DAQ

SCXI™-1102/B/C User Manual

32-Channel Thermocouple Amplifier Modules

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Table of Contents

About This Manual

Organization of This Manual ix
Conventions Used in This Manual x
National Instruments Documentation xi
Customer Communication xii

Chapter 1
Introduction

About the SCXI-1102/B/C Modules 1-1
What You Need to Get Started 1-2
Software Programming Choices 1-3
National Instruments Application Software 1-3
NI-DAQ Driver Software 1-4
Register-Level Programming 1-5
Optional Equipment 1-5
Custom Cables 1-6
Unpacking 1-6

Chapter 2
Configuration and Installation

Module Configuration 2-1
Digital Configuration 2-3
Analog Configuration 2-4
Current-Loop Receivers 2-4
Hardware Installation 2-6

Chapter 3
Signal Connections

Front Connector 3-1
Front Connector Signal Descriptions 3-3
Analog Input Signal Connections 3-3
Ground-Referencing Your Signals 3-4
Cold-Junction Sensor Connection 3-6

Rear Signal Connector 3-7
Rear Signal Connector Descriptions 3-8
Analog Output Signal Connections 3-9
Digital I/O Signal Connections 3-9
Digital Timing Signal Connection 3-10
Digital Signal Specifications 3-10

Chapter 4
Theory of Operation

Functional Overview 4-1
Rear Signal Connector, SCXIbus Connector, and SCXIbus Interface 4-2
Digital Control Circuitry 4-2
Analog Circuitry 4-3
Analog Input Channels 4-3
Analog Bus Switch 4-4

Chapter 5
Calibration

Overview 5-1
Calibration Procedure 5-1
Calibration Equipment Requirements 5-1
Gain and Offset Calibration 5-2

Appendix A
Specifications

Appendix B
Calibration Sample Program

Appendix C
Customer Communication

Glossary

Index

Figures

Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware 1-4
Figure 2-1. SCXI-1102/B/C Module Parts Locator Diagram (1102 shown) 2-2
Figure 2-2. Removing the SCXI Module Cover 2-4
Figure 2-3. Bent and Trimmed Resistor 2-5

Figure 3-1. SCXI-1102/B/C Module Front Connector Pin Assignments 3-2
Figure 3-2. Ground-Referenced Signal Connection 3-5
Figure 3-3. Floating Signal Connection Referenced to Chassis Ground 3-6
Figure 3-4. SCXI-1102/B/C Module Rear Signal Connector Pin Assignments 3-7

Figure 4-1. SCXI-1102/B/C Module Block Diagram 4-1

Tables

Table 2-1. Jumper Settings for Digital Signal Connection 2-3

Table 3-1. SCXIbus to SCXI-1102/B/C Module Rear Signal Connector to DAQ Device Pin Equivalencies 3-10

About This Manual

This manual describes the electrical and mechanical aspects of the SCXI-1102 family of modules and contains information concerning their installation and operation.

The SCXI-1102 family consists of the following modules:

- SCXI-1102
- SCXI-1102B
- SCXI-1102C

Unless otherwise noted, *SCXI-1102/B/C* will hereafter refer to all three modules in the SCXI-1102 family.

The SCXI-1102/B/C modules are members of the National Instruments Signal Conditioning eXtensions for Instrumentation (SCXI) Series for the National Instruments data acquisition (DAQ) plug-in devices. These modules are designed for signal conditioning thermocouples, volt and millivolt sources, and 4–20 mA sources or 0–20 mA process-current sources. The SCXI-1102/B/C modules have 32 differential analog input channels and one cold-junction sensor channel.

Organization of This Manual

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

- Chapter 1, *Introduction*, describes the SCXI-1102/B/C modules; lists what you need to get started with your SCXI-1102/B/C module, the optional software, optional equipment, and custom cables; and explains how to unpack the SCXI-1102/B/C modules.
- Chapter 2, *Configuration and Installation*, describes how to configure the SCXI-1102/B/C jumper, how to install current-loop receivers, and how to install the SCXI-1102/B/C module into the SCXI chassis.
- Chapter 3, *Signal Connections*, describes the input and output signal connections to the SCXI-1102/B/C module via the module front connector and rear signal connector. This chapter also

includes specifications and connection instructions for the signals on the SCXI-1102/B/C connectors.

