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SCXI™

SCXI-1502 User Manual

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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, AO <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. When this icon is marked on the product, refer to the *Read Me First: Safety and Radio-Frequency Interference* document, shipped with the product, for precautions to take.

 — When symbol is marked on a product it denotes a warning advising you to take precautions to avoid electrical shock.

 — When symbol is marked on a product it denotes a component that may be hot. Touching this component may result in bodily injury.

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

italic — Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text 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.

`monospace bold` — Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

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About the SCXI-1502

This chapter introduces the SCXI-1502 module, and explains how to install and remove the software and hardware.

The SCXI-1502 modules are for signal conditioning of thermocouples, low-bandwidth volt and millivolt sources, 4 to 20 mA current sources, and 0 to 20 mA process-current sources. When used with the SCXI-1581 precision current source module, you can use the SCXI-1502 to measure RTDs and thermistors. The SCXI-1502 has 32 differential analog input channels and one cold-junction sensor channel. Each channel also has an amplifier with a selectable gain of 1 or 100. Each channel of the SCXI-1502 has a lowpass filter with a 5 Hz cutoff frequency to reject 50/60 Hz noise.

The SCXI-1502 can programmatically connect each input to ground, which greatly improves its accuracy by enabling input offset voltage self-calibration of each input to reduce offset drift errors.

You can multiplex several SCXI-1502 modules and other SCXI modules into a single channel on the DAQ device, greatly increasing the number of analog input signals that you can digitize.

Detailed specifications of the SCXI-1502 modules are listed in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use the SCXI-1502 module, you need the following:

- ❑ Hardware
  - – SCXI-1502 module
  - – One of the following terminal blocks:
    - • SCXI-1300
    - • SCXI-1303
    - • SCXI-1308
    - • SCXI-1310
    - • TC-2095

    - TBX-1303
    - TBX-96
  - An SCXI chassis or PXI/SCXI combination chassis
  - One of the following:
    - E/M Series DAQ device
    - SCXI-1600
  - A computer if using an SCXI chassis
  - Cabling, cable adapter, and sensors as required for your application

- ❑ Software
  - NI-DAQ
  - One of the following software packages:
    - LabVIEW
    - Measurement Studio
    - LabWindows™/CVI™

- ❑ Documentation
  - *Read Me First: Safety and Radio-Frequency Interference*
  - *DAQ Getting Started Guide*
  - *SCXI Quick Start Guide*
  - *SCXI-1502 User Manual*
  - Terminal block installation guide for your application
  - Documentation for your software

You can download NI documents from `ni.com/manuals`. To download the latest version of NI-DAQ, click **Download Software** at `ni.com`.

National Instruments Documentation

The SCXI-1502 User Manual is one piece of the documentation set for data acquisition (DAQ) systems. You could have any of several types of manuals depending on the hardware and software in the system. Use the manuals you have as follows:

- SCXI chassis or PXI/SCXI combination chassis manual—Read this manual for maintenance information on the chassis and for installation instructions.
- The *DAQ Getting Started Guide*—This document has information on installing NI-DAQ and the E/M Series DAQ device. Install these before you install the SCXI module.
- The *SCXI Quick Start Guide*—This document contains a quick overview for setting up an SCXI chassis, installing SCXI modules and terminal blocks, and attaching sensors. It also describes setting up the SCXI system in MAX.
- The SCXI hardware user manuals—Read these manuals next for detailed information about signal connections and module configuration. They also explain, in greater detail, how the module works and contain application hints.
- Accessory installation guides or manuals—Read the terminal block and cable assembly installation guides. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making the connections.
- The E/M Series DAQ device documentation—This documentation has detailed information about the E/M Series DAQ device that plugs into or is connected to the computer. Use this documentation for hardware installation and configuration instructions, specification information about the E/M Series DAQ device, and application hints.
- Software documentation—You may have both application software and NI-DAQ software documentation. NI application software includes LabVIEW, LabWindows/CVI, and Measurement Studio. After you set up the hardware system, use either your application software documentation or the NI-DAQ documentation to help you write your application. If you have a large, complex system, it is worthwhile to look through the software documentation before you configure the hardware.
- The following help file for software information:
  - **Start»Programs»National Instruments»NI-DAQ» NI-DAQmx Help**

Installing Application Software, NI-DAQ, and the DAQ Device

Refer to the *DAQ Getting Started Guide* packaged with the NI-DAQ software to install your application software, NI-DAQ driver software, and the E/M Series DAQ device to which you will connect the SCXI-1502. NI-DAQ 8.1 or later is required to configure and program the SCXI-1502 module. If you do not have NI-DAQ 8.1 or later, you can either contact a NI sales representative to request it on a CD or download the latest NI-DAQ version from `ni.com`.

Note Refer to the *Read Me First: Safety and Radio-Frequency Interference* document before removing equipment covers or connecting or disconnecting any signal wires.

Installing the SCXI-1502 into an SCXI Chassis or a PXI/SCXI Combination Chassis

Refer to the *SCXI Quick Start Guide* to install the SCXI-1502 module.

Installing the Terminal Block

Table 1-1 shows the supported SCXI-1502 terminal blocks. Refer to the *SCXI Quick Start Guide* and the terminal block installation guide for more information about the terminal block.

Table 1-1. Supported SCXI-1502 Terminal Blocks

Terminal Block	CJC Sensor	Measurement Type
SCXI-1303	Yes	Thermocouple measurements
TBX-1303	Yes	
TC-2095	Yes	
SCXI-1300	Yes	Voltage, RTD
TBX-96	No	
SCXI-1310	No	
SCXI-1308	No	Current

Verifying the SCXI-1502 Installation in Software

Refer to the *SCXI Quick Start Guide* for information on verifying the SCXI installation.

Installing SCXI Chassis and Modules in Software

Refer to the *SCXI Quick Start Guide* for information on installing chassis and modules using NI-DAQmx in software.

Troubleshooting the Self-Test Verification

If the self-test verification did not verify the chassis configuration, complete the steps in this section to troubleshoot the SCXI configuration.

Troubleshooting in NI-DAQmx

- If you get a **Verify SCXI Chassis** message box showing the SCXI chassis model number, **Chassis ID: *x***, and one or more messages stating **Slot Number: *x* Configuration has module: SCXI-*XXXX*** or **1502, hardware in chassis is: Empty**, take the following troubleshooting actions:
  - Make sure the SCXI chassis is powered on.
  - Make sure all SCXI modules are properly installed in the chassis. Refer to the *SCXI Quick Start Guide* for proper installation instructions.
  - Make sure the cable between the SCXI chassis and E/M Series DAQ device is properly connected.
  - Inspect the cable connectors for bent pins.
  - Make sure you are using the correct NI cable assembly.
  - Test the E/M Series DAQ device to verify it is working properly. Refer to the E/M Series DAQ device help file for more information.

- If you get a **Verify SCXI Chassis** message box showing the SCXI chassis model number, **Chassis ID: *x***, and the message **Slot Number: *x* Configuration has module: SCXI-*XXXX*** or **1502, hardware in chassis is: SCXI-*YYYY***, **1502**, or **Empty**, complete the following troubleshooting steps to correct the error.
  1. Expand **NI-DAQmx Devices**.
  2. Right-click the SCXI chassis and click **Properties** to load the chassis configurator.
  3. Under the **Modules** tab, ensure that the cabled module is listed in the correct slot.
  4. If the cabled module is not listed in the correct slot, complete the following troubleshooting steps:
     a. If the cabled module is not listed in the correct slot and the slot is empty, click the drop-down listbox next to the correct slot and select the cabled module. Configure the cabled module following the steps listed in the *SCXI Quick Start Guide*. Click **OK**.
     b. If another module appears where the cabled module should be, click the drop-down listbox next to the correct slot and select the cabled module. A message box appears asking you to confirm the module replacement. Click **OK**. Configure the cabled module following the steps listed in the *SCXI Quick Start Guide*. Click **OK**.
- If you have more than one kind of SCXI module in the SCXI chassis, ensure that you have the highest priority SCXI module cabled to the E/M Series DAQ device. Refer to the *SCXI Quick Start Guide* to find out which SCXI module in the chassis should be cabled to the E/M Series DAQ device.
- After checking the preceding items, return to the *Troubleshooting the Self-Test Verification* section and retest the SCXI chassis.

If these measures do not successfully configure the SCXI system, contact NI. Refer to the *Technical Support Information* document for contact information.

2

Connecting the Signals

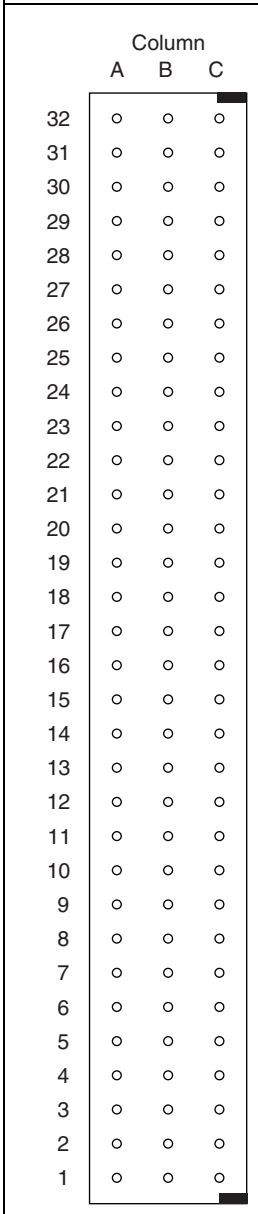
This chapter describes the input and output signal connections to the SCXI-1502 module with the module front connector and rear signal connector. This chapter also includes connection instructions for the signals on the SCXI-1502 module connectors.

Refer to the installation guide of the terminal block for detailed information regarding connecting the signals. If you are using a custom cable or connector block, refer to the *Front Connector* section.

Front Connector

Table 2-1 shows the pin assignments for the SCXI-1502 module front connector.

