
PXle-5633 User Manual

2025-07-23



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PXIe-5633 User Manual

The PXIe-5633 User Manual provides detailed descriptions of the product functionality and the step by step processes for use.

Looking for Something Else?

For information not found in the User Manual for your product, such as specifications and API reference, browse ***Related Information***.

Related information:

- [PXIe-5633 Specifications](#)
- [CAL-5501 Specifications](#)
- [RFmx VNA User Manual](#)
- [Software and Driver Downloads](#)
- [License Setup and Activation](#)
- [Dimensional Drawings](#)
- [Product Certifications](#)
- [Letter of Volatility](#)
- [Discussion Forums](#)
- [NI Learning Center](#)

PXIe-5633 Overview

The PXIe-5633 is a single-slot PXI vector network analyzer (VNA) that covers a frequency range of 50 MHz up to a maximum of 26.5 GHz. Use the CAL-5501 automatic vector calibration module or a mechanical calibration kit for VNA measurement calibration.

The PXIe-5633 can also combine with NI vector signal transceivers (VSTs) to add VNA functionality to the VST.

You can purchase the PXIe-5633 with different frequency range options as follows:

- 50 MHz to 8 GHz
- 50 MHz to 12 GHz
- 50 MHz to 18 GHz
- 50 MHz to 26.5 GHz

PXIe-5633 Key Features

The PXIe-5633 has the following features and capabilities.

- Frequency range 50 MHz to 26.5 GHz
- CW or pulsed S-parameter measurements
- Support for manual or automatic two-port S-parameter calibration
- Pass-through path: when integrating the PXIe-5633 with a supported NI VST, you can access both VST functionality and VNA functionality from the same ports on the PXIe-5633

PXIe-5633 Driver Support

Determine the earliest driver version supported for your product.

**Tip** To optimize product performance, update to the most recent driver version.

RFmx VNA is the driver for the PXIe-5633. RFmx VNA in turn requires the NI-RFSA driver.

**Note** You must install matching versions of RFmx VNA and NI-RFSA.

Table 1. PXIe-5633 Earliest Driver Version Support

Driver Name	Earliest Version Support
RFmx VNA	2023 Q4
NI-RFSA	2023 Q4

**Note** This information applies to the earliest driver version that supports using the PXIe-5633 as a standalone VNA. If your product is a VST that integrates the PXIe-5633 to add VNA functionality, refer to the user manual for the VST for information on driver support.

Related information:

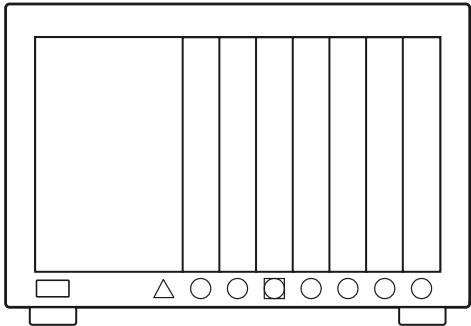
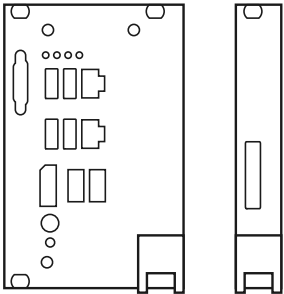
- [RFmx VNA User Manual](#)

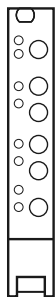
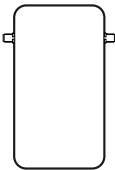
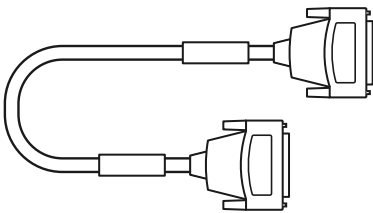
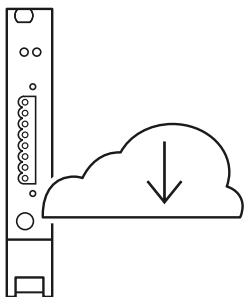
Components of a PXIe-5633 System

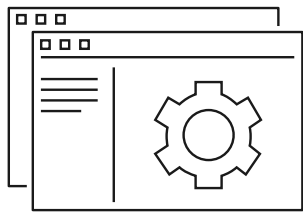
PXIe-5633 is designed for use in a system that might require hardware, drivers, and software to optimize the PXIe-5633 for your application. Use the minimum required PXIe-5633 system components as a starting point for building your system.

**Note** A system and the surrounding environment must meet any requirements defined in the relevant specifications documents.

Table 2. Minimum Required PXIe-5633 System Components

Component	Description and Recommendations
PXI chassis 	A PXI chassis houses the PXIe-5633 and supplies power for PXIe-5633 functions. Note The PXIe-5633 requires a chassis with ≥ 82 W slot cooling capacity.
PXI controller or PXI Remote Control Module 	You can install a PXI controller or a PXI remote control (MXI) module depending on your system requirements. These components, installed in the same PXI chassis as the PXIe-5633, interface with the instrument using NI device drivers.
VNA	Your PXIe-5633 VNA instrument.

Component	Description and Recommendations
	
Calibration accessory 	CAL-5501 VNA measurement calibrator to perform electronic calibration for the PXIe-5633. Alternatively, you can perform manual calibration with your own calibration standards.
Cables and accessories 	Cables and accessories allow connectivity to/from your instrument for measurements. Refer to Part Numbers for Cables and Accessories for recommended cables and accessories and guidance.
RFmx VNA driver 	Instrument driver software that provides functions to interact with the PXIe-5633 and execute measurements using the PXIe-5633.  Note For optimal performance, use the most current version of RFmx VNA with the PXIe-5633.
NI Applications	RFmx VNA offers driver support for the following

Component	Description and Recommendations
	applications: • InstrumentStudio • LabVIEW • C/C++ • .NET

Related reference:

- [Part Numbers for Recommended PXIe-5633 Cables and Accessories](#)

Part Numbers for Recommended PXIe-5633 Cables and Accessories

Use part numbers to purchase the cables and the accessories for optimizing the performance of PXIe-5633.

Table 3. Part numbers for recommended cables and accessories

Accessory or cable	Description	Part number
0.9 N · m (8 lb · in.) calibrated torque wrench, 5/16 in.	For installing threaded connections	751120-01
100 N · cm calibrated torque screwdriver	For use with SMA driver bit included in PXIe-5633 kits	780487-01
CAL-5501	Measurement calibrator for the PXIe-5633	788189-01 ¹
PXI slot blockers	Fills an empty instrument slot in a PXI chassis	199198-01
PXI filler panels	Covers an empty slot within a PXI chassis	778700-01



Tip For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

Related concepts:

- [RF Cabling Guidelines](#)

Related reference:

- [Components of a PXIe-5633 System](#)

Related information:

1. The CAL-5501 in turn requires the purchase of a hardware services calibration. Choose from traceable calibration (960380-01), compliant calibration (960380-03), and ISO 17025 accredited calibration 960380-04.

- [Installing Slot Blockers and Filler Panels](#)

PXIe-5633 Theory of Operation

The PXIe-5633 is a single-slot PXI Express vector network analyzer (VNA). The PXIe-5633 also includes a VST pass-through path to provide VST functionality when connected to a supported VST.

Measurement Calibration

The PXIe-5633 supports measurement calibration. Measurement calibration allows you to calculate and then apply corrections that optimize your VNA measurements for your unique test setup.

