

NI DIGITAL MULTIMETERS GETTING STARTED GUIDE

For the NI PCMCIA-4050, NI PXI/PCI-4060, and NI PXI-4070

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 the *NI Digital Multimeters Help* at **Program Files»National Instruments»NI-DMM»Documentation»NI Digital Multimeters Help**.

Detailed specifications about the DMM are available in the specifications document included with the DMM.

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

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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 otherwise specified.
<i>italic</i>	Italic text denotes variables, emphasis, a cross reference, hardware labels, 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.
NI 4050	Refers to the NI PCMCIA-4050.
NI 4060	Refers to the NI PXI/PCI-4060 unless otherwise specified.
NI 4070	Refers to the NI PXI-4070 unless otherwise specified.

FCC/Canada Radio Frequency Interference Compliance

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). All NI products are FCC Class A products.

Depending on where it is operated, this Class A 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.

All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated. Consult the FCC Web site at 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 Marking Declaration of Conformity¹, may cause interference to 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 NI 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

¹ The CE Marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is 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.

Compliance to EU Directives

Readers in the European Union (EU) must refer to the Manufacturer's Declaration of Conformity (DoC) for information¹ 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 the product, and a link to the DoC appears in Adobe Acrobat format. Click the Acrobat icon to download or read the DoC.

Safety Instructions

The following section contains important safety information that you *must* follow when installing and using the product.

Do *not* operate the product in a manner not specified in this document. 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.

Do *not* substitute parts or modify the product except as described in this document. Use the product only with the chassis, modules, accessories, and cables specified in the installation instructions. You *must* have all covers and filler panels installed during operation of the product.

Do *not* operate the product in an explosive atmosphere or where there may be flammable gases or fumes. If you must operate the product in such an environment, it must be in a suitably rated enclosure.

If you need to clean the product, use a soft, nonmetallic brush. Make sure that the product is completely dry and free from contaminants before returning it to service.

Operate the product only at or below Pollution Degree 2. 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 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, a temporary conductivity caused by condensation must be expected.
- Pollution Degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs that becomes conductive due to condensation.

You *must* insulate signal connections for the maximum voltage for which the product is rated. Do *not* exceed the maximum ratings for the product. Do not install wiring while the product is live with electrical signals. Do not remove or add connector blocks when power is connected to the system. Avoid contact between your body and the connector block signal when hot swapping modules. Remove power from signal lines before connecting them to or disconnecting them from the product.

Operate the product at or below the *installation category*¹ marked on the hardware label. Measurement circuits are subjected to *working voltages*² and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Installation categories establish standard impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of installation categories:

- Installation Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS³ voltage. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.
- Installation Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe).

¹ Installation categories, also referred to as *measurement categories*, are defined in electrical safety standard IEC 61010-1.

² Working voltage is the highest rms value of an AC or DC voltage that can occur across any particular insulation.

³ MAINS is defined as a hazardous live electrical supply system that powers equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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

- Installation Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.
- Installation Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.



Note Refer to the specifications document included with the DMM to determine the relevant pollution and installation categories.

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 document included with the DMM
- 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
 - NI LabWindows™/CVI™
 - Microsoft Visual C++
 - Microsoft Visual Basic

Unpacking

The DMM ships in an antistatic package to prevent electrostatic discharge (ESD). ESD 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:

- Ground yourself using a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of the 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 the 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 National Instruments 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 the DMM.

Installing the Hardware



Caution You *must* power off the PC or chassis before installing the DMM hardware.

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



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

Installing the PXI-DMM

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 screw provided.
4. Power on the PXI chassis.