- Chapter 4, *Theory of Operation*, contains a functional overview of the SCXI-1102/B/C module and explains the operation of each functional unit making up the SCXI-1102/B/C module.
- Chapter 5, *Calibration*, discusses the calibration procedures for the SCXI-1102/B/C modules.
- Appendix A, *Specifications*, lists the specifications for the SCXI-1102/B/C modules.
- Appendix B, *Calibration Sample Program*, contains a sample program to help you calibrate your submodule.
- Appendix C, *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.

♦	The ♦ symbol indicates that the text following it applies only to specific SCXI-1102 modules.
< >	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).
☞	This icon to the left of bold italicized text denotes a note, which alerts you to important information.
⚠	This icon to the left of bold italicized text denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
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+.

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.
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*.
SCXI-1102/B/C modules	Refers to all modules in the SCXI-1102 family unless otherwise noted.
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/B/C 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 documentation—Examples of software documentation you may have are the LabVIEW and LabWindows®/CVI manual sets and the NI-DAQ documentation. After you set up your hardware system, use either the application software documentation or the NI-DAQ documentation to help you write your application. If you have a large and complicated system, it is worthwhile to look through the software documentation 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 Manual*—Read this manual for maintenance information on the chassis and installation instructions.

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 C, *Customer Communication*, at the end of this manual.

Introduction

Chapter 1

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

About the SCXI-1102/B/C Modules

- SCXI-1102
  This module is 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 three-pole lowpass filter with a 2 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 device channel.

- SCXI-1102B
  This module is for the signal conditioning of thermocouples, medium-bandwidth volt and millivolt sources, 4 to 20 mA current sources, and 0 to 20 mA process-current sources. The SCXI-1102B has 32 different analog input channels and one cold-junction sensor channel. On each channel, the SCXI-1102B has a three-pole lowpass filter with a 200 Hz cutoff frequency. Each channel also has an amplifier with a selectable gain of 1 or 100. You can multiplex the SCXI-1102B inputs to a single output, which drives a single DAQ device channel.

- SCXI-1102C
  This module is for the signal conditioning of thermocouples, high-bandwidth volt and millivolt sources, 4 to 20 mA current sources, and 0 to 20 mA process-current sources. The SCXI-1102C has 32 different analog input channels and one cold-junction sensor channel. On each channel, the SCXI-1102C has a three-pole lowpass filter with a 10 kHz cutoff frequency. Each channel also has an amplifier with a

selectable gain of 1 or 100. You can multiplex the SCXI-1102C inputs to a single output, which drives a single DAQ device channel.

The SCXI-1102/B/C modules operate with full functionality with the National Instruments MIO, Lab-PC+, PCI-1200, DAQCard-1200, and SCXI-1200 modules. You can use the PC-LPM-16 board and the DAQCard-700 with the SCXI-1102/B/C, but these devices cannot scan the module; they can only perform single-channel reads. You can multiplex several SCXI-1102/B/C 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-1102/B/C modules are listed in Appendix A, *Specifications*.

What You Need to Get Started

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

- ❑ One of the following modules:
  - SCXI-1102
  - SCXI-1102B
  - SCXI-1102C
- ❑ *SCXI-1102/B/C User Manual*
- ❑ One of the following software packages and documentation:
  - ComponentWorks
  - LabVIEW for Macintosh
  - LabVIEW for Windows
  - LabWindows/CVI for Windows
  - Measure
  - NI-DAQ for Macintosh
  - NI-DAQ for PC Compatibles
  - VirtualBench
- ❑ Your computer

Software Programming Choices

You have several options to choose from when programming your National Instruments DAQ and SCXI hardware. You can use National Instruments application software, NI-DAQ, or register-level programming.

National Instruments Application Software

ComponentWorks contains tools for data acquisition and instrument control built on NI-DAQ driver software. ComponentWorks provides a higher-level programming interface for building virtual instruments through standard OLE controls and DLLs. With ComponentWorks, you can use all of the configuration tools, resource management utilities, and interactive control utilities included with NI-DAQ.

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 DAQ hardware, is included with LabVIEW. The LabVIEW Data Acquisition VI Library is functionally equivalent to NI-DAQ software.

LabWindows/CVI features interactive graphics, 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 DAQ hardware, is included with the NI-DAQ software kit. The LabWindows/CVI Data Acquisition Library is functionally equivalent to the NI-DAQ software.