The PXIe-5633 supports two types of measurement calibration: ***manual calibration*** and ***electronic calibration***.

- **Manual calibration**—Perform measurement calibration with individual calibration standards.
- **Electronic calibration**—Perform measurement calibration with the CAL-5501 accessory.

The CAL-5501 is the automatic electronic calibrator designed for the PXIe-5633. The CAL-5501 includes multiple standards in a single device to simplify the measurement calibration process.

VST Pass-through

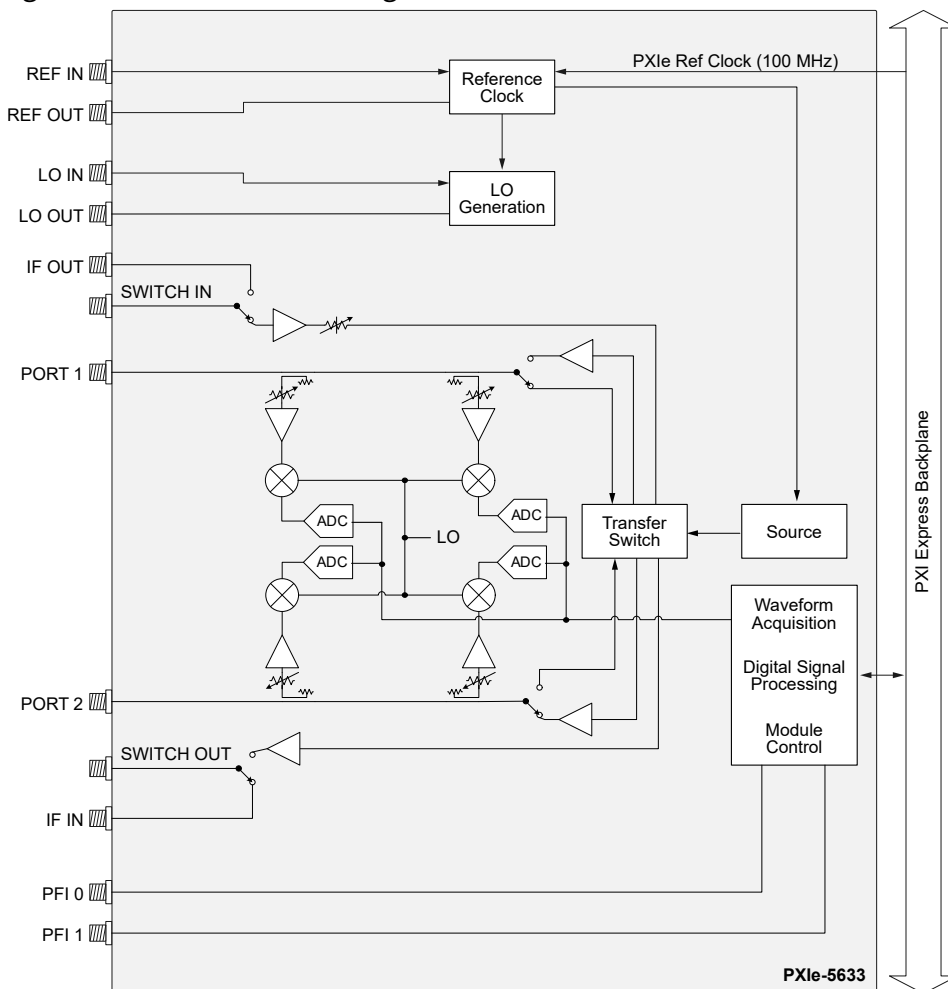
The PXIe-5633 includes a ***VST pass-through*** path. When integrated with a supported NI VST, this path of the PXIe-5633 allows you to access the following from the same ports of the PXIe-5633:

- The VST functionality of the integrated VST
- The VNA functionality of the PXIe-5633

PXIe-5633 Block Diagram

Block diagrams describe the hardware architecture of your instrument and the paths that signals take through components of the instrument.

Figure 1. PXIe-5633 Block Diagram



PXIe-5633 Examples

NI installs example code with your software or driver that demonstrates the functionality of PXIe-5633. Use these examples to learn about the product or accelerate your own application development.

Most NI products install examples that you can access directly or from within NI software. The example experience can differ slightly across products and versions.

RFmx VNA is the driver that provides the API to program the PXIe-5633. Locate RFmx VNA examples for the PXIe-5633 on your system as follows:

- **File Explorer**—%PUBLIC%\Documents\National Instruments\NI-RFmx\VNA\Examples
- **Start Menu**—**Start » National Instruments » National Instruments » RFmx VNA Examples**

The examples for the PXIe-5633 include programs to accomplish the following tasks, among others:

- Calculate S-parameters
- De-embed fixtures
- Generate pulses
- Perform measurement calibration for the PXIe-5633 with the CAL-5501

RFmx VNA examples for the PXIe-5633 support the following programming environments or programming languages:

- LabVIEW
- C/C++
- C#/.NET

Related tasks:

- [Designing VNA Measurement Applications for the PXIe-5633](#)

PXIe-5633 and CAL-5501 Front Panels and LEDs

Understand the connectors and LED behaviors of the PXIe-5633 and CAL-5501.

PXIe-5633 Front Panel and LEDs

Figure 2. PXIe-5633 Front Panel

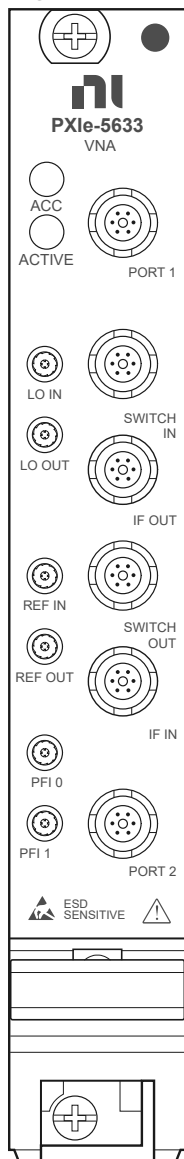


Table 4. PXIe-5633 Connector Descriptions

Connector	Connector Type	Description
PORT 1	3.5 mm (f)	Port 1 for VNA measurements; input/output terminal for RF signals for VST measurements when integrated with VST
SWITCH IN	3.5 mm (f)	Intermodule connection only (when integrated with VST)
IF OUT	3.5 mm (f)	Reserved
SWITCH OUT	3.5 mm (f)	Intermodule connection only (when integrated with VST)
IF IN	3.5 mm (f)	Reserved
PORT 2	3.5 mm (f)	Port 2 for VNA measurements; input/output terminal for RF signals for VST measurements when integrated with VST
LO IN	MMPX (f)	Reserved
LO OUT	MMPX (f)	Reserved
REF IN	MMPX (f)	Reserved
REF OUT	MMPX (f)	Reserved
PFI 0	MMPX (f)	Reserved
PFI 1	MMPX (f)	Reserved

Table 5. PXIe-5633 LED Indicators

LED	Indications
ACC	Access: Indicates the basic hardware status of the module. • Off—The module is not yet functional or has detected a problem with a PXI Express power rail • Amber—The module is being accessed; accessed means that you are writing to the

LED	Indications
	module setup registers to control the module, reading from the module to monitor its status, or transferring data to or from the module • Green—The module is controllable through the software
ACTIVE	Indicates the state of the module. • Off—The module is idle • Dim amber—The module is armed and waiting for an acquisition trigger • Solid green—The module has received an acquisition trigger and is making a measurement • Solid red—The module has detected an error; the LED remains red until the error condition is removed Error conditions include loss of PLL lock and thermal shutdown.  Note Indicators are listed in increasing order of priority.

