SCXI-1102

User Manual

32-Channel Thermocouple Amplifier Module

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Part Number 320975A-01

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About This Manual

This manual describes the electrical and mechanical aspects of the SCXI-1102 and contains information concerning its installation and operation. The SCXI-1102 is a member of the National Instruments Signal Conditioning eXtensions for Instrumentation (SCXI) Series for the National Instruments data acquisition (DAQ) plug-in boards. This module is designed for signal conditioning thermocouples, volt and millivolt sources, and 4 to 20 mA sources or 0 to 20 mA process-current sources. The SCXI-1102 has 32 differential analog input channels and one cold-junction sensor channel.

Organization of This Manual

The *SCXI-1102 User Manual* is organized as follows:

*   Chapter 1, *Introduction*, describes the SCXI-1102; lists what you need to get started with your SCXI-1102, the optional software, optional equipment, and custom cables; and explains how to unpack the SCXI-1102.

*   Chapter 2, *Configuration and Installation*, describes how to configure the SCXI-1102 jumper and how to install the SCXI-1102 into the SCXI chassis.

*   Chapter 3, *Signal Connections,* describes the input and output signal connections to the SCXI-1102 module via the SCXI-1102 front connector and rear signal connector. This chapter also includes specifications and connection instructions for the signals on the SCXI-1102 connectors.

*   Chapter 4, *Theory of Operation*, contains a functional overview of the SCXI-1102 module and explains the operation of each functional unit making up the SCXI-1102.

*   Chapter 5, *Calibration*, discusses the calibration procedures for the SCXI-1102.

*   Appendix A, *Specifications*, lists the specifications for the SCXI-1102.

*   Appendix B, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products.

*   The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms.

*   The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual.

< >	Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a port, bit, or signal name (for example, ACH<0..7> stands for the signals ACH0 through ACH7).
bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
Lab board	Refers to the boards that have *Lab* in their names, such as the Lab-LC and the Lab-PC+.
MC	Refers to the Micro Channel series computers.
MIO board	Refers to the multichannel I/O DAQ boards that have *MIO* in their names, such as the AT-MIO-16 and the NEC-MIO-16E-4.
`monospace`	Denotes text or characters that are to be literally input 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, variables, filenames, and extensions, and for statements and comments taken from program code.
NB	Refers to the NuBus series computers.
PC	Refers to the IBM PC/XT, the IBM PC AT, and compatible computers.
SCXIbus	Refers to the backplane in the chassis. A signal on the backplane is referred to as the SCXIbus <signal name> line (or signal). The SCXIbus descriptor may be omitted when the meaning is clear. Descriptions of all SCXIbus signals are in Chapter 3, *Signal Connections*.
Slot 0	Refers to the power supply and control circuitry in the SCXI chassis.

Abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms are listed in the *Glossary*.

National Instruments Documentation

The *SCXI-1102 User Manual* is one piece of the documentation set for your data acquisition system. You could have any of several types of manuals, depending on the hardware and software in your system. Use the manuals you have as follows:

- *Getting Started with SCXI*—This is the first manual you should read. It gives an overview of the SCXI system and contains the most commonly needed information for the modules, chassis, and software.

- Your 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.

- Your DAQ hardware user manuals—These manuals have detailed information about the DAQ hardware that plugs into or is connected to your computer. Use these manuals for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.

- Software manuals—Examples of software manuals you may have are the LabVIEW and LabWindows®/CVI manual sets and the NI-DAQ manuals. After you set up your hardware system, use either the application software (LabVIEW or LabWindows/CVI) manuals or the NI-DAQ manuals to help you write your application. If you have a large and complicated system, it is worthwhile to look through the software manuals before you configure your hardware.

- Accessory installation guides or manuals—If you are using accessory products, 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 your connections.

- SCXI chassis manuals—Read these manuals for maintenance information on the chassis and installation instructions.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- Your NI-DAQ or LabVIEW software manuals for PC compatibles

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix B, *Customer Communication*, at the end of this manual.

Chapter 1
Introduction

This chapter describes the SCXI-1102; lists what you need to get started with your SCXI-1102, the optional software, optional equipment, and custom cables; and explains how to unpack the SCXI-1102.

About the SCXI-1102

The SCXI-1102 is a module 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. The SCXI-1102 has 32 differential analog input channels and one cold-junction sensor channel. On each channel, the SCXI-1102 has a 3-pole lowpass filter with a 1 Hz cutoff frequency to reject 60 Hz noise. Each channel also has an amplifier with a selectable gain of 1 or 100. You can multiplex the SCXI-1102 inputs to a single output, which drives a single DAQ board channel.

The SCXI-1102 operates with full functionality with the National Instruments MIO, Lab-PC+, PCI-1200, DAQCard-1200, and SCXI-1200 boards. You can use the Lab and PC-LPM-16 boards and the DAQCard-700 with the SCXI-1102, but these boards cannot scan the module; they can only perform single-channel reads. You can multiplex several SCXI-1102 modules and other SCXI modules into a single channel on the DAQ board, greatly increasing the number of analog input signals that you can digitize.

You can use the SCXI-1300 or SCXI-1303 terminal blocks, which have screw terminals to which you attach the input signals for the SCXI-1102. In addition, these terminal blocks have a temperature sensor for thermocouple cold-junction compensation. The isothermal SCXI-1303 is recommended for thermocouple applications. The SCXI-1102 multiplexes this cold-junction sensor with the 32 input channels during a hardware scan.

Detailed specifications of the SCXI-1102 are listed in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use your SCXI-1102, you will need the following items:

❏ SCXI-1102 module

❏ *SCXI-1102 User Manual*

❏ One of the following software packages and documentation:
   LabVIEW for Macintosh
   LabVIEW for Windows
   LabWindows/CVI for Windows
   NI-DAQ for Macintosh
   NI-DAQ for PC compatibles

❏ Your computer

Software Programming Choices

There are several options to choose from when programming your National Instruments plug-in DAQ and SCXI hardware. You can use LabVIEW, LabWindows/CVI, or NI-DAQ.

LabVIEW and LabWindows/CVI Application Software

LabVIEW and LabWindows/CVI are innovative program development software packages for data acquisition and control applications. LabVIEW uses graphical programming, whereas LabWindows/CVI enhances traditional programming languages. Both packages include extensive libraries for data acquisition, instrument control, data analysis, and graphical data presentation.

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition VI Library, a series of VIs for using LabVIEW with National Instruments boards, is included with LabVIEW. The LabVIEW Data Acquisition VI Libraries are functionally equivalent to the NI-DAQ software.

LabWindows/CVI features interactive graphics and a state-of-the-art user interface and uses the ANSI standard C programming language. The LabWindows/CVI Data Acquisition Library, a series of functions for using LabWindows/CVI with National Instruments boards, is included with your NI-DAQ software kit. The LabWindows/CVI Data Acquisition libraries are functionally equivalent to the NI-DAQ software.

Using LabVIEW or LabWindows/CVI software will greatly reduce the development time for your data acquisition and control application.

NI-DAQ Driver Software

The NI-DAQ driver software is included at no charge with all National Instruments DAQ hardware. NI-DAQ has an extensive library of functions that you can call from your application programming environment. These functions include routines for analog input (A/D conversion), buffered data acquisition (high-speed A/D conversion), analog output (D/A conversion), waveform generation, digital I/O, counter/timer operations, SCXI, RTSI, self-calibration, messaging, and acquiring data to extended memory.

