PICOTEST

Component Test Fixture

Documentation

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Declaration of Conformity (EU)

CE

The equipment adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) directive and the RoHS directive.

Declaration of Conformity (UK)

UKCA

The equipment adheres to the regulations of the UK government for meeting the requirements regarding the Electromagnetic Compatibility (EMC) Regulation and the Regulation for Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment.

Information for disposal and recycling

The Picotest Probes and Cables and all its accessories are not intended for household use. At the end of its service life, do not dispose of the test set with household waste!

For customers in EU countries (incl. European Economic Area) Picotest test sets are subject to the EU Waste Electrical and Electronic Equipment Directive (WEEE directive). As part of our legal obligations under this legislation, Picotest offers to take back the test set and to ensure that it is disposed of by an authorized recycling facility.

For customers outside the European Economic Area

Please contact the authorities in charge of the relevant environmental regulations in your country and dispose of Picotest products and all its accessories only in accordance with your local legal requirements.

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Chapter 1 - Overview

Welcome

Thank you for purchasing Picotest's Component Test Fixture (CTF).

The Picotest Component Test Fixture is a precision, two-port shunt-through measurement interface designed specifically for ultra-precise impedance (capacitance, inductance, impedance magnitude & phase) characterization of discrete components over a wide frequency range and with the ability to DC bias components up to 75VDC. With this fixture you can connect directly to a vector-network analyzer (VNA)with minimal parasitics and outstanding accuracy and repeatability. The CTF is especially designed to work with VNAs such as the OMICRON Lab Bode 100/500 and the Keysight E5061B.

Whether you are creating models for SPICE, Keysight ADS, or end-to-end PDN/impedance simulation, the fixture empowers you to base your work on real, measurement-derived impedance data rather than relying on approximate datasheet values.

Mounting is fast and intuitive—swap in inductors, capacitors, resistors or custom beads, apply AC and an optional DC bias, and capture impedance vs frequency, phase, or parasitic inductance as needed. With support for uΩ to kΩ impedance levels and DC to 3 GHz bandwidth, the fixture covers most discrete component test needs for power-electronics, aerospace, cloud/data-center and automotive power-integrity work.

The CTF includes the bottom base unit (with 2-port connectors), DC bias module, and top personality module with pin contacts. Calibration, sample, and blank DUT boards are also included.

The provided DUT boards accept 0201, 0402, 0603, 0805, 1206, and 1210 component sizes. Customized DUT boards to test under/oversized parts or updated personality modules for other devices are available.

Included in the kit are SMA and N torque wrenches for consistent connector engagement, calibration standards (SOLT boards and impedance calibration), blank DUT boards, and known reference DUTs so you can verify and optimize your setup. Built-in common-mode transformers isolate the shunt path from ground-loop artifacts—so you don't need to add external isolators. Simply connect your VNA, apply bias if required, calibrate, mount the part and measure—delivering component data that directly feeds into your modelling, simulation and PB-networks. With the Picotest Component Test Fixture you gain:

- A compact, repeatable 2-port measurement setup optimized for discrete component impedance quantification.
- Full compatibility with VNA workflows and simulation-model creation (capacitance, inductance, ESR, impedance vs frequency, phase).
- De-embedding and calibration ready so that you minimize fixture-residual error and maximize the fidelity of the DUT measurement.
- Flexible mounting and bias capability (AC via VNA; DC bias up to 75 V) supporting realistic operating conditions.
- A comprehensive kit—including reference parts, calibration boards and blank DUT boards—so you are up and running quickly with known performance.

In short, this fixture is engineered for power-integrity and component-characterization engineers who demand measurement-based models, not just datasheet approximations. It enables the accurate benchmark data you need to ensure your simulation models reflect real-world behavior, improving your confidence in the results and integrity of your end-applications.

Benefits

- Measure components to an accuracy and fidelity level that could not be measured before.
- Achieve measurements with pH fidelity necessary for today's PDN simulations
- Easy to use and calibrate 2-port shunt through impedance measurement
- Simple part mounting – Covers 0201 - 1206
- Characterized PCB enables accurate calibration and de-embedding
- Greatly enhances simulation accuracy
- Enables accurate part characterization for use with the Bode Analyzer SPICE Modeling tool and other simulators
- Enables measurement-based models
- Fixture physically holds the DUT
- Excellent accuracy with repeatability
- Multiple component form factors
- AC (Instrument) and DC Bias (up to 75V)

Features

- Offers a wide frequency range: DC to 3GHz.
- Enables measuring impedance from uΩ to kΩ
- Features hand placed DUT and quick mounting for component changes
- Includes calibrator PCBs for each setup (SOL).
- Supports AC (through the VNA) and DC Bias testing
- Includes the common mode transformer to alleviate ground loop issues. No additional isolator needed.

What's Included

Your Picotest CTF includes the following:

- One (1) Component Test Fixture
- One (1) SMA torque wrench
- One (1) N torque wrench
- Known DUT kit: One (1) 1.2nH Inductor, One (1) 50 mOhm DUT, One (1) 1 mOhm DUT, One (1) Ceramic Capacitor
- Impedance calibration kit: Three (3) calibration boards - to be used with Bode 100/500 or E5061B
- 2-port calibration kit: Three (3) calibration boards - to be used with E5601B and other VNAs
- Five (5) blank boards (0402, 0603, 0805, 1206, and 1210)
- DC Bias Adapter
- Two (2) PDN cables 12" BNC-SMA
- One (1) Molex 4-pin cable *

* Cabling to the fixture is supplied (Molex cable) allowing you to apply a DC bias of up to 75V.

Figures 1: The calibration, sample, and blank DUT boards that come with the CTF.

Figures 2: The CTF base unit (showing the 2-port connections), top personality module (left) and the DC bias module (interleaved between the two when stacked).

Documentation and Support

This documentation details the use of the CTF for various types of measurements. Specifications are also included.

The support section of Picotest's web site, https://www.picotest.com/support.html, contains additional documentation and various publications on testing power supplies, PDNs, and components using the Picotest CTF.

Warranty

Every Picotest product you buy from Picotest.com is backed by a 1-year manufacturer's warranty. For warranty service or repair this product must be returned to a service facility designated by PICOTEST. Please contact your local service representative for further assistance.

Calibration

The CTF unit itself does not require calibration.

Chapter 2 – Introduction to the Component Test Fixture

Connecting the CTF to the VNA

The CTF consists of a base unit, DC bias module, calibration boards, device under test (DUT) boards to hold the part being tested, and a personality module (holder for the DUT boards). The three modules stack on one another. The DC bias layer should not be connected unless you plan to bias the component. The unused DC bias layer will impact results if not active. The CTF is designed to be connected in a 2-port shunt through configuration using the supplied PDN cables and to perform an impedance measurement. DUT boards are placed on the six pogo pins of the personality module and handheld in place for the duration of the measurement.

Figures 3: The CTF is connected to the Bode 100 (left) and the Keysight E5061B (right) on the S-parameter ports. You can connect to the low frequency T/R ports via the Picotest J2160A 2-Port Probe Adapter Panel.

Figures 4: Picotest J2160A 2-Port Probe Adapter Panel that converts the low frequency E5061B T/R port into a 2-port shunt through configuration.

Except for the DC bias module, the CTF does not require any external power. The fixture ports are symmetrical. For the Bode 100/500, one port is connected to the VNA output, and the other port is connected to Channel 2. No external software is required for CTF operation.

NO additional ground loop isolator is needed to alleviate ground loop issues, as one is included inside the CTF. Ground loop isolation is included in the CTF so no external isolators (J2102B, J2113A, J2114A, J2115A, etc.) are needed.

