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**SCXI-2000**



# **SCXI-1127/1128**

## **User Manual**

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# Compliance

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## FCC/Canada Radio Frequency Interference Compliance\*

### Determining FCC Class

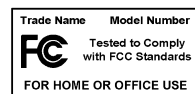
The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). 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 here on the right.

Consult the FCC web site <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\*\*, 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 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 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.

## European Union - Compliance to EEC Directives

Readers in the EU/EEC/EEA must refer to the Manufacturer's Declaration of Conformity (DoC) for information\*\* 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.

\* 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.

\*\* The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

# Conventions

---

The following conventions are used in this manual:

<>

Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DBIO<3..0>.

»

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.



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 on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

*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.

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# Installing and Configuring the SCXI-1127/1128

The SCXI-1127 and SCXI-1128 modules are high-voltage multiplexer/matrix modules. The SCXI-1127 is a high-density armature relay module. The SCXI-1128 is a high-density solid-state relay module. Both modules provide a  $1 \times 32$ , 2-wire multiplexer and several switch matrix configurations on an SCXI platform. The SCXI-1127/1128 can also operate as two  $1 \times 16$  or four  $1 \times 8$ , 2-wire multiplexers (in independent mode) allowing a single module to handle several multiplexing needs.

Through software-configurable switches, the module can also operate as a 1-wire  $1 \times 64$  multiplexer, enabling you to make a large number of common referenced measurements. It can also operate as a  $1 \times 64$ , 4-wire multiplexer to make resistive measurements such as those needed for thermistors and RTDs. With the use of special terminal blocks, the SCXI-1127/1128 can become a  $4 \times 8$  or  $1 \times 32$ , 2-wire matrix. A complete list of possible configurations is given in Table 1-1.

**Table 1-1.** SCXI-1127/1128 Configurations

Scanning Configuration	Multiplexer	Matrix
1-wire	$1 \times 64$	N/A
2-wire	$1 \times 32$	$4 \times 8$ (also $2 \times 16$ , $1 \times 32$ )
4-wire	$1 \times 16$	N/A

To handle large channel counts, you can expand the size of the multiplexer with additional SCXI-1127/1128 modules. These modules support the analog bus through a special adapter, the high-voltage analog bus (HVAB) backplane adapter in the SCXI-1357/1358 kit, at the rear of the module. This adapter allows you to expand the HVAB without complicated wiring. For example, you can connect two SCXI-1127/1128 modules using the HVAB-backplane adapter to create a  $1 \times 64$ , 2-wire multiplexer.

In a matrix configuration, you can expand the columns of the matrix using the HVAB-backplane adapter. For example, you can connect two SCXI-1127/1128 modules via the HVAB-backplane adapter to create a  $4 \times 16$  matrix. You can also expand the rows and columns of a matrix through the front connector of the SCXI-1127/1128 using the SCXI-1332 and matrix expansion cables. Refer to Chapter 2, *Matrix Expansion*, for further information on matrix expansion.

The SCXI-1127/1128 is designed to work well at both low and high voltages. For low-voltage measurements such as those taken with thermocouples, the SCXI-1127/1128 uses relays with very low thermal offset to ensure accurate measurements. At high voltages, the SCXI-1127 can handle signals up to 250 V<sub>rms</sub> at a 200 mA load and 30 VDC at a 1 A load. The SCXI-1128 can handle signals up to 250 V<sub>rms</sub> at a 0.8 mA load and 30 VDC at a 10 mA load. The SCXI-1127/1128 complies with the CE low-voltage directive for an installation category II environment. Refer to Appendix A, *Specifications*, for detailed specifications of the SCXI-1127/1128.

The following section explains how to install the software required to use the SCXI-1127/1128, including installing the latest version of NI-SWITCH. After installing the software, install the SCXI-1127/1128 hardware and its accessories, then configure and test the SCXI-1127/1128.

## Installing the Software

---

You can control the SCXI-1127/1128 programmatically in an application development environment (ADE) using NI-SWITCH. The supported ADEs include LabVIEW, Measurement Studio, Visual Basic, and C or C++ environments. To install software for the SCXI-1129, complete the following:

1. Insert your NI-SWITCH software CD into your CD-ROM drive.
2. Click the **Install NI-SWITCH** option from the installation window that appears automatically.



**Note** If the installation window does not appear, double-click the **My Computer** icon on your PC desktop. Find the CD drive, and double-click it. In the CD directory, double-click `install.exe`.

The NI-SWITCH and NI-DMM version 1.5 installation window offers three choices:

- **Install NI-DMM**—Choose this selection if you want to install only the software for the DMM.
  - **Install NI-SWITCH**—Choose this selection if you want to install only the software for the switches.
  - **Install NI-SWITCH and NI-DMM**—Choose this selection if you want to install the software for both the DMM and the switches.
3. To install the instrument driver, VirtualBench, and application development examples, choose **Programmatic and Interactive Support**. To install only the instrument driver files for VirtualBench, choose **Interactive Support Only**.



**Note** The **Interactive Support Only** choice will *not* allow you to program the instrument with any programming languages.

4. When installing NI-SWITCH, notice the **Development Environments** panel.
- If you click the **Advanced** button on this panel, you can custom install National Instruments drivers such as NI-DAQ, NI-IVI, and NI-VISA.
  - If you do *not* want to install certain drivers, click **Advanced** and uncheck the driver(s) you do not want installed.

If a driver is already unchecked, your computer has the same driver or a newer version of the driver already installed.



**Note** If a newer version of a driver is present on your PC, the installer will *not* overwrite the driver.

5. After completing the installation, turn off your computer.

## Installing the Hardware

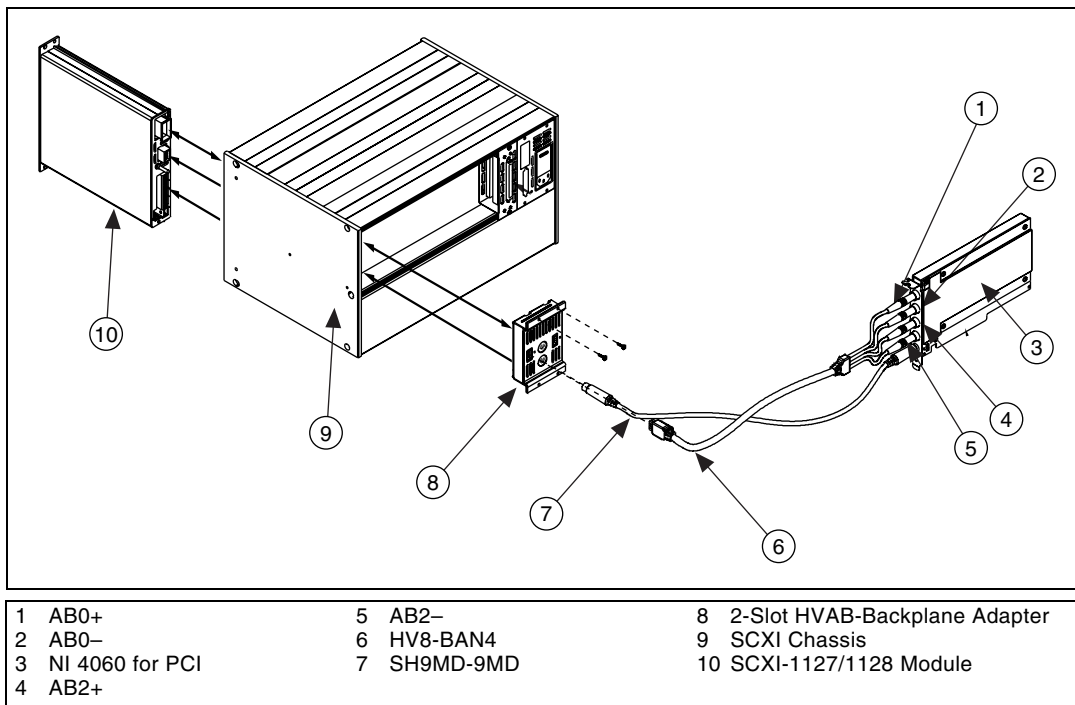
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The following section describes how to install your SCXI-1127/1128 for use with SCXI chassis, National Instruments DAQ devices, and National Instruments DMMs.

## Installing the SCXI-1127/1128 Module into the SCXI Chassis

You need the following items to complete the installation:

- SCXI-1127/1128
- SCXI chassis
- 1/8 in. flathead screwdriver



**Figure 1-1.** Installing the SCXI-1127/1128 into an SCXI Chassis

Follow these steps to install your SCXI-1127/1128 module into the SCXI chassis while referring to Figure 1-1.

1. Turn off the computer that contains the DAQ/DMM device or disconnect it from your SCXI chassis.
2. Turn off the SCXI chassis. Do *not* insert the SCXI-1127/1128 module into a chassis that is turned on.
3. Insert the SCXI-1127/1128 module into the rightmost slot. Gently guide the module into the module guides and push it to the back of the slot until the connectors make good contact. The module must be firmly engaged; however *do not force* the module into place.



**Note** When installing the SCXI-1127/1128 module in an SCXI chassis, the rightmost slot (when the chassis is viewed from the front) must be filled first, then fill the slot to the left with the next SCXI-1127/1128. Other SCXI modules can be loaded from left to right.

4. Insert any other SCXI modules into the remaining slots in the same manner as described in step 3.
5. Secure all the SCXI-1127/1128 modules to the SCXI chassis using both thumbscrews.

To finish installing your SCXI-1127/1128, follow one of the procedures in the appropriate section that follows.

## Connecting the SCXI-1127/1128 to the DMM in a Single-Chassis System

You need the following items for this installation:

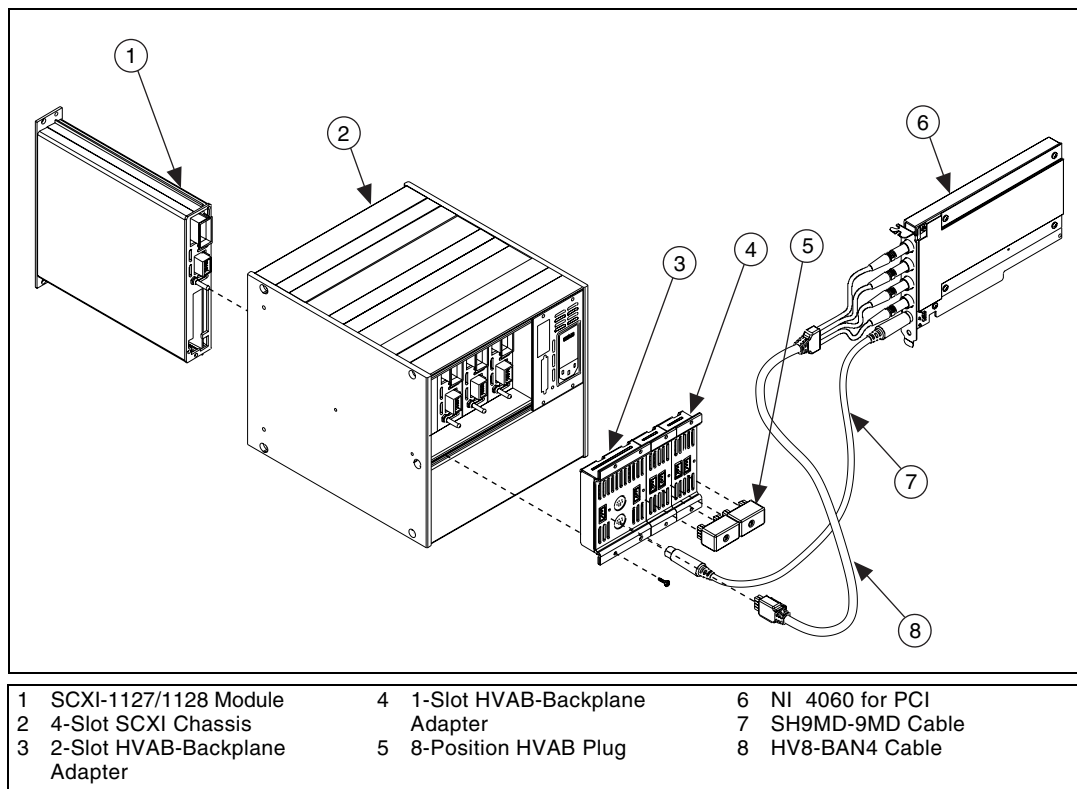
- SCXI-1000/1000DC/1001 chassis with the SCXI-1127/1128 modules installed
- SCXI-1357 (4-slot)/1358 (12-slot) kit
  - 1-slot, 2-slot, and/or 8-slot HVAB-backplane adapter
  - HV8-to-BAN4 cable
  - SH9MD-9MD cable
  - Two or three 8-position high-voltage plugs
- DMM
- 1/8 in. flathead screwdriver

Consult your SCXI chassis documentation and DMM documentation for additional instructions and warnings. Your SCXI-1127/1128 modules and any other SCXI modules should already be installed in the chassis according to their installation instructions. Before you proceed with your connections, make sure you turn off your SCXI chassis.

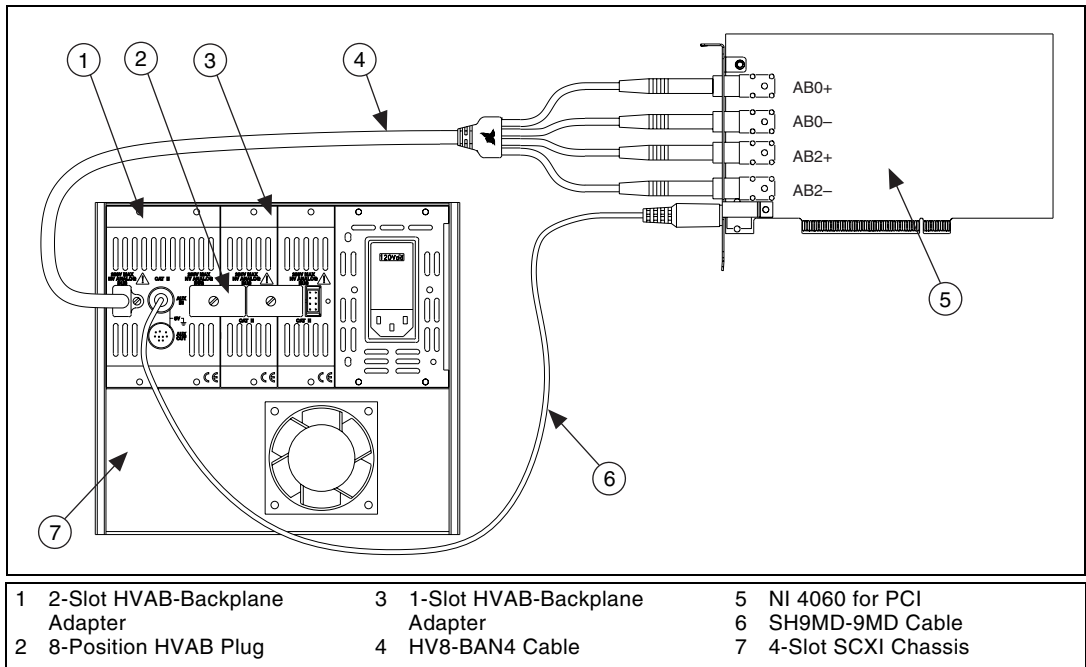


## Single 4-Slot Chassis Configuration

Refer to Figures 1-2 and 1-3 to make connections in the single 4-slot chassis configuration.



**Figure 1-2.** 4-Slot Single-Chassis Installation



**Figure 1-3.** 4-Slot Configuration Parts Locator Diagram

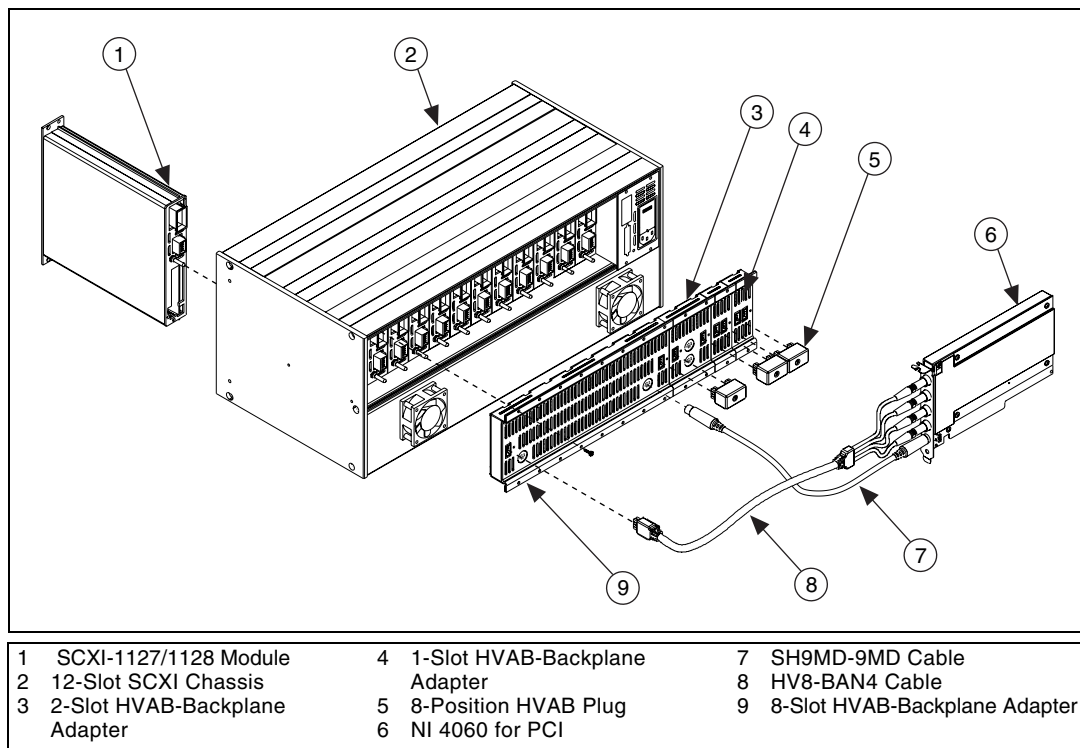
1. Install the 2-slot HVAB-backplane adapter behind slots 3 and 4.
2. Install additional 1-slot HVAB-backplane adapters behind slots 1 and 2 if needed.
3. Install the 8-position HVAB plugs to connect the HVAB-backplane adapters as needed.
4. Connect the HV8-BAN4 cable from the DMM to the HVAB connector behind slot 4.
5. Connect the SH9MD-9MD cable from the DMM to the AUX IN connector.
6. You can install any additional SCXI-1127/1128 modules in any slot that has an HVAB-backplane adapter behind it.



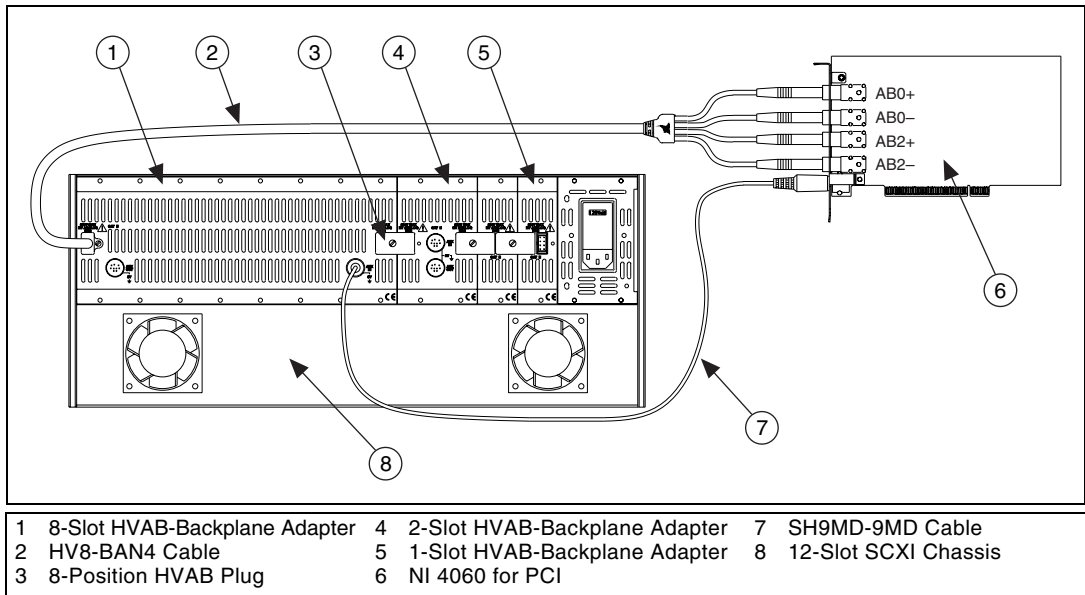
**Note** An SCXI-1127/1128 is required in slot 4 to establish communication with the chassis. If slot 4 is empty, the system will not operate. It is this module that you must specify in Measurement & Automation Explorer (MAX) as the module cabled to the DMM.

## Single 12-Slot Chassis Configuration

Refer to Figures 1-4 and 1-5 to make connections in the single 12-slot chassis configuration.



