NI Digital Multimeters Getting Started Guide

NI PCMCIA-4050, NI PXI/PCI-4060, NI PXI-4070

Contents

NATIONAL INSTRUMENTS

Conventions

The following conventions are used in this manual:

» The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.

♦ The ♦ symbol indicates that the following text applies only to a specific product, a specific operating system, or a specific software version.

This icon denotes a tip, which alerts you to advisory information.

This icon denotes a note, which alerts you to important information.

This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

bold Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names and information on hardware labels.

DMM Digital multimeter—refers to either the NI PCMCIA-4050, NI PCI-4060, NI PXI-4060, or NI PXI-4070 unless specified otherwise.

italic Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace` Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

Introduction

This document explains how to install, configure, test, and set up a National Instruments digital multimeter (DMM) for common measurements. For more information on the DMM, such as features and programming, refer to *NI Digital Multimeters Help* at **Program Files»National Instruments» NI-DMM»Documentation»NI Digital Multimeters Help**.

Detailed specifications about your DMM are available in the specifications guide included with your DMM module.

For free downloads of the most current versions of manuals and example programs, visit `ni.com/instruments`.

FCC/Canada Radio Frequency Interference Compliance[1]

Determining FCC Class

The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). Depending on where it is operated, this product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.)

Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labeled at all for FCC; if so, the reader should then assume these are Class A devices.)

FCC Class A products only display a simple warning statement of one paragraph in length regarding interference and undesired operation. Most of our products are FCC Class A. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

FCC Class B products display either a FCC ID code, starting with the letters **EXN**, or the FCC Class B compliance mark that appears as shown below.

Trade Name   Model Number
FC Tested to Comply
with FCC Standards
FOR HOME OR OFFICE USE
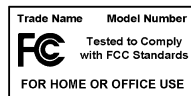
Consult the FCC Web site at `http://www.fcc.gov` for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE Mark Declaration of Conformity[2], may cause interference to

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[1] Certain exemptions may apply in the USA, see FCC Rules §15.103 **Exempted devices**, and §15.105(c). Also available in sections of CFR 47.

radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the

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[2] The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Department of Communications

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Compliance to EU Directives

Readers in the European Union (EU) must refer to the Manufacturer's Declaration of Conformity (DoC) for information[1] pertaining to the CE Mark compliance scheme. The Manufacturer includes a DoC for most every hardware product except for those bought for OEMs, if also available from an original manufacturer that also markets in the EU, or where compliance is not required as for electrically benign apparatus or cables.

To obtain the DoC for this product, click **Declaration of Conformity** at `ni.com/hardref.nsf/`. This Web site lists the DoCs by product family. Select the appropriate product family, followed by your product, and a link to the DoC appears in Adobe Acrobat format. Click the Acrobat icon to download or read the DoC.

Safety Instructions

This section contains important safety instructions that you *must* follow when installing and using the product.

Do *not* operate the product in a manner not specified in the product documentation. Misuse of the product can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to National Instruments for repair.

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[1] The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

Do *not* substitute parts or modify the product except as described in the product documentation.

Do *not* operate the product in an explosive atmosphere or where there may be flammable gases or fumes. Operate the product only at or below the pollution degree stated in the hardware specifications. Pollution is foreign matter in a solid, liquid, or gaseous state that can reduce dielectric strength or surface resistivity. The following is a description of pollution degrees:

- Pollution degree 1 means that no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.

- Pollution degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, condensation can cause temporary conductivity.

- Pollution degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs that becomes conductive due to condensation.

Clean the product with a soft nonmetallic brush. Make sure the product is completely dry and free from contaminants before returning it to service.

You *must* insulate signal connections for the maximum voltage for which the product is rated. Do *not* exceed the maximum ratings for the product. Remove power from signal lines before connecting them to or disconnecting them from the product.

Operate this product only at or below the installation category stated in the hardware specifications.

The following is a description of installation categories:

- Installation Category I is for measurements performed on circuits not directly connected to MAINS[1]. This category includes signals such as voltages on a printed circuit board (PCB) on the secondary of an isolation transformer.

  Examples of Installation Category I are measurements on circuits not derived from MAINS and on specially protected (internal) MAINS-derived circuits.

- Installation Category II is for measurements performed on circuits directly connected to the low-voltage installation. This category refers to local-level distribution such as that provided by a standard wall outlet.

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[1] MAINS is defined as the electricity supply system to which the equipment concerned is designed to be connected either for powering the equipment or for measurement purposes.

Examples of Installation Category II are measurements on household appliances, portable tools, and similar equipment.

- Installation Category III is for measurements performed in the building installation. This category is a distribution level referring to hardwired equipment that does not rely on standard building insulation.

Examples of Installation Category III include measurements on distribution circuits and circuit breakers. Other examples of Installation Category III are wiring including cables, bus-bars, junction boxes, switches, socket outlets in the building/fixed installation, and equipment for industrial use, such as stationary motors with a permanent connection to the building/fixed installation.

- Installation Category IV is for measurements performed at the source of the low-voltage (<1,000 V) installation.

Examples of Installation Category IV are electric meters, and measurements on primary overcurrent protection devices and on ripple-control units.

Below is a diagram of a sample installation.
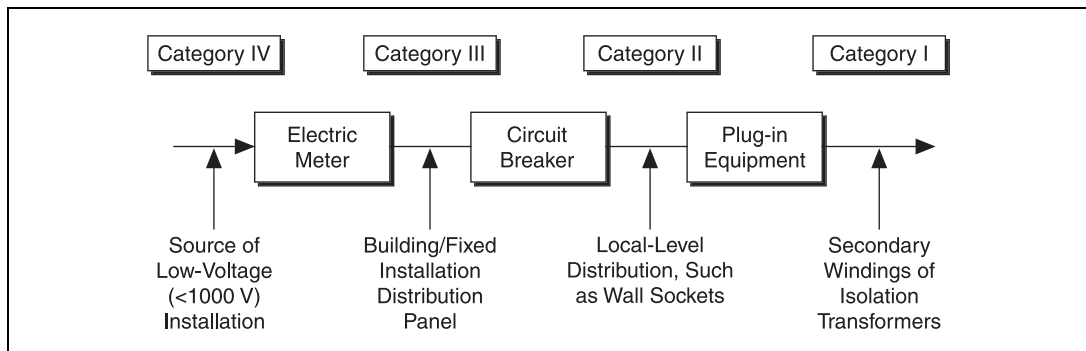
Refer to the specifications guide included with the DMM to determine the pollution and installation categories of the DMM.

