is downloaded. All our VNA applications contain built-in emulator modes for each supported instrument, which can be enabled during the initial software installation.

To enable demo mode click the following buttons: **System > Misc Setup > Demo Mode > ON**.

Getting started

This section describes how to start and configure the AFR and the Analyzer.

First start

Removing fixture characteristics using the AFR plug-in involves following steps:

1. Describe the Test Fixture

   Provide general information about the test fixture and select a removal method. Recommendations for selecting the removal method can be found in this section.

2. Setup the VNA

   Configure the VNA for optimal fixture removal results. VNA settings are displayed and reviewed in this step.

3. Calibrate the VNA
   VNA calibration is essential for accurate fixture removal. VNA calibration status is displayed and reviewed in this step.

4. Measure Fixture Standards

   Connect each port of the fixture to the VNA and measure the calibration standards. The fixture removal correction is calculated and applied automatically to the VNA upon clicking the APPLY button in this step.

5. Save Correction Files and Setup (optional)

   If desired, save the correction files and AFR setup for future use.

Next start

If fixture measurements are previously performed in the AFR and there is a setup file, it can be loaded there by skipping the Analyzer setting, calibration and fixture description.

To load setup file click Recall setup... button on the describe fixture page.

After loading:

- Perform the VNA calibration (if it is out of date).

- Measure the standards (or load previously measured standard from Touchstone file).

- Click Apply button.

- Save correction files (if necessary).

Fixture removal correction is applied to the VNA automatically. Analyzer is ready for measurements.

Operating

The section describes how to operate the AFR.

Plugin Interface

After launching the plug-in, the plug-in window will be displayed on the PC screen (See figure below).
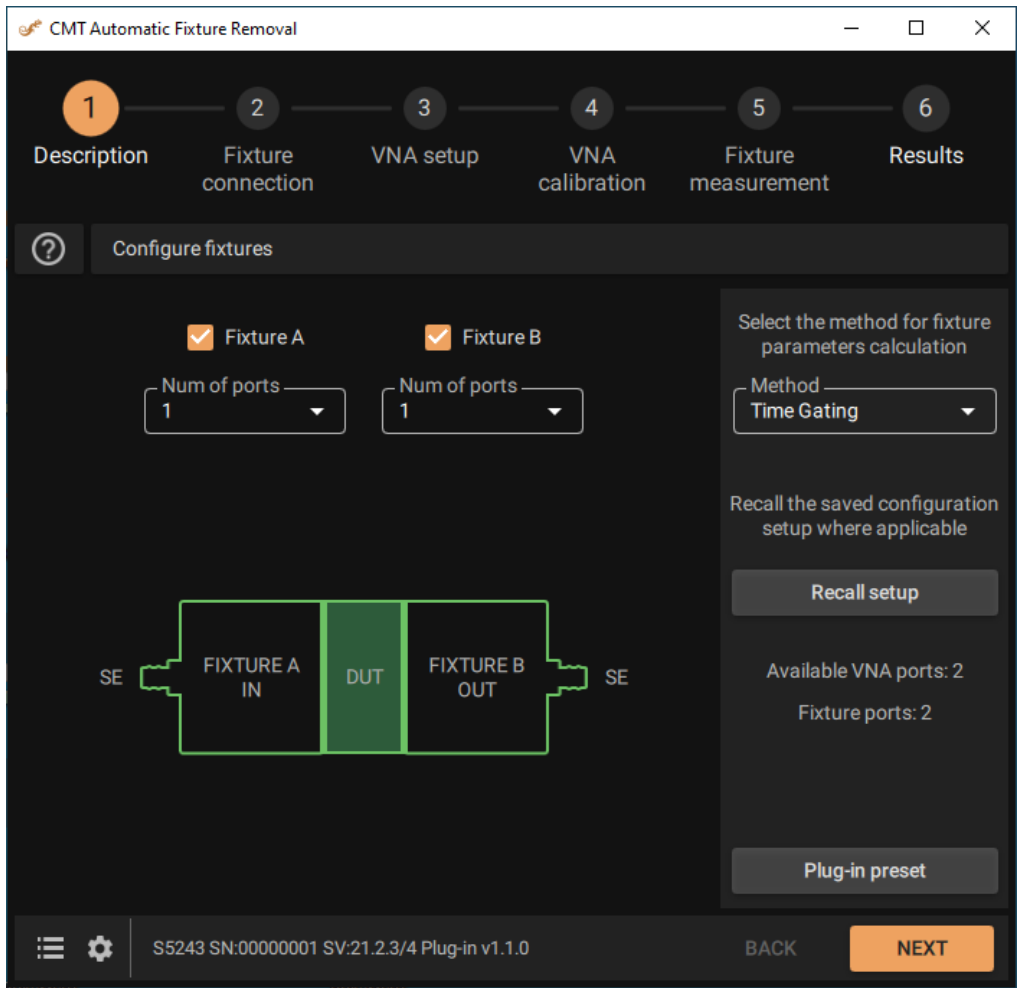
Plug-in window

Follow the step-by-step instructions to take measurements (See figure below).

Measurement steps

Moving through the measurement steps is performed by filling in the required step settings and clicking the **Next** button.

Moving to the next step without changing the preset data is performed by clicking the number of the required step or the **Next** button.

The measurement process, errors that occur when performing measurements and other information is displayed on the Notification Panel.

Description

The first step Description allows to select the configuration of the fixture with a DUT, as well as the correction method of calculating the fixture parameters (See figure below).

On this step, the following is to be confirmed:

- The selected configuration Fixture A – DUT – Fixture B corresponds to the actual DUT configuration.

- The Analyzer has enough ports for connection.

Also, make sure that the types of Analyzer test port connectors match the fixture connectors.

NOTE	The fixture is the device to which the DUT will be connected at the time of measurement.
	It is assumed that the user does not have a calibration kit to calibrate the Analyzer in the connection plane of the DUT.
	This version of the plug-in works only with Single Ended (non-differential) ports. This is shown in the figure as SE.
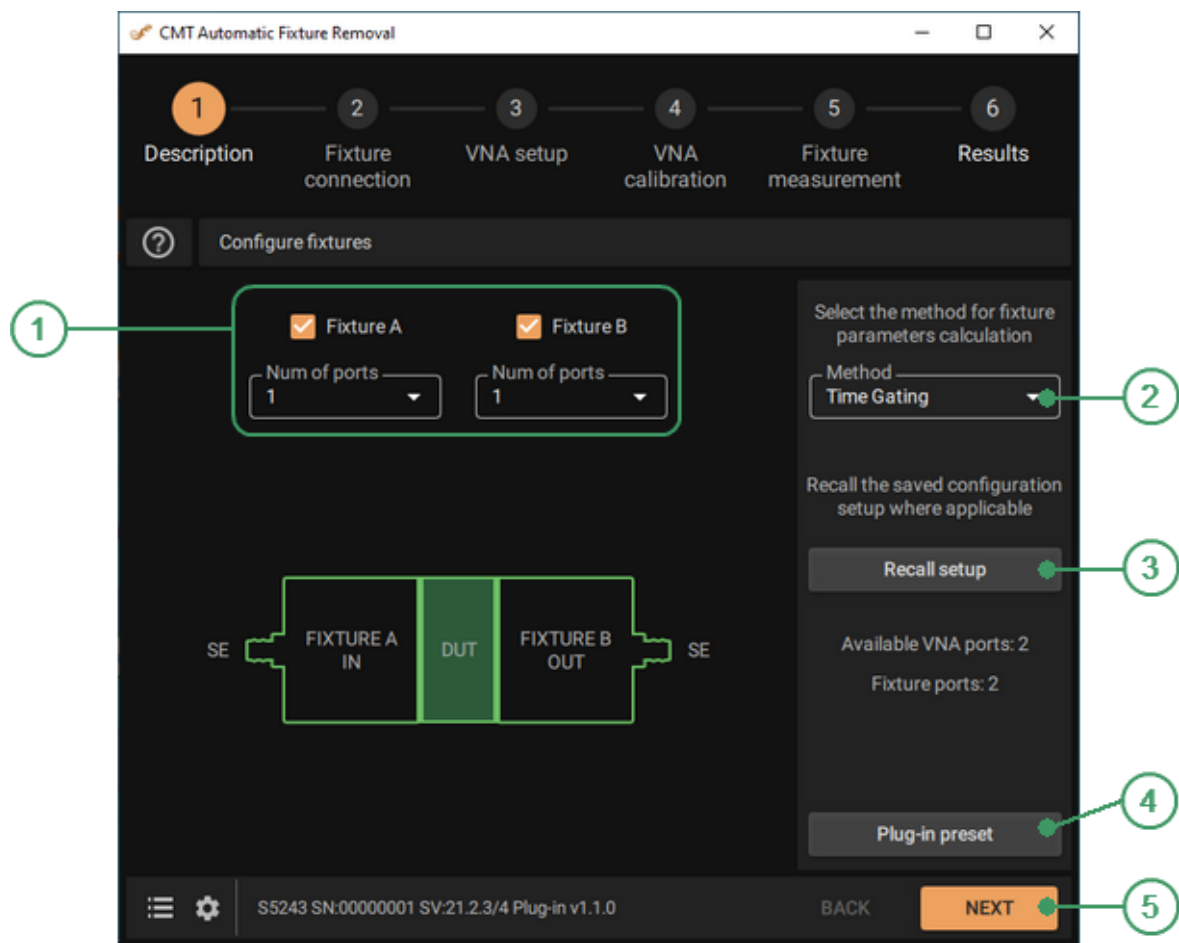
Description

---

① **Fixture A (B) Area**

Select the required number of Fixture A (B) port(s) from the list. If Fixture A (B) will not be used, it can be disabled.

---

② **Method Drop-down list**

Select the appropriate method for calculating fixture parameters from the list.

---

③ **Recall setup Button**

Click this button to load the previously saved configuration file with the *.STA extension. The next step is to perform fixture measurement on the Fixture measurement tab.

The configuration file describes the behavior of the controls in the Fixture description, Fixture connection, VNA setup and VNA calibration tabs, and contains:

- Analyzer settings.
- Calibration results.
- Plug-in settings on the listed tabs.

After loading the configuration file, all that remains is to measure the fixture parameters and immediately start measuring the DUT.

④ **Plug-in-preset Button**

Click this button to reset the plug-in.

CAUTION. The preset deletes all measured data without saving it and returns the plug-in to its initial state. The message about this will appear. The selected action must be confirmed.

⑤ **NEXT Button**

Click **Next** button to move to the next step.

WARNING	If the selected number of Fixture A and Fixture B ports exceeds the available number of Analyzer ports, the plug-in will report a warning. Ignoring this warning will result in incorrect measurement results for future measurements.
	The plug-in tracks errors related to incorrect actions or calculations. Remember that with a Critical error icon ⊙, the results obtained in the subsequent steps will be incorrect.
	Calculation errors, and status messages about saving and loading files, or about setting default plug-in parameters, are displayed in the Notification Panel.

Instruction

1. Check that the number of Analyzer ports is sufficient to connect the DUT in the fixture.

   Also, make sure that the types of Analyzer test port connectors match the fixture connectors.

2. Select the required number of Fixture A port(s) from the list. If Fixture A will not be used, it can be disabled.

3. Select the required number of Fixture B port(s) from the list. If Fixture B will not be used, it can be disabled.

4. Select the appropriate method for calculating fixture parameters from the list.

Correction Methods

The plug-in uses metrology grade de-embedding algorithms to eliminate fixture effects on a DUT.

CMT offers 2xThrough (transmission measurement) and 1xReflect (reflection measurement) fixture removal support with three methods that fit different fixture configurations (See table below).

Method	Description
Time gating	Ideal for fixtures having leading transmission lines with long electrical length or for higher frequency options. It supports both 2xThrough and 1xReflect. This method should be used when the electrical fixture length is greater than 4x the rise time. It is acceptable to have some impedance variations along the fixture length.
Filtering	The most accurate method in cases where signals passing through the fixture significantly overlap in time domain and are difficult to separate from each other. It supports both 2xThrough and 1xReflect. This method should be used when the electrical fixture length is greater than or close to 4x the rise time and there are no impedance variations along the fixture length.
Bisection (Split in Half)	Method can be used when the fixture has leading transmission lines with short electrical length and inadequate time domain resolution. This is the most basic method. It does not perform processing in time domain. Bisection method supports 2xThrough only.

A description of the application of the methods is given in the table below.

Description or Case	Time Gating	Filtering	Bisect (Split in Half)
Description			
Calculation base	Time Domain	Time-Frequency Model	Frequency Domain
Principle	Traditional Time Domain Gating	LMS Joint Estimation Algorithm	Advanced Solver of Nonlinear Equations System
Filtering properties	YES	YES	NO
It is recommended to use			
Electrical fixture length more than 4 x Rise Time	+	+	—
Electrical fixture length less than 4 x Rise Time	—	—	+
Electrical fixture length close to 4 x Rise Time	—	+	+
There are some impedance variations along fixture length	+	—	NC
There are no impedance variations along fixture length	—	+	NC

Rise time is $\cong 0.8/Fmax$, where *Fmax* — maximum frequency range of the analyzer during measurement. NC — not considered.

Time-Gating

Time-Gating method uses a conventional time domain gating algorithm, which implies the definition and extraction of fixture parameters separated by distance or time.

In order for this method to work, the appropriate resolution should be provided in the time domain. This resolution depends on the maximum VNA frequency and electrical length of the fixture. Different examples of signal separation are presented in the sections covering 2xThrough and 1xReflect.

NOTE	It is recommended to choose fixture that has its electrical length more than 4xRise Time of VNA.
	For determination of time gate points related with the beginning, middle or the end of fixture(s), impulse responses analysis is performed in auto mode.
	To reduce the side lobes of the impulse response of measured data and achieve max available resolution in the time domain, gating procedure with appropriate shifting, and adjusting phase at the end of frequency range are performed. Also we apply windowing functions to smooth the sharpness of the original response.
	Time domain gating supports 2xThrough and 1xReflect methods for fixtures parameters definition and further de-embedding them.

Filtering

Filtering method is a modified time domain gating algorithm. It is able to filter all required signals strictly according to the signal flow graph representation of a fixture, connected to a VNA. Filtering procedure is conducted at the same time for all parameters, rather than sequentially over time for each of them (i.e., the estimations of fixture parameters depend on each other).

Differences between filtering and time domain gating

Difference	Filtering	Traditional time domain gating algorithm
Calculation base	Time - Frequency model	Time domain
Basic algorithm	Least mean squares	Fourier transform
Interpolation function	Cubic spline	Harmonic function
Estimations	Dependent (all together)	Independent

The filtering approach utilizes an LMS joint estimation algorithm to determine fixture parameters in accordance with a time-frequency model. Below there is an example for a THRU connection of a fixture.
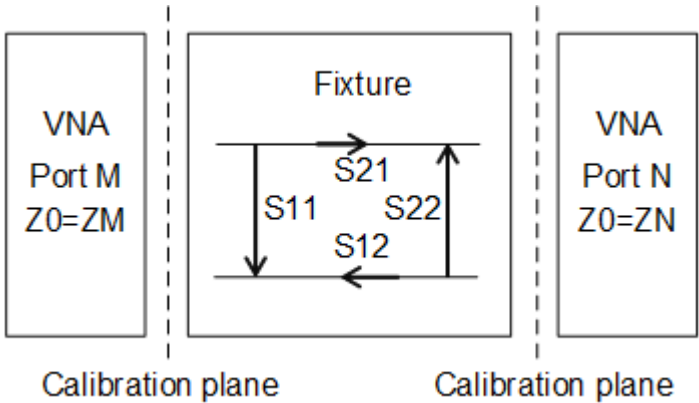
Fixture (THRU connection) Measurement by Using a Calibrated VNA in the Forward Direction

VNA Residual Parameters According to the 12 (10) Term Error Model
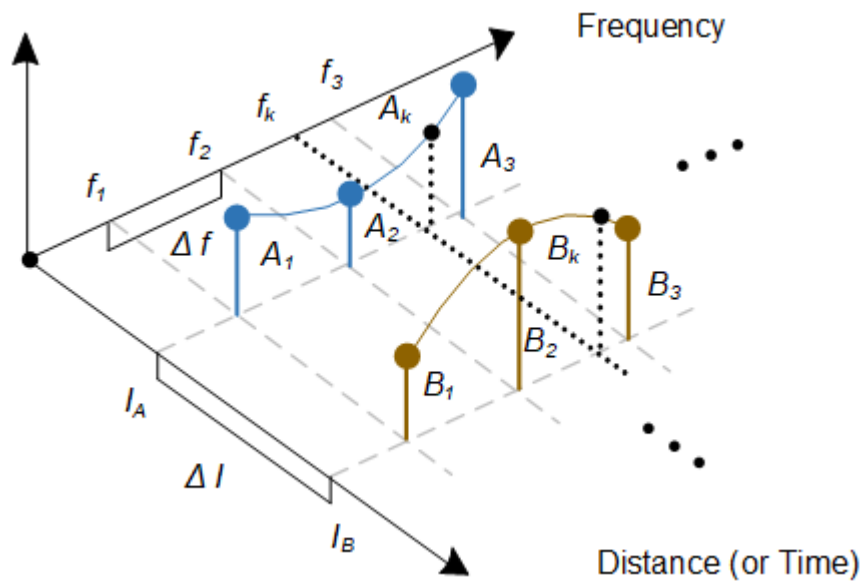
Time - Frequency model. Reflection measurement of the THRU connection: A and B – input and output reflections of a fixture, connected between calibrated VNA ports, separated by a distance (or time).

Measurement result M:

$$M_k = A_k \cdot e^{-j2\pi f_k TA} + B_k \cdot e^{-j2\pi f_k TB}$$

where T – time delays.

The model is described by a set of so-called reflectors. Each reflector has:

- **Known** time delays, i.e. known reflectors' positions in the time domain.
- **Unknown** frequency characteristics.
- **Set of Reference Samples** in the time-frequency plane.

The set of samples and cubic splines are used to interpolate the frequency characteristics of the reflectors.

Joint estimation of fixture parameters, obtained during reflection measurements, allows this method to separate different parts of the fixture even when signals (side lobes of impulse responses of these reflectors) according to the flow graph overlap in the time domain significantly. In other words, this algorithm potentially has a better resolution for separating signals (propagating inside the fixture) than the traditional time gating method.

Filtering supports 2xThrough and 1xReflect methods for fixture parameter definition and de-embedding.

NOTE	Quality of this method is defined by quality of fixture lines. In case if there are some impedance variations along fixture length, this method will degrade the accuracy. It is assumed that lines between reflectors will be quite homogeneous, and we may consider that we know where the points of reflectors are.

Bisection (Split in Half)

Improved bisect de-embedding for Analyzer measurements or simply Bisect. This method splits a set of measured S-parameters of a reciprocal fixture that has S21 $\cong$ S12 and S11 ≠ S22 into two halves. To perform this splitting, only frequency domain data is used. Bisect allows de-embedding when the electrical length of the fixture is not enough to provide appropriate time domain resolution, and the use of time-based methods, such as Time-Gating or Filtering, is not possible. This method does not possess the filtering property and is not able to separate different signals along fixture length.

NOTE	In order to achieve suitable measurement results by using the Bisect method, the fixture should have a sufficiently low reflection level. The recommended level is no higher than -20 dB over the desired frequency range.
	It is assumed that the VNA will have an impedance Z0 at each port.
	The bisect method works only with 2xThrough measurements (where fixture A and B are connected to each other). It does not support 1xReflect technique.
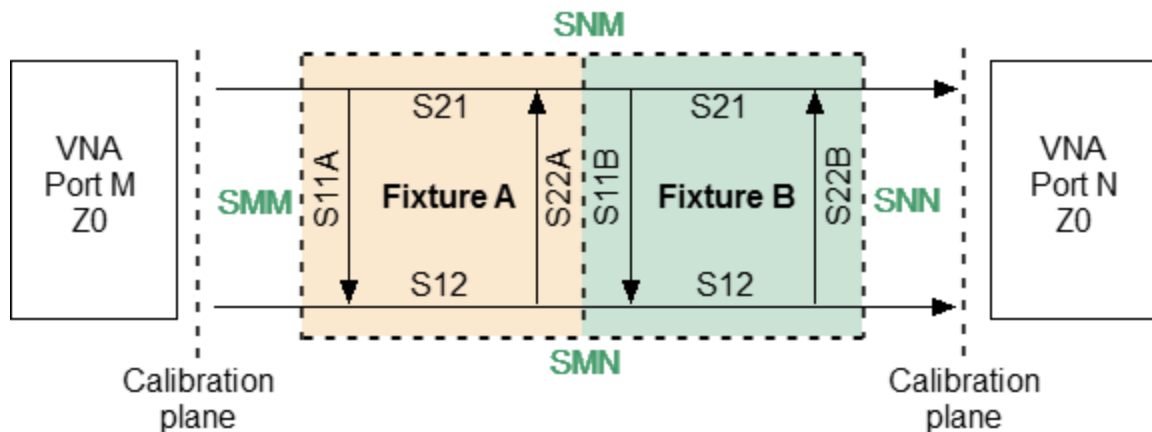
Signal Flow Graph for Demonstration of S-parameters Assignment for Each Fixture

System of Equations for Finding S-parameters of Each Fixture:

$$
\begin{cases}
SMM_{MEAS} = S11A + \dfrac{S11B \cdot S21^2}{1 - S11B \cdot S22A} \\[3em]
SNN_{MEAS} = S22B + \dfrac{S22A \cdot S21^2}{1 - S11B \cdot S22A} \\[3em]
\dfrac{SNM_{MEAS} + SMN_{MEAS}}{2} = \dfrac{S21^2}{1 - S11B \cdot S22A}
\end{cases}
$$

Fixture connection

The second step Fixture connection allows to select measurement patterns, as well as assigning ports between the Analyzer and the fixture (See figure below).

The selected configurations will be measured in the Fixture measurement tab. The number of measurement steps will correspond to the number of configurations.