**Figure 1-4.** 12-Slot Single-Chassis Installation



**Figure 1-5.** 12-Slot Configuration Parts Locator Diagram

1. Install the 8-slot HVAB-backplane adapter behind slots 5 through 12.
2. Install additional 2-slot and 1-slot HVAB-backplane adapters behind slots 1 through 4 if needed.
3. Install the 8-position HVAB plugs to connect the HVAB-backplane adapters as needed.
4. Connect the HV8-BAN4 cable from the DMM to the HVAB connector behind slot 12.
5. Connect the SH9MD-9MD cable from the DMM to the AUX IN connector behind slot 5.
6. You can install any additional SCXI-1127 modules in any slot that has an HVAB-backplane adapter behind it.



**Notes** Do *not* connect the SH9MD-9MD cable to the AUX IN connector behind slot 4 on the 2-slot HVAB-backplane adapter.

An SCXI-1127/1128 is required in slot 12 to establish communications with the chassis. If slot 12 is empty, the system will not operate. It is this module that you must specify in MAX as the module cabled to the DMM.

## Connecting the SCXI-1127/1128 to the DMM in a Multichassis System

The following sections describe how to configure the following multichassis configurations:

- 4-slot and 4-slot multichassis configuration
- 4-slot and 12-slot multichassis configuration
- 12-slot and 12-slot multichassis configuration

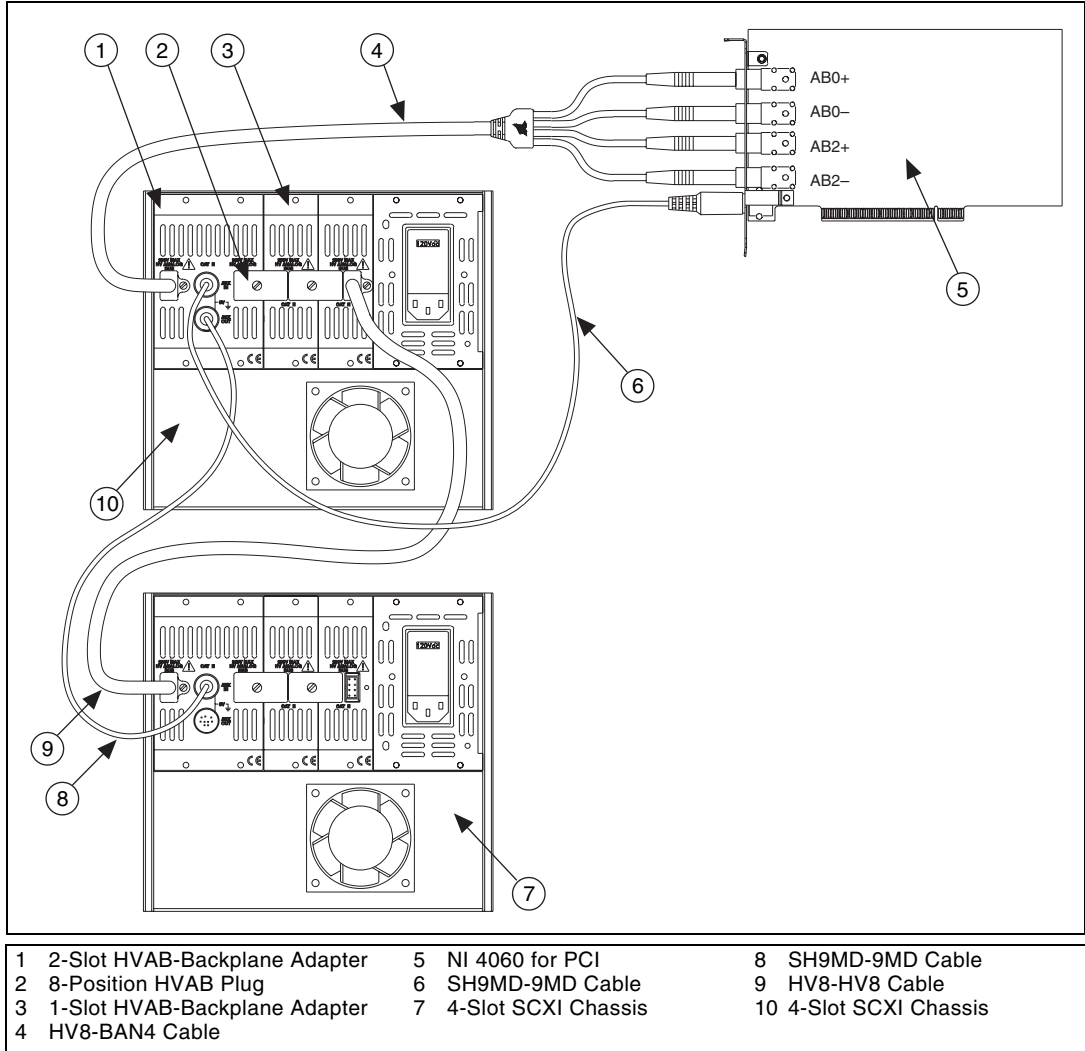
You can also create larger configurations.

### 4-Slot and 4-Slot Multichassis Configuration

In addition to the items needed for a single-chassis system, you need the following to install this configuration:

- SCXI-1357 multichassis expansion kit
  - HV8-HV8 cable
  - SH9MD-9MD cable
  - Two 8-position HVAB plugs
  - One 2-slot HVAB-backplane adapter
  - Two 1-slot HVAB-backplane adapters

Refer to Figure 1-6 to set up this multichassis configuration.



**Figure 1-6.** 4-Slot to 4-Slot Multichassis Configuration Parts Locator Diagram

1. Install the HVAB-backplane adapters and 8-position HVAB plugs in the next chassis as described in steps 1 through 3 in [Single 4-Slot Chassis Configuration](#).

2. Connect the HV8-HV8 cable from the first chassis, normally the connector behind slot 1, to the HVAB connector (behind slot 4) of the next chassis.
3. Connect the SH9MD-9MD cable from the AUX OUT connector of the first chassis to the AUX IN connector of the next chassis.
4. Repeat steps 1 through 3 for each additional chassis.



**Notes** An SCXI-1127/1128 is required in slot 4 to establish communications with the chassis. If slot 4 is empty, the system will not operate. It is this module that you must specify in MAX as the module cabled to the DMM.

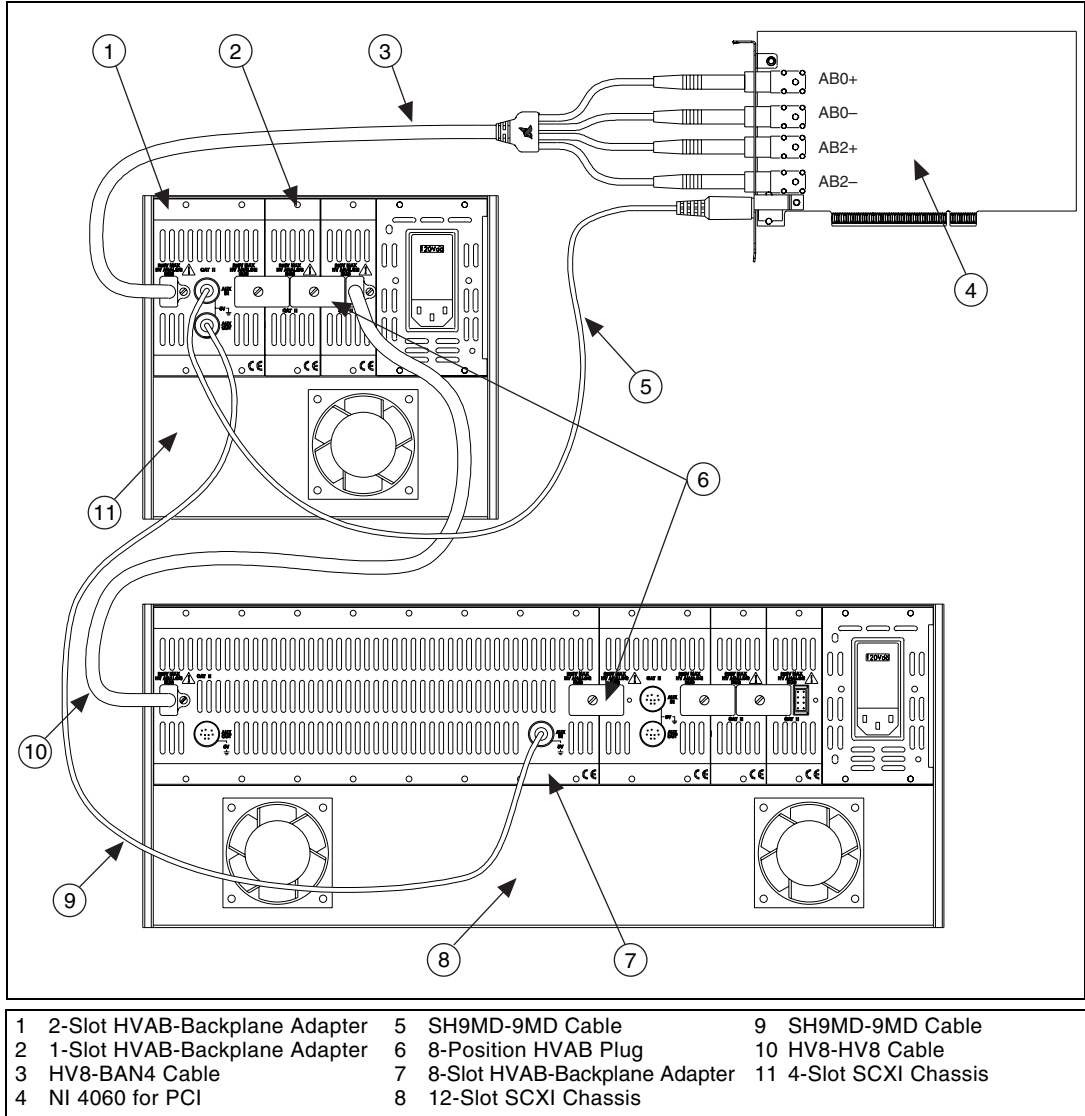
If a chassis is configured with less than four slots of the HVAB-backplane adapter, use the right-most available HVAB connector to extend to the next chassis. In this instance, right-most means the slot closest to slot 1 when the chassis is viewed from the back.

## 4-Slot and 12-Slot Multichassis Configuration

In addition to the items needed for a single-chassis system, you need the following items to install this configuration:

- SCXI-1358 multichassis expansion kit
  - HV8-HV8 cable
  - SH9MD-9MD cable
  - Three 8-position HVAB plugs
  - One 8-slot HVAB-backplane adapter
  - One 2-slot HVAB-backplane adapter
  - Two 1-slot HVAB-backplane adapters

Refer to Figure 1-7 to set up this multichassis configuration.



**Figure 1-7.** 4-Slot to 12-Slot Multichassis Configuration Parts Locator Diagram



1. Install the HVAB-backplane adapters and jumper blocks in the 12-slot chassis as described in steps 1 through 3 in [Single 12-Slot Chassis Configuration](#).
2. Connect the HV8-HV8 cable from the first chassis, normally the connector behind slot 1, to the HVAB connector (behind slot 12) of the next chassis.
3. Connect the SH9MD-9MD cable from the AUX OUT connector of the first chassis to the AUX IN connector (behind slot 5) of the next chassis.
4. Repeat steps 1 through 3 for each additional chassis.



**Notes** Do not use the SH9MD-9MD cable behind slot 4 of the 2-slot HVAB-backplane adapter on the 12-slot chassis.

An SCXI-1127/1128 is required in slot 4 of the 4-slot chassis and slot 12 of the 12-slot chassis to establish communications with all the chassis in the system. If slot 4 is empty in the 4-slot chassis or slot 12 is empty in the 12-slot chassis, the chassis will not operate. It is this module that you must specify in MAX as the module cabled to the DMM.

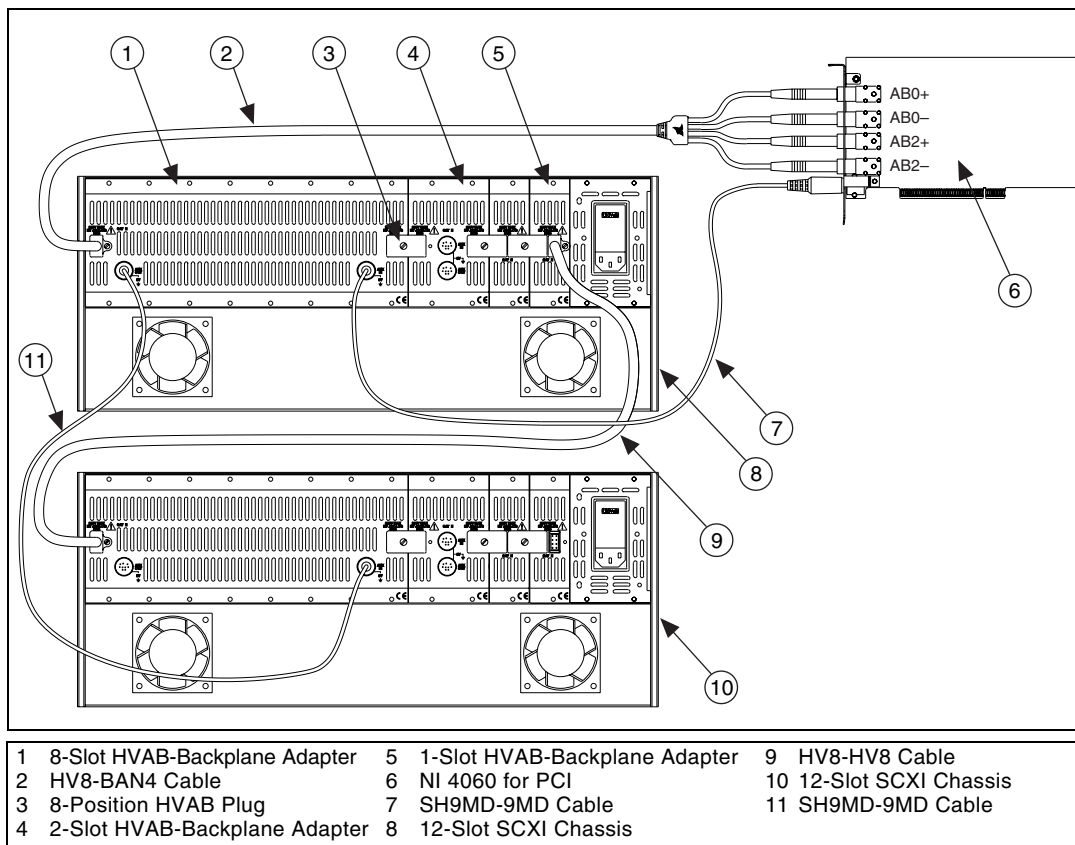
If the 4-slot chassis is configured with less than four slots of the HVAB-backplane adapter, use the right-most available HVAB connector to extend to the next chassis. In this instance, right-most means the slot closest to slot 1 when the chassis is viewed from the back.

## 12-Slot and 12-Slot Multichassis Configuration

In addition to the items needed for a single-chassis system, you need the following items to install this configuration:

- SCXI-1358 multichassis expansion kit
  - HV8-HV8 cable
  - SH9MD-9MD cable
  - Three 8-position HVAB plugs
  - One 8-slot HVAB-backplane adapter
  - One 2-slot HVAB-backplane adapter
  - Two 1-slot HVAB-backplane adapters

Refer to Figure 1-8 to set up this multichassis configuration.



**Figure 1-8.** 12-Slot to 12-Slot Multichassis Configuration Parts Locator Diagram

1. Install the HVAB-backplane adapters and jumper blocks in the 12-slot chassis as described in steps 1 through 3 in [Single 12-Slot Chassis Configuration](#).
2. Connect the HV8-HV8 cable from the first chassis, normally the connector behind slot 1, to the HVAB connector (behind slot 12) of the next chassis.
3. Connect the SH9MD-9MD cable from the AUX OUT connector of the first chassis to the AUX IN connector (behind slot 5) of the next chassis.
4. Repeat steps 1 through 3 for each additional chassis.



**Notes** Do not connect the SH9MD-9MD cable to the 2-slot HVAB-backplane adapter.

An SCXI-1127/1128 is required in slot 12 of each 12-slot chassis to establish communications with all the chassis in the system. If slot 12 is empty, the chassis will not operate. It is this module that you must specify in MAX as the module cabled to the DMM.

If a chassis is configured with less than 12 slots of the HVAB-backplane adapter, use the right-most available HVAB connector to extend to the next chassis. In this instance, right-most means the slot closest to slot 1 when the chassis is viewed from the back.

## Connecting the SCXI-1127/1128 to the DMM in a PXI-1010 Chassis

You need the following items to complete the installation:

- PXI chassis with the SCXI-1127/1128 modules installed
- SCXI-1357 kit
  - Two 1-slot HVAB-backplane adapters
  - One 2-slot HVAB-backplane adapter
  - HV8 to BAN4 cable
  - Two 8-position HVAB plugs
  - SH9MD-9MD cable
- DMM
- 1/8 in. flathead screwdriver

Consult your PXI-1010 and DMM documentation for additional instructions and warnings. Your SCXI-1127/1128 modules and any other SCXI modules should already be installed in the chassis according to their installation instructions. Before you proceed with your connections, make sure you turn off your SCXI chassis.

### DMM in PXI Slots 1 through 7 Configuration

To install your DMM in PXI slots 1 through 7, follow these steps:

1. Install your DMM in any one of the PXI slots 1 through 7.
2. In the SCXI subsystem, install the 2-slot HVAB-backplane adapter behind SCXI slots 3 and 4.
3. Install additional 1-slot HVAB-backplane adapters behind SCXI slots 1 and 2 if needed.
4. Install the 8-position HVAB plugs to connect the HVAB-backplane adapters as needed.

5. Connect the HV8-BAN4 cable from the DMM to the HVAB connector behind SCXI slot 4.
6. Connect the SH9MD-9MD cable from the DMM to the AUX IN connector.
7. You can install any additional SCXI-1127/1128 modules in any slot that has an HVAB-backplane adapter behind it.

## DMM in PXI Slot 8 Configuration

To install your DMM in PXI slot 8, follow these steps:

1. Install your DMM in PXI slot 8.
2. In the SCXI subsystem, install the 2-slot HVAB-backplane adapter behind SCXI slots 3 and 4.
3. Install additional 1-slot HVAB-backplane adapters behind SCXI slots 1 and 2 if needed.
4. Install the 8-position HVAB plugs to connect the HVAB-backplane adapters as needed.
5. Connect the HV8-BAN4 cable from the DMM to the HVAB connector behind SCXI slot 4 of the SCXI subsystem.
6. You can install any additional SCXI-1127/1128 modules in any slot that has an HVAB-backplane adapter behind it.



**Note** The SH9MD-9MD is not required for this configuration.

## Connecting the SCXI-1127/1128 to the DMM in the PXI-1011 Chassis

You will need the following items to complete the installation:

- PXI-1011 chassis with the SCXI-1127/1128 modules installed
- HV8-BAN4 cable
- DMM
- 1/8 in. flathead screwdriver

Consult your PXI-1011 and DMM documentation for additional instructions and warnings. Your SCXI-1127/1128 modules and any other SCXI modules should already be installed in the chassis according to their installation instructions. Before you proceed with your connections, make sure you turn off your SCXI chassis.

## DMM in PXI Slots 1 through 3 Configuration

To install your DMM in PXI slots 1 through 3, follow these steps:

1. Install your DMM in any one of the PXI slots 1 through 3.
2. In the SCXI subsystem, install the 2-slot HVAB-backplane adapter behind SCXI slots 3 and 4.
3. Install additional 1-slot HVAB-backplane adapters behind SCXI slots 1 and 2 if needed.
4. Install the 8-position HVAB plugs to connect the HVAB-backplane adapters as needed.
5. Connect the HV8-BAN4 cable from the DMM to the HVAB connector behind SCXI slot 4.
6. Connect the SH9MD-9MD cable from the DMM to the AUX IN connector.
7. You can install any additional SCXI-1127/1128 modules in any slot that has an HVAB-backplane adapter behind it.

## DMM in PXI Slot 4 Configuration

To install your DMM in slot 4, follow these steps:

1. Install you DMM in PXI slot 4.
2. Connect the HV8-BAN4 cable from the DMM to the HVAB connector on the front of the PXI-1011 chassis.
3. Install any additional SCXI-1127/1128 modules in any SCXI slot.