VirtualBench features virtual instruments that combine DAQ products, software, and your computer to create a stand-alone instrument with the added benefit of the processing, display, and storage capabilities of your computer. VirtualBench instruments load and save waveform data to disk in the same forms that can be used in popular spreadsheet programs and word processors.

Using ComponentWorks, LabVIEW, LabWindows/CVI, or VirtualBench 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 device, 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 your National Instruments application software.

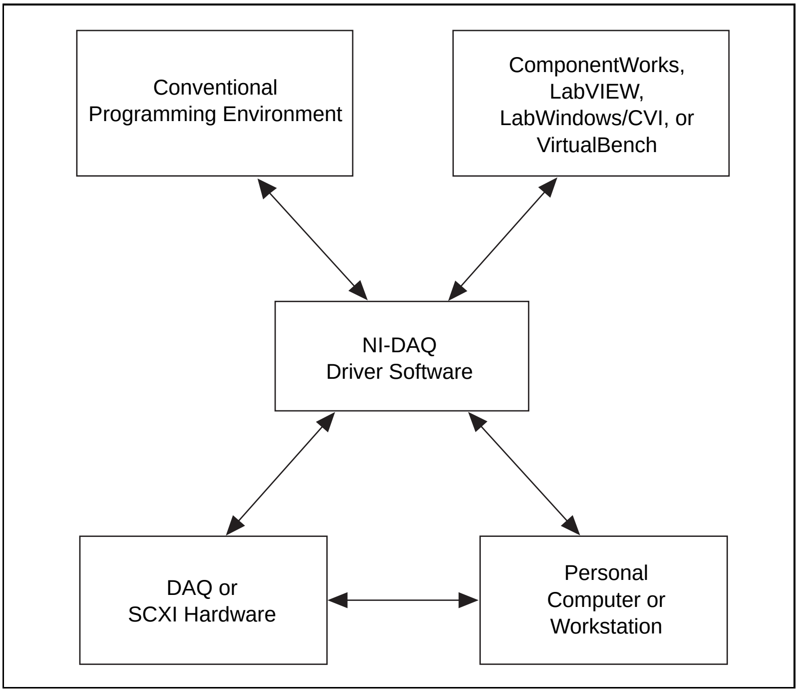


Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware

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 or other National Instruments application software to program your National Instruments DAQ hardware. Using the application software is easier than and as flexible as register-level programming and can save weeks of development time.

Optional Equipment

National Instruments offers a variety of products to use with your SCXI-1102/B/C module, as follows:

- Terminal blocks and 96-pin cables that allow you to attach input signals to your module.
- SCXI process-current resistor kit
- Cables and cable assemblies, shielded and ribbon

For more specific information about these products, refer to your National Instruments catalogue or call the office nearest you.

Custom Cables

The following table summarizes the custom cable information.

Signal Connector	SCXI–1102/B/C Connector	Mating Connector	Cable
Rear	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	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/B/C 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