Getting Started

To set up and use the DMM, you need the following:

❑ NI PCMCIA-4050 (NI 4050), NI PXI/PCI-4060 (NI 4060), or NI PXI-4070 (NI 4070)

❑ NI-DMM driver software

Note The NI PXI-4070 requires NI-DMM 2.0 or later.

❑ *NI Digital Multimeters Getting Started Guide*

❑ *NI Digital Multimeters Help* located at **Program Files»National Instruments»NI-DMM»NI Digital Multimeters Help**

❑ The specifications guide included with your DMM module.

❑ A PXI chassis and controller, desktop computer, or a laptop with a PCMCIA slot

❑ 1/8 in. flathead screwdriver

❑ One of the following software packages and documentation:
  – NI LabVIEW
  – LabWindows/CVI
  – Microsoft Visual C++
  – Microsoft Visual Basic

Unpacking

The DMM ships in an antistatic package to prevent electrostatic damage. Electrostatic discharge can damage several components on the DMM.

Caution *Never* touch the exposed pins of connectors.

To avoid damage in handling the DMM, take the following precautions:

1. Ground yourself using a grounding strap or by holding a grounded object.

2. Touch the antistatic package to a metal part of your computer chassis before removing the DMM from the package.

Remove the DMM from the package and inspect it for loose components or any sign of damage. Notify NI if the DMM appears damaged in any way. Do *not* install a damaged DMM into your computer or chassis.

Store the DMM in the antistatic envelope when not in use.

Installing the Software

Complete the following steps to install the software before installing the DMM.

1. Install an application development environment (ADE) such as LabVIEW, LabWindows/CVI, Microsoft Visual C++, or Microsoft Visual Basic.

2. Install the NI-DMM instrument driver software according to the instructions on the CD included with your DMM.

Installing the Hardware

⚠ **Cautions** You *must* power off your PC or chassis before installing the DMM.

To prevent damage to the DMM due to electrostatic discharge or contamination, handle the device using the edges or the metal bracket.

✏ **Note** Install the NI-DMM software before installing the hardware.

PXI Installation

To install the PXI-DMM, refer to Figure 1 and complete the following steps:

1. Power off the PXI chassis.

2. Slide the PXI-DMM into an available slot until the ejector handle locks in the up position.

3. Secure the DMM with the screws provided.
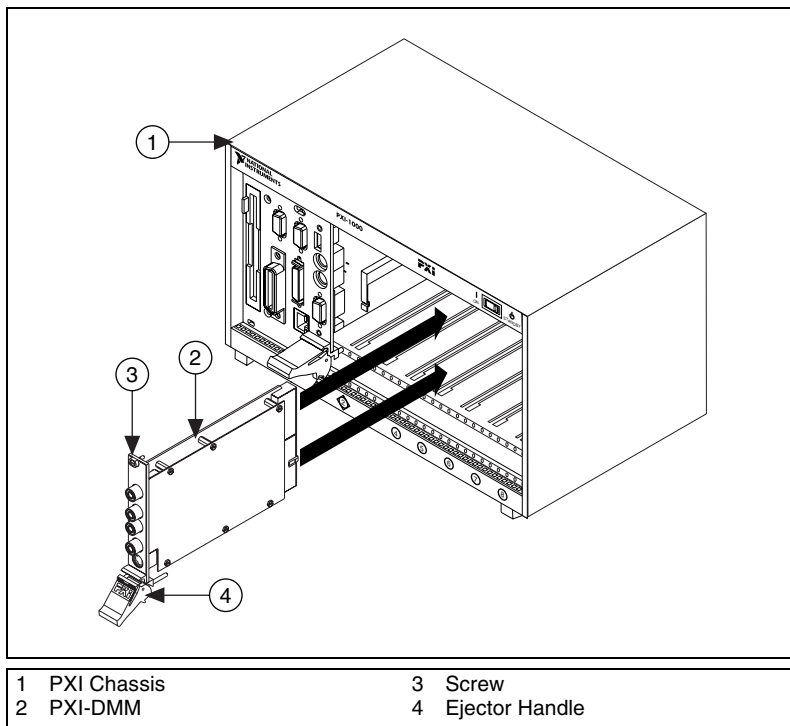
4. Power on the PXI chassis.

1	PXI Chassis	3	Screw
2	PXI-DMM	4	Ejector Handle

Figure 1. PXI Installation

PCI Installation

To install the PCI-DMM, refer to Figure 2 and complete the following steps:

1. Power off your PC and remove the cover.
2. Insert the PCI-DMM into an open PCI slot.
3. Secure the DMM with the screw provided.
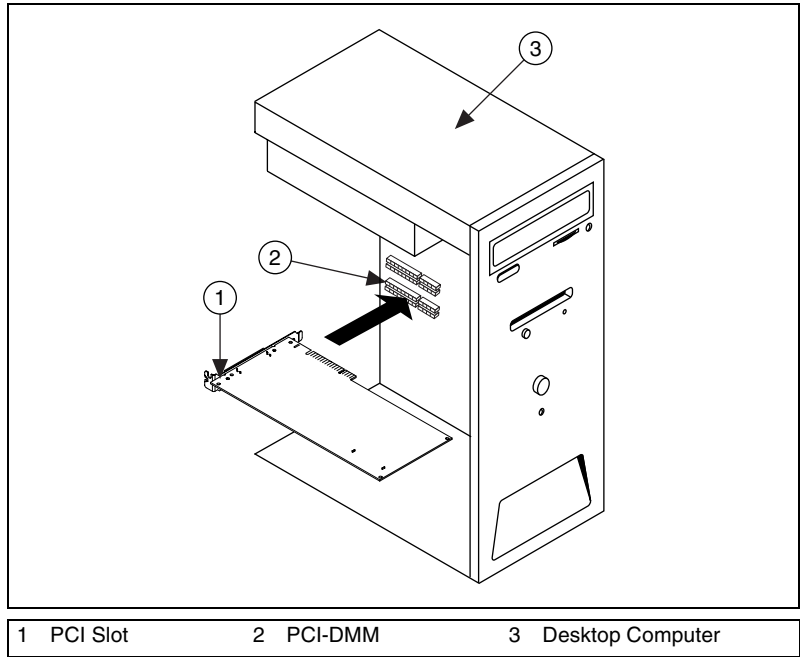4. Replace the PC cover.
5. Power on your computer.

1 PCI Slot	2 PCI-DMM	3 Desktop Computer

Figure 2. PCI Installation

PCMCIA Installation

To install the PCMCIA-DMM, refer to Figure 3 and insert the PCMCIA-DMM into an open PCMCIA slot.