NI-DAQ also internally addresses many of the complex issues between the computer and the plug-in board, such as programming interrupts and DMA controllers. NI-DAQ maintains a consistent software interface among its different versions so that you can change platforms with minimal modifications to your code. Figure 1-1 illustrates the relationship between NI-DAQ and LabVIEW and LabWindows/CVI.
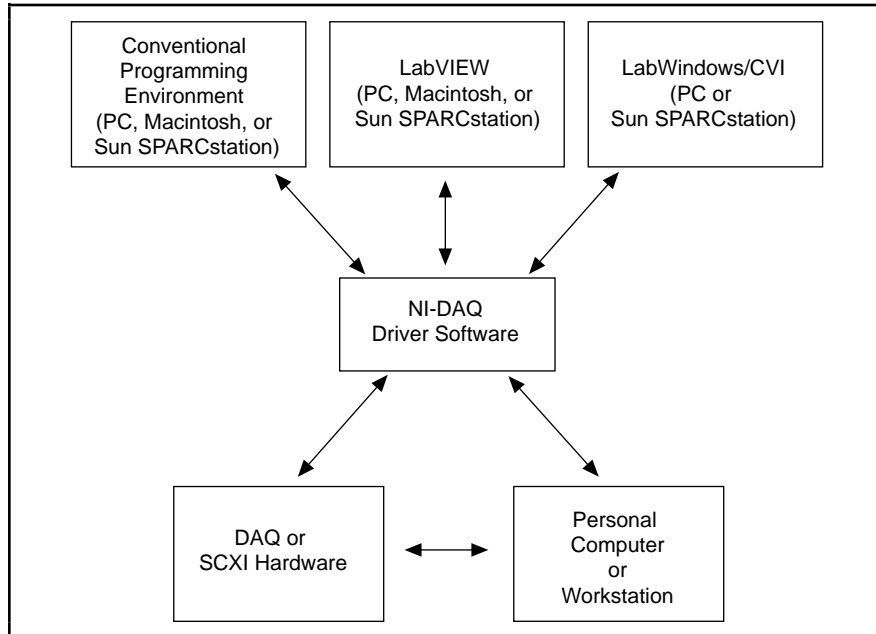
Figure 1-1. The Relationship between the Programming Environment,
NI-DAQ, and Your Hardware

Register-Level Programming

The final option for programming any National Instruments DAQ hardware is to write register-level software. Writing register-level programming software can be very time-consuming and inefficient and is not recommended.

Even if you are an experienced register-level programmer, consider using NI-DAQ, LabVIEW, or LabWindows/CVI to program your National Instruments DAQ hardware. Using the NI-DAQ, LabVIEW, or LabWindows/CVI software is easier than and as flexible as register-level programming and can save weeks of development time.

Optional Equipment

You can use the following National Instruments products with your SCXI-1102:

- SCXI-1300 front terminal block
- SCXI-1303 front terminal block
- SCXI-1340 cable assembly
- SCXI-1341 Lab-NB/Lab-PC+ cable assembly
- SCXI-1342 PC-LPM-16 cable assembly
- SCXI-1343 rear screw terminal adapter
- SCXI-1344 Lab-LC cable assembly
- SCXI-1345 with a 1, 2, 5, or 10 m cable
- SCXI-1347 with a 1, 2, 5, or 10 m cable
- SCXI-1349 with a 1, 2, 5, or 10 m cable
- SCXI-1346 multichassis adapter
- SCXI-1350 multichassis adapter
- SCXI-1353 with a 1, 2, 5, or 10 m shielded cable
- SCXI-1354 cable assembly for the DAQCard-1200
- SCXI process-current resistor kit
- 0.5 or 1.0 m standard ribbon cable

For more information about optional equipment available from National Instruments, refer to your National Instruments catalog or call the office nearest you.

Custom Cables

The following table summarizes the custom cable information.

	SCXI-1102 Connector	**Mating Connector**	**Cable**
Rear Signal Connector	AMP Inc. (1-103310-0) 50-pin male ribbon cable header	Electronic Products Division/3M (3425-7650) or T&B/Ansley Corp. (609-5041CE) 50-position polarized ribbon-socket connector	Electronic Products Division/3M (3365/50) or T&B/Ansley Corp. (171-50) 50-conductor, 28 AWG stranded ribbon cable
Front Signal Connector	Harting Electronik Inc. (09-03-396-6921) 96-pin DIN C male connector	AMP Inc. (535020; right-angle pins) or Panduit Corp. (100-096-434 straight-solder pins) 96-pin, polarized, DIN C female connector	n/a

Unpacking

Your SCXI-1102 module is shipped in an antistatic package to prevent electrostatic damage to the module. Electrostatic discharge can damage several components on the module. To avoid such damage in handling the module, take the following precautions.

- Ground yourself via a grounding strap or by holding a grounded object.

- Touch the antistatic package to a metal part of your SCXI chassis before removing the module from the package.

- Remove the module from the package and inspect the module for loose components or any other sign of damage. Notify National Instruments if the module appears damaged in any way. *Do not* install a damaged module into your SCXI chassis.

- *Never* touch the exposed pins of connectors.

Chapter 2
Configuration and Installation

This chapter describes how to configure the SCXI-1102 jumper and how to install the SCXI-1102 into the SCXI chassis.

Module Configuration

The SCXI-1102 contains one jumper, shown in Figure 2-1. Jumper W1 connects a pullup resistor to the SERDATOUT signal on the rear signal connector.

The remainder of the module configuration (gain, output signal referencing, etc.) is software-programmable.
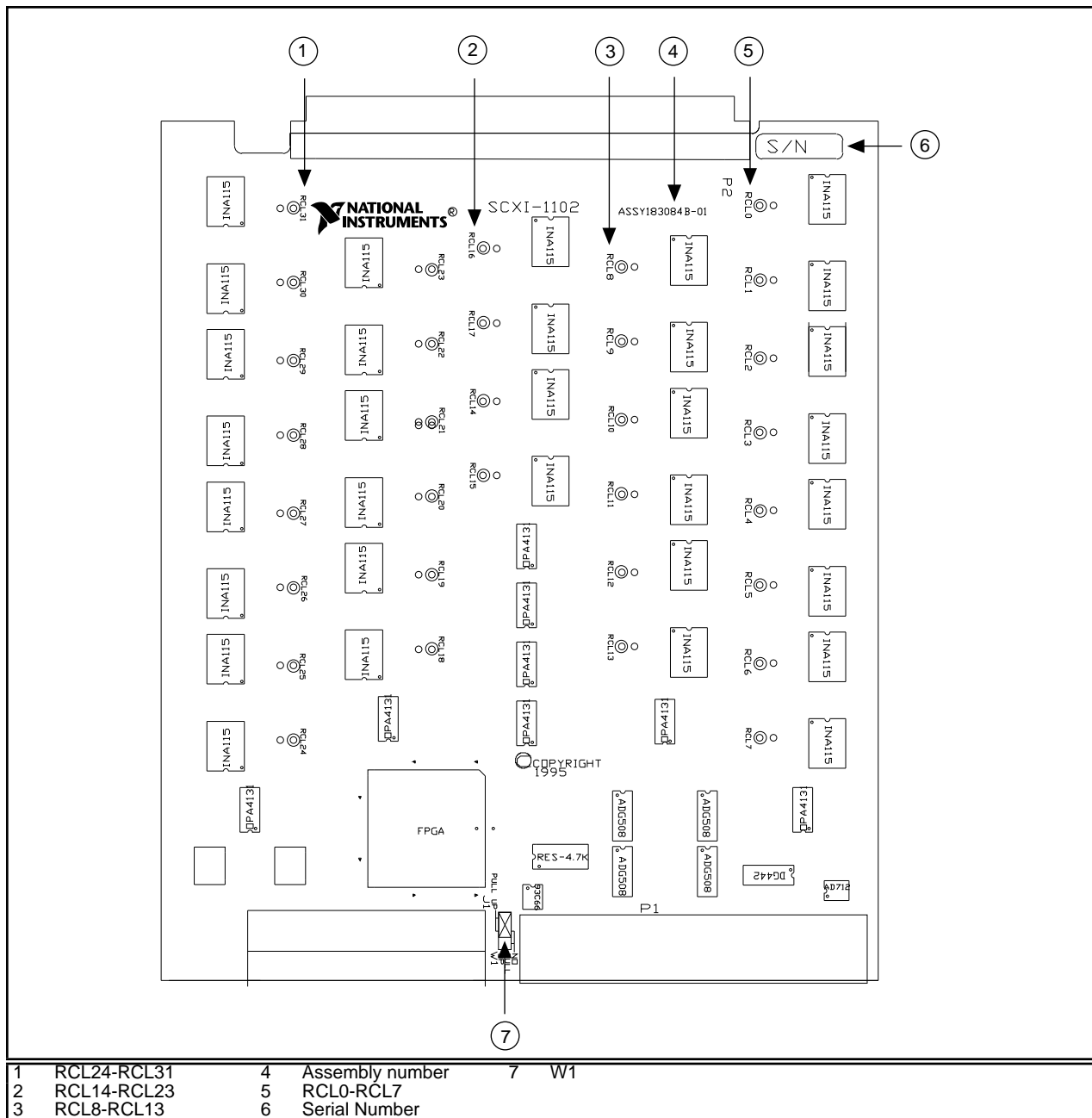
Figure 2-1. SCXI-1102 Parts Locator Diagram