Table 2-1. SCXI-1502 Front Signal Pin Assignments

Front Connector Diagram	Pin Number	Column A	Column B	Column C
	32	GND	CH 0 –	CH 0 +
	31	GND	CH 1 –	CH 1 +
	30	GND	CH 2 –	CH 2 +
	29	GND	CH 3 –	CH 3 +
	28	RSVD	CH 4 –	CH 4 +
	27	RSVD	CH 5 –	CH 5 +
	26	RSVD	CH 6 –	CH 6 +
	25	RSVD	CH 7 –	CH 7 +
	24	GND	CH 8 –	CH 8 +
	23	GND	CH 9 –	CH 9 +
	22	GND	CH 10 –	CH 10 +
	21	GND	CH 11 –	CH 11 +
	20	RSVD	CH 12–	CH 12 +
	19	RSVD	CH 13 –	CH 13 +
	18	NC	CH 14 –	CH 14 +
	17	NC	CH 15 –	CH 15 +
	16	GND	CH 16 –	CH 16 +
	15	GND	CH 17 –	CH 17 +
	14	GND	CH 18 –	CH 18 +
	13	GND	CH 19 –	CH 19 +
	12	NC	CH 20 –	CH 20 +
	11	NC	CH 21 –	CH 21 +
	10	NC	CH 22 –	CH 22 +
	9	NC	CH 23 –	CH 23 +
	8	GND	CH 24 –	CH 24 +
	7	GND	CH 25 –	CH 25 +
	6	GND	CH 26 –	CH 26 +
	5	GND	CH 27 –	CH 27 +
	4	CJ SENSOR	CH 28 –	CH 28 +
	3	CJ SENSOR	CH 29 –	CH 29 +
	2	GND	CH 30 –	CH 30 +
	1	+5 V	CH 31 –	CH 31 +

NC—No Connection
RSVD—Reserved

Front Connector Signal Descriptions

Table 2-2. Front Connector Signals

Pin	Signal Name	Description
A1	+5 V	+5 VDC Source—Used to power circuitry on the terminal block. 0.1 mA of source not protected.
A2, A5, A16, A24, A32	GND	Ground—Tied to the SCXI module ground.
A3, A4	CJ SENSOR	Cold-Junction Temperature Sensor Input—Connects to the temperature sensor of the terminal block.
B1–B32	CH 31 – through CH 0 –	Negative Input Channels—Negative side of differential input channels.
C1–C32	CH 31 + through CH 0 +	Positive Input Channels 31 through 0—Positive side of differential input channels.
A19, A20, A25 to A28	RSVD	Reserved—Reserved for use by the SCXI-1502.

Analog Input Signal Connections

The signal terminals for the negative input channel are located in column B of the connector. The signal terminal for each corresponding positive input channel is located in column C of the connector. Each input goes to a separate filter and amplifier that is multiplexed to the module output buffer. If the terminal block has a temperature sensor, the sensor output—connected to pins A3 and/or A4 (CJ SENSOR)—is also filtered and multiplexed to the module output buffer.

The differential input signal range of an SCXI-1502 module input channel is ±10 V when using a gain of 1 or ±0.1 V when using a gain of 100. This differential input range is the maximum measurable voltage difference between the positive and negative channel inputs. The common-mode input signal range of an SCXI-1502 module input channel is ±10 V. This common-mode input range for either positive or negative channel input is the maximum input voltage that results in a valid measurement. Each channel includes input protection circuitry to withstand the accidental application of voltages up to ±42 VDC powered on or ±25 VDC powered off.

Caution Exceeding the input damage level (±42 VDC powered on or ±25 VDC powered off between input channels and chassis ground) can damage the SCXI-1502 module, the SCXIbus, and the DAQ device. NI is *not* liable for any injuries resulting from such signal connections.

Note Exceeding the differential or common-mode input channel ranges results in a distorted signal measurement, and can also increase the settling time requirement of the connected E/M Series DAQ device.

Ground-Referencing the Signals

The input signals can be either ground-referenced, as shown in Figure 2-1, or floating, as shown in Figure 2-2. Before you connect the thermocouple or any other signal, determine whether it is floating or ground-referenced. If it is a floating signal, you must ground-reference the signal in one of two ways. You can connect the negative channel input to chassis ground through a bias resistor as shown in Figure 2-2 or you can use the bias resistors that are included with some terminal blocks such as the SCXI-1303. The SCXI-1303 also has a resistor pack for pulling up the positive inputs for open-thermocouple detection. Consult the installation guide of your terminal block for details.

Do not ground signals that are already ground-referenced; doing so results in a ground loop, which can adversely affect the measurement accuracy. Directly grounding floating signals to the chassis ground without using a bias resistor is not recommended as this can result in noisy readings.

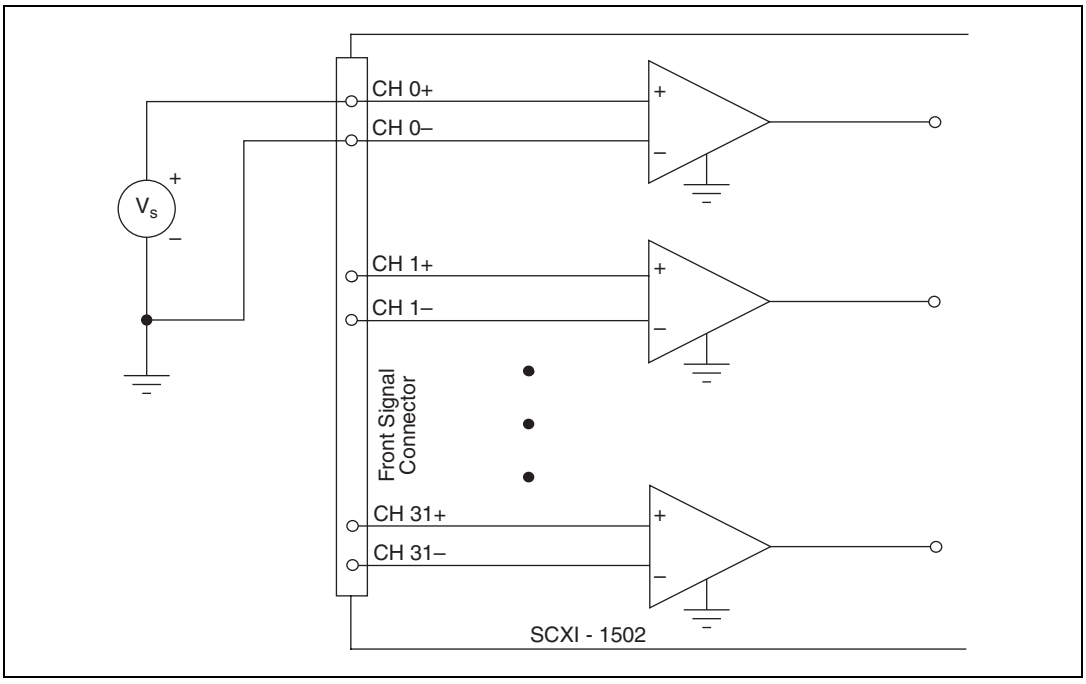


Figure 2-1. Ground-Referenced Signal Connection

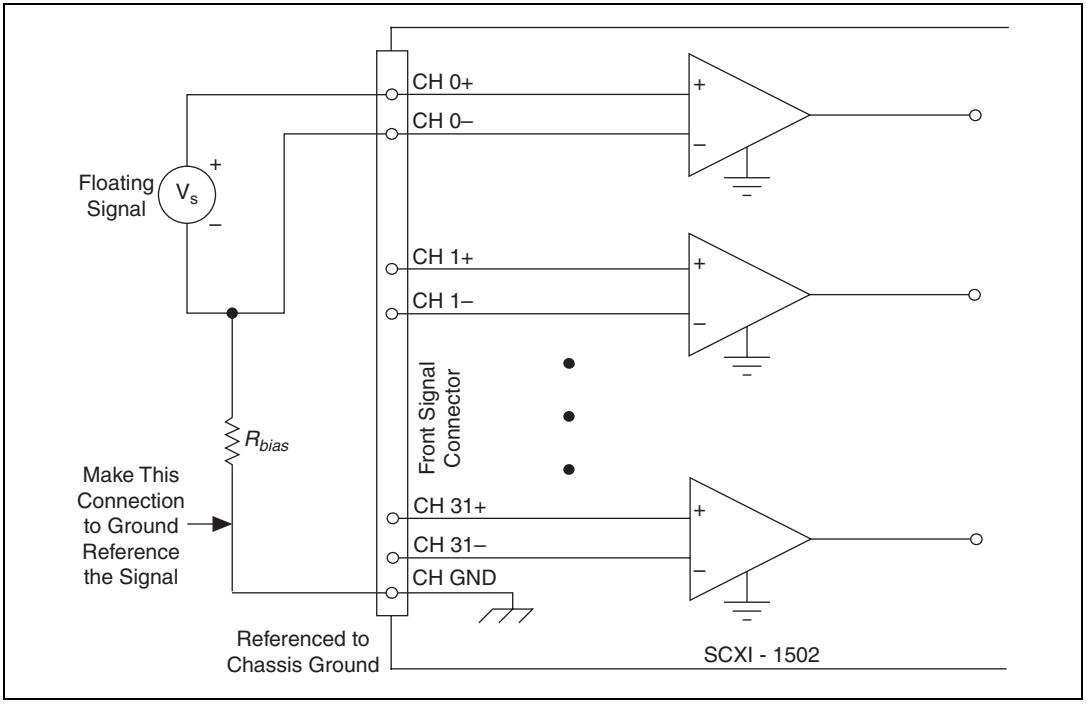


Figure 2-2. Floating Signal Connection Referenced to Chassis Ground

Cold-Junction Sensor Connection

Pins A3 and A4 (CJ SENSOR) connect the temperature sensor located on the terminal block to the SCXI-1502 module. Refer to the installation guide of the terminal block, to determine if it has a CJC sensor. The CJ SENSOR signal is measured relative to CH GND. Pins A3 and A4 are connected within the SCXI-1502 module so the position of the *MTEMP/DTEMP* jumper on the SCXI-1300 or SCXI-1303 does *not* matter. The input is overvoltage-protected to ±15 VDC with power on and off.

Caution Exceeding the overvoltage protection on the CJ SENSOR input can damage the SCXI-1502 module, the SCXIbus, and the DAQ device. NI is *not* liable for any damages or injuries resulting from such signal connections.