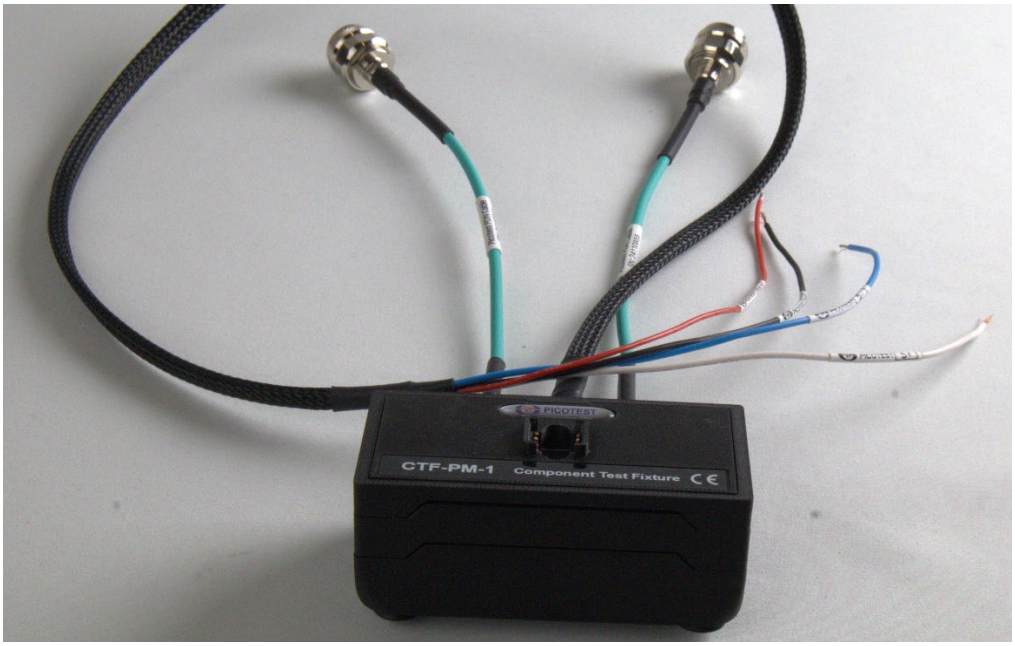


Figure 5: Assembled unit with 2-port connections and DC bias cable. Do NOT use the DC bias layer unless you plan on biasing the test component.

Calibrating a Measurement – Bode 100/500

The procedure for calibrating the CTF when used with the OMICRON Lab Bode 100 or Bode 500 VNAs is shown below.

Bode 100/500 VNA Setting Notes
For very low impedance (< ~1mOhm) measurements it is best to set the following items in the Bode Analyzer software:

- Set Receiver 2 attenuation to 0dB
- For the OPEN (THRU board) and LOAD (2PM board) calibrations, set the source power level so it doesn't overload (0dBm should be ok)
- Close the calibration panel and increase the source power to the MAXIMUM level and open calibration panel. The OPEN and LOAD will still be green. Now perform the SHORT (ISO SHORT) calibration. They will all be green and ready for DUT measurements.

Setting the Receiver Bandwidth to half of your start frequency will allow accurate readings at the lower frequencies of your sweep while also maintaining a proper signal-to-noise ratio. The recommended initial starting point is to set this to 30 Hz. However, as per the Bode 500 datasheet the maximum dynamic range can be achieved by setting this to 10Hz if desired. Sweeps may take longer as the BW is lowered.

Bode 100/500 VNA Setting Notes

Step 1: In the Bode Analyzer Suite, if starting a new project, select *Impedance Analysis* > *Shunt-Thru*. Otherwise, open your existing project.

Step 2: Set your desired frequency sweep settings and change the *Source Level* to 16 dBm (or 13 dBm if using the Bode 100).

Set the *Attenuator* level to 0 dB and the *Receiver Bandwidth* to at least half of your start frequency. You may or may not need to set 10dB on Attenuator 2 in order to prevent channel overload.

Step 3: Under the *Home* tab, select the *User-Range Impedance Calibration* > *Perform New Calibration*.

Step 4: Perform the Open calibration using the THRU board. To do so, place the calibration board **FACE DOWN** on the CTF. (NOT the 'OPEN Board for Bode users).

Press ***FIRMLY*** and hold, as shown in Figure 3, then select "*Start*" next to *Open* in the Open/Short/Load calibration. Once the Open calibration is complete, you will see "*Performed*" next to the corresponding step.

- Note: you must press firmly enough so that the contact pins are all depressed. You do NOT have to compress the pins all the way down to their limit.
- NOTE - if you receive an overload warning during the Open calibration, exit the calibration screen and increase the *Attenuator* level ONLY for the Open calibration step. Change the attenuation level back to 0 dB for Load and Short.

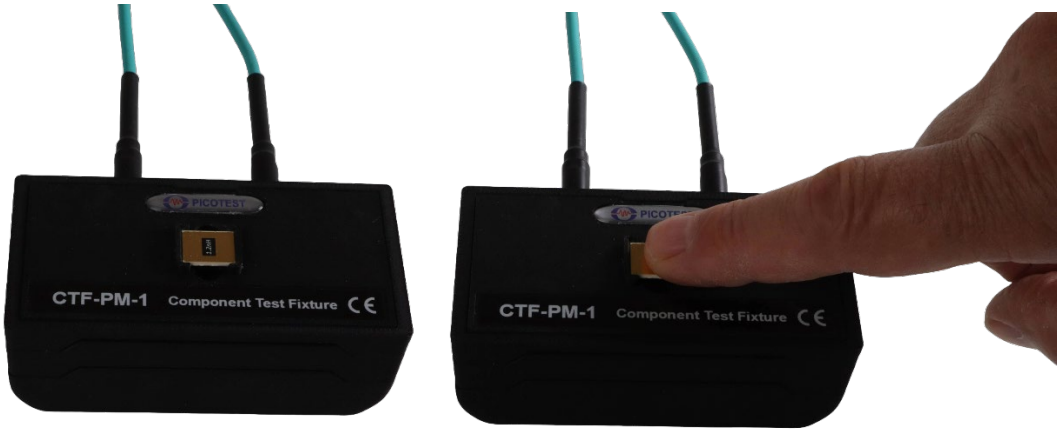


Figure 6: With the Calibration Board on the CTF, Press Firmly and Hold for the Entire Duration of Calibration Step.

Step 5: Perform the Load calibration using the **2PM board**, with the same method as used in step 4. (NOT the 'LOAD' Board for Bode users).

Step 6: Perform the Short calibration using the ISO SHORT board, with the same method as used in step 4. (NOT the 'SHORT Board for Bode users).

Step 7: Confirm that all calibration steps were completed, as shown in Figure 4.