WARNING	The plug-in tracks errors related to incorrect actions or calculations. Remember that with a Critical error � the results obtained in the subsequent steps will be incorrect.
	Calculation errors and status messages about saving and loading files, or about setting default plug-in parameters, are displayed in the Notification Panel.
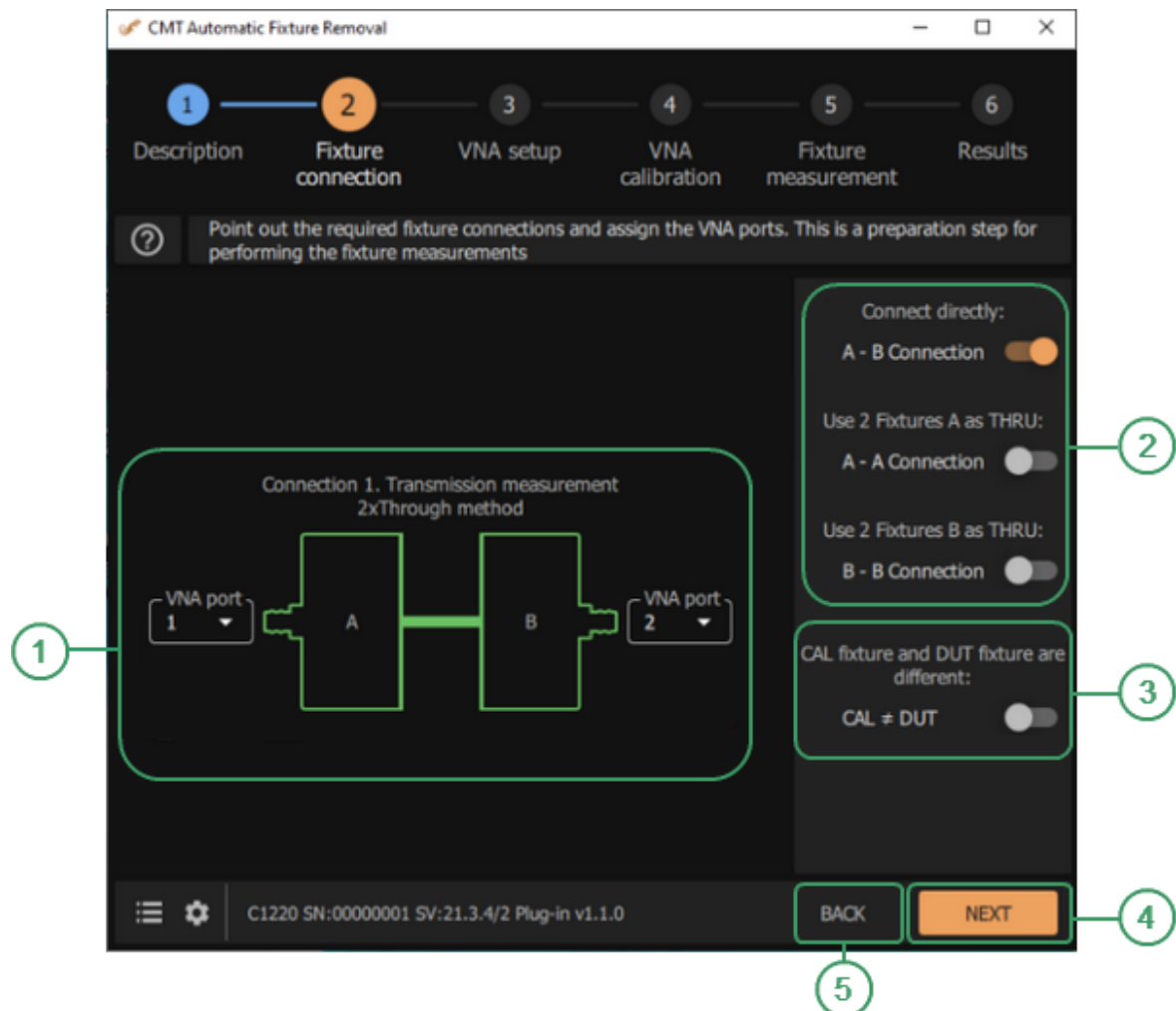
Fixture connection

① **Analyzer Ports Area**

Select the Analyzer port from the drop-down list.

② **Connection Checkboxes**

Select the appropriate measurement configuration: A-B, A-A, or B-B.

③ **CAL ≠ DUT Checkbox**

Use the CAL ≠ DUT mode if the DUT is installed in a fixture or is structurally implemented in a fixture where there is no possibility to remove it.

CAUTION. The CAL ≠ DUT mode is available only when the time gating method is selected.

④ **NEXT Button**

Click this button to move to the next step.

⑤ **BACK Button**

Click this button to return to the previous step.

Instruction

1. Use options A-B, A-A, or B-B to select the appropriate measurement configuration. The plug-in will automatically display the selected configuration on the screen. The ON state for the configuration corresponds to 2xThrough, and the OFF state to 1xReflect.

The A-B configuration is used when using fixtures close in topology and length, located along the input and output of the DUT.

The A-A configuration is used if there are two identical input fixtures A that can be connected to each other. The auxiliary fixture is shown in the A Aux figure.

The B-B configuration is used if there are two identical output fixtures B that can be connected to each other. The auxiliary fixture is shown in the B Aux figure.

The A-A and B-B configurations allow thru measurement, if fixture A and B are fundamentally different.

If a THRU connection is not possible, the fixture parameters will be determined by 1xReflect, i.e. in open or short circuit mode.

2. The plug-in offers to use the CAL ≠ DUT mode if the DUT is installed in a fixture or is structurally implemented in a fixture where there is no possibility to remove it. In this case, two measurements are taken: (1) the calibration

fixture without the DUT and (2) the test fixture with the DUT installed. These two fixtures should be identical. The joint processing of measurements will allow to obtain more reliable parameters of the investigated fixture without disconnecting the DUT. Note that if the calibration and test fixtures differ, especially in length, then the result of joint measurements will be invalid. The results, in graphical form, can be viewed in Fixture measurement / Edit characterization.

The CAL ≠ DUT mode is available only when the time gating method is selected.
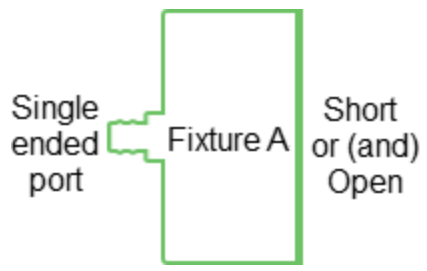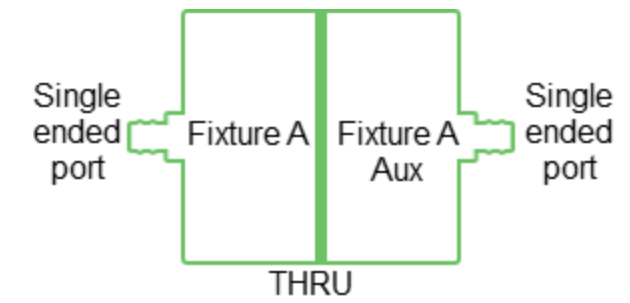
3. After selecting a measurement configuration, assign the Analyzer ports. Select the Analyzer port from the drop-down list.
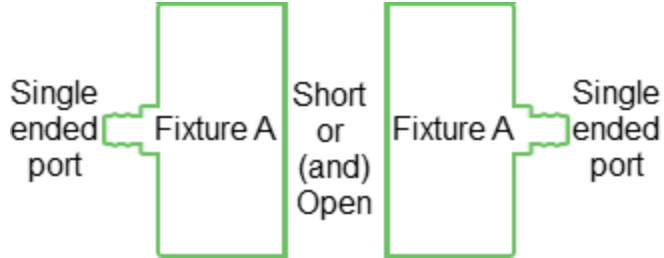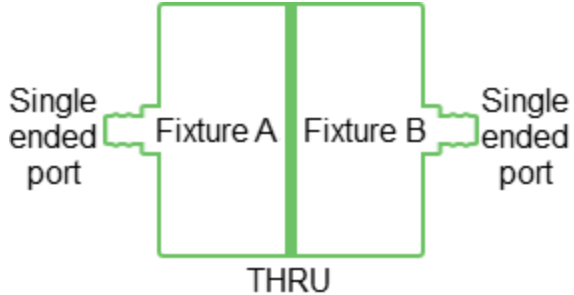
Configurations
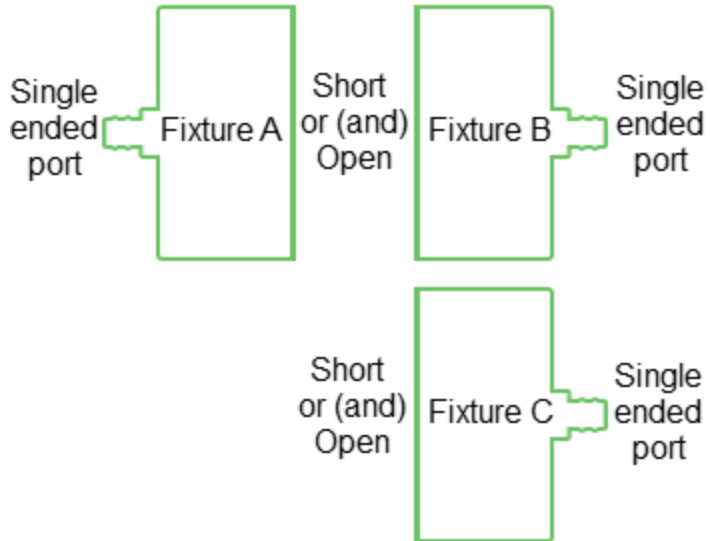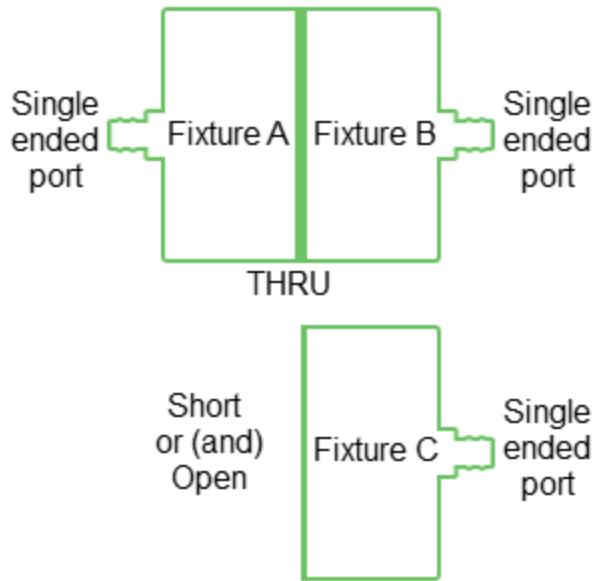
The following sections describe the types of fixture inputs.
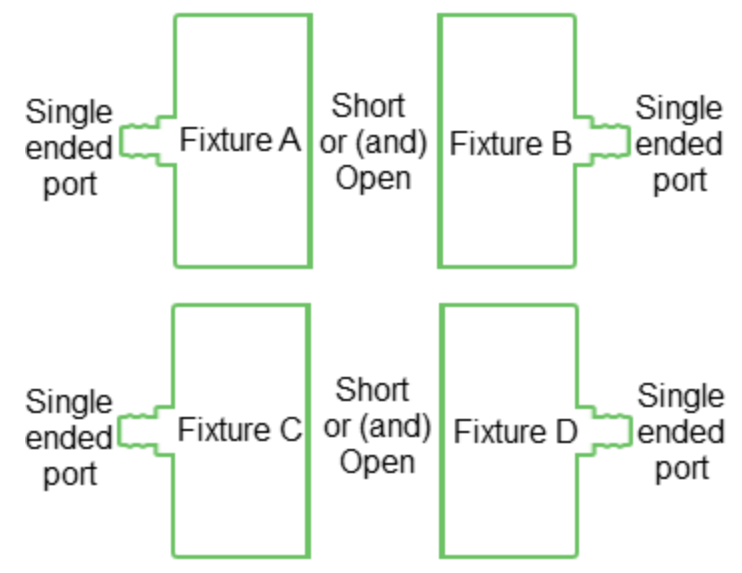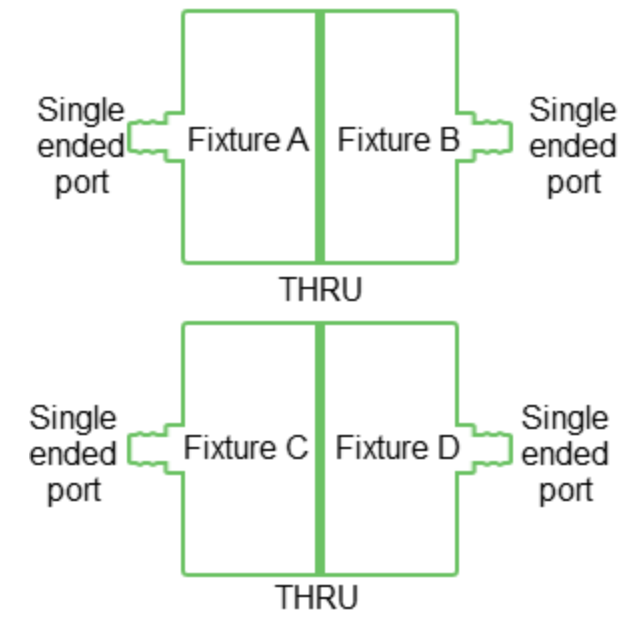
Single Ended

Fixtures having 1, 2, 3 or 4 single ended ports.

Reflection	Transmission
1X Reflect, Open or (and) Short Measurement	2XThrough, Thru Measurement
Single Ended 1-Port Fixture	
	  NOTE. If there are two identical fixtures, then they can be connected together.
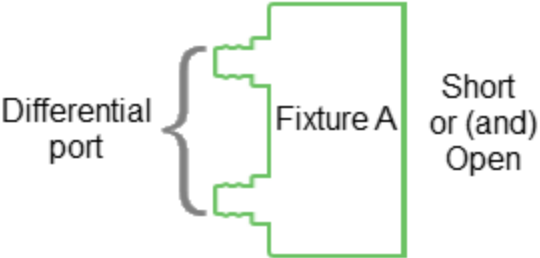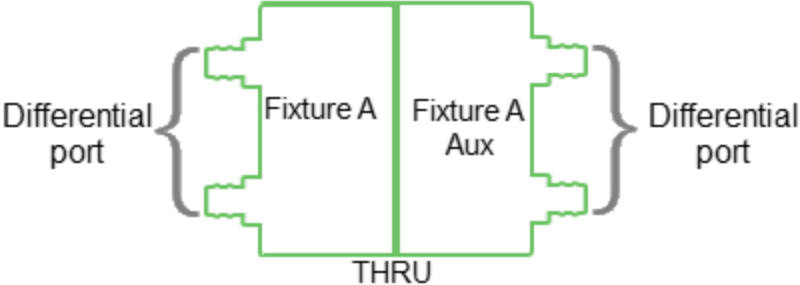
Reflection	Transmission
Single Ended 2-Port Fixture	

Reflection:
Single ended port — Fixture A — Short or (and) Open — Fixture A — Single ended port

Transmission:
Single ended port — Fixture A | Fixture B — Single ended port
THRU
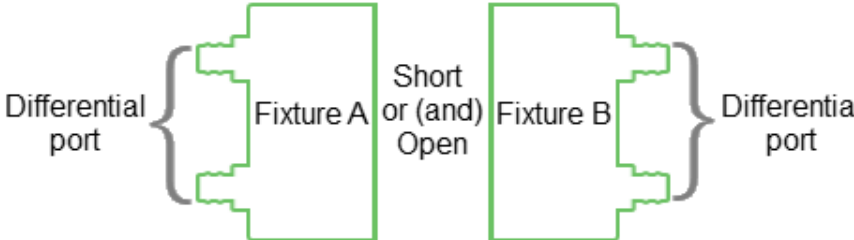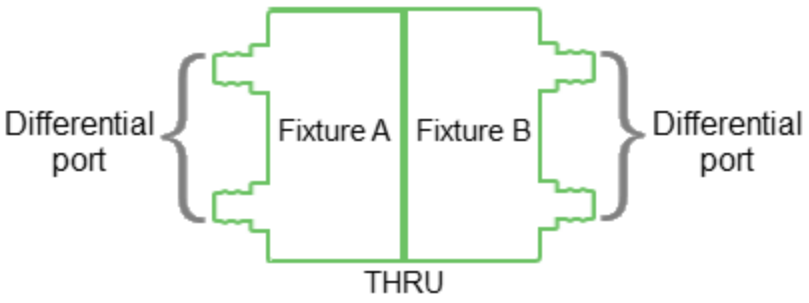
Reflection	Transmission
Single Ended 3-Port Fixture	

NOTE. Transmission can be measured between any two pairs of fixtures.

Reflection	Transmission
Single Ended 4-Port Fixture	
Single ended port — Fixture A — Short or (and) Open — Fixture B — Single ended port Single ended port — Fixture C — Short or (and) Open — Fixture D — Single ended port	Single ended port — Fixture A | Fixture B — Single ended port THRU Single ended port — Fixture C | Fixture D — Single ended port THRU NOTE. Transmission can be measured between any two pairs of fixtures.

Differential

Fixtures having 1 or 2 differential ports.

Reflection	Transmission
1X Reflect, Open or (and) Short Measurement	2XThrough,Thru Measurement
Differential 1-Port Fixture	

NOTE. If there are two identical fixtures, then they can be connected together.

Reflection	Transmission
Differential 2-Port Fixture	

VNA setup

The VNA setup allows to set the parameters of the Analyzer and select the impedance value, relative to which the S-parameters of the fixture will be calculated.

CAUTION	The impedance calculation and conversion functions are available only in low pass mode. Use this mode in all cases when it is possible to set a frequency grid in which the start frequency and step frequency are equal to each other.

The current mode is displayed at the top of the plug-in:

- Band pass mode Fstart ≠ Fstep.

- Low pass mode Fstart = Fstep. This makes impedance calculation and conversion functions available. It has better frequency resolution, which contributes to a better time gating method.

Measure the fixture in the widest possible frequency range regardless of the measurement range of the DUT. The results of the fixture parameters calculation are saved to a file and can be interpolated to any narrower frequency range without loss of accuracy.

WARNING	The plug-in tracks errors related to incorrect actions or calculations. Remember that with a Critical error icon ⊘, the results obtained in the subsequent steps will be incorrect.
	Calculation errors and status messages about saving and loading files, or about setting default plug-in parameters, are displayed in the Notification Panel.
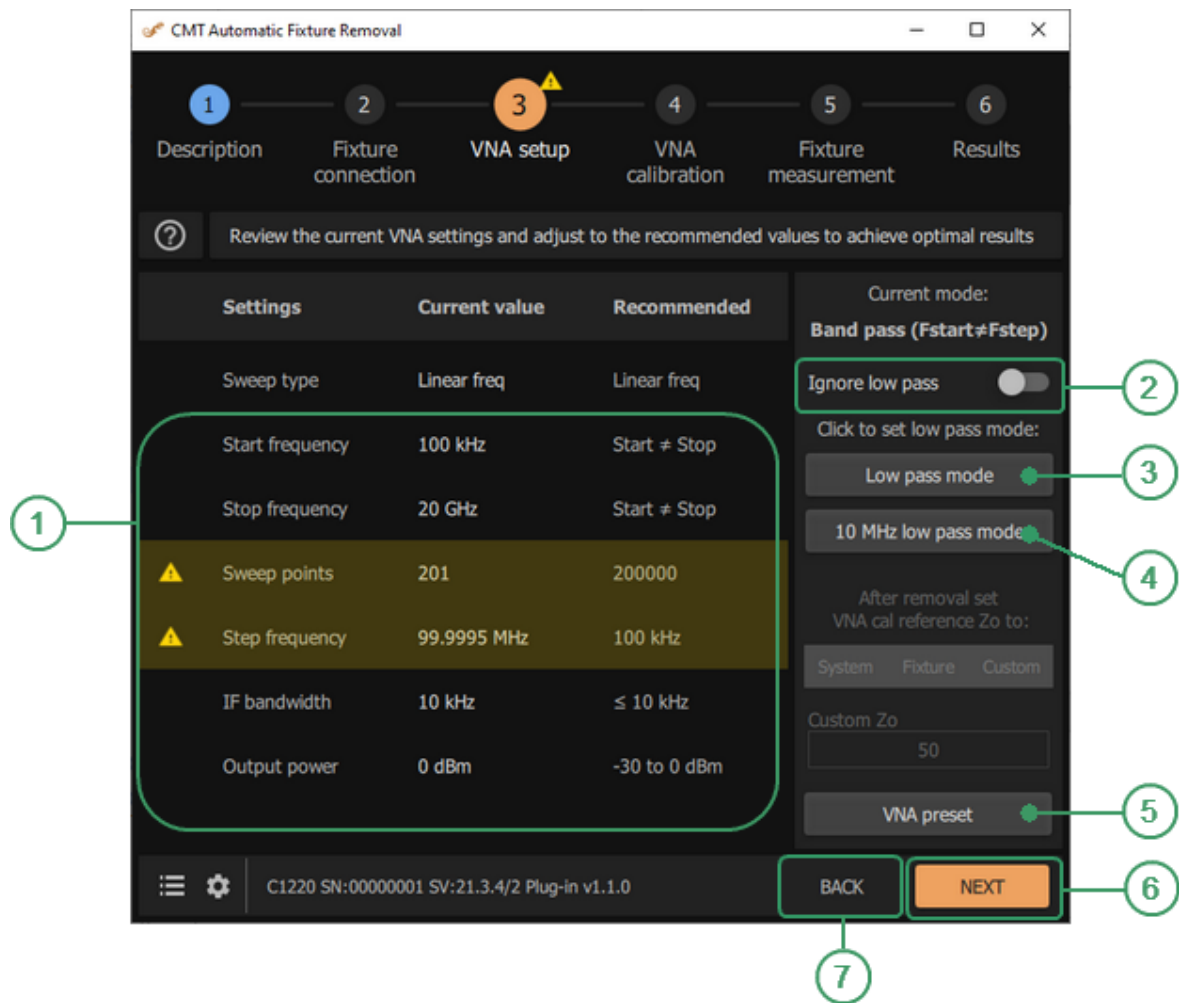
VNA setup

---

① **Analyzer Parameters**

Set the Analyzer parameters:

- Start and stop frequencies, as well as the number of points.
- IF bandwidth.
- Output power level value.
- Impedance conversion parameters (if necessary).

---

② **Ignore low pass Checkbox**

Check this checkbox to ignore the recommended frequency grid.

---

③ **Low pass mode Button**

Click this button to set Fstart = Fstep, changing the start frequency and keeping the number of points unchanged.

④ **10 MHz low pass mode Button**

Click this button to set Fstart = Fstep = 10 MHz and the maximum stop frequency.

⑤ **VNA preset Button**

This button to set the default Analyzer parameters.

⑥ **NEXT Button**

Click this button to continue to the next step.

⑦ **BACK Button**

Click this button to return to the previous step.

Instruction

1. Set the Analyzer parameters.

CAUTION	The calculation of the fixture parameters is performed only with linear frequency sweep (uniform distribution of points in the frequency range).

Click **VNA preset** button to set the default Analyzer parameters.

To quickly set the frequency grid corresponding to low pass mode, the plug-in has two buttons: **Low pass mode** and **10 MHz low pass mode**:

The **Low pass mode** button – sets Fstart = Fstep, changing the start frequency and keeping the number of points unchanged.

The **10 MHz low pass mode** button – sets Fstart = Fstep = 10 MHz and the maximum stop frequency.

CAUTION	To ignore the recommended frequency grid check and not perform an impedance conversion, turn ON **Ignore low pass** toggle button.

Manual input of Analyzer parameters:

- Enter values of frequency-dependent parameters: start and stop frequencies, as well as the number of points. The step is calculated automatically.

WARNING	Setting the number of points to more than 20,000 significantly decreases the speed of measurements and calculations.

- Enter a value for the IF bandwidth. The choice of IF bandwidth is a compromise between the speed of measurement and the dynamics of S-parameter measurements. Wider bandwidth means higher speed, but less dynamics, i.e. less sensitivity of the Analyzer's receivers. In most cases, the bandwidth is chosen in the range of 1 to 10 kHz.

- Enter the output power level value. Do not exceed 0 dBm. This can lead to compression of the Analyzer's receivers and distortion of measurement results. At a low power level, the result may be too noisy. This will affect the quality of all correction methods implemented in the plug-in.

CAUTION	Entering values other than the recommended ones results in an error message notification with an explanation of how to correct or change the parameter. The recommended values are indicated in the «Recommended» column. In most cases they are optional – their purpose is to facilitate the process of setting the Analyzer parameters.

2. If necessary, select the impedance conversion parameters.

The impedance calculation and conversion functions are only available in low pass mode.

The plug-in is used to determine the parameters of the fixture and exclude its influence on the measurement result of the DUT, i.e. the plug-in is designed to shift the calibration plane of the Analyzer through the fixture directly to the device.