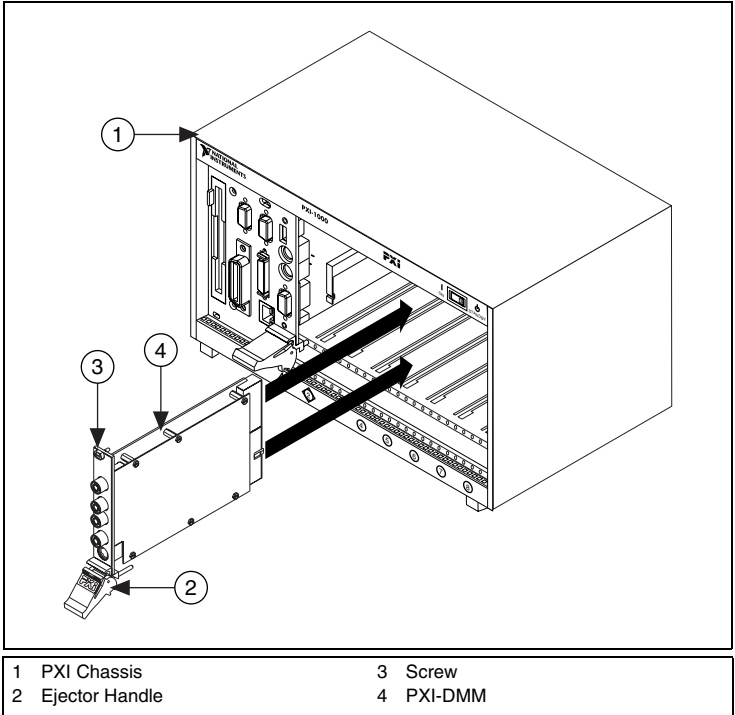


Figure 1. PXI Installation

Installing the PCI-DMM

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

1. Power off the 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 the computer.

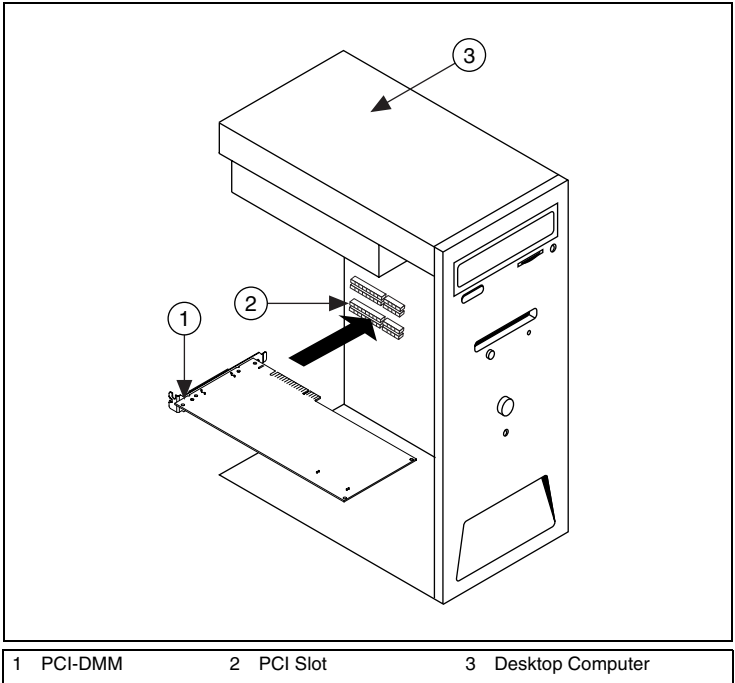


Figure 2. PCI Installation

Installing the PCMCIA-DMM

To install the PCMCIA-DMM, insert the PCMCIA-DMM into an open PCMCIA slot as shown in Figure 3.

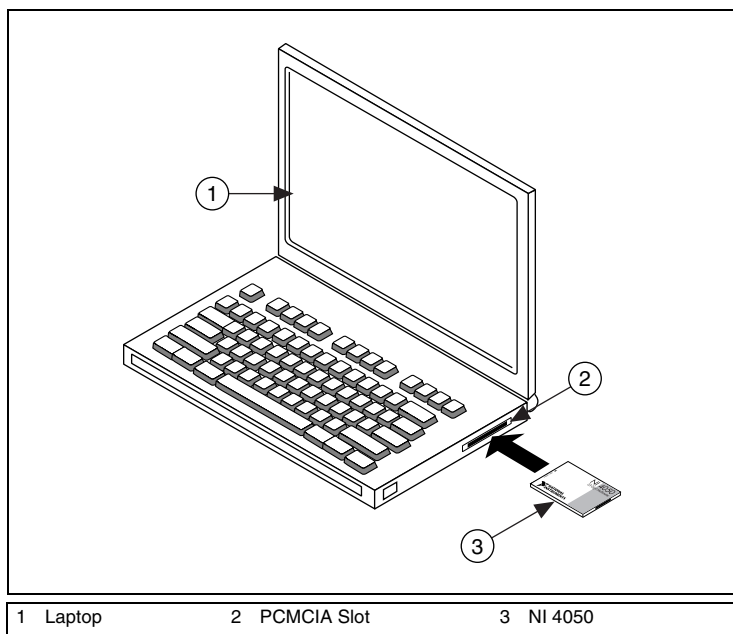


Figure 3. PCMCIA Installation

Configuring in MAX

To configure the DMM in MAX, complete the following steps:

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> to refresh the list.
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 hardware installation procedure. If the device still does not pass the test, refer to 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. Run the DMM Soft Front Panel (SFP) to run functional tests of the NI 4070. You can launch the DMM SFP from **Program Files»National Instruments»NI-DMM»NI-DMM Soft Front Panel**.