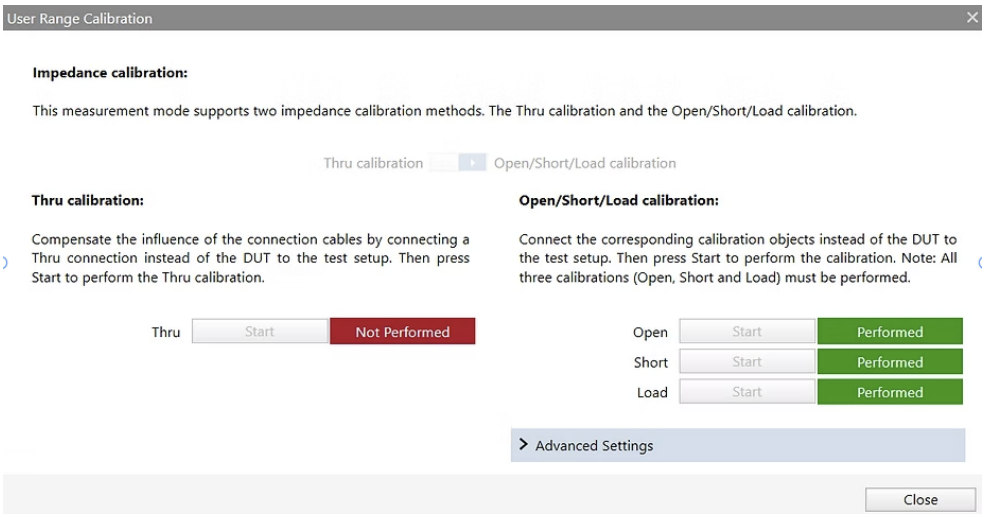


Figure 7: Completed Calibration in the Bode Analyzer Suite.

Step 8: Press **Close** to exit the calibration screen.

Step 9: Use the ISO SHORT board to obtain a noise floor measurement. This should look like the figure below.

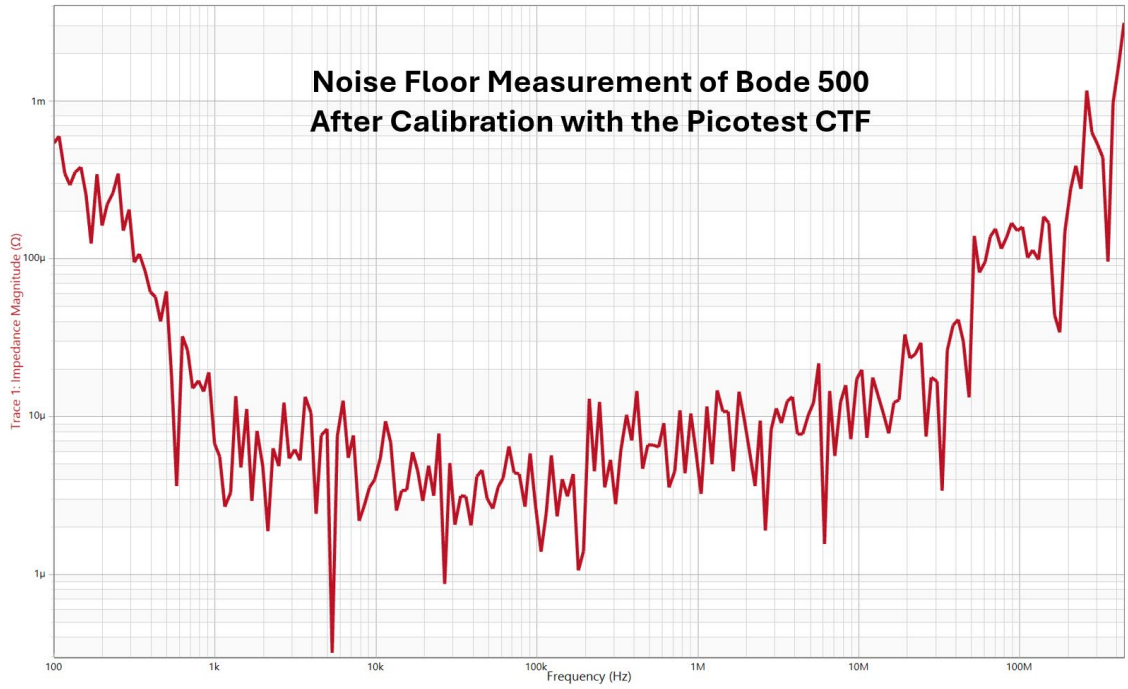


Figure 8: Noise Floor on Bode 500 After Calibrating with the CTF.

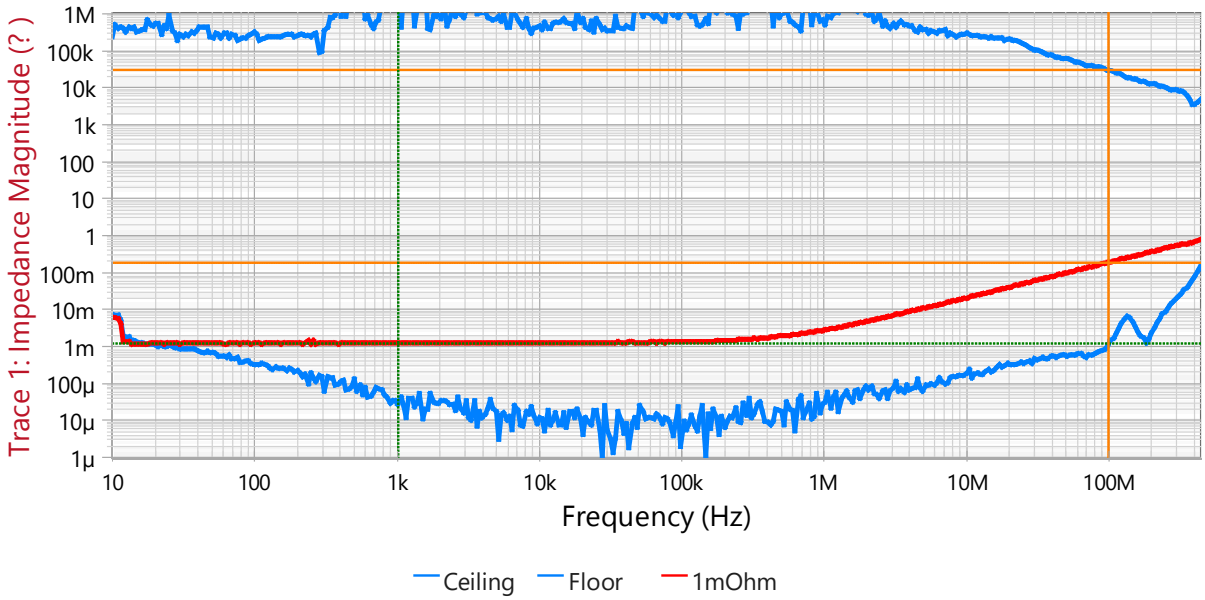


Figure 9: Post Calibration Waveforms Bode 100 VNA – Ceiling, Floor and 1mohm.

Step 10: Always measure a known DUT after completing calibration to ensure you have obtained a proper calibration. Once you've confirmed your calibration, you are now ready to measure your component! (See Sample Measurements Below)

Calibrating a Measurement – E5061B and Other VNAs

The full 2-port calibration on VNAs such as the Keysight E5061B or the Rohde & Schwarz ZNL will follow the same general steps (i.e., short, open, load for each individual port), then an additional step of a thru calibration measurement. For more detailed steps on E5061B 2-port calibration, see 2-Port Impedance Measurement using the P2102A Probe and E5061B VNA.

Full calibration of a 2-port measurement requires calibrating each port independently and then through and optionally isolation. Therefore, these calibrations are included to support traditional VNAs, which do NOT offer impedance calibration.

ALL the 1-port calibrators are included for traditional VNAs. 1-port SHORT, 1-port OPEN and 1- port LOAD. For instance, calibration boards (Short, Open, Load) are included, allowing you to perform a 1-port match on the E5061B. Please see the E5061B manual for calibration instructions.

The E5061B can do traditional **Full 2-port** calibration: SOL on each port, through and isolation (using iso-short). You can also perform the 2-port impedance calibration using the Through (OPEN), ISO-SHORT (SHORT), and 2PM – (LOAD). These are both supported for both GP ports and the S parameter ports. Sample measurements of the 1.2nH supplied

inductor are shown below in various setups.