Rear Signal Connector

Table 2-3 shows the SCXI-1502 module rear signal connector pin assignments.

Table 2-3. Rear Signal Pin Assignments

Rear Connector Diagram	Signal Name	Pin Number	Pin Number	Signal Name
 NC—No Connection	AI GND	1	2	AI GND
	CH 0 +	3	4	CH 0 –
	NC	5	6	NC
	NC	7	8	NC
	NC	9	10	NC
	NC	11	12	NC
	NC	13	14	NC
	NC	15	16	NC
	NC	17	18	NC
	OUT REF	19	20	NC
	NC	21	22	NC
	NC	23	24	D GND
	SER DAT IN	25	26	SER DAT OUT
	DAQ D*/A	27	28	NC
	SLOT 0 SEL*	29	30	NC
	D GND	31	32	NC
	NC	33	34	NC
	NC	35	36	AI HOLD COMP, AI HOLD
	SER CLK	37	38	NC
	NC	39	40	NC
	NC	41	42	NC
	RSVD	43	44	NC
	NC	45	46	RSVD
	NC	47	48	NC
	NC	49	50	NC

Rear Signal Connector Descriptions

The rear signal connector on the cabled module is the interface between the DAQ device and all modules in the SCXI chassis. CH 0 is used to differentially multiplex all 32 channels, the CJ sensor, and analog signals from the modules to the connected DAQ device.

The analog and communication signals between the DAQ device and the SCXI system are listed in Table 2-4. If the DAQ device is connected to the SCXI-1502, the digital lines are unavailable for general-purpose digital I/O.

Table 2-4. SCXI-1502 Rear Connector Signals

Pin	SCXI Signal Name	NI-DAQmx Device Signal Name	Direction	Description
1, 2	AI GND	AI GND	—	Analog input ground—connects to the analog input ground of the DAQ device.
3	CH 0 +	CH 0 +	Input	Channel 0 positive—used to differentially multiplex all 32 channels, the CJ sensor, and analog signals from the modules to the connected DAQ device.
4	CH 0 –	CH 0 –	Input	Channel 0 negative—used to differentially multiplex all 32 channels, the CJ sensor, and analog signals from the modules to the connected DAQ device.
24, 33	DIG GND	D GND	—	Digital ground—these pins supply the reference for E/M Series DAQ device digital signals and are connected to the module digital ground.
25	SER DAT IN	P0.0	Input	Serial data in—this signal taps into the SCXIbus MOSI line to send serial input data to a module or Slot 0.

Table 2-4. SCXI-1502 Rear Connector Signals (Continued)

Pin	SCXI Signal Name	NI-DAQmx Device Signal Name	Direction	Description
26	SER DAT OUT	P0.4	Output	Serial data out—this signal taps into the SCXIbus MISO line to accept serial output data from a module.
27	DAQ D*/A	P0.1	Input	Board data/address line—this signal taps into the SCXIbus D*/A line to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	P0.2	Input	Slot 0 select—this signal taps into the SCXIbus INTR* line to indicate whether the information on MOSI is being sent to a module or Slot 0.
36	SCANCLK	AI HOLD COMP, AI HOLD	Input	Scan clock—a rising edge indicates to the scanned SCXI module that the E/M Series DAQ device has taken a sample and causes the module to advance channels.
37	SER CLK	EXTSTROBE*	Input	Serial clock—this signal taps into the SCXIbus SPICLK line to clock the data on the MOSI and MISO lines.
43, 46	RSVD	RSVD	Input	Reserved.
Note: All other pins are not connected.				

Connecting Thermocouples

Refer to the terminal block installation guide, such as the SCXI-1303, for information about connecting thermocouples. NI recommends using an isothermal terminal block, such as the SCXI-1303, for accurate thermocouple measurements.

Connecting RTDs

Refer to the *SCXI-1581 User Manual* for information about connecting RTDs and for additional RTD theory.

Connecting a Current-Loop Receiver

Measuring current with an SCXI-1502 requires a precision current-sense resistor to convert the current into a voltage. Refer to the *SCXI-1308 32-Channel Current Input Installation Guide* for more information.

3

Configuring and Testing

This chapter discusses configuring the SCXI-1502 in MAX using NI-DAQmx, creating and testing a virtual channel, global channel, and/or task.

Notes You must have NI-DAQmx 8.1 or later installed.

Refer to the *SCXI Quick Start Guide* if you have not already configured the chassis.

SCXI-1502 Software-Configurable Settings

This section describes how to set the gain/input signal range and how to configure your software for compatible sensor types. It also describes how to perform configuration of these settings for the SCXI-1502 in NI-DAQmx. For more information on the relationship between the settings and the measurements and how to configure settings in your application, refer to Chapter 4, *Theory of Operation*.

Common Software-Configurable Settings

This section describes the most frequently used software-configurable settings for the SCXI-1502. Refer to Chapter 4, *Theory of Operation*, for a complete list of software-configurable settings.

Gain/Input Range

Gain/input range is a software-configurable setting that allows you to choose the appropriate amplification to fully utilize the range of the E/M Series DAQ device. In most applications NI-DAQ chooses and sets the gain for you determined by the input range. This feature is described in Chapter 4, *Theory of Operation*. Otherwise, you should determine the appropriate gain using the input signal voltage range and the full-scale limits of the SCXI-1502 output. You can select a gain of 1 or 100 on a per channel basis.

Input Selection

The front end of the SCXI-1502 includes a software configurable switch that allows you to programmatically connect the input channels of the SCXI-1502 to either the front connector or internal ground. Refer to Table 5-1, *NI-DAQmx Voltage Measurement Properties* for details about the available input coupling modes supported by the SCXI-1502.

CJC Source/Value

When using a terminal block that has a CJ sensor for thermocouple measurements, you can set the CJC source as internal, which scans the sensor at the beginning of each measurement and scales the readings accordingly.

Auto-Zero

Setting the Auto-zero mode to *Once* improves the accuracy of the measurement. With auto-zero enabled, the inputs of the SCXI-1502 are internally grounded. The driver makes a measurement when the task begins and then subtracts the measured offset from all future measurements.

Configurable Settings in MAX

Note If you are not using an NI ADE, using an NI ADE prior to version 8.1, or are using an unlicensed copy of an NI ADE, additional dialog boxes from the NI License Manager appear allowing you to create a task or global channel in unlicensed mode. These messages continue to appear until you install version 8.1 or later of an NI ADE.

This section describes where you can access each software-configurable setting in MAX. The location of the settings varies depending on the version of NI-DAQmx you use. Refer to the *DAQ Getting Started Guide* and the *SCXI Quick Start Guide* for more information on installing and configuring the hardware. You can use DAQ Assistant to graphically configure common measurement tasks, channels, or scales.

NI-DAQmx

Using NI-DAQmx, you can configure software settings such as sensor type and gain/input signal range in the following ways:

- Task or global channel in MAX
- Functions in your application

Note All software-configurable settings are not configurable both ways. This section only discusses settings in MAX. Refer to Chapter 4, *Theory of Operation*, for information on using functions in your application.

Dependent upon the terminal block in use, you can use the SCXI-1502 module to make the following types of measurements:

- Voltage input
- Thermocouple
- RTD
- Thermistors
- Current input

Creating a Global Channel or Task

To create a new voltage, temperature, or current input NI-DAQmx global task or channel, complete the following steps:

1. Double-click **Measurement & Automation** on the desktop.
2. Right-click **Data Neighborhood** and select **Create New**.
3. Select **NI-DAQmx Task** or **NI-DAQmx Global Channel**, and click **Next**.
4. Select **Analog Input**.
5. Select one of the following:
   - **Voltage**
   - **Temperature** and then select one of the following:
     - **Iex Thermistor**
     - **RTD**
     - **Thermocouple**
     - **Vex Thermistor**
   - **Current**
6. If you are creating a task, you can select a range of channels by holding down the <Shift> key while selecting the channels. You can select multiple individual channels by holding down the <Ctrl> key while selecting channels. If you are creating a channel, you can only select one channel. Click **Next**.
7. Name the task or channel and click **Finish**.

8. Select the channel(s) you want to configure. You can select a range of channels by holding down the <Shift> key while selecting the channels. You can select multiple individual channels by holding down the <Ctrl> key while selecting channels.

Note If you want to add channels of various measurement types to the same task, click the **Add Channels** button to select the measurement type for the additional channels.

9. Enter the specific values for your application in the **Settings** tab. Context help information for each setting is provided on the right side of the screen. Configure the input signal range using either **NI-DAQmx Task** or **NI-DAQmx Global Channel**. When you set the minimum and maximum range of **NI-DAQmx Task** or **NI-DAQmx Global Channel**, the driver selects the best gain for the measurement. You also can set it through your application. Refer to Chapter 3, *Configuring and Testing*, for more information.
10. If you are creating a task and want to set timing or triggering controls, enter the values in the **Task Timing** and **Task Triggering** tabs.
11. Click **Device** and select **Auto Zero** mode if desired.

Verifying the Signal

This section describes how to take measurements using test panels in order to verify signal, and configuring and installing a system in NI-DAQmx.

Verifying the Signal in NI-DAQmx Using a Task or Global Channel

You can verify the signals on the SCXI-1502 using NI-DAQmx by completing the following steps:

1. Expand **Data Neighborhood**.
2. Expand **NI-DAQmx Tasks**.
3. Click the task you created in the *Creating a Global Channel or Task* section.
4. Select the channel(s) you want to verify. You can select a block of channels by holding down the <Shift> key or multiple channels by holding down the <Ctrl> key. Click **OK**.
5. Enter the appropriate information on the **Settings** and **Device** tab.
6. Click the **Test** button.

7. Click the **Start** button.
8. After you have completed verifying the channels, click the **Stop** button.

You have now verified the SCXI-1502 configuration and signal connection.



Note For more information on how to further configure the SCXI-1502, or how to use LabVIEW to configure the module and take measurements, refer to Chapter 4, *Theory of Operation*.

4

Theory of Operation

This section includes a brief overview and a detailed discussion of the circuit features of the module.