1	Laptop	2	PCMCIA Slot	3	NI 4050
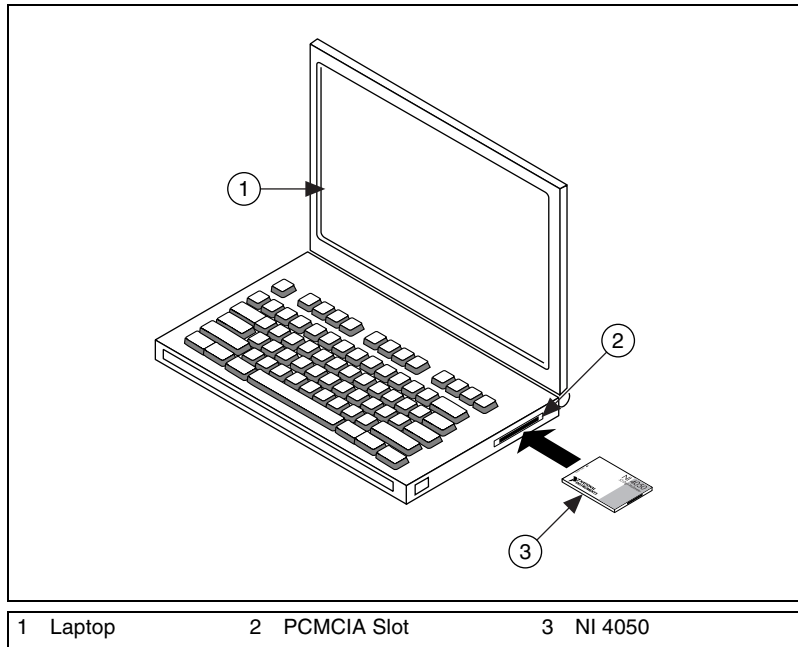
Figure 3. PCMCIA Installation

Configuration in MAX

1. Launch **Measurement & Automation Explorer** (MAX) to configure and test the DMM. MAX detects the DMM you installed.

2. Double-click **Devices and Interfaces** to see the DMM listed. If the device is not listed, press <F5>.

3. Right-click the DMM icon, and select **Properties**. Refer to the device number and resources assigned to the DMM by MAX.

4. In the Configuring Device window, click **Test Resources**. A dialog box appears and indicates if the DMM has passed the resource test.

Note If the device does not pass the test, power off the PC, remove the DMM, and repeat the appropriate installation procedure. If the device still does not pass the test, visit our support Web site at `ni.com/support`.

5. Click **Run Test Panels** to run the functional test panels and to use the DMM. Refer to the *Connecting Signals* section to connect a signal to the DMM.

Note The **Run Test Panels** option is currently not available for the NI 4070.

6. Click **Close** to close the Test Panel.

7. Click **OK** to close the Properties window and return to the MAX main window.

8. Exit MAX.

Connecting Signals

This section discusses what connections are available on the DMM and how to connect signals to the DMM.

PXI/PCI

Figure 4 shows the front panels for PXI and PCI devices. The PXI and PCI front panels contain five connectors—four shrouded banana jacks and one 9-pin connector.
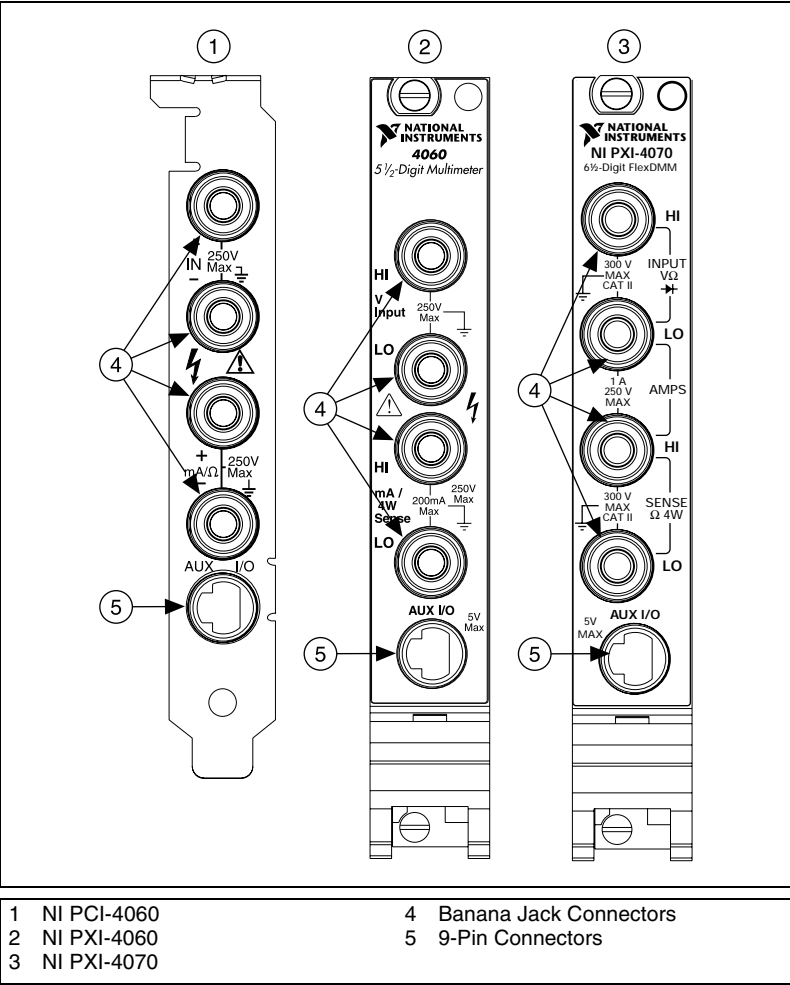

1	NI PCI-4060	4	Banana Jack Connectors
2	NI PXI-4060	5	9-Pin Connectors
3	NI PXI-4070		

Figure 4. Connections on the PXI and PCI Devices

The four banana jacks are high-voltage, safety signal connectors. The 9-pin connector labeled **AUX I/O** is a digital signal connector, which carries

TTL-level triggering signals for use with external scanning equipment. Refer to the *NI Digital Multimeters Help* located at **Program Files» National Instruments»NI-DMM»NI Digital Multimeters Help** for information about scanning.

PCMCIA

The NI 4050 instrument kit contains the NI 4050 accessory cable that connects the NI 4050 to a pair of test probes with shrouded banana jacks, which are also included in the kit.

Connect the cable to the PCMCIA card as shown in Figure 5. The accessory cable connector is polarized so that it cannot be plugged in incorrectly.