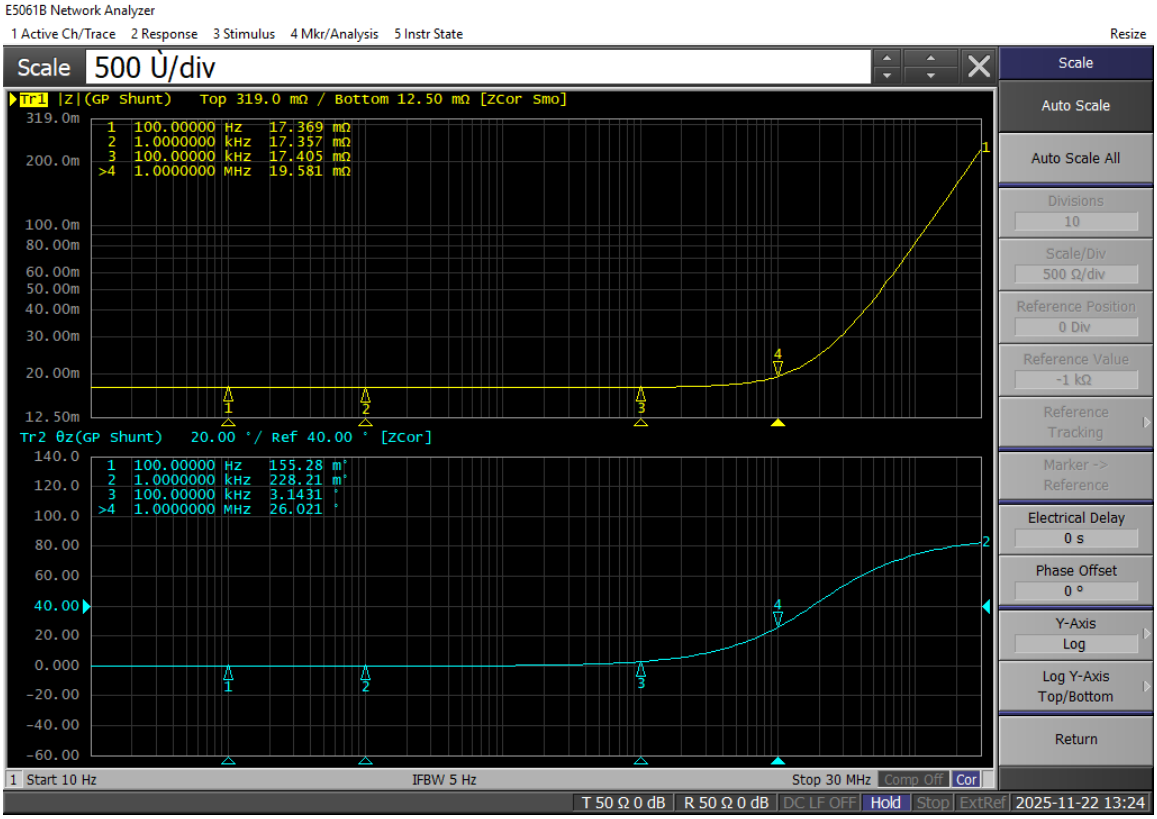


Figure 10: 1.2nH inductor test on the GP Ports using impedance calibration.

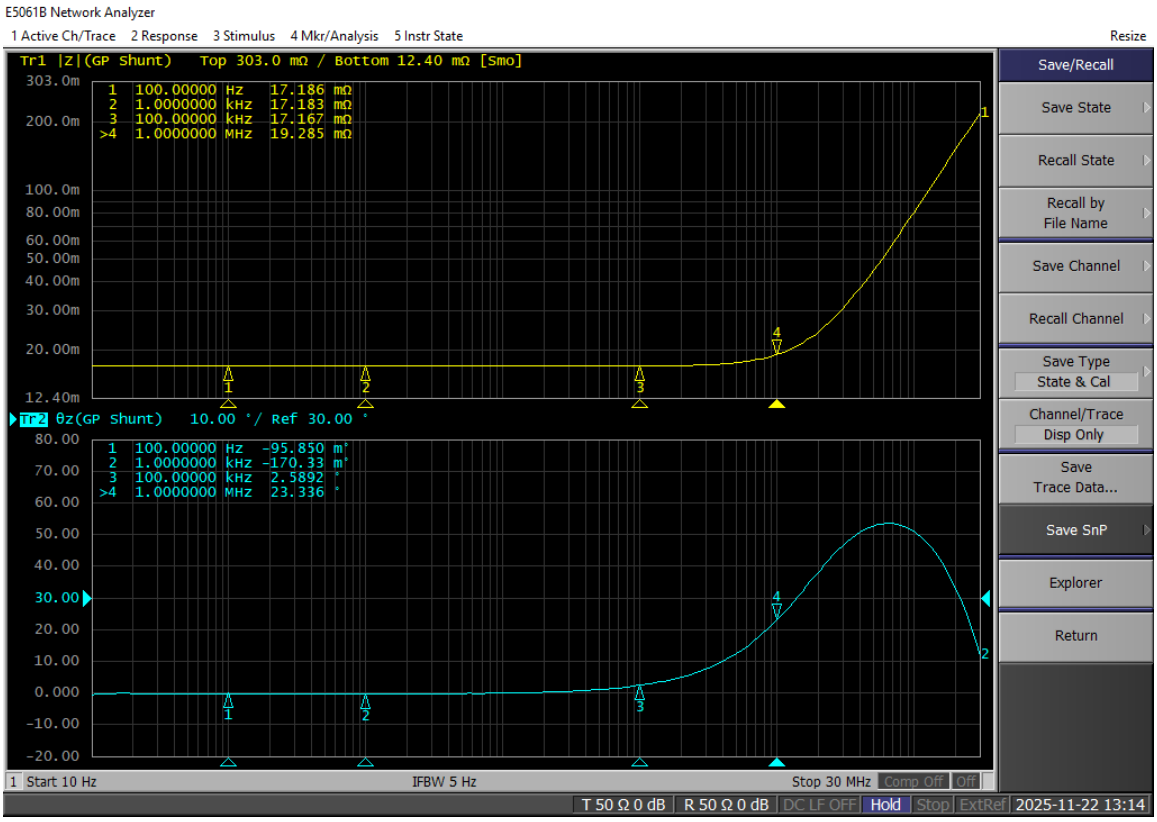


Figure 11: 1.2nH inductor test on the ports with no calibration.