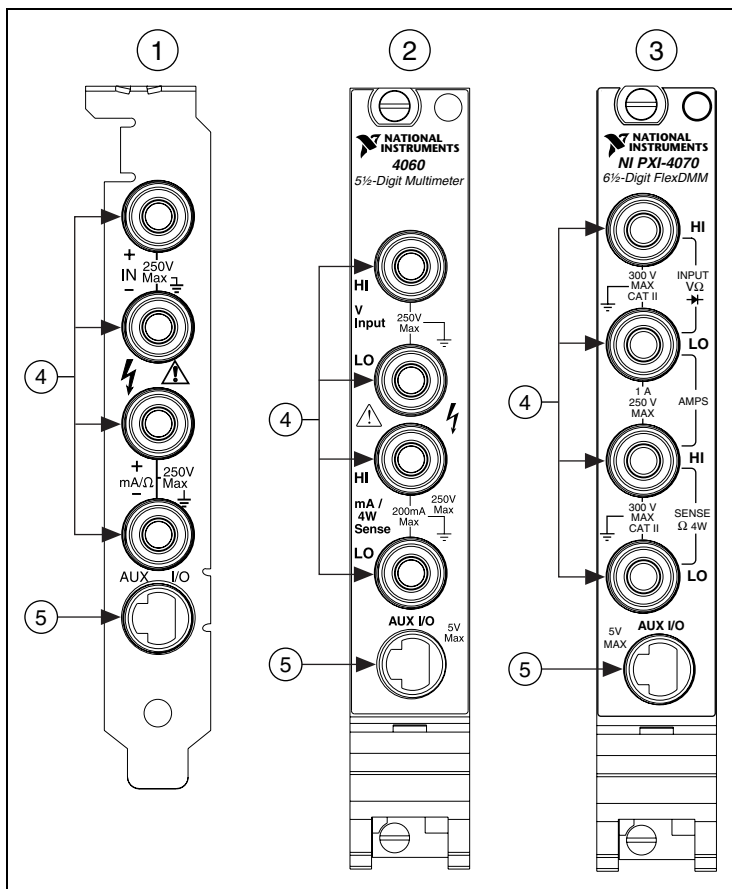
6. Click **Close** to close the Test Panel.
7. Click **OK** to close the Properties window and return to the MAX main window.
8. Exit MAX.

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
- 2 NI PXI-4060
- 3 NI PXI-4070

- 4 Banana Jack Connectors
- 5 9-Pin Connectors

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 NI 4050 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.

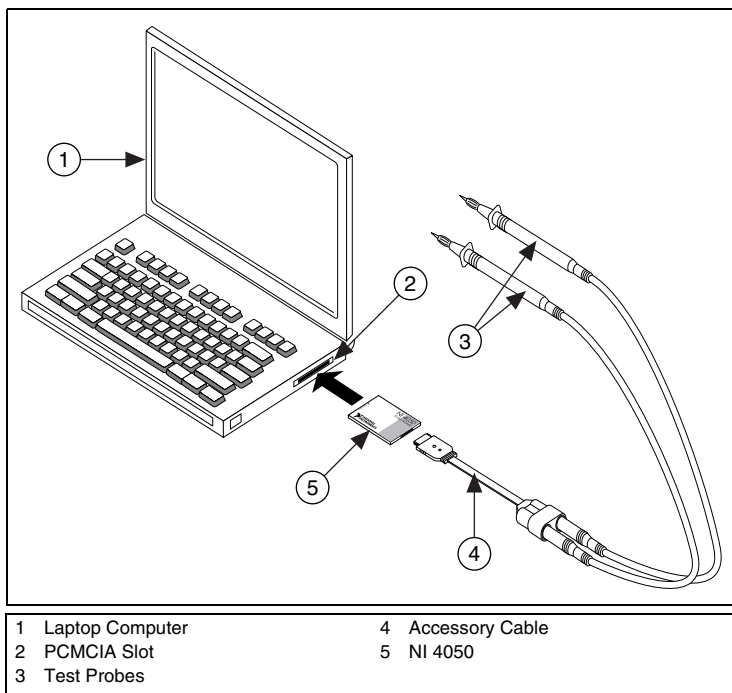


Figure 5. Connecting Cables to the NI 4050

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 $30 V_{\text{rms}}$ and $42 V_{\text{pk}}$, 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 $250 V_{\text{rms}}$.