CAL-5501 Front Panel and LEDs

Figure 3. CAL-5501 Front Panel

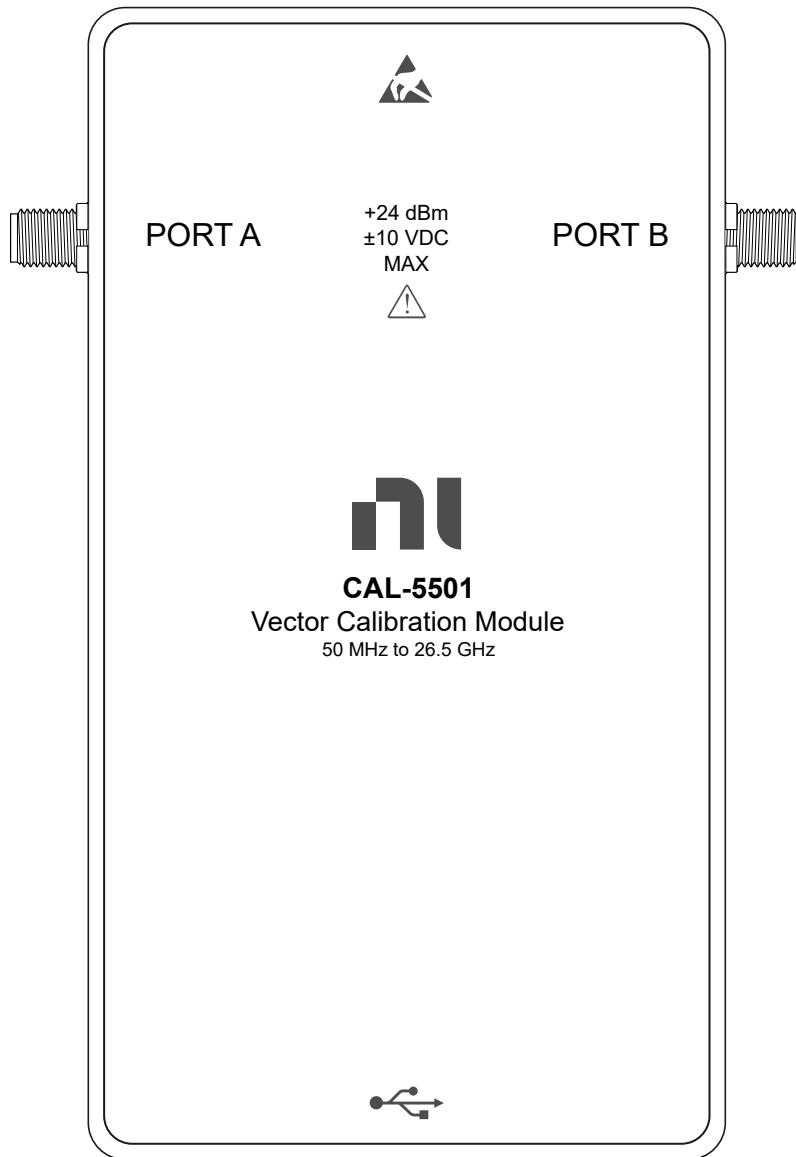


Figure 4. CAL-5501 Side Panel

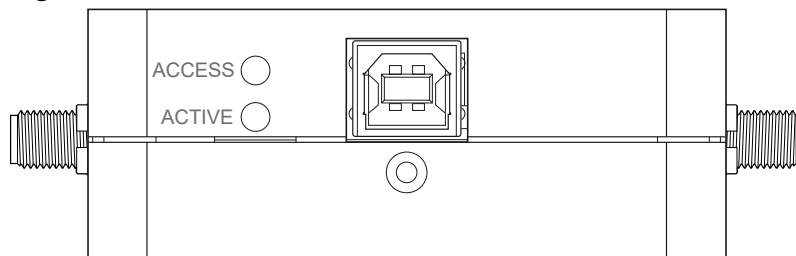


Table 6. CAL-5501 Connector Descriptions

Connector	Connector Type	Description
PORT A	3.5 mm (f)	Port A for connection with VNA module
PORT B	3.5 mm (f)	Port B for connection with VNA module
	USB Type B (f)	USB communication and control

Table 7. CAL-5501 LED Indicators

LED	Indications
ACCESS	Indicates the basic hardware status of the module. • Off—The module is not yet functional or is not receiving power • Blinking amber—The module is being accessed over USB; accessed means that you are writing to the module setup registers to control the module, reading from the module to monitor its status, or transferring data to or from the module • Green—The module is controllable through the software
ACTIVE	Indicates the state of the module. • Off—The module is not yet functional or is not receiving power • Solid amber—The module is warming up to prepare for use • Solid green—The module is ready for use • Solid red—The module has detected an error; the LED remains red until the error condition is removed For example, the module could have

LED	Indications
	exceeded its operating temperature and entered thermal shutdown.

PXIe-5633 and CAL-5501 Kit Contents

Identify the items in the PXIe-5633 and CAL-5501 kits.

PXIe-5633 Kit Contents

- PXIe-5633 module
- SMA driver bit
- Documentation

CAL-5501 Package Contents



Note The CAL-5501 is not included in the PXIe-5633 kit; it is sold and shipped separately.

Shipping kit part number: 788189-01

- Wooden case
- CAL-5501
- Torque wrench, NI part number 751120-01
- Locking USB cable, 2 m, NI part number 198506D-02
- Documentation

The CAL-5501 kit also includes one of the following calibration certificates based on the type of mandatory calibration purchased with the accessory:

- Traceable
- Compliant
- ISO 17025 accredited

PXIe-5633 Safety Guidelines

Follow these guidelines to use the PXIe-5633 safely.



Notice For comprehensive safety information, refer to the safety, environmental, and regulatory information document that shipped with your hardware.



Caution Observe all instructions and cautions in the user documentation. Using the product in a manner not specified can damage the product and compromise the built-in safety protection.

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Related information:

- [Product Certifications](#)

PXle-5633 Operating Guidelines

Follow these guidelines when operating the PXle-5633.

RF Cabling Guidelines

Use the right RF cables for the connectors on your test instrumentation and DUTs.

The cables you must use to connect external equipment or DUTs to your PXle-5633 instrument are not included with the PXle-5633.

NI recommends that the cables you use to connect to your PXle-5633 instrument meet the following guidelines, depending on the connector type, to meet the RF performance requirements of your application:

- 3.5 mm connectors: NI recommends 3.5 mm cables. 2.92 mm cables are acceptable.

You can also use SMA cables, but verify the following when using SMA cables for 3.5 mm connectors:

- Verify that the SMA cable is rated to the frequencies you are using the cable for.
- Verify that the center pin length of the SMA connector on your cable does not exceed the center pin length of the 3.5 mm standard.
- Other connector types: Use a cable that matches the connector type.

Related reference:

- [Part Numbers for Recommended PXle-5633 Cables and Accessories](#)

Guidelines for Making Threaded RF Connections

Follow the guidelines to maximize connector life and connection quality.

- Inspect connectors before making a connection:
 - Ensure that the mating connectors are clean.