Refer to Figure 4-1 while reading this section.

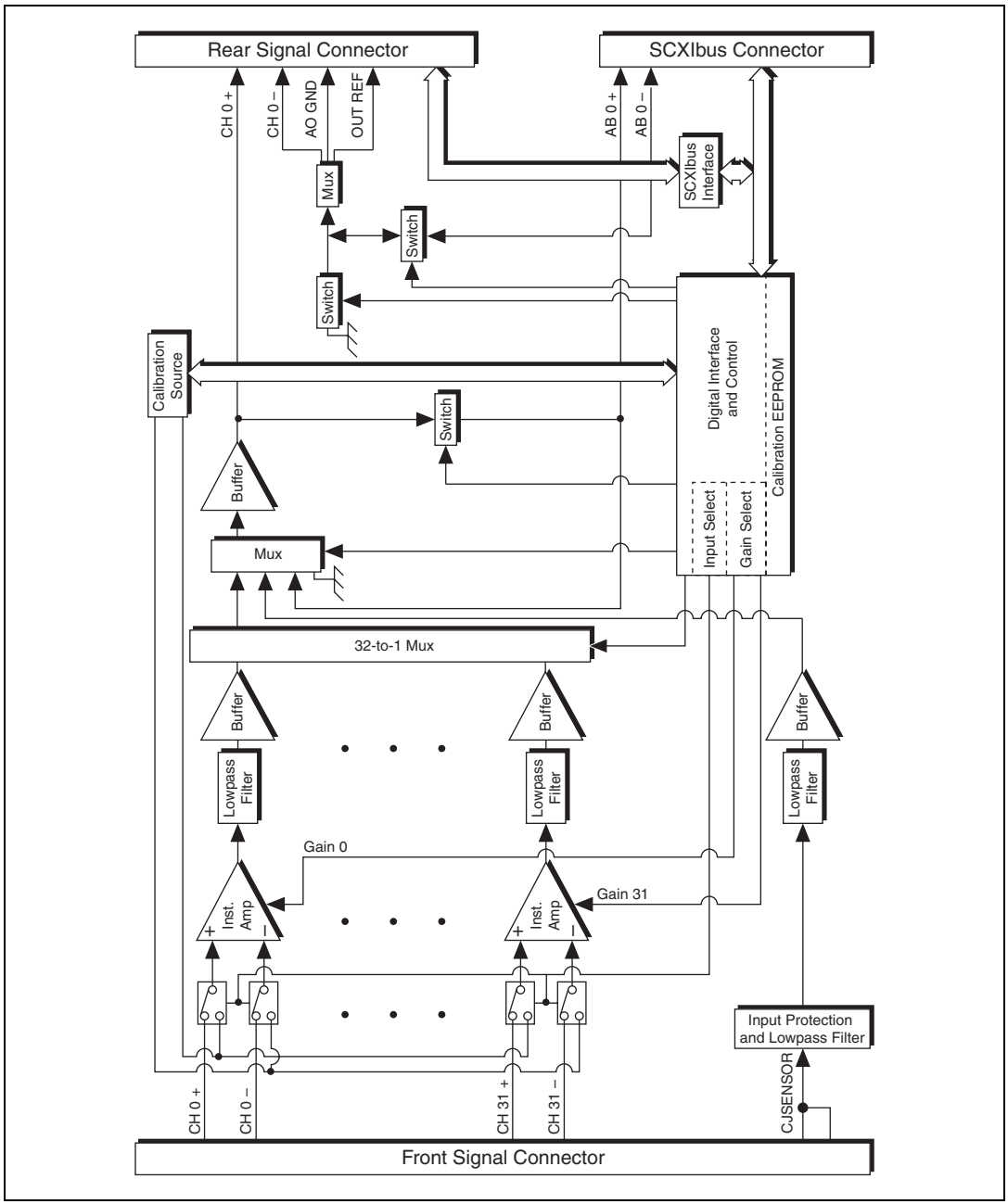


Figure 4-1. SCXI-1502 Module Block Diagram

The major components of the SCXI-1502 modules are as follows:

- Rear signal connector
- SCXIbus connector
- SCXIbus interface
- Digital control circuitry
- Analog circuitry

The SCXI-1502 modules consist of 32 multiplexed input channels, each with a software-programmable gain of 1 or 100. Each input channel has its own lowpass filter. The SCXI-1502 modules also have a digital section for automatic control of channel scanning, temperature sensor selection, gain selection, and auto-zero mode.

Rear Signal Connector, SCXIbus Connector, and SCXIbus Interface

The SCXIbus controls the SCXI-1502 module. The SCXIbus interface connects the rear signal connector to the SCXIbus, allowing a DAQ device to control the SCXI-1502 module and the rest of the chassis.

Digital Control Circuitry

The digital control circuitry consists of the Address Handler and registers that are necessary for identifying the module, reading/setting calibration information, setting the gain, and selecting the appropriate channel.

Analog Circuitry

The analog circuitry per channel consists of a lowpass filter and an amplifier with a software selectable gain of 1 or 100. The CJ SENSOR channel has a lowpass filter buffered by a unity gain amplifier. The channels and CJ SENSOR are multiplexed to a single output buffer.

Analog Input Channels

Each of the 32 differential analog input channels feeds to a separate instrumentation amplifier with a programmable gain of 1 or 100. Then the signal passes through a fixed 2-pole, 5 Hz lowpass filter.

The CJ SENSOR input channel is used to read the sensor temperature from the terminal blocks that have one, such as the SCXI-1300 and SCXI-1303. The temperature sensor is for cold-junction compensation of thermocouple measurements. The CJ SENSOR channel also passes through a 5 Hz lowpass filter to reject unwanted noise on the SCXI-1502. Along with the other 32 input channels, the CJ SENSOR is multiplexed to the output buffer, where it can be read by the DAQ device.

Theory of Multiplexed Operation

In multiplexed mode, all input channels of an SCXI module are multiplexed into a single analog input channel of the DAQ device. Multiplexed mode operation is ideal for high channel count systems. Multiplexed mode is typically used for performing scanning operations with the SCXI-1502. The power of SCXI multiplexed mode scanning is its ability to route many input channels to a single channel of the DAQ device.

The multiplexing operation of the analog input signals is performed entirely by multiplexers in the SCXI modules, not inside the DAQ device or SCXI chassis. In multiplexed mode the SCXI-1502 scanned channels are kept by the NI-DAQ driver in a scan list. Immediately prior to a multiplexed scanning operation, the SCXI chassis is programmed with a module scan list that controls which module sends its output to the SCXIbus during a scan through the cabled SCXI module.

The list can contain channels in any physical order and the multiplexer can sequence the channel selection from the scan list in any order. The ordering of scanned channels need not be sequential. Channels can occur multiple times in a single scan list. The scan list can contain an arbitrary number of channels for each module entry in the scan list, limited to a total of 512 channels per DAQ device. This is referred to as flexible scanning (random scanning). Not all SCXI modules provide flexible scanning.

The module includes first-in first-out (FIFO) memory for storing the channel scan list defined in your application code. NI-DAQ drivers load the FIFO based on the channel assignments you make in your application. You need not explicitly program the module FIFO as this is done automatically for you by the NI-DAQ driver.

When you configure a module for multiplexed mode operation, the routing of multiplexed signals to the DAQ device depends on which module in the SCXI system is cabled to the DAQ device. There are several possible scenarios for routing signals from the multiplexed modules to the DAQ device.

If the scanned SCXI-1502 module is not directly cabled to the DAQ device, the module sends its signals through the SCXIbus to the cabled module. The cabled module, whose routing is controlled by the SCXI chassis, routes the SCXIbus signals to the DAQ device through the AI 0 pin on its rear signal connector.

If the DAQ device scans the cabled module, the module routes its input signals through the AI 0 pin on its rear signal connector to a single channel on the DAQ device.

5

Using the SCXI-1502

This chapter makes suggestions for developing your application and provides basic information regarding calibration.

Developing Your Application in NI-DAQmx

Note If you are not using an NI ADE, using an NI ADE prior to version 8.1, or are using an unlicensed copy of an NI ADE, additional dialog boxes from the NI License Manager appear allowing you to create a task or global channel in unlicensed mode. These messages continue to appear until you install version 8.1 or later of an NI ADE.

This section describes how to configure and use NI-DAQmx to control the SCXI-1502 in LabVIEW, LabWindows/CVI, and Measurement Studio. These ADEs provide greater flexibility and access to more settings than MAX, but you can use ADEs in conjunction with MAX to quickly create a customized application.

Typical Program Flowchart

Figure 5-1 shows a typical program voltage measurement flowchart for creating a task to configure channels, take a measurement, analyze the data, present the data, stop the measurement, and clear the task.