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 $300 V_{\text{rms}}$. The maximum current that the NI 4060 can measure between the current inputs is ± 200 mA DC or $200 \text{ mA}_{\text{rms}}$. The maximum current that the NI 4070 can measure between the current inputs is ± 1 A DC or 1 A_{rms} .

Wiring for Common Measurements

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



Caution Always refer to the specifications document included with the DMM *before* connecting signals. Failure to observe the maximum signal ratings on the DMM can cause a shock, fire hazard, or damage to 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

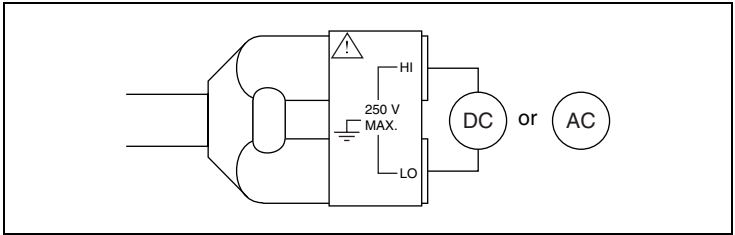


Figure 6. NI 4050 Signal Connections for Voltage Measurements

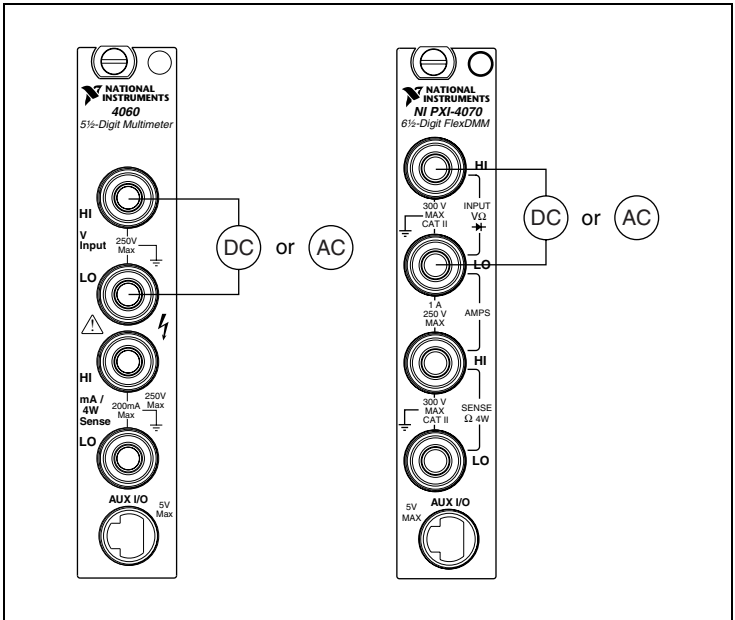


Figure 7. NI 4060/4070 Signal Connections for Voltage Measurements

DC and AC Current

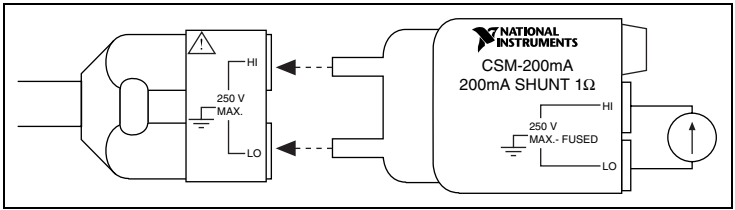


Figure 8. NI 4050 Signal Connections for Current Measurements



Note To measure current, the NI 4050 requires the CSM-200mA current shunt module available from NI.