**Note** The DMM needs to be in PXI slot 4 in order for it to control the SCXI-1127/1128 in the chassis.

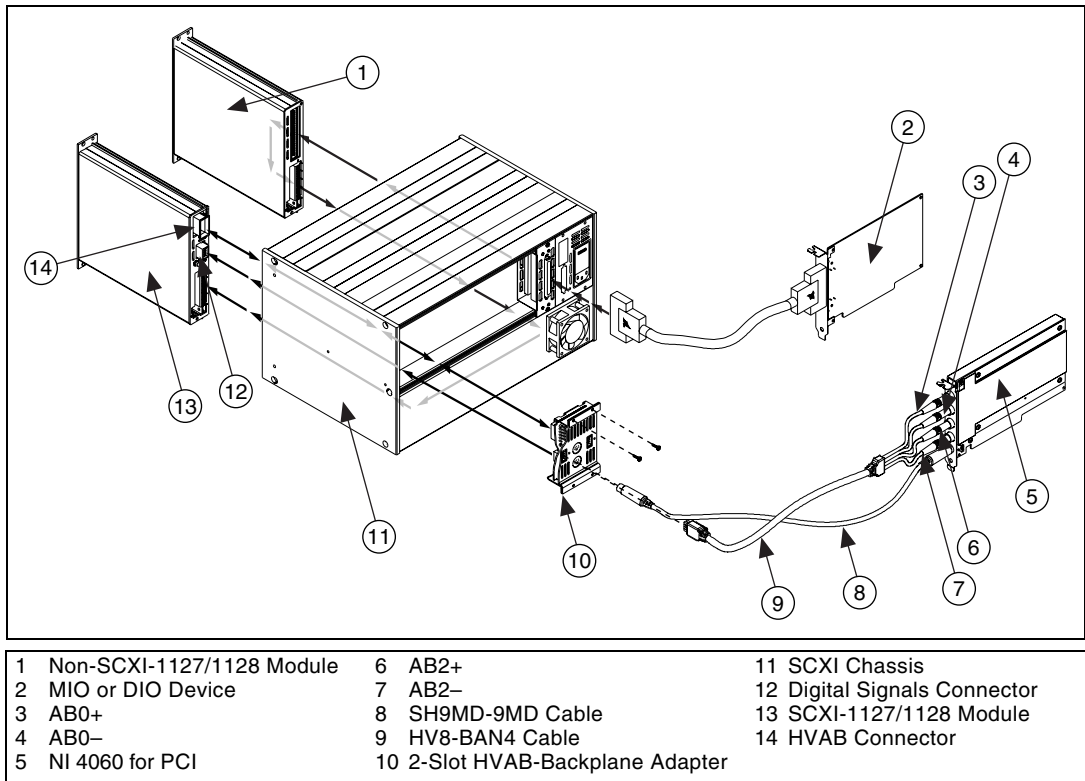
## Accessing the SCXI-1127/1128 through Other SCXI Modules Using a DAQ Device

You need the following items to complete the installation:

- SCXI chassis with the SCXI-1127/1128 modules installed (see the appropriate previous sections)
- DAQ device cable adapter
- National Instruments DAQ device
- DAQ cable
- 1/8 in. flathead screwdriver

- At least one other SCXI module other than the SCXI-1127/1128, installed in the chassis

Consult the documentation for your SCXI chassis and other SCXI modules for additional instructions and warnings. Any non-SCXI-1127/1128 modules should already be installed according to their installation instructions. To set up the SCXI-1127/1128 module to be accessed by a DAQ device via another SCXI module, follow these steps while referring to Figure 1-9:



**Figure 1-9.** Installing the SCXI-1127/1128 with Two DAQ Devices

You should have already installed the SCXI-1127/1128 modules and their HVAB-backplane adapters (1357/1358) according to the instructions found earlier in this chapter.

1. Connect the MIO/DIO cable adapter to the rear of a module that is not the SCXI-1127/1128 module. Secure the adapter to the SCXI chassis using the screws provided.
2. Attach your DAQ cable to the cable adapter at the rear connector.

3. Attach the other end of the DAQ cable to the National Instruments DAQ device.
4. Check the installation.
5. Turn on the SCXI chassis.
6. Turn on the computer or reconnect it to your chassis.

If you already have the appropriate software installed, you are ready to configure the SCXI-1127/1128 via an SCXI module other than the SCXI-1127/1128 module.

## Using a DAQ Device on a PXI-1010 Chassis

You should have already installed the SCXI-1128 modules and their HVAB-backplane adapters.

1. Turn off the power to the PXI and SCXI chassis.
2. Install your DAQ device in PXI slot 8.

Installation in this slot allows the DAQ device to directly control the SCXI-1128 without the need for additional cabling.

3. Turn on the power to both the PXI and SCXI chassis.

## Using a DAQ Device on a PXI-1011 Chassis

You should have already installed the SCXI-1128 modules and their HVAB-backplane adapters.

1. Turn off the power to the PXI and SCXI chassis.
2. Install your DAQ device in PXI slot 4.

Installation in this slot allows the DAQ device to directly control the SCXI-1128 without the need for additional cabling.

3. Turn on the power to both the PXI and SCXI chassis.

## Connecting the SCXI-1127/1128 to an External DMM

You need the following items to complete this installation:

- SCXI-2000/2400 chassis with the SCXI-1127/1128 modules installed or SCXI-1000/1001 chassis containing a non-SCXI-1127/1128 module connected to a DAQ device with the SCXI-1127/1128 modules installed
- SCXI-1357 or SCXI-1358 kit
  - 1-slot, 2-slot, and/or 8-slot HVAB-backplane adapter

- SH9MD-9MD cable
- 8-position HVAB plug
- HV8-BAN4 cable
- External DMM (if needed)
- BAN2-WIRE kit (two kits needed for 4-wire), if not using the HV8-BAN4 cable
- Cable or wires to connect the handshaking lines to the SCXI-1127/1128
- 1/8 in. flathead screwdriver

Consult the documentation for your SCXI chassis and other SCXI modules for additional instructions and warnings. You should have installed your SCXI-1127/1128 modules according to the instructions given in [Installing the SCXI-1127/1128 Module into the SCXI Chassis](#) section. Any other SCXI modules should already be installed according to their installation instructions. To install the SCXI-1127/1128 module with an SCXI chassis, follow these steps:

1. Install the SCXI-1127/1128s in the chassis and install the HVAB as described in one of the *Connecting the SCXI-1127/1128 Backplane* sections.
2. To connect an SCXI-1127/1128 to an external DMM device, you need two cables—the HV8-BAN4 or BAN2-WIRE cable, and a cable to connect the handshaking lines from the SCXI-1127/1128 to the DMM. Attach your HV8-BAN4 cable to the HVAB connector on the HVAB-backplane adapter or connect your BAN2-WIRE cable to the OUT0 terminals on the SCXI-1331 terminal block. When making four-wire measurements you must also connect a BAN2-WIRE cable to the OUT2 terminals.
3. Attach the other end of the HV8-BAN4 or BAN2-WIRE cable to the inputs of your external DMM device.
4. Connect the handshaking lines from the front of the SCXI-1331 terminal block to the appropriate lines on the external DMM. See Chapter 2, [Handshaking Scanning](#), for information on how to use the SCXI-1127/1128 handshaking lines.
5. Check the installation.
6. Turn on the SCXI chassis.
7. Turn on the computer or reconnect it to your chassis.

The SCXI-1127/1128 module is now installed.





**Note** For the system to function properly, it must be controlled by a DAQ device or NI 4021 switch controller, or be a 2000 Series SCXI chassis.

## Configuring and Self-Test

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Run Measurement & Automation Explorer (MAX) to configure and test your SCXI-1127/1128. If you need help during the configuration process, open the Measurement & Automation Help file by selecting **Help»Help Topics**.

1. Run MAX by double-clicking the icon on your desktop.
2. To add a new chassis, right-click **Devices and Interfaces** and select **Create New**. Select the appropriate chassis from the list box and click **Finish**.
3. Configure the chassis by selecting the **Chassis ID**. The chassis ID is an arbitrary number that you choose for use by the software to uniquely specify the chassis.
4. Select the **Chassis Address** (refer to your *SCXI Chassis User Manual* for further information).

For the SCXI-2000, you also need to select the **Baud Rate** and **COM Port**.

You now have the choice of auto-detecting your modules or manually adding them depending on your application. If you are using an MIO or DIO DAQ device, you can either auto-detect or manually add the modules. If you are using a DMM, you must manually add the modules.

## Auto-Detecting Modules

If you selected auto-detect and the chassis is not an SCXI-2000 remote chassis, you must have your chassis connected to your DAQ device.

1. Click **Next**.
2. Select your communication path, except in the case of the SCXI-2000, and click **Next**.
3. Select the module cabled to your communication path, except in the case of the SCXI-2000, and click **Finish**.

Your SCXI chassis and SCXI-1127/1128 modules are now configured in the software with your modules. To configure the properties for a particular module, perform the following steps:

1. Display the list of Devices and Interfaces by clicking the + next to the **Devices and Interfaces** icon.

2. You will see the chassis selected in the list. Display the list of modules in the chassis by clicking the **+** next to the **Chassis** icon.
3. Right-click the module you want to configure and select **Properties**. You will be presented with tabs containing attributes for different properties of the module. You can select any tab to see and/or change any attributes.



**Note** For the SCXI-1127/1128, the second tab is for configuring the wire modes for each channel. At the end of the pop-up list of channels, you can select multiple channels.

## Manually Adding Modules

If you chose to not auto-detect your SCXI modules, you must add each of your modules separately.

1. Click **Finish** in the Chassis Configuration window.
2. Display the list of Devices and Interfaces by clicking the **+** next to the **Devices and Interfaces** icon.
3. You will see the chassis you selected in the list. Display the list of modules in the chassis by clicking the **+** next to the **Chassis** icon.
4. Right-click the slot that is cabled to your device and select **Insert**. For DAQ devices, this is the slot cabled to the DAQ device. For DMMs, this is typically slot 4 on a 4-slot chassis and slot 12 on a 12-slot chassis.
5. Select the module that is intended for that slot and click **Next**.
6. You are now given the option to make this the module that controls the chassis. Select the DAQ device or DMM you cabled to the chassis using the **Connected to:** control. Confirm that there is a check in the checkbox labeled **This device will control the chassis** and click **Next**.
7. You are presented with a series of properties for the module. Select the appropriate values for the attributes and click **Next**. After making your selections, click **Finish**.



**Note** For the SCXI-1127/1128, the second tab is for configuring the wire modes for each channel. At the end of the pop-up list of channels, you can select multiple channels.

You are now finished configuring the slot. Configure the rest of your modules in the same manner.

To remove a module or chassis, right-click the chassis or module you want to remove and select **Delete**.

To test the chassis configuration, right-click the chassis and select **Test**.

## Safety Information

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The following cautions contain important safety information concerning hazardous voltages.



**Cautions** You must insulate all of your signal connections appropriately to the highest available voltage with which the SCXI-1127/1128 may come in contact. Any voltage connected to the SCXI-1127/1128 connector may appear on any other pin of this connector.

Equipment described in this document must be used in an Installation Category II or lower environment per IEC 60664.

Do *not* operate the module in an explosive atmosphere or where there may be flammable gases or fumes.

**SHOCK HAZARD**—This unit should only be opened by qualified personnel aware of the dangers involved. Disconnect all power before removing the cover. Always install the grounding screw. If signal wires are connected to the module or terminal block, dangerous voltages may exist even when the equipment is turned off. Before you remove any installed terminal block or module, disconnect the AC power line or any high-voltage sources, ( $\geq 30 V_{\text{rms}}$  and  $42.4 V_{\text{peak}}$ , or 60 VDC), that may be connected to any terminal block or module.

Do *not* operate damaged equipment. The safety-protection features built into this module can be impaired if the module becomes damaged in any way. If it is damaged, turn the module off and do not use it until service-trained personnel can check its safety. If necessary, return the module to National Instruments for service and repair to ensure that its safety is not compromised.

Clean the module and accessories by brushing off light dust with a soft non metallic brush. Remove other contaminants with a stiff non metallic brush. The unit must be completely dry and free from contaminants before returning it to service.

The module must be used in a UL-listed SCXI chassis.

Do *not* substitute or modify equipment. Because of the danger of introducing additional hazards, do *not* install unauthorized parts or modify the module. Return the module to

National Instruments for service and repair to ensure that its safety features are *not* compromised.

When using the terminal block with high common-mode voltages, you must insulate your signal wires appropriately. National Instruments is *not* liable for any damages or injuries resulting from inadequate signal wire insulation.

Connections, including power signals to ground and vice versa, that exceed any of the maximum signal ratings on the SCXI-1127/1128 can damage any or all of the modules connected to the SCXI chassis, the host computer, and the SCXI-1127/1128 module. National Instruments is *not* liable for any damages or injuries resulting from incorrect signal connections.

If high voltages ( $\geq 30 V_{\text{rms}}$  and  $42.4 V_{\text{peak}}$ , or 60 VDC) are present, you must connect safety earth ground to the strain-relief tab of the terminal block. This maintains compliance with UL 3111 and IEC-61010, and protects against electric shock when the terminal block is not connected to the chassis. To connect the safety earth ground to the strain-relief tab, run an earth ground wire in the cable from the signal source to the terminal block. National Instruments is *not* liable for any damages or injuries resulting from inadequate safety earth ground connections.

Do *not* loosen or re-orient the safety ground solder lug hardware when connecting the safety ground wire; to do so reduces the safety isolation between the high voltage and safety ground.

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# Using the SCXI-1127/1128

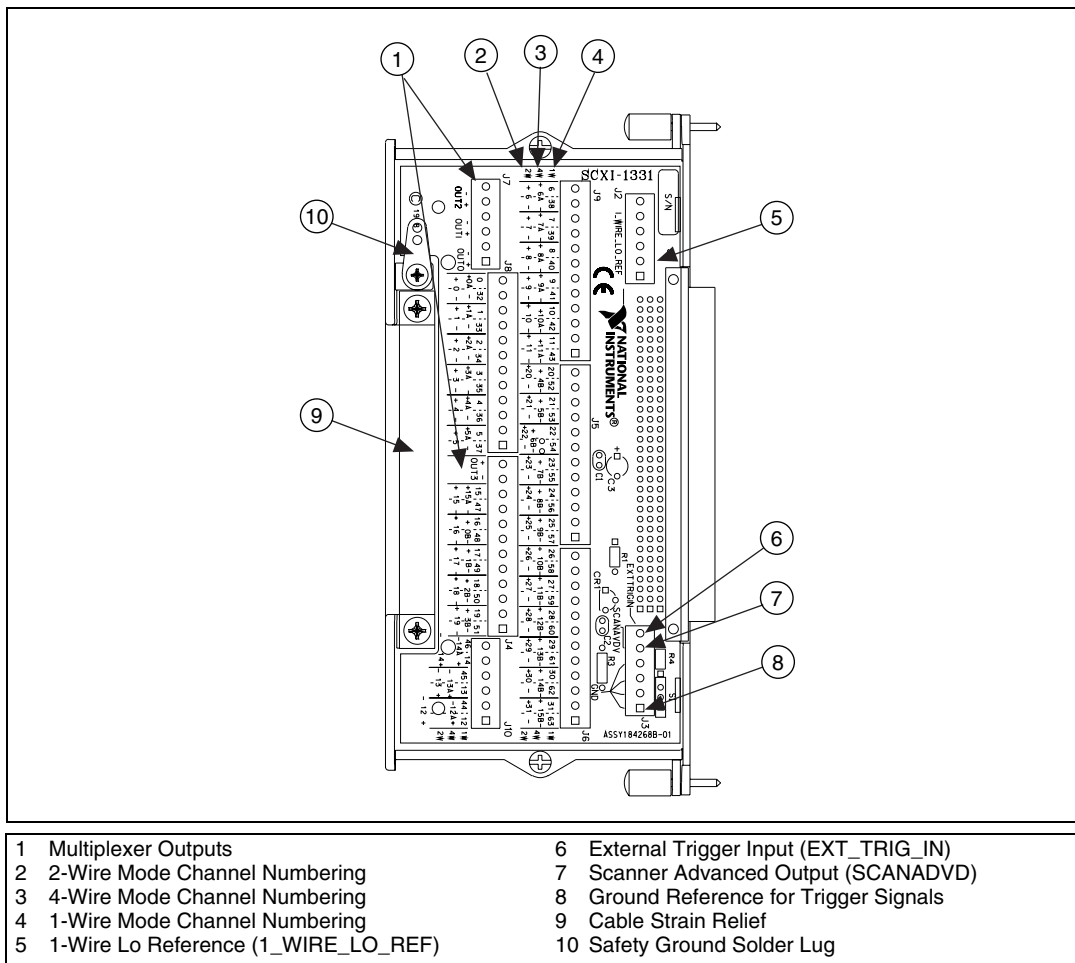
This chapter discusses in detail the operation of the SCXI-1127/1128. There are two major modes of operation: multiplexer and matrix. A third mode of operation, independent mode, allows you to access advanced features of the SCXI-1127/1128.

## Operating as a Multiplexer/Scanner

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You can configure the SCXI-1127/1128 to operate as a multiplexer/scanner. Using this mode of operation, you can configure channels in the scan in three different ways: 2-wire, 1-wire, and/or 4-wire channel configurations. In all scanning modes, only one channel is closed at a time in the multiplexer.

The SCXI-1331 terminal block consists of a shielded board with 84 screw terminals for easy connection to the SCXI-1127/1128 input connector. The SCXI-1331 is shown in Figure 2-1.



**Figure 2-1.** SCXI-1331 Signal Connections

Depending on the input mode configuration of the SCXI-1127/1128, the SCXI-1331 has a maximum of 64, 1-wire channels; 32, 2-wire channels; or 16, 4-wire channels. The SCXI-1331 also has terminals for external triggering signals. The SCXI-1127/1128 supports the standard voltmeter complete and scanner advanced triggering signals. The following sections describe signal connections using the SCXI-1331 and the various input mode configurations. For more information on scanning and triggering, consult the [Hardware-Timed and Software Scanning](#) section.

The SCXI-1127/1128 contains a safety interlocking mechanism that prevents high voltages from appearing on the input connector when a terminal block is not present. However, when a SCXI-1331 or SCXI-1332 is plugged into the front of the SCXI-1127/1128, the module detects its presence and allows the module to close relays.

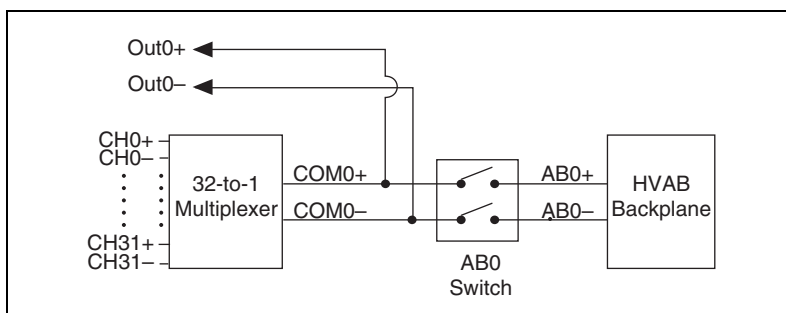
If you are using a custom terminal block, you must provide this interlocking feature on your terminal block so that it is possible for the SCXI-1127/1128 to detect that a terminal block is present. Please refer to Appendix D, *SCXI-1127/1128 Front Connector*, for information on how to do this.

## 2-Wire Channel Scanning Configuration

You can use the SCXI-1127/1128 as a 32-channel, 2-wire (differential) multiplexer. Figure 2-2 shows the block diagram of the input switching structure in 2-wire mode. You can connect up to 32 channels to the SCXI-1127/1128 using the SCXI-1331 terminal block. The input signals are switched using a 32 to 1 multiplexer. The output of the multiplexer is available at the OUT0+ and OUT0- screw terminals on the SCXI-1331.



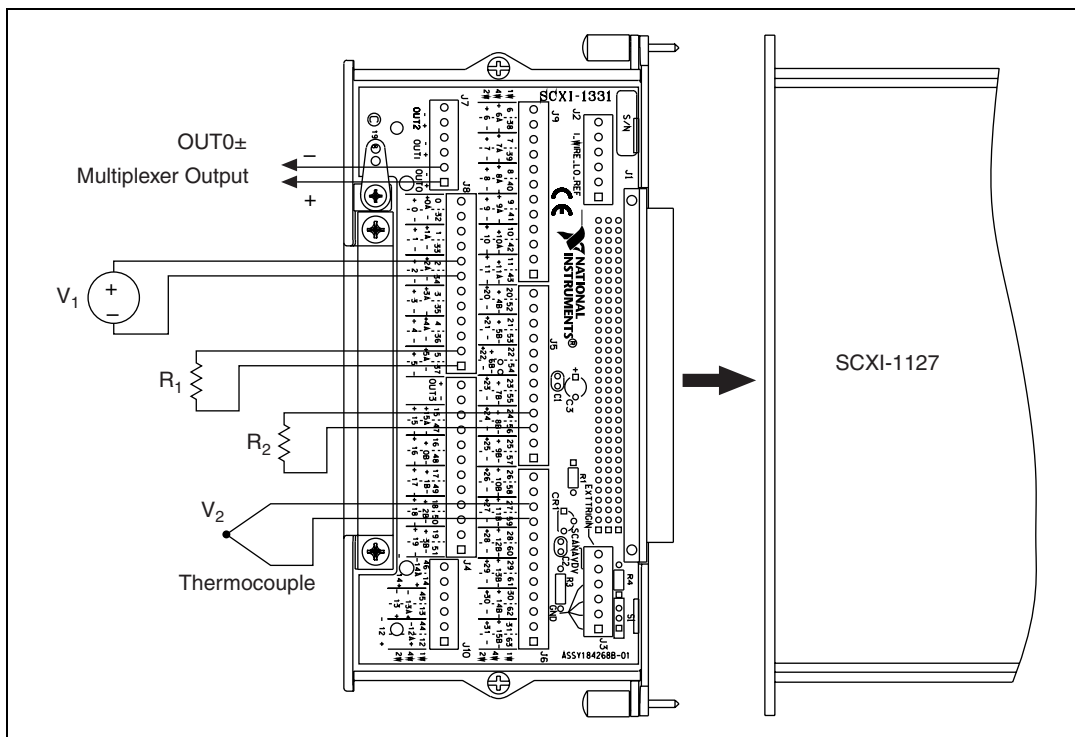
**Note** OUT0± is also referred to as the multiplexer common or COM0±.