1	RCL24-RCL31	4	Assembly number	7	W1
2	RCL14-RCL23	5	RCL0-RCL7		
3	RCL8-RCL13	6	Serial Number		
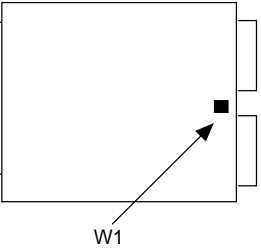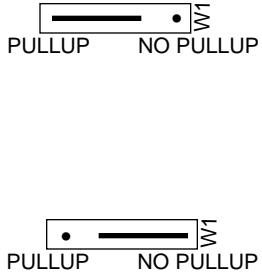
Digital Configuration

If you have a one-chassis system, you do not have to read this section. You can skip to the next section, *Analog Configuration*.

Note: ***If nothing is cabled to the SCXI-1102 rear signal connector, the position of jumper W1 is irrelevant.***

The SCXI-1102 has only one jumper—jumper W1—for communication between the DAQ board and the SCXIbus, shown in Table 2-1.

Table 2-1. Jumper Settings for Digital Signal Connection

Jumper	Description	Configuration
W1	Position PULLUP—Use this setting for a single-chassis system and for one cabled module in a multi-chassis system. Connects a 2.2 kΩ pullup resistor to the SERDATOUT line. (factory setting)	PULLUP NO PULLUP
	Position NO PULLUP—Use this setting for additional chassis in a multichassis system. No pullup resistor is connected to the SERDATOUT line.	PULLUP NO PULLUP

All SCXI modules have a jumper that corresponds to jumper W1 on the SCXI-1102. Refer to the user manuals of the other SCXI modules in your system to determine the designator and settings of this jumper. In the pullup position, this jumper connects a pullup resistor to the SERDATOUT line. This pullup resistor pulls the SERDATOUT line high when its open-collector driver goes to a high-impedance state. The SERDATOUT line on the SCXI-1102 reads the Module ID Register, the Status Register, and the EEPROM.

When using a single-chassis system, set the jumper in the pullup position on the SCXI module cabled to the DAQ board. When using multiple chassis, set the jumper to the pullup position on only one of the SCXI modules cabled to the DAQ board.

If you want to change the W1 jumper setting, refer to Figure 2-2 as you perform the following steps:

1. Ground yourself via a grounding strap or via a ground connected to your SCXI chassis. Properly grounding yourself prevents damage to your SCXI module from electrostatic discharge.

2. Remove the grounding screw of 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 on the screwdriver.

4. Change the W1 jumper setting.

5. Reinstall the top cover and grounding screw.
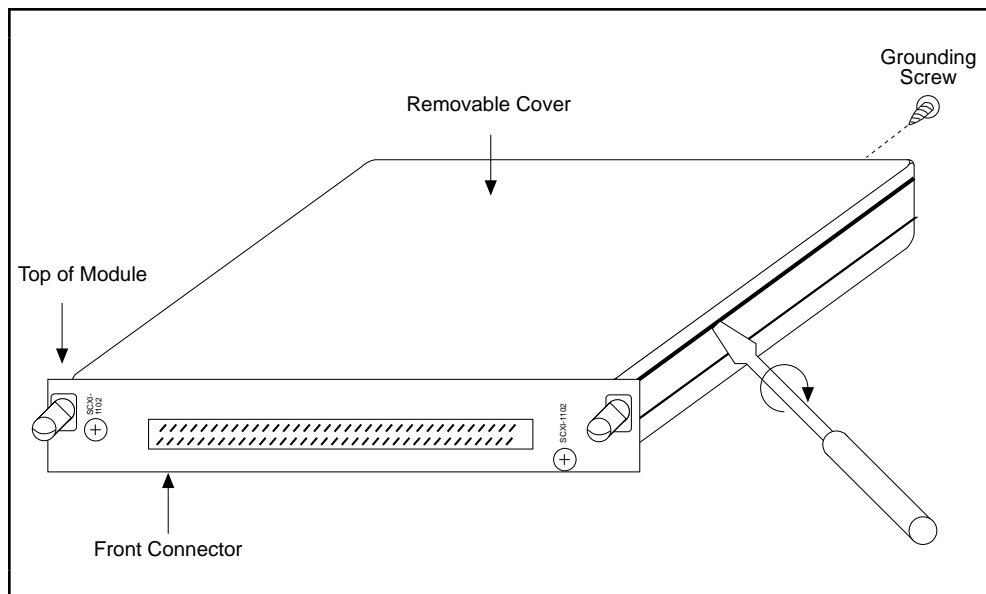
Figure 2-2. Removing the SCXI Module Cover

Analog Configuration

Current-Loop Receivers

The SCXI-1102 has pads for transforming individual channels to current-to-voltage converters. National Instruments offers an SCXI process-current pack of four 249 Ω, 0.1%, 5 ppm, 1/4 W resistors. The reference designators for the current loop resistors have the format: for input channel *x*, the resistor is RCL*x*. For example, the resistor for channel 28 is RCL28.

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

Before installing your module in the SCXI chassis, you must install the resistors by performing the following steps:

1.   Ground yourself via a grounding strap or via a ground connected to your SCXI chassis. Properly grounding yourself prevents damage to your SCXI module from electrostatic discharge.

2.   Remove the grounding screw of 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 2-3. Be sure that the resistor does not extend more than 0.65 in. above the surface of the circuit board.

Figure 2-3. Bent and Trimmed Resistor

7. Insert the resistor into the appropriate pad, labeled RCL*x*.

8. Solder the leads to the pad on the bottom side of the module.

9. Slide the module back into its enclosure.

10. Reinstall the rear panel.

11. Reinstall the top cover and grounding screw.

Hardware Installation

You can install the SCXI-1102 in any available SCXI chassis slot. After you have made any necessary changes and have verified and recorded the jumper setting on the form in Appendix B, *Customer Communi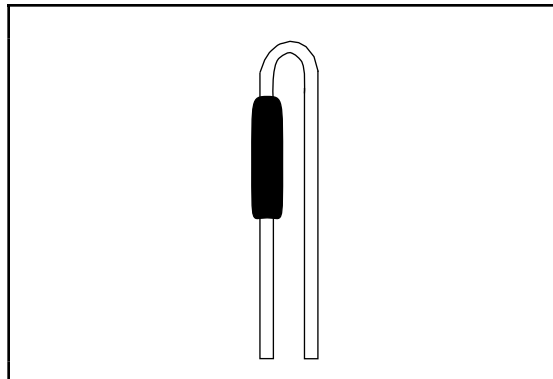cation*, you are ready to install the SCXI-1102. The following are general installation instructions; consult the user manual or technical reference manual of your SCXI chassis for specific instructions and warnings.

1. Turn off the computer that contains the DAQ board or disconnect it from your SCXI chassis.

2. Turn off the SCXI chassis. Do not insert the SCXI-1102 into a chassis that is turned on.

3. Insert the SCXI-1102 into the module guides. Gently guide the module into the back of the slot until the connectors make good contact. If a cable assembly has already been installed in the rear of the chassis, the module and cable assembly must be firmly engaged; however, do not *force* the module into place.

4. Screw the front mounting panel of the SCXI-1102 to the top and bottom threaded strips of your SCXI chassis.

5. If this module is to be connected to an MIO-16 DAQ board, attach the connector at the metal end of the SCXI-1340 cable assembly to the rear signal connector on the SCXI-1102 module. Screw the rear panel to the rear threaded strip. Attach the loose end of the cable to the MIO-16 board.

