

CALIBRATION PROCEDURE

NI Switches

This document contains information for calibrating National Instruments switches. For more information on calibration, visit ni.com/calibration.

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Software Requirements

Calibrating NI switches requires installing the NI-SWITCH instrument driver on the calibration system. The NI-SWITCH version must support the switch you want to calibrate. You can download NI-SWITCH from ni.com/downloads.

Documentation Requirements

For information about NI-SWITCH and NI switches, you can consult the following documents:

- *NI Switches Getting Started Guide*—provides instructions for installing and configuring NI switches.
- *NI Switches Help*—includes detailed information about NI switches and NI-SWITCH VIs and functions.
- *NI Switch Specifications*—provide the published specification values for switch products. Refer to the most recent specifications document for your product online at ni.com/manuals.

These documents are installed with NI-SWITCH. You also can find the latest versions of the documentation at ni.com/manuals.

Test Equipment

National Instruments recommends that you use the equipment in Table 1 for calibrating NI switches.

Table 1. Recommended Equipment

Type of Switch	Equipment	Recommended Model	Parameter Measured	Minimum Requirements
All modules	Digital Multimeter	NI PXI-4070/ 4071/4072	Path resistance	Four-wire resistance measurement accuracy $\pm 1.2 \text{ m}\Omega$ or better.
RF-only modules up to 6 GHz	Vector Network Analyzer (VNA)	NI PXIe-5630	VSWR, insertion loss, isolation	The VNA must be capable of measuring to the rated frequency of the switch module.
RF-only modules up to 40 GHz	Vector Network Analyzer (VNA)	Rohde & Schwarz ZVA40	VSWR, insertion loss, isolation	The VNA must be capable of measuring to the rated frequency of the switch module.

Test Conditions

The following setup and environmental conditions are required to ensure the NI switch meets published specifications.

- Verify that all connections to the device, including front panel connections, are secure.
- Maintain an ambient temperature of $23 \pm 5 \text{ }^\circ\text{C}$. The device temperature will be greater than the ambient temperature.
- Keep relative humidity below 80%.
- Allow adequate warm-up time to ensure that the measurement circuitry is at a stable operating temperature. For the NI PXI-4070/4071/4072, the warm-up time is one hour. For the NI PXIe-5630, the warm-up time is 30 minutes.
- Ensure that the PXI/PXI Express chassis fan speed is set to HIGH, that the fan filters are clean, and that the empty slots contain filler panels. For more information, refer to the *Maintain Forced-Air Cooling Note to Users* document available at ni.com/manuals.
- Plug the chassis or computer and all instruments into the same power strip to avoid ground loops.

Calibration Procedures

The calibration process includes the following steps:

1. *Initial Setup*—Install the device and configure it in Measurement & Automation Explorer (MAX).
2. *Verification*—Verify the operation of the device. This step confirms whether the device is operating within the published specifications.

These procedures are described in more detail in the following sections.

Initial Setup

Refer to the *NI Switches Getting Started Guide* for information about how to install the software and hardware and how to configure the device in MAX.

Verification

All Switch Modules

This section provides instructions for verifying NI switch specifications.

Verifying Path Resistance

Complete the following steps to verify path resistance:

1. Launch the NI-SWITCH Soft Front Panel and select the device to calibrate.
2. Use the soft front panel to connect each channel or crosspoint in sequence.
3. While the channel or crosspoint is closed, measure the total path resistance from interface connector pin to interface connector pin using the digital multimeter in four-wire resistance mode.
4. Disconnect the channel and verify that the path is open.
5. Refer to the product-specific specifications document for path resistance specifications and the *NI Switches Help* for connector pinouts.



Note You can automate steps 2, 3, and 4 using a separate dual 2-wire $N \times 1$ multiplexer.

RF Switch Modules

This section provides instructions for verifying NI RF switch specifications.



Caution Torque SMA connectors with 0.8 to 1.1 N·m per product specifications. Failure to do so may lead to inaccurate measurements or damage to the connector.

Verifying VSWR and Insertion Loss

Complete the following steps to verify VSWR and insertion loss:

1. Launch the NI-SWITCH Soft Front Panel and select the device to calibrate.
2. Use the soft front panel to connect each channel or crosspoint in sequence.
3. Calibrate the VNA up to the rated frequency of the switch. Refer the VNA's user manual and follow the calibration procedure.
4. While the channel or crosspoint is closed, connect the ports of the VNA to the endpoints of the path created in step 2. Observe the VSWR plots S11 and S22 at both ports as well as both insertion loss plots S12 and S21 (port 1 to port 2 and port 2 to port 1.)
5. Refer to the product-specific specifications document for VSWR and insertion loss specifications and the *NI Switches Help* for connector pinouts.

Verifying Isolation

Complete the following steps to verify isolation:

1. Launch the NI-SWITCH Soft Front Panel and select the device to calibrate.
2. Use the soft front panel to connect each channel or crosspoint in sequence.
3. Calibrate the VNA up to the rated frequency of the switch. Refer the VNA's user manual and follow its calibration procedure.
4. While the channel or crosspoint is closed, connect one port of the VNA to an endpoint in the path created. Connect a 50 Ω termination to the other endpoint of the path created. Connect the other port of the VNA to a different channel. Observe both isolation plots on the VNA (S12 and S21.)
5. Refer to the product-specific specifications document for isolation specifications and the *NI Switches Help* for connector pinouts.

Troubleshooting

If your module fails any verification step, it might be because a relay has reached end-of-life. If your module has replaceable relays, follow the relay replacement procedure for your module in the *NI Switches Help*. After replacing the relay, rerun the verification procedure until all verification steps pass.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At ni.com/support you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

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