**Figure 2-2.** 2-Wire Block Diagram

You can also connect the output of the SCXI-1127/1128 to the high-voltage backplane using switch AB0 to make the connection. On power up, switch AB0 is open, disconnecting the SCXI-1127/1128 from the high-voltage bus. If you are using the module with a high-voltage backplane, you need to close the AB0 switch to connect the multiplexer output to the high-voltage analog backplane. You can do this through NI-SWITCH.

Figure 2-3 shows an example of a 2-wire configuration using the SCXI-1331 terminal block. The diagram shows the 2-wire terminal block connections for channels 2, 5, 24, and 27. Channel 2 measures a voltage source ( $V_1$ ). The positive terminal of channel 2 is labeled +2 with the negative channel labeled -2. The output of the multiplexer is available through the OUT0 bus.



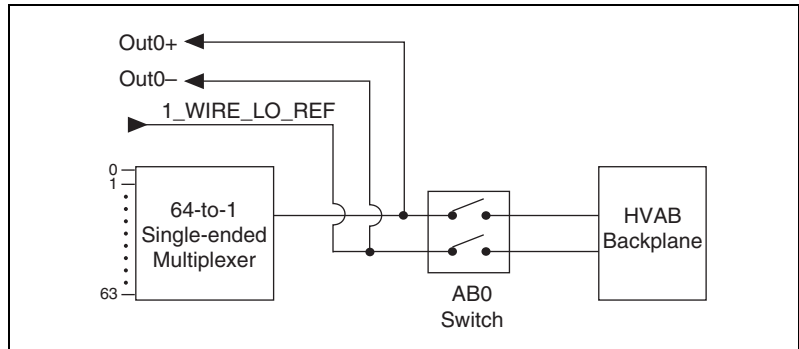
**Figure 2-3.** 2-Wire Wiring Diagram

You can connect different types of 2-wire inputs to the SCXI-1127. For example, in Figure 2-3, a thermocouple ( $V_2$ ) is shown connected to channel 27, and on channel 5 ( $R_1$ ) and 24 ( $R_2$ ) resistance measurements are being made. Consult the [Making Temperature Measurements](#) section for more information on temperature compensation measurements for making accurate thermocouple measurements.



## 1-Wire Channel Scanning Configuration

The SCXI-1127/1128 has 64, 1-wire channels in the multiplexer mode that are available through the SCXI-1331 terminal block. Figure 2-4 shows the SCXI-1127/1128 configured as a 64-to-1, 1-wire multiplexer. A 1-wire configuration provides a high channel count because all input signals have the same reference. This common reference, called 1\_WIRE\_LO\_REF on the SCXI-1127/1128, is available through the screw terminals on the SCXI-1331 terminal block.

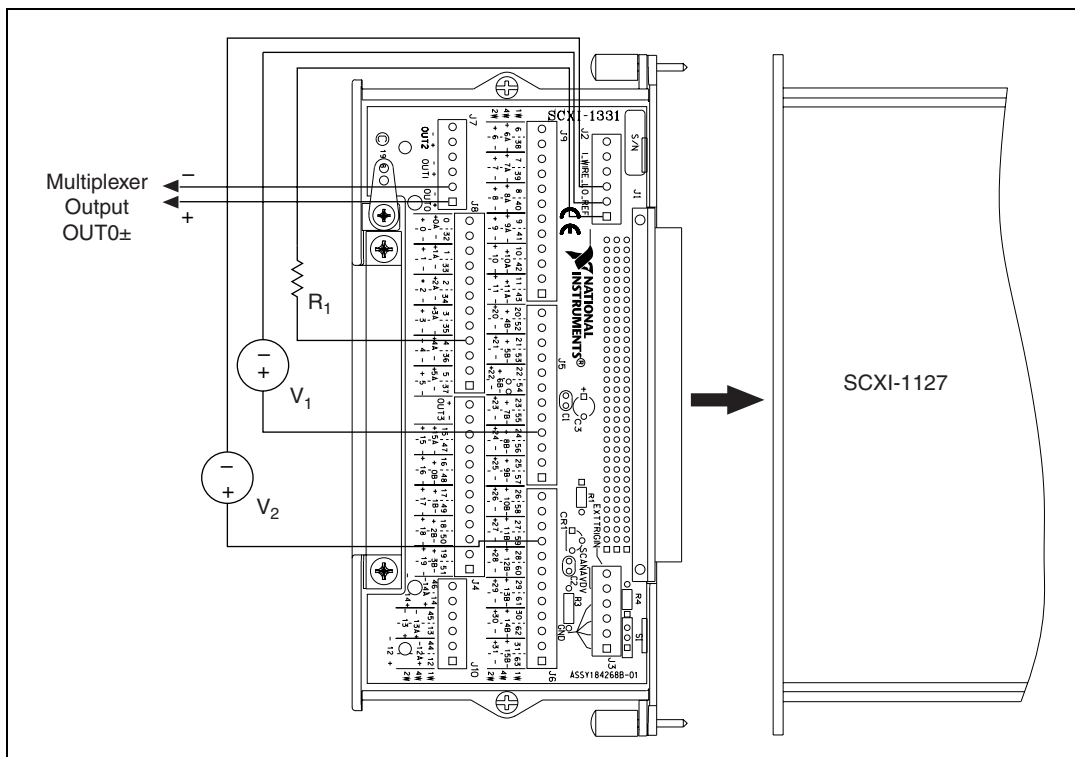


**Figure 2-4.** 1-Wire Block Diagram

The output of the 64-to-1 multiplexer is available through the OUT0+ and OUT0– screw terminals on the SCXI-1331. You can also connect the output of the SCXI-1127/1128 to the HVAB backplane using switch AB0 to make the connection.

On power up, switch AB0 is open, disconnecting the SCXI-1127/1128 from the high-voltage bus. If you are using the module with a high-voltage backplane, you need to close the AB0 switch to connect the multiplexer output to the HVAB backplane. You can do this through NI-SWITCH.

Figure 2-5 shows an example of a 1-wire configuration using the SCXI-1331 terminal block. The diagram shows the 1-wire terminal block connections for channels 4, 24, and 59. Channel 4 ( $R_1$ ) is measuring a resistance. The positive channel is labeled 4 while the negative terminal (common reference) is labeled 1\_WIRE\_LO\_REF.



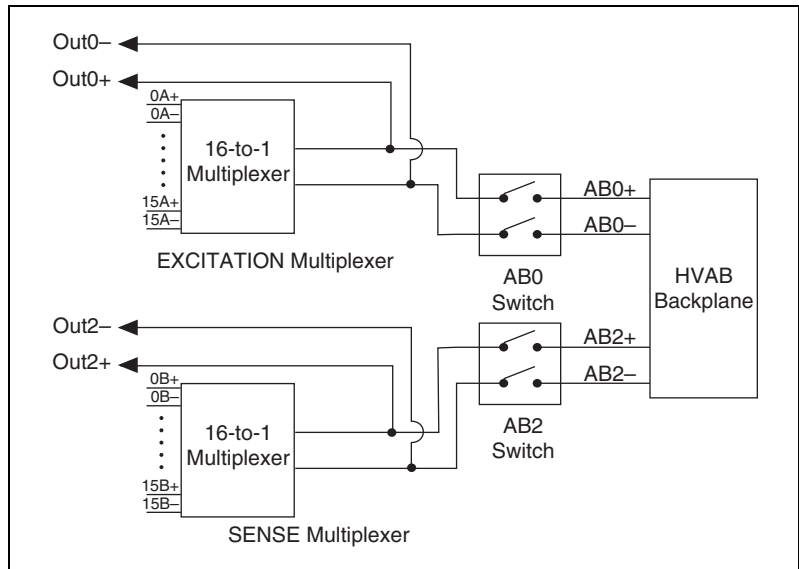
### Figure 2-5. 1-Wire Wiring Diagram

Both channel 24 ( $V_1$ ) and 59 ( $V_2$ ) are measuring voltage sources. The positive terminal of these sources go to screw terminals labeled 24 and 59 respectively. The negative terminals or the common reference for the voltage source is wired to the 1\_WIRE\_LO\_REF screw terminals.

The output of the multiplexer is available through the OUT0 bus. Resistance is measured at channel 4 and voltage at channels 24 and 59.

## 4-Wire Channel Scanning Configuration

You can use an SCXI-1127/1128 as a 16-to-1, 4-wire multiplexer. Figure 2-6 shows a block diagram of the input switching structure in 4-wire mode. You can connect up to 16, 4-wire channels to the SCXI-1127/1128 using a SCXI-1331 terminal block. The 4-wire multiplexer consists of dual 16-to-1 multiplexers.

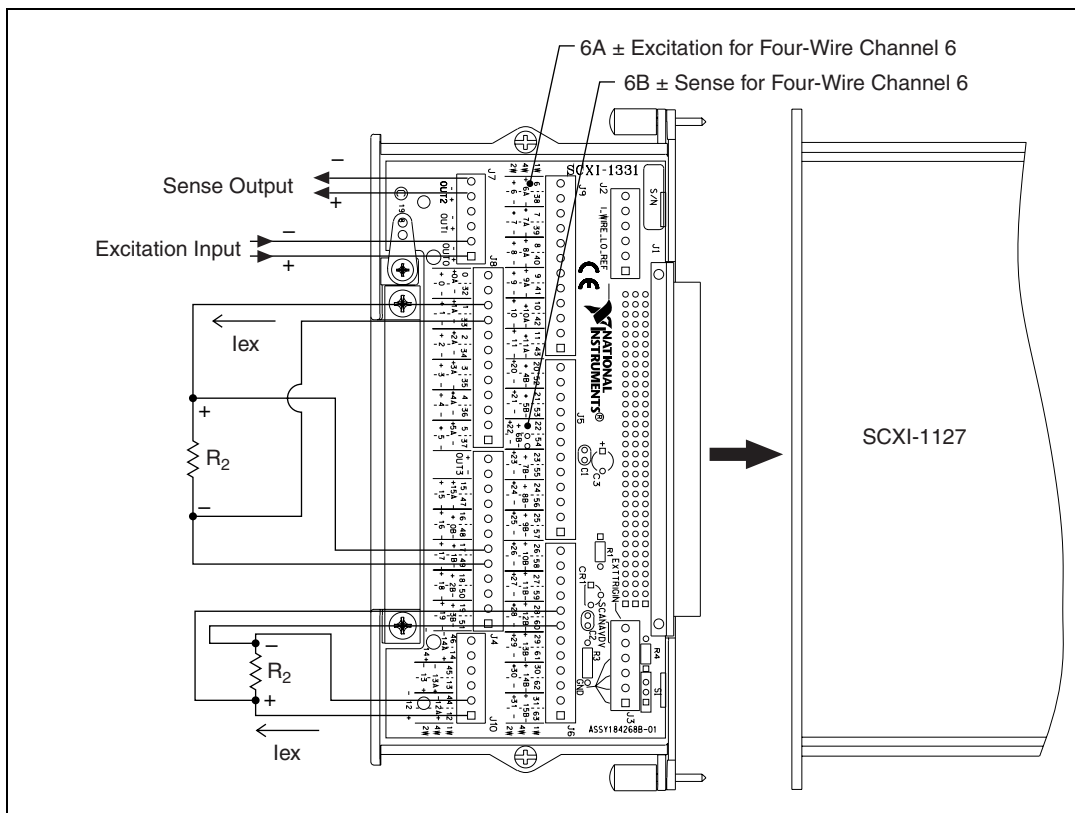


**Figure 2-6.** 4-Wire Block Diagram

When used with a DMM for 4-wire ohms measurement, the upper differential multiplexer provides the excitation source for the 4-wire channel being scanned.

The EXCITATION input to the upper multiplexer is available through the OUT0+ and OUT0– screw terminals on the SCXI-1331. The SENSE output from the lower 16-to-1 multiplexer is available through the OUT2+ and OUT2– screw terminals on the SCXI-1331. You can also connect the EXCITATION and SENSE commons of the SCXI-1127/1128 to the HVAB backplane. Use switches AB0 and AB2 to make this connection. You can do this through NI-SWITCH. This is the recommended usage with the DMM.

Figure 2-7 shows an example of a 4-wire channel configuration of the SCXI-1331 terminal block. Channel 6 consists of channel 6A+ and 6A–, and 6B+ and 6B–. Channel 6A of 4-wire channel 6 is the excitation channel and channel 6B is the voltage sense channel. Therefore, to make a 4-wire resistance measurement, a DMM should excite the current through high-voltage AB0 or OUT0 using channel 6A and sense the voltage across the resistor through AB2 or OUT2 using channel 6B.



**Figure 2-7. 4-Wire Wiring Diagram**

On power up, the AB0 and AB2 switches are open, disconnecting the SCXI-1127/1128 from the high-voltage bus. If you are using this module with a high-voltage backplane, you need to close the AB0 and AB2 switches to connect the EXCITATION and SENSE commons to the HVAB backplane.

Figure 2-7 shows an example of a 4-wire configuration using the SCXI-1331 terminal block. The diagram shows the 4-wire terminal block connections for channels 1 and 12. Resistance is measured on both channels. Each channel has excitation pair positive and negative terminals labeled 1A and 12A and SENSE terminals labeled 1B and 12B respectively.

R1 is excited through the 12A positive and negative screw terminals and the voltage drop across the resistor is measured through the 12B positive and negative screw terminals. R2 is excited through the 1A positive and

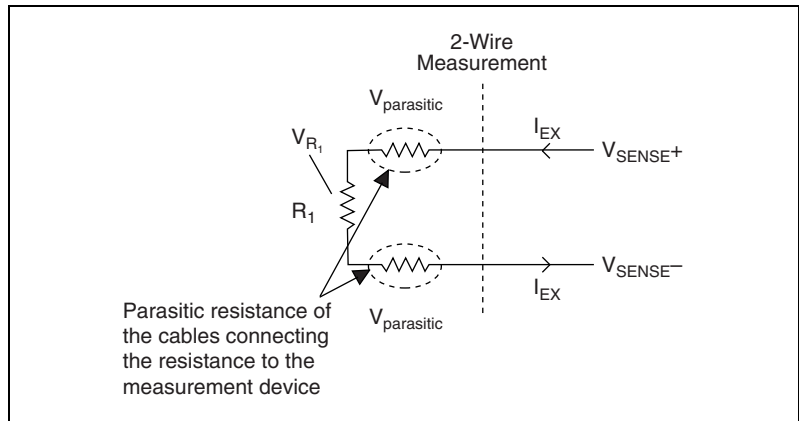
negative screw terminals and sensed via 1B positive and negative screw terminals.



**Note** OUT0± and OUT2± are also referred to as COM0± in a 4-wire configuration.

## 4-Wire versus 2-Wire Resistance Measurement

The primary advantage of using a 4-wire configuration is that it has greater accuracy than a 2-wire configuration while making resistance measurements. Figure 2-8 shows signal connections for a 2-wire resistance measurement of a resistor  $R_1$ .



**Figure 2-8.** Signal Connections for a 2-Wire Resistance Measurement

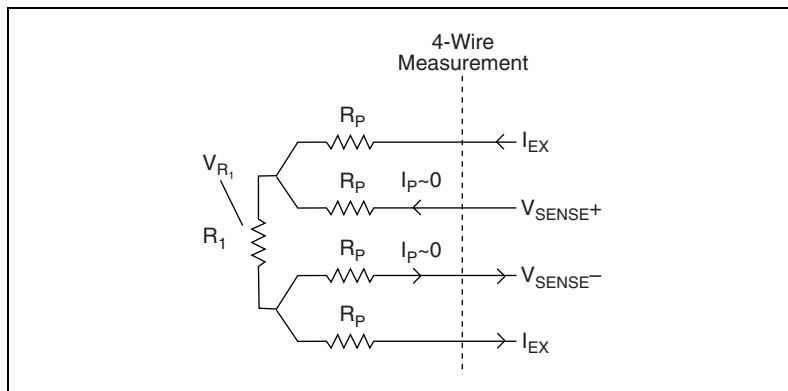
When measuring  $R_1$  in a 2-wire configuration, the voltmeter measures not only voltage across  $R_1$  due to the excitation current (of the voltmeter) but also the voltages developed across the parasitic resistance of the voltmeter cables. When the resistance is finally calculated, these parasitic voltages make the measurement inaccurate:

$$R_{1\text{measured}} = \frac{2V_{\text{parasitic}} + V_{R_1}}{I_{EX}} = 2R_{\text{parasitic}} + R_1$$

Therefore, in a 2-wire resistance measurement, the voltmeter ends up measuring a resistance that includes the parasitic resistance of the cables and switches.

To overcome this problem—to eliminate the parasitic resistance of the connecting cables—a voltmeter uses two sets of cables, one for excitation

current and the other for sensing the voltage developed across the resistor, as shown in Figure 2-9.



**Figure 2-9.** Signal Connections for a 4-Wire Resistance Measurement

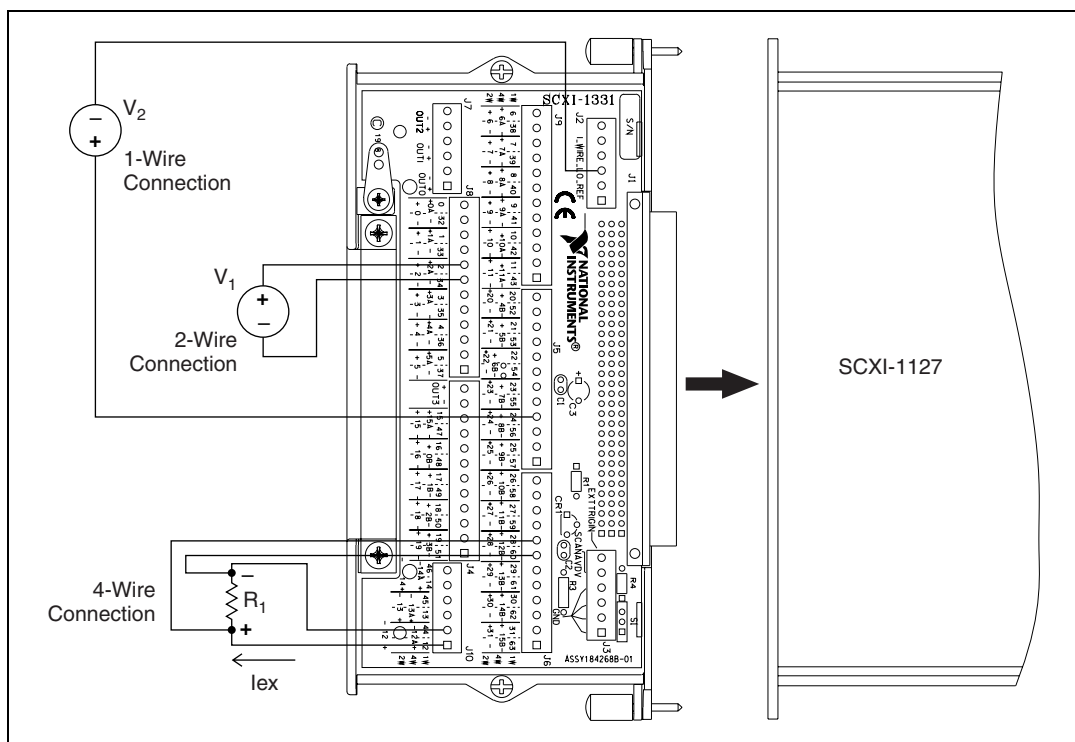
Since ideally the impedance of the voltmeter is infinite, very little or no current passes through the sense leads of the voltmeter. As a result, the voltmeter reads the exact voltage developed across  $R_1$ , and no parasitic resistances are introduced into the measurement:

$$R_{1\text{measured}} = \frac{V_{R_1}}{I_{EX}} = R_1$$

Therefore, a 4-wire configuration is a more accurate way of performing resistance measurements than a 2-wire configuration.

## Mixed Mode Configuration

The input mode of the SCXI-1127/1128 is configurable on a per channel basis; therefore, you can connect a variety of signal types in 2-wire, 1-wire, and 4-wire modes to the same module. An SCXI-1127/1128 can have 2-wire, 1-wire, and 4-wire channels connected to its front at the same time, as shown in Figure 2-10.