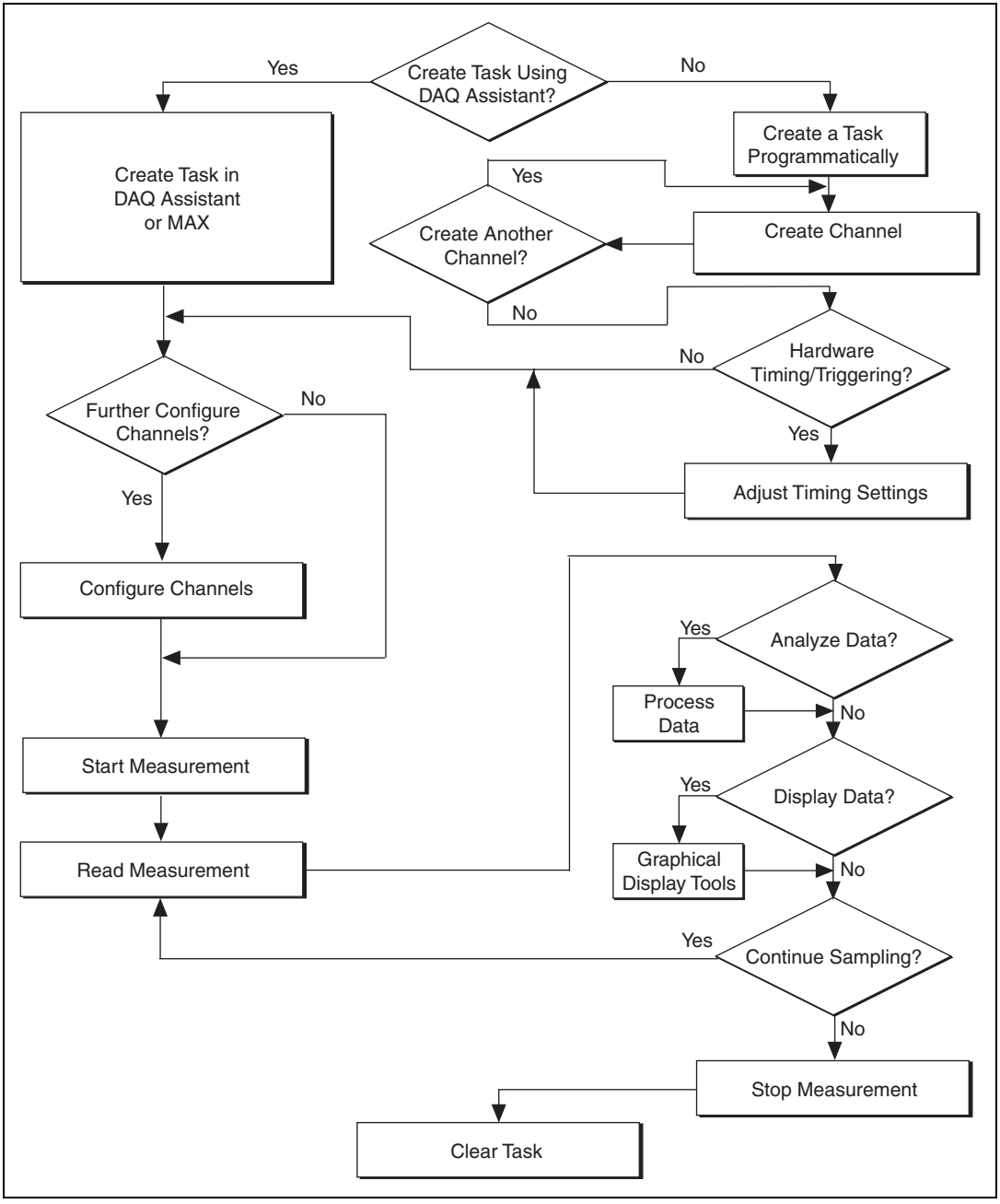


Figure 5-1. Typical Program Flowchart for Voltage Measurement Channels

General Discussion of Typical Flowchart

The following sections briefly discuss some considerations for a few of the steps in Figure 5-1. These sections are meant to give an overview of some of the options and features available when programming with NI-DAQmx.

Creating a Task Using DAQ Assistant or Programmatically

When creating an application, you must first decide whether to create the appropriate task using the DAQ Assistant or programmatically in the ADE.

Developing your application using DAQ Assistant gives you the ability to configure most settings such as measurement type, selection of channels, excitation voltage, signal input limits, task timing, and task triggering. You can access the DAQ Assistant through MAX or your NI ADE. Choosing to use the DAQ Assistant can simplify the development of your application. NI recommends creating tasks using the DAQ Assistant for ease of use, when using a sensor that requires complex scaling, or when many properties differ between channels in the same task.

If you are using an ADE other than an NI ADE, or if you want to explicitly create and configure a task for a certain type of acquisition, you can programmatically create the task from your ADE using functions or VIs. If you create a task using the DAQ Assistant, you can still further configure the individual properties of the task programmatically with functions or property nodes in your ADE. NI recommends creating a task programmatically if you need explicit control of programmatically adjustable properties of the DAQ system.

Programmatically adjusting properties for a task created in the DAQ Assistant overrides the original, or default, settings only for that session. The changes are not saved to the task configuration. The next time you load the task, the task uses the settings originally configured in the DAQ Assistant.

Adjusting Timing and Triggering

There are several timing properties that you can configure through the DAQ Assistant or programmatically using function calls or property nodes. If you create a task in the DAQ Assistant, you can still modify the timing properties of the task programmatically in your application.

When programmatically adjusting timing settings, you can set the task to acquire continuously, acquire a buffer of samples, or acquire one point at a

time. For continuous acquisition, you must use a while loop around the acquisition components even if you configured the task for continuous acquisition using MAX or the DAQ Assistant. For continuous and buffered acquisitions, you can set the acquisition rate and the number of samples to read in the DAQ Assistant or programmatically in your application. By default, the clock settings are automatically set by an internal clock based on the requested sample rate. You also can select advanced features such as clock settings that specify an external clock source, internal routing of the clock source, or select the active edge of the clock signal.

Configuring Channel Properties

All ADEs used to configure the SCXI-1502 access an underlying set of NI-DAQmx properties. Table 5-1 shows some of these properties. You can use Table 5-1 to determine what kind of properties you need to set to configure the module for your application. For a complete list of NI-DAQmx properties, refer to your ADE help file.

Note You cannot adjust some properties while a task is running. For these properties, you must stop the task, make the adjustment, and re-start the application. Tables 5-1 through 5-4 assume all properties are configured before the task is started.

Table 5-1. NI-DAQmx Voltage Measurement Properties

Property	Short Name	Description
Analog Input»Maximum Value	AI.Max	Specifies the maximum value you expect to measure. The SCXI-1502 gain and E/M Series DAQ device range are computed automatically from this value.
Analog Input»Minimum Value	AI.Min	Specifies the minimum value you expect to measure. The SCXI-1502 gain and E/M Series DAQ device range are computed automatically from this value.
Analog Input»General Properties» Advanced»Gain and Offset»Gain Value	AI.Gain	Specifies a gain factor to apply to the signal conditioning portion of the channel. The SCXI-1502 supports 1 or 100.

Table 5-1. NI-DAQmx Voltage Measurement Properties (Continued)

Property	Short Name	Description
Analog Input»General Properties» Advanced»High Accuracy Settings» Auto Zero Mode	AI.AutoZeroMode	Specifies when to measure ground. NI-DAQmx subtracts the measured ground voltage from every sample.
Analog Input»General Properties» Advanced»Input Configuration» Coupling	AI.Coupling	Specifies the input coupling of the channel. The SCXI-1502 supports DC and GND coupling.

Table 5-2. NI-DAQmx Thermocouple Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» Thermocouple»Type	AI.Thermcpl.Type	Specifies the type of thermocouple connected to the channel.
Analog Input»Temperature» Thermocouple»CJC Source (read only)	AI.Thermcpl.CJCSrc	Indicates the source of cold-junction compensation.
Analog Input»Temperature» Thermocouple»CJC Value	AI.Thermcpl.CJCVal	Specifies the temperature of the cold-junction if the CJC source is constant value.
Analog Input»Temperature» Thermocouple»CJC Channel (read only)	AI.Thermcpl.CJCChan	Indicates the channel that acquires the temperature of the cold junction if CJC is channel.

Table 5-3. NI-DAQmx RTD Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» RTD»Type	AI.RTD.Type	Specifies the type of RTD connected to the channel.
Analog Input»Temperature» RTD»R0	AI.RTD.R0	Specifies the resistance in ohms of the sensor at 0° C.

Table 5-3. NI-DAQmx RTD Measurement Properties (Continued)

Property	Short Name	Description
Analog Input»Temperature» RTD»Custom»A, B, C	AI.RTD.A AI.RTD.B AI.RTD.C	Specifies the A, B, or C constant of the Callendar-Van Dusen equation when using a custom RTD type.
Analog Input»General Properties» Signal Conditioning»Resistance Configuration	AI.Resistance.Cfg	Specifies the resistance configuration for the channel, such as 2-wire, 3-wire, or 4-wire.

Table 5-4. NI-DAQmx Thermistor Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» Thermistor»R1	AI.Thrmistr.R1	Specifies the resistance in ohms of the sensor at 0° C.
Analog Input»Temperature» Thermistor»Custom»A, B, C	AI.Thrmistr.A AI.Thrmistr.B AI.Thrmistr.C	Specifies the A, B, or C constant of the Steinhart-Hart thermistor equation, which NI-DAQmx uses to scale thermistors.

Table 5-5. NI-DAQmx Current Measurement Properties

Property	Short Name	Description
Analog Input»General Properties» Signal Conditioning»Current Shunt Resistors»Location	AI.CurrentShunt.Loc	Specifies whether the shunt resistance location is internal or external.
Analog Input»General Properties» Signal Conditioning»Current Shunt Resistor»Value	AI.CurrentShunt.Resistance	Specifies the resistance, in ohms, of the external shunt resistance.

Note This is *not* a complete list of NI-DAQmx properties and does not include every property you may need to configure your application. It is a representative sample of important properties to configure for voltage measurements. For a complete list of NI-DAQmx properties and more information about NI-DAQmx properties, refer to your ADE help file.

Acquiring, Analyzing, and Presenting

After configuring the task and channels, you can start the acquisition, read measurements, analyze the data returned, and display it according to the needs of your application. Typical methods of analysis include digital filtering, averaging data, performing harmonic analysis, applying a custom scale, or adjusting measurements mathematically.

NI provides powerful analysis toolsets for each NI ADE to help you perform advanced analysis on the data without requiring you to have a programming background. After you acquire the data and perform any required analysis, it is useful to display the data in a graphical form or log it to a file. NI ADEs provide easy-to-use tools for graphical display, such as charts, graphs, slide controls, and gauge indicators. NI ADEs have tools that allow you to easily save the data to files such as spread sheets for easy viewing, ASCII files for universality, or binary files for smaller file sizes.

Completing the Application

After you have completed the measurement, analysis, and presentation of the data, it is important to stop and clear the task. This releases any memory used by the task and frees up the DAQ hardware for use in another task.

Note In LabVIEW, tasks are automatically cleared.

Developing an Application Using LabVIEW

This section describes in more detail the steps shown in the typical program flowchart in Figure 5-1, such as how to create a task in LabVIEW and configure the channels of the SCXI-1502. If you need more information or for further instructions, select **Help»VI, Function, & How-To Help** from the LabVIEW menu bar.