    Note: ***For installation procedures with other SCXI accessories and DAQ boards, consult your cable installation guide.***

6. Check the installation.

7. Turn on the SCXI chassis.

8. Turn on the computer or reconnect it to your chassis.

The SCXI-1102 module is installed. You are now ready to install and configure your software.

If you are using NI-DAQ, LabVIEW, or LabWindows/CVI, refer to the installation instructions in your documentation to install and configure your software.

Chapter 3
Signal Connections

This chapter describes the input and output signal connections to the SCXI-1102 module via the SCXI-1102 front connector and rear signal connector. This chapter also includes specifications and connection instructions for the signals on the SCXI-1102 connectors.

Caution: *Static electricity is a major cause of component failure. To prevent damage to the electrical components in the module, observe antistatic techniques whenever removing a module from the chassis or whenever working on a module.*

Front Connector

Figure 3-1 shows the pin assignments for the SCXI-1102 front connector.

Pin Number	Signal Name	Column			Signal Name
		A	B	C	
32	CGND				CH0 / CH0+
31	NC				CH1 / CH1+
30	NC				CH2 / CH2+
29	NC				CH3 / CH3+
28	NC				CH4 / CH4+
27	NC				CH5 / CH5+
26	NC				CH6 / CH6+
25	NC				CH7 / CH7+
24	CGND				CH8 / CH8+
23	NC				CH9 / CH9+
22	NC				CH10 / CH10+
21	NC				CH11 / CH11+
20	NC				CH12 / CH12+
19	NC				CH13 / CH13+
18	NC				CH14 / CH14+
17	NC				CH15 / CH15+
16	CGND				CH16 / CH16+
15	NC				CH17 / CH17+
14	NC				CH18 / CH18+
13	NC				CH19 / CH19+
12	NC				CH20 / CH20+
11	NC				CH21 / CH21+
10	NC				CH22 / CH22+
9	NC				CH23 / CH23+
8	NC				CH24 / CH24+
7	NC				CH25 / CH25+
6	NC				CH26 / CH26+
5	CGND				CH27 / CH27+
4	CJSENSOR				CH28 / CH28+
3	CJSENSOR				CH29 / CH29+
2	CGND				CH30 / CH30+
1	+5 V				CH31 / CH31+

Figure 3-1. SCXI-1102 Front Connector Pin Assignments

Front Connector Signal Descriptions

Pin	Signal Name	Description
A1	+5 V	+5 VDC Source—Used to power the temperature sensor on the terminal block. 0.2 mA of source not protected.
A2, A5, A16, A24, A32	CGND	Chassis Ground—Tied to the SCXI chassis.
A3, A4	CJSENSOR	Cold-junction Temperature Sensor Input—Connects to the temperature sensor of the terminal block.
B1–B32	CH31- through CH0-	Negative Input Channels —Negative side of differential input channels.
C1–C32	CH31+ through CH0+	Positive Input Channels 31 through 0—Positive side of differential input channels.

All other pins are not connected.

Analog Input Signal Connections

The signal terminals for the positive input channel are located in column B of the connector. The signal terminal for each corresponding negative 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. The terminal block temperature sensor output—connected to pins A3 and A4 (CJSENSOR)—is also filtered and multiplexed to the module output buffer.

The differential input signal range of an SCXI-1102 input channel is ± 10 V/G, where G is the gain selected on the SCXI-1102 input channel. 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-1102 input channel is ± 11 V. This common-mode input range for either positive or negative channel input is the maximum input voltage which will result in a valid measurement. Each channel includes input protection circuitry to withstand the accidental application of voltages up to 120 VAC/VDC.

Warnings: *Exceeding the input damage level (120 VAC/VDC between input channels and chassis ground) can damage the SCXI-1102, the SCXIbus, and the DAQ board. National Instruments is NOT liable for any injuries resulting from such signal connections.*

Applying a voltage greater than ± 50 VDC or 30 Vrms to the SCXI-1102 is hazardous. National Instruments is NOT liable for any damages or injuries resulting from such voltage application.

Note: *Exceeding the differential or common-mode input channel ranges results in a distorted signal measurement.*

Ground-Referencing Your Signals

Your input signals can be either ground-referenced, as shown in Figure 3-2, or floating, as shown in Figure 3-3. Before you connect your 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 as shown in Figure 3-3 or you can use the clamping resistors on the SCXI-1303 terminal block. The SCXI-1303 also has a resistor pack for pulling up the positive inputs for open-thermocouple detection. Consult the *SCXI-1303 32-Channel Isothermal Block Installation Guide* for details.

Do not ground signals which are already ground-referenced; doing so will result in a ground loop, which adversely affects your measurement accuracy.
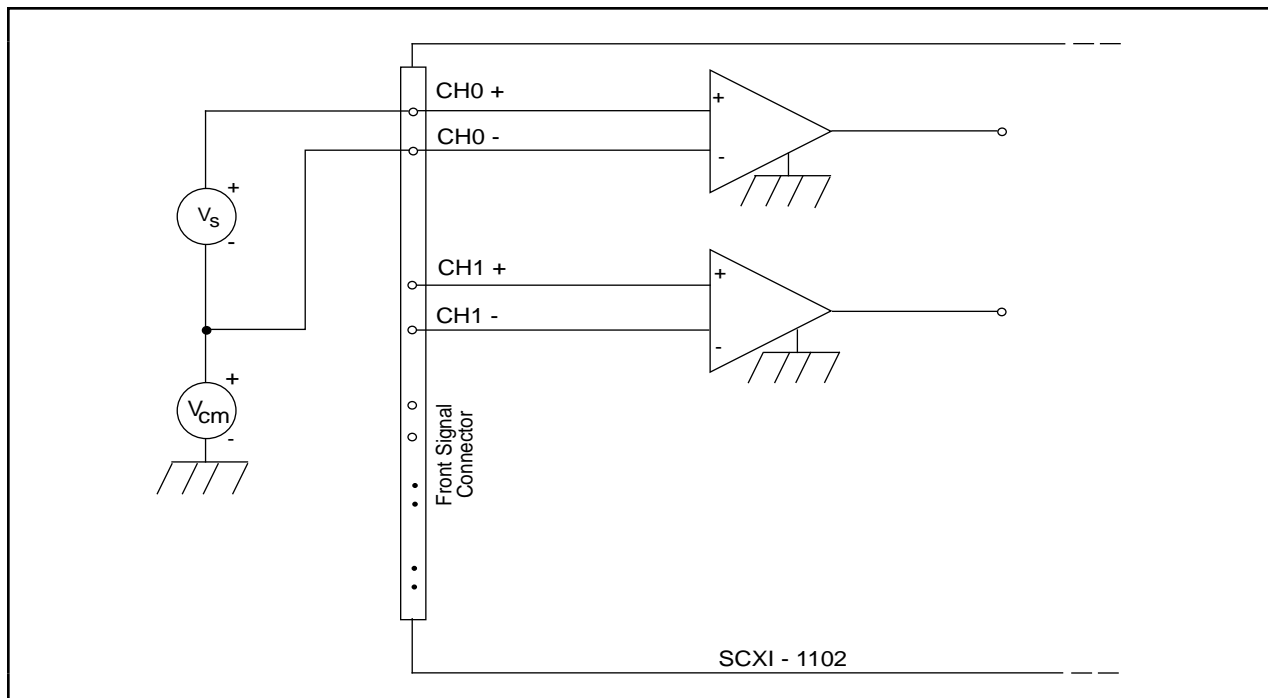
Figure 3-2. Ground-Referenced Signal Connection
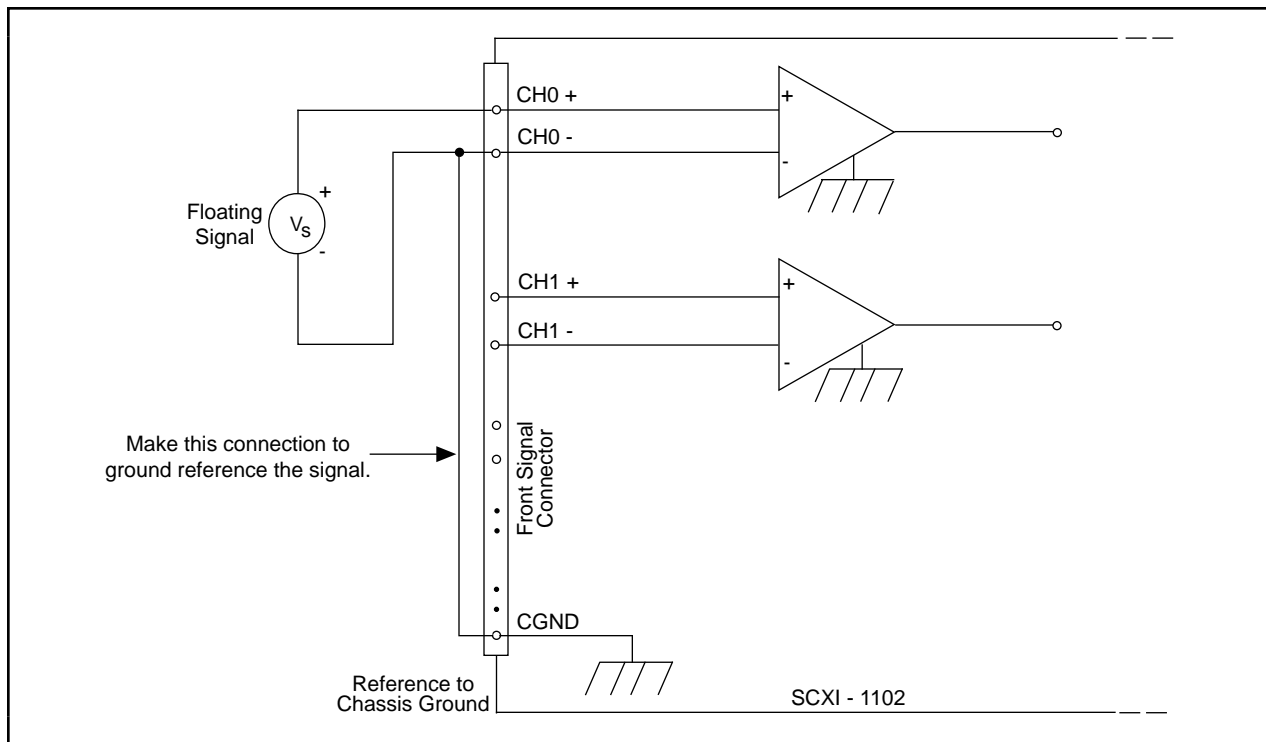
Figure 3-3. Floating Signal Connection Referenced to Chassis Ground