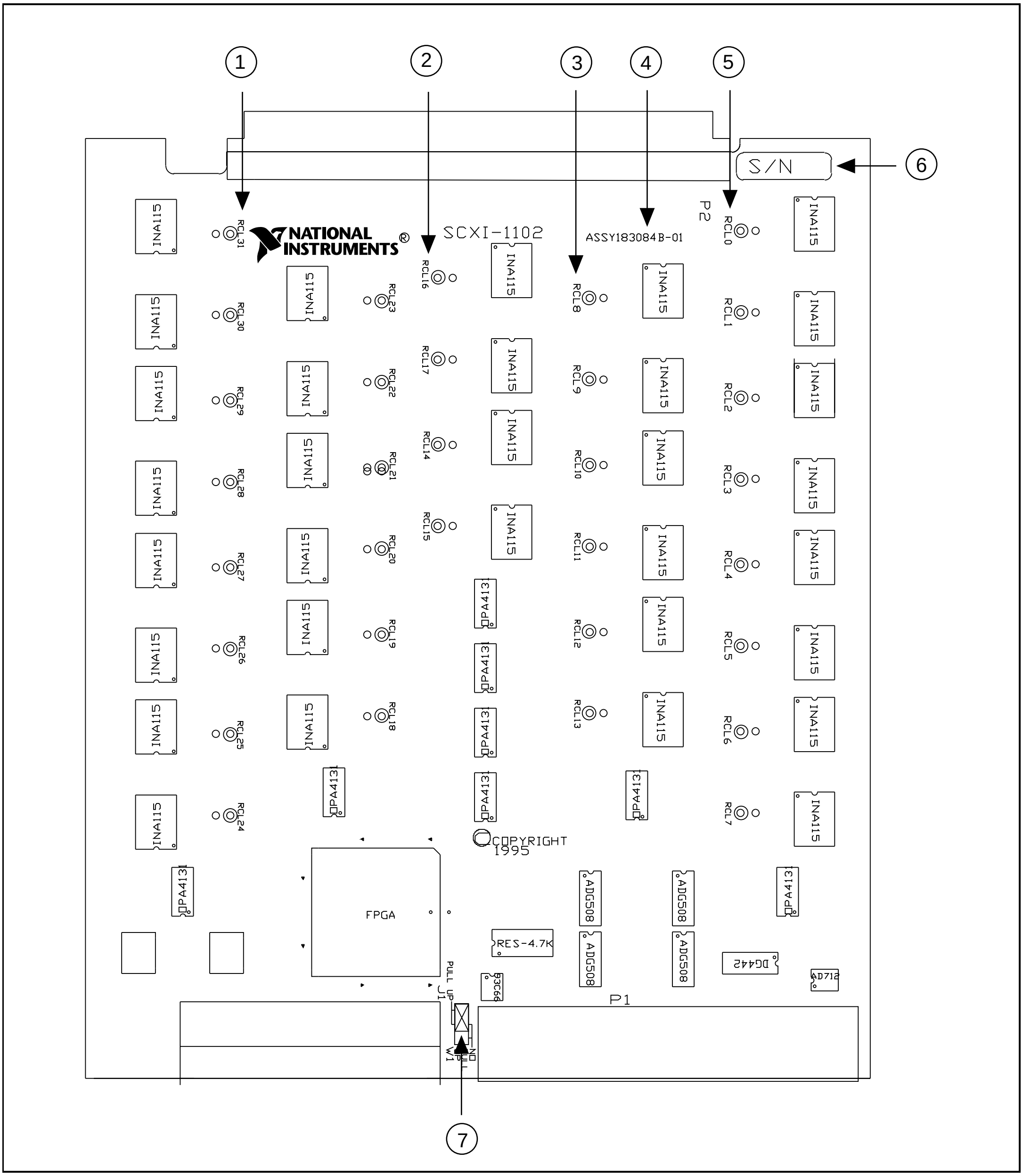
Configuration and Installation

This chapter describes how to configure your SCXI-1102/B/C jumper, how to install current-loop receivers, and how to install your SCXI-1102/B/C module into the SCXI chassis.

Module Configuration

The SCXI-1102/B/C 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, and so on) is software-programmable.



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

Figure 2-1. SCXI-1102/B/C Module Parts Locator Diagram (1102 shown)

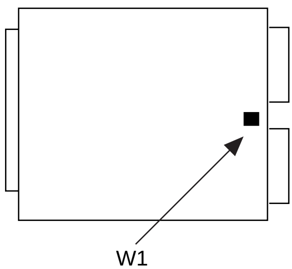
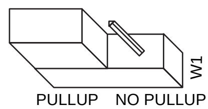
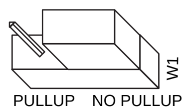
Digital Configuration

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/B/C module rear signal connector, the position of jumper W1 is irrelevant.***

The SCXI-1102/B/C modules have only one jumper—jumper W1—for communication between the DAQ device and the SCXIbus, shown in Table 2-1.

Table 2-1. Jumper Settings for Digital Signal Connection

Jumper	Description	Configuration
	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)	
	Position NO PULLUP—Use this setting for additional chassis in a multi-chassis system. No pullup resistor is connected to the SERDATOUT line.	

All SCXI modules have a jumper that corresponds to jumper W1 on the SCXI-1102/B/C module. 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/B/C module 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 device. When using multiple chassis, set the jumper to the pullup position on only one of the SCXI modules cabled to the DAQ device.

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.