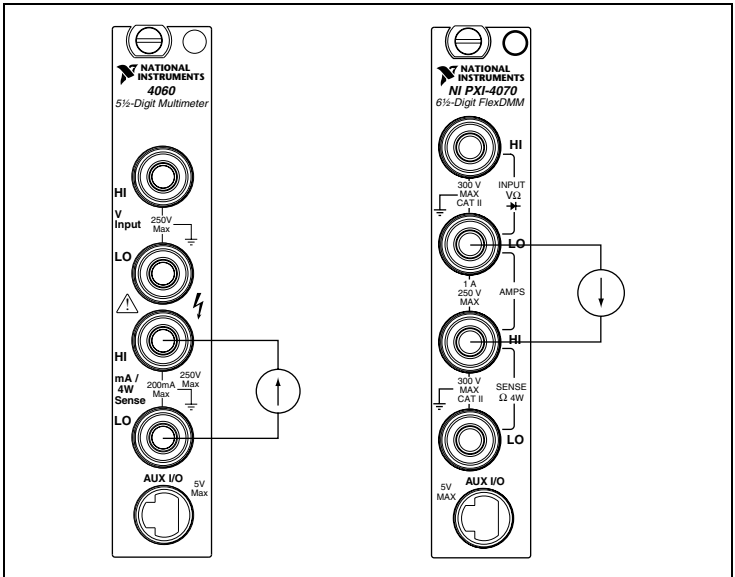


Figure 9. NI 4060/4070 Signal Connections for Current Measurements



Tip To measure current beyond the specifications of the NI 4060 and NI 4070, a 10 A current shunt, the CSM-10A, is available from NI. Refer to the *CSM-10A and CSM-200mA Current Shunt Modules Installation Guide* included with the CSM-10A for more

information. Refer to ni.com/instruments for purchasing information.

2-Wire Resistance

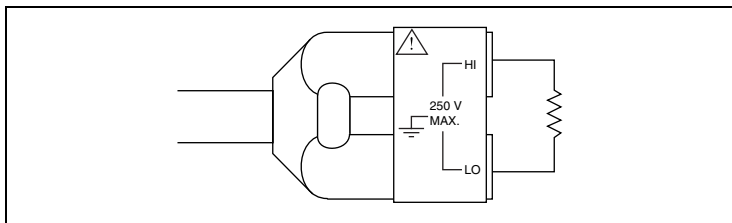


Figure 10. NI 4050 Signal Connections for 2-Wire Resistance Measurements

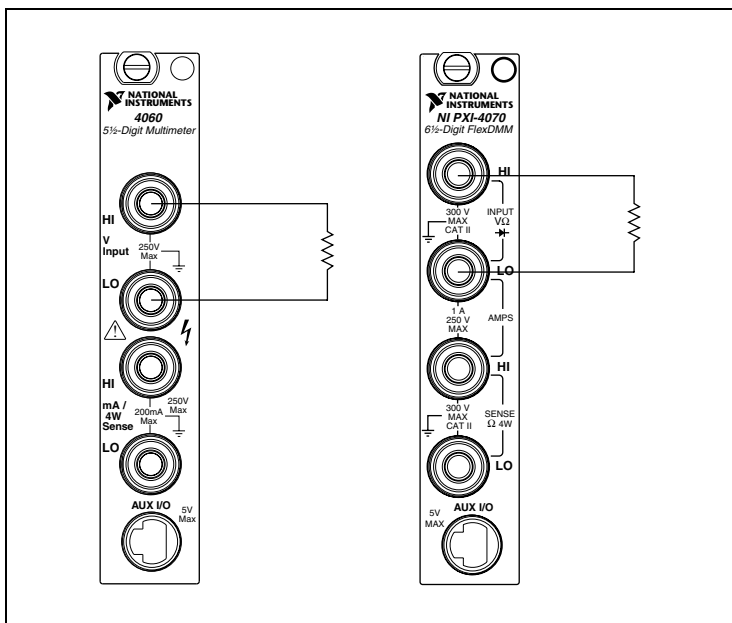


Figure 11. NI 4060/4070 Signal Connections for 2-Wire Resistance Measurements

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.

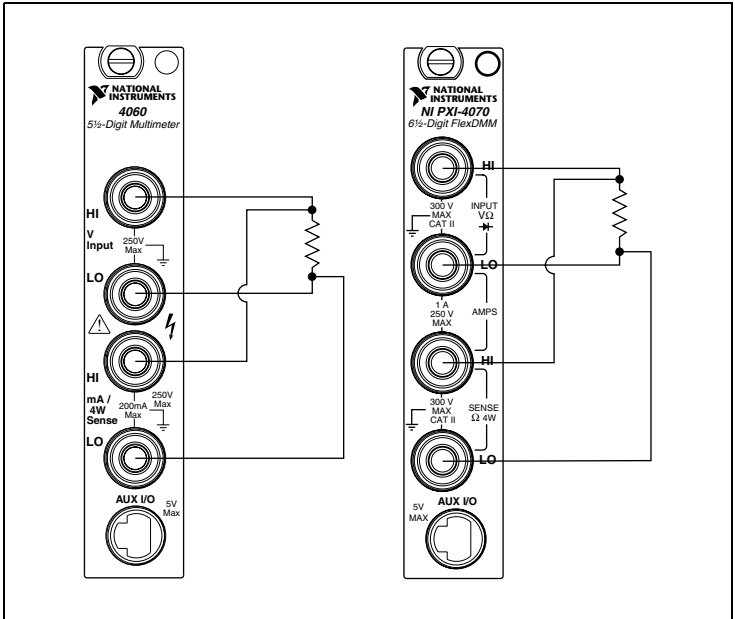


Figure 12. NI 4060/4070 Signal Connections for 4-Wire Resistance Measurements

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.