Cold-Junction Sensor Connection

Pins A3 and A4 (CJSENSOR) connect the temperature sensor located on the SCXI-1300 or
SCXI-1303 terminal blocks to the SCXI-1102. The CJSENSOR signal is measured relative to
CGND. Pins A3 and A4 are connected within the SCXI-1102 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.

Warning: *Exceeding the overvoltage protection on the CJSENSOR input can damage the
                SCXI-1102, the SCXIbus, and the DAQ board. National Instruments is* NOT
                liable for any damages or injuries resulting from such signal connections.

Rear Signal Connector

Note: *If you are using the SCXI-1102 with a National Instruments DAQ board and cable assembly, you do not need to read the remainder of this chapter. If you are using the SCXI-1180 feedthrough panel, the SCXI-1343 rear screw terminal adapter, or the SCXI-1351 one-slot cable extender with the SCXI-1102, read this section.*

Figure 3-4 shows the SCXI-1102 rear signal connector pin assignments.

AOGND	1	2	AOGND
MCH0+	3	4	MCH0-
	5	6	
	7	8	
	9	10	
	11	12	
	13	14	
	15	16	
	17	18	
OUTREF	19	20	
	21	22	
	23	24	DGND
SERDATIN	25	26	SERDATOUT
DAQD*/A	27	28	
SLOT0SEL*	29	30	
DGND	31	32	
	33	34	
	35	36	SCANCLK
SERCLK	37	38	
	39	40	
	41	42	
RSVD	43	44	
	45	46	RSVD
	47	48	
	49	50	

Figure 3-4. SCXI-1102 Rear Signal Connector Pin Assignments

Rear Signal Connector Descriptions

The rear signal connector on the cabled module is the interface between the DAQ board and all modules in the SCXI chassis.

Pin	Signal Name	Direction	Description
1, 2	AOGND	Output	Negative Module Analog Output—With software, you can configure these pins to connect to the analog reference.
3	MCH0+	Output	Positive Module Analog Output—This pin connects to the positive side of the differential analog input channel 0 of the DAQ board.
4	MCH0-	Output	Negative Module Analog Output—In the reset state of the module, this pin is configured to connect to the analog reference.
19	OUTREF	Output	Negative Module Analog Output—With software, you can configure this pin to connect to the analog reference.
24, 33	DGND	—	Digital Ground—These pins supply the reference for DAQ board digital signals and are tied to the module digital ground.
25	SERDATIN	Input	Serial Data In—The DAQ board uses this signal to program modules in all slots.
26	SERDATOUT	Output	Serial Data Out—A cabled module uses this signal to return data from any module to the DAQ board.
27	DAQD*/A	Input	DAQ Board Data/Address Line—The DAQ board asserts this signal to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	Input	Slot 0 Select—The DAQ board asserts this signal low to indicate that the SERDATIN line information is going to the Slot 0 controller instead of a module.
36	SCANCLK	Input	Scan Clock—A rising edge indicates to the scanned SCXI module that the DAQ board has taken a sample and causes the module to advance channels.
37	SERCLK	Input	Serial Clock—This signal clocks the data on the SERDATIN and SERDATOUT lines.
43, 46	RSVD	Input	Reserved

All other pins are not connected.

The signals on the rear signal connector are analog output signals, digital I/O signals, or digital timing signals. The following section contains signal connection guidelines for each of these groups.

Analog Output Signal Connections

Pins 1 through 4 and pin 19 of the rear signal connector are analog output signal pins. Pins 1 and 2 are AOGND signal pins, pin 4 is the MCH0- pin, and pin 19 is the OUTREF pin. With software, you can configure pin 1, 2, 4 or 19 to connect to the module's analog ground (AGND). You can use the pin that is connected to AGND as a general analog power ground tie point to the SCXI-1102, if necessary.

Warning: *The SCXI-1102 analog outputs are not overvoltage-protected. Applying external voltages to these outputs can damage the SCXI-1102. National Instruments is* NOT *liable for any damages resulting from such signal connections.*

Note: *The SCXI-1102 analog outputs are short-circuit protected.*

Digital I/O Signal Connections

Pins 24 through 27, 29, 33, 36, 37, 43, and 46 constitute the digital I/O lines of the rear signal connector.

The SCXI-1102 digital input and output signals match the digital I/O lines of the MIO-16 boards. When used with an SCXI-1341, SCXI-1342, or SCXI-1344 cable assembly, the SCXI-1102 signals match the digital lines of the Lab-NB/PC/PC+, the PC-LPM-16, and the Lab-LC boards, respectively. Table 3-1 lists the equivalencies. For more detailed information, consult your cable installation guide.

Table 3-1. SCXIbus to SCXI-1102 Rear Signal Connector to DAQ Board Pin Equivalencies

SCXIbus Line	SCXI-1102 Rear Signal Connector	MIO-16	Lab Boards	PC-LPM-16
MOSI	SERDATIN	ADIO0	PB4	DOUT4
D*/A	DAQD*/A	ADIO1	PB5	DOUT5
INTR*	SLOT0SEL*	ADIO2	PB6	DOUT6
SPICLK	SERCLK	EXTSTROBE*	PB7	DOUT7
MISO	SERDATOUT	BDIO0	PC1	DIN6

Digital Timing Signal Connection

The SCXI-1102 uses pin 36, SCANCLK, to increment to the next channel after each DAQ board conversion during scanning.