Note Except where otherwise stated, the VIs in Table 5-6 are located on the **Functions» All Functions»NI Measurements»DAQmx - Data Acquisition** subpalette and accompanying subpalettes in LabVIEW.

Table 5-6. Programming a Task in LabVIEW

Flowchart Step	VI or Program Step
Create Task in DAQ Assistant	Create a `DAQmx Task Name Control` located on the **Controls»All Controls»I/O»DAQmx Name Controls** subpalette, right-click it, and select `New Task (DAQ Assistant)`.
Create a Task Programmatically (optional)	`DAQmx Create Task.vi` located on the **Functions»All Functions»NI Measurements»DAQmx - Data Acquisition» DAQmx Advanced Task Options** subpalette—This VI is optional if you created and configured the task using the DAQ Assistant. However, if you use it in LabVIEW, any changes you make to the task are not saved to a task in MAX.
Create Virtual Channel(s)	`DAQMX Create Virtual Channel.vi` located on the **Functions»All Functions»NI Measurements»DAQmx - Data Acquisition** subpalette—Use this VI to add virtual channels to the task. Select the type of virtual channel based on the measurement you plan to perform.
Adjust Timing Settings (optional)	`DAQmx Timing.vi` (Sample Clock by default)—This VI is optional if you created and configured the task using the DAQ Assistant. Any timing settings modified with this VI are not saved in the DAQ Assistant. They are only available for the present session.
Configure Channels (optional)	NI-DAQmx Channel Property Node, refer to the *Using a NI-DAQmx Channel Property Node in LabVIEW* section for more information. This step is optional if you created and fully configured the channels using the DAQ Assistant. Any channel modifications made with a channel property node are not saved in the task in the DAQ Assistant. They are only available for the present session.
Start Measurement	`DAQmx Start Task.vi`
Read Measurement	`DAQmx Read.vi`
Analyze Data	Some examples of data analysis include filtering, scaling, harmonic analysis, or level checking. Some data analysis tools are located on the **Functions»Signal Analysis** subpalette and on the **Functions»All Functions»Analyze** subpalette.

Table 5-6. Programming a Task in LabVIEW (Continued)

Flowchart Step	VI or Program Step
Display Data	You can use graphical tools such as charts, gauges, and graphs to display the data. Some display tools are located on the **Controls»All Controls»Numeric»Numeric Indicator** subpalette and **Controls»All Controls»Graph** subpalette.
Continue Sampling	For continuous sampling, use a While Loop. If you are using hardware timing, you also need to set the `DAQmx Timing.vi` sample mode to Continuous Samples. To do this, right-click the terminal of the `DAQmx Timing.vi` labeled **sample mode** and click **Create»Constant**. Click the box that appears and select **Continuous Samples**.
Stop Measurement	`DAQmx Stop Task.vi` (This VI is optional, clearing the task automatically stops the task.)
Clear Task	`DAQmx Clear Task.vi`

Using a NI-DAQmx Channel Property Node in LabVIEW

You can use property nodes in LabVIEW to manually configure the channels. To create a LabVIEW property node, complete the following steps:

1. Launch LabVIEW.
2. Create the property node in a new VI or in an existing VI.
3. Open the block diagram view.
4. From the **Functions** toolbox, select **All Functions» NI Measurements»DAQmx - Data Acquisition**, and select `DAQmx Channel Property Node`.
5. The **ActiveChans** property is displayed by default. This allows you to specify exactly what channel(s) you want to configure. If you want to configure several channels with different properties, separate the lists of properties with another **Active Channels** box and assign the appropriate channel to each list of properties.



Note If you do not use Active Channels, the properties are set on all of the channels in the task.

6. Right-click **ActiveChans**, and select **Add Element**. Left-click the new **ActiveChans** box. Navigate through the menus, and select the property you wish to define.
7. Change the property to read or write to either get the property or write a new value. Right-click the property, go to **Change To**, and select **Write**, **Read**, or **Default Value**.
8. After you have added the property to the property node, right-click the terminal to change the attributes of the property, add a control, constant, or indicator.
9. To add another property to the property node, right-click an existing property and left-click **Add Element**. To change the new property, left-click it and select the property you wish to define.

Note Refer to the *LabVIEW Help* for information about property nodes and specific NI-DAQmx properties.

Specifying Channel Strings in NI-DAQmx

Use the channel input of **DAQmx Create Channel** to specify the SCXI-1502 channels. The input control/constant has a pull-down menu showing all available external channels. The strings take one of the following forms:

- single device identifier/channel number—for example `SC1Mod1/ch0`
- multiple, noncontinuous channels—for example `SC1Mod1/ch0`, `SC1Mod1/ch4`.
- multiple continuous channels—for example `SC1Mod1/ch0:4` (channels 0 through 4)

When you have a task containing SCXI-1502 channels, you can set the properties of the channels programmatically using the **DAQmx Channel Property Node**.

Text Based ADEs

You can use text based ADEs such as LabWindows/CVI, Measurement Studio, Visual Basic 6, .NET, and C# to create code for using the SCXI-1502.

LabWindows/CVI

LabWindows/CVI works with the **DAQ Assistant** in MAX to generate code for an voltage measurement task. You can then use the appropriate function call to modify the task. To create a configurable channel or task in LabWindows/CVI, complete the following steps:

1. Launch LabWindows/CVI.
2. Open a new or existing project.
3. From the menu bar, select **Tools»Create/Edit DAQmx Tasks**.
4. Choose **Create New Task In MAX** or **Create New Task In Project** to load the DAQ Assistant.
5. The DAQ Assistant creates the code for the task based on the parameters you define in MAX and the device defaults. To change a property of the channel programmatically, use the `DAQmxSetChanAttribute` function.

Note Refer to the *NI LabWindows/CVI Help* for more information on creating NI-DAQmx tasks in LabWindows/CVI and NI-DAQmx property information.

Measurement Studio (Visual Basic 6, .NET, and C#)

When creating an voltage measurement task in Visual Basic 6, .NET and C#, follow the general programming flow in Figure 5-1. You can then use the appropriate function calls to modify the task. This example creates a new task and configures an NI-DAQmx voltage measurement channel on the SCXI-1502. You can use the same functions for Visual Basic 6, .NET and C#.

The following text is a function prototype example:

```
void AIChannelCollection.CreateVoltageChannel(
    System.String physicalChannelName,
    System.String nameToAssignChannel,
    System.Double minVal,
    System.Double maxVal);
```

To actually create and configure the channel, you would enter something resembling the following example code:

```
Task myTask = new
NationalInstruments.DAQmx.Task("myTaskName");
MyTask.DAQmxCreateAIVoltageChan (
    "SC1Mod1/ai0", // System.String physicalChannelName
    "Voltage0", // System.String nameToAssignChannel
    -10.0, // System.Double minVal
    10.0); // System.Double maxVal
// setting attributes after the channel is created
AIChannel myChannel = myTask.AIChannels["Voltage0"];
myChannel.AutoZeroMode = kAutoZeroTypeOnce;
```

Modify the example code above or the code from one of the shipping examples as needed to suit your application.



Note You can create and configure the voltage measurement task in MAX and load it into your application with the function call `NationalInstruments.DAQmx.DaqSystem.Local.LoadTask`.

Refer to the *NI Measurement Studio Help* for more information on creating NI-DAQmx tasks in LabWindows/CVI and NI-DAQmx property information.

Programmable NI-DAQmx Properties

All of the different ADEs that configure the SCXI-1502 access an underlying set of NI-DAQmx properties. Tables 5-1, 5-2, and 5-3 provide a list of some of the properties that configure the SCXI-1502. You can use this list to determine what kind of properties you need to set to configure the device for your application. For a complete list of NI-DAQmx properties, refer to your ADE help file.



Note Tables 5-1, 5-2, and 5-3 are *not* complete lists of NI-DAQmx properties and do not include every property you may need to configure voltage measurements. It is a representative sample of important properties to configure voltage measurements. For a complete list of NI-DAQmx properties and more information on NI-DAQmx properties, refer to your ADE help file.

Calibration

The SCXI-1502 is shipped with a calibration certificate and is calibrated at the factory to the specifications described in Appendix A, *Specifications*. Calibration constants are stored inside the calibration EEPROM and provide software correction values your application development software uses to correct the measurements for both offset and gain errors in the module.

Internal/Self-Calibration

You can self-calibrate the SCXI-1502 in MAX by right-clicking the module and selecting Self Calibrate. The NI-DAQmx Self Calibrate Device function does the same. A self-calibration of the SCXI-1502 grounds all the input channels and stores the resulting measurement as an offset correction constant on the module. You should perform a self-calibration every time you install the SCXI-1502 to a new system.

Note You should self-calibrate the connected DAQ device before self-calibrating the SCXI-1502.

External Calibration

If you have an accurate calibrator and DMM, you can externally calibrate the SCXI-1502 gain and offset constants using NI-DAQmx functions.

The functions that are required for externally calibrating the SCXI-1502 are available in NI-DAQmx 8.1 or later. Refer to the *NI-DAQmx Help* for details about these functions.

Most external calibration documents for SCXI modules are available to download from `ni.com/calibration` by clicking **Manual Calibration Procedures**. For external calibration of modules not listed there, Basic Calibration Service or Detailed Calibration Service is recommended. You can get information about both of these calibration services from `ni.com/calibration`. NI recommends performing an external calibration once a year.

A

Specifications

This appendix lists the specifications for the SCXI-1502 modules. These specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels ..... 32 differential

Input coupling ..... DC

Input signal ranges ..... ±100 mV (gain = 100) or
±10 V (gain = 1)

Input overvoltage protection

- Powered on ..... ±42 VDC
- Powered off ..... ±25 VDC
- Inputs protected ..... CH<0..31>
- CJ Sensor input protection ..... ±15 VDC powered on or off

Transfer Characteristics

Nonlinearity ..... 0.005% FSR

Input offset error (RTI)

- Gain = 1
  - Calibrated[1] ..... ±650 µV max
    ±250 µV typ
  - With autozero enabled[2] ..... ±300 µV max
    ±150 µV typ

[1] Assumes 1,000 point average, 25 °C ±10 °C over one year.