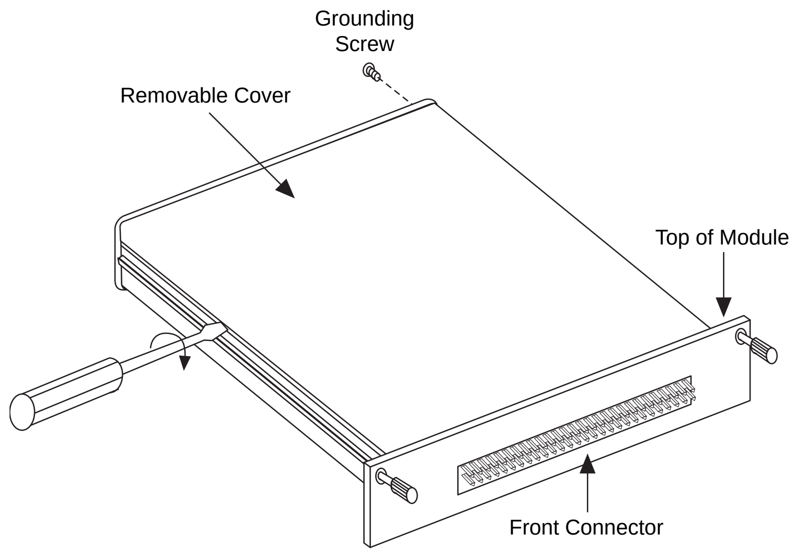


Figure 2-2. Removing the SCXI Module Cover

Analog Configuration

Current-Loop Receivers

The SCXI-1102/B/C modules have 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.

Caution: ***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.

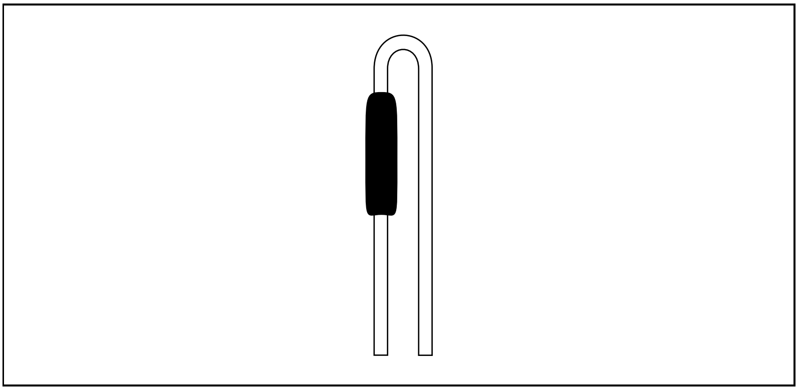


Figure 2-3. Bent and Trimmed Resistor

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/B/C module 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 C, *Customer Communication*, you are ready to install the SCXI-1102/B/C module. 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 device or disconnect it from your SCXI chassis.
2. Turn off the SCXI chassis. Do not insert the SCXI-1102/B/C module into a chassis that is turned on.
3. Insert the SCXI-1102/B/C module 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/B/C module to the top and bottom threaded strips of your SCXI chassis.
5. If this module is to be connected to an MIO-16 DAQ device, attach the connector at the metal end of the SCXI-1340 cable assembly to the rear signal connector on the SCXI-1102/B/C module. Screw the rear panel to the rear threaded strip. Attach the loose end of the cable to the MIO-16 device.

☞ **Note:** ***For installation procedures with other SCXI accessories and DAQ devices, 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/B/C module is installed. You are now ready to install and configure your software.

If you are using NI-DAQ or other National Instruments application software, refer to the installation instructions in your documentation to install and configure your software.

Signal Connections

Chapter 3

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

	A		B		C
CGND	32	CH0-	64	CH0+	96
NC	31	CH1-	63	CH1+	95
NC	30	CH2-	62	CH2+	94
NC	29	CH3-	61	CH3+	93
NC	28	CH4-	60	CH4+	92
NC	27	CH5-	59	CH5+	91
NC	26	CH6-	58	CH6+	90
NC	25	CH7-	57	CH7+	89
CGND	24	CH8-	56	CH8+	88
NC	23	CH9-	55	CH9+	87
NC	22	CH10-	54	CH10+	86
NC	21	CH11-	53	CH11+	85
NC	20	CH12-	52	CH12+	84
NC	19	CH13-	51	CH13+	83
NC	18	CH14-	50	CH14+	82
NC	17	CH15-	49	CH15+	81
CGND	16	CH16-	48	CH16+	80
NC	15	CH17-	47	CH17+	79
NC	14	CH18-	46	CH18+	78
NC	13	CH19-	45	CH19+	77
NC	12	CH20-	44	CH20+	76
NC	11	CH21-	43	CH21+	75
NC	10	CH22-	42	CH22+	74
NC	9	CH23-	41	CH23+	73
NC	8	CH24-	40	CH24+	72
NC	7	CH25-	39	CH25+	71
NC	6	CH26-	38	CH26+	70
CGND	5	CH27-	37	CH27+	69
CJSENSOR	4	CH28-	36	CH28+	68
CJSENSOR	3	CH29-	35	CH29+	67
CGND	2	CH30-	34	CH30+	66
+5 V	1	CH31-	33	CH31+	65