Digital Signal Specifications

The following specifications and ratings apply to the digital signals:

- Absolute maximum voltage input rating   5.5 V with respect to DGND

- Digital input specifications (referenced to DGND):

    – V_{IH} input logic high voltage   2 V minimum

    – V_{IL} input logic low voltage   0.8 V maximum

    – I_I input current leakage   ±1 µA maximum

- Digital output specifications (referenced to DGND):

    – V_{OH} output logic high voltage   3.7 V minimum at 4 mA maximum

    – V_{OL} output logic low voltage   0.4 V maximum at 4 mA maximum

Chapter 4
Theory of Operation

This chapter contains a functional overview of the SCXI-1102 module and explains the operation of each functional unit making up the SCXI-1102.

Functional Overview

The block diagram in Figure 4-1 illustrates the key functional components of the SCXI-1102.
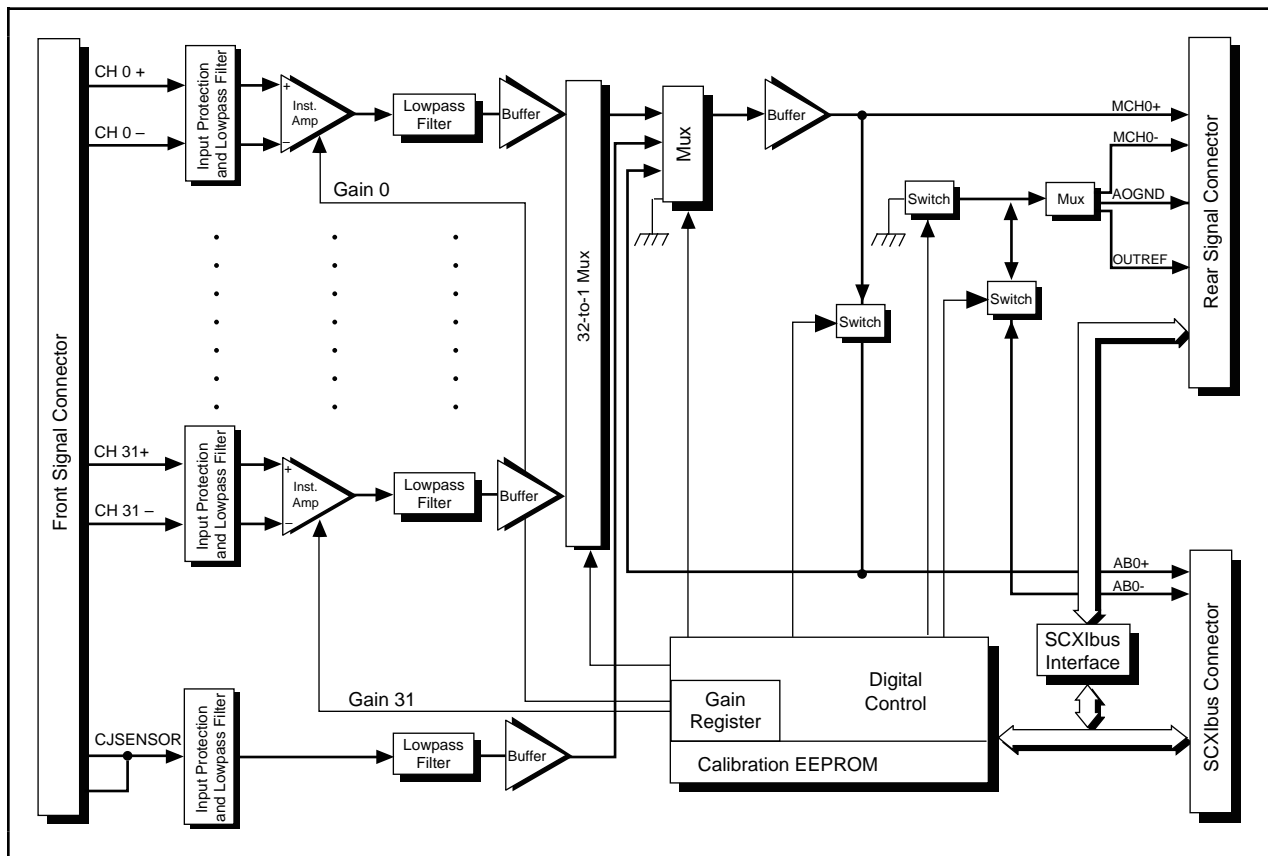

Figure 4-1. SCXI-1102 Block Diagram

The major components of the SCXI-1102 are as follows:

- Rear signal connector

- SCXIbus connector

- SCXIbus interface

- Digital control circuitry

- Analog circuitry

The SCXI-1102 consists of 32 multiplexed input channels, each with a software-programmable gain of 1 or 100. Each input channel has its own lowpass filter with a cutoff frequency of 1 Hz. The SCXI-1102 also has a digital section for automatic control of channel scanning, temperature sensor selection, and gain selection.

Rear Signal Connector, SCXIbus Connector, and SCXIbus Interface

The SCXIbus controls the SCXI-1102. The SCXIbus interface connects the rear signal connector to the SCXIbus, allowing a DAQ board to control the SCXI-1102 and the rest of the chassis.

Digital Control Circuitry

The digital control circuitry consists of the Address Handler and the following registers: Module ID, Configuration, Status, EEPROM, Gain, and Channel. The Address Handler controls which register is being addressed. The Module ID Register contains the module ID 30 decimal, a code unique to the SCXI-1102. The Configuration Register configures the SCXI-1102 for the desired scanning mode and connection to the rear signal connector. The Status Register indicates whether the input channels have settled after a change in the gains. The EEPROM Register is the address for interfacing with the module EEPROM, which contains calibration information. The Gain Register selects between gains of 1 or 100 for each of the 32 channels. The Channel Register selects a channel for a single measurement or a start channel for a scan. Refer to *Software Programming Choices* in Chapter 1, *Introduction*, of this manual to learn about options for programming the control circuitry.

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 CJSENSOR channel also has a buffered lowpass filter but has no amplifier. The channels and CJSENSOR are multiplexed to a single output buffer.

Analog Input Channels

Each of the 32 analog input channels feeds to a separate amplifier with a programmable gain of 1 or 100. Then the signal passes through a 3-pole lowpass filter with a cutoff frequency of 1 Hz.

Note: *Because of the 1 Hz bandwidth of the input channels, you must wait approximately 3 s after changing the gains before the channels settle and you can take an accurate measurement. NI-DAQ automatically reads the Status Register to determine when the module output has settled.*

The temperature sensor consists of a thermistor located on the SCXI-1300 or SCXI-1303 terminal block. The temperature sensor is for cold-junction compensation of thermocouples. The CJSENSOR channel also passes through a 1 Hz lowpass filter to reject unwanted noise. Along with the other 32 input channels, the CJSENSOR is multiplexed to the output buffer, where it can be read by the DAQ board.

For measurement accuracy of 0.012% of full scale, the minimum scan interval is 3 μs. This is the smallest interval in which you can switch between analog channels on the module and still measure accurate voltages. The 3 μs scan interval gives you a maximum sampling rate of 333 kHz. Because this rate is much higher than the 1 Hz bandwidth of a single SCXI-1102 channel, you can sample multiple channels on multiple SCXI modules without undersampling one of the SCXI-1102 channels.

Analog Bus Switch

The SCXI-1102 contains switches to place its analog output on the SCXIbus to pass the output to the SCXI module cabled to the DAQ board. The SCXI-1102 also contains switches to receive a signal placed on the SCXIbus by another SCXI module. The output buffer of the cabled module drives a received signal onto the MCH0+ line of the rear signal connector so that the DAQ board can read it. When a signal passes on the SCXIbus from the scanned SCXI module to the cabled SCXI module, the measurement is known as *indirect scanning*.

Chapter 5
Calibration

This chapter discusses the calibration procedures for the SCXI-1102.

Overview

Using the procedure described in this chapter, you will be able to calculate the gain error and voltage offset on a per channel per gain basis. You can store these constants in the onboard EEPROM for future use and for automatic calibration when you are using National Instruments software. The module comes from the factory with factory-determined calibration constants in the EEPROM. However, it is recommended that you recalibrate a module at least once per year or when you operate the module outside of the 20° to 30° C temperature range. If you are not using National Instruments software to store the calibration data in the EEPROM, refer to the *SCXI-1102 Register-Level Programmer Manual* for a more a detailed description of the EEPROM.