⚠️ **Caution** To measure current with the NI 4050, you *must* use a shunt. Refer to the *DC and AC Current* section for more information.

| 1 | Laptop Computer | 3 | NI PCMCIA-4050 | 5 | Test Probes |
| 2 | PCMCIA Slot | 4 | Accessory Cable | | |
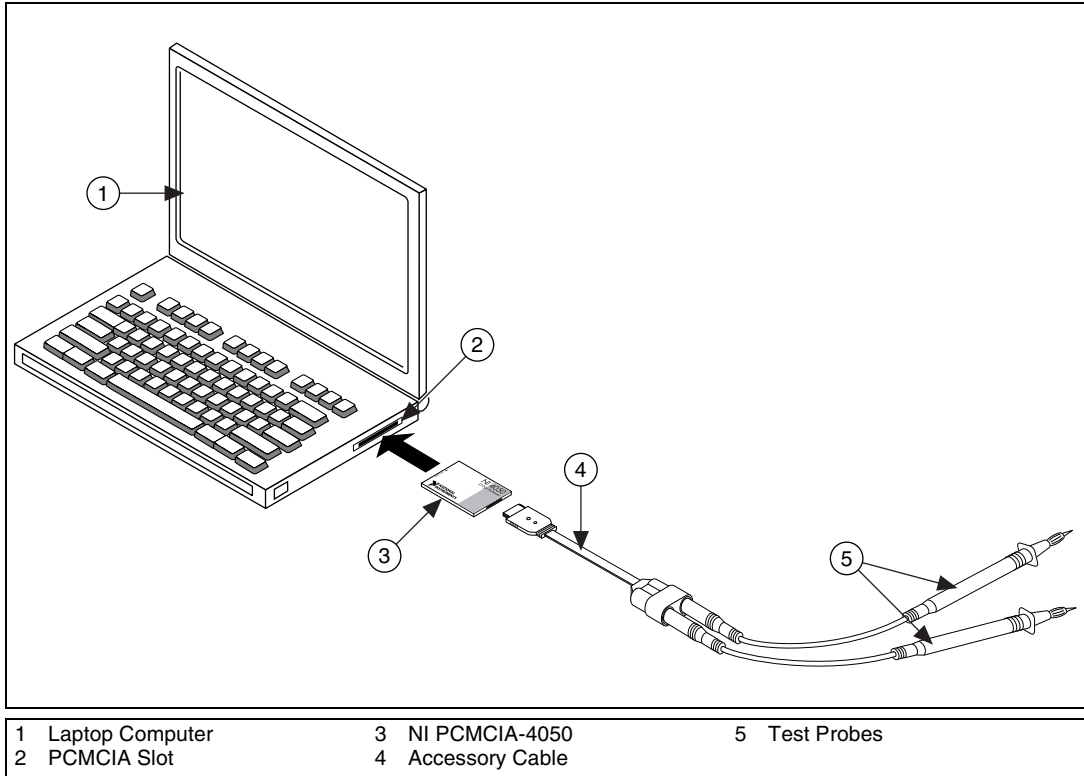
Figure 5. Connecting Cables to the NI 4050

Using Cable and Probes

The DMM kit contains a pair of test probes with safety banana jacks. These probes meet international safety requirements, including UL 3111 and IEC 1010-1, for the full range of applications supported by the DMM.

⚠ **Caution**   Before using any probes or accessories not supplied by NI, ensure that they meet applicable safety requirements for the signal levels you may encounter.

Connect the test probes to the DMM using safety banana jacks. The shrouds around the banana jacks prevent you from contacting potentially hazardous voltages connected to the test probes. You also can connect the cable to standard, unshrouded banana jack probes or accessories. Use unshrouded probes or accessories only when the voltages are less than 30 Vrms and 42 V_{pk}, or 60 VDC.

⚠ **Caution**   **NI 4050 users**—to prevent possible safety hazards, the maximum voltage between either of the inputs and the ground of the computer should never exceed ±250 VDC or 250 Vrms.

⚠ **Caution**   **NI 4060/4070 users**—to prevent possible safety hazards, the maximum voltage between either of the inputs and the ground of the computer should never exceed ±300 VDC or 300 Vrms. The maximum current that the NI 4060 can measure between the current inputs is ±200 mA DC or 200 mArms. The maximum current that the NI 4070 can measure between the current inputs is ±1 A DC or 1 Arms.

Wiring for Common Measurements

The following sections explain how to wire your DMM for common measurements. To learn more about these measurements refer to *NI Digital Multimeters Help* at **Program Files»National Instruments»NI-DMM» NI Digital Multimeters Help**.

⚠ **Caution**   Always refer to the specifications guide included with your DMM *before* connecting signals. Failure to observe the maximum signal ratings on the DMM can create a shock or fire hazard or can damage any or all of the devices connected to the DMM. NI is *not* liable for any damages or injuries resulting from incorrect signal connections.
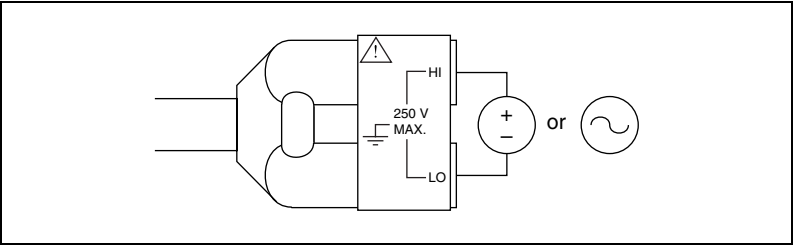
DC and AC Voltage

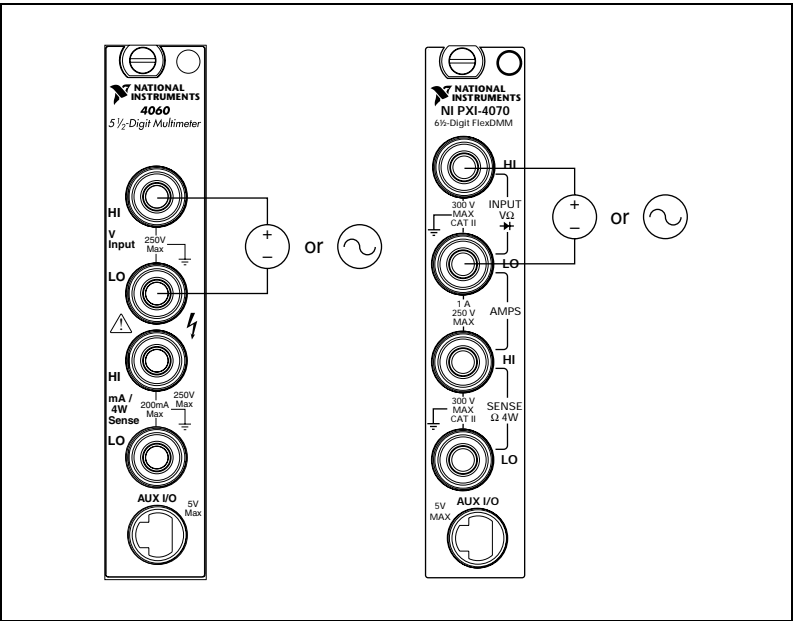**Figure 6.** NI 4050 Signal Connections for Voltage Measurements