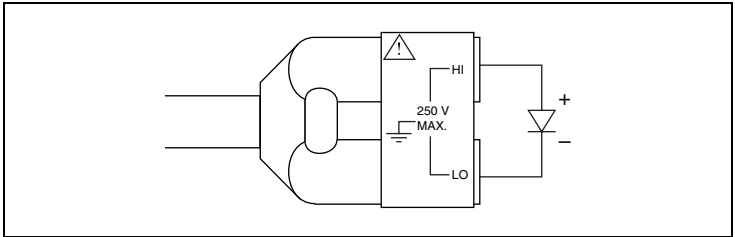


Figure 13. NI 4050 Signal Connections for Diode Measurements

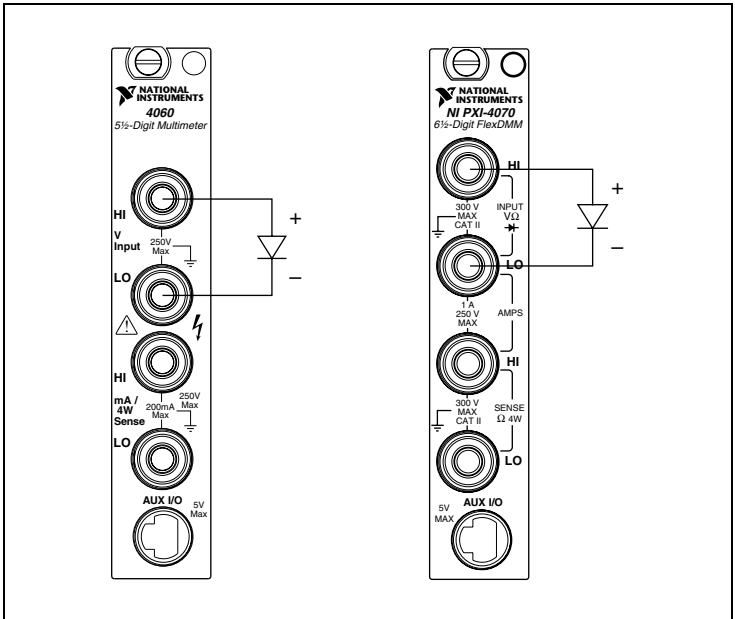


Figure 14. NI 4060/4070 Signal Connections for Diode Measurements

Acquiring Data

You can acquire data with the DMM either by using the DMM SFP or by using the NI-DMM instrument driver in your application.



Tip For best accuracy, NI 4070 users should run the Self-Cal example once they have installed their device. The example is located at `C:\VXIpnp\Win[95|NT]\NIDMM\Examples\\Advanced Examples`.

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»Documentation»NI Digital Multimeters Help** for information on using NI-DMM in your applications.

Replacing the Fuse

This section explains how to replace the fuse in the NI 4060 and NI 4070.



Note The NI 4050 does not have a user-replacable fuse.

Replace the fuse with one of the fuse types listed in Table 1. 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 the fuse only with fuses of the same type and rating. Refer to Table 1 for fuse types.

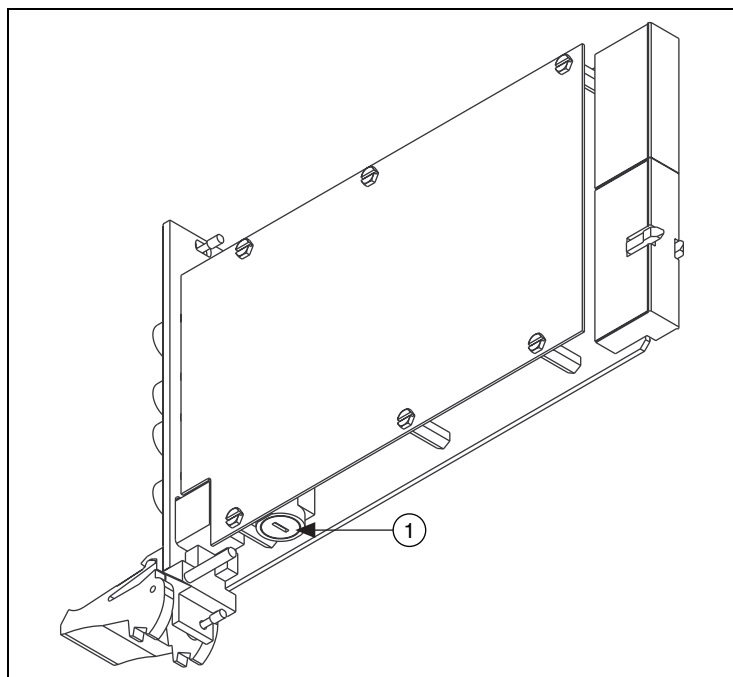
Table 1. Appropriate Fuses for the NI 4060 and NI 4070