In order to calibrate the SCXI-1102, you will need to apply precision voltages to the channel inputs and/or ground the channel inputs.

Calibration Procedure

Calibration Equipment Requirements

According to standard practice, the equipment you use to calibrate the SCXI-1102 should be 10 times as accurate as the SCXI-1102. Calibration equipment with four times the accuracy of the SCXI-1102 is generally considered acceptable. To calibrate the SCXI-1102, you need a voltmeter with the following specifications:

- Accuracy   ±6 ppm standard reading
                          ±15 ppm sufficient reading

- Range   -10 to +10 V

- Resolution   8.5 digits

A multiranging 8.5-digit digital multimeter (DMM) can perform the necessary calibrations.

To make sure that the DMM does not introduce an additional offset, you can determine the offset error of the DMM by shorting its leads together and reading the measured value. This value, the DMM offset, must be subtracted from all subsequent measurements.

You will need to measure the module's output between MCH0+ and MCH0-. To access these pins, connect a 50-pin ribbon cable from the CB-50 I/O connector block to the module rear signal connector or to the rear signal adapter. Then connect to MCH0+ and MCH0- on the CB-50 pins 3 and 4, respectively.

Gain and Offset Calibration

To determine the offset and gain calibration factors of the SCXI-1102 for a given gain, perform the following steps for a two-point calibration. For two-point calibration, it is best to use input voltages that correspond to the signal range of interest. For example, if you are planning to measure bipolar voltages over the module's full input range, choose -9.9 V/G (negative full-scale) and +9.9 V/G (positive full-scale) as your two input voltages.

1. Select the desired channel. Set the channel gain to the desired gain.

2. Apply the input for the first calibration point. To select negative full scale as the calibration point, apply -9.9 V/G for an input voltage.

    a. Apply the input voltage to the channel selected in step 1.

        Note: ***To make one of your calibration points the zero point, connect the positive and negative channel leads to one of the chassis ground pins on the front connector or terminal block.***

    b. Measure the input voltage with the DMM. Call the measured voltage `input1`.

        Note: ***If you are using a calibrator that supplies accurate voltages, you can simply use the known applied voltage for `input1` instead of measuring.***

    c. Measure the module output between MCH0+ and MCH0- with the DMM. Call the measured voltage `output1`.

3. Repeat step 2, applying the input for the second calibration point. Call the measured voltages `input1` and `output2`. To select positive full scale as the calibration point, repeat step 2 and apply +9.9 V/G.

4. You now have two pairs of voltages (`input1`, `output1`) and (`input2`, `output2`). Each pair consists of an input voltage and an output voltage.

5. Convert the output voltages from volt units to your DAQ board binary unit. You must take into consideration the polarity of your DAQ board, its resolution (12 bits or 16 bits), and gain. For example, if you are using the 12-bit AT-MIO-16E-2 in bipolar mode with the gain set to G_{MIO}, your output voltages for the autozeroing option will be represented in binary units as given by the following formula:

$$Binary = \frac{Output}{5\ V} \cdot 2^{12} \cdot G_{MIO}$$

For other DAQ boards, refer to your DAQ board user manual to determine the appropriate formula.

6. You now have a new set of pairs referred to as voltage binary pairs (`input1`, `bin_output1`) and (`input2`, `bin_output2`). Pass these pairs to the `SCXI_Cal_Constants` function or VI as described in your software user manual.

Notes: ***When you use 0 V and positive full-scale for your two calibration points, you eliminate the error at 0 V and at positive full-scale voltage. However, because of nonlinearity, the error at the negative full-scale voltage will be two times the nonlinearity error. This is also true for the positive full-scale voltage if you use the negative full-scale voltage and 0 V as your two calibration points.***

When you make a measurement using National Instruments software, the driver automatically uses the calibration constants to correct the measured voltages.

Sample Program for Calibration

The following is a sample C program that implements the procedure discussed in the previous section and `SCXI_Cal_Constants`:

```
/*  This sample program assists the user in calibrating the SCXI-1102.  The calibration
    constants are stored only in NI-DAQ memory.  The (input, output) voltage pairs read by a
    DMM must be entered by hand.  Before running this program,you must run WDAQCONF or
    DAQCONF to set up the DAQ board that will communicate with the SCXI-1102.

    This program is written for the four-slot SCXI-1000 chassis.  The program prompts for all
    required configuration information about the SCXI chassis. */

#include <ansi_c.h>
#include <dataacq.h>

#define SCXI1102    30                          /* the SCXI-1102 module ID */
#define TWOPOINT    2
#define NIDAQMEM    0

void main()
{
    char    entry[4];
    int     SCXI_Chassis_ID,
            moduleSlot,                   /* chassis slot of module
                                                 to calibrate */
            moduleChan;
    long    modulesPresent[] = {-1, -1, -1, -1};
    short   operatingModes[] = {0, 0, 0, 0},
            connectionMap[] = {0, 0, 0, 0},
            commPath,                           /* DAQ board that communicates with
                                                SCXI chassis */
            dummyRangeCode = 0,
            dummyDAQboard,
            dummyDAQchan = 0,
            dummyDAQgain = 1,
            dummyDAQrange,                      /* These dummy variables would be
                                                   used if the measurement actually
                                                   came from a DAQ board and not
                                                   an external DMM. */
            ret;
    double  scale,
            gain,
            vinput1,
            voutput1,
            vinput2,
```

```
            voutput2,
            bin_output1,
            bin_output2,
            bin_offset,
            gainerr,
            offset;

   do
   {
       printf("Enter the slot of the SCXI-1102:  ");
       fflush(stdin);
       ret = scanf("%d", &moduleSlot);
   } while (!ret || moduleSlot < 1 || moduleSlot > 4);
   modulesPresent[moduleSlot - 1] = SCXI1102;
   do
   {
       printf("Enter the chassis ID of the chassis containing the SCXI-1102:  ");
       fflush(stdin);
       ret = scanf("%d", &SCXI_Chassis_ID);
   } while (!ret);
   commPath = SCXI_Chassis_ID;
   do
   {
       printf("Enter the device number of the DAQ board communicating \n");
       printf("with the chassis (default %d):  ", SCXI_Chassis_ID);
       fflush(stdin);
       fgets(entry, 3, stdin);
       if (strlen(entry) - 1) commPath = atof(entry);
   } while (!commPath);
   dummyDAQboard = connectionMap[moduleSlot - 1] = commPath;
                                            /* Since the DAQ board is not used
                                            to acquire data, the
                                            connectionMap does not need to be
                                            accurate. */
   dummyDAQrange = 5.0 / dummyDAQgain;
   scale = pow(2.0, 12.0) * dummyDAQgain / 5; /* factor for converting to format
                                            of 12-bit bipolar DAQ board with
                                            5 V full scale*/
   SCXI_Set_Config(SCXI_Chassis_ID, 0, 0, 1, commPath, 4,
                   modulesPresent, operatingModes, connectionMap);
                                            /* Set up communication path
                                            to  module. */
   SCXI_Reset(SCXI_Chassis_ID, moduleSlot);
                                            /* In reset state, the module
                                            will drive the MCH0+ output */
   SCXI_Single_Chan_Setup(SCXI_Chassis_ID, moduleSlot, 0, dummyDAQboard);
                                            /* This is necessary only so that
                                            SCXI_Change_Chan won't return
                                            an error. */
   for (moduleChan = 0; moduleChan < 31; moduleChan++)
   {
       for (gain = 1; gain <= 100; gain = gain + 99)
       {
           SCXI_Change_Chan(SCXI_Chassis_ID, moduleSlot, moduleChan);
           SCXI_Set_Gain(SCXI_Chassis_ID, moduleSlot, moduleChan, gain);
                                            /* Select the channel and gain. */
           printf("Apply input voltage for point 1, channel %d, gain %.0f.\n",
                   moduleChan, gain);
           do
           {
               printf("Enter SCXI-1102 input voltage:  ");
               fflush(stdin);
               ret = scanf("%lf", &vinput1);     /* User enters vinput1. */
           } while (!ret);
```

```
        do
        {
            printf("Enter SCXI-1102 output voltage:  ");
            fflush(stdin);
            ret = scanf("%lf", &voutput1);    /* User enters voutput1. */
        } while (!ret);

        printf("Apply input voltage for point 2, channel %d, gain %.0f.\n",
                moduleChan, gain);
        do
        {
            printf("Enter SCXI-1102 input voltage:  ");
            fflush(stdin);
            ret = scanf("%lf", &vinput2);     /* User enters vinput2. */
        } while (!ret);
        do
        {
            printf("Enter SCXI-1102 output voltage:  ");
            fflush(stdin);
            ret = scanf("%lf", &voutput2);    /* User enters voutput2. */
        } while (!ret);

        bin_output1 = voutput1 * scale;
        bin_output2 = voutput2 * scale;        /* Convert to format of DAQ board. */
        SCXI_Cal_Constants(SCXI_Chassis_ID, moduleSlot, moduleChan,
                            TWOPOINT, NIDAQMEM, dummyRangeCode, gain,
                            dummyDAQboard, dummyDAQchan, dummyDAQgain, 1,
                            vinput1, bin_output1, vinput2, bin_output2,
                            &bin_offset, &gainerr);
                                            /* Calculate offset and gain error. */
        offset = bin_offset / scale;       /* Convert from DAQ board format. */
        printf("Calculated offset %f V, gain error %f%% ", offset, gainerr);
        printf("and stored in NI-DAQ memory.\n\n");
    }
  }
}
```