Depending on the fixture design, the characteristic impedance of its transmission lines may differ from the system impedance of the Analyzer. This means that without impedance conversion, the subsequently measured S-parameters of the device will be determined relative to the fixture impedance. If the impedance of the fixture and the Analyzer are significantly different, the S-parameters of the device will be offset.

The plug-in evaluates the impedance of the fixture's transmission lines and allows to adjust its S-parameters so as to get the S-parameters of the device within the required impedance value.

The results of the impedance calculations along the length of the fixture can be viewed using Fixture measurement / Edit characterization.

Possible conversion options. The plug-in determines the fixture impedance and converts its calculated S-parameters relative to:

- System Analyzer impedance.

- The fixture impedance.

- Arbitrary impedance value.

After the conversion, the system impedance of the Analyzer is set to the selected value. In this case, the Analyzer, the loadable S-parameters of the fixture, and the S-parameters of the DUT will be linked to the same impedance value.

VNA calibration

The VNA calibration provides recommendations on how to calibrate the Analyzer, leading to reliable measurement results for the selected Fixture connection configurations.

An N-port calibration of the Analyzer's active channel is required for fixture measurements. Calibration is performed in the Analyzer's software. The necessary information about the current calibration is tabulated on this tab.

The Calibrated ports line shows which ports are to be calibrated. The number of ports determines the type of N-port calibration required. The data for filling Calibrated ports is linked to the assigned ports in the Fixture connection, i.e. to the selected fixture measurement configurations.

CAUTION	Interpolation or extrapolation of calibration data is not allowed. This means that calibration must be performed at the frequencies corresponding to those set in VNA setup.

WARNING	The plug-in tracks errors related to incorrect actions or calculations. Remember that with a Critical error icon , the results obtained in the subsequent steps will be incorrect.
	Calculation errors and status messages about saving and loading files, or about setting default plug-in parameters, are displayed in the Notification Panel.
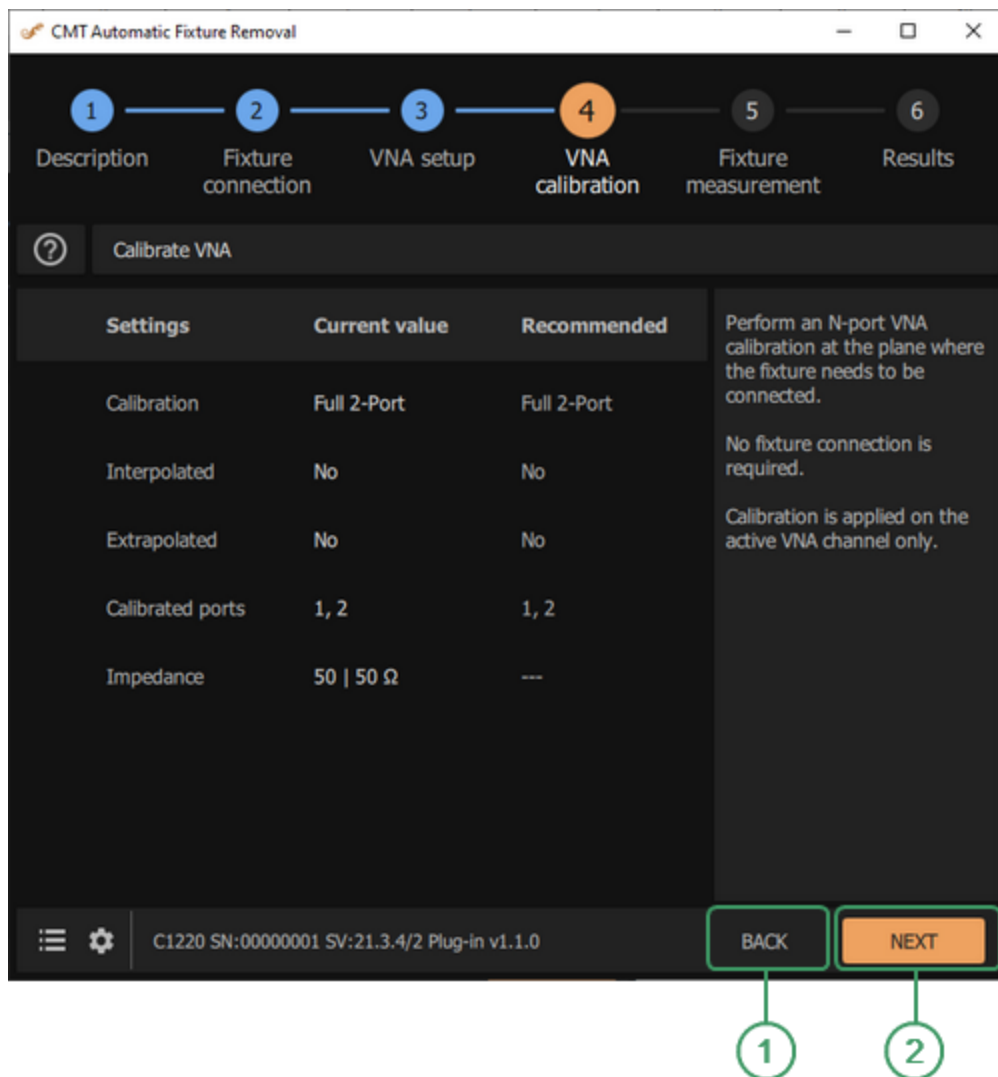
VNA calibration

---

① **BACK Button**

Click this button to return to the previous step.

---

② **NEXT Button**

Click this button to continue to the next step.

Instruction

1. Connect RF cables to the ports listed in the plug-in. The fixture does not need to be connected.

2. Go to the Analyzer software and perform an N-port calibration. Refer to the Analyzer operating manual for calibration procedures. A calibration kit, either

mechanical or automated, with the appropriate types of connectors, is required to perform the calibration.

3. Return to the plug-in, check for errors, and verify that the port impedances match the required values. If there are no errors, move to the Fixture measurements tab.

4. Do not change the cables after calibration. Cables should be bent as little as possible at the time of calibration.

Calibration Setup

The following sections describe how to setup the various types of calibration.

Two-Port Calibration Setup

Full two-port calibration combines two one-port calibrations for each test port with measurement of transmission and reflection of a THRU standard in both directions. You can also calibrate using an automatic calibration module (ACM).

The figures below show calibration using ports 1 and 2 as an example.
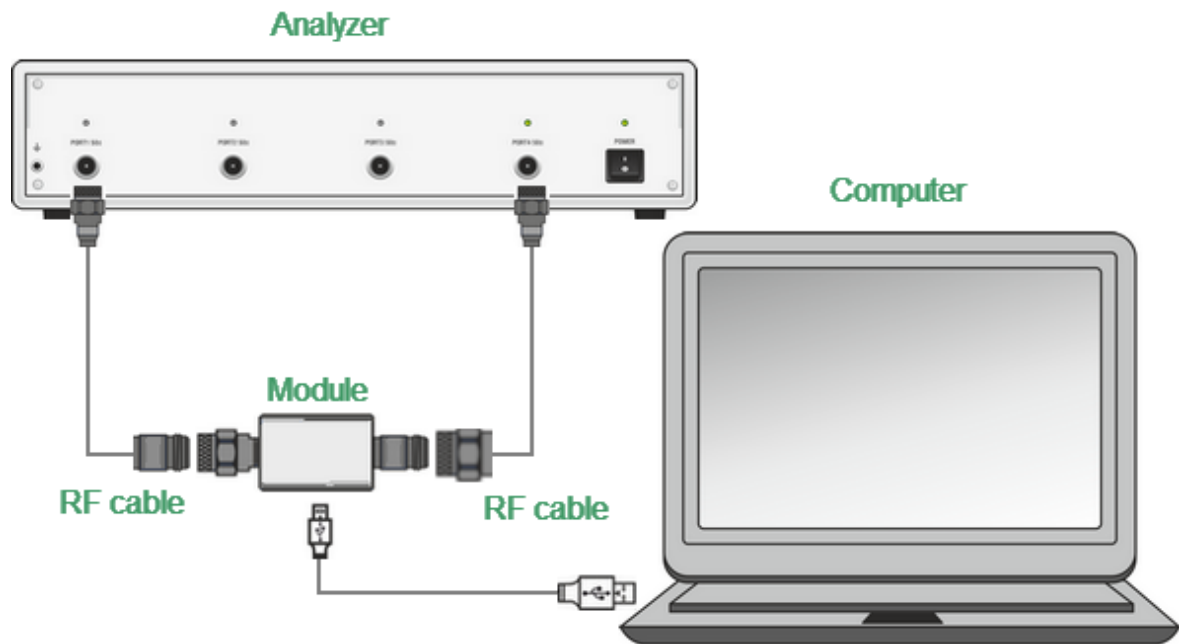
Full Two-Port Calibration with Automatic Calibration Module (ACM)
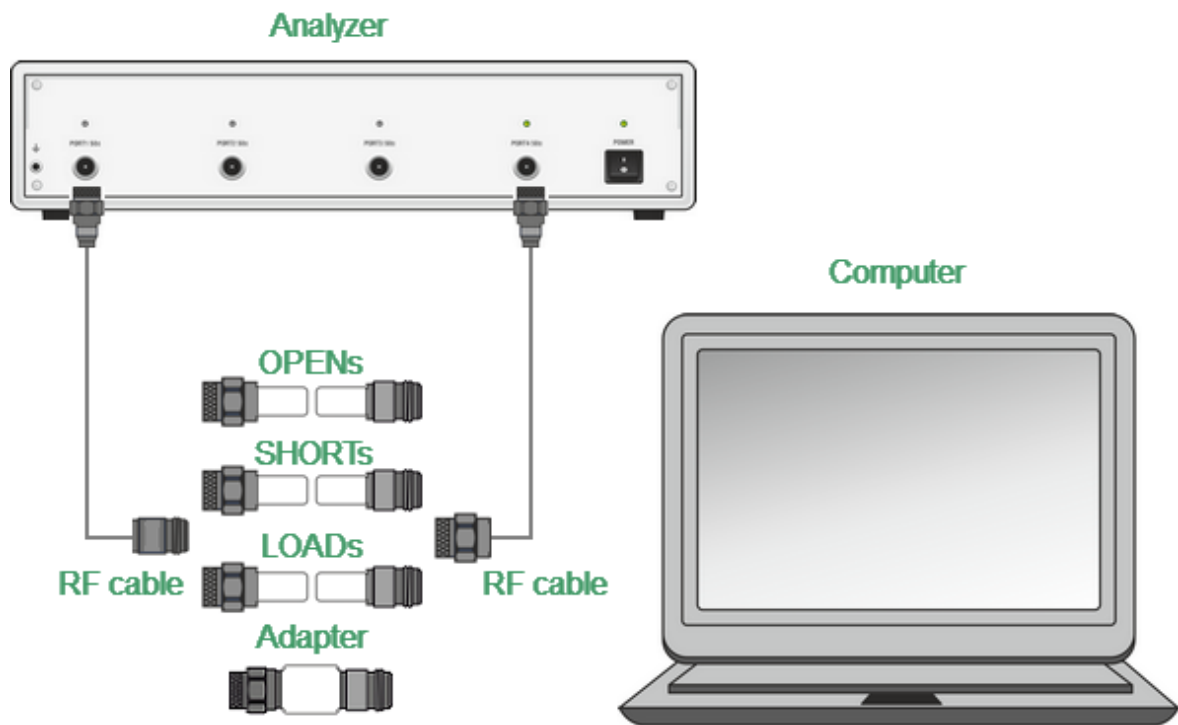
Full Two-Port Calibration with Mechanical Calibration Kit

Three-Port Calibration Setup

Full three-port calibration combines three full one-port calibrations for each port, and THRU connections for each test port pair, which provides three transmission measurements. One of the three THRU measurements may be omitted. You can also calibrate using an automatic calibration module (ACM).

The figures below show calibration using ports 1, 2 and 3 as an example.

Full Three-Port Calibration with Automatic Calibration Module (ACM)

Full Three-Port Calibration with Mechanical Calibration Kit

Four-Port Calibration Setup

Full four-port calibration combines four full one-port calibrations for each port, and THRU connections for each test port pair, which provides six transmission measurements. Three of the six THRU measurements may be omitted. You can also calibrate using an automatic calibration module (ACM).
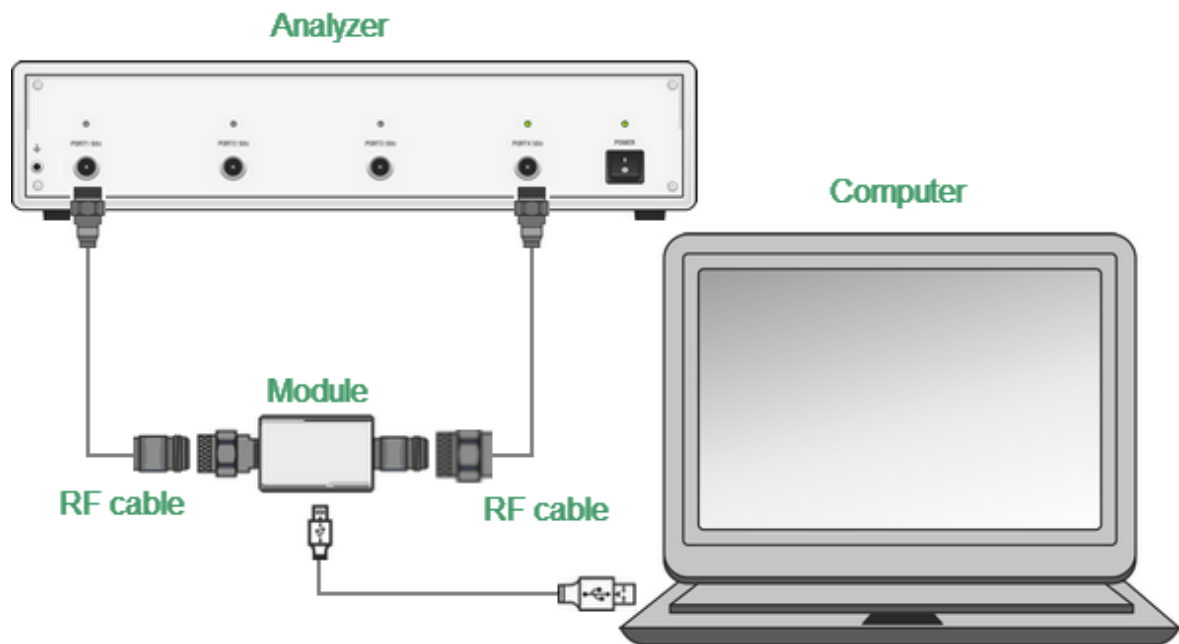
Full Four-Port Calibration with Automatic Calibration Module (ACM)
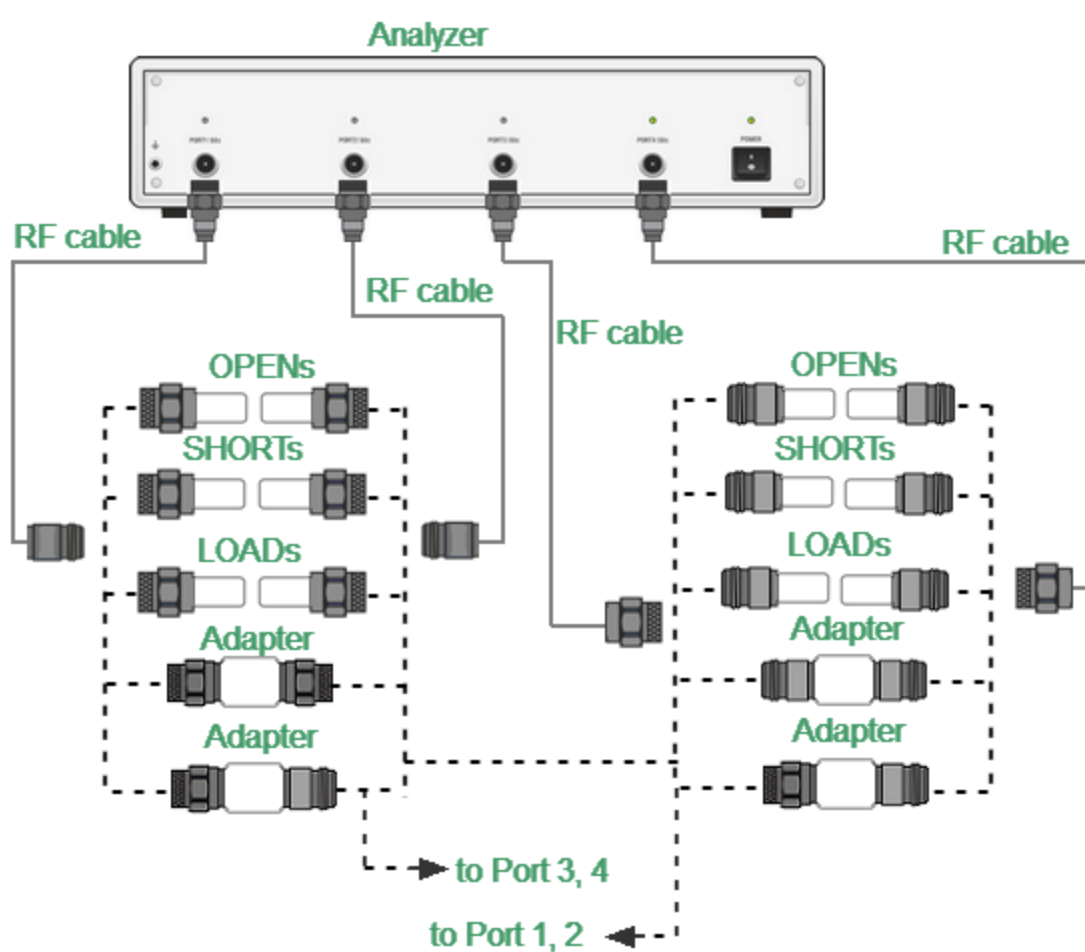
Full Four-Port Calibration with Mechanical Calibration Kit

Fixture measurement

Fixture measurement guides fixture measurement and calculation of its S-parameters.

The calculated S-parameters will be loaded into the analyzer as *.S2P files. One Analyzer port equals one fixture description file. Note that parameters of the fixture marked Aux are not sent to the Analyzer software.

The number of measurement steps will correspond to the number of configurations selected in Fixture connection.

Go through the plug-in measurement steps sequentially.

There are two methods for determining fixture parameters:

- 1xReflect. Full reflection of the fixture at the connection point of the DUT. Reflection in open and/or short circuit mode.

- 2xThrough. Thru measurement of two connected fixtures.

WARNING	The plug-in tracks errors related to incorrect actions or calculations. Remember that with a Critical error icon , the results obtained in the subsequent steps will be incorrect.
	Calculation errors and status messages about saving and loading files, or about setting default plug-in parameters, are displayed in the Notification Panel.
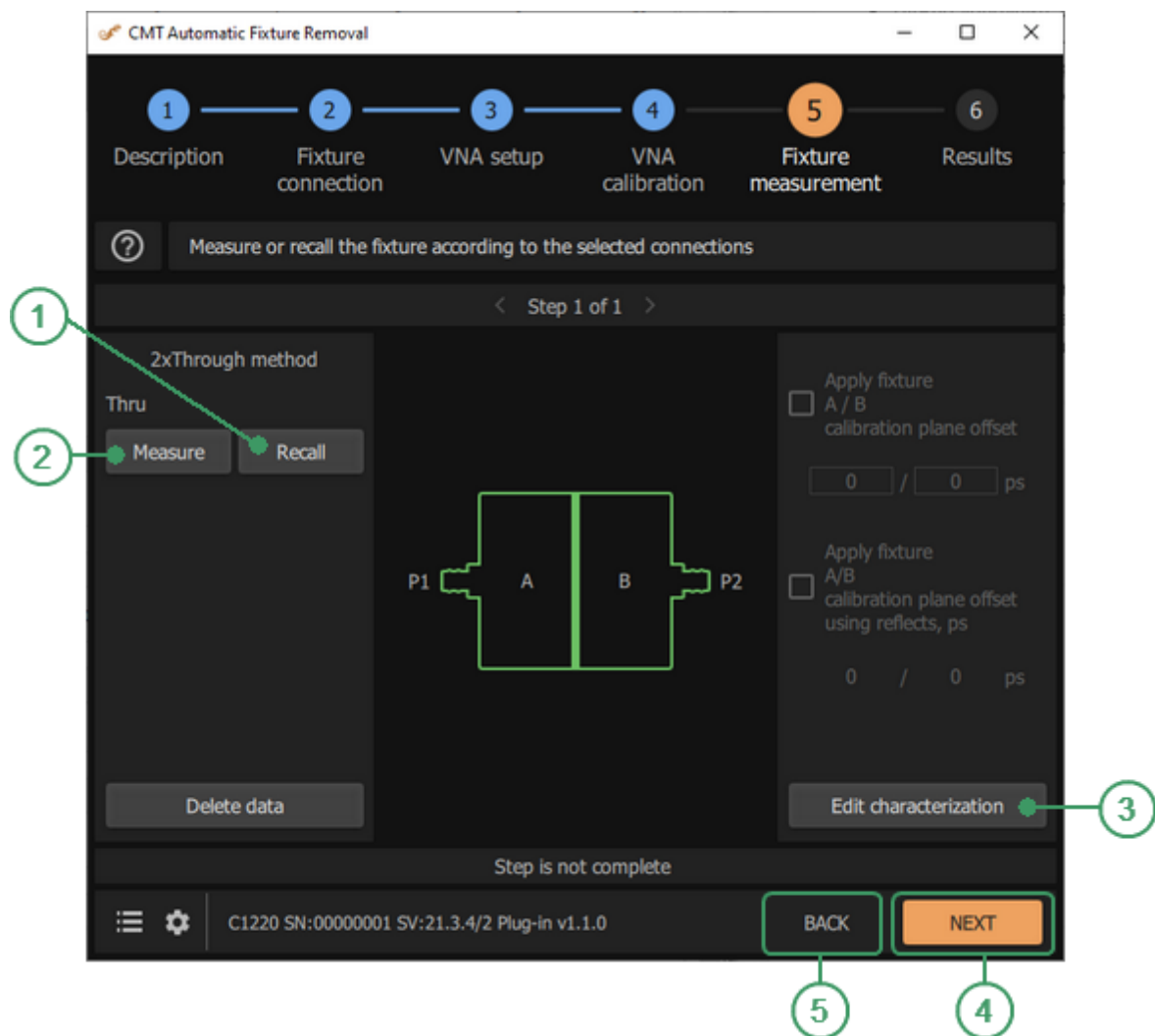
Fixture measurement

---

① **Recall Button**

Click this button to load previously measured standard data from a Touchstone file (*.SNP).

---

② **Measure Button**

Click this button to perform measurements.

---

③ **Edit characterization Button**

Click this button to view plots of the results.

CAUTION   Also see possible Messages.

Instruction

Procedure for 2xThrough

- Connect the fixtures that have two identical halves connected to each other to the calibrated Analyzer.

The plug-in displays the Analyzer ports for fixture connection, as well as the status of the current calibration.

- Click **Measure** button to take measurements or click **Recall** button to load a file and calculate from previously saved data.

The S-parameters of the fixture, the frequency grid, and the impedance value at which the data were obtained are read from the file. Here, the S-parameters of the fixture are the parameters measured on the calibrated Analyzer without performing additional calculations. These are the raw parameters. The calculations are performed using the frequency grid from the file. If the frequency grid does not match the current parameters, the data will be interpolated when further loaded into the Analyzer.

After the calculation, the plug-in displays key information on the screen: Analyzer port number, Analyzer system impedance, fixture electrical length, fixture impedance (low pass mode), together with the impedance selected for conversion.