**Figure 2-10.** Mixed Mode Scanning with an SCXI-1331

You can scan the channels in any sequence you want. You can connect more than one SCXI-1127/1128 module together using the HVAB-backplane adapter from the SCXI-1357/1358 kits to expand the channel count of the system.

When combining different modes in one module it is important to use the channels efficiently. Generally you should connect the 4-wire channels first, followed by the 2-wire channels, and finally by the 1-wire channels.

## Hardware-Timed and Software Scanning

The SCXI-1127/1128 provides a very flexible scanning architecture. You can scan the channels randomly and can have multiple input modes in the same scan. This is useful for connecting multiple sensor types to one module.

There are two basic methods of scanning—*hardware-timed scanning* and software scanning. In hardware-timed scanning, the measurement instrument, such as a DMM, communicates via digital trigger signals to the

SCXI-1127/1128. In its simplest form, hardware-timed scanning uses one triggering signal to advance the multiplexer to the next channel in the scan. This is called *synchronous scanning*.



**Note** When using a DMM with the SCXI-1127/1128, synchronous mode is the only mode in which the DMM and the SCXI-1127/1128 operate.

Another hardware-timed scanning method is called *handshaking*. While synchronous scanning requires just one signal from the instrument to the multiplexer, handshaking requires an additional signal connected from the multiplexer to the instrument. This additional trigger, SCANADVD, notifies the measuring instrument that the multiplexer has settled and the next measurement can be made. This method is useful when using an SCXI-1127/1128 with external instruments to guarantee that both the measurement instrument and the multiplexer have settled before taking the next measurement.

The second type of scanning, *software scanning*, is a method by which channels are selected through the software. This method requires no trigger connections. Software scanning does not offer the time accuracy of hardware-timed scanning.

## Hardware-Timed Scanning

In hardware-timed scanning, the software downloads to the SCXI-1127/1128 a list of channels to scan, including each channels configuration information, such as whether the channel is 2-wire, 1-wire, or 4-wire. The software then arms the SCXI-1127. Once armed, the SCXI-1127/1128 advances to the next channel when it receives a trigger from the DMM. In multi-module scanning, the chassis arbitrates between modules. Each module in turn drives its output onto the analog bus and on the OUT (COM) terminals. Figure 2-11 shows the hardware scanning flowchart and may be useful in understanding the scanning/triggering operation of the SCXI-1127/1128.



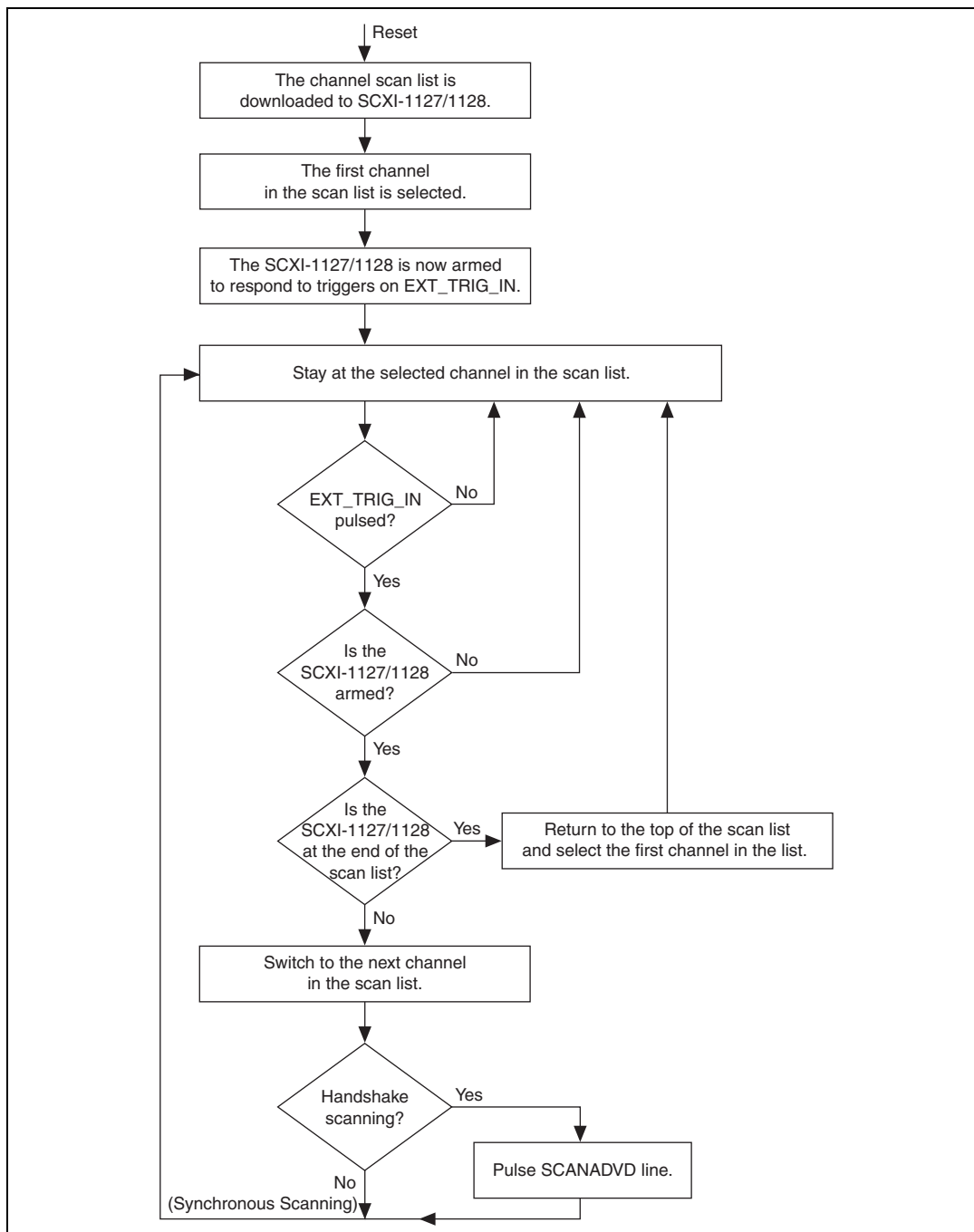
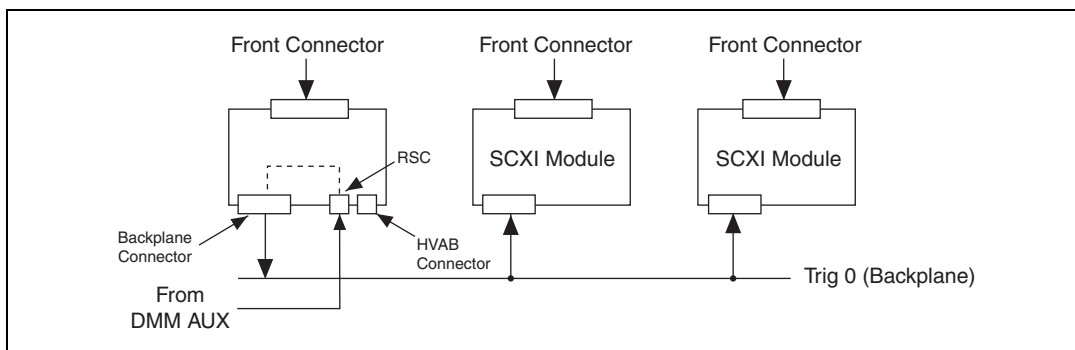


Figure 2-11. Hardware Scanning Flowchart

## Hardware-Timed Scanning Using a DMM

When using a DMM with the SCXI-1127/1128, synchronous mode is the only mode in which the DMM and the SCXI-1127/1128 operate. The DMM issues a trigger to advance the multiplexer at regular intervals. The DMM and the software guarantee that the switch has fully settled before the next measurement is taken.

The module that connects directly to the digital connector on the HVAB-backplane adapter is referred to as the cabled module. If you add additional SCXI-1127/1128 modules to your system the trigger is bused over the SCXI backplane (Trig 0) allowing other modules to be triggered, as shown in Figure 2-12. These additional modules are referred to as non-cabled modules because they do not require the DMM to be cabled directly to them.



**Figure 2-12.** Cabling a DMM and Using the TRIG0 to Bus the VMC/EXT\_TRIG\_IN to Non-Cabled Modules

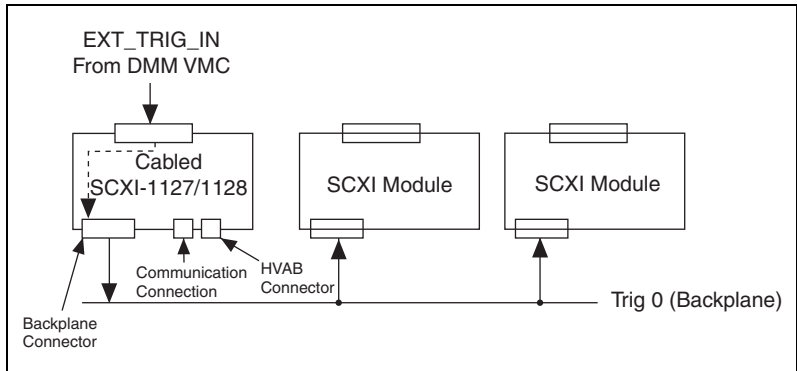
## Hardware-Timed Scanning Using External Instruments

When using the SCXI-1127/1128 with an external measurement instrument, you can use either synchronous or handshaking mode to advance the SCXI-1127/1128.

### Synchronous Scanning

In the synchronous scanning mode, the measuring device such as a DMM issues a trigger, voltmeter complete (VMC), to advance the multiplexer at regular intervals. Each interval must be at least 10 ms to guarantee that the switch has fully settled before the next measurement is taken. For example, you can connect the VMC of your DMM to the SCXI-1127/1128 via a screw terminal labeled EXT\_TRIG\_IN (external trigger input) on the SCXI-1331 terminal block.

The module to which you connected your external DMM trigger signals is referred to as the cabled module. If you add additional SCXI-1127/1128 modules to your system, it is not necessary to cable the VMC signal to each module. You can bus the VMC signal onto the SCXI backplane (Trig 0), allowing other modules to be triggered as shown in Figure 2-13. These additional modules are referred to as non-cabled modules because they do not require the VMC to be connected directly to them.



**Figure 2-13.** Cabling an External DMM

## Handshaking Scanning

The SCXI-1127/1128 supports a handshaking scanning mode. This is implemented using the standard VMC/SCANADVD handshaking scheme. In this mode, the multiplexer responds to every EXT\_TRIG\_IN trigger by advancing the multiplexer to the next channel, waiting for the multiplexer to settle, and then sending a scanner advanced pulse out on a SCANADVD output trigger back to the DMM.

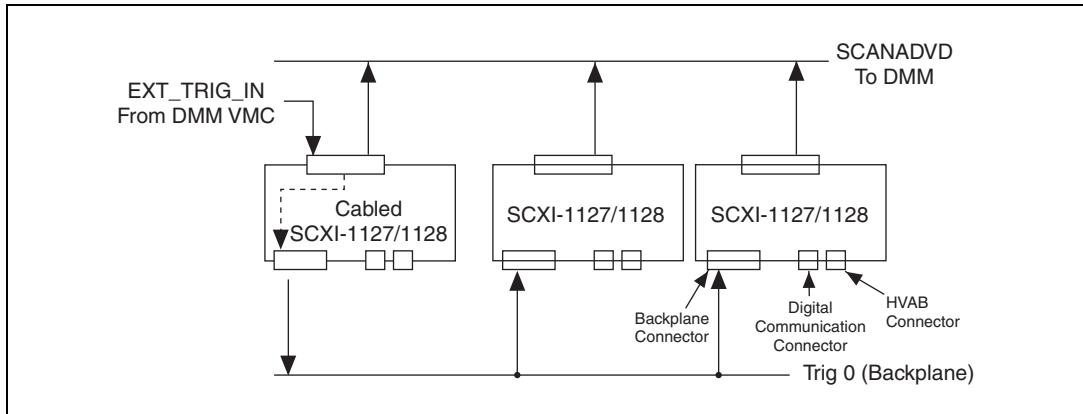
For example, you can connect the VMC of the DMM to the SCXI-1127/1128 via a screw terminal labeled EXT\_TRIG\_IN on the SCXI-1331 terminal block. You must also connect the SCANADVD signal from the SCXI-1331 terminal block to your DMM external trigger input.



**Note** If the external DMM has an internal pull-up on its external trigger input, you need to configure the SCANADVD signal of the SCXI-1127/1128 as a negative going pulse. If the external DMM has an internal pull-down on its external trigger input, you need to configure the SCANADVD signal of the SCXI-1127/1128 as a positive going pulse.

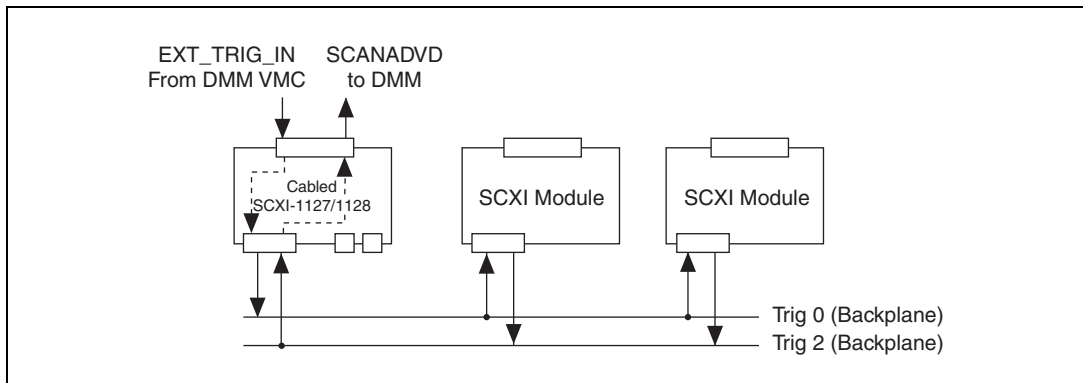
The module to which you connected your external DMM trigger signals is referred to as the cabled module. If you add additional SCXI-1127/1128 modules to your system, it is not necessary to cable the VMC to each

module. You can bus the VMC onto the SCXI backplane (Trig 0), allowing other modules to be triggered as shown in Figure 2-14. You must daisy-chain the SCANADVD trigger from one module to another.



**Figure 2-14.** Daisy-Chained for Handshaking

If you are using an SCXI-2000 chassis, you can bus the SCANADVD signal over the SCXI backplane (Trig 2). This eliminates the need to physically connect the SCANADVD trigger from one SCXI-1127/1128 module to another. This configuration is shown in Figure 2-15. Refer to your SCXI chassis manual to check the Trig 2 specifications.



**Figure 2-15.** Connecting an External DMM to an SCXI-1127/1128 in an SCXI-2000 Series Chassis

## Software Scanning

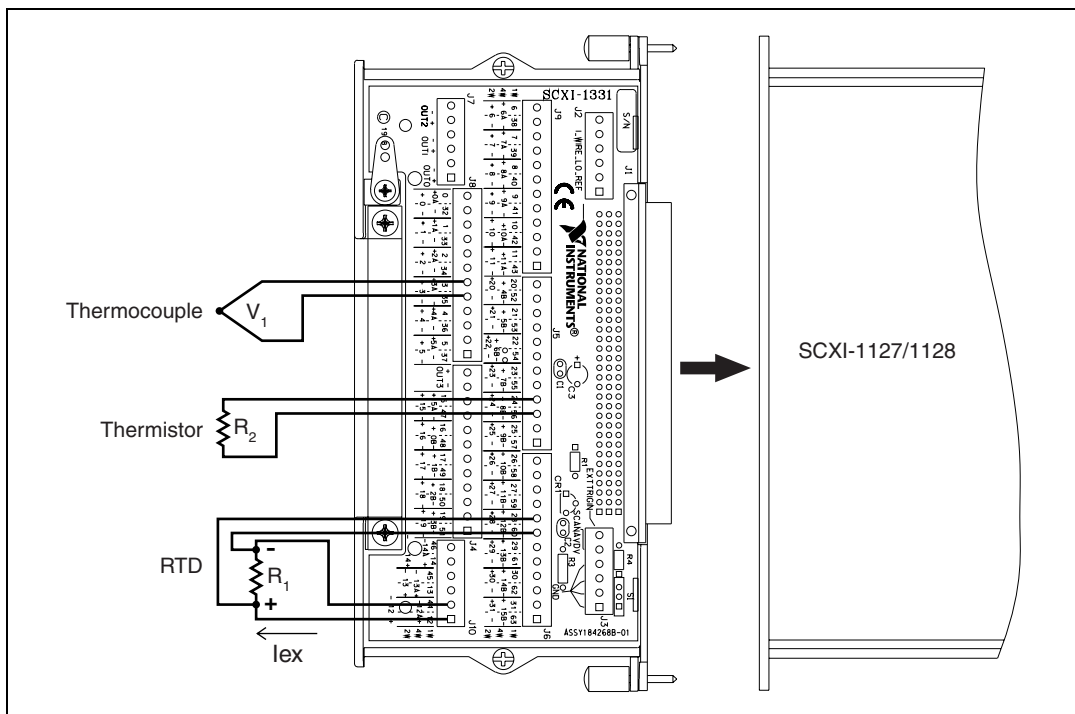
Unlike hardware scanning, software scanning does not use hardware-generated triggers. In software scanning, a list of channels kept by the software is scanned by selecting the desired channel on the SCXI-1127/1128 and making the required measurement. Refer to the NI-SWITCH documentation for more information on software scanning.

## Making Temperature Measurements

You can use the SCXI-1127/1128 to measure a variety of temperature devices including thermocouples, RTDs, and thermistors. The following sections discuss how to use these types of sensors with the SCXI-1127/1128.

### Making Thermocouple Measurements

Figure 2-16 shows a thermocouple ( $V_1$ ) connected to channel 3 on the SCXI-1331 terminal block. The thermocouple is connected in the 2-wire configuration. Due to the small voltages that thermocouples produce, National Instruments recommends that you connect them in a 2-wire (differential) configuration versus a 1-wire configuration.



**Figure 2-16.** Temperature Measurement Wiring Diagram

The SCXI-1331 contains a cold-junction temperature sensor (CJS). This sensor is a special channel on the SCXI-1127/1128 dedicated to measuring the ambient temperature of the terminal block. This channel is always scanned as a 2-wire channel. Including a CJS channel in the scan list is optional. You can include a CJS channel at any position in the list with any number of repetitions.

The SCXI-1331 temperature sensor outputs 0.2–0.024 V from 0–50 °C and has an accuracy of  $\pm 0.5$  °C over the 15–35 °C range and  $\pm 0.9$  °C over the 0–15 °C and 35–50 °C ranges.<sup>1</sup>

National Instruments software can convert a thermistor voltage to the thermistor temperature. In LabVIEW, you can use the Convert Thermistor Reading virtual instrument (VI) in the **Data Acquisition» Signal Conditioning** palette. If you are using Measurement Studio or

<sup>1</sup> Includes the combined effects of the temperature sensor accuracy and the temperature difference between the temperature sensor and any screw terminal. The temperature sensor accuracy includes tolerances in all component values, the effects caused by temperature and loading, and self-heating.

NI-DAQ, use the `Thermistor_Convert` function. The VI takes the output voltage of the temperature sensor, the reference voltage, and the precision resistance and returns the thermistor temperature.

Alternatively, you can use the following formulas:

$$T(^{\circ}\text{C}) = T_K - 273.15$$

where  $T_K$  is the temperature in Kelvin,

$$T_K = \frac{1}{[a + b(\ln R_T) + c(\ln R_T)^3]}$$

where  $a = 1.295361 \times 10^{-3}$

$b = 2.343159 \times 10^{-4}$

$c = 1.018703 \times 10^{-7}$

$R_T$  = resistance of the thermistor in ohms,

$$R_T = 189,000 \left( \frac{V_{TEMPOUT}}{2.5 - V_{TEMPOUT}} \right)$$

where  $V_{TEMPOUT}$  is the output voltage of the temperature sensor,

$$T(^{\circ}\text{F}) = \frac{[T(^{\circ}\text{C})]9}{5} + 32$$

where  $T(^{\circ}\text{F})$  and  $T(^{\circ}\text{C})$  are the temperature readings in degrees Fahrenheit and degrees Celsius, respectively.

## Making RTD Measurements

Figure 2-16 shows an RTD ( $R_1$ ) connected to channel 12 on the SCXI-1331 terminal block. The RTD is connected in the 4-wire configuration. It is recommended that you connect RTDs in a 4-wire configuration to eliminate the effects of lead resistance on the measurement. See the [4-Wire versus 2-Wire Resistance Measurement](#) section for more information.