Appendix A
Specifications

This appendix lists the specifications for the SCXI-1102. These specifications are typical at 25° C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels .... 32 differential
Input signal ranges .... ±100 mV (gain = 100) or ±10 V (gain = 1)
Max working voltage (signal + common mode) .... Each input should remain within ±10 V
Input damage level .... ±42 V
    Inputs protected .... CH<0..31>, CJSENSOR

Transfer Characteristics

Nonlinearity .... 0.005% FSR
Offset error
    Gain = 1
        After calibration .... 150 μV max
        Before calibration... 600 μV
    Gain = 100
        After calibration .... 15 μV max
        Before calibration... 100 μV
Gain error (relative to calibration reference)
    Gain = 1
        After calibration .... 0.015% of reading max
        Before calibration... 0.04% of reading
    Gain = 100
        After calibration .... 0.017% of reading max
        Before calibration... 0.1% of reading

Amplifier Characteristics

Input impedance
    Normal powered on.. > 1 GΩ
    Powered off .... 10 kΩ
    Overload.. 10 kΩ
Input bias current .... ±0.5 nA
Input offset current .... ±1.0 nA
CMRR
    50 to 60 Hz, either gain .... 110 dB
    0 Hz, gain 1 .... 75 dB min
    0 Hz, gain 100 .... 100 dB min
Output range .... ±10 V
Output impedance .... 91 Ω

Dynamic Characteristics

Bandwidth .... 1 Hz
Scan interval (per channel, any gain)
     0.012%[1] ....3 μs
     0.0061%[2] ....10 μs
System noise (related to input) ....
     Gain = 1 .... 50 μVrms
     Gain = 100 .... 5 μVrms

Filters

Cutoff frequency (-3 dB) .... 1 Hz
NMR (60 Hz) .... 40 dB
Step response (either gain)
     To 0.1% .... 1 s
     To 0.01% .... 10 s

Stability

Recommended warm-up time .... 20 min.
Offset temperature coefficient
     Gain = 1 .... 20 μV/°C
     Gain = 100 .... 1 μV/°C
Gain temperature coefficient .... 10 ppm/°C

Physical

Dimensions .... 3.0 by 17.2 by 20.3 cm (1.2 by 6.8 by 8.0 in.)
I/O connector .... 50-pin male ribbon cable rear connector
                                                  96-pin male DIN C front connector

Environment

Operating temperature .... 0° to 50° C
Storage temperature .... -55° to 150° C
Relative humidity .... 5% to 90% noncondensing

---

[1] Includes effects of AT-MIO-16E-2 using 1 or 2 m SCXI cable assembly.
[2] Includes effects of AT-MIO-16X using 1 or 2 m SCXI cable assembly.

Appendix B
Customer Communication

_____

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

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Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 71 11
Finland	90 527 2321	90 502 2930
France	1 48 14 24 24	1 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Italy	02 48301892	02 48301915
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	95 800 010 0793	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 20 51 51	056 20 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	01635 523545	01635 523154

Technical Support Form

_____

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____   Phone (___)_____

Computer brand _____   Model _____   Processor _____

Operating system _____

Speed _____ MHz   RAM _____ MB   Display adapter _____

Mouse _____ yes _____ no   Other adapters installed _____

Hard disk capacity _____ MB   Brand _____

Instruments used _____

National Instruments hardware product model _____   Revision _____

Configuration _____

National Instruments software product _____   Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

SCXI-1102 Hardware and Software Configuration Form

_____

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

- LabVIEW, LabWindows,   _____
  LabWindows/CVI, or
  NI-DAQ Version

- PCMCIA Software Version   _____

Other Products

- Computer Make and Model   _____

- Microprocessor   _____

- Clock Frequency   _____

- Type of Video Board Installed   _____

- Operating System   _____

- Operating System Version   _____

- Programming Language   _____

- Programming Language Version   _____

- Other Boards in System   _____

- Base I/O Address of Other Boards   _____

- DMA Channels of Other Boards   _____

- Interrupt Level of Other Boards   _____

Documentation Comment Form

_____

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: **SCXI-1102 User Manual**

Edition Date: **January 1996**

Part Number: **320975A-01**

Please comment on the completeness, clarity, and organization of the manual.

_____

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If you find errors in the manual, please record the page numbers and describe the errors.

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Thank you for your help.

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Glossary

_____

Prefix	Meaning	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^{12}

+5 V	+5 volt signal
°	degrees
Ω	ohms
%	percent
A	amperes
AC	alternating current
ACH	analog input channel signal
A/D	analog-to-digital
ADC	A/D converter
AIGND	analog input ground signal
AOGND	analog output ground signal
AWG	American Wire Gauge
BCD	binary-coded decimal
C	Celsius
CE	card enable signal
CGND	chassis ground signal
CJSENSOR	cold-junction sensor
CLK	clock input signal
CMOS	complementary metallic oxide semiconductor
CMRR	common-mode rejection ratio
D/A	digital-to-analog
DAQ	data acquisition
DAQD*/A	data acquisition digital to analog signal
DC	direct current
DGND	digital ground signal
DIFF	differential configuration
DIN	digital input signal
DMA	direct memory access
DNL	differential nonlinearity
DOUT	digital output signal
EISA	Extended Industry Standard Architecture
ESP	Engineering Software Package
EXTCONV	external control signal to trigger A/D conversions

EXTINT	external interrupt signal
F	farads
FIFO	first-in-first-out
G	gain
GATE	gate input signal
hex	hexadecimal
Hz	hertz
in.	inches
I/O	input/output
ISA	Industry Standard Architecture
LED	light-emitting diode
LSB	least significant bit
MB	megabytes of memory
MSB	most significant bit
NC	not connected (signal)
NRSE	nonreferenced single ended
OUT	output signal
OUTREF	output reference signal
PCMCIA	Personal Computer Memory Card International Association
RAM	random-access memory
RMA	Return Material Authorization
rms	root mean square
RSVD	reserved bit
S	samples
s	seconds
SCANCLK	scan clock signal
SCXI	Signal Conditioning eXtensions for Instrumentation
SERCLK	serial clock signal
SERDATIN	serial data input signal
SERDATOUT	serial data output signal
SLOT0SEL*	Slot 0 select signal
TTL	transistor-transistor logic
V	volts
VCC	positive supply voltage from the PCMCIA bus (usually +5V)
VDC	volts, direct current
VI	virtual instrument
V_{IH}	volts, input high
V_{IL}	volts, input low
V_{in}	volts in
V_{OH}	volts, output high
V_{OL}	volts, output low

Index

Numbers

A

B

C

D