[2] Assumes 1,000 point average, ±1 °C of autozero temperature.

Gain = 100

Calibrated[1] .....±25 µV max
±10 µV typ

With autozero enabled.....±10 µV max
±5 µV typ

Gain error (relative to calibration reference)

Gain = 1 or 100

Calibrated[2] .....0.074% of reading max
0.02% of reading typ

Amplifier Characteristics

Input coupling .....DC

Input impedance

Normal powered on .....>1 GΩ

Input bias current .....±2.8 nA

CMRR characteristics (DC to 60 Hz)

Gain 1 .....–75 dB min
–90 dB typ

Gain 100 .....–106 dB min
–110 dB typ

Output range .....±10 V

Output impedance .....91 Ω

Dynamic Characteristics

Minimum scan interval (per channel, any gain)

±0.012% accuracy .....3 µs

±0.0061% accuracy .....10 µs

±0.0015% accuracy .....20 µs

[1] 25 °C ±10 °C over one year.

[2] Assumes 1,000 point average, ±1 °C of autozero temperature.

Noise characteristics (RTI)

Gain = 1
10 Hz to 1 MHz ..... 100 μV_{rms}

Gain = 100
10 Hz to 1 MHz ..... 1 μV_{rms}
0.1 to 10 Hz..... 0.5 μV_{p-p}

Filter

Cutoff frequency (–3 dB)..... 5 Hz

NMR (60 Hz) ..... –40 dB min

Step response characteristics (gain 1 or 100)
Settling to 0.0015%..... 0.6 sec

Stability

Recommended warm-up time ..... 20 min

Offset temperature coefficient
Gain = 1 ..... ±35 µV/°C max
±10 µV/°C typ
Gain = 100 ..... ±1.5 µV/°C max
±0.5 µV/°C typ

Gain temperature coefficient
(gain 1 or 100)..... ±15 ppm/°C max
±5 ppm/°C typ

Long-term gain drift
(gain 1 or 100)..... ±0.475 ppm/year max
±70 ppm/year typ

Power Requirements

5 V supply ..... 15 mA max

±15 V supply
(regulated from ±24 V supply)..... 150 mA max

V+..... 18.5 to 25 VDC, 170 mA max

V– .....–18.5 to –25 VDC, –170 mA max

+5 V .....4.75 to 5.25 VDC, 50 mA max

Physical

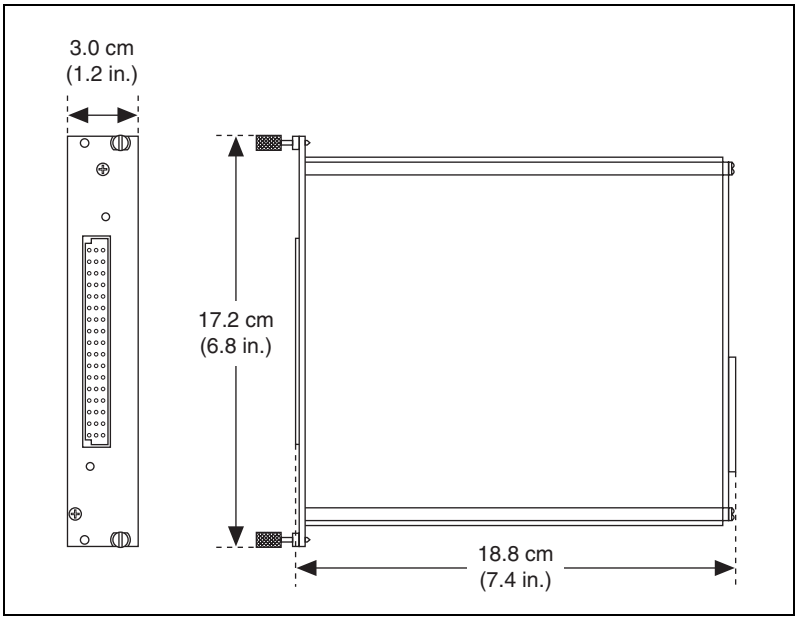


Figure A-1. SCXI-1502 Dimensions

Weight .....758 gm (26.7 oz)

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Signal + common mode .....Each input should remain within ±10 V of CH GND

Environmental

Operating temperature .....0 to 50 °C

Storage temperature .....–20 to 70 °C

Humidity .....10 to 90% RH, noncondensing

Maximum altitude ..... 2,000 m

Pollution Degree (indoor use only) 2

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN-61010-1
- UL 61010-1, CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device according to product documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 73/23/EEC; Low-Voltage Directive (safety)
- 89/336/EEC; Electromagnetic Compatibility Directive (EMC)

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee.htm`.

B

Removing the SCXI-1502

This appendix explains how to remove the SCXI-1502 from MAX and an SCXI chassis.

Note Figure B-1 shows an SCXI chassis, but the same steps are applicable to a PXI/SCXI combination chassis.

Removing the SCXI-1502 from MAX

To remove a module from MAX, complete the following steps after launching MAX:

1. Expand **Devices and Interfaces** to display the list of installed devices and interfaces.
2. Expand **NI-DAQmx Devices** to display the chassis.
3. Expand the appropriate chassis to display the installed modules.
4. Right-click the module or chassis you want to delete and click **Delete**.
5. You are presented with a confirmation window. Click **Yes** to continue deleting the module or chassis or **No** to cancel this action.

Note Deleting the SCXI chassis deletes all modules in the chassis. All configuration information for these modules is also deleted.

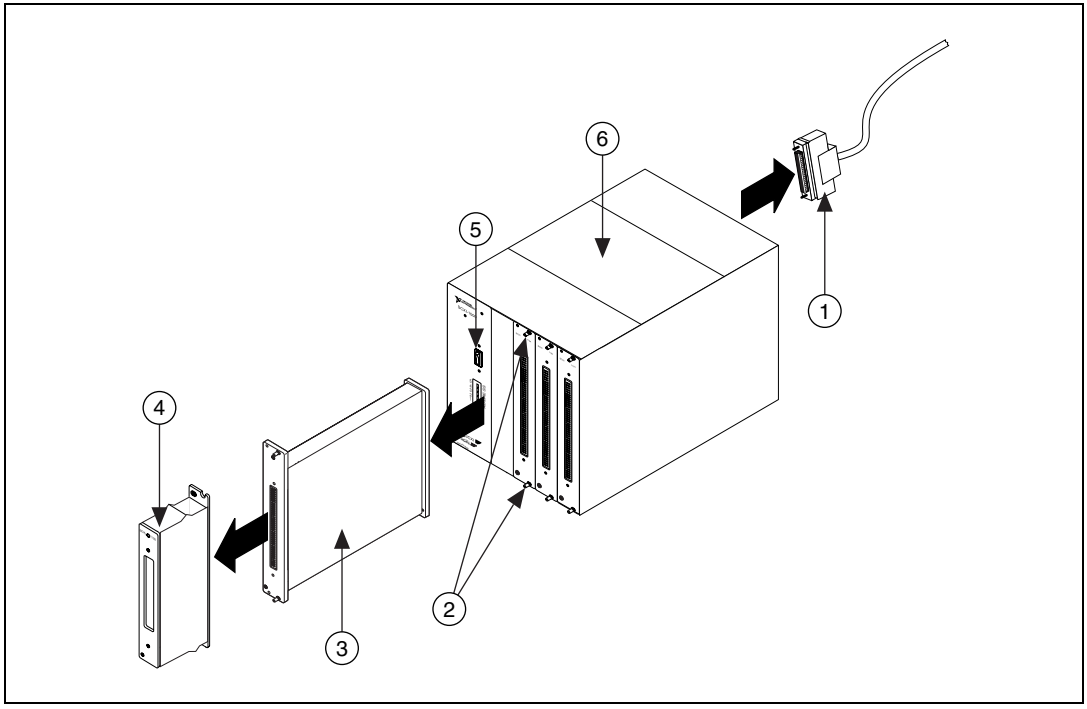
The SCXI chassis and/or SCXI module(s) should now be removed from the list of installed devices in MAX.

Removing the SCXI-1502 from a Chassis

Consult the documentation for the chassis and accessories for additional instructions and precautions. To remove the SCXI-1502 module from a chassis, complete the following steps while referring to Figure B-1:

1. Power off the chassis. Do *not* remove the SCXI-1502 module from a chassis that is powered on.
2. If the SCXI-1502 is the module cabled to the E /M Series DAQ device, disconnect the cable.
3. Remove any terminal block that connects to the SCXI-1502.

4. Rotate the thumbscrews that secure the SCXI-1502 to the chassis counterclockwise until they are loose, but do not completely remove the thumbscrews.
5. Remove the SCXI-1502 by pulling steadily on both thumbscrews until the module slides completely out.



1 Cable	4 Terminal Block
2 SCXI Module Thumbscrews	5 SCXI Chassis Power Switch
3 SCXI-1502	6 SCXI Chassis

Figure B-1. Removing the SCXI-1502

C

Common Questions

This appendix lists common questions related to the use of the SCXI-1502.

Which version of NI-DAQ works with the SCXI-1502, and how do I get the most current version of NI-DAQ?

You must have NI-DAQ 8.1 or later. Visit the NI Web site at `ni.com` and select **Download Software»Drivers and Updates»Search Drivers and Updates**. Enter the keyword `NI-DAQ` to find the latest version of NI-DAQ for your operating system.

I cannot correctly test and verify that my SCXI-1502 is working. What should I do?

Unfortunately, there is always the chance that one or more components in the system are not operating correctly. You may have to call or email a technical support representative. The technical support representative often suggests troubleshooting measures. If requesting technical support by phone, have the system nearby so you can try these measures immediately. NI contact information is listed in the *Technical Support Information* document.

In NI-DAQmx, can I use channels of different measurement types in the same task?

Yes.

Does MAX allow me to configure two SCXI-1502 modules that are in the same chassis in the multiplexed mode with two different E/M Series DAQ devices?

No.

Can I use the unused analog input channels of the E/M Series DAQ device if I am directly cabled to the SCXI-1502, for example with the SCXI-1180 feedthrough?

No. E/M Series DAQ device channels 1 through 7 are not available when directly connected to the SCXI-1502.