Figure 3-1. SCXI-1102/B/C Module 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/B/C module input channel is ±10 V/G, where G is the gain selected on the SCXI-1102/B/C module 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/B/C module 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 ±42 VAC peak or VDC.

Caution: ***Exceeding the input damage level (±42 VAC peak or VDC between input channels and chassis ground) can damage the SCXI-1102/B/C module, the SCXIbus, and the DAQ device. National Instruments is NOT liable for any injuries resulting from such signal connections.***

Applying a voltage greater than ±42 VAC peak or VDC to the SCXI-1102/B/C is an electrical shock hazard. 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.

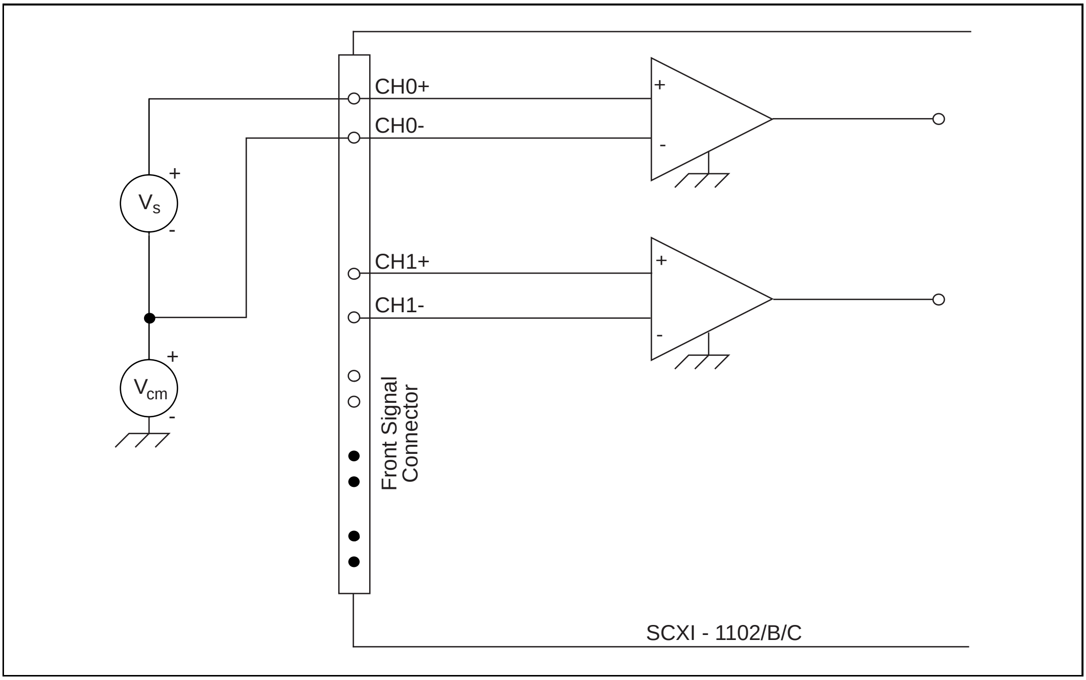


Figure 3-2. Ground-Referenced Signal Connection

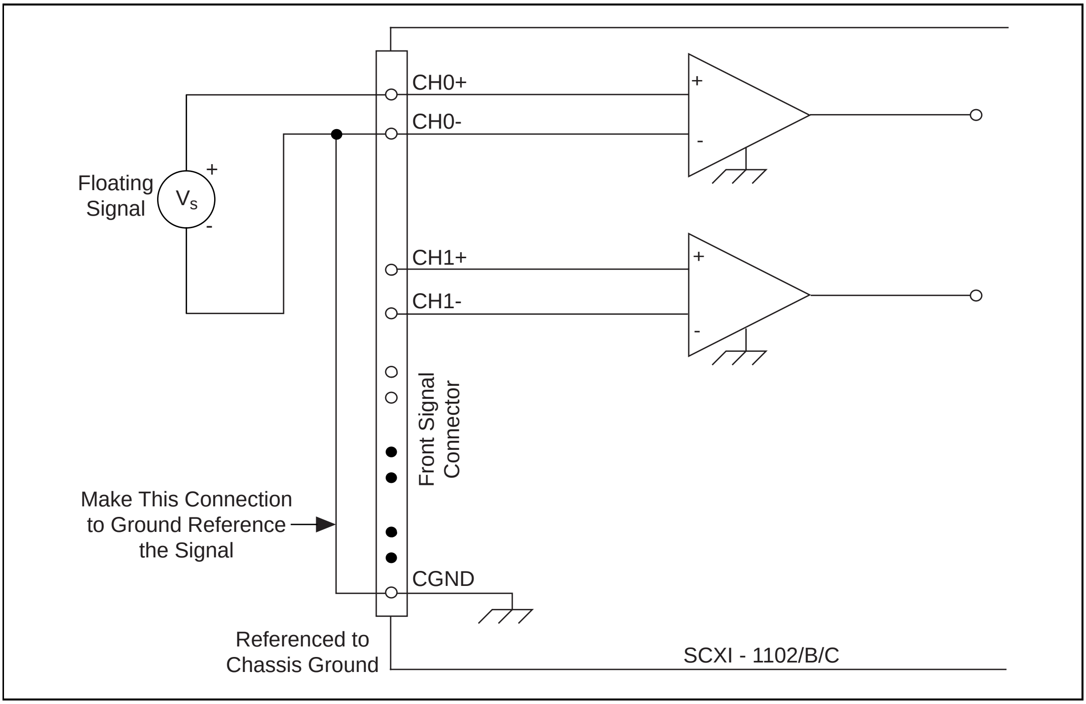


Figure 3-3. Floating Signal Connection Referenced to Chassis Ground

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/B/C module. The CJSENSOR signal is measured relative to CGND. Pins A3 and A4 are connected within the SCXI-1102/B/C 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 CJSENSOR input can damage the SCXI-1102/B/C module, the SCXIbus, and the DAQ device. 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/B/C module with a National Instruments DAQ device 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/B/C module, read this section.***

Figure 3-4 shows the SCXI-1102/B/C module rear signal connector pin assignments.

AOGND	1	2	AOGND
MCH0+	3	4	MCH0-
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
OUTREF	19	20	NC
NC	21	22	NC
NC	23	24	DGND
SERDATIN	25	26	SERDATOUT
DAQD*/A	27	28	NC
SLOT0SEL*	29	30	NC
DGND	31	32	NC
NC	33	34	NC
NC	35	36	SCANCLK
SERCLK	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

Figure 3-4. SCXI-1102/B/C Module Rear Signal Connector Pin Assignments

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.