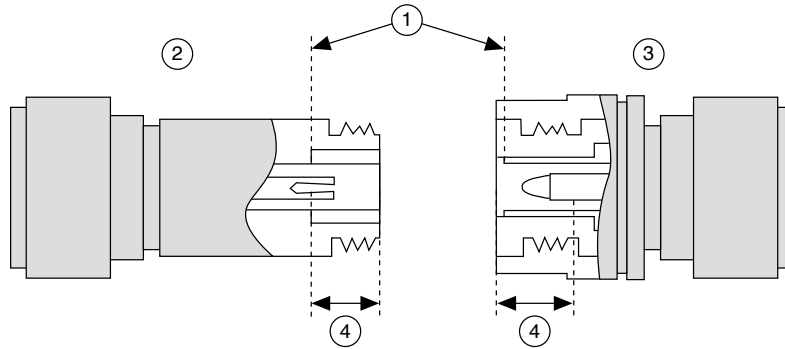
- When making a connection, ensure that the male center pin on the connector aligns with the mating connector. Before mating connectors or cables, verify that the connector ends match and will mate without damage.
- When making a connection, never turn the cable or body: turn only the connector nut. Turning the body instead of the nut causes the mating surfaces to wear down and become loose, which causes a mismatch between the connectors and degrades measurements. The turning motion of the surfaces can also produce burrs and loose metal shavings that not only affect the measurement but can also damage other surfaces these contaminants come into contact with.
- You can use connector savers to reduce wear on critical connectors in environments where you frequently change cables and connectors. Account for all connector savers in the error budget for a measurement. Only use connector savers when appropriate for the degree of accuracy your measurement requires.

Threaded RF Connector Care Guidelines

Follow all guidelines to prevent damage to instruments and connectors and to make the best possible measurements.

- **Tighten connectors without rotating the center pin.**—Never tighten the connectors, adapters, or cables such that the center pin rotates.
- **Avoid touching connectors with bare hands.**—Touching connectors can contaminate the connectors with natural skin oils and microscopic dirt particles. Natural skin oils and microscopic dirt particles are difficult to remove from connectors. Contaminated connectors can affect your measurements.
- **Observe the pin depth of mating connectors.**—Mate the proper connectors with PXIe-5633 instruments. Before mating the connector with another device or cable, measure the pin depth of the device that you want to mate. To measure the pin depth, use a pin depth gauge. Improper pin depth of mating connectors is a major cause of failure in the field.

Figure 5. Features of Mating Connectors



1. Reference plane
2. Female connector
3. Male connector
4. Pin depth

The center pin of RF component connectors has a precision tolerance measured in mils (1/1000 in.). Connectors on test devices that mate with RF components might not be precision types and might not have the proper depth. To ensure suitability, measure the connectors before mating.

Gauge the pin depth of the test device connector. If the pin depth measures outside the tolerances listed in the following table, the center pin is too long and can damage the termination connector:

Port/Connector Type	Pin Depth	Gauge Setting
3.5 mm (m), 3.5 mm (f)	-0.0002 in. -0.0007 in.	Same as pin depth
2.92 mm (m), 2.92 mm (f)	-0.0002 in. -0.0007 in.	Same as pin depth
1.85 mm (m), 1.85 mm (f)	-0.0002 in. -0.0010 in.	Same as pin depth

If the test device connector measures out of tolerance in the "-" region, the center pin is too short. While this connection does not cause damage, it results in a poor connection and consequent performance degradation.

- **Avoid lateral pressure.**—Never put lateral pressure on the center pin of the connector.
- **Always torque connectors to the specified torque using a torque wrench.**—Do not over-tighten connectors. Over-tightening might damage the connector center pin. Always use a 0.9 N · m (8 in. · lb) torque wrench when tightening 1.85 mm, 2.92 mm, 3.5 mm, and SMA connectors for PXle-5633 instruments. Always tighten to the torque specified in this manual.
- **Do not disturb Teflon tuning washers.**—The center conductor on some RF components contains a small Teflon tuning washer that compensates for minor impedance discontinuities at the interface. The washer location is critical to the RF component performance.



Notice Do not disturb the Teflon tuning washer in connectors.

- **Avoid mechanical shock.**—Precision connectors are designed to withstand years of normal bench handling. Handle the connectors carefully. Mechanical shock significantly reduces the service life of the connectors.
- **Avoid applying excessive power.**—Test instrumentation is rated for a specific maximum continuous input power. Exceeding the maximum input power level permanently damages the internal components. Refer to the safety, environmental, and regulatory information document or the instrument specifications for these levels.
- **Protect connectors when not in use.**—Cover connectors that are not in use with the dust cap included with your instrument.

Avoiding Damage when Making Direct Connections to the PXle-5633

Because the PXle-5633 is a precision RF instrument, it is sensitive to ESD and transients. When you make direct connections to the PXle-5633, you can avoid damaging the RF ports by adhering to the following guidelines.

- Apply external signals only while the hardware is powered on.



Notice Applying external signals while the hardware is powered off may cause damage.

- Ensure you are properly grounded when manipulating cables or antennas connected to the instrument.
- If you are using non-insulated devices, such as an RF antenna, ensure the devices are maintained in a static-free environment.
- If you are using an active device, such as a preamplifier or switch routed to the PXle-5633, ensure that the device cannot generate signal transients greater than the RF and DC specifications of the PXle-5633.

VNA Measurement Calibration Guidelines

For best VNA measurement results with the PXle-5633, you should always apply a valid measurement calibration dataset, or **calset**, to your measurements. Refer to the guidelines for when to perform VNA measurement calibration and for VNA measurement calibration best practices.

- Always apply a measurement calibration that corresponds to your test setup to VNA measurements. If you have saved a calset for a given configuration, ensure that the calset is applied to the measurement.
- NI recommends using high-performance, phase-stable RF test port cables. NI offers several suitable cables to choose from, including the Sucoflex 526S (NI part number 137445-01).
- NI recommends configuring the PXle-5633 with the same settings across both measurement calibration and the measurements that use that calset.
- The frequency list you define determines the frequencies that are used for the VNA measurement calibration.
- For the best measurement calibration results, do the following:
 - Ensure that all connectors of the PXle-5633, CAL-5501, and all cables that connect the two are completely free of debris and are undamaged.
 - Keep the physical layout of your test system, such as the orientation of cables, as consistent as possible between measurement calibration and measurement and between different measurements.
 - If your test fixture includes any adapters or more complex elements between the PXle-5633 and the calibration standards or DUT, you can characterize and

de-embed them to remove their influence from measurement calibration and from VNA measurements.

- Perform a new measurement calibration in any of the following situations:
 - If any aspects of your test fixtures, such as new connectors or cables, are replaced or added between the PXIe-5633 and the DUT.
 - If you change the set of frequencies or any attenuation settings used for your VNA measurements to any frequencies or attenuation settings not already included in the calset.
 - For applications that require the highest accuracy:
 - If you change the IF bandwidth for your measurements.
 - If the ambient temperature in the test environment or the onboard temperature of the instrument changes by an amount you deem significant enough.
 - To account for drift, if an amount of time you deem significant enough elapses since the previous measurement calibration.

Setting up the PXIe-5633

Install the PXIe-5633 into a chassis and prepare it for use.

1. [Unpacking the Kit](#)
Take precautions to prevent electrostatic discharge when unpacking and inspecting your hardware.
2. [Installing the Software](#)
You must be an administrator to install NI software on your computer.
3. [Installing the PXIe-5633 into a Chassis](#)
Once the required software is installed on your system, install the PXIe-5633 in a supported PXI chassis.
4. [Verifying the Installation](#)
Before using the PXIe-5633, verify that it is installed correctly through Hardware Configuration Utility or Measurement & Automation Explorer (MAX).