The results of the fixture calculation can be viewed by clicking **Edit characterization** button.

To delete the measured data, click on the **Delete data** button.

2xThrough – returns the S-parameters of two fixtures with the same transmission coefficients and different reflection coefficients. The parity of the transmission coefficients shows that after applying the calculation results, the Analyzer calibration plane will pass exactly in the middle of the two connected fixtures. If necessary, the plug-in allows for adjustment of the electrical length of each of them. Two options are provided for this: (1) manual input of the offset or (2)

automatic determination of the offset using the result of the reflection coefficient measurements of each fixture in open and/or short circuit mode. To perform measurements according to option (2), the fixture must be disconnected. Normally, the offset range is 0 to 10 ps.

Procedure for 1xReflect

- Connect the fixture to the calibration Analyzer.

The plug-in displays the Analyzer ports for fixture connection, as well as the status of the current calibration.

- Select the fixture state. The available options are: (1) open state, (2) short state, or (3) alternately open and short circuit states. In this context, "fixture state" refers to the location where the DUT is planned to be connected, i.e. where the Analyzer calibration plane will pass after excluding the fixture. This is where the appropriate mode should be created.

The selection is made based on the fixture state, how stable the reflection coefficient measurements are at that point, and how close the condition is to ideal open or short. A state deviation from the ideal condition will distort the measurement results of the fixture S-parameters. The mode is selected individually for each fixture.

- Choose a method to estimate the reflection coefficient of the maximum fixture signal in open or short circuit mode. When **Use compensation of the max signal by the spline approximation** checkbox is enabled, the max signal is filtered in the time domain and smoothed. When this option is off, the signal is only filtered. Smoothing allows for elimination of outliers at the beginning and the end of the frequency response of the reflection coefficient due to effects of truncation. By default, the plug-in applies smoothing.

- Click **Measure** button to take measurements or click **Recall** button to load a file and calculate from previously saved data.

- To delete the measured data, click **Delete** button.

1xReflect – returns the S-parameters of one fixture. If necessary, the plug-in allows for correction of the electrical length. There is only one option for this: entering the offset manually.

Procedure for Fixture with DUT

This measurement step appears when CAL ≠ DUT is selected. Combined processing of measurements made at all steps allows to obtain more reliable parameters of the test fixture without disconnecting the DUT. This step, as well as the previous ones, is designed to assess the parameters of the fixture to further eliminate it.

- Connect a fixture with the DUT to a calibrated Analyzer.
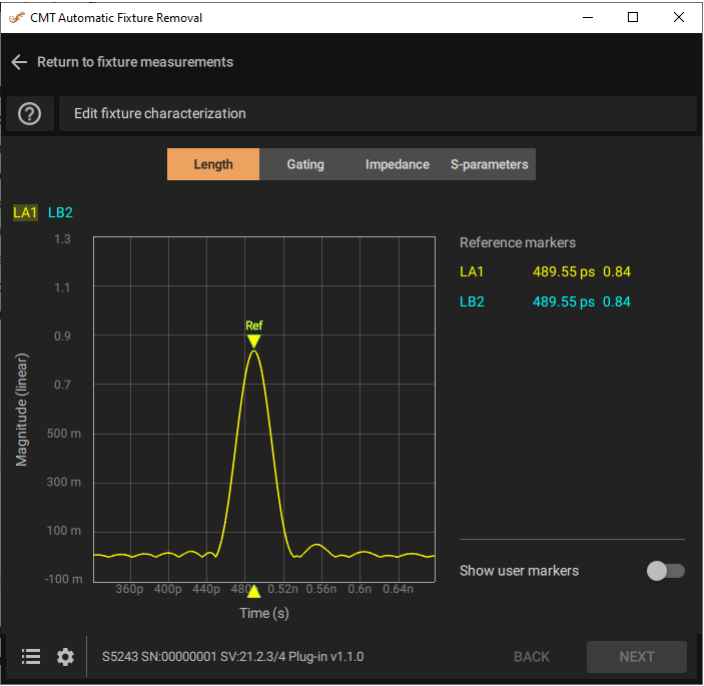
The plug-in displays the Analyzer ports for fixture connection, as well as the status of the current calibration.
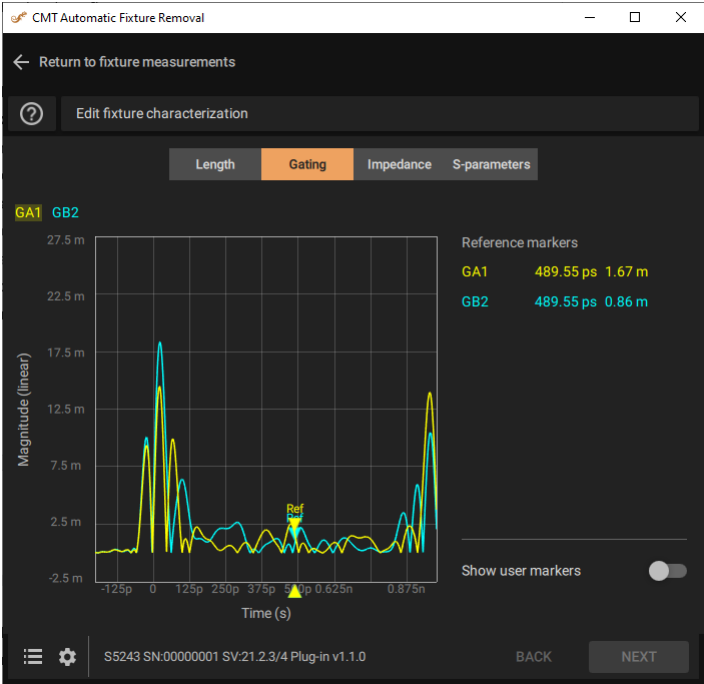
- Click **Measure** button to take measurements or click **Recall** button to load a file and calculate from previously saved data.

Fixture with DUT returns the updated values of the input and output fixture reflection coefficients. The rest of their parameters remain unchanged from the previous measurement steps including the entered offset. If the fixtures with and without the DUT are different, the present measurement results may be degraded. This mode should be used with the utmost care.

Edit characterization

The page opens by clicking **EDIT CHARACTERIZATION** button and has four tabs (See table below).

Tab Name	Description
Length	Length displays the impulse response of the circuit from which the electrical length is estimated. To calculate this, the 2xThrough transmission coefficient data or 1xReflect reflection coefficient data is used.

Tab Name	Description
Gating	Gating displays the impulse response of the circuit with an indication of the time gating range. The calculation uses the 2xThrough reflection coefficient and the 1xReflect reflection coefficient with maximum signal suppression. The characteristic can be used to judge the quality of the fixture, i.e. the presence of heterogeneities in its design.

Tab Name	Description
Impedance	Impedance displays the fixture impedance along its length. The characteristic shows how much the impedance changes and what its value is in the connection area of the DUT. A deviation of impedance from the required value by more than 5-10% can further lead to significant distortions in the measurement results of the DUT.

Tab Name	Description
S-parameters	S-parameters displays the calculated parameters of each fixture in the frequency domain.

Click **Show user markers** toggle button, to set markers and open the measured values table.

NOTE	Available scaling of plots by selecting the desired area with the cursor.

Measurement setups

One-port measurement setup
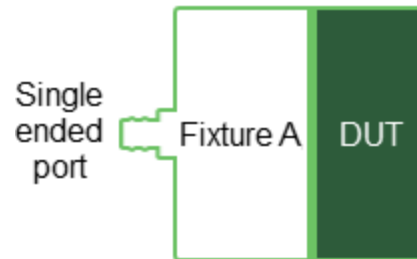
One-port fixture measurement setup using the example of port 1

Two-port measurement setup
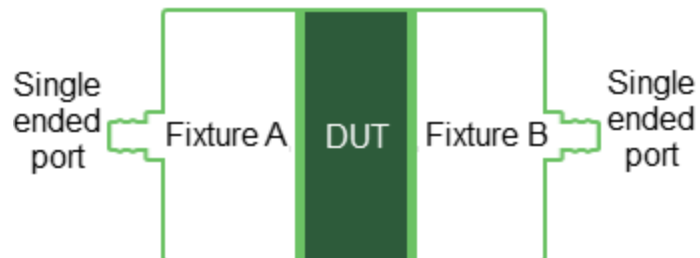
Two-port fixture measurement setup using the example of ports 1 and 2
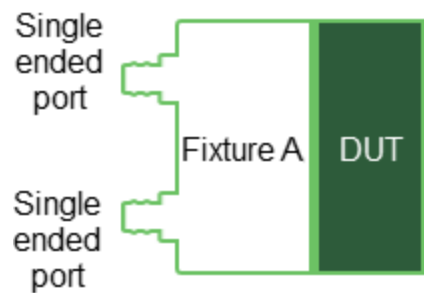
Two-port fixture measurement setup using the example of ports 1 and 2

Three-port measurement setup
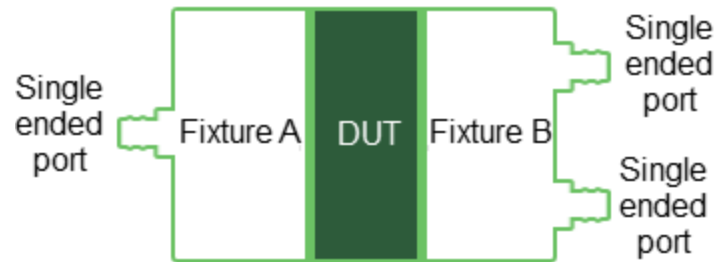
Three-port fixture measurement setup using the example of ports 1, 2 and 3

Four-port measurement setup
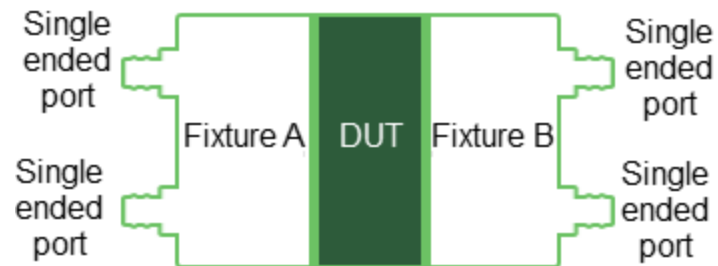
Four-port fixture measurement setup

Status bar

The status bar is located at the bottom of the tab. It shows the status of the measurement.

If a critical error ⛔ occurs during the measurement, [messages](#) about this appear.
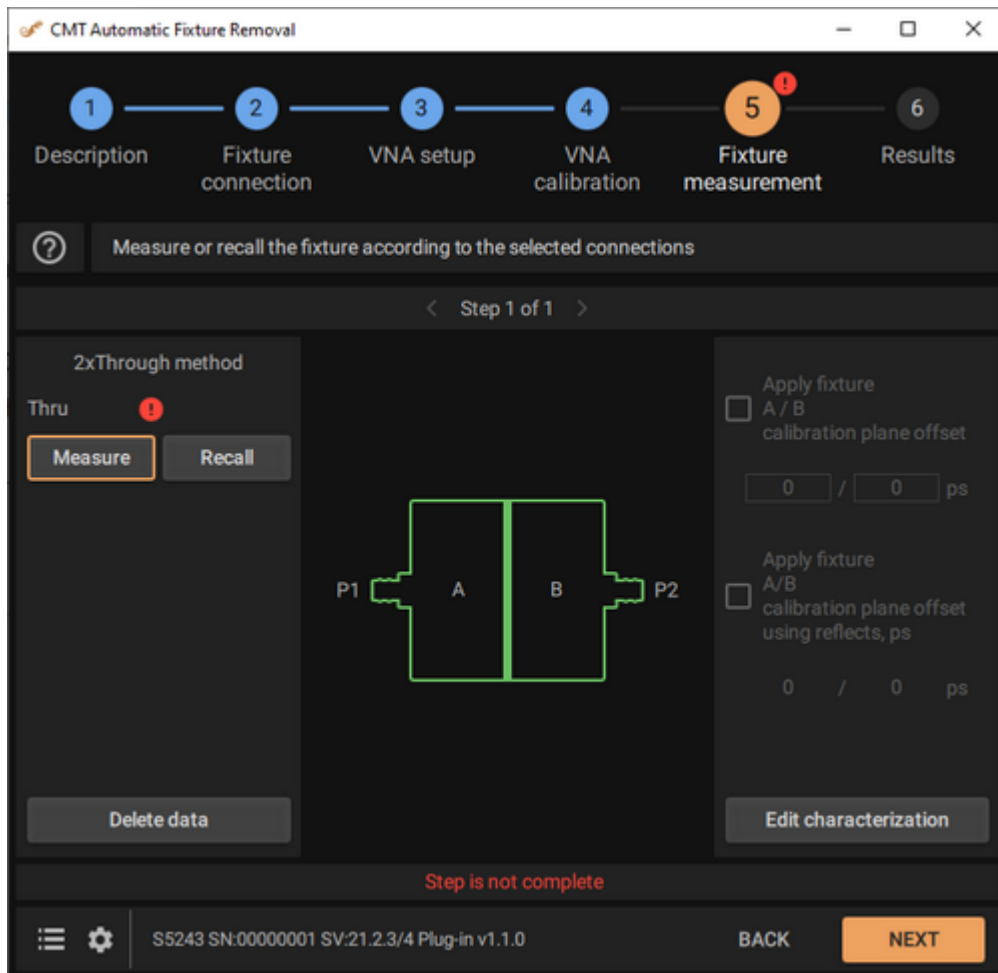
An example of a critical error

Results

The Results step is used to transfer files with calculated S-parameters of the fixture to the Analyzer software, and to apply the offset of the calibration plane (See figure below).

NOTE	The sequence of parameters in the file is counted from the Analyzer port, i.e. the S11 of the fixture is always on the port side.
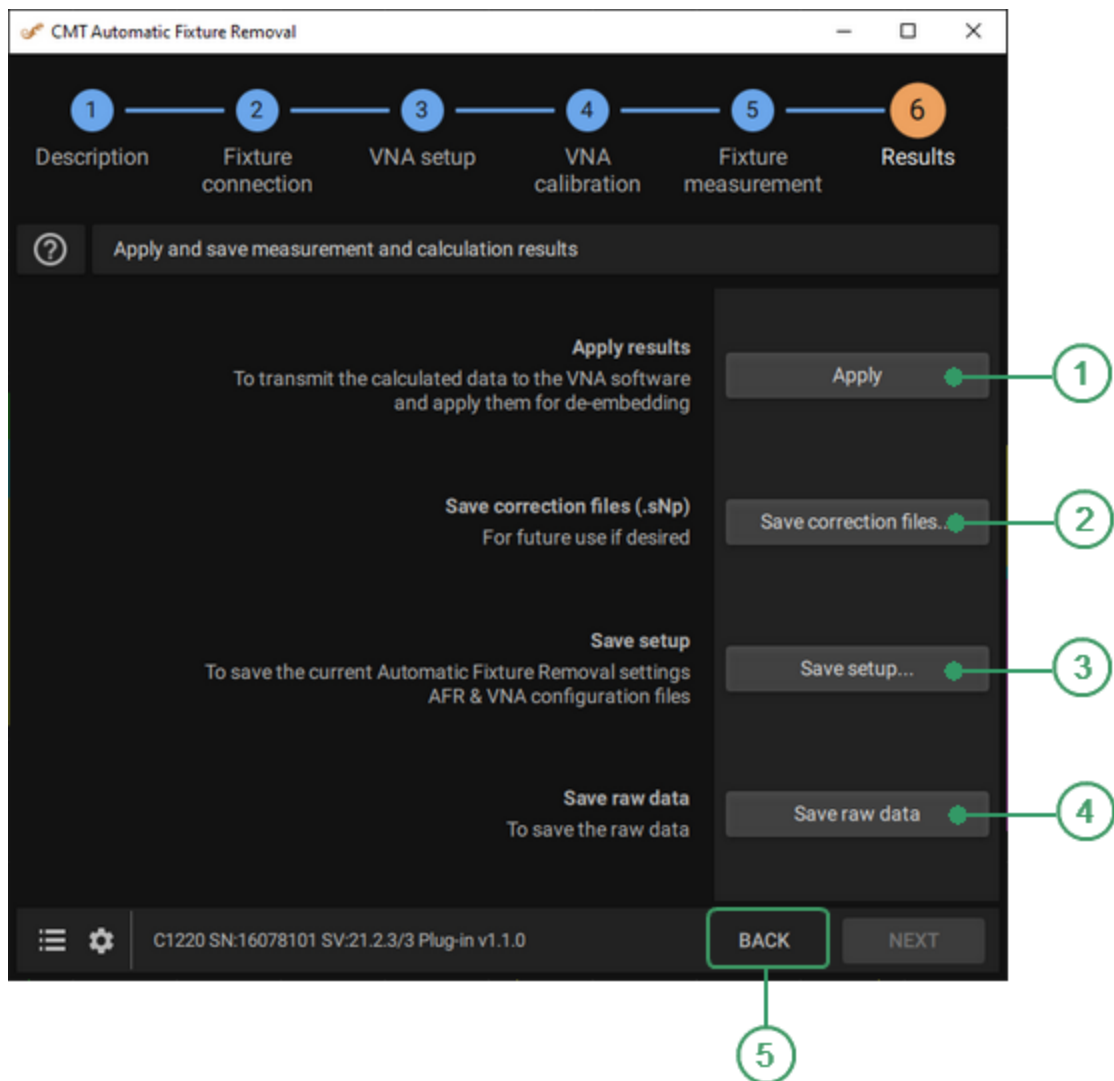
Results

① **Apply Button**

Click this button to apply and transmit the calculated data to the VNA software and apply them for de-embedding.

CAUTION If the files are missing or empty, the plug-in will report an error.

② **Save correction files... Button**

Click this button to save fixture parameter files (*.SNP) for future use if desired.

③ **Save setup... Button**

Click this button to save Automatic Fixture Removal settings, fixture setup and Analyzer configuration.

④ **Save raw data Button**

Click this button to save raw data of fixture measurement for future use if desired. Raw data file can be recalled to Fixture measurement tab.

⑤ **Back Button**

Click this button to return to the previous step.

Notification Sidebar

The Notification Sidebar displays message about VNA calibration errors, VNA configuration errors, etc. Also, message shows the time of its appearance. Messages are divided into two categories: critical and informational (See table below). Critical errors are highlighted with an exclamation mark icon in step.
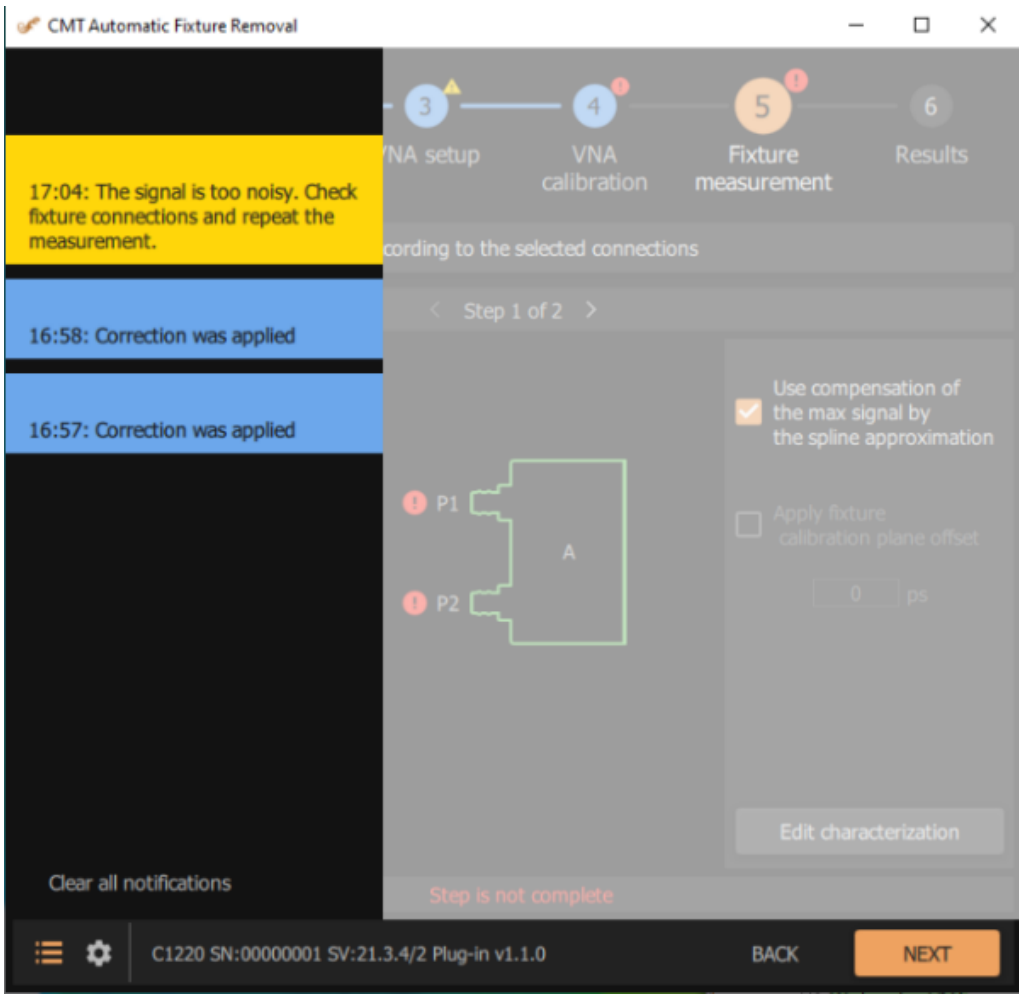
Example Notification Sodebar

Message	Color	Discription
Critical message	yellow	In most cases, these are calculation errors. Check connections, setup, calibration, loaded files and repeat measurement.
Information message	blue	Messages for user information. For example, the successful loading of a user setup.

Click the ▤ icon in the lower left corner to open Notification sidebar. The messages include information about VNA calibration errors, VNA configuration errors, etc.

Click **Clear all notifications** button to clear all messages.

Settings

Click the ![gear icon] icon in the lower left corner to open Settings window. Window contains three tabs: general and network settings.