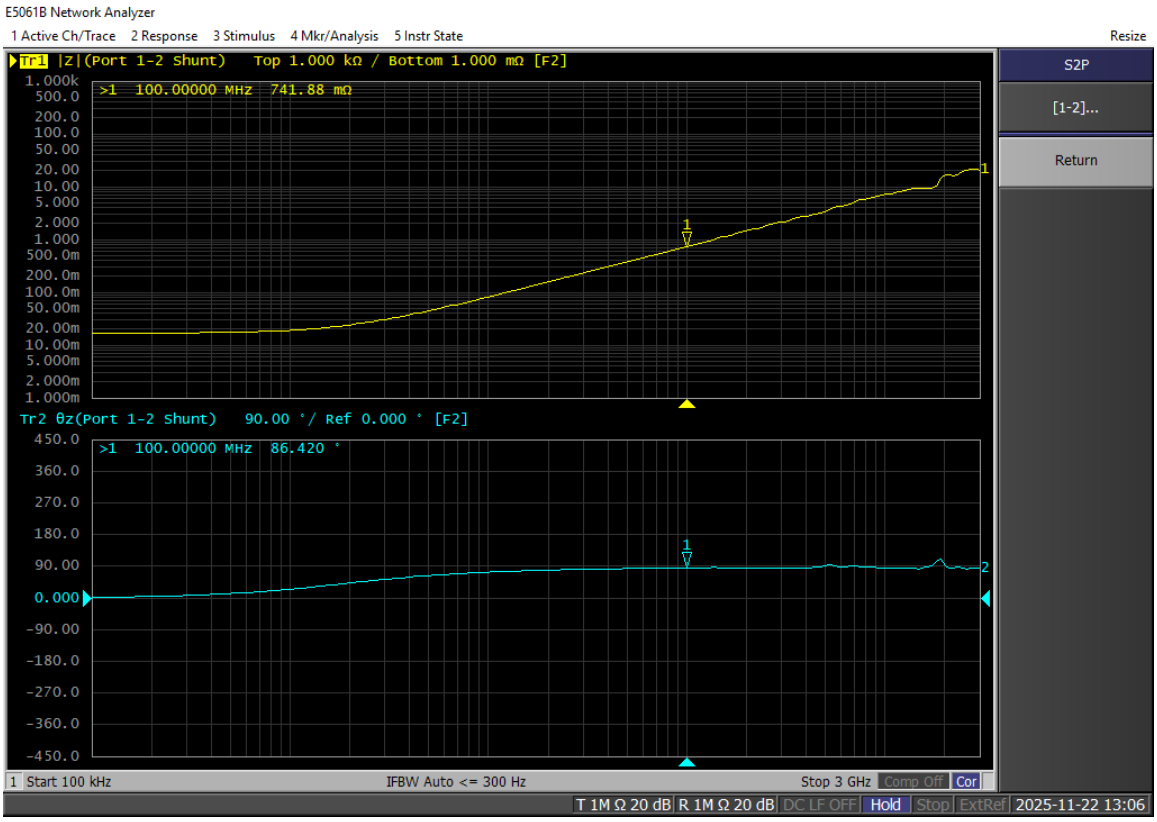


Figure 12: 1.2nH inductor test on Port 1-Port 2 with full 2-port calibration.

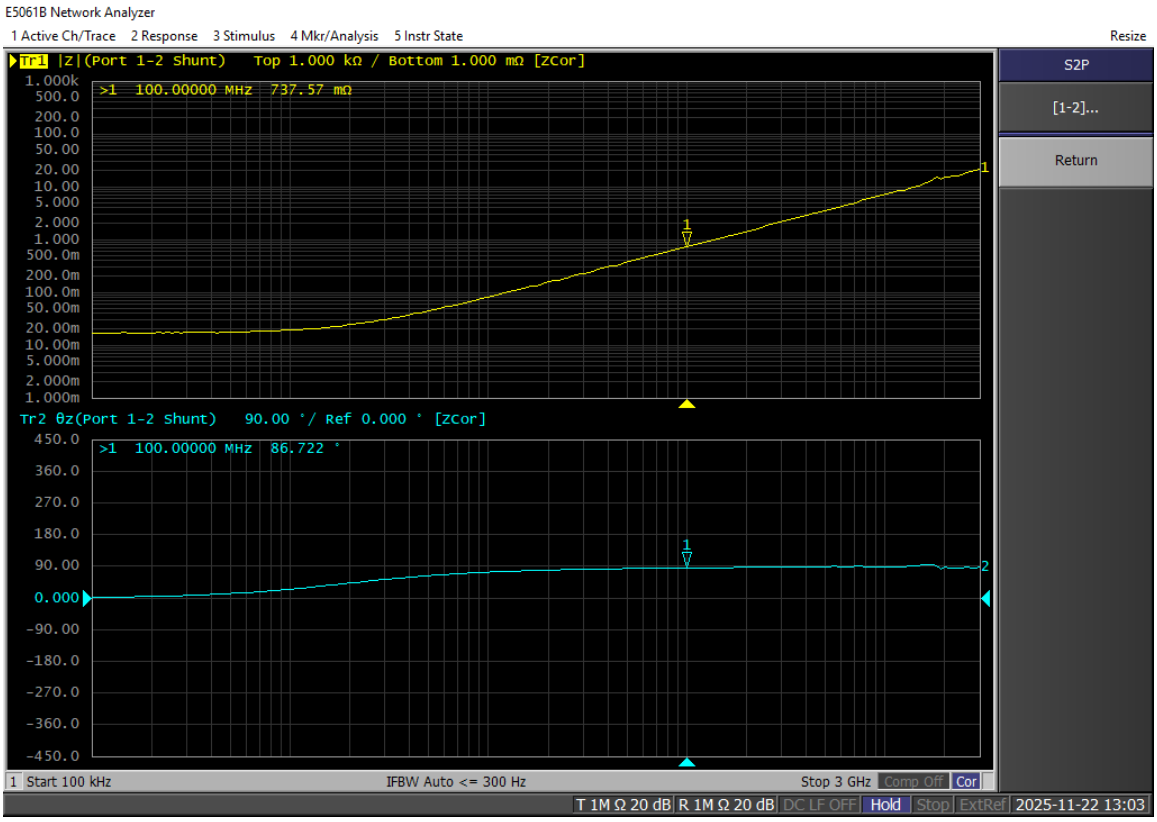


Figure 13: 1.2nH inductor test on Port 1-Port 2 using impedance calibration.

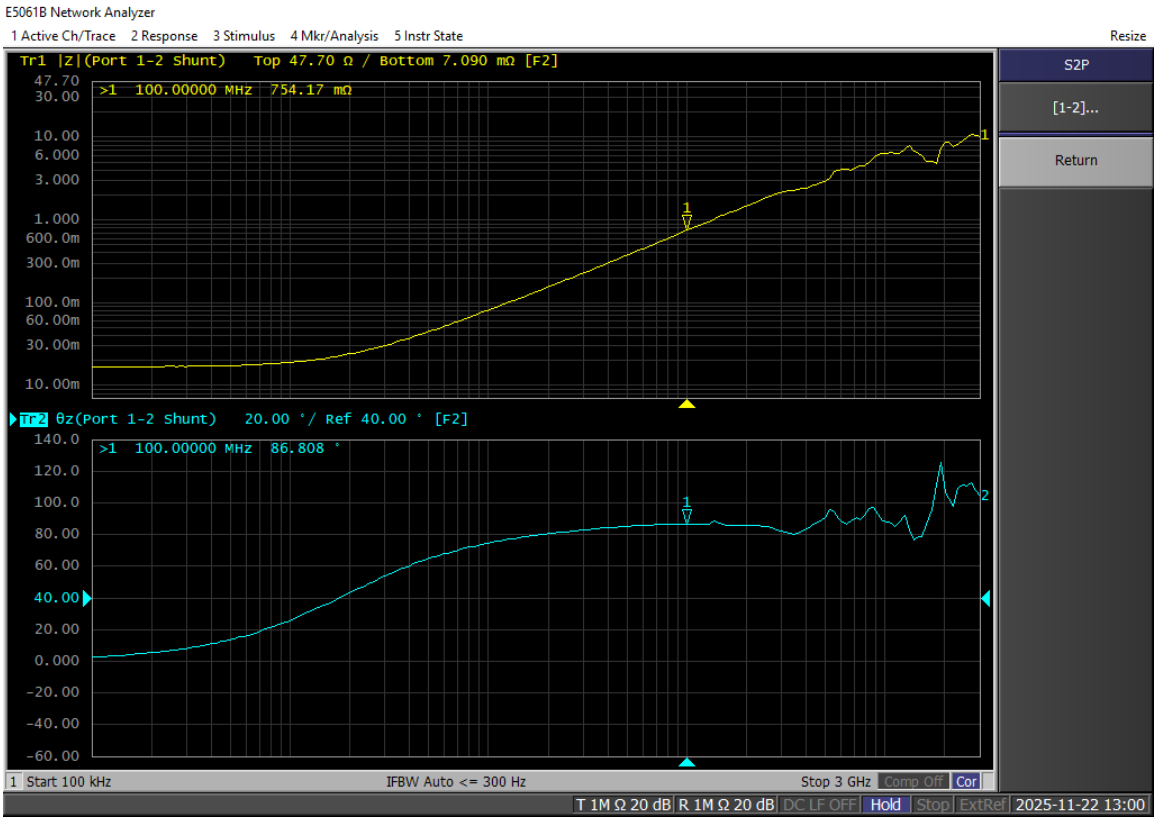


Figure 14: 1.2nH inductor test on Port 1-Port 2 using no calibration.