Unpacking the Kit

Take precautions to prevent electrostatic discharge when unpacking and inspecting your hardware.



Notice To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.
2. Remove the device from the package and inspect the device for loose components or any other sign of damage.



Notice Never touch the exposed pins of connectors.



Note Do not install a device if it appears damaged in any way.

3. Unpack any other items and documentation from the kit.



Note Store the device in the antistatic package when the device is not in use.

Installing the Software

You must be an administrator to install NI software on your computer.

RFmx VNA is the driver for the PXIe-5633. RFmx VNA in turn requires the NI-RFSA driver.

1. Install an ADE, such as LabVIEW.
2. Install RFmx VNA and NI-RFSA using either of the following methods:
 - Download the software from ni.com/downloads
 - Select the software to install in Package Manager



Note You must install matching versions of RFmx VNA and NI-RFSA. The order in which you install these drivers is not important.

3. Follow the instructions in the installation prompts.



Note Windows users might see access and security messages during installation. To complete the installation, accept the prompts.

4. When the installer completes, select **Restart** in the dialog box that prompts you to restart, shut down, or restart later.

Related reference:

- [PXIe-5633 Driver Support](#)

Related information:

- [Package Manager User Manual: Installing, Updating, Repairing, and Removing NI Software](#)

Installing the PXIe-5633 into a Chassis

Once the required software is installed on your system, install the PXIe-5633 in a supported PXI chassis.

Install your application software and driver software on the controller before installing the PXIe-5633 in the PXI chassis.

To install the PXIe-5633 in a PXI chassis, complete the following steps :

1. Ensure that the AC power source is connected to the chassis before installing the module.
The AC power cord grounds the chassis and protects it from electrical damage while you install the module.
2. Power off the chassis.
3. Inspect the slot pins on the chassis backplane for any bends or damage prior to installation.



Notice Only install a module if the backplane is undamaged.

4. Remove the black plastic covers from all the captive screws on the module front panel.
5. Identify a supported slot in the chassis.

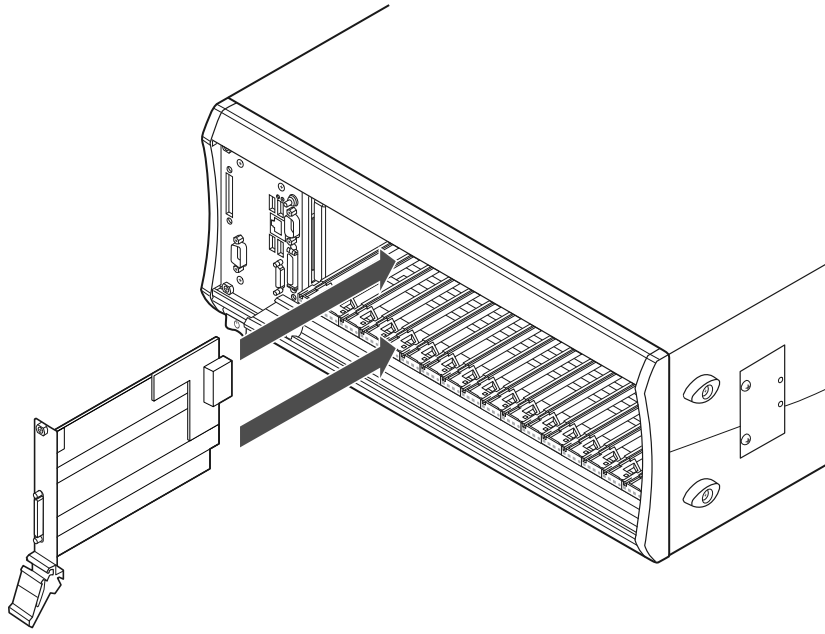
The PXIe-5633 module requires a PXI Express-compatible slot. PXI Express-compatible slots encompass PXI Express hybrid peripheral slots (●^H), PXI Express peripheral slots (●), and the PXI Express system timing slot (◻●).



Tip If you plan to use the optional PXIe-6674T timing and synchronization module, reserve the PXI Express system timing slot for the PXIe-6674T.

6. To discharge static electricity, touch any metal part of the chassis.
7. Ensure that the ejector handle is in the downward (unlatched) position.

Figure 6. PXI Module Installation



8. Place the module edges into the module guides at the top and bottom of the chassis and slide the module into the slot until it is fully inserted.
9. Latch the module in place by pulling up on the ejector handle.
10. Secure the module front panel to the chassis using the front-panel mounting screws.



Note All front panel mounting screws must be attached to the PXI Express chassis to ensure that all backplane connectors are fully mated. Tightening the mounting screws also increases mechanical stability and electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.

11. Depending on your application, cover all empty slots with either filler panels (standard or EMC) or with slot blockers and filler panels.



Note For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

Verifying the Installation

Before using the PXIe-5633, verify that it is installed correctly through Hardware Configuration Utility or Measurement & Automation Explorer (MAX).

Verifying the Installation in Hardware Configuration Utility

NI recommends using Hardware Configuration Utility to perform and to validate initial hardware configuration.

1. Open Hardware Configuration Utility.
The PXIe-5633 appears in the system pane automatically.
2. Record the name that Hardware Configuration Utility assigns to the PXIe-5633 or provide a custom name.
Use this name when programming the PXIe-5633.
3. Validate that your instrument is installed correctly: select the PXIe-5633 module in the system pane, expand the **Troubleshooting** area of the configuration pane, and click **Self-test**.
Hardware Configuration Utility reports when it has validated the hardware setup.

What Should I Do If the PXIe-5633 Does Not Appear in Hardware Configuration Utility?

Check if you must refresh the connection between the hardware and the software in Hardware Configuration Utility.

1. Click the refresh button ().
2. If the PXIe-5633 is still not listed, complete the following steps.
 - a. Power off the system.
 - b. Ensure that all hardware is correctly installed.
 - c. Restart the system.
3. Right-click the **Start** button and select **Device Manager**.
4. Depending on your controller type, verify the Device Manager settings.

Controller type	Description
PXI controller	a. Verify that a National Instruments entry appears in the system device list. b. If error conditions appear in the list, right-click the module you are using in the Device Manager and select Update Driver.
MXI controller	a. Right-click PCI-to-PCI Bridge and select

Controller type	Description
	Properties. - Verify that you enabled the bridge. - Verify that no error conditions appear.

If error conditions persist, reinstall the driver.

- Restart your computer.

What Should I Do If the PXIe-5633 Fails the Self-Test in Hardware Configuration Utility?

- Reset the PXIe-5633 through Hardware Configuration Utility and then perform the self-test again.
- Restart the system, and then perform the self-test again.
- Power off the chassis.
- Reinstall the failed module in a different slot.
- Power on the chassis.
- Perform the self-test again.



Note If the module fails the self-test again, contact NI or visit ni.com/support for further troubleshooting information.

Verifying the Installation in MAX

To configure your NI hardware, use Measurement & Automation Explorer (MAX).

MAX informs other programs about the NI hardware products in the system and their hardware configuration. MAX is automatically installed with the driver.



Note MAX is not available on Linux.

- Launch MAX.
- In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware.

Installed modules appear under the name of their associated chassis.

- Expand your **Chassis** tree item.

MAX lists all modules installed in the chassis. Your default names might vary.