Click this **Return to plug-in** button to close Settings page.
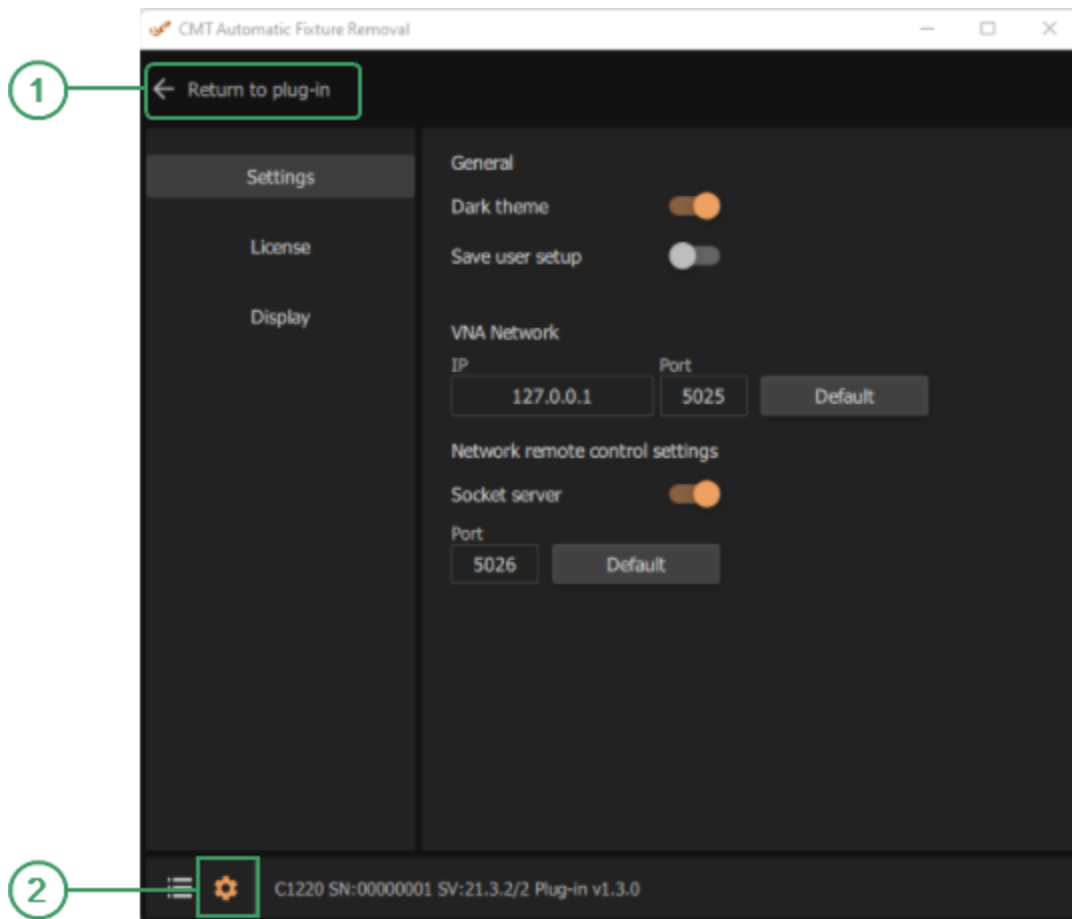
Settings window

---

① **Return to plug-in Button**

Click this **Return to plug-in** button to close Settings page.

---

② **Setting Button**

Click the ![gear icon] icon in the lower left corner to open Settings window. Window contains three tabs: network settings, license and display properties.

General

The tab contains general settings for the AFR plug-in.
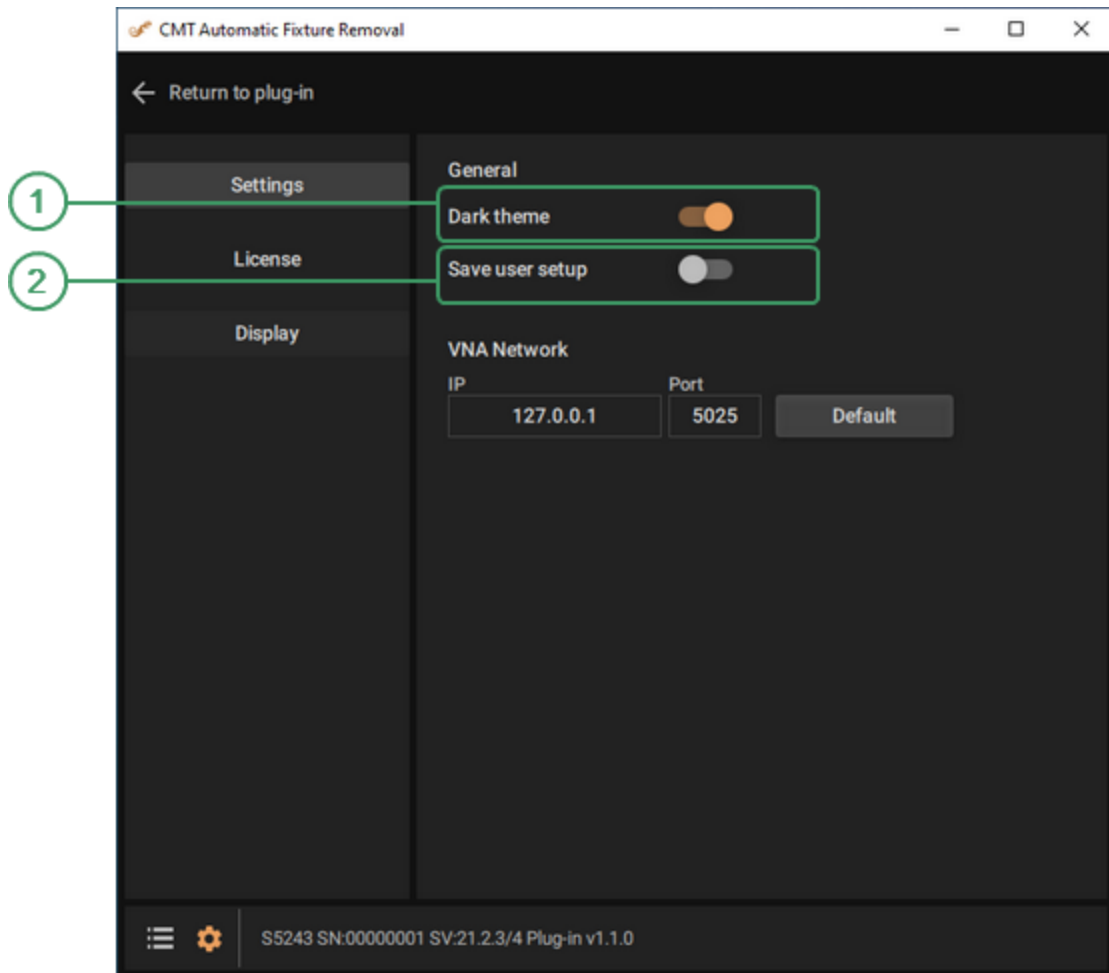
General settings

---

① **Dark theme Toggle button**

Check this button to enable Dark theme.

---

② **Save user setup Toggle button**

Select this button to load the last saved user setup automatically the next time.

VNA Network

The AFR plug-in automates the VNA software through TCP/IP using an integrated Socket Server. The VNA server network settings must be configured properly for AFR plug-in operation.
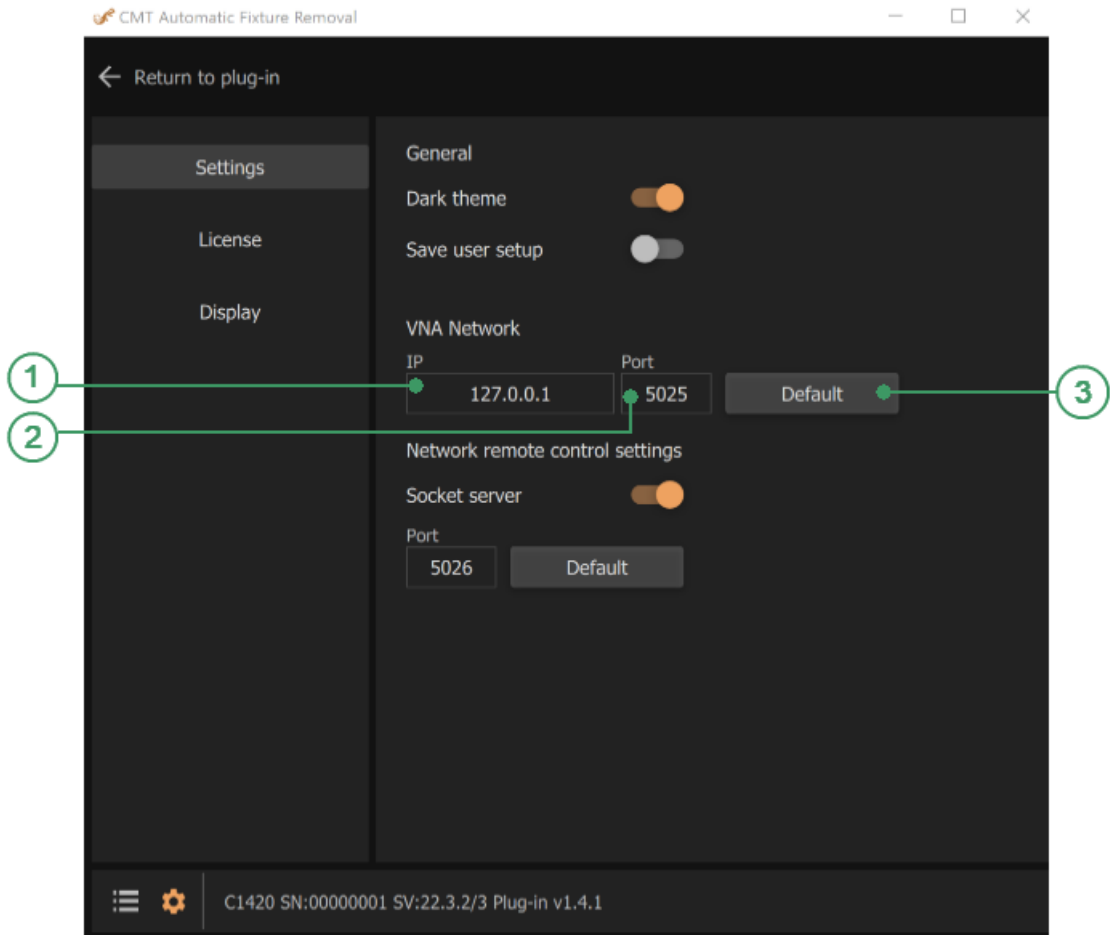
VNA network settings

---

① **IP Textbox**

The IP address of the VNA Socket Server. Typically, the plug-in and VNA software are running on the same computer in which case the IP address must be set to 127.0.0.1. This only needs to be changed in the very unlikely situation where the plug-in and VNA software are running on separate computers.

CAUTION The IP address: 127.0.0.1 is used when the plug-in and VNA software are running on the same computer. To find the IP address of a remote PC, open the Command Prompt on the remote PC and type the following: ipconfig /all. IPv4-address is the active IP address.

---

② **Port Textbox**

The Port number of the VNA software's Socket Server. This must match the Port number configured on the VNA software. If the value has been changed from the default of 5025 on the VNA software, it will need to be set to the same value on the plug-in.To view the VNA software Socket Port setting click the following VNA software buttons: **System > Misc Setup > Network Remote Control Settings > Socket Port**. The Port setting will be disabled when the Socket Server is **ON**.

CAUTION Port number: 5025 by default. If multiple VNA instruments are used concurrently on the same PC, individual port numbers must be assigned to each VNA software instance.

③ **Default Button**

Click this button to revert all VNA Network settings to their default values.

The default VNA Network setting values are:

- IP: 127.0.0.1
- Port: 5025

License

The tab displays following information contained in the license file:

- Sales order

- Company

- Contact

- Email

- Licensed VNA Serial Numbers

- Expiration Date
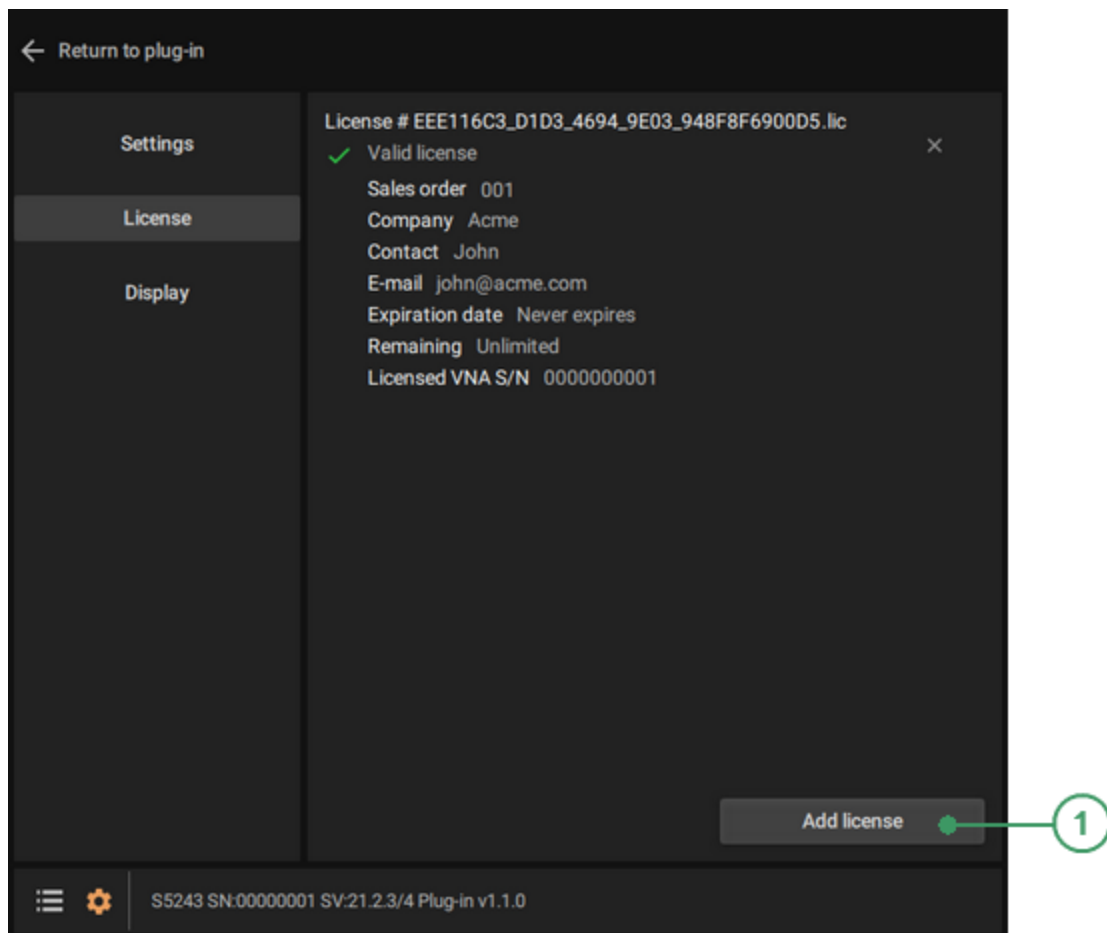
Licence tab

---

① **Add license Button**

Click this button to specify the path to the license file.

Display

The tab displays properties for the AFR plug-in.
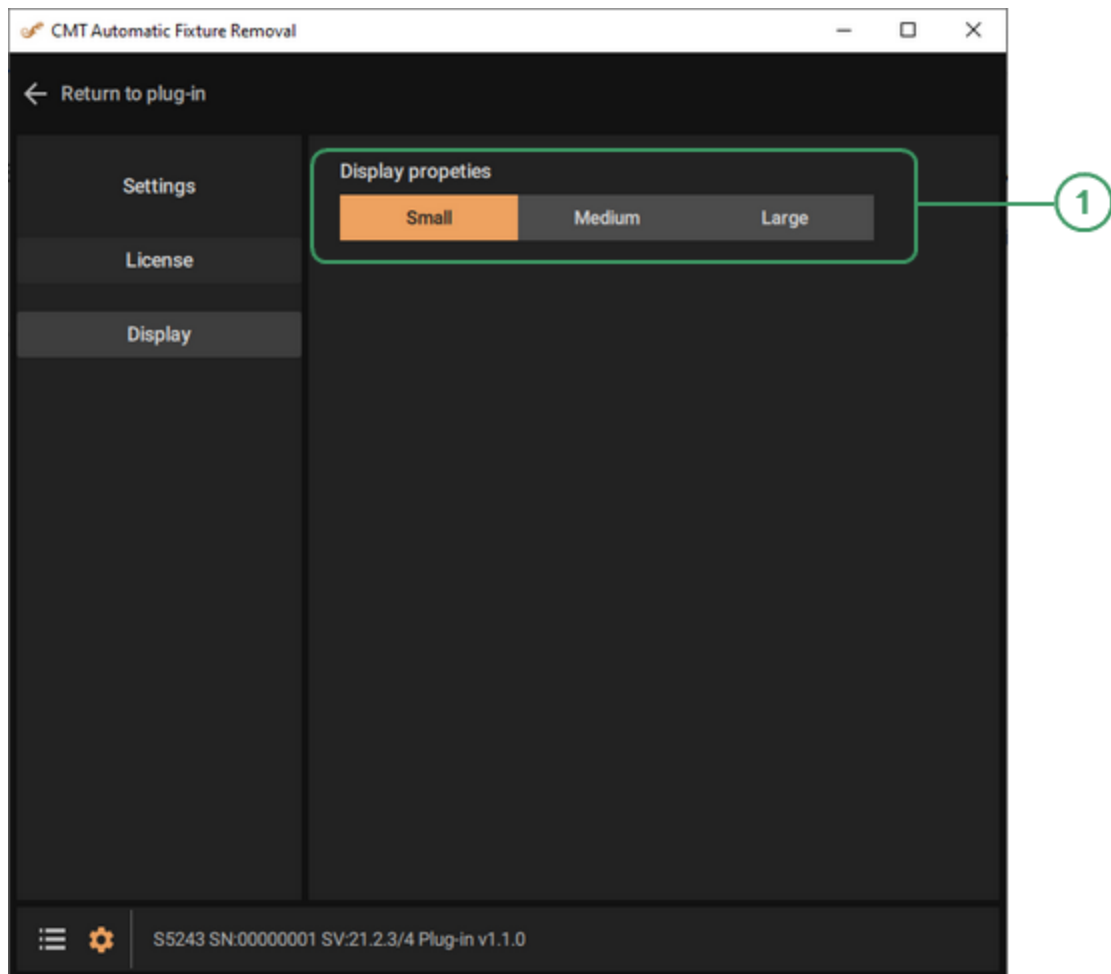
Display tab

---

① **Properties Buttons**

Select the button with the required display scaling.

NOTE The display scaling change will take effect after restart.

Programming

The following section describes AFR remote control.

SCPI (Standard Commands for Programmable Instruments) text commands are used to control the AFR remotely.

Commands sent to the plug-in and responses from the plug-in are sent as text messages that comply with the SCPI standard. These messages are delivered over computer networks using the TCP/IP Socket network protocol. TCP/IP Socket is a general purpose network protocol.

Setting

To access the plugin remotely, go to the settings window and follow the steps shown below in the **Network remote control settings** section:

- Enable Socket server (**Settings > Network remote control settings > Socket server**).

- Configure the TCP/IP port number (**Settings > Network remote control settings > Port**). Port value can be set as default (5026).
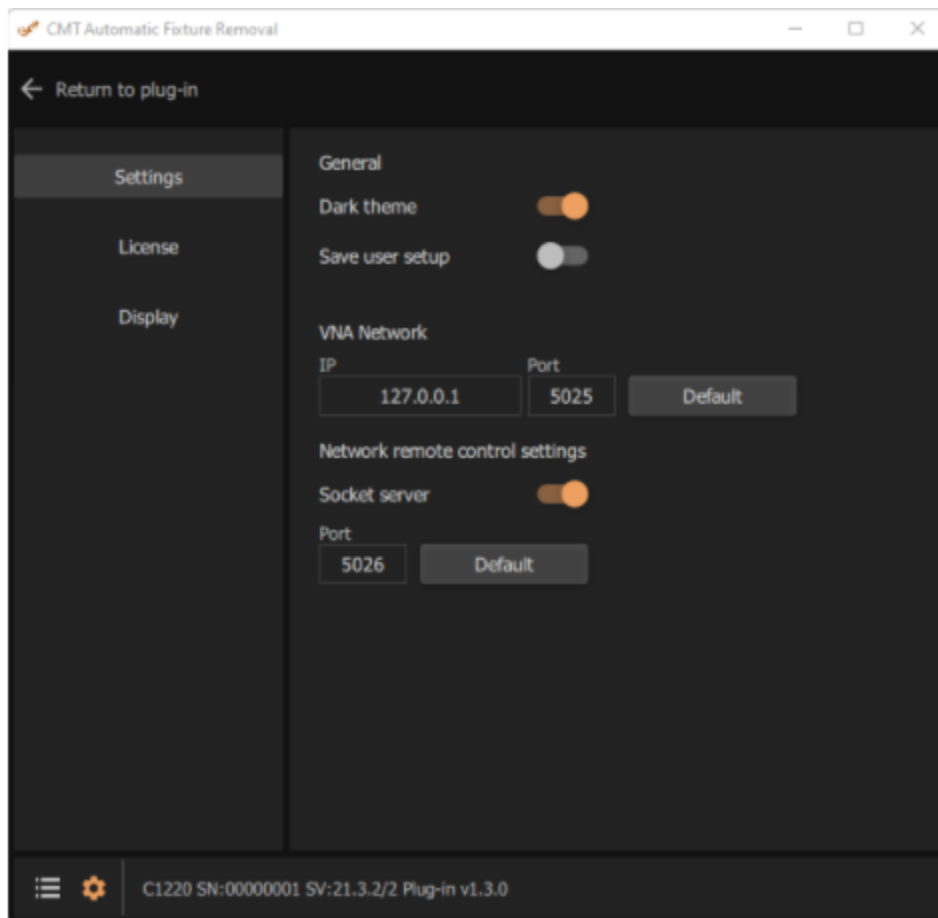
Settings window

SCPI Overview

The Analyzer implements a set of commands based on the standard SCPI-1999 (Standard Commands for Programmable Instruments). This is a set of instructions for the exchange of textual messages.

SCPI was developed by the SCPI Consortium (currently supported by the IVI Foundation). The main details of the SCPI standard are described further on.

Messages

The SCPI is a text message oriented protocol. The commands are sent as character messages. One message can contain one or several commands.

Command Tree

The SCPI commands are organized in a tree structure. Each tree structure forms a functional system. The base of the tree is called the root. Each functional system can have subsystems of lower level. The final nodes are called leaves. The entire sequence from root to leaf makes up the command. For example, part of the "AFR:SYSTem" functional system looks as follows:

AFR:SYSTem

    :STATe

      :LOAD

The tree can contain subsystems and leaves with the same names if they belong to different branches, e.g. "OPEN" leaf is on the tips of different branches:

AFR:CALCulate   AFR:CALCulate

    :STEP   :STEP#

      :REFlect   :THRU

        :   :OPEN

OPEN

Long and Short Formats

Each keyword in a command specification has a long format and a short format. The short format of a command is indicated by capital letters. For example, a command specification:

    AFR:SYSTem:STATe:LOAD

can be written as:

    AFR: SYST:STAT:LOAD

Only one form can be used at a time, as combining forms will be incorrect. For example, the following specification is incorrect:

    AFR:SYSTe:STATe:LOAD

Case Sensitivity

The commands are not case sensitive. Upper case and lower case letters are only used to indicate the long and short formats of a command specification. For example, the following commands are equivalent:

AFR:SYST:STAT:LOAD

afr:system:state:load

Parameters

The commands can have parameters. The parameters are separated from the command by a space. If a command has several parameters, they are separated by commas (',').

Query Commands

The query commands read out the parameter values from the Analyzer. After a query command has been sent, the response should return via remote control interface. The query commands has a question mark ('?') at the end of the command.

For example:

AFR:SYSTem:STEP:COUNt?

Boolean parameters

The Booleans can assume two values: logical yes and logical no (ON and OFF), and are specified in commands as:

ON or 1   — boolean yes

OFF or 0 — boolean no

For example:

AFR:SYSTem:STEP1:THRU:OFFSet 1

String parameters

In some cases, the Analyzer can accept parameters made of character strings. Such strings are enclosed with single quotes (') or double quotes ("). For example, the file name in the state saving command:

AFR:SYST:STAT:LOAD "C:/User/Desktop/state.sta"

Numeric suffixes

The Analyzer contains several items of the same type, such as multiple measuring steps. A numeric suffix is used to denote the item number in a command. The suffix is added to the keyword of the item.

For example, the following command specification specifies the measuring step number to which the command applies:

AFR:CALCulate:STEP<St>:DUT

According to this specification, the command that applies to the third measuring step is written as follows:

AFR:CALCulate:STEP3:DUT

Command Reference

The following conventions are used throughout this section.