Figure 7. NI 4060/4070 Signal Connections for Voltage Measurements
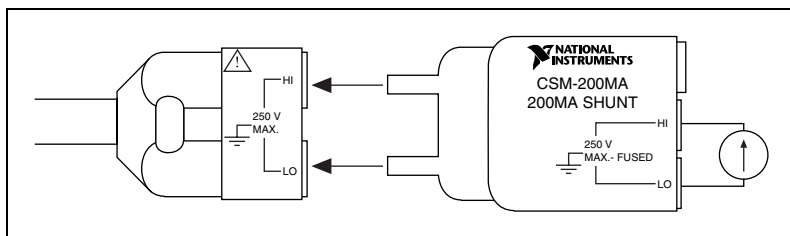
DC and AC Current

Figure 8. NI 4050 Signal Connections for Current Measurements

📝 **Note** To measure current (up to 200 mA), the NI 4050 requires the CSM-200mA current shunt module included with your NI 4050.
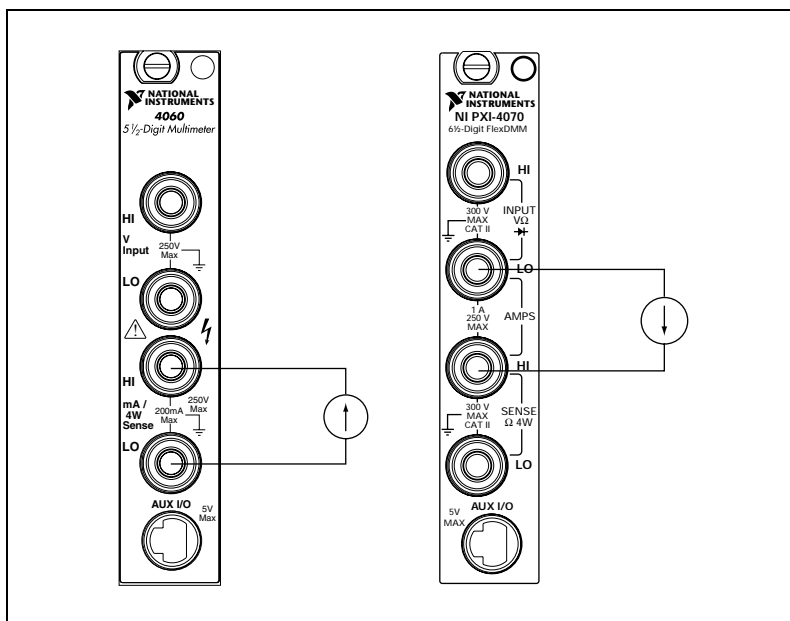

Figure 9. NI 4060/4070 Signal Connections for Current Measurements

💡 **Tip** To measure current up to 10 A, NI provides an external shunt package (CSM-10A) for your convenience. Refer to the *CSM-10A and CSM-200mA Current Shunt Modules Installation Guide* included with your CSM-10A shunt for information. Refer to ni.com/instruments for purchasing information.

2-Wire Resistance
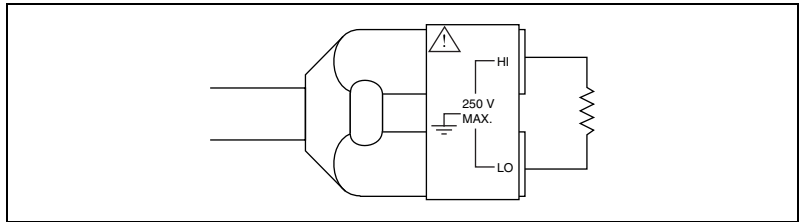
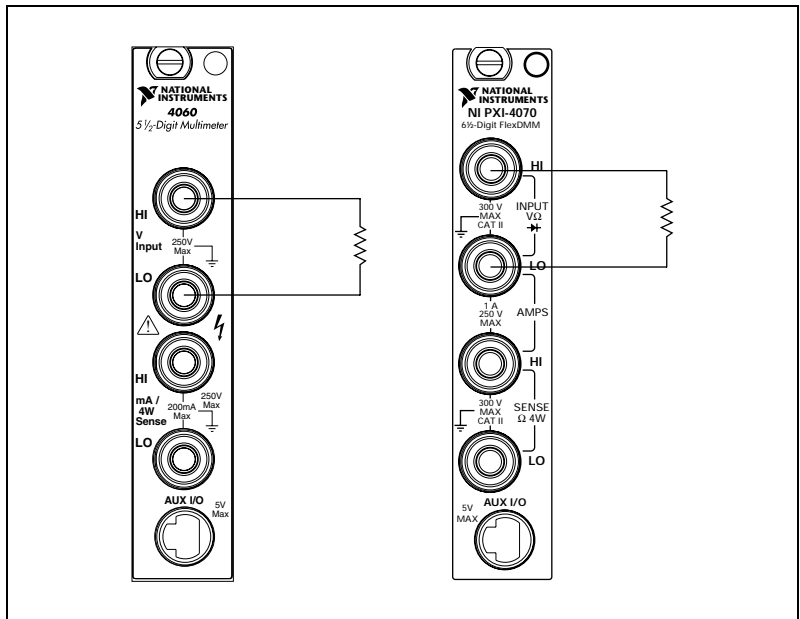**Figure 10.** NI 4050 Signal Connections for 2-Wire Resistance Measurements

Figure 11. NI 4060/4070 Signal Connections for 2-Wire Resistance Measurements

4-Wire Resistance

4-wire resistance measurements use both pairs of terminals, which allows you to measure low resistances accurately by eliminating the effects of lead resistance.