Note If you do not see your module in the list, press <F5> to refresh the list of installed modules. If the module is still not listed, power off the system, ensure that the module is correctly installed, and restart.

- Record the name MAX assigns to the hardware. Use this identifier when programming the PXIe-5633.
- Self-test the hardware by selecting the item in the configuration tree and clicking **Self-Test** in the MAX toolbar.

The MAX self-test performs a basic verification of hardware resources.

What Should I Do If the PXIe-5633 Does Not Appear in MAX?

Check if you must refresh the connection between the hardware and the software in MAX.

- In the MAX configuration tree, expand **Devices and Interfaces**.
- To see the list of installed hardware, expand the **Chassis** tree and press <F5> to refresh the list.
- If the PXIe-5633 is still not listed, complete the following steps.
 - Power off the system.
 - Ensure that all hardware is correctly installed.
 - Restart the system.
- Right-click the **Start** button and select **Device Manager**.
- Depending on your controller type, verify the Device Manager settings.

Controller type	Description
PXI controller	- Verify that a National Instruments entry appears in the system device list. - If error conditions appear in the list, right-click the module you are using in the Device Manager and select Update Driver.
MXI controller	- Right-click PCI-to-PCI Bridge and select Properties. - Verify that you enabled the bridge.

Controller type	Description
	c. Verify that no error conditions appear.

If error conditions persist, reinstall the driver.

6. Restart your computer.

What Should I Do If the PXIe-5633 Fails the Self-Test in MAX?

1. Reset the PXIe-5633 through MAX and then perform the self-test again.
2. Restart the system, and then perform the self-test again.
3. Power off the chassis.
4. Reinstall the failed module in a different slot.
5. Power on the chassis.
6. Perform the self-test again.



Note If the module fails the self-test again, contact NI or visit ni.com/support for further troubleshooting information.

Using the PXIe-5633

You can design your own programs to control the PXIe-5633 or use the PXIe-5633 interactively with InstrumentStudio.

Designing VNA Measurement Applications for the PXIe-5633

Use the PXIe-5633 to make VNA measurements—S-parameters and incident and reflected waves—for 1-port and 2-port devices. To design measurement programs for the PXIe-5633, use the RFmx VNA API.

You can also control the PXIe-5633 interactively with InstrumentStudio. This process describes how to use the RFmx VNA API to build VNA measurement applications for the PXIe-5633 that include measurement calibration with the CAL-5501 vector calibration module.



Note RFmx VNA includes a wide array of entry points to control your instrument and optimize its behavior for your application. This process describes only the basic programming flow to create a VNA measurement program successfully.

Related concepts:

- [PXIe-5633 Examples](#)

Related information:

- [RFmx VNA User Manual](#)

Initialize a Session

Use RFmxInstr Initialize to create a session with the PXIe-5633. All RFmx programs must begin with an RFmxInstr function.

Initializing returns an instrument handle with the session configured to a known state. Initialization can take a significant amount of time compared to other functions, so you should not include it in loops. Ideally, your program should call `RFmxInstr Initialize` one time.

Call `RFmxInstr Initialize`.



Tip For most RFmx personalities, you can include measurement functions from any number of personalities in a single session initialized with `RFmxInstr Initialize`; you do not need to create unique sessions for each personality.

The exception is RFmx VNA, which cannot be used in a session that includes any other RFmx personalities.

De-Embed Fixtures

De-embed the effects of all cabling and connectors between your DUT and the PXIe-5633 instrument to ensure that you are characterizing your DUT, not your larger test setup.

This process assumes your overall testing process uses an `.s2p` file to accomplish de-embedding.



Note De-embedding is not necessary in certain situations where you can perform measurement calibration so that the measurement calibration plane is at the DUT. If you can do so, you can avoid de-embedding in the following situations:

- If you are using a manual calibration kit.
- If you are using the PXIe-5633 with a connectorized fixture that can connect to the CAL-5501.

This process describes de-embedding for 2-port devices.

You can de-embed elements of your physical setup with RFmxInstr Load S-parameter External Attenuation Table from S2P File.

Iterate through the following steps for each port.

1. Specify, or allow an operator to input, the following information:
 - Name of the port in question
 - Filepath to the `.s2p` file
 - Orientation of the port with respect to the DUT: whether port 1 or port 2 of the `.s2p` is oriented towards the DUT
2. Construct a port string with the port name entry and the Build Port String function in the RFmx API you are using.
3. Call RFmxInstr Load S-parameter External Attenuation Table from S2P File.

Configure Frequency Sweep Settings

Use RFmx VNA properties to configure the frequency sweep parameters.

1. Define the sweep by choosing the Sweep Type and, based on the option you choose, define the frequencies to include in the sweep.
Each sweep type has its own properties for configuring the frequencies that are included in the sweep. Refer to the contextual help in your programming environment for more information.
2. Define the IF Bandwidth (Hz) for the sweep.
Only certain discrete bandwidth values are supported. Refer to the contextual help in your programming environment for these values.



Tip The smaller the IF bandwidth, the lesser the influence of noise on the measurement, but the longer the sweep time.

3. Set port-specific parameters.
 - Selector String: Define the port(s) to apply the settings to.
 - Power Level (dBm): Set the source power level for the VNA port.
 - Test Receiver Attn (dB): Specify the attenuation you want the VNA to apply to:
 - Waves reflected by the DUT back to the source port of the PXIe-5633
 - Waves emitted from the DUT to the receiver port of the PXIe-5633

Configure VNA Measurement Settings

The PXIe-5633 can measure either S-parameters or incident and reflected waves.

S-parameters are represented with the convention S_{xy} , where x is the measure port and y is the source port. For example, if port 1 is connected to the DUT input and port 2 is connected to the DUT output, S_{21} refers to sourcing on port 1 and measuring on port 2.

The PXIe-5633 can also measure incident and reflected waves.

Use RFmx VNA to configure the settings for these measurements.

1. Define measurement averaging settings:
 - a. Control whether to apply averaging with Averaging Enabled.
 - b. If using averaging, define the number of acquisitions to average with Averaging Count.
2. Depending on whether you want to perform a single measurement type or multiple, call the relevant RFmx VNA function and select the measurement(s) to perform:
 - Single measurement type: RFmx VNA Select Measurement (Single)
 - Multiple measurement types: RFmx VNA Select Measurement (Multiple)
3. Depending on the measurement type, specify the number of items to measure:
 - S-parameter measurement: SParams Num SParams
 - Waves measurement: Waves Num Waves
4. For as many individual S-parameters or waves as you are measuring, iteratively configure port-specific settings for the measurement(s) you are performing.
 - a. Depending on your measurement type, use either RFmx VNA Build S-Parameter String or Build Wave String to provide the Selector String for the remaining elements of this step.
 - b. Define the port acting as the receiver:
 - S-parameters: SParams Configure S-Parameter
 - Waves: Waves Configure Wave
 - c. (Waves only) Use Waves Receiver to define whether to measure the wave on the reference receiver or the test receiver of the port you defined with Waves Receiver Port.
 - d. Define the port acting as the source:

- S-parameters: SPParams Configure S-Parameter
- Waves: Waves Configure Wave
- e. Define the format for the measurement:
 - S-parameters: SPParams Format
 - Waves: Waves Format

For both measurement types, you can return magnitude, phase, or raw complex values.
- 5. For magnitude and phase measurements, choose how you want the measurements to be presented by picking the units for magnitude measurements and, for phase, whether the result should be wrapped between -180° and 180° or unwrapped.
 - S-parameters: SPParams Magnitude Units, SPParams Phase Trace Type
 - Waves: Waves Magnitude Units, Waves Phase Trace Type

Implement a Measurement Calibration Process

When designing VNA measurement programs, include measurement calibration prompts to your end users to ensure the most accurate results.