Syntax	Description
<>	Identifiers enclosed in angular brackets indicate that a particular type of data must be specified.
{}	Parts enclosed in curly brackets indicate that you must select one of the items in this part. Individual items are separated by a vertical bar "|".
Space	Space separates commands from parameters.
,	Comma separates adjacent parameters.
…	Ellipses indicate that parameters in that part are omitted.

Identifiers

Identifier	Parameter	Description
<numeric>	Number	{<integer>|<real>}
<time>	Time	<numeric>
<numeric list>	Numeric List	<numeric 1>, <numeric 2>,… <numeric N>
<bool>	Boolean parameter	{0|1|ON|OFF}
<string>	String parameter	Quoted string

IEEE488.2 Common Commands

The set of common commands of IEEE488.2 standard. These commands start with an asterix ("*").

Command	Description
*OPC?	Reads out the "1" at the completion of all pending operations. The query blocks the execution of the user program until execution of all previous instructions.

*OPC?

SCPI Command

*OPC?

Description

Reads out the "1" at the completion of all pending operations. The query blocks the execution of the user program until execution of all previous instructions.

query only

Target

Plug-in

Query Response

1

Related Elements of User Interface

None

Back to IEEE488.2 Common Commands

AFR:CALCulate

Command	Description
AFR:CALC:LP	Sets low pass mode (Fstart = Fstep), changing Fstart: Fstart - start frequency Fstep - step frequency
AFR:CALC:LP:10M	Sets low pass mode (Fstart = Fstep), changing Fstep and Fstart to 10 MHz: Fstart - start frequency Fstep - step frequency
AFR:CALC:STEP:DUT	Performs input and output reflection measurement of the fixture with the DUT. Measurement results are used to correct the resultant S-parameters of the fixture, specifically the reflection coefficients. Other S-parameters remain unchanged from the previous measurement steps, including the entered calibration plane offset values.
AFR:CALC:STEP:REF:OFFS	1xReflect method. Sets the offset value of the fixture calibration plane in the <Step> measurement step. First, activate the calibration plane offset mode by the AFR:SYST:STEP<Step>:REF:OFFS 1 command.
AFR:CALC:STEP:REF:OPEN	1xReflect method. Performs fixture reflection measurement in the Open state at the <Step> measurement step. First, activate the measurement mode by the AFR:SYST:STEP<Step>:REF:OPEN 1 command.

Command	Description
AFR:CALC:STEP:REF:SHOR	1xReflect method. Performs fixture reflection measurement in short-circuit mode (Short state) at the <Step> measurement step. First, activate the measurement mode by the AFR:SYST:STEP<Step>:REF:SHOR 1 command.
AFR:CALC:STEP:THRU	2xThrough method. Performs S-parameters measurement of two connected fixtures at the <Step> measurement step. The command is valid for all possible configuration sets: A-B, A-A aux, B-B aux.
AFR:CALC:STEP:THRU:OFFS	2xThrough method. Sets the offset values of the fixture calibration plane at the <Step> measurement step. First, activate the calibration plane offset mode by the command AFR:SYST:STEP<Step>:THRU:OFFS 1.
AFR:CALC:STEP:THRU:REFOFFS:OPEN	2xThrough → 1xReflect calibration plane offset determination by 1xReflect method. Performs fixture reflection measurements in the Open state at the <Step> measurement step to automatically determine the offset values of the calibration plane. First, activate the measurement mode by the AFR:SYST:STEP<Step>:THRU:REFOFFS:OPEN 1 command.

Command	Description
AFR:CALC:STEP:THRU: REFOFFS:SHOR	2xThrough measurement → 1xReflect calibration plane offset determination by 1xReflect method. Performs fixture reflection measurements in the Short state at the <Step> measurement step to automatically determine the offset values of the calibration plane. First, activate the measurement mode by the AFR:SYST:STEP<Step>:THRU:REFOFFS:SHOR 1 command.
AFR:CALC:ZCON	Sets a custom impedance value.

AFR:CALC:LP

SCPI Command

AFR:CALCulate:LP

Description

Sets low pass mode (Fstart = Fstep), changing Fstart:

Fstart - start frequency

Fstep - step frequency

no query

Related Controls of User Interface

VNA setup > Low pass mode

Back to AFR:CALCulate

AFR:CALC:LP:10M

SCPI Command

AFR:CALCulate:LP:10Mhz

Description

Sets low pass mode (Fstart = Fstep), changing Fstep and Fstart to 10 MHz:

Fstart - start frequency

Fstep - step frequency

No query

Related Controls of User Interface

VNA setup > 10 MHz low pass mode

Back to AFR:CALCulate

AFR:CALC:STEP:DUT

SCPI Command

AFR:CALCulate:STEP<Step>:DUT

Description

Performs input and output reflection measurement of the fixture with the DUT. Measurement results are used to correct the resultant S-parameters of the fixture, specifically the reflection coefficients. Other S-parameters remain unchanged from the previous measurement steps, including the entered calibration plane offset values.

no query

Target

Measurement step <Step> of the fixture with the DUT,

<Step> = {1|2|...}

Related Controls of User Interface

Fixture measurement > Step <Step> of N > Fixture with DUT > Measure

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:REF:OFFS

SCPI command

AFR:CALCulate:STEP<Step>:REFlect:OFFSet <numeric>

Описание

1xReflect method.

Sets the offset value of the fixture calibration plane in the <Step> measurement step.

First, activate the calibration plane offset mode by the AFR:SYST:STEP<Step>:REF:OFFS 1 command.

no query

Target

Value of the calibration plane offset at the <Step> measurement step,

<Step> = {1|2|...}

Parameter

<numeric> offset value, is specified in picoseconds

Related commands

SYSTem:STEP<Step>:REFlect:OFFSet

Related Controls of User Interface

Fixture measurement > Step <Step> из N > Apply fixture calibration plane offset

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:REF:OPEN

SCPI Command

AFR:CALCulate:STEP<Step>:REFLect:OPEN

Description

> 1xReflect method.
>
> Performs fixture reflection measurement in the Open state at the <Step> measurement step.
>
> First, activate the measurement mode by the AFR:SYST:STEP<Step>:REF:OPEN 1 command.

no query

Target

Measurement step <Step> of one of the fixtures,

<Step> = {1|2|...}

Related Commands

AFR:SYSTem:STEP<Step>:REFlect:OPEN

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 1xReflect setup > Open > Measure

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:REF:SHOR

SCPI Command

AFR:CALCulate:STEP<Step>:REFLect:SHORt

Description

1xReflect method.

Performs fixture reflection measurement in the Short state at the <Step> measurement step.

First, activate the measurement mode by the AFR:SYST:STEP<Step>:REF:SHOR 1 command.

no query

Target

Measurement step <Step> of one of the fixtures,

<Step> = {1|2|...}

Related Commands

AFR:SYSTem:STEP<Step>:REFlect:SHORt

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 1xReflect setup > Short > Measure

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:THRU

SCPI Command

AFR:CALCulate:STEP<Step>:THRU

Description

2xThrough method.

Performs S-parameters measurement of two connected fixtures at the <Step> measurement step. The command is valid for all possible configuration sets:

- A-B

- A-A aux

- B-B aux.

no query

Target

Measurement step <Step> of two fixtures,

<Step> = {1|2|...}

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Measure

N - maximum number of steps.

Back to

AFR:CALC:STEP:THRU:OFFS

SCPI Command

AFR:CALCulate:STEP<Step>:THRU:OFFset <numeric 1>,<numeric 2>

Description

2xThrough method.

Sets the offset values of the fixture calibration plane at the <Step> measurement step.

First, activate the calibration plane offset mode by the AFR:SYST:STEP<Step>:THRU:OFFS 1 command.

no query

Target

Offset value of the calibration plane at the measurement step <Step>,

<Step> = {1|2|...}

Parameter

<numeric 1> Left fixture offset, is specified in picoseconds

<numeric 2> Right fixture offset, is specified in picoseconds

Related Commands

AFR:SYSTem:STEP<Step>:THRU:OFFSet

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset,

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:THRU:REFOFFS:OPEN

SCPI Command

AFR:CALCulate:STEP<Step>:THRU:REFOFFSet:OPEN

Description

2xThrough → 1xReflect calibration plane offset determination by 1xReflect method.

Performs fixture reflection measurements in the Open state at the <Step> measurement step to automatically determine the offset values of the calibration plane.

First, activate the measurement mode by the AFR:SYST:STEP<Step>:THRU:REFOFFS:OPEN 1 command.

no query

Target

Measurement step <Step> of two fixtures,

<Step> = {1|2|...}

Related Commands

AFR:SYSTem:STEP<Step>:THRU:REFOFFSet:OPEN

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset using reflects > Open > Measure

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:STEP:THRU:REFOFFS:SHOR

SCPI Command

AFR:CALCulate:STEP<St>:THRU:REFOFFSet:SHORt

Description

2xThrough measurement → 1xReflect calibration plane offset determination by 1xReflect method.

Performs fixture reflection measurements in the Short state at the <Step> measurement step to automatically determine the offset values of the calibration plane.

First, activate the measurement mode by the AFR:SYST:STEP<Step>:THRU:REFOFFS:SHOR 1 command.

no query

Target

Measurement step <Step> of two fixtures,

<Step> = {1|2|...}

Related Commands

AFR:SYSTem:STEP<Step>:THRU:REFOFFSet:SHORt

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset using reflects > Short > Measure

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to AFR:CALCulate

AFR:CALC:ZCON

SCPI Command

AFR:CALCulate:ZCONversion <numeric>

Description

Sets a custom impedance value.
no query

Parameter

<numeric> impedance value

Related Commands

[AFR:SYSTem:ZCONversion:TYPE](#)

Related Elements of User Interface

VNA setup > VNA cal reference set to Z0 > Custom

Back to [AFR:CALCulate](#)

AFR:SENSe

Command	Description
AFR:SENS:BAND	Sets or reads out the IF bandwidth value of the analyzer.
AFR:SENS:CALIB:TYPE?	Reads out the calibration type of the analyzer.
AFR:SENS:FREQ:STAR	Sets or reads out the start frequency value of the analyzer.
AFR:SENS:FREQ:STEP?	Reads out the step frequency value of the analyzer.
AFR:SENS:FREQ:STOP	Sets or reads out the stop frequency value of the analyzer.
AFR:SENS:POW	Sets or reads out the output power value of the analyzer.
AFR:SENS:PRES	Resets the analyzer to default settings.
AFR:SENS:SWE:POIN	Sets or reads out the number of sweep (measurement) points of the analyzer.
AFR:SENS:SWE:TYPE?	Sets or reads out the sweep type of the analyzer.

The calculation of the fixture parameters is performed only with the uniform distribution of points within the frequency range (linear frequency sweep).

AFR:SENS:BAND

SCPI Command

AFR:SENSe:BANDwidth <numeric>

AFR:SENSe:BANDwidth?

Description

Sets or reads out the IF bandwidth value of the analyzer.

command/query

Parameter

<numeric> IF bandwidth value

Query Response

<numeric>

Related Elements of User Interface

VNA Setup > IF bandwidth

Back to AFR:SENSe

AFR:SENS:CALIB:TYPE?

SCPI Command

AFR:SENSe:CALIBration:TYPE?

Description

Reads out the calibration type of the analyzer.

only query

Query Response

{OFF|SOLT1|SOLT2|SOLT3|SOLT4|NONE|1PATH|RESPO|RESPS|RESPT)

Related Elements of User Interface

VNA calibration > Calibration

Back to AFR:SENSe

AFR:SENS:FREQ:STAR

SCPI Command

AFR:SENSe:FREQeuncy:STARt <numeric>

AFR:SENSe:FREQeuncy:STARt?

Description

Sets or reads out the start frequency value of the analyzer.

command/query

Parameter

<numeric> start frequency value within the frequency range of the analyzer.

Query Response

<numeric>

Related Elements of User Interface

VNA setup > Start frequency

Back to AFR:SENSe

AFR:SENS:FREQ:STEP?

SCPI Command

AFR:SENSe:FREQeuncy:STEP?

Description

Reads out the step frequency value of the analyzer.

only query

Query Response

<numeric>

Related Elements of User Interface

VNA setup > Step frequency

Back to AFR:SENSe

AFR:SENS:FREQ:STOP

SCPI Command

AFR:SENSe:FREQeuncy:STOP <numeric>

AFR:SENSe:FREQeuncy:STOP?

Description

Sets or reads out the stop frequency value of the analyzer.
command/query

Parameter

<numeric> stop frequency value within the working frequency range of the analyzer.

Related Elements of User Interface

VNA setup > Stop frequency

Back to AFR:SENSe

AFR:SENS:POW

SCPI Command

AFR:SENSe:POWer <numeric>

AFR:SENSe:POWer?

Description

Sets or reads out the output power value of the analyzer.
command/query

Parameter

<numeric> output power value within the setting range of the analyzer output power.

Related Elements of User Interface

VNA setup > Output power

Back to

AFR:SENS:PRES

SCPI Command

AFR:SENSe:PRESet

Description

Resets the analyzer to default settings.

no query

Related Elements of User Interface

VNA setup > VNA preset

Back to AFR:SENSe

AFR:SENS:SWE:POIN

SCPI Command

AFR:SENSe:SWEep:POINts <numeric>

AFR:SENSe:SWEep:POINts?

Description

Sets or reads out the number of sweep (measurement) points of the analyzer.

command/query

Parameter

<numeric> number of the analyzer measurement points

Related Elements of User Interface

VNA setup > Sweep points

Back to AFR:SENSe

AFR:SENS:SWE:TYPE?

SCPI Command

AFR:SENSe:SWEep:TYPE?

Description

Sets or reads out the sweep type of the analyzer.

only query

Related Elements of User Interface

VNA setup > Sweep type

Back to AFR:SENSe

AFR:SYSTem

Command	Description
AFR:SYST:CALC:METH	Sets or reads out the method for calculating fixture parameters.
AFR:SYST:CORRECT:APPL	Activates fixture simulation mode in the Analyzer software and applies the network de-embedding function to the analyzer ports connected to the fixture by loading the calculated S-parameters.
AFR:SYST:CORRECT:SAVE	Saves the calculated S-parameters of the fixture.
AFR:SYST:DATA:SAVE	Saves the raw S-parameters of the fixture measured on the calibrated analyzer without additional processing.
AFR:SYST:ERR?	Reads out the error message when executing SCPI commands from the FIFO (First In First Out) error queue stored in the plug-in. The read-out error is deleted from the error queue.
AFR:SYST:FIXT:CONNECT:DIR	Sets or reads out the connection configuration of the input fixture A (left) and the output fixture B (right): Corresponds to the toggle switch **A-B connection**.
AFR:SYST:FIXT:CONNECT:DUT:DIFF	Sets or reads out the CAL ≠ DUT toggle switch state. The plug-in can use the CAL ≠ DUT mode if the DUT is installed in a fixture or is structurally implemented in a fixture where there is no possibility of removal. When the mode is turned on, an additional measurement step of the fixture along with DUT appears. The CAL ≠ DUT mode is available only when the time gating method is selected. Corresponds to the toggle switch **CAL fixture and DUT fixture are different**.

Command	Description
AFR:SYST:FIXT:CONNECT:LEFT:THRU	Sets or reads out the connection configuration of the fixtures A and A aux. Corresponds to the toggle switch **A-A connection**.
AFR:SYST:FIXT:CONNECT:RIGHT:THRU	Sets or reads out the connection configuration of the fixtures B and B aux: Corresponds to the toggle switch **B-B connection**.
AFR:SYST:FIXT:LEFT	Sets or reads out the state of the checkbox indicating whether the left fixture is in use. Corresponds to the checkbox **Fixture A.**
AFR:SYST:FIXT:LEFT:PORT	Sets or reads out the port number of the analyzer connected to the left fixture. Corresponds to the area **Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:COUN	Sets or reads out the number of ports of the left fixture. Corresponds to the area **Fixture A. Num of ports**.
AFR:SYST:FIXT:LEFT:PORT:GAT?	Reads out the impulse response value of the left fixture for port <Port>. Corresponds to **Gating. Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:GAT:TRAC?	Reads out the impulse response values of the left fixture for port <Port>. Corresponds to **Gating. Gating trace. Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:IMP?	Reads out the impedance value of the left fixture for port <Port>. Corresponds to **Impedance. Fixture A. Port <Port>**.

Command	Description
AFR:SYST:FIXT:LEFT:PORT:IMP:TRAC?	Reads out the impedance values of the left fixture for port <Port>. Corresponds to **Impedance. Impedance trace. Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:LEN?	Reads out the impulse response value of the left fixture for port <Port>. Corresponds to **Length. Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:LEN:TRAC?	Reads out the impulse response values of the left fixture for port <Port>. Corresponds to **Length. Length trace. Fixture A. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX	Sets or reads out the port number of the analyzer connected to the auxiliary (left) fixture. Corresponds to **Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX:GAT?	Reads out the impulse response value of the auxiliary (left) fixture for port <Port>. Corresponds to **Gating. Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX:GAT:TRAC?	Reads out the impulse response values of the auxiliary (left) fixture for port <Port>. Corresponds to **Gating. Gating trace. Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX:IMP?	Reads out the impedance value of the auxiliary (left) fixture for port <Port>. Corresponds to **Impedance. Fixture A aux. Port <Port>**.

Command	Description
AFR:SYST:FIXT:LEFT:PORT:AUX:IMP:TRAC?	Reads out the impedance values of the auxiliary (left) fixture for port <Port>. Corresponds to **Impedance. Impedance trace. Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX:LEN?	Reads out the impulse response value of the auxiliary (left) fixture for port <Port>. Corresponds to **Length. Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:LEFT:PORT:AUX:LEN:TRAC?	Reads out the impulse response values of the auxiliary (left) fixture for port <Port>. Corresponds to **Length. Length trace. Fixture A aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT	Sets or reads out the state of the checkbox indicating whether the right fixture is in use. Corresponds to the checkbox **Fixture B**.
AFR:SYST:FIXT:RIGHT:PORT	Sets or reads out the port number of the analyzer connected to the right fixture. Corresponds to the area **Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT:PORT:COUN	Sets or reads out the number of ports of the right fixture. Corresponds to the area **Fixture B. Num of ports**.
AFR:SYST:FIXT:RIGHT:PORT:GAT?	Reads out the impulse response value of the right fixture for port <Port>. Corresponds to **Gating. Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT:PORT:GAT:TRAC?	Reads out the impulse response values of the right fixture for port <Port>. Corresponds to **Gating. Gating trace. Fixture B. Port <Port>**.

Command	Description
AFR:SYST:FIXT:RIGHT: PORT:IMP?	Reads out the impedance value of the right fixture for port <Port>. Corresponds to **Impedance. Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:IMP:TRAC?	Reads out the impedance values of the right fixture for port <Port>. Corresponds to **Impedance. Impedance trace. Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:LEN?	Reads out the impulse response value of the right fixture for port <Port>. Corresponds to **Length. Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:LEN:TRAC?	Reads out the impulse response values of the right fixture for port <Port>. Corresponds to **Length. Length trace. Fixture B. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX	Sets or reads out the port number of the analyzer connected to the auxiliary (right) fixture. Corresponds to the area **Fixture B aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX:GAT?	Reads out the impulse response value of the auxiliary (right) fixture for port <Port>. Corresponds to **Gating. Fixture B aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX:GAT:TRAC?	Reads out the impulse response values of the auxiliary (right) fixture for port <Port>. Corresponds to **Gating. Gating trace. Fixture B aux. Port <Port>**.

Command	Description
AFR:SYST:FIXT:RIGHT: PORT:AUX:IMP?	Reads out the impedance value of the auxiliary (right) fixture for port <Port>. Corresponds to **Impedance. Fixture B aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX:IMP:TRAC?	Reads out the impedance values of the auxiliary (right) fixture for port <Port>. Corresponds to **Impedance. Impedance trace. Fixture B aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX:LEN?	Reads out the impulse response value of the auxiliary (right) fixture for port <Port>. Corresponds to **Length. Fixture B aux. Port <Port>**.
AFR:SYST:FIXT:RIGHT: PORT:AUX:LEN:TRAC?	Reads out the impulse response values of the auxiliary (right) fixture for port <Port>. Corresponds to **Length. Length trace. Fixture B aux. Port <Port>**.
AFR:SYST:LP:IGN	Sets or reads out the state of the Ignore low pass toggle switch. Corresponds to the toggle switch **Ignore low pass.** When the switch is turned on, the plug-in ignores the recommended frequency grid check and does not perform impedance conversion.
AFR:SYST:PRES	Resets the plug-in to the default settings.
AFR:SYST:SET:SAVE	Saves the current plug-in settings.
AFR:SYST:READ?	Reads out the analyzer readiness status.

Command	Description
AFR:SYST:STAT:LOAD	Recalls the plug-in state file. The plug-in control setup and analyzer parameters, including the calibration data, are loaded.
AFR:SYST:STEP:COUN?	Returns the number of measurement steps on the Fixture Measurement tab.
AFR:SYST:STEP:DATA:DEL	Deletes the data at the <Step> measurement step. Corresponds to **Fixture measurement > Step <Step > of N > Delete data**.
AFR:SYST:STEP:MEAS?	Returns the completion state of a particular measurement step <Step>. Corresponds to **Fixture measurement > Step <Step> of N**.
AFR:SYST:STEP:REF:APPR	Sets the state of the Use compensation of the max signal by the spline compensation checkbox. 1xReflect method. When the checkbox is enabled, the max signal is filtered in the time domain and smoothed. When this option is off, the signal is only filtered. Corresponds to the checkbox **Use compensation of the max signal by the spline compensation**.
AFR:SYST:STEP:REF:OFFS	Sets the offset mode of the fixture calibration plane at the <Step> measurement step. 1xReflect method. To set the offset value, use the AFR:CALC:STEP<Step>:REF:OFFS command.
AFR:SYST:STEP:REF:OPEN	Sets the fixture reflection measurement mode at the <Step> measurement step to the Open state. 1xReflect method. To make measurements, use the AFR:CALC:STEP<Step>:REF:OPEN command.

Command	Description
AFR:SYST:STEP:REF:SHOR	Sets the fixture reflection measurement mode at the <Step> measurement step to the Short state. 1xReflect method. To make measurements, use the AFR:CALC:STEP<Step>:REFL:SHOR command.
AFR:SYST:STEP:THRU:OFFS	Sets the manual input mode of the calibration plane offset at the <Step> measurement step. 2xThrough method. To set the offset values of each fixture, use the AFR:CALC:STEP<Step>:THRU:OFFS <numeric 1> , <numeric 2> command. The command disables automatic determination mode of the calibration plane offset if it was previously enabled by the AFR:SYST:STEP<Step>:THRU:REFOFFS 1 command. Execution of the command is ignored if the measurements were not performed at step <Step>. To find out the state of the measurement step, use the AFR:SYST:STEP<Step>:MEAS? command.
AFR:SYST:STEP:THRU:REFOFFS	Sets automatic calibration plane offset mode at the <Step> measurement step. The command disables manual input mode of the calibration plane offset if it was previously enabled by the AFR:SYST:STEP<Step>:THRU:OFFS {1|ON} command. Execution of the command is ignored if the measurements were not performed at step <Step>. To find out the state of the measurement step, use the AFR:SYST:STEP<Step>:MEAS? command.
AFR:SYST:STEP:THRU:REFOFFS:OPEN	Sets reflection measurements at the <Step> measurement step to the Open state. It is used for automatic determination of the calibration plane offset values.