Mounting Parts and Making Part Measurements

The CTF comes with calibration boards, sample devices to test, as well as blank boards.

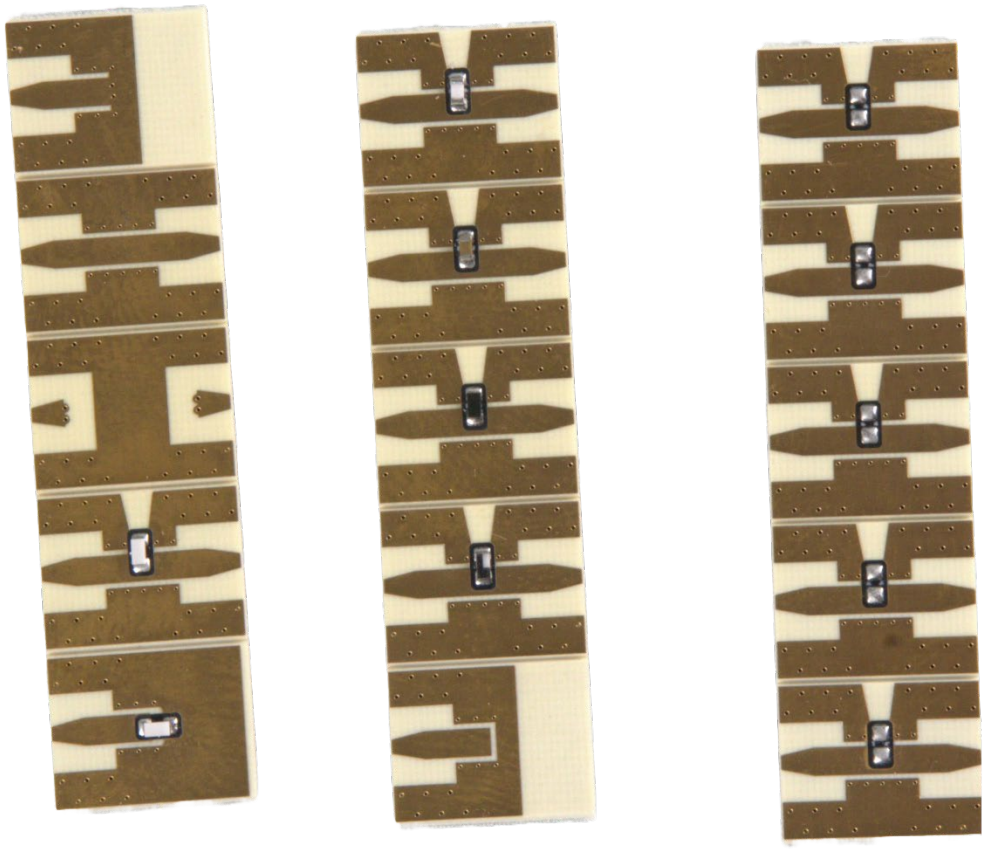


Figure 15: Calibration boards (left), sample test components (center) and blank DUT boards (right).

Parts you want to test can be soldered to the blank board and desoldered for reuse.

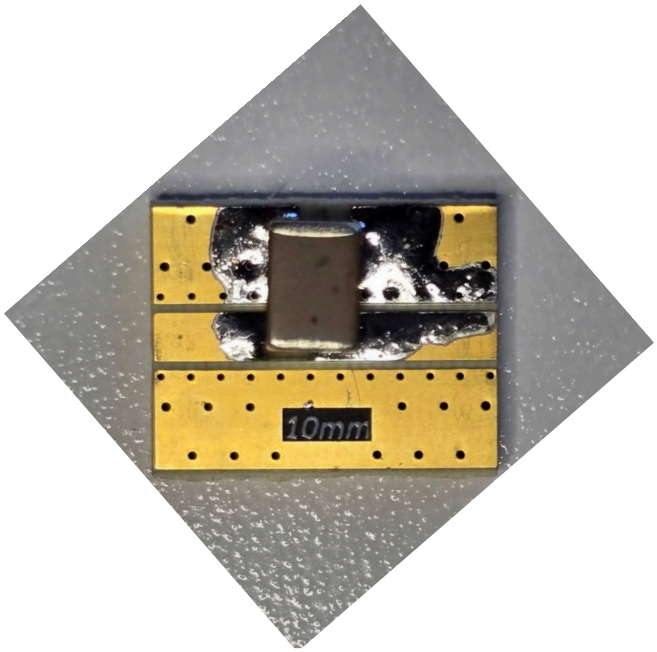


Figure 16: Soldered 1210 part covers the top and middle rows. You don't need to solder directly to the pads. Contact should be made with the top and middle planes and the part is centered.

To measure a DUT, simply mount your component on a CTF mount board and press and hold this board onto the CTF, similarly to what was done during calibration. Begin the sweep by going to the *Home* tab and pressing either *Continuous* or *Single*. Save your waveform by pressing *Measurement* > *New Memory* in the rightmost pane of the Bode Analyzer Suite. Ensure you hold your DUT to the CTF for the entirety of the sweep.

Hand Contact Note: Your hand (finger, thumb, etc.) pressure will not impact the measurement so long as a reasonable amount of pressure is applied to hold the test board down and in place.