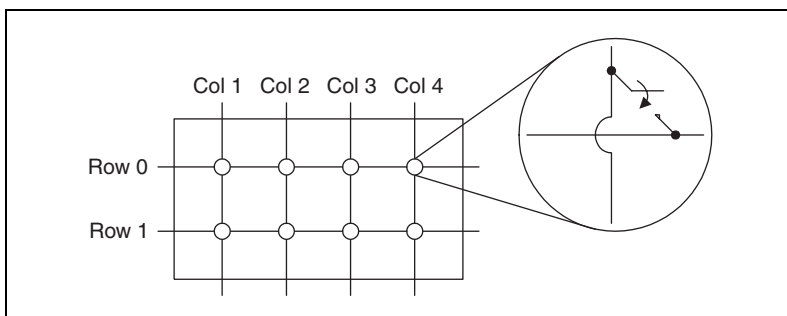
## Making Thermistor Measurements

Figure 2-16 shows a thermistor ( $R_2$ ) connected to channel 24 on the SCXI-1331 terminal block. The thermistor is connected in the 2-wire configuration. You can connect the thermistor in the two, four, or even 1-wire input configurations. The choice is typically dictated by channel cost and required accuracy. The 4-wire configuration is ideal and provides

the best accuracy, while 1-wire provides the maximum channel count. Use the 4-wire configuration to eliminate the effects of lead resistance on the measurement. Since the lead resistance is typically small when compared with the thermistor range, the impact of the lead resistance error is smaller than you have in an RTD measurement. See the [4-Wire versus 2-Wire Resistance Measurement](#) section for more information.

## Operating as a Matrix

A matrix is one of the most flexible switching configurations. Unlike a multiplexer, a matrix can connect multiple inputs to multiple outputs. A multiplexer is typically organized into channels and commons, while a matrix is organized into columns and rows. You can connect any column to any number of rows and any row to any number of columns. Figure 2-17 shows an example of a  $2 \times 4$ , 1-wire matrix configuration. At each intersection of a row and column, there is a switch. When the switch is closed, the row is connected to the column. Figure 2-17 depicts a 1-wire matrix; the SCXI-1127/1128 is a 2-wire matrix. The switching method for a 2-wire matrix remains the same. A 2-wire matrix is shown in Figure 2-21. Matrices are useful in applications where maximum switching flexibility is desired.



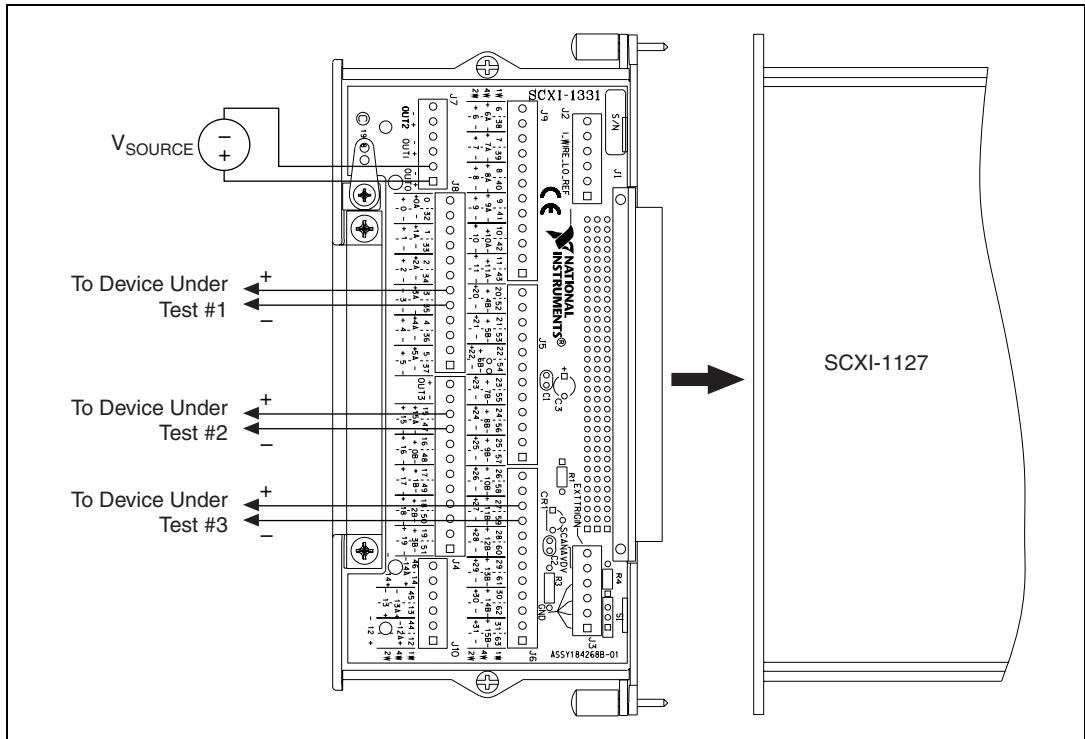
**Figure 2-17.**  $2 \times 4$ , 1-Wire Matrix Configuration

### $32 \times 1$ Matrix Configuration

You can use the SCXI-1127/1128 with the SCXI-1331 to make various matrix configurations such as a  $1 \times 32$ , 32 columns by one row, matrix. OUT0 $\pm$  (COM0 $\pm$ ) provide the row signals on the SCXI-1331 terminal block. Screw terminals for 2-wire channel 0 provide access to column 0 of the  $1 \times 32$  matrix. Similarly, the screw terminals for channel  $x$  provides access to column  $x$ .



Figure 2-18 shows an example of the SCXI-1331 and SCXI-1127/1128 configured as a  $1 \times 32$ , 2-wire matrix. The diagram shows the 2-wire terminal block connections for channels 3, 15, 27 and OUT0. You can use this configuration to connect  $V_{SOURCE}$  to one or all of the device under test (DUT) channels.



**Figure 2-18.**  $1 \times 32$  Matrix Wiring Diagram

## 4 × 8 Matrix Configuration

You can configure the SCXI-1127/1128, with the SCXI-1332 as an  $4 \times 8$ , four rows by eight columns, matrix. The SCXI-1332 terminal block has 12 pairs of screw terminals, eight pairs for accessing eight columns (C0...C7) and four pairs for accessing four rows (R0...R3) of the  $4 \times 8$  matrix when installed in the front connector of the SCXI-1127/1128. In addition to the screw terminals, the SCXI-1332 has six connectors for matrix expansion. Four of the six connectors are for expanding the eight columns and the other two connectors are for row expansion. The SCXI-1332 is shown in Figure 2-19.

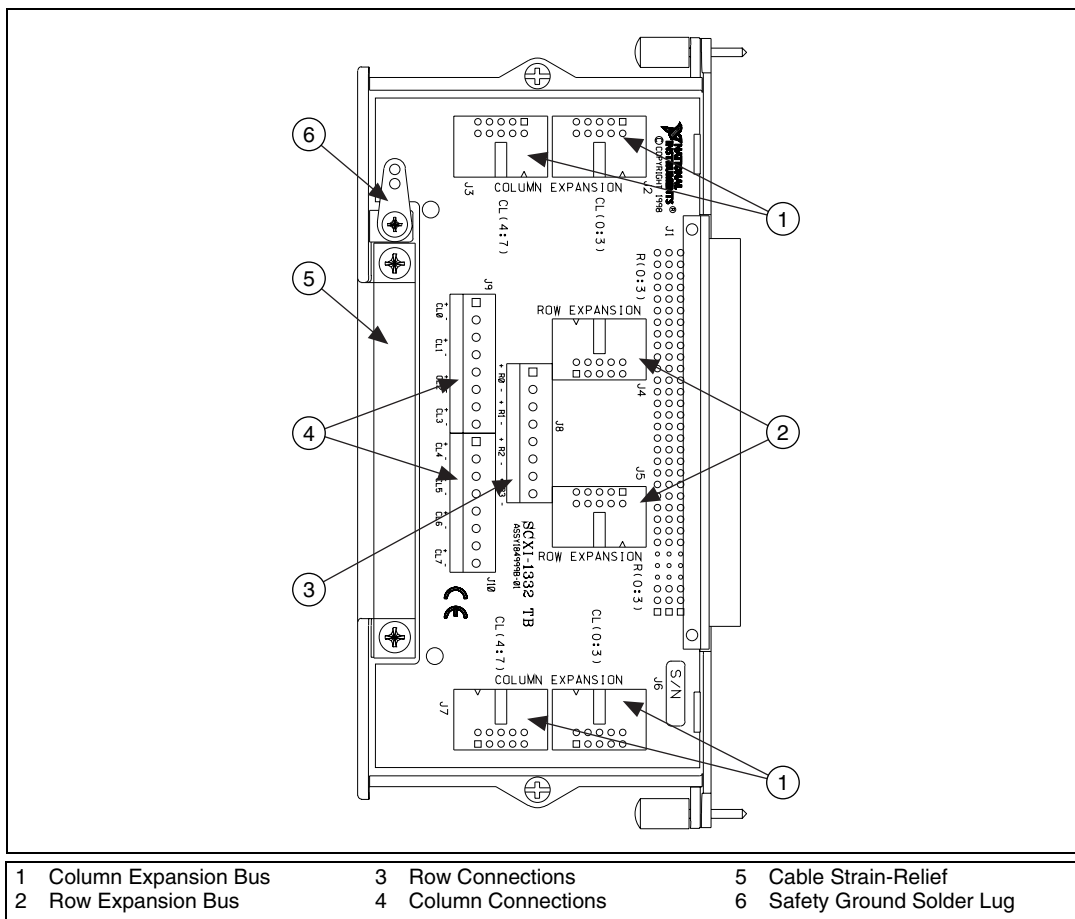
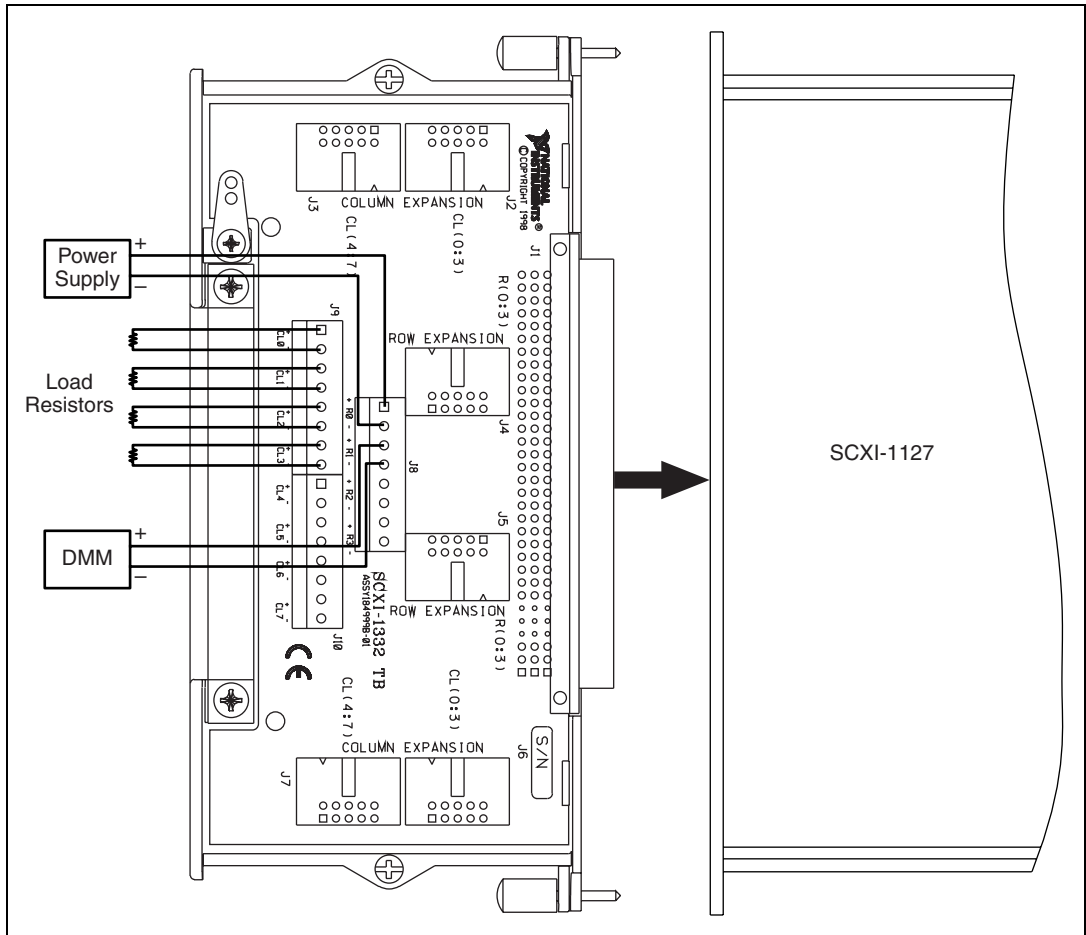


Figure 2-19. SCXI-1332 Terminal Block

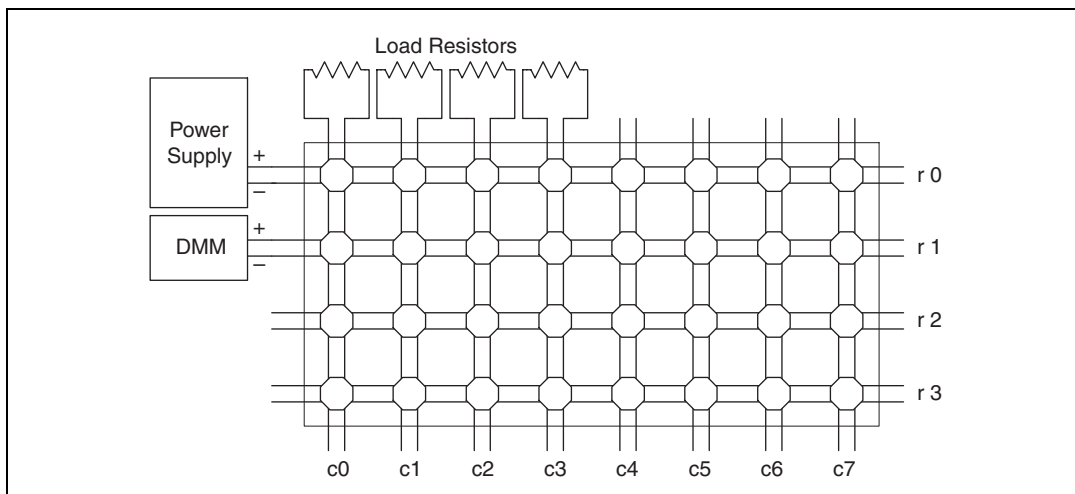
The SCXI-1127/1128 installed with the SCXI-1332 provides you with an  $4 \times 8$  matrix without any extra wiring except for hooking up your signals to the columns and rows of the matrix. Refer to [Matrix Expansion](#) for information on using multiple SCXI-1127/SCXI-1332 systems to build matrices larger than  $4 \times 8$ .

Figure 2-20 shows an example of an SCXI-1332 connected to an SCXI-1127/1128. The SCXI-1127/1128 is configured for  $4 \times 8$  matrix operation by the software. This is an example of a power supply test station. The purpose of this test station is to measure the output voltage of a power supply under various load conditions. The loads are connected to the first four columns, C0...C3. The power supply is connected to row 0 and is the DUT. A DMM is connected to row 1 and is used to measure the power

supply output voltage and to measure the load resistors. A simple test can consist of first measuring the values of the resistances while they are not connected to the power supply, and then monitoring the output voltage as different resistors are connected. Figure 2-21 shows a schematic of this application.



**Figure 2-20.** SCXI-1332 Connected to an SCXI-1127

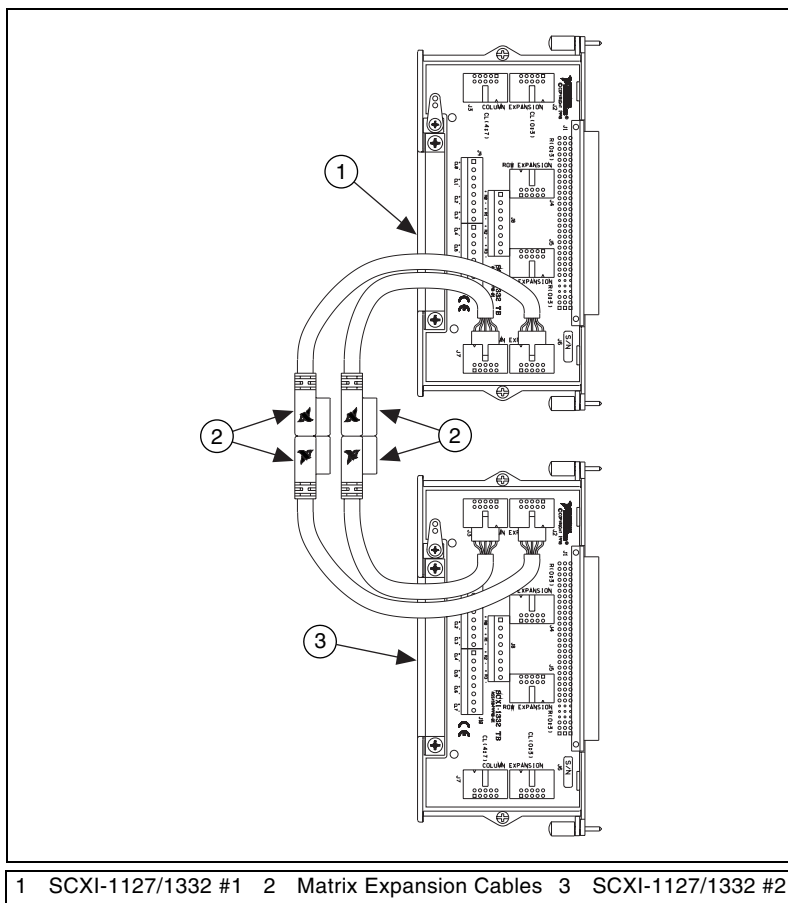


**Figure 2-21.** SCXI-1332 Connected to an SCXI-1127/1128 Schematic

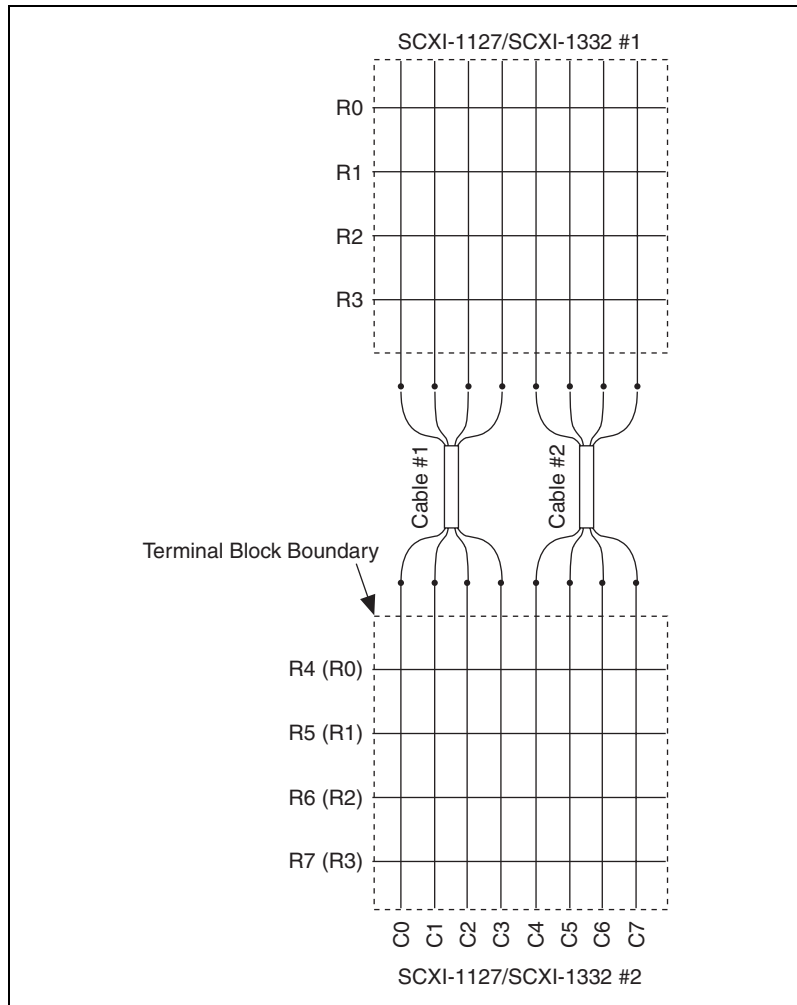
## Matrix Expansion

You can build matrices larger than  $4 \times 8$  by using multiple SCXI-1127/1128 modules. You can build these larger matrices using row and column expansion of the  $4 \times 8$  matrix. An example of row expansion is an  $8 \times 8$  matrix. A  $4 \times 16$  matrix is an example of a column expansion. A  $8 \times 16$  matrix is an example of both a row and column expansion.

Figure 2-22 shows an example of two SCXI-1332 terminal blocks connected to form an  $8 \times 8$  matrix. You can connect the terminal blocks using matrix expansion cables that are available from National Instruments. The columns of one module are connected to the other module, doubling the number of rows from four to eight. Figure 2-23 shows the schematic of an  $8 \times 8$  matrix made this way. The rows in module 2 are now rows R4 through R7 due to the matrix expansion. Similarly, you can make a  $4 \times 16$  matrix by connecting the rows of two SCXI-1332s.