The PXIe-5633 is designed to use the CAL-5501 vector calibration module for electronic calibration. The PXIe-5633 also supports manual calibration, in which you use your own calibration standards to perform measurement calibration.

1. Specify the ports for the measurement calibration with Cal Ports.
2. Use Cal Method to choose the measurement calibration method that corresponds to your test setup.
3. Input the type of connector for your measurement calibrator with Connector Type. This value must correspond to the connectors of the measurement calibrator you are using. To use the CAL-5501, set this field to `3.5 mm female`.
4. Provide the vCal Resource Name to include the measurement calibrator in the session.



Note In the RFmx VNA API, **vCal** refers to the CAL-5501 electronic calibrator.

5. Call RFmx VNA Calibration Initiate to commit measurement calibration settings to the session.
6. Include a prompt that directs the operator to connect the correct ports of the

CAL-5501 (or manual calibration kit) and the PXIe-5633 module.

The prompt should allow the operator to signal that the task is complete and then proceed.

7. Call RFmx VNA Calibration Acquire and Calibration Save.

Calibration Acquire gathers measurement calibration data using the connected CAL-5501. Calibration Save calculates error correction terms and saves the resulting correction data (**calset**) in memory.



Tip You can also design programs around saving and loading calsets to and from files (.ncst), rather than memory. Use Calset Save to File and Calset Load from File.

8. Depending on the measurement calibration type, include a prompt that directs the operator to connect the DUT to the PXIe-5633 module and that gives the operator a way to signal that this task is complete:

- 1-port calibration and measurement: Connect the DUT port to the calibrated port of the PXIe-5633. Connect the other port as follows, depending on the number of DUTs:
 - If you are making two one-port measurements at the same time: Connect to the other DUT
 - Otherwise: Connect to a 50 Ω terminator
- 2-port calibration and measurement: Connect both ports of the PXIe-5633 to both ports of the DUT.

The prompt should allow the operator to signal that the task is complete and then proceed.

9. Set Correction Enabled to True to apply the calset to the measurements the program will enable.

Related concepts:

- [VNA Measurement Calibration Guidelines](#)

Related reference:

- [PXIe-5633 Operating Guidelines](#)

Initiate VNA Measurement

Initiate the instrument to apply any configured settings and begin VNA measurement.

Call RFmx VNA Initiate to apply all configured settings, if they have not already been applied, and start VNA measurement, including any corrections you have .

Fetch VNA Measurement Data

Iteratively fetch the VNA measurement data to return data for each S-parameter or wave you have configured in your program.

1. Call an RFmx VNA fetch function for the S-parameters or waves that you configured.
 - S-parameters: SParams Fetch Y Data
 - Waves: Waves Fetch Y Data



Tip You can use Build S-Parameter String or Build Wave String to furnish the `Selector String` to the fetch function you use.

2. **Optional:** If you want to graph the measurements visually, call SParams Fetch X Data or Waves Fetch X Data to return the frequency values for the data as the x-axis of the graph.

Close the Session

Every RFmx session must be closed in order to deallocate memory, destroy threads, and free operating system resources.

Required: Use RFmxInstr Close to conclude the session and free system resources.

Performing Interactive VNA Measurements in InstrumentStudio

You can use InstrumentStudio to access the VNA functionality of the PXIe-5633 through an interactive soft front panel.

This process assumes you have already performed initial hardware configuration in Hardware Configuration Utility or MAX.

Refer to InstrumentStudio documentation for information on the layout of InstrumentStudio.



Notice Follow all guidelines when making connections to the PXIe-5633.

Complete the following steps to make interactive VNA measurements with the PXIe-5633 in InstrumentStudio:

1. Open a Network Analyzer panel in InstrumentStudio.
 - From InstrumentStudio: Click  » **Network Analyzer**, or create a layout automatically based on the equipment in your system.
 - From Hardware Configuration Utility: Select the PXIe-5633 module and, within the instrument configuration panel on the right side, click **Measurement panel**.
2. Configure reference clock settings with ... » **Instrument**.
PXI_Clk is the valid source for PXIe-5633 VNA functionality.
3. **Optional:** If you want to use de-embedding to remove the effect of fixtures from your measurements, in the instrument configuration panel, click ... » **Instrument** and choose the relevant settings.



Note To apply de-embedding, you must have .s2p files available for each port you want to de-embed.

4. Define the frequency sweep settings.

Sweep Type	Description
Linear	Sweep a linear set of frequencies. Define a low start frequency and a high stop frequency for the sweep, as well as the total number of frequency points to include in the sweep.
List	Sweep only specific frequency points.

Sweep Type	Description
	Specify the individual frequencies to include.
Segment	Divide the sweep into discrete frequency segments and apply independent settings to each segment. For each segment of the sweep, define a low start frequency and a high stop frequency, as well as the total number of frequency points for the segment. Also specify additional settings, such as IF bandwidth, dwell time, and more.

5. **Optional:** Configure advanced sweep settings with **... » Sweep**.

- Configure IF bandwidth.



Note Only discrete bandwidth values are supported. If you choose an unsupported value, the bandwidth is coerced up to the next supported value.

- Configure power and attenuation settings.
- Configure delay and dwell.
- Choose whether to turn the VNA source off during measurements.

6. **Optional:** Enable per-point measurement averaging and choose the number of measurements to average with **... » Averaging**.

7. Apply or perform measurement calibration.

- Apply an existing correction from a file:
 - Select the **active calset** (.ncst).
 - Toggle correction **ON**.
- Perform manual calibration with your own measurement calibration standards: select **Calibration » Manual Calibration** follow the onscreen prompts, and toggle correction **ON**.
- Perform electronic calibration with the CAL-5501:
 - Select **Calibration » Electronic Calibration**.
 - Select options for the measurement calibration:

- 1-port calibration: For **Ports**, select **port1** or **port2** and select an appropriate **Method**
 - 2-port calibration: For **Ports**, select **port1**, **port2** and select an appropriate **Method**
- c. Enter the identifier of the CAL-5501 device you are using for the calibration in **vCal Resource Name**.



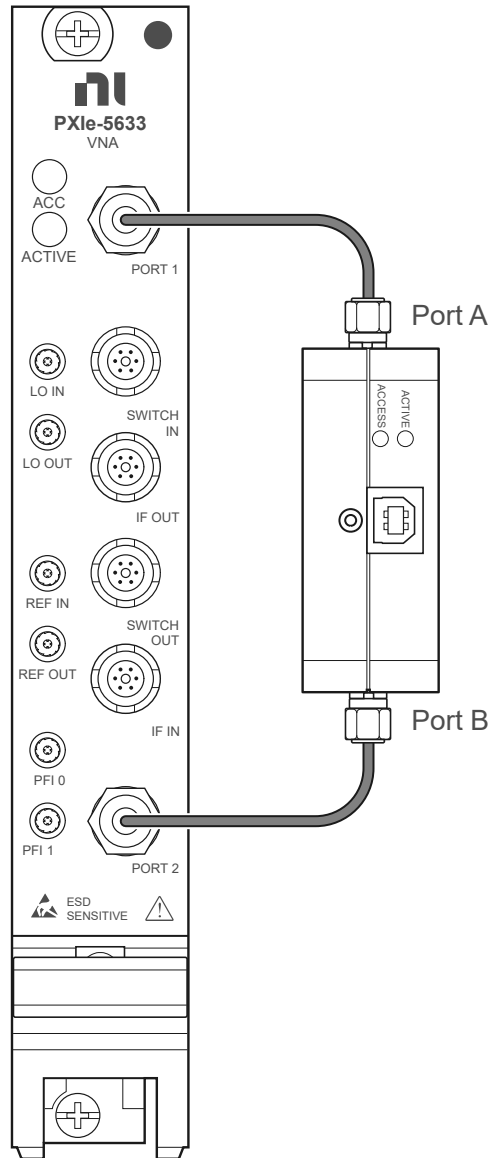
Note In InstrumentStudio, **vCal** refers to the CAL-5501 electronic calibrator.