DMM	Fuse Rating	Fuse Type	Manufacturer
NI PXI/PCI-4060	500 mA/250 V	Fast acting	Schurter
	500 mA/250 V	Fast acting	Littelfuse
NI PXI-4070	1.25 A/250 V	Fast acting	Littelfuse

NI PXI/PCI-4060

To replace the fuse, complete the following steps:

- ◆ NI PXI-4060
- 1. Remove all signal connections from the NI PXI-4060.
- 2. Power down the chassis and remove the device.
- 3. Hold the device at the angle shown in Figure 15, and locate the fuse holder.



1 Fuse Holder

Figure 15. 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 the NI PCI-4060.
2. Power off the computer and remove the device.
3. Remove the four screws that secure the top and bottom insulators onto the device, as shown in Figure 16.

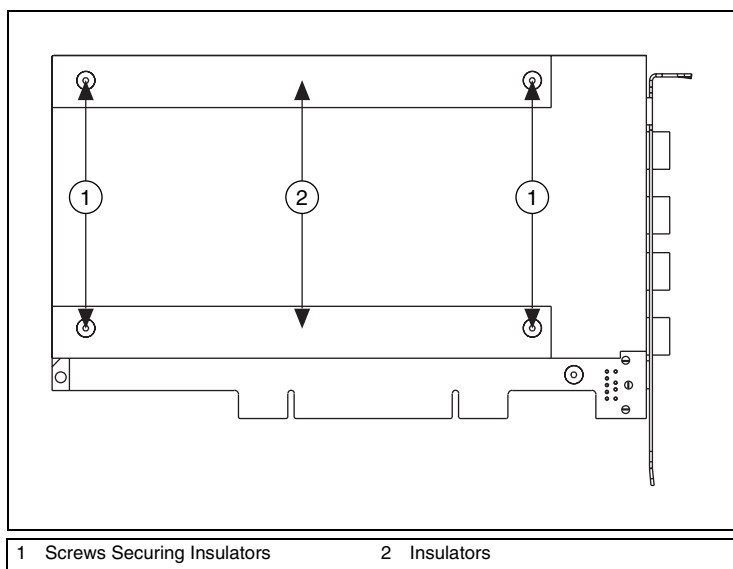


Figure 16. Removing the Insulators from the NI PCI-4060

4. Remove the bottom and top insulators.
5. Locate the 5×20 mm glass fuse shown in Figure 17.
6. Visually verify that the fuse is blown and remove it.

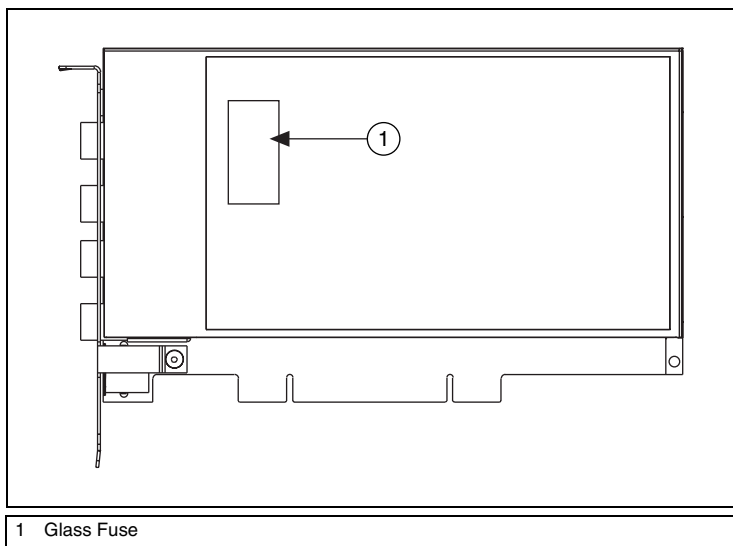


Figure 17. Removing the Fuse from the NI PCI-4060

7. Press the new fuse into the silver holding fixture until you hear a snap.
8. Reattach the top and bottom covers in the opposite order that you removed them.