**Figure 2-22.** 8 × 8 Matrix Parts Locator Diagram



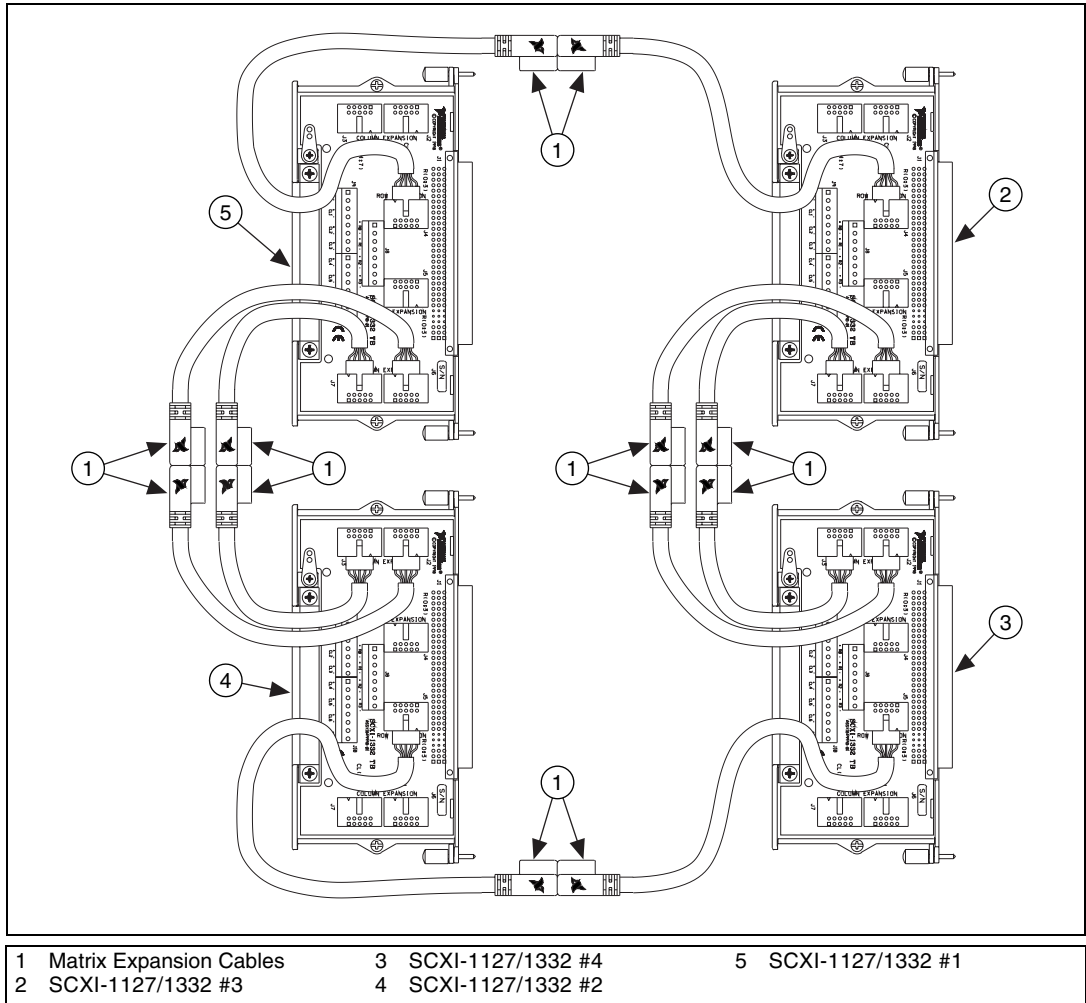
**Figure 2-23.** 8 × 8 Matrix Schematic

To make a larger matrix, such as a 8 × 16 matrix, you must make both column and row expansions. Follow these instructions to build a larger matrix:

1. Expand the columns to the target number, 16 in this case, by connecting the rows of the appropriate number of SCXI-1332s, two in this case, using matrix expansion cables. This results in a 4 × 16 matrix block.

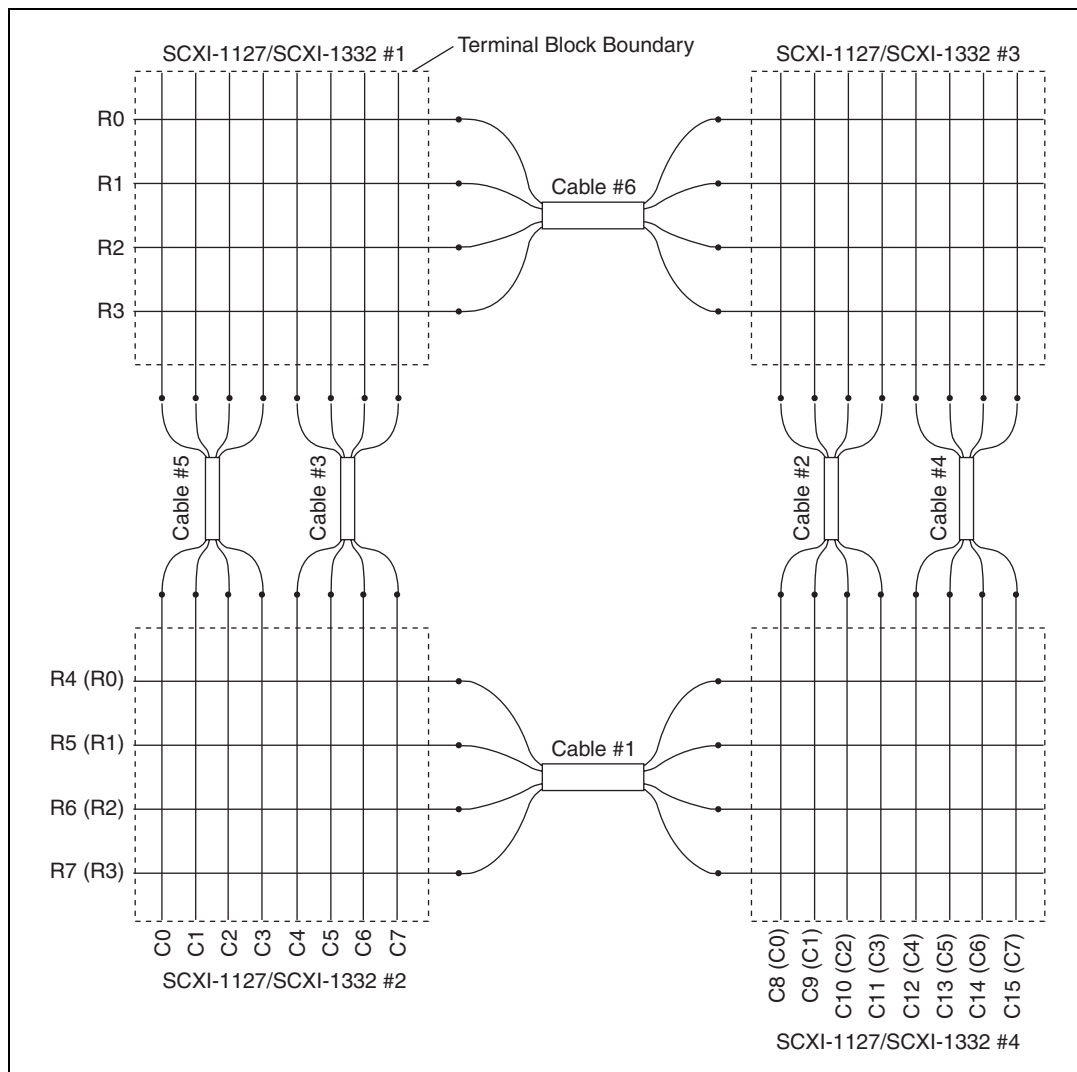
- Expand the rows to the target number, 8 in this case, by connecting the columns of the appropriate number of  $4 \times 16$  matrix blocks, two in this case, using matrix expansion cables.

Figure 2-24 shows four SCXI-1332s connected to form a  $8 \times 16$  matrix.



**Figure 2-24.**  $8 \times 16$  Matrix Parts Locator Diagram

Figure 2-25 shows the schematic of the  $8 \times 16$  matrix shown in Figure 2-24.



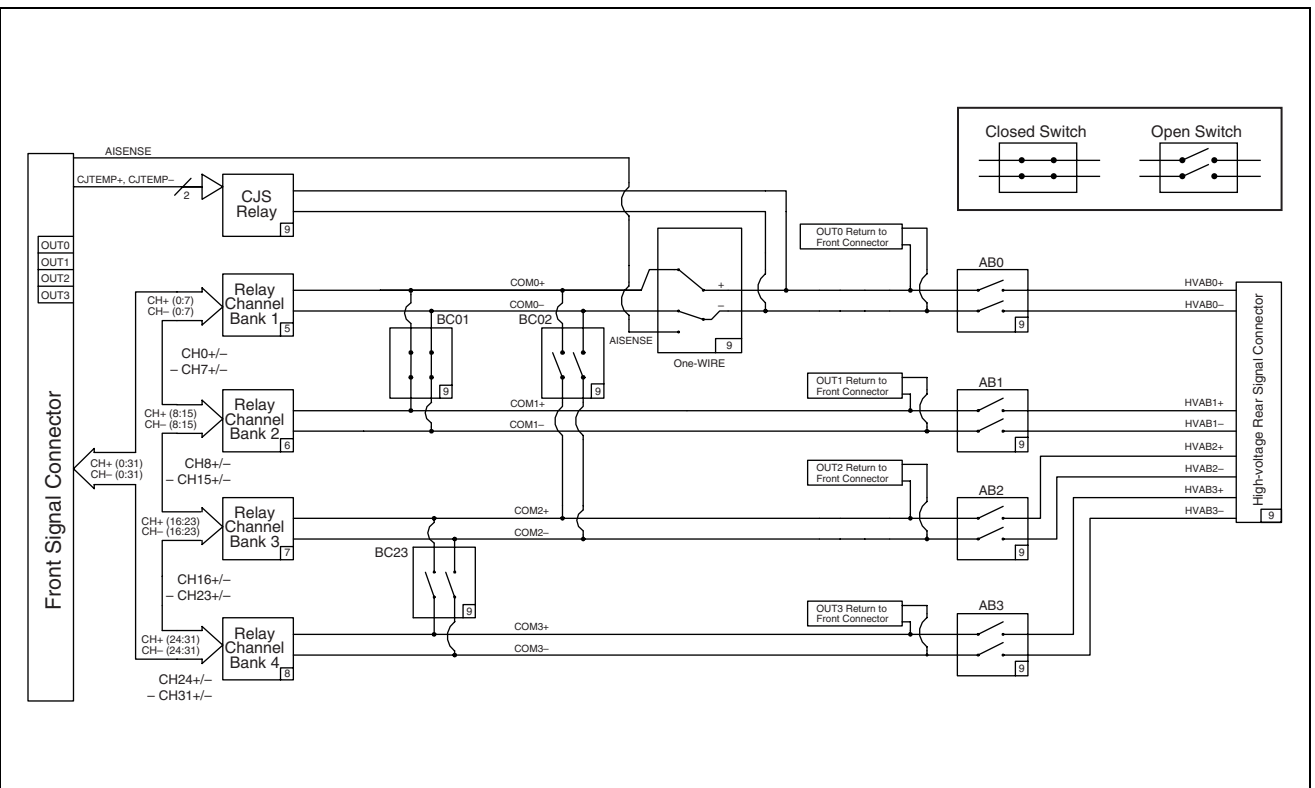
**Figure 2-25.**  $8 \times 16$  Matrix Schematic



## Independent Mode

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The SCXI-1127/1128 powers up in independent mode. In this mode, you can close or open any switch on the module via NI-SWITCH to the SCXI-1127/1128. All software-controllable switches are shown in Figure 2-26. You can use the independent mode for advanced switching or scanning needs. You can control these switches using NI-SWITCH.



**Figure 2-26.** SCXI-1127/1128 Relay Configuration

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# Specifications

This appendix lists the specifications for the SCXI-1127/1128 modules. These specifications are typical at 25 °C unless otherwise noted.

## SCXI-1127

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### Input Characteristics

Number of relays available as channels .....	32
Common-mode voltage	
Channel to channel.....	300 V <sub>rms</sub> or DC
Channel to earth .....	300 V <sub>rms</sub> or DC
Maximum allowed voltage—differential mode or single-ended	
AC .....	300 V <sub>rms</sub>
DC .....	300 VDC
Maximum switching capacity—differential mode or single-ended	
DC .....	1 A at 30 VDC
AC .....	200 mA at 250 V <sub>rms</sub> , 0.5 A at 125 V <sub>rms</sub>
Maximum switching power per differential channel or single ended .....	60 VA, 30 W
Contact on resistance (initial) .....	100 mΩ
Contact material .....	Gold-clad silver alloy

### Transfer Characteristics

Thermal EMF (differential) .....	<3 μV
Maximum frequency bandwidth .....	50 Ω termination
Worst-case channel .....	10 MHz

Channel to channel crosstalk .....	50 $\Omega$ termination
10 kHz .....	$\leq -70$ dB
100 kHz .....	$\leq -57.79$ dB
1 MHz .....	$\leq -53.31$ dB
5 MHz .....	$\leq -41.47$ dB
11 MHz .....	$\leq -27.23$ dB

## Dynamic Characteristics

Maximum operating speed .....	100 cycles/s
Relay operate time (at 20 °C) .....	3 ms typical, 5 ms max
Relay release time (at 20 °C) .....	1.5 ms typical, 5 ms max
Expected life	
Mechanical (at 180 cpm) .....	$5 \times 10^7$ operations
Electrical at maximum load .....	$2 \times 10^5$ operations

Operating life variations versus switching conditions (differential or single-ended mode operation) at 20 cpm

Volts	Amps	Operational Life Cycles
30 VDC	1 A	200,000
250 V <sub>rms</sub>	200 mA	50,000
250 VDC	200 mA	50,000
250 V <sub>rms</sub>	250 μA	100,000
250 VDC	250 μA	100,000

## Trigger Characteristics

Scanner advanced pulsewidth.....1.1  $\mu$ s

External trigger input pulsewidth .....500 ns (min)

## Stability

Recommended warm-up time.....5 minutes

## Physical

Dimensions..... 3.0 by 17.2 by 20.3 cm  
(1.2 by 6.9 by 8.0 in.)

## Environment

Operating temperature .....0 to 50 °C

Storage temperature.....–20 to 70 °C

Relative humidity ..... 10% to 90% noncondensing

Electromagnetic compatibility (EMC)

emissions..... Refer to the document supplied  
with the chassis for compliance  
to relevant directives.

EMI ..... FCC Class A compliant

## Safety

Designed in accordance with IEC-61010-1, UL 3111-1, and  
CAN/CSA C22.2 No. 1010.1 for electrical measuring and test equipment

Approved at altitudes up to 2000 m.

Installation Category II

Pollution Degree 2

Indoor use only

# SCXI-1128

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## Input Characteristics

Number of relays available as channels .....	32
Common-mode voltage	
Channel to channel .....	300 V <sub>rms</sub> or DC
Channel to earth.....	300 V <sub>rms</sub> or DC
Maximum allowed voltage—differential mode or single-ended	
AC.....	250 V <sub>rms</sub>
DC.....	300 VDC
Maximum switching capacity—differential mode or single-ended	
DC.....	30 mA at 10 VDC
AC.....	0.8 mA at 250 V <sub>rms</sub> ,
Maximum switching power per differential channel or single ended.....	0.3 W
Contact on resistance (initial) .....	<1.2 k $\Omega$ (differential mode)

## Transfer Characteristics

Thermal EMF (differential)	
0 to 25 °C .....	<25 $\mu$ V
Above 25 °C .....	<100 $\mu$ V
Maximum frequency bandwidth.....	50 $\Omega$ termination
Worst-case channel.....	1.5 MHz (–3 dB point)
Channel to channel crosstalk .....	50 $\Omega$ termination
100 Hz .....	< –82 dB
1 KHz.....	< –74 dB
10 KHz.....	< –58 dB
100 KHz.....	< –38 dB
1 MHz.....	< –20 dB

## Dynamic Characteristics

Maximum operating speed .....	1200 cycles/s
Relay operate time (at 20 °C) .....	0.25 ms typical, 0.5 ms max
Relay release time (at 20 °C) .....	0.08 ms typical, 0.2 ms max

## Trigger Characteristics

Scanner advanced pulsewidth .....	1.1 $\mu$ s
External trigger input pulsewidth .....	500 ns (min)

## Stability

Recommended warm-up time .....	5 minutes
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## Physical

Dimensions .....	3.0 by 17.2 by 20.3 cm (1.2 by 6.9 by 8.0 in.)
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## Environment

Operating temperature .....	0 to 50 °C
Storage temperature .....	–20 to 70 °C
Relative humidity .....	10% to 90% noncondensing
Electromagnetic compatibility (EMC) emissions .....	Refer to the document supplied with the chassis for compliance to relevant directives.
EMI .....	FCC Class A compliant

## Safety

Designed in accordance with IEC-61010-1, UL 3111-1, and CAN/CSA C22.2 No. 1010.1 for electrical measuring and test equipment
Approved at altitudes up to 2000 m.
Installation Category II

Pollution Degree 2

Indoor use only



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# Accessories

This appendix lists various National Instruments products you can use with your SCXI-1127/1128 module.

- The SCXI-1331 terminal block has screw terminal connections for all channels, bank commons, analog bus, and trigger signals. You can use this module for multiplexer switching applications. The terminal block has a temperature sensor that is used for thermocouple cold-junction compensation.
- The SCXI-1332 terminal block converts the switch card to a  $4 \times 8$ , 2-wire matrix configuration. This terminal block creates the matrix configuration by connecting channels (0, 8, 16, 24), (1, 9, 17, 25), (7, 15, 23, 31).
- Use the high-voltage matrix expansion cables to interconnect several SCXI-1332s to build matrices larger than  $4 \times 8$ .
- Use the 1-slot, 2-slot, and 8-slot HVAB-backplane adapters to connect the HVAB of the SCXI-1127/1128 to the DMM. You can also use them to establish HVAB connections across multiple SCXI-1127/1128 modules or SCXI chassis. The 2-slot and 8-slot HVAB-backplane adapters have four connectors on the external side—two HVAB connectors, one digital input in (AUXIN) connector, and one digital input out (AUXOUT) connector. The 1-slot SCXI-1357 has only HVAB connectors. The purpose of the AUXIN connector is to cable the digital communication signals from the DMM to the SCXI-1127/1128 and finally to the SCXI chassis backplane as shown in Figure 1-9, *Installing the SCXI-1127/1128 with Two DAQ Devices*. The AUXOUT connector connects the DMM communication signals to the next chassis if one is present.
- Use a SH9MD-9MD cable to connect digital communication lines of the NI-DMM to the SCXI-1127 AUXOUT connector. You can also use this cable to carry signals to the next chassis.
- Use an HV8-BAN4 cable to connect the HVAB of the SCXI-1127/1128 to the DMM analog bus.
- Use 8-position HVAB plugs to interconnect the HVAB of the HVAB-backplane adapters.

Contact National Instruments for more specific information about these products.



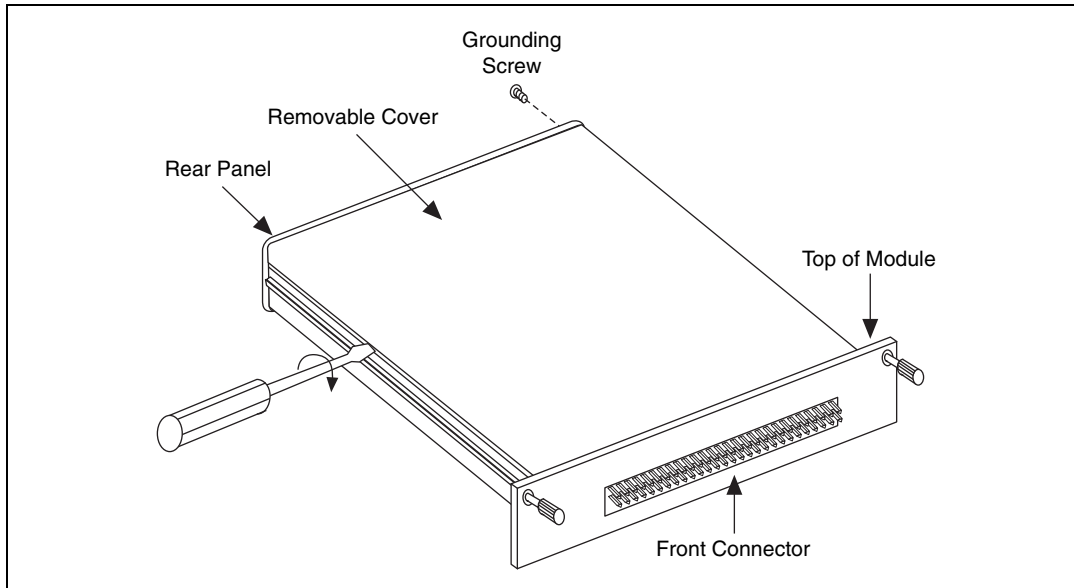
# Customizing Your Module

This appendix describes how to customize your SCXI-1127/1128 module for current-loop receiving. The SCXI-1127/1128 modules have plated through holes for transforming individual channels to current-to-voltage converters. National Instruments offers a process-current pack of four  $249\ \Omega$ , 0.1%, 5 ppm, 0.25 W resistors. The reference designator format for the current-loop resistors is such that input channel  $x$  corresponds to the resistor reference designator  $RCLx$ . For example, the resistor pad for channel 14 is  $RCL14$ .