Command	Description
	2xThrough method. To make measurements, use the AFR:CALC:STEP<Step>:THRU:REFOFFS:OPEN command.
AFR:SYST:STEP:THRU:REFOFFS:SHOR	Sets reflection measurements at the <Step> measurement step to the Short state.

It is used for automatic determination of the calibration plane offset values.

2xThrough method. To make measurements, use the AFR:CALC:STEP<Step>:THRU:REFOFFS:SHOR command. |
| AFR:SYST:STEP:TYPE? | Returns the <Step> step type according to the connection configuration: 1xReflect (reflection), 2xThrough (transmission), DUT (measurement of the parameters of the fixture along with the DUT). |
| AFR:SYST:VNA:DEF | Resets the IP address and connection port of the analyzer to default settings.

Corresponds to the area **VNA network.** |
| AFR:SYST:VNA:IP | Sets or reads out the IP address of the connection to the analyzer.

Corresponds to the area **VNA network**. |
| AFR:SYST:VNA:PORT | Sets or reads out the port number of the connection to the analyzer.

Corresponds to the area **VNA network**. |
| AFR:SYST:ZCON:TYPE | Sets or reads out the state of the VNA cal reference Zo options. The impedance calculation and conversion functions are available in low pass mode only.

Corresponds to the segment switch **After removal set VNA cal reference Zo to.** |

AFR:SYST:CALC:METH

SCPI Command

AFR:SYST:CALC:METH <char>

AFR:SYST:CALC:METH?

Description

Sets or reads out the method for calculating fixture parameters.
command/query

Parameter

<char> method for calculating fixture parameters:

BIsect	Bisection method (split in half)
TIMEgating	Time gating
FILTERing	Filtering method

Query Response

{BI|TIME|FILTER}

Related Elements of User Interface

Description > method

Back to

AFR:SYST:CORRECT:APPL

SCPI Command

AFR:SYSTem:CORRECTion:APPLy

Description

Activates fixture simulation mode in the Analyzer software and applies the network de-embedding function to the analyzer ports connected to the fixture by loading the calculated S-parameters.

no query

Related Controls of User Interface

Results > Apply

Back to AFR:SYSTem

AFR:SYST:CORRECT:SAVE

SCPI Command

AFR:SYSTem:CORRECTion:SAVE <string>

Description

Saves the calculated S-parameters of the fixtures.
no query

Parameter

<string> path for the desired folder to save S-parameters of the fixture (*.SNP).

NOTE	The number of files to be saved is equal to the number of analyzer ports at which fixture ports are measured. However the user interface, as well as the command, requires to enter only one path to save files. An example of a file saving path is "C:/Users/setup1", where setup1 is the prefix for saving all S-parameters. Suppose the fixtures were measured on the analyzer ports 1 and 3, then when calling the command **SYSTem:CORRECTion:SAVE"C:/Users/setup1"** the files **setup11.s2p, setup13.s2p** will be saved into the folder **"C:/Users"**. The analyzer port number will be added to the prefix **setup1** specified by the user.

Related Controls of User Interface

Results > Save correction files…

Back to

AFR:SYST:DATA:SAVE

SCPI Command

AFR:SYSTem:DATA:SAVE <string>

Description

Saves the raw S-parameters of the fixture measured on the calibrated analyzer without additional processing.

no query

Parameter

<string> path for the desired folder to save the raw S-parameters (*.SNP).

CAUTION	The number of files to be saved is equal to the number of fixture measurement patterns (measurement steps). However the user interface, as well as the command, requires to enter only one path to save files.
	An example of the file saving path is **"C:/Users/setup1"**, where setup1 is the prefix for saving all files. When calling the command **SYSTem:CORRECTion:SAVE "C:/Users/setup1"** the files **setup1_TranmsissionRawData.s2p, setup1_OpenRawData.s2p, setup1_ShortRawData.s2p, setup1_DutRawData.s2p** will be saved into the folder **"C:/Users".** The measurement pattern will be added to the prefix **setup1** specified by the user.

Related Elements of User Interface

Results > Save raw data

Back to

AFR:SYST:ERR?

SCPI Command

AFR:SYSTem:ERRor?

Description

Reads out the error message when executing SCPI commands from the FIFO (First In First Out) error queue stored in the plug-in. The read-out error is deleted from the error queue.

query only

Query Response

<numeric>, <string>

Where:

   <numeric> — error code,

   <string> — error message text.

If there is no error in the queue, "0, No error" is read out.

Related Controls of User Interface

None

Back to AFR:SYSTem

AFR:SYST:FIXT:CONNECT:DIR

SCPI Command

AFR:SYSTem:FIXTure:CONNECTion:DIRect {OFF|ON|0|1}

AFR:SYSTem:FIXTure:CONNECTion:DIRect?

Description

Sets or reads out the connection configuration of the input fixture A (left) and the output fixture B (right):

Note. Corresponds to the toggle switch **A-B connection** (see Fixture connection).

command/query

Parameter

{ON|1}   ON (fixtures A and B are connected)

{OFF|0}   OFF (fixtures A and B are not connected)

Query Response

{0|1}

Related Elements of User Interface

Fixture connection > A - B Connection

Back to AFR:SYSTem

AFR:SYST:FIXT:CONNECT:DUT:DIFF

SCPI Command

AFR:SYSTem:FIXTure:CONNECTion:DUT:DIFFerent {OFF|ON|0|1}

AFR:SYSTem:FIXTure:CONNECTion:DUT:DIFFerent?

Description

Sets or reads out the **CAL ≠ DUT** toggle switch state. The plug-in can use the CAL ≠ DUT mode if the DUT is installed in a fixture or is structurally implemented in a fixture where there is no possibility of removal. When the mode is turned on, an additional measurement step of the fixture along with DUT appears.

The CAL ≠ DUT mode is available only when the time gating method is selected.

Note. Corresponds to the toggle switch **CAL ≠ DUT** (see Fixture connection).

command/query

Parameter

{ON|1}   ON

{OFF|0}   OFF

Query Response

{0|1}

Related Elements of User Interface

Fixture connection > CAL ≠ DUT

Back to AFR:SYSTem

AFR:SYST:FIXT:CONNECT:LEFT:THRU

SCPI Command

AFR:SYSTem:FIXTure:CONNECTion:LEFT:THRU {OFF|ON|0|1}

AFR:SYSTem:FIXTure:CONNECTion:LEFT:THRU?

Description

Sets or reads out the connection configuration of the fixtures A and A aux.

Note. Corresponds to the toggle switch **A-A connection** (see Fixture connection).

command/query

Parameter

{ON|1}   ON (fixtures A and A aux are connected)

{OFF|0}   OFF (fixtures A and A aux are not connected)

Query Response

{0|1}

Related Elements of User Interface

Fixture connection > A - A Connection

Back to AFR:SYSTem

AFR:SYST:FIXT:CONNECT:RIGHT:THRU

SCPI Command

AFR:SYSTem:FIXTure:CONNECTion:RIGHT:THRU {OFF|ON|0|1}

AFR:SYSTem:FIXTure:CONNECTion:RIGHT:THRU?

Description

Sets or reads out the connection configuration of the fixtures B and B aux:

Note. Corresponds to the toggle switch **B-B connection** (see [Fixture connection](#)).

command/query

Parameter

{ON|1}   ON (fixtures B and B aux are connected)

{OFF|0}   OFF (fixtures B and B aux are not connected)

Query Response

{0|1}

Related Elements of User Interface

Fixture connection > B - B Connection

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:LEFT

SCPI Command

AFR:SYSTem:FIXTure:LEFT {OFF|ON|0|1}

AFR:SYSTem:FIXTure:LEFT?

Description

Sets or reads out the state of the checkbox indicating whether the left fixture is in use.

Note. Corresponds to the checkbox **Fixture A** (see Description).

command/query

Parameter

{ON|1}   ON (fixture A is in use)

{OFF|0}   OFF (fixture A is not in use)

Query Response

{0|1}

Related Elements of User Interface

Description > Fixture A

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port> <numeric>

AFR:SYSTem:FIXTure:LEFT:PORT<Port>?

Description

Sets or reads out the port number of the analyzer connected to the left fixture.

Note. Corresponds to the area **Fixture A. Port <Port>** (see Fixture connection).

command/query

Target

Port number <Port> of the fixture,

<Port> = {1|2|...}

The number of fixture ports is specified by the command:

AFR:SYSTem:FIXTure:LEFT:PORT:COUNt?

Parameter

<numeric> port number of the analyzer

Query Response

<numeric>

Related Elements of User Interface

Fixture connection > VNA port

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:COUN

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT:COUNt <numeric>

AFR:SYSTem:FIXTure:LEFT:PORT:COUNt?

Description

Sets or reads out the number of ports of the left fixture.

Note. Corresponds to the area **Fixture A. Num of ports** (see Description).

command/query

Parameter

<numeric> the number of fixture ports

Query Response

<numeric>

Related Elements of User Interface

Description > Num of ports

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:GAT?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:GATing?

Description

Reads out the impulse response value of the left fixture for port <Port>.

Note. Corresponds to **Gating. Fixture A. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

   <Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:GAT:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:GATing:TRACe?

Description

Reads out the impulse response values of the left fixture for port <Port>.

Note. Corresponds to **Gating. Gating trace. Fixture A. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:IMP?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:IMPedance?

Description

Reads out the impedance value of the left fixture for port <Port>.

Note. Corresponds to **Impedance. Fixture A. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:IMP:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:IMPedance:TRACe?

Description

Reads out the impedance values of the left fixture for port <Port>.

Note. Corresponds to **Impedance. Impedance trace. Fixture A. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:LEN?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:LENgth?

Description

Reads out the impulse response value of the left fixture for port <Port>.

Note. Corresponds to **Length. Fixture A. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:LEN:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:LENgth:TRACe?

Description

Reads out the impulse response values of the right fixture for port <Port>.

Note. Corresponds to **Length. Length trace. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:AUX

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX <numeric>

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX?

Description

Sets or reads out the port number of the analyzer connected to the auxiliary (left) fixture.

Note. Corresponds to **Fixture A aux. Port <Port>** (see Fixture connection).

command/query

Target

Fixture port number <Port>,

<Port> = {1|2|...}

The number of fixture ports is specified by the command:

AFR:SYSTem:FIXTure:LEFT:PORT:COUNt?

Parameter

<numeric> the port number of the analyzer

Query Response

<numeric>

Related Elements of User Interface

Fixture connection > VNA port

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:AUX:GAT?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:GATing?

Description

Reads out the impulse response value of the auxiliary (left) fixture for port <Port>.

Note. Corresponds to **Gating. Fixture A aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:AUX:GAT:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:GATing:TRACe?

Description

Reads out the impulse response values of the auxiliary (left) fixture for port <Port>.

Note. Corresponds to **Gating. Gating trace. Fixture A aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:AUX:IMP?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:IMPedance?

Description

Reads out the impedance value of the auxiliary (left) fixture for port <Port>.

Note. Corresponds to **Impedance. Fixture A aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:AUX:IMP:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:IMPedance:TRACe?

Description

Reads out the impedance values of the auxiliary (left) fixture for port <Port>.

Note. Corresponds to **Impedance. Impedance trace. Fixture A aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to AFR:SYSTem

AFR:SYST:FIXT:LEFT:PORT:AUX:LEN?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:LENgth?

Description

Reads out the impulse response value of the left fixture for port <Port>.

Note. Corresponds to **Length. Fixture A. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:LEFT:PORT:AUX:LEN:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:LEFT:PORT<Port>:AUX:LENgth:TRACe?

Description

Reads out the impulse response values of the auxiliary (left) fixture for port <Port>.

Note. Corresponds to **Length. Length trace. Fixture A aux. Port <Port>** (see Fixture measurement).

only query

Target

Number of the fixture port <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT

SCPI Command

AFR:SYSTem:FIXTure:RIGHT {OFF|ON|0|1}

AFR:SYSTem:FIXTure:RIGHT?

Description

Sets or reads out the state of the checkbox indicating whether the right fixture is in use.

Note. Corresponds to the checkbox **Fixture B** (see Description).

command/query

Parameter

{ON|1}	ON (fixture B is in use)
{OFF|0}	OFF (fixture B is not in use)

Query Response

{0|1}

Related Elements of User Interface

Description > Fixture B

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port> <numeric>

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>?

Description

Sets or reads out the port number of the analyzer connected to the right fixture.

Note. Corresponds to the area **Fixture B. Port <Port>** (see [Fixture connection](#)).

command/query

Target

Port number <Port> of the fixture,

<Port> = {1|2|...}

The number of fixture ports is specified by the command:

AFR:SYSTem:FIXTure:RIGHT:PORT:COUNt?

Parameter

<numeric> port number of the analyzer

Query Response

<numeric>

Related Elements of User Interface

Fixture connection > VNA port

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:COUN

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT:COUNt <numeric>

AFR:SYSTem:FIXTure:RIGHT:PORT:COUNt?

Description

Sets or reads out the number of ports of the right fixture.

Note. Corresponds to the area **Fixture B. Num of ports** (see Description).

command/query

Parameter

<numeric> number of fixture ports

Query Response

<numeric>

Related Elements of User Interface

Description > Num of ports

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT:GAT?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:GATing?

Description

Reads out the impulse response value of the right fixture for port <Port>.

Note. Corresponds to **Gating. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to [AFR](#):[SYSTem](#)

FR:SYST:FIXT:RIGHT:PORT:GAT:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT::PORT<Port>:LENgth:TRACe?

Description

Reads out the impulse response values of the right fixture for port <Port>.

Note. Corresponds to **Gating. Gating trace. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to [AFR](#):[SYSTem](#)

AFR:YST:FIXT:RIGHT:PORT:IMP?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:IMPedance?

Description

Reads out the impedance value of the right fixture for port <Port>.

Note. Corresponds to **Impedance. Fixture B. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT:IMP:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:IMPedance:TRACe?

Description

Reads out the impedance values of the right fixture for port <Port>.

Note. Corresponds to **Impedance. Impedance trace. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:LEN?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:LENgth?

Description

Reads out the impulse response value of the right fixture for port <Port>.

Note. Corresponds to **Length. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to [AFR:SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:LEN:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:LENgth:TRACe?

Description

Reads out the impulse response values of the right fixture for port <Port>.

Note. Corresponds to **Length. Length trace. Fixture B. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:AUX

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX <numeric>

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX?

Description

Sets or reads out the port number of the analyzer connected to the auxiliary (right) fixture.

Note. Corresponds to the area **Fixture B aux. Port <Port>** (see Fixture connection).

command/query

Target

Fixture port number <Port>,

<Port> = {1|2|...}

The number of fixture ports is specified by the command:

AFR:SYSTem:FIXTure:RIGHT:PORT:COUNt?

Parameter

<numeric> the analyzer port number

Query Response

<numeric>

Related Elements of User Interface

Fixture connection > VNA port

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT:AUX:GAT?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:GATing?

Description

Reads out the impulse response value of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Gating. Fixture B aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT:AUX:GAT:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:GATing:TRACe?

Description

Reads out the impulse response values of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Gating. Gating trace. Fixture B aux. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Gating

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:AUX:IMP?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:IMPedance?

Description

Reads out the impedance value of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Impedance. Fixture B aux. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:AUX:IMP:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:IMPedance:TRACe?

Description

Reads out the impedance values of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Impedance. Impedance trace. Fixture B aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Impedance

Back to AFR:SYSTem

AFR:SYST:FIXT:RIGHT:PORT:AUX:LEN?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:LENgth?

Description

Reads out the impulse response value of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Length. Fixture B aux. Port <Port>** (see [Fixture measurement](#)).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to [AFR](#):[SYSTem](#)

AFR:SYST:FIXT:RIGHT:PORT:AUX:LEN:TRAC?

SCPI Command

AFR:SYSTem:FIXTure:RIGHT:PORT<Port>:AUX:LENgth:TRACe?

Description

Reads out the impulse response values of the auxiliary (right) fixture for port <Port>.

Note. Corresponds to **Length. Length trace. Fixture B aux. Port <Port>** (see Fixture measurement).

only query

Target

Port number <Port>,

<Port> = {1|2|...}

Query Response

<numeric 1>, <numeric 2>, … <numeric N>

Related Elements of User Interface

Fixture measurement > Edit characterization > Length

Back to AFR:SYSTem

AFR:SYST:LP:IGN

SCPI Command

AFR:SYSTem:LPass:IGNore {OFF|ON|0|1}

AFR:SYSTem:LPass:IGNore?

Description

Sets or reads out the state of the Ignore low pass toggle switch.

Note. Corresponds to the toggle switch **Ignore low pass** (see VNA setup).

When the switch is turned on, the plug-in ignores the recommended frequency grid check and does not perform impedance conversion.

command/query

Parameter

{ON|1}   ON

{OFF|0}   OFF

Query Response

{0|1}

Related Elements of User Interface

VNA setup > Ignore low pass

Back to AFR:SYSTem

AFR:SYST:PRES

SCPI Command

AFR:SYSTem:PRESet

Description

Resets the plug-in to the default settings.

no query

Related Elements of User Interface

Description > Plug-in preset

Back to [AFR:SYSTem](#)

AFR:SYST:SET:SAVE

SCPI Command

AFR:SYSTem:SETup:SAVE <string>

Description

Saves the current plug-in settings.

no query

Parameter

<string> - name of the file where the settings will be written.

Related Elements of User Interface

Description > Plug-in preset

Back to [AFR](#):[SYSTem](#)

AFR:SYST:READ?

SCPI Command

AFR:SYSTem:READy?

Description

Reads out the analyzer readiness status.
query only

Query Response

{0|1}

Where "0" is plug-in is not ready, "1" is plug-in is ready

Related Controls of User Interface

None

Back to <u>AFR</u>:<u>SYSTem</u>

AFR:SYST:STAT:LOAD

SCPI Command

AFR:SYSTem:STATe:LOAD <string>

Description

Recalls the plug-in state file.

The plug-in control setup and analyzer parameters, including the calibration data, are loaded.

no query

Parameter

<string> file name, with the *.sta extention

Related Controls of User Interface

Description > Recall Setup

Back to AFR:SYSTem

AFR:SYST:STEP:COUN?

SCPI Command

AFR:SYSTem:STEP:COUNt?

Description

Returns the number of measurement steps in the Fixture Measurement tab.

query only

Query Response

<numeric>

Related Controls of User Interface

None

Back to AFR:SYSTem

AFR:SYST:STEP:DATA:DEL

SCPI Command

AFR:SYSTem:STEP<Step>:DATA:DELete

Description

Deletes the data at the <Step> measurement step.

Note. Corresponds to **Fixture measurement > Step <Step> of N > Delete data** (see [Fixture measurement](#)).

no query

Target

Measurement step <Step>, except for the step of measuring the parameters of the fixture with the DUT.

<Step> = {1|2|...}

Related Elements of User Interface

None

Back to [AFR](#):[SYSTem](#)

AFR:SYST:STEP:MEAS?

SCPI Command

AFR:SYST:STEP<Step>:MEASured?

Description

Returns the completion state of a particular measurement step <Step>.

Note. Corresponds to **Fixture measurement > Step <Step> of N** (see Fixture measurement).

query only

Target

Measurement step <Step>,

<Step> = {1|2|...}

Query Response

{0|1}

Where "0" - step is not measured, "1" - step is successfully measured.

Related Controls of User Interface

None

Back to AFR:SYSTem

AFR:SYST:STEP:REF:APPR

SCPI Command

AFR:SYSTem:STEP<St>:REFlect:APPRoximation {OFF|ON|0|1}

Description

Sets the state of the Use compensation of the max signal by the spline compensation checkbox.

1xReflect method. When the checkbox is enabled, the max signal is filtered in the time domain and smoothed. When this option is off, the signal is only filtered.

Note. Corresponds to the checkbox **Use compensation of the max signal by the spline compensation** (See Fixture Measurement).

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}	ON
{OFF|0}	OFF

Related Controls of User Interface

Fixture measurement > Step <Step> of N > Use compensation of the max signal by the spline approximation

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:REF:OFFS

SCPI Command

AFR:SYSTem:STEP<Step>:REF:OFFS {OFF|ON|0|1}

Description

Sets the offset mode of the fixture calibration plane at the <Step> measurement step.

1xReflect method. To set the offset value, use the AFR:CALC:STEP<Step>:REF:OFFS command.

no query

Target

Measurement step <Step>,

> <Step> = {1|2|...}

Parameter

{ON|1}	ON
{OFF|0}	OFF

Related Commands

AFR:CALCulate:STEP<Step>:REFlect:OFFSet <numeric>

Related Controls of User Interface

Fixture measurement > Step <Step> of N > Apply fixture calibration plane offset

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:REF:OPEN

SCPI Command

AFR:SYSTem:STEP<Step>:REFlect:OPEN {OFF|ON|0|1}

Description

Sets the fixture reflection measurement mode at the <Step> measurement step to the Open state.

1xReflect method. To make measurements, use the AFR:CALC:STEP<Step>:REF:OPEN command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}   ON

{OFF|0}   OFF

Related Commands

AFR:CALCulate:STEP<Step>:REFLect:OPEN

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 1xReflect setup > Open

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:REF:SHOR

SCPI Command

AFR:SYST:STEP<Step>:REF:SHORt {OFF|ON|0|1}

Description

Sets the fixture reflection measurement mode at the <Step> measurement step to the Short state.

1xReflect method. To make measurements, use the AFR:CALC:STEP<Step>:REFL:SHOR command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

| {ON|1} | ON |
| {OFF|0} | OFF |

Related Commands

AFR:CALCulate:STEP<Step>:REFLect:SHORt

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 1xReflect setup > Short

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:THRU:OFFS

SCPI Command

AFR:SYSTem:STEP<Step>:THRU:OFFSet {OFF|ON|0|1}

Description

Sets the manual input mode of the calibration plane offset at the <Step> measurement step.

2xThrough method. To set the offset values of each fixture, use the AFR:CALC:STEP<Step>:THRU:OFFS <numeric 1> , <numeric 2> command.

The command disables automatic determination mode of the calibration plane offset if it was previously enabled by the AFR:SYST:STEP<Step>:THRU:REFOFFS 1 command.

Execution of the command is ignored if the measurements were not performed at step <Step>. To find out the state of the measurement step, use the AFR:SYST:STEP<Step>:MEAS? command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}   ON

{OFF|0}   OFF

Related Commands

AFR:CALCulate:STEP<Step>:THRU:OFFSet <numeric 1>,<numeric 2>

AFR: SYST:STEP<Step>:MEASured?

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to [AFR](#):[SYSTem](#)

AFR:SYST:STEP:THRU:REFOFFS

SCPI Command

AFR:SYSTem:STEP<St>:THRU: REFOFFSet {OFF|ON|0|1}

Description

Sets automatic calibration plane offset mode at the <Step> measurement step.

The command disables manual input mode of the calibration plane offset if it was previously enabled by the AFR:SYST:STEP<Step>:THRU:OFFS {1|ON} command.

Execution of the command is ignored if the measurements were not performed at step <Step>. To find out the state of the measurement step, use the AFR:SYST:STEP<Step>:MEAS? command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}	ON
{OFF|0}	OFF

Related Commands

AFR:SYSTem:STEP<Step>:THRU:OFFSet

AFR:SYST:STEP<Step>:MEASured?