- d. If needed, modify the **vCal Orientation**.

vCal Orientation defines which port of the PXIe-5633 is connected to which port of the CAL-5501.

- e. If it is not connected already, make the USB connection between the CAL-5501 and the controller for your system.
- f. Connect the CAL-5501 to the PXIe-5633 module in the way that corresponds to the **vCal Orientation** you specified:

Figure 7. CAL-5501 Connection to PXIe-5633



Connection shown:

- CAL-5501 PORT A to PXIe-5633 PORT 1
- CAL-5501 PORT B to PXIe-5633 PORT 2

CAL-5501 USB connection not shown.



Note Measurement calibration calculates corrections at the ports of the CAL-5501 module. For best results, connect the

CAL-5501 in place of your DUT, leaving the rest of your physical setup exactly as it is during DUT measurements.

- g. Click **Continue**.
 - h. To save the calibration data for later use, select **Save Calset to File**.
 - i. Toggle correction **ON**.
8. **Optional:** If desired, adjust correction settings: click ...» **Correction** and adjust the options.

You can do the following:

- Apply correction to only a subset of the ports for which the calset contains correction data



Note If the calset originates from a two-port measurement calibration but you are measuring on only one port, you still need to perform both sweeps to apply the corrections for the single port.

- Enable port extension to extend the measurement reference plane
9. Define the measurements to perform, S-parameters or incident and reflected waves, with the **ADD / REMOVE** button in the **Measurements** section of the instrument configuration panel.
10. Configure measurement-specific settings in the instrument configuration panel or with ...» **S-parameters** or ...» **Waves**.



Note Corrected measurements use interpolated error terms if the frequency points used for measurement deviate from the calibrated frequency points. However, interpolated error correction may affect measurement accuracy. Use interpolation judiciously.

- To disable interpolated error correction, uncheck ...» **Correction** » **Interpolation Enabled**.
- See the status bar below the graph for the **Correction State** (None, Corrected, or Interpolated) to determine whether the corrected measurements use interpolated error terms.

11. Connect your DUT, if it is not connected already.
- 1-port, 1-device measurement: Connect the port of your device to a port of the

PXIe-5633 module, and terminate the other PXIe-5633 port with a 50 Ω terminator

- 2-port measurement: Connect each port of your device to a port of the PXIe-5633 module

12. Run the measurement by clicking **RUN** to measure continuously or **SINGLE** to capture a single measurement.

The measurement you have configured displays in the measurement graph.

Related concepts:

- [Guidelines for Making Threaded RF Connections](#)
- [Threaded RF Connector Care Guidelines](#)

Related tasks:

- [Avoiding Damage when Making Direct Connections to the PXIe-5633](#)
- [Cleaning Threaded RF Connectors](#)

Related information:

- [InstrumentStudio User Manual](#)
- [RFmx VNA User Manual](#)

Cleaning and Maintaining the PXIe-5633

NI recommends the following to clean and maintain your instrument's system.

- Clean the fan filters on the chassis regularly to prevent fan blockage and to ensure efficient air circulation. Cleaning frequency depends on the amount of use and the operating environment. For specific information about cleaning procedures and other recommended maintenance, refer to the chassis user documentation.
- Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

Cleaning Threaded RF Connectors

Keep connector interfaces, especially the outer conductors of threaded RF connectors, clean and free of dirt and any other debris. Follow the guidelines to maintain the connectors, and therefore the performance, of your instruments and cables over time.

Contaminants such as metal fibers are sources of uncertainty in measurements. Contaminants can be abrasive and cause damage to the surfaces of mating connectors, which inhibits the repeatability of your measurements. Contaminated connectors pose problems especially for high-frequency, high-precision measurements because they prevent a good impedance match. Therefore, it is important to keep the threaded RF connectors in your test system clean.

Required equipment:

- Protective eyewear
- Pure, filtered compressed air or nitrogen
- Magnifying glass
- (Non-air dielectric connectors only) Lint-free swabs, such as foam swabs, of appropriate size for the connectors
- (Non-air dielectric connectors only) Pure (99.5%) isopropyl alcohol
- (Non-air dielectric connectors only) Toothpick



Notice Do not use swabs or isopropyl alcohol on connectors that have an air dielectric, such as 3.5 mm, 2.92 mm, or 1.85 mm connectors. Refer to front panel and pinout documentation to confirm the connector types for your instrument. If using isopropyl alcohol to clean the appropriate connector types, do so in a well ventilated area.

Complete as many of the following steps as you need to clean threaded RF connectors. Complete only the steps that are appropriate for the type of connector you are cleaning:

1. After putting on protective eyewear, blow out any loose debris from the connector with compressed air or nitrogen by blowing across the connector face.



Tip Do not blow directly into the connector: blowing into the connector can lodge any debris more firmly. Blowing across the connector is the safest method for cleaning connectors that use air dielectric.

2. (Non-air dielectric connectors only) Examine the connector with a magnifying glass to check for debris. If you still notice debris, try removing it with a lint-free, foam-tipped swab by gently moving the foam swab around the center conductor.



Notice Follow these guidelines when cleaning connectors with a foam swab:

- Always clean the connector in a circular motion around the center pin, not across the pin. Never put lateral pressure on the center pin of a connector.
- Apply as little pressure as necessary. Applying too much pressure can embed debris deeper into the connector.



Notice NI does not recommend using cotton swabs to clean threaded RF connectors. Cotton fibers can become lodged in the connector, where they can cause damage or measurement errors.

3. (Non-air dielectric connectors only) Examine the connector with a magnifying glass again. If you still notice debris, barely dampen another foam swab with isopropyl alcohol (do not saturate it) and attempt to clean the connector in the same manner as with the first swab.



Notice Do not apply isopropyl alcohol directly to a connector.

4. Verify that no foam or other foreign material remains in the connector.
5. (Non-air dielectric connectors only) If the connector is still contaminated, use a very small toothpick with a small amount of isopropyl alcohol applied. Use the magnifying glass when using the toothpick.



Notice Use extreme care to avoid damaging the connector with the toothpick.

6. If desired, use the compressed air or nitrogen to remove any foreign particles and, if you used isopropyl alcohol, to dry the connector.

After cleaning, verify that the center pin has not been bent or damaged. Also verify that the collets of the mating connector are neither bent nor damaged. When connectors are not in use, keep them covered with the dust cap for included with your instrument for the connector.

If you are not successful in cleaning the connector after completing as many steps of this procedure as are appropriate for the connector type, remove the item from service and label it accordingly.