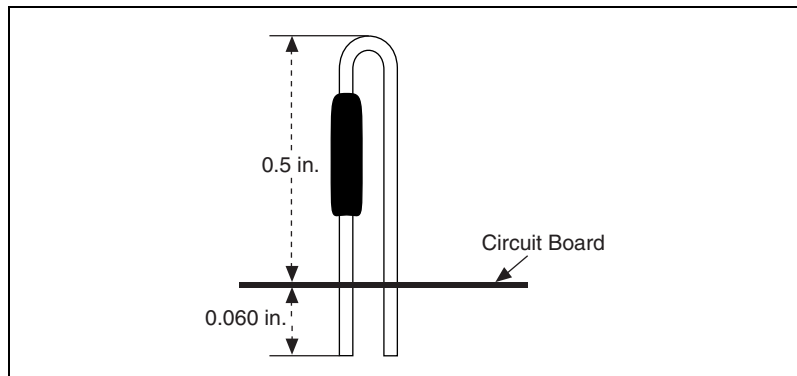
**Caution** Before installing the resistors in your module, make sure that no signals are connected to your module front connector.

Before installing your module in the SCXI chassis, you must install the resistors by performing the following steps while referring to Figure C-1:



**Figure C-1.** Removing the SCXI Module Cover

1. Ground yourself via a grounding strap or a ground connected to your SCXI chassis. Properly grounding yourself prevents damage to your SCXI module from electrostatic discharge.
2. Remove the grounding screw from the top cover.
3. Snap out the top cover of the shield by placing a screwdriver in the groove at the bottom of the module and pushing down.
4. Remove the rear panel by unscrewing the two remaining screws.
5. Slide the module out of its enclosure.
6. Bend and trim the resistor lead as shown in Figure C-2. Be sure that the resistor does not extend more than 0.5 in. above the surface of the circuit board and that the leads do not protrude through the bottom of the board by more than 0.060 in.



**Figure C-2.** Bent and Trimmed Resistor

7. Insert the resistor into the appropriate socket, labeled RCLx.
8. Solder the leads to the pad on the bottom side of the module.
9. Slide the module back into its enclosure.
10. Install the hex bracket screw.
11. Install the rear panel.
12. Install the top cover and grounding screw.

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# SCXI-1127/1128

## Front Connector

This appendix contains connector diagrams for the SCXI-1127/1128 switch cards. The diagrams also show the signal names that are used when the modules are in 2-wire mode, 1-wire mode, 4-wire mode, and  $4 \times 8$  matrix configuration.

When you connect a custom terminal block or cable it is important that you incorporate the safety interlock scheme into the terminal block/cable. You do this by connecting the +5 V (ISO)\_HVAB\_EN signal to the +5 V (ISO) signal. These signals are shown in the following figures. Refer to Table D-1 for descriptions of signal names.

Pin Number	Signal Name	Column A	Column B	Column C	Signal Name
32	CH2+	○	○	○	CH0-
31	CH2-	○	○	○	CH0+
30	CH5+	○	○	○	CH1-
29	CH5-	○	○	○	CH1+
28	CH8+	○	○	○	CH3-
27	CH8-	○	○	○	CH3+
26	CH11+	○	○	○	CH4-
25	CH11-	○	○	○	CH4+
24	CH14+	○	○	○	CH6-
23	CH14-	○	○	○	CH6+
22	CH17+	○	○	○	CH7-
21	CH17-	○	○	○	CH7+
20	CH20+	○	○	○	CH9-
19	CH20-	○	○	○	CH9+
18	CH23+	○	○	○	CH10-
17	CH23-	○	○	○	CH10+
16	CH26+	○	○	○	CH12-
15	CH26-	○	○	○	CH12+
14	CH29+	○	○	○	CH13-
13	CH29-	○	○	○	CH13+
12	OUT0+	○	○	○	CH15-
11	OUT0-	○	○	○	CH15+
10	OUT3+	○	○	○	CH16-
9	OUT3-	○	○	○	CH16+
8	CJS0-	○	○	○	CH18-
7	+5 V (ISO)	○	○	○	CH18+
6	NC	○	○	○	CH19-
5	NC	○	○	○	CH19+
4	NC	○	○	○	CH21-
3	+5 V (Non-Isolated)	○	○	○	CH21+
2	GND (Non-Isolated)	○	○	○	CH22-
1	SCANADVD	○	○	○	CH22+
					CH24-
					CH24+
					CH25-
					CH25+
					CH27-
					CH27+
					CH28-
					CH28+
					CH30-
					CH30+
					CH31+
					CH31-
					OUT1-
					OUT1+
					OUT2-
					OUT2+
					CJS0-
					CJS0+
					1_WIRE_LO_REF
					+5 V (ISO)_HVAB_EN
					NC
					NC
					NC
					NC
					NC
					NC
					GND (Non-Isolated)
					NC
					GND (Non-Isolated)
					GND (Non-Isolated)
					EXT_TRIG_IN
					GND (Non-Isolated)

Figure D-1. SCXI-1127/1128 Front Connector Pin Assignments for 2-Wire Mode

Pin Number	Signal Name	Column A	Column B	Column C	Signal Name
32	CH2				CH32
31	CH34				CH0
30	CH5				CH33
29	CH37				CH1
28	CH8				CH35
27	CH40				CH3
26	CH11				CH36
25	CH43				CH4
24	CH14				CH38
23	CH46				CH6
22	CH17				CH39
21	CH49				CH7
20	CH20				CH41
19	CH52				CH9
18	CH23				CH42
17	CH55				CH10
16	CH26				CH44
15	CH58				CH12
14	CH29				CH45
13	CH61				CH13
12	OUT0+				CH47
11	OUT0-				CH15
10	OUT3+ (CH24-CH31)				CH48
9	OUT3- (CH56-CH63)				CH16
8	CJS-				CH50
7	+5 V (ISO)				CH18
6	NC				CH51
5	NC				CH19
4	NC				CH53
3	+5 V (Non-Isolated)				CH21
2	GND (Non-Isolated)				CH54
1	SCANADVD				CH22
					CH56
					CH24
					CH57
					CH25
					CH59
					CH27
					CH60
					CH28
					CH62
					CH30
					CH63
					CH31
					OUT1- (CH40-CH47)
					OUT1+ (CH8-CH15)
					OUT2- (CH48-CH55)
					OUT2+ (CH16-CH23)
					CJS-
					CJS+
					1_WIRE_LO_REF
					+5 V (ISO)_HVAB_EN
					NC
					NC
					NC
					NC
					GND (Non-Isolated)
					NC
					GND (Non-Isolated)
					NC
					GND (Non-Isolated)
					GND (Non-Isolated)
					EXT_TRIG_IN
					GND (Non-Isolated)

Figure D-2. SCXI-1127/1128 Front Connector Pin Assignments for 1-Wire Mode

Pin Number	Signal Name	Column A B C			Signal Name
32	CH2A+	○	○	○	CH0A-
31	CH2A-	○	○	○	CH0A+
30	CH5A+	○	○	○	CH1A-
29	CH5A-	○	○	○	CH1A+
28	CH8A+	○	○	○	CH3A-
27	CH8A-	○	○	○	CH3A+
26	CH11A+	○	○	○	CH4A-
25	CH11A-	○	○	○	CH4A+
24	CH14A+	○	○	○	CH6A-
23	CH14A-	○	○	○	CH6A+
22	CH1B+	○	○	○	CH7A-
21	CH1B-	○	○	○	CH7A+
20	CH4B+	○	○	○	CH9A-
19	CH4B-	○	○	○	CH9A+
18	CH7B+	○	○	○	CH10A-
17	CH7B-	○	○	○	CH10A+
16	CH10B+	○	○	○	CH12A-
15	CH10B-	○	○	○	CH12A+
14	CH13B+	○	○	○	CH13A-
13	CH13B-	○	○	○	CH13A+
12	OUT0A+	○	○	○	CH15A-
11	OUT0A-	○	○	○	CH15A+
10	OUT1B+	○	○	○	CH0B-
9	OUT1B-	○	○	○	CH0B+
8	CJS-	○	○	○	CH2B-
7	+5 V (ISO)	○	○	○	CH2B+
6	NC	○	○	○	CH3B-
5	NC	○	○	○	CH3B+
4	NC	○	○	○	CH5B-
3	+5 V (Non-Isolated)	○	○	○	CH5B+
2	GND (Non-Isolated)	○	○	○	CH6B-
1	SCANADVD	○	○	○	CH6B+
					CH8B-
					CH8B+
					CH9B-
					CH9B+
					CH11B-
					CH11B+
					CH12B-
					CH12B+
					CH14B-
					CH14B+
					CH15B-
					CH15B+
					OUT1A-
					OUT1A+
					OUT0B-
					OUT0B+
					CJS-
					CJS+
					1_WIRE_LO_REF
					+5 V (ISO)_HVAB_EN
					NC
					NC
					NC
					NC
					NC
					NC
					GND (Non-Isolated)
					NC
					GND (Non-Isolated)
					GND (Non-Isolated)
					GND (Non-Isolated)
					EXT_TRIG_IN
					GND (Non-Isolated)

Figure D-3. SCXI-1127/1128 Front Connector Pin Assignments for 4-Wire Mode



Pin Number	Signal Name	Column A	Column B	Column C	Signal Name
32	C2+	○	○	○	C0-
31	C2-	○	○	○	C0+
30	C5+	○	○	○	C1-
29	C5-	○	○	○	C1+
28	C0+	○	○	○	C3-
27	C0-	○	○	○	C3+
26	C3+	○	○	○	C4-
25	C3-	○	○	○	C4+
24	C6+	○	○	○	C6-
23	C6-	○	○	○	C6+
22	C1+	○	○	○	C7-
21	C1-	○	○	○	C7+
20	C4+	○	○	○	C0-
19	C4-	○	○	○	C0+
18	C7+	○	○	○	C2-
17	C7-	○	○	○	C2+
16	C2+	○	○	○	C3-
15	C2-	○	○	○	C3+
14	C5+	○	○	○	C5-
13	C5-	○	○	○	C5+
12	R0+	○	○	○	C7-
11	R0-	○	○	○	C7+
10	R3+	○	○	○	R1-
9	R3-	○	○	○	R1+
8	CJS-	○	○	○	R2-
7	+5 V (ISO)	○	○	○	R2+
6	NC	○	○	○	CJS-
5	NC	○	○	○	CJS+
4	NC	○	○	○	1_WIRE_LO_REF
3	+5 V (Non-Isolated)	○	○	○	+5 V (ISO)_HVAB_EN
2	GND (Non-Isolated)	○	○	○	NC
1	SCANADVD	○	○	○	NC

**Figure D-4.** SCXI-1127/1128 Front Connector Pin Assignments to Create an 4 × 8 Matrix

**Table D-1.** Front Connector Signal Description

Signal Name	Type	Description
+5 V(ISO)	Output	+5 VDC isolated source—Powers the temperature sensor on the terminal block
GND	Output	Ground
CJS±	Input	Cold-junction Temperature Sensor Input—Connects to the temperature sensor of the terminal block
1_WIRE_LO_REF	Input	The common reference signal used in one-wire mode
EXT_TRIG_IN	Input	External Trigger Input—Trigger from an instrument to advance the switch card to the next scan entry
SCANADVD	Output	Scanner Advanced—Trigger to an instrument that indicated the switch card has advanced to the next scan and relays are debounced
CH<0..63>± (1-wire) CH<0..31> ±(2-wire) CH<0..15>A± (4-wire excitation) CH<0..15>B± (4-wire sense)	Input/Output	Channels—Where signals are connected to the switch card. CHx+ and CHx– are switched together
OUT0± OUT<0..3> (2-wire) OUT<0..1>A± (4-wire excitation) OUT<0..1>B± (4-wire sense)	Input/Output	Common—The common for each bank
C<0..7>	Input/Output	Columns—Where signal are connected to the switch card. The card behaves as a matrix when proper external wiring is added
R<0..3>	Input/Output	Rows—Where signals are connected to the switch card. In matrix configuration any row can be connected to any column

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# Common Questions

This appendix addresses common questions you may have while using your SCXI-1127/1128 module.

## **How fast can I scan with the SCXI-1127/1128 module?**

The fastest scan rate for the SCXI-1127 is 100 scans/s, and the fastest scan rate for the SCXI-1128 is 1000 scans/s. Typically, when using a DMM to make accurate measurements, the DMM requires hundreds of milliseconds. Consequently, the DMM becomes the limiting factor in determining the scan rate.

## **What should I do if the software detects the module, but the switches do not switch?**

- Verify that the switches do not switch. Close your application program and then launch the soft front panel as described in the Set up and Test document you received with your kit. The soft front panel shows the state of each relay switch on the module. Try closing and opening the switches using the low level switch functions.
- Check the return codes of the NI-SWITCH operation to ensure that there are no errors (negative values) or warnings (positive values). You can also use the NI-Spy utility, which is installed with NI-SWITCH, to check for error codes.
- Finally, verify that your code is correct. For reference, see the examples described in the *NI-SWITCH Software User Manual*. NI-SWITCH also ships with several examples in source code. Compare your algorithm to the ones in the examples.

## **What should I do if scanning does not work in the handshaking mode with a third-party DMM?**

- Ensure that you have configured the SCXI-1127/1128 and the instrument to correctly route all the trigger lines. The output trigger of the instrument should connect to the trigger input of the SCXI-1127/1128. In addition, make sure the scanner advanced trigger of the SCXI-1127/1128 connects to the input trigger of the instrument.

- If you use the SCXI-1127/1128 to initiate the scan, make sure the DMM is waiting for a trigger before enabling scanning on the SCXI-1127/1128.
- If you use the DMM to initiate the scan, enable scanning on the SCXI-1127/1128 before configuring the DMM to start taking measurements. This is the recommended method for scanning.
- Be sure to check the return codes of the NI-SWITCH operation to ensure that there are no errors (negative values) or warnings (positive values). You can also use the NI-Spy utility, which is installed with NI-SWITCH, to check for error codes.
- Verify that your code is correct. For reference, see the examples described in the *NI-SWITCH Software User Manual*. NI-SWITCH also ships with several examples in source code. Compare your algorithm to the ones in the examples.

### **Do I need to program the SCXI-1127/1128 myself?**

The SCXI-1127/1128 comes with the NI-SWITCH driver software that exports the full functionality of the module. NI-SWITCH handles the complex issues of register writes to the module and operating system interfacing.

### **Can I plug a non SCXI-1127/1128 module into a slot that has a high-voltage analog backplane?**

Yes. You can plug in a module that does not support the HVAB. The non-SCXI-1127/1128 module does not connect to the HVAB or the digital communication lines on the HVAB backplane adapter.

### **Must I install the complete high-voltage analog backplane?**

No. You do not have to install the complete backplane. There may be instances where it is necessary for a non SCXI-1127/1128 module to communicate to a device using a different backplane adapter. For example, using a separate digital module in parallel mode. In this case, you can remove that segment of the HVAB although it is important that you do not remove the section of the HVAB that is controlling the chassis.

### **Can I use the HVAB for matrix expansion?**

Yes. You can use the HVAB backplane to connect the matrix rows together. For example you can create a  $8 \times 16$  matrix in a 4-slot chassis. First install four SCXI-1127/1128s into the chassis. Now you have four independent  $4 \times 8$  matrices. Now if you install the 2-slot HVAB-backplane adapter

behind slots 3 and 4 you have connected the rows between slot 3 and 4 which creates a  $4 \times 16$  matrix. Now install the two 1-slot adapters behind slots 1 and 2. Connect the two 1-slot adapters together with an 8-position HVAB plug. Do not connect the 2-slot HVAB-backplane adapter to the 1-slot adapters as this would create a  $4 \times 32$  matrix. You now have created two independent  $4 \times 16$  matrices. Finally, to create a  $8 \times 16$  matrix you must connect the 16 columns of each  $4 \times 16$  matrix through the SCXI-1332 terminal block by using either matrix expansion cables or by wiring the terminal blocks by hand.

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# Technical Support Resources

## Web Support

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National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of [ni.com](http://ni.com)

## NI Developer Zone

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The NI Developer Zone at [ni.com/zone](http://ni.com/zone) is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

## Customer Education

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National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of [ni.com](http://ni.com) for online course schedules, syllabi, training centers, and class registration.

## System Integration

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If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of [ni.com](http://ni.com)

## Worldwide Support

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National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of [ni.com](http://ni.com). Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

# Glossary

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Prefix	Meanings	Value
n-	nano-	$10^{-9}$
$\mu$ -	micro-	$10^{-6}$
m-	milli-	$10^{-3}$
k-	kilo-	$10^3$
M-	mega-	$10^6$
G-	giga-	$10^9$

## Symbols

°	degrees
$\Omega$	ohms
%	percent
$\pm$	plus or minus

## A

A	amperes
AC	alternating current
ADE	application development environment
ANSI	American National Standards Institute

## B

bus	the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the ISA and PCI bus.
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## C

C	Celsius
channel	pin or wire lead on the multiplexer to which you apply or from which you read the analog or digital signal. Signals can be single-ended or differential.
CJS	cold junction sensor
cold-junction compensation	a method of compensating for inaccuracies in thermocouple circuits
contact bounce	the intermittent switching that occurs when the movable metal parts of a relay make or break contact

## D

DC	direct current
debounced	indicates when the contact bounce has ended. <i>See</i> contact bounce.
device	a plug-in board, card, or pad that can contain multiple channels and conversion devices. Some examples of devices are computers, multimeters, multiplexers, oscillators, operator interfaces, and counters.
digital multimeter	a multifunction meter used to make measurements such as voltage, current, resistance frequency, temperature, and so on
DMA	direct memory access—a method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.
DMM	<i>See</i> digital multimeter.
drivers/driver software	software that controls a specific hardware device such as a switch card

## E

external trigger	a voltage pulse from an external source that triggers an event such as A/D conversion
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## H

handshaking	the use of two trigger lines between two instruments, such as a switch and a DMM, to synchronize their actions
hardware-timed scanning	the measurement instrument communicates via digital trigger signals
HVAB	high-voltage analog bus
Hz	hertz—the number of scans read or updates written per second

## I

in.	inches
I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces

## M

MB	megabytes of memory
matrix	superset of multiplexer; consists of connected rows and columns that allows for a direct connection from any row to any column
multiplexer	a switching device with multiple inputs that sequentially connects each of its inputs to its output, typically at high speeds, in order to measure several signals with a single analog input channel

## N

NI-SWITCH	an IVI-based instrument driver that supports the National Instruments line of switch cards
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## P

PXI	PCI with extensions for instrumentation
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## R

random scanning	scanning the channels in a mux in any order
relay	a switch that connects or disconnects the signal to a common through the physical movement of a metal arm
RMA	Return Material Authorization
rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RTD	resistance temperature detector—a metallic probe that measures temperature based upon its coefficient of resistivity

## S

s	seconds
scan	the data acquisition of signals connected to multiple channels of a multiplexer. Typically, the measurement device uses a trigger to advance the multiplexer to the next channel in the scan.
SCANADVD	scanner advance signal—in handshake scanning this signal is generated by the switching module to let the instrument or DMM know that the switching module has finished settling at the current channel
scan list	a list of channels supplied to NI-SWITCH that indicates the order in which channels will be scanned
scanner advanced trigger	the trigger generated by the switch card when scanning. The trigger occurs after the switch card has closed a switch and the switch has settled.
SCXI	Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ boards in the noisy PC environment
sensor	a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal
settling time	the amount of time required for a voltage to reach its final value within specified limits

soft front panel	a graphical program included with NI-SWITCH that you can use to interactively control the switch
software scanning	a method by which channels are selected through the software
synchronous scanning	hardware-timed scanning uses one triggering signal to advance the multiplexer to the next channel in the scan

## T

TBX	Terminal Block eXtension
terminal block	an accessory containing wire connection points, typically screw terminals
thermistor	a semiconductor sensor that exhibits a repeatable change in electrical resistance as a function of temperature. Most thermistors exhibit a negative temperature coefficient.
thermocouple	a temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature.
trigger	any event that causes or starts some form of data capture
TTL	Transistor-Transistor Logic

## V

V	volts
VDC	volts, direct current
VI	virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program
VMC	voltmeter complete signal—during synchronous or handshake scanning with an external DMM, this signal advances the switching module to the next channel. It is called External Trigger In (EXT_TRIG_IN) on the SCXI-1331 terminal block.

## **W**

W	watts
wire	data path between nodes

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