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

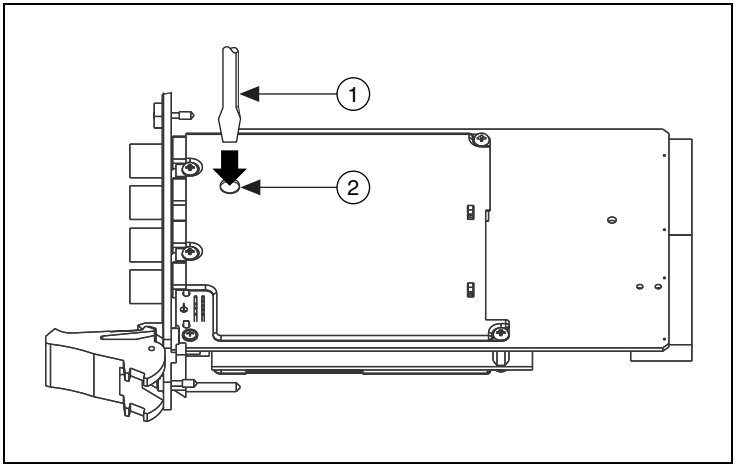
NI PXI-4070

To replace the fuse, complete the following steps:

1. Remove all signal connections from the NI PXI-4070.
2. Power off the chassis and remove the NI PXI-4070.
3. Locate the fuse hole shown in Figure 18.
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 PXI-4070 with your hand, as doing so may cause injury.

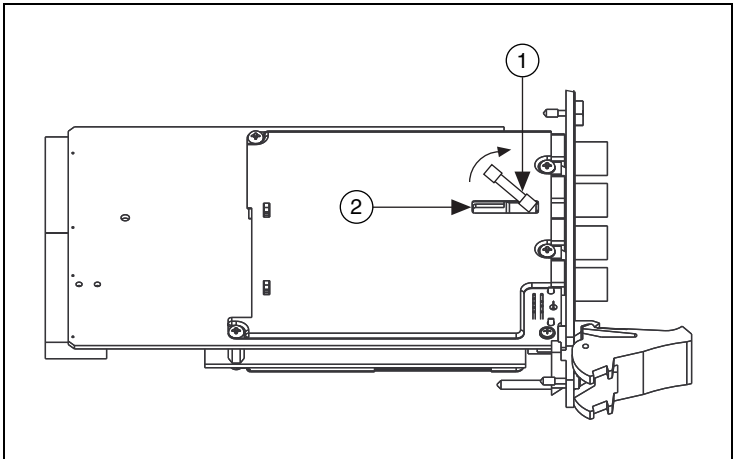


1 Screwdriver

2 Fuse Hole

Figure 18. Removing the Fuse from the NI PXI-4070

6. Locate the fuse slot shown in Figure 19.
7. Pry the fuse loose from the slot.



1 Fuse

2 Fuse Slot

Figure 19. Removing the Fuse from the NI PXI-4070

8. Visually verify that the fuse is blown.
9. Insert a new fuse into the fuse slot, as shown in Figure 20.

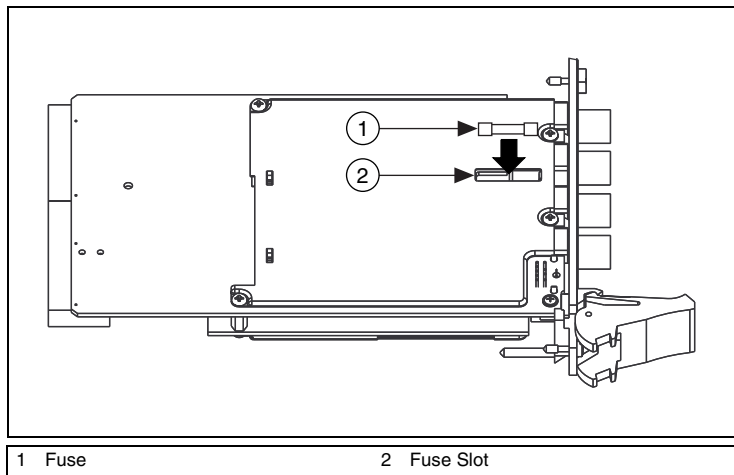


Figure 20. Replacing the Blown Fuse in the NI PXI-4070

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