Sample Bode 100/500 VNA Measurements

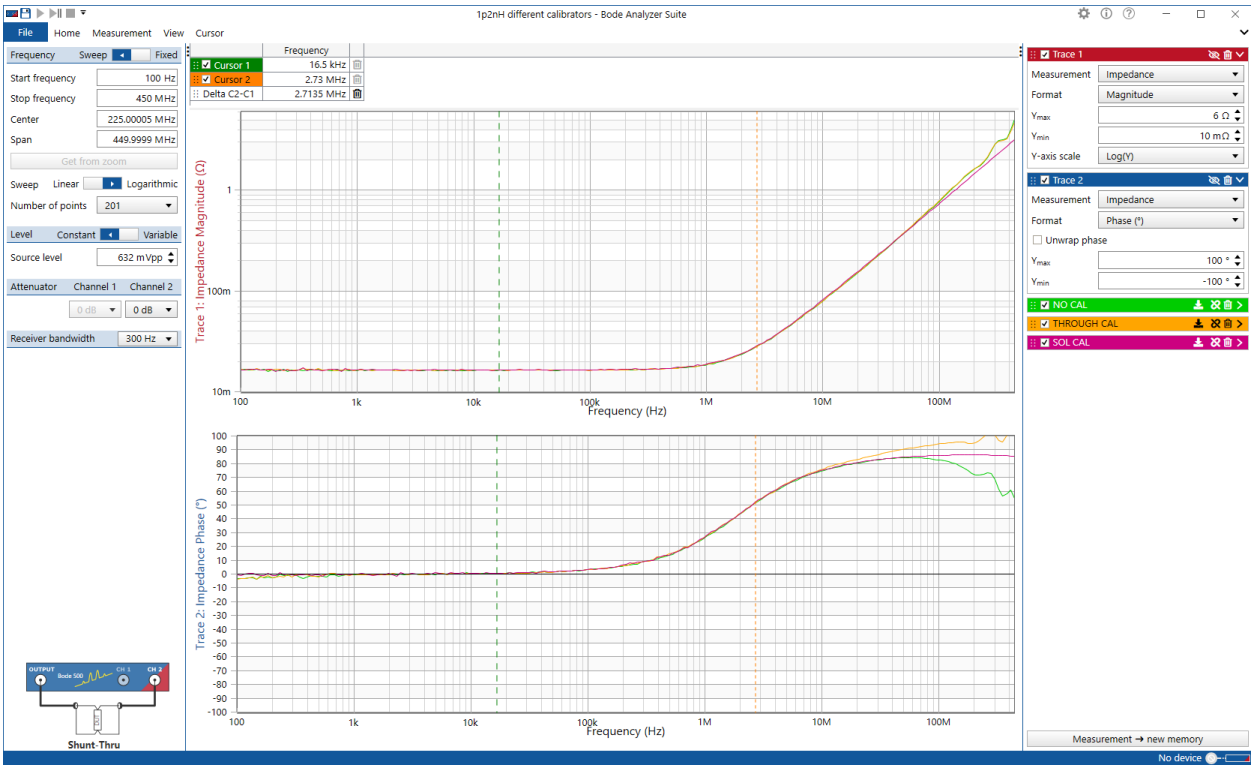
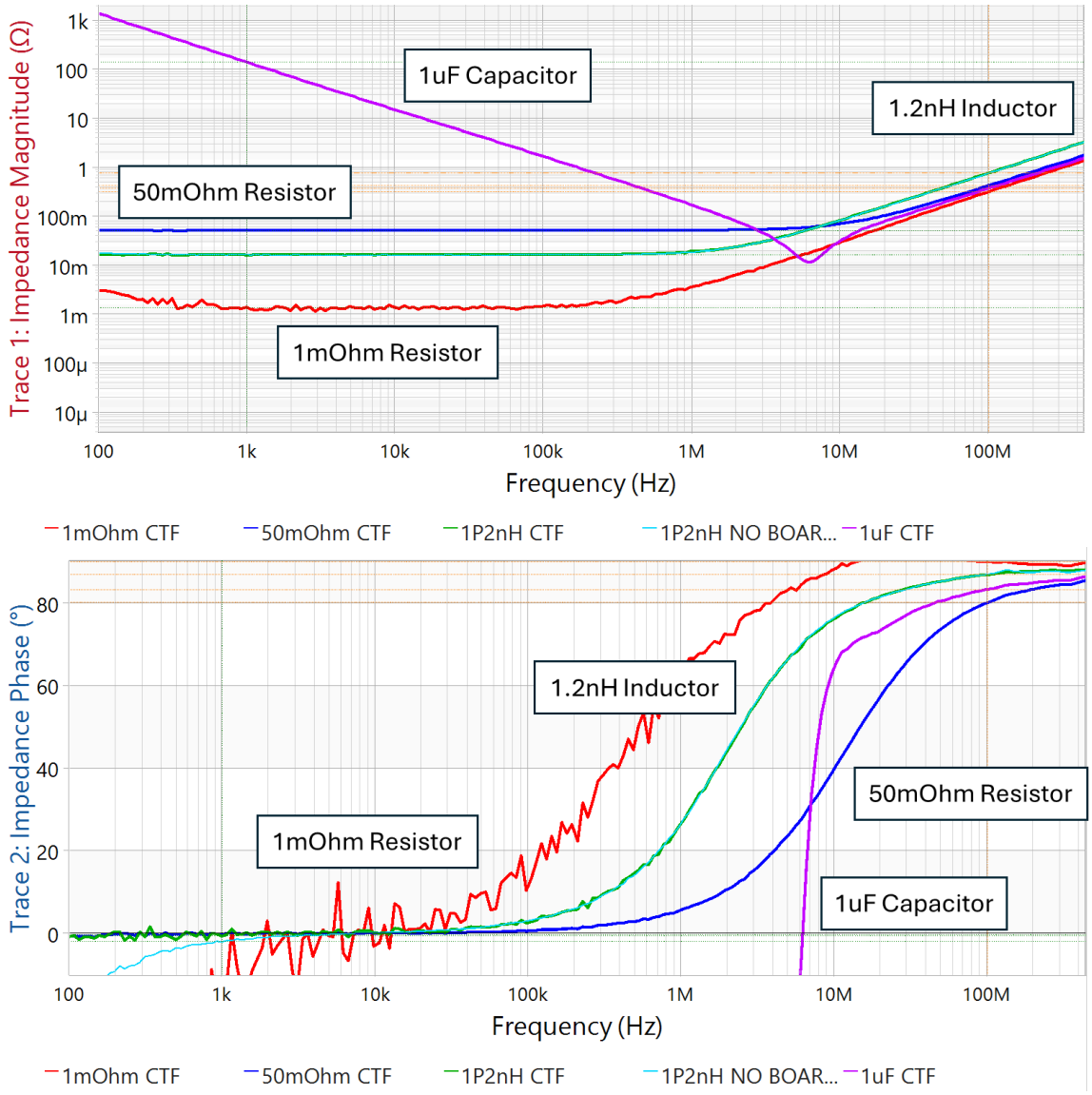


Figure 17: 1.2nH inductors using three different calibration methods: no calibration (green), through calibration only (orange), and SOL calibration (red). The phase is critical to get right. Without an accurate phase response, simulation models may have significant errors.



Red – 1mohm resistor
Dark Blue – 50mohm resistor (UR73D1JTTD50L0F)
Green – 1.2nH inductor (L06031R2BGSTR)
Blue – 1.2nH inductor NO BOARD SHORT
Purple – 1uF capacitor (CL10A105KO8NNNC)

Figure 18: Sample measurements - Impedance magnitude and phase (Included DUTs).

Modeling a Component

After a measurement is taken, the Bode Analyzer Circuit Fit tool can be used to generate a SPICE model using the test data. It is important to make sure that a good PHASE measurement is obtained. Poor phase accuracy will result in a less than accurate SPICE models.

Adding DC Bias

Installing the DC Bias module will reduce maximum frequency and degrade accuracy. If DC Bias isn't needed, it is best to remove the DC Bias module as it can impact the measurement results when not activated.

NOTE: With the DC Bias module installed, the maximum source level is 1Vpp or 4dBm. Otherwise, the Bias Module will activate its transient protection and alter the results.

With the DC Bias module installed, you can perform Calibration with the external power supply connected and ON. It can be at 0V.

The provided Molex cable connects the bench-top power supply to the DC Bias module via the Vin+ and GND - connections. S+ and S- are for optional remote sense usage, depending on the voltage drop.