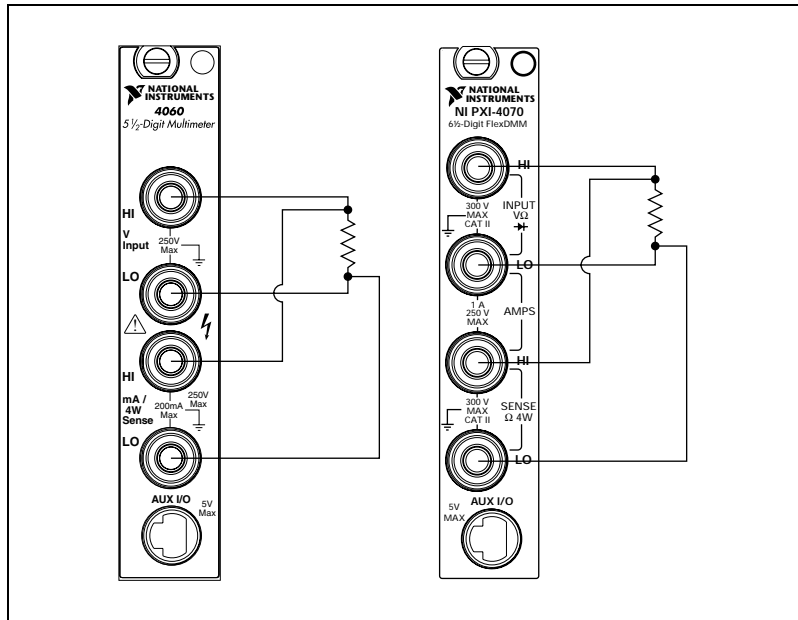✏️ **Note** The NI 4050 does not support 4-wire resistance measurements.

Figure 12. NI 4060/4070 Signal Connections for 4-Wire Resistance Measurements

Voltage Drop across a Diode

The DMM can excite a device under test and read the resulting voltage drop which is useful for testing diodes.
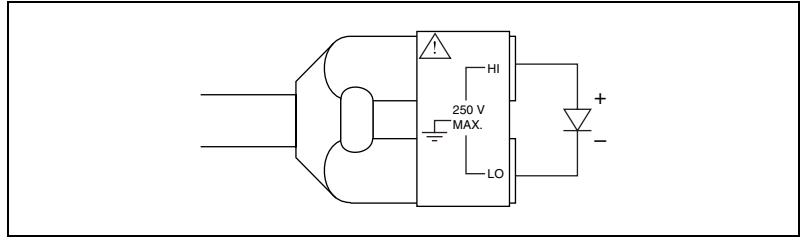

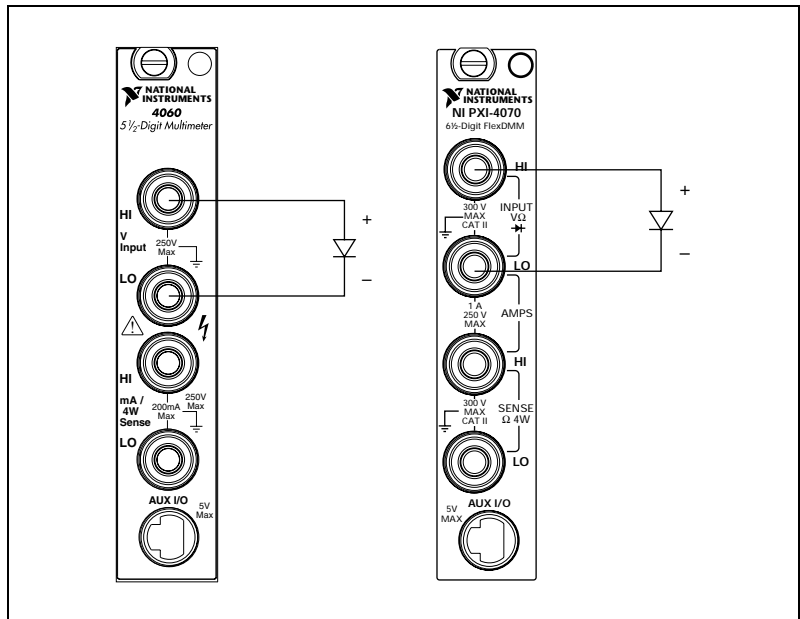**Figure 13.** NI 4050 Signal Connections for Diode Measurements

Figure 14. NI 4060/4070 Signal Connections for Diode Measurements

Temperature

You can measure temperature using common temperature transducers such as resistive temperature devices (RTD) and thermistors. You can measure resistive transducers in the 2-wire resistance mode, as shown in Figure 16.
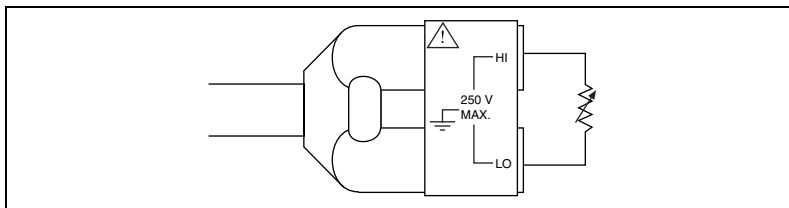

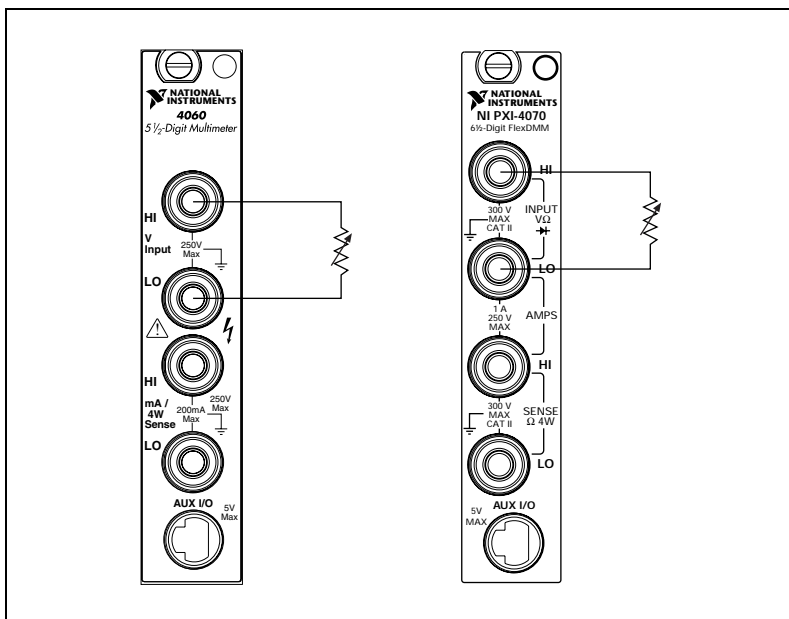**Figure 15.** NI 4050 Signal Connections for Temperature Measurements

Figure 16. NI 4060/4070 Signal Connections for Temperature Measurements

You can write mathematical operations in your program to convert and scale the resistance value of the transducer to temperature.

You can also measure the devices in 4-wire resistance mode to eliminate the effects of lead resistance, as shown in Figure 12.

Acquiring Data

You can acquire data with the DMM in one of two ways: by using the DMM Soft Front Panel (SFP) or the NI-DMM instrument driver in your application.