Which digital lines are unavailable on the E/M Series DAQ device if I am cabled to an SCXI-1502 module?

Table C-1 shows the digital lines that are used by the SCXI-1502 for communication and scanning. These lines are unavailable for general-purpose digital I/O if the SCXI-1502 is connected to the E/M Series DAQ device.

Table C-1. Digital Signals on the SCXI-1502

E/M Series DAQ Device Signal Name	NI-DAQmx SCXI Signal Name	50-Pin Connector	68-Pin Connector	Direction[1]
DIO0	P0.0	25	52	Output
DIO4	P0.4	26	19	Input
DIO1	P0.1	27	17	Output
DIO2	P0.2	29	49	Output
SCANCLK	AI Hold Comp, AI Hold	36	46	Output
PFI7/ STARTSCAN	PFI 7/ AI SAMP CLK, AI SAMP	46	38	Input
EXTSROBE*	EXTSROBE*	37	45	Input

[1] With respect to the E/M Series DAQ device.

In LabVIEW, can I programmatically change my SCXI-1502 NI-DAQmx Task or Global Channel settings?

Yes. You can use NI-DAQmx property nodes to programmatically change these settings.

Is a register-level programming manual available for the SCXI-1502?

NI does not support register-level programming for the SCXI-1502.

What is the power-on state of the SCXI-1502 multiplexer, analog bus switches, and configuration settings?

The multiplexer, analog bus switches, and configuration settings are not in a known state immediately after power on. All hardware settings are

programmed automatically when beginning an acquisition in LabVIEW or a test panel in MAX.

Which accessories can I use to connect signals to the front of the SCXI-1502 module?

Refer to Chapter 1, *About the SCXI-1502*, for more information.

Glossary

Symbol	Prefix	Value
p	pico	10^{-12}
n	nano	10^{-9}
μ	micro	10^{-6}
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}
G	giga	10^{9}

Numbers/Symbols

%	Percent.
±	Plus or minus.
°	Degree.
Ω	Ohm.
+5 V	+5 VDC source signal.

A

A	Amperes.
A/D	Analog-to-digital.
absolute accuracy	The maximum difference between the measured value from a data acquisition device and the true voltage applied to the input, typically specified as ± voltage.
AC	Alternating current.
ADE	Application development environment.

AI GND	Analog input ground signal.
AI +	Positive analog output channel number signal.
AI # +	Positive input channel number signal.
AI # –	Negative input channel number signal.
AI HOLD COMP, AI HOLD	Scan clock signal used to increment to the next channel after each DAQ device analog-to-digital conversion.
amplification	A type of signal conditioning that improves accuracy in the resulting digitized signal by increasing signal amplitude relative to noise.
AO #	Data acquisition device analog output channel number.
AO # +	Positive output channel number signal.
AO # –	Negative output channel number signal.
AO GND	(DAQ and SCXI) analog output ground signal.
AO REF	Analog output reference.

B

bandwidth	The range of frequencies present in a signal, or the range of frequencies to which a measuring device can respond.
bias current	The small input current flowing into or out of the input terminals of an amplifier.
bit	One binary digit, either 0 or 1.
bus	The group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion interface to which I/O or other devices are connected. Examples of a PC bus is a PCI bus.

C

C	Celsius.
CE	European emissions control standard.

CH	Analog input channel signal.
CH GND	Chassis ground signal.
channel	Pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
chassis	The enclosure that houses, powers, and controls SCXI modules.
CJ SENSOR	Cold-junction temperature sensor.
CLK	Clock input signal.
clock	Hardware component that controls timing for reading from or writing to groups.
CMRR	Common-mode rejection ratio—a measure of the ability of a differential amplifier to reject interference from a common-mode signal, usually expressed in decibels (dB).
common-mode voltage	Voltage that appears on both inputs of a differential amplifier.
cutoff frequency	The frequency that defines the upper end of the passband of a lowpass filter.

D

D/A	Digital-to-analog.
D GND	Digital ground signal.
D OUT	Digital output signal.
DAQ device	A data acquisition device.
DAQD*/A	The data acquisition device data/address line signal used to indicate whether the SER DAT IN pulse train transmitted to the SCXI chassis contains data or address information.
dB	Decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: $dB = 20\log_{10} V1/V2$, for signals in volts.
DC	Direct current.

device	A plug-in data acquisition product, card, or pad that can contain multiple channels and conversion devices. Plug-in products, PCMCIA cards, and devices such as DAQPads, which connects to the computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices.
differential input	An analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured.
DIO	Digital input/output.
DMA	Direct memory access—a method by which data is 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	Digital multimeter.
drivers/driver software	Software that controls a specific hardware device, such as an E/M Series DAQ device.

E

EEPROM	Electrically erasable programmable read-only memory—ROM that can be erased with an electrical signal and reprogrammed.
EMC	Electromagnetic compliance.
EMI	Electromagnetic interference.
EXTSTROBE*	EXTSTROBE* is an output-only signal that generates either a single pulse or a sequence of eight pulses in the hardware-strobe mode. An external device can use this signal to latch signals or to trigger events. In the single-pulse mode, software controls the level of the EXTSTROBE* signal. A 10 and a 1.2 microsecond clock are available for generating the pulse sequence in the hardware-strobe mode. Refer to the E/M Series device user manual for more detailed information. This functionality is not available in LabVIEW or NI-DAQ. EXTSTROBE* is used for controlling SCXI chassis, and it is not a general-purpose signal. If you want to use or control this signal, you must perform register-level programming.
excitation	Supplying a voltage or current source to energize an active sensor or circuit.

EXT CONV	External control signal to trigger A/D conversions.
EXT INT	External interrupt signal.

F

F	(1) Fahrenheit—a temperature measurement scale; (2) farad—a measurement unit of capacitance.
FIFO	First-in first-out memory buffer—the first data stored is the first data sent to the acceptor. FIFOs are often used on DAQ devices to temporarily store incoming or outgoing data until that data can be retrieved or output.
filtering	A type of signal conditioning that allows you to remove unwanted frequency components from the signal you are trying to measure.
FSR	Full-scale range. The FSR is the positive full-scale input voltage minus the negative full-scale input voltage. For example, the FSR of the SCXI-1502 for a gain of 1 is +10 V – (–10 V) = 20 V.
ft	Feet.

G

G	Gain.
gain	The factor by which a signal is amplified, sometimes expressed in decibels.
GND	Ground.

H

Hz	Hertz—cycles per second of a periodic signal; the unit of measure for frequency.

I

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.
ID	Identifier.
in.	Inch or inches.
input damage level	The highest voltage level that you can apply to the module without damaging it.

L

lowpass filter	A filter that passes signals below a cutoff frequency while blocking signals above that frequency.

M

m	Meters.
MB	Megabytes of memory.
MIO	Multifunction I/O.
MISO	Master-in-slave-out signal.
MOSI	Master-out-slave-in signal
max	Maximum.
min	(1) Minutes (2) minimum.
multiplex	To route one of many input signals to a single output.
mutliplexed mode	An SCXI operating mode in which analog input channels are multiplexed into one module output so that the cabled E/M Series DAQ device has accessed the module's multiplexed output as well as the outputs of all other multiplexed modules in the chassis.

N

NC	Normally closed, or not connected.
NI-DAQ	The driver software needed in order to use E/M Series DAQ devices and SCXI components.
noise	An undesirable electrical signal—noise comes from external sources such as AC power lines, motors, generators, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Noise corrupts signals you are trying to measure.
nonlinearity	For an amplifier, a measure of the maximum output deviation from an ideal linear response in units of percent relative to full scale. The ideal linear response is taken to be a straight line on a plot of measured output voltage to measured input voltage with the ends of the line connecting the extremes of the plot at the full-scale limits.

O

OUT	Output signal.
OUT REF	Output reference signal.
overvoltage protection	Maximum voltage that does not cause hardware damage.

P

passband	The range of input frequencies that are passed to the filter output without attenuation.
pole	A term used to describe the quality of a lowpass filter. In general, the more poles a lowpass filter has, the better it attenuates frequencies beyond the cutoff frequency.
ppm	Parts per million.
PXI	PCI eXtensions for Instrumentation–an open specification that builds on the CompactPCI specification by adding instrumentation-specific features.

R

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.
RSVD	Reserved bit, pin, or signal.

S

s	Seconds.
S	Samples.
sample	An instantaneous measurement of a signal, normally using an analog-to-digital converter in an E/M Series DAQ device.
sample rate	The number of samples a system takes over a given time period, usually expressed in samples per second.
scan	One or more analog samples taken at the same time, or nearly the same time. Typically, the number of input samples in a scan is equal to the number of channels in the input group. For example, one scan acquires one new sample from every analog input channel in the group.
SCANCLK	Scan clock signal used to increment to the next channel after each E/M Series DAQ device analog-to-digital conversion.
SCXI	Signal Conditioning eXtensions for Instrumentation—the NI product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ devices in the noisy PC environment.
SCXIbus	Located in the rear of an SCXI chassis, the SCXIbus is the backplane that connects modules in the same chassis to each other.
sensor	A device that converts a physical phenomenon into an electrical signal.
SER CLK	Serial clock signal used to synchronize digital data transfers over the SER DAT IN and SER DAT OUT lines.
SER DAT IN	Serial data input signal.

SER DAT OUT	Serial data output signal.
signal conditioning	The manipulation of signals to prepare them for digitizing.
Slot 0	Refers to the power supply and control circuitry in the SCXI chassis.
SLOT 0 SEL*	Slot 0 select signal.

U

UL	Underwriters laboratory.

V

V	Volts.
V_{CC}	Positive supply voltage from the PCMCIA bus (usually +5V).
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.
virtual channels	Channel names that can be defined outside the application and used without having to perform scaling operations.
V_{IH}	Volts, input high.
V_{IL}	Volts, input low.
V_{in}	Volts in.
V_{OH}	Volts, output high.
V_{OL}	Volts, output low.

W

W	Watts.
working voltage	The highest voltage with respect to ground that should be applied to an input terminal during normal use, normally well under the breakdown voltage for safety margin. Includes both the signal and common-mode voltages.

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