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to

AFR:SYST:STEP:THRU:REFOFFS:OPEN

SCPI Command

AFR:SYSTem:STEP<St>:THRU: REFOFFSet:OPEN {OFF|ON|0|1}

Description

Sets reflection measurements at the <Step> measurement step to the Open state. It is used for automatic determination of the calibration plane offset values. **2xThrough method.** To make measurements, use the AFR:CALC:STEP<Step>:THRU:REFOFFS:OPEN command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}	ON
{OFF|0}	OFF

Related Commands

AFR:CALCulate:STEP<Step>:THRU:REFOFFSet:OPEN

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 calibration plane offset using reflects > Open

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:THRU:REFOFFS:SHOR

SCPI Command

AFR:SYSTem:STEP<St>:THRU:REFOFFSet:SHORt {OFF|ON|0|1}

Description

Sets reflection measurements at the <Step> measurement step to the Short state. It is used for automatic determination of the calibration plane offset values. **2xThrough method.** To make measurements, use the AFR:CALC:STEP<Step>:THRU:REFOFFS:SHOR command.

no query

Target

Measurement step <Step>,

<Step> = {1|2|...}

Parameter

{ON|1}	ON
{OFF|0}	OFF

Related Commands

AFR:CALCulate:STEP<Step>:THRU:REFOFFSet:SHORt

Related Controls of User Interface

Fixture measurement > Step <Step> of N > 2xThrough method > Apply fixture F1/F2 Aux calibration plane offset using reflects > Short

F1 - name of the left fixture,

F2 - name of the right fixture,

N - maximum number of steps.

Back to AFR:SYSTem

AFR:SYST:STEP:TYPE?

SCPI Command

AFR:SYSTem:STEP<Step>:TYPE?

Description

Returns the <Step> step type according to the connection configuration: 1xReflect (reflection), 2xThrough (transmission), DUT (measurement of the parameters of the fixture along with the DUT).

query only

Target

Measurement step <Step>,

<Step> = {1|2|...}

Query Response

{REFLECTION|TRANSMISSION|DUT}

Related Controls of User Interface

None

Back to AFR:SYSTem

AFR:SYST:VNA:DEF

SCPI Command

AFR:SYSTem:VNA:DEFault

Description

Resets the IP address and connection port of the analyzer to default settings.

Note. Corresponds to the area **VNA network** (see Settings).

no query

Related Elements of User Interface

Settings > Default

Back to AFR:SYSTem

AFR:SYST:VNA:IP

SCPI Command

AFR:SYSTem:VNA:IP <string>

AFR:SYSTem:VNA:IP?

Description

Sets or reads out the IP address of the connection to the analyzer.

Note. Corresponds to the area **VNA network** (see Settings).

command/query

Parameter

<string> IP address of the analyzer

Query Response

<string>

Related Elements of User Interface

Settings > IP

Back to AFR:SYSTem

AFR:SYST:VNA:PORT

SCPI Command

AFR:SYSTem:VNA:PORT <numeric>

AFR:SYSTem:VNA:PORT?

Description

Sets or reads out the port number of the connection to the analyzer.

Note. Corresponds to the area **VNA network** (see Settings).

command/query

Parameter

<numeric> analyzer port number

Query Response

<numeric>

Related Elements of User Interface

Settings > Port

Back to AFR:SYSTem

AFR:SYST:ZCON:TYPE

SCPI Command

AFR:SYSTem:ZCONversion:TYPE <char>

AFR:SYSTem:ZCONversion:TYPE?

Description

Sets or reads out the state of the **VNA cal reference Zo** segment switch. The impedance calculation and conversion functions are available in low pass mode only.

Note. Corresponds to the segment switch **After removal set VNA cal reference Zo to** (See VNA setup).

command/query

Parameter

<char> impedance used for S-parameters conversion:

FIXTure	Impedance of the fixture
SYSTem	System impedance of the Analyzer
USer	Impedance value specified by the user

Query Response

{FIXT|SYST|US|NONE}

Related Elements of User Interface

VNA setup > After removal set VNA cal reference set to Z0 { Fixture | System | Custom }

Back to AFR:SYSTem

Programming Examples

To control AFR remotely, it is required to set the settings as specified in <u>Settings</u> section.

This plug-in demonstrates AFR remote control using the Python 3 programming language.

```python
import socket
import sys

def runQuery(client, command):
client.send(bytes(command, encoding='raw_unicode_escape'))
return client.recv(4096).decode("utf-8")

def runCommand(client, command):
client.send(bytes(command, encoding='raw_unicode_escape'))

HOST = '127.0.0.1'
PORT = 5026

client = socket.socket()
client.connect((HOST,PORT))
isReady = True if (runQuery(client, 'AFR:SYST:READ?\n') == '1\n') else False

if (not isReady):

    print('Plugin not ready')
    client.close()
    sys.exit()
```

```python
stepCount = int(runQuery(client, 'AFR:SYST:STEP:COUN?\n'))
for step in range(1, stepCount + 1):
  type = runQuery(client, 'AFR:SYST:STEP{}:TYPE?\n'.format(step))
  print(type)


  if (type == 'TRANSMISSION\n'):
      runCommand(client, 'AFR:CALC:STEP{}:THRU\n'.format(step))


      runCommand(client, 'AFR:SYST:STEP{}:THRU:OFFS
ON\n'.format(step))
      runCommand(client, 'AFR:CALC:STEP{}:THRU:OFFS
100,200\n'.format(step))
      elif (type == 'REFLECT\n'):
      runCommand(client, 'AFR:SYST:STEP{}:REF:APPR ON\n'.format(step))


      runCommand(client, 'AFR:SYST:STEP{}:REF:OPEN ON\n'.format(step))
      runCommand(client, 'AFR:CALC:STEP{}:REF:OPEN\n'.format(step))


      runCommand(client, 'AFR:SYST:STEP{}:REF:SHOR ON\n'.format(step))
      runCommand(client, 'AFR:CALC:STEP{}:REF:SHOR\n'.format(step))


  elif (type == 'DUT\n'):
      runCommand(client, 'AFR:CALC:STEP{}:DUT\n'.format(step))


runCommand(client, 'AFR:CALC:STEP{}:THRU\n'.format(stepCount + 1))
print(runQuery(client, 'AFR:SYST:ERR?\n'))


runCommand(client, 'AFR:SYST:CORRECT:SAVE
\"C:/Users/User/Desktop/File\"\n')


runQuery(client, '*OPC?\n')
client.close()
```

Program description:

1. Connects the libraries that will be used in the program code.

```
import socket
import sys
```

The socket library is used to communicate with the TCP server. **The sys library** is used to interact with the Python interpreter.

2. Declares auxiliary functions that allow reuse of server communication code.

```
def runQuery(client, command):
  client.send(bytes(command, encoding='raw_unicode_escape'))
  return client.recv(4096).decode("utf-8")


  def runCommand(client, command):
      client.send(bytes(command, encoding='raw_unicode_escape'))
```

The runQuery(client, command) function receives a socket and a command as input. The command is converted from a string to an array of bytes. The array is sent to the server using the socket. The socket then waits for a response from the server. The recv() method of the socket is used for this action. The recv() method of the socket requires to specify the number of bytes to be received from the server, e. g. 4096. The result is then converted to a string.

The runCommand(client, command) function also receives a socket and a command as input. The command is converted from a string to an array of bytes, which is then sent to the server using the socket. The runCommand(client, command) function does not get the result from the server.

3. Saves the server IP address (127.0.0.1) and the port used to connect (5026) to variables. Then creates a socket that connects to the server at the specified IP address and port.

```
HOST = '127.0.0.1'
PORT = 5026


client = socket.socket()
client.connect((HOST,PORT))
```

4. Sends the 'AFR:SYST:READ?\n' command to the server, which queries the connection status of the plugin to VNA. If the answer is 1, i.e. the plug-in is connected to VNA, it sets the variable to True.

Checks the connection status. If there is no connection, it displays the message Plug-in is not ready. Then closes the socket connection and terminates the program.

```
isReady = True if (run_query(client, 'AFR:SYST:READ?\n') == '1\n') else False

if (not isReady):

  print('Plugin is not ready')

  client.close()

  sys.exit()
```

5. Retrieves the number of measurement steps with the command 'AFR:SYST:STEP:COUN?\n'. Then for each step starting from the first one it retrieves its type by using the command 'AFR:SYST:STEP{}:TYPE?\n'.

The format() method is used to write values to the command line. Inputting the step number into this method will replace the curly brackets. The measurement step is written similarly for the rest of the commands.

```
stepCount = int(runQuery(client, 'AFR:SYST:STEP:COUN?\n'))

for step in range(1, stepCount + 1):

  type = runQuery(client, 'AFR:SYST:STEP{}:TYPE?\n'.format(step))
```

6. If the measurement step type is 'TRANSMISSION', it performs an S-parameter measurement of the two fixtures with the 'AFR:CALC:STEP{}:THRU\n' command. Then it activates the offset mode of the calibration plane with the command 'AFR:SYST:STEP{}:THRU:OFFS ON\n'. After activating the mode, the offset values can be set with the command 'AFR:CALC:STEP{}:THRU:OFFS 100,200\n'. It passes the necessary offset values set in picoseconds, e.g. 100 and 200 in place of parameters.

```
if (type == 'TRANSMISSION\n'):

  runCommand(client, 'AFR:CALC:STEP{}:THRU\n'.format(step))


  runCommand(client, 'AFR:SYST:STEP{}:THRU:OFFS ON\n'.format(step))

  runCommand(client,                           'AFR:CALC:STEP{}:THRU:OFFS
  100,200\n'.format(step))
```

7. If the step type is 'REFLECT\n' the command 'AFR:SYST:STEP{}:REF:APPR ON\n' is executed, which enables filtering and smoothing of the maximum signal.

'AFR:SYST:STEP{}:REF:OPEN ON\n' then activates the mode to measure the reflection coefficients of the fixture in the second step in the Open state. When this mode is activated, you can measure fixture reflection coefficients with the 'AFR:CALC:STEP{}:REF:OPEN\n' command.

'AFR:SYST:STEP{}:REF:SHOR ON\n' then activates the mode to measure fixture reflection coefficients in the second step in the Short state. When the mode is activated, fixture reflection coefficients can be measured with the command 'AFR:CALC:STEP{}:REF:SHOR\n'..

```
elif (type == 'REFLECT\n'):

  runCommand(client, 'AFR:SYST:STEP{}:REF:APPR ON\n'.format(step))



  runCommand(client, 'AFR:SYST:STEP{}:REF:OPEN ON\n'.format(step))

  runCommand(client, 'AFR:CALC:STEP{}:REF:OPEN\n'.format(step))



  runCommand(client, 'AFR:SYST:STEP{}:REF:SHOR ON\n'.format(step))

  runCommand(client, 'AFR:CALC:STEP{}:REF:SHOR\n'.format(step))
```

8. Provided that the measurement step type is 'DUT\n, performs a measurement of the input and output reflection coefficient of the fixture with the DUT using the 'AFR:CALC:STEP{}:DUT\n' command.

```
elif (type == 'DUT\n'):

  runCommand(client, 'AFR:CALC:STEP{}:DUT\n'.format(step))
```

9. When executing a command for a non-existent step, the 'AFR:SYST:ERR?\n' command can be used to obtain the error code. The received value is displayed on the screen as follows:

```
runCommand(client, 'AFR:CALC:STEP{}:THRU\n'.format(stepCount + 1))

print(runQuery(client, 'AFR:SYST:ERR?\n'))
```

10. Saves the results using the command 'AFR:SYST:CORRECT:SAVE \"C:/Users/User/Desktop/File\"\n', specifying the file path.

```
run_command(client, 'AFR:SYST:CORRECT:SAVE
\"C:/Users/User/Desktop/File\"\n')
```

11. Using the command '*OPC?\n' makes the pug-in wait for completion of all requested commands. Before execution, it performs socket connection to ensure that all commands are completed.

```
run_query(client, '*OPC?\n')

client.close()
```

Troubleshooting

This section describes troubleshooting:

- [The AFR plug-in is waiting for the VNA to be connected and the VNA is not connecting](#).

- [The AFR plug-in cannot locate a valid license file](#).

- [Internet Connection Required for License Validation.](#)

If you can't find a solution to your problem in the above sections, please [contact us](#).

Waiting for VNA

The AFR plug-in is waiting for the VNA to be connected and the VNA is not connecting.
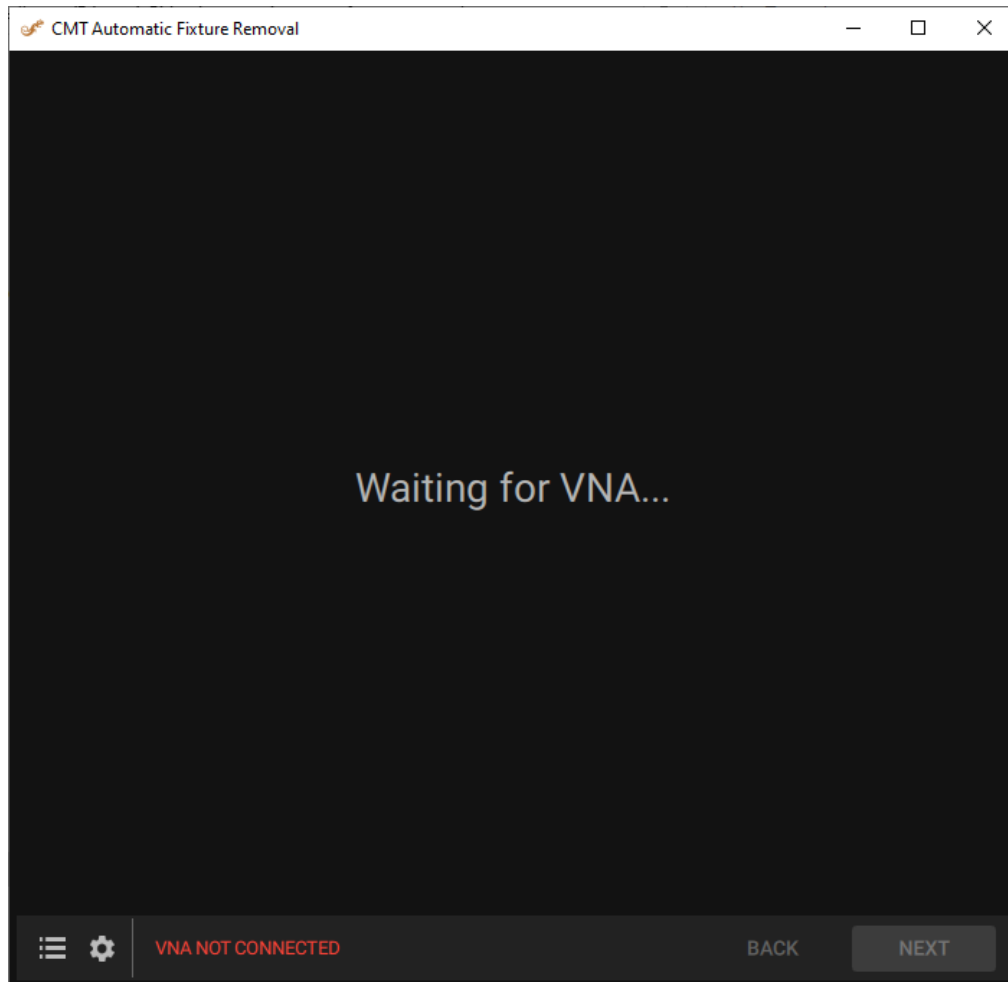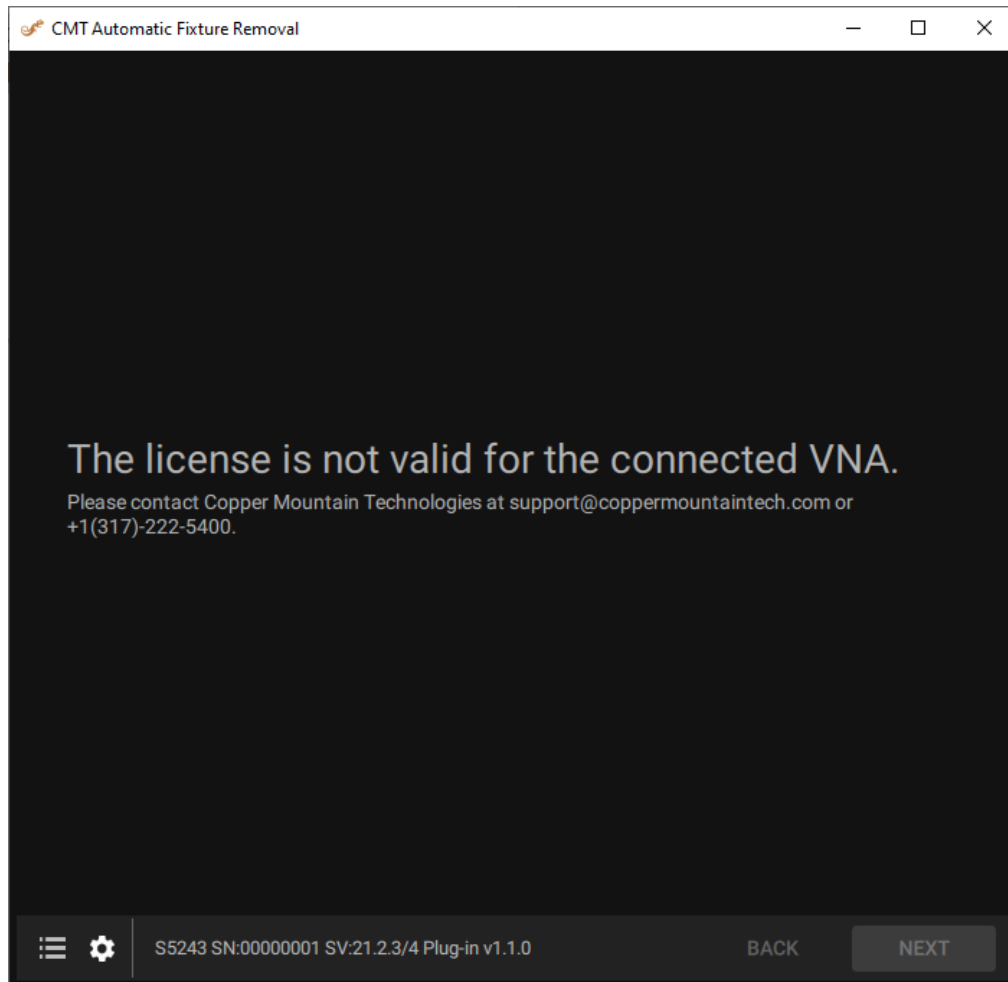
Solution

1. Confirm the VNA is powered on. The VNA software should display **READY** in the status bar.

2. Confirm the Socket Server is ON in the VNA software. To enable the Socket Server, click the following VNA software buttons: **System > Misc Setup > Network Remote Control Settings > Socket Server > ON**.

3. Confirm the [Socket Server settings](#) are correct and match in both the VNA software and the AFR plug-in. To access the VNA software Socket Server settings, click the following VNA software buttons: **System > Misc Setup > Network Remote Control Settings**.

4. If the problem persists, switch off the power to all VNAs, restart the computer, then power on only the VNA you want to use. Open the VNA software and start the AFR plug
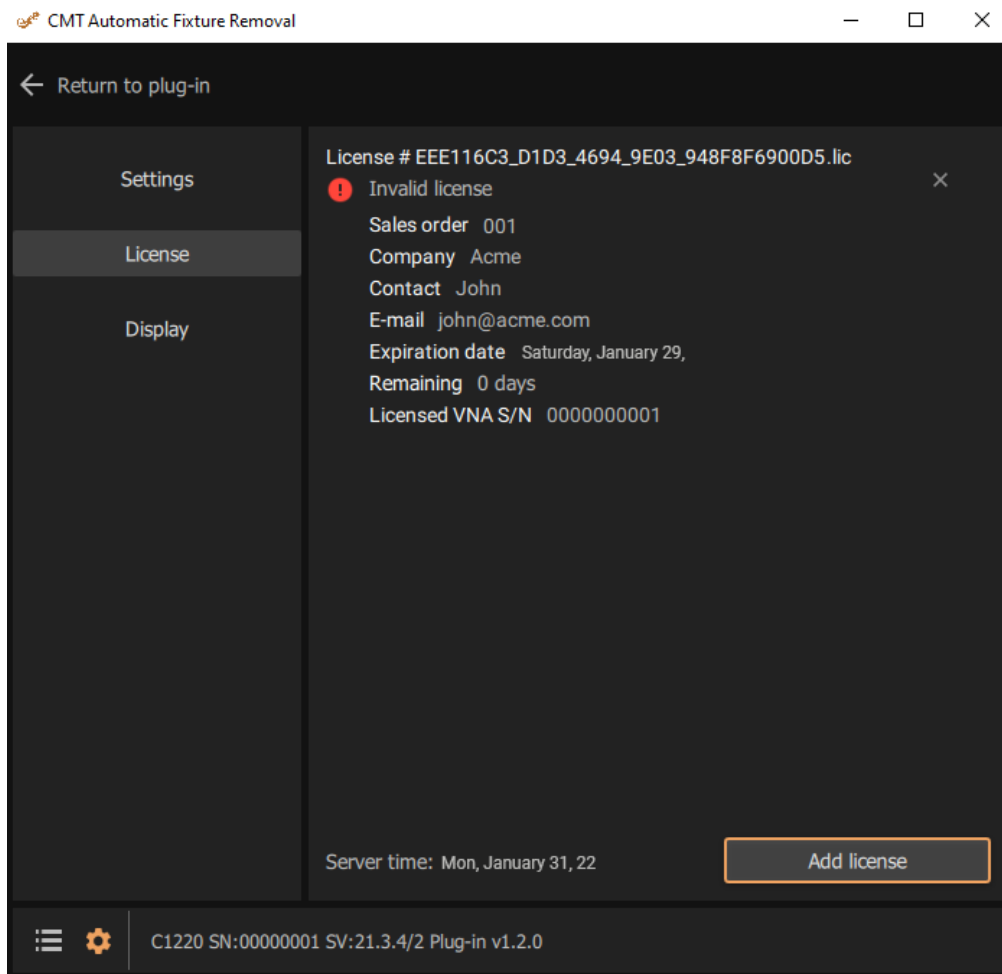

NOTE	See [VNA Network](#) settings for more information.

A Valid License File Cannot Be Found

The AFR plug-in cannot locate a valid license file.

Missing license file

Limited license expired

Solution

1. The AFR requires a license purchase. To obtain a license, please contact Copper Mountain Technologies at sales@coppermountaintech.com or +1 (317) 222-5400.

2. Confirm that license file is located in the Plugins folder of the VNA software.

3. Confirm that serial number of connected VNA matches the the license.

4. Confirm that license has not expired.

5. Confirm there is an Internet connection.

NOTE

You can view the license information in the AFR plug-in Settings.

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END-USER LICENSE AGREEMENT

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Glossary

Prefixes

μ	micro (10^{-6})
m	milli (10^{-3})
k	kilo (10^{3})
M	Mega (10^{6})
G	Giga (10^{9})

Number / Symbols

Ω	ohm
dB	decibel
dBm	decibels above 1 milliwatt
W	Watt
F	Farad
H	Henry
Hz	Hertz
m	meter
sec	second
V	Volt

ACM	Automatic Calibration Module
AFR	Automatic Fixture Removal
CMT	Copper Mountain Technologies
DUT	Device Under Test
IF	Intermediate Frequency
LRL	Line-Reflect-Line calibration
PC	Personal Computer
SCPI	Standard Commands for Programmable Instruments
S-parameters	Scattering parameters of linear electrical network
SOLT	Short-Open-Load-Through Calibration
SOLR	Short-Open-Load-Reciprocal Calibration
TRL	Thru-Reflect-Line Calibration
USB	Universal Serial Bus
VNA	Vector Network Analyzer

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