DMM Soft Front Panel

The DMM SFP is a software representation of a traditional benchtop DMM. Use the DMM SFP to test the basic functionality of the DMM and become familiar with its operation.

You can launch the DMM SFP from **Program Files»National Instruments»NI-DMM»NI-DMM Soft Front Panel**.

NI-DMM Instrument Driver

NI-DMM features a set of operations and attributes that exercise all the functionality of the DMM, including configuration, control, and other module-specific functions. NI-DMM controls all NI digital multimeters.

Refer to the *Programming* section of the *NI Digital Multimeters Help* at **Program Files»National Instruments»NI-DMM»NI Digital Multimeters Help**, for information on using NI-DMM in your applications.

Fuse Replacement

This section explains how to replace the fuse in the NI 4060 and NI 4070. Replace the fuse with one of the fuse types listed in the chart below. To replace the fuse in the CSM-10A or CSM-200ma shunt modules, refer to the *CSM-10A and CSM-200ma Current Shunt Modules Installation Guide.*

⚠ **Caution** For continued protection against fire, replace only with fuses of the same type and rating. Refer to Table 1 for fuse types.

Table 1. Appropriate Fuses for the NI 4060 and NI 4070

DMM	Fuse Rating	Fuse Type	Manufacturer	Part Number
NI PXI/PCI-4060	500 mA/250 V	Fast acting	Schurter	FSF 034.1513
	500 mA/250 V	Fast acting	LittelFuse	217.500
NI PXI-4070	1.25 A/250 V	Fast acting	LittelFuse	216 1.25

NI PXI/PCI-4060

To replace the fuse, complete the following steps:

♦ NI PXI-4060

1. Remove all signal connections from your NI PXI-4060.

2. Power down your chassis and remove the device.

3. Hold the device as shown in Figure 17 and locate the fuse holder.
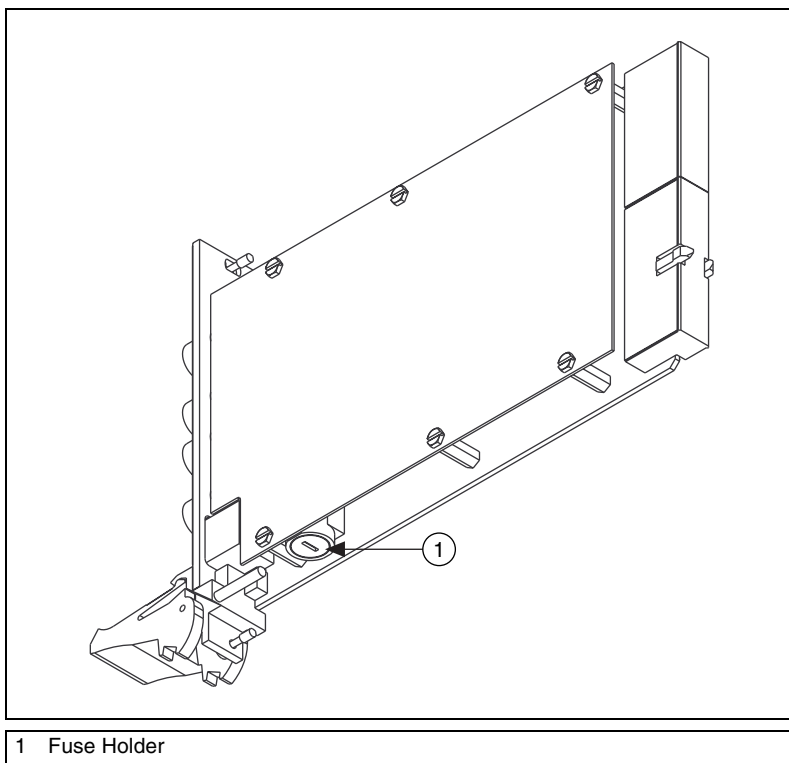

1	Fuse Holder

Figure 17. Removing the Fuse from the NI PXI-4060

4. Insert a screwdriver into the slot on the fuse holder.

5. Turn counterclockwise.

6. Pull out the holder and remove the 5×20 mm glass fuse.

7. Visually verify that the fuse is blown and remove it.

8. Insert a new fuse into the holder and slide the holder back into place.

9. Turn the fuse holder clockwise until it snaps shut.

♦ NI PCI-4060

   1. Remove all signal connections from your NI PCI-4060.

   2. Power off your computer and remove the device.

   3. Remove the four screws that secure the top and bottom insulators onto the device as shown in Figure 18.
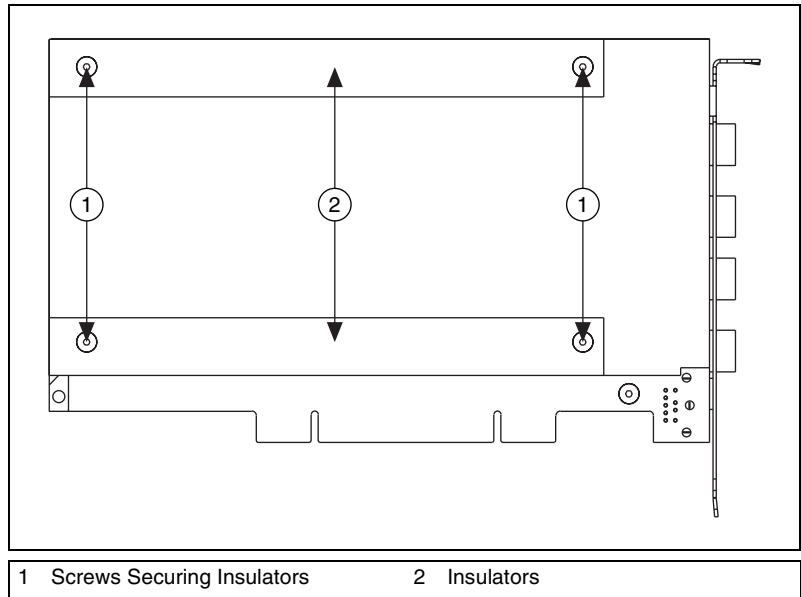