To apply a DC bias to the fixture:

- Plug the supplied Moles cable into the CTF.
- Connect the two wires to positive and negative voltage. The positive wire is marked with a + sign/color coded. The other cable is ground.
- **NOTE: Do not apply more than 75V DC to the bias module.**

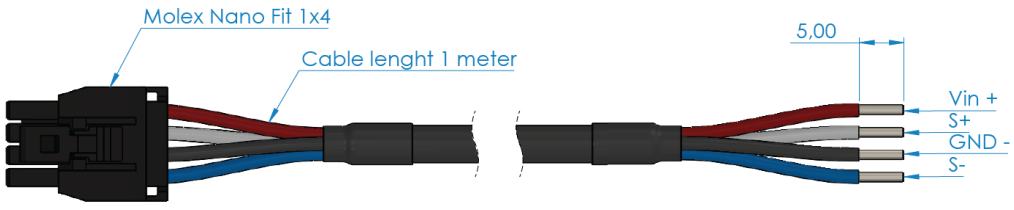


Figure 19: Supplied Molex cable.

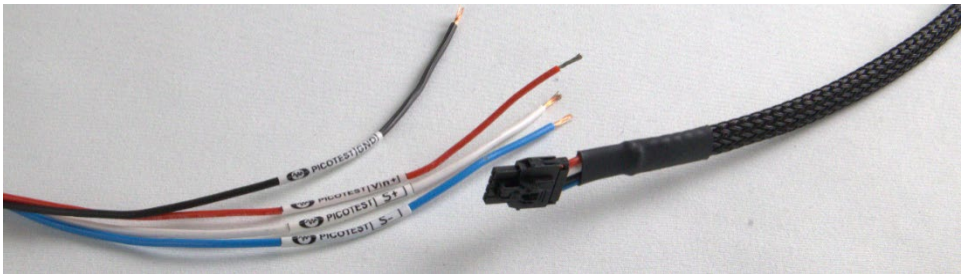


Figure 20: Unconnected supplied Molex cable for DC bias and sense.

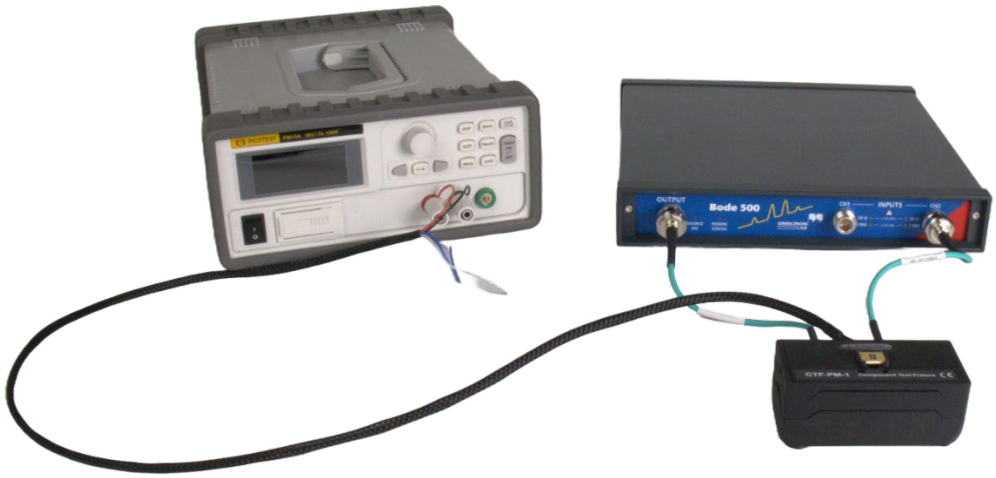


Figure 21: CTF test setup with the Picotest P9610 power supply, CTF, and Bode 500.

Leakage Current may cause a voltage drop

Real capacitors have leakage (especially electrolytic, MLCCs under bias, Tantalum/niobium capacitors, aged parts, or semiconductive dielectrics). This leakage current flows through the Molex cables, connector and internal bias resistors connecting to the external power supply. The sense wires can be used to monitor the voltage on a voltmeter and manually adjusted. It may be possible to use remote sense, but doing so may degrade the measurement accuracy.

Most high-quality power supplies, such as the Picotest P9610, include remote sense inputs, sometimes marked as "+S / –S" or "SENSE". These are high-impedance measurement inputs that connect directly at the DUT (capacitor) sense leads. Very little current flows through the sense wires → negligible voltage drop. The power supply sees the actual voltage at the capacitor and increases its output until: This effectively compensates for voltage loss in the leads. Please see your power supply's manual for further instructions on connecting and using its sense leads.

Calibration should be performed with the DC Bias module installed and the external bias power supply turned on.

Chapter 3 - Specifications

Specifications that are not defined to be guaranteed are typical and are published as general information to the user. The environmental conditions do not exceed the CTF's specified limits.

Component Test Fixture Specifications

Characteristic	Rating
Part Size Limits	0201, 0402, 0603, 0805, 1206, and 1210 – Default Personality Module, Custom modules and DUT boards supporting other part sizes are available
Impedance Floor	31pH
Frequency Limits w/o DC Bias Adapter	DC – 3GHz+
Frequency Limits with DC Bias Adapter	DC – 500MHz
Connectors	3.5mm
Maximum DC Bias Voltage	-75VDC to +75VDC
DUT Board Compatibility	DUT boards accept 0201, 0402, 0603, 0805, 1206, and 1210 component sizes. Please inquire for other part sizes.

Parts included with the CTF

1.2 nH	THIN FILM, ACCU-L INDUCTOR - 0603	L06031R2BGSTR
1 uF	CAP CER 1UF 50V X5R 0603	CL10A105KO8NNNC
50 mΩ	RES 50 mOHM 1% 1/4W 0603	UR73D1JTTD50L0F
1 mΩ	RES 0.001 OHM 1% 1/5W 0603	PA0603FRP7W0R001L

Connector and Cable Notes: The CTF unit uses precision 3.5mm connectors. 2.92mm, 3.5mm and SMA connectors are generally compatible, but due to tolerances they can be damaged when repeatedly connected. However, since Picotest's makes both SMA and 3.5mm connectors, they are designed to be compatible, and the connection can be secure. Consequently, only our SMA PDN cables or precision 3.5mm cables should be used with the 3.5mm connectors on the CTF.

Safety Information

To avoid personal injury and to prevent fire or damage to this product or products connected to it, review and comply with the following safety precautions. Be aware that if you use this CTF assembly in a manner not specified, the protection this product provides may be impaired. Only qualified personnel should use this CTF assembly. Do not connect the CTF to any voltage that exceeds the maximum permissible input voltage specified in the data sheet. Non-compliance with this instruction carries the risk of an electric shock. Make sure not to cause any short circuits when performing measurements on sources with high output currents. Short circuits may cause injuries or burns.

Use only grounded instruments.
Do not connect the CTF ground (SMA connector) to a potential other than ground or earth ground or to any power source that isn't grounded. Always make sure the CTF and the measurement instrument/power source are grounded properly.

Observe CTF ratings.
Do not apply any electrical potential to the CTF input which exceeds the maximum ratings of the CTF. To avoid equipment damage and/or severe injuries death or death do not use this probe close to voltages higher than 50 VAC or 75 VDC.

Do not operate with suspected failures.
Refer to qualified service personnel.

Indoor use only.
Do not operate in wet/damp environment. Keep product surfaces dry and clean. Do not operate the product in an explosive atmosphere.

Handling Information

Handle with care to avoid any injury. Note that the CTF cable is a sensitive part of the CTF and connector. Do not damage through excessive bending or pulling. Avoid mechanical shock to this product in general to guarantee accurate performance and protection.

Caution: To avoid equipment damage and/or severe injuries or death ensure that the absolute maximum ratings defined in this manual are observed at all times and never exceeded.

Cleaning

To clean the exterior of the CTF, use a soft cloth moistened with either distillated water or isopropyl alcohol. Before use allow the CTF to dry completely.