| 1 | Screws Securing Insulators | 2 | Insulators |

Figure 18. Removing the Insulators from the NI PCI-4060

   4. Remove the bottom and top insulators.

   5. Locate the 5×20 mm glass fuse shown in Figure 19.

   6. Visually verify that the fuse is blown and remove it.
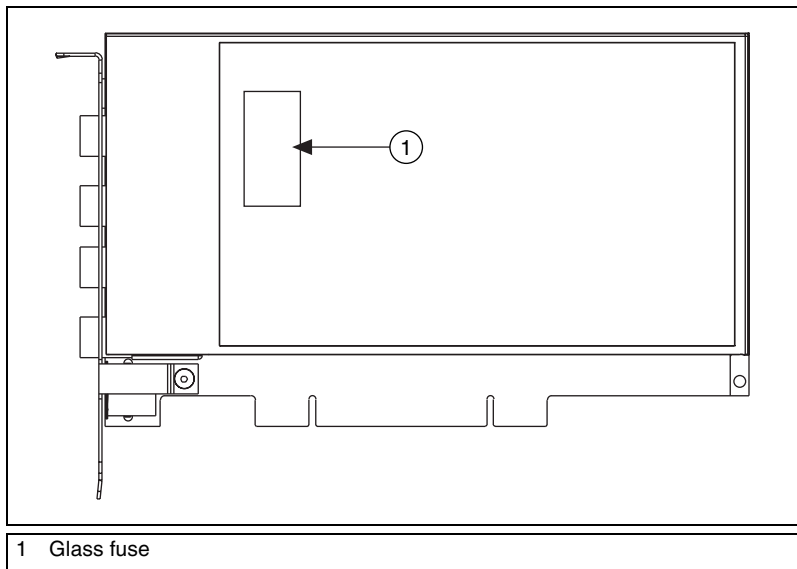
| 1 | Glass fuse |

Figure 19. Removing the Fuse from the NI PCI-4060

7. Press the new fuse into the silver holding fixture until you hear a snap.

8. Reattach the top and bottom covers in the same order as you removed them.

⚠ **Caution** Do not operate the NI PCI-4060 without both insulators replaced and fastened.

NI PXI-4070

To replace the fuse, complete the following steps:

1. Remove all signal connections from the NI 4070.

2. Power off the chassis and remove the NI 4070.

3. Locate the fuse hole shown in Figure 20.

4. Insert a screwdriver into the hole.

5. Gently press the fuse with the screwdriver until one of the fuse clamps releases.

⚠ **Caution** Do not cover the fuse slot on the opposite side of the NI 4070 with your hand, as doing so may cause injury.

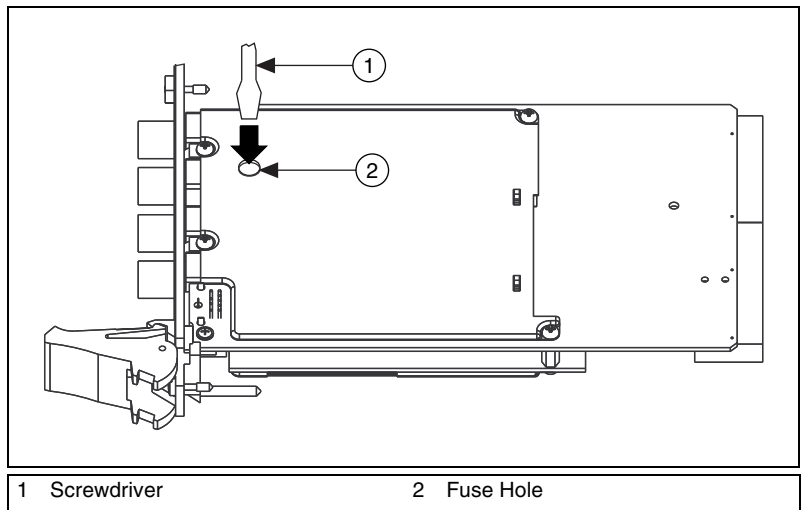| 1 Screwdriver	2 Fuse Hole

Figure 20. Removing the Fuse from the NI PXI-4070

6. Locate the fuse slot shown in Figure 21.
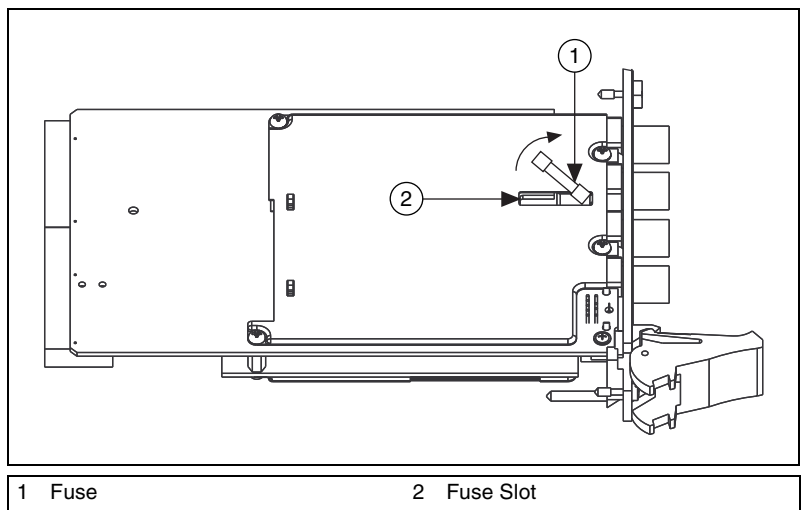7. Use a screwdriver or your finger to pry the fuse loose from the slot.

1 Fuse	2 Fuse Slot

Figure 21. Removing the Fuse from the NI PXI-4070

8. Insert a new fuse into the fuse slot as shown in Figure 22.
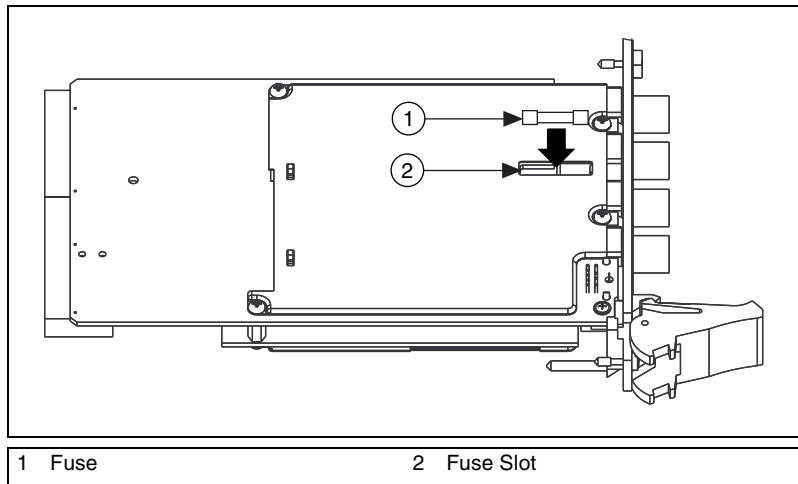

| 1 | Fuse | 2 | Fuse Slot |

Figure 22. Replacing the Blown Fuse in the NI PXI-4070

9. Gently press the fuse with the screwdriver until both fuse clamps snap the fuse into place.

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