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 device.
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 device digital signals and are tied to the module digital ground.
25	SERDATIN	Input	Serial Data In—The DAQ device 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 device.
27	DAQD*/A	Input	DAQ Device Data/Address Line—The DAQ device 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 device 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 device has taken a sample and causes the module to advance channels.

Pin	Signal Name	Direction	Description
37	SERCLK	Input	Serial Clock—This signal clocks the data on the SER-DATIN 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/B/C module, if necessary.

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

Note: ***The SCXI-1102/B/C module 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/B/C module 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/B/C module signals match the digital lines of the Lab-NB/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/B/C Module Rear Signal Connector to DAQ Device Pin Equivalencies

SCXIbus Line	SCXI-1102/B/C 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/B/C module uses pin 36, SCANCLK, to increment to the next channel after each DAQ device conversion during scanning.

Digital Signal Specifications

The following specifications and ratings apply to the digital signals:

- Absolute max voltage input rating — 5.5 V with respect to DGND
- Digital input specifications (referenced to DGND)
  - V_{IH} input logic high voltage — 2 V min
  - V_{IL} input logic low voltage — 0.8 V max
  - I_I input current leakage — ±1 µA max
- Digital output specifications (referenced to DGND)
  - V_{OH} output logic high voltage — 3.7 V min at 4 mA max
  - V_{OL} output logic low voltage — 0.4 V max at 4 mA max

Chapter 4

Theory of Operation

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

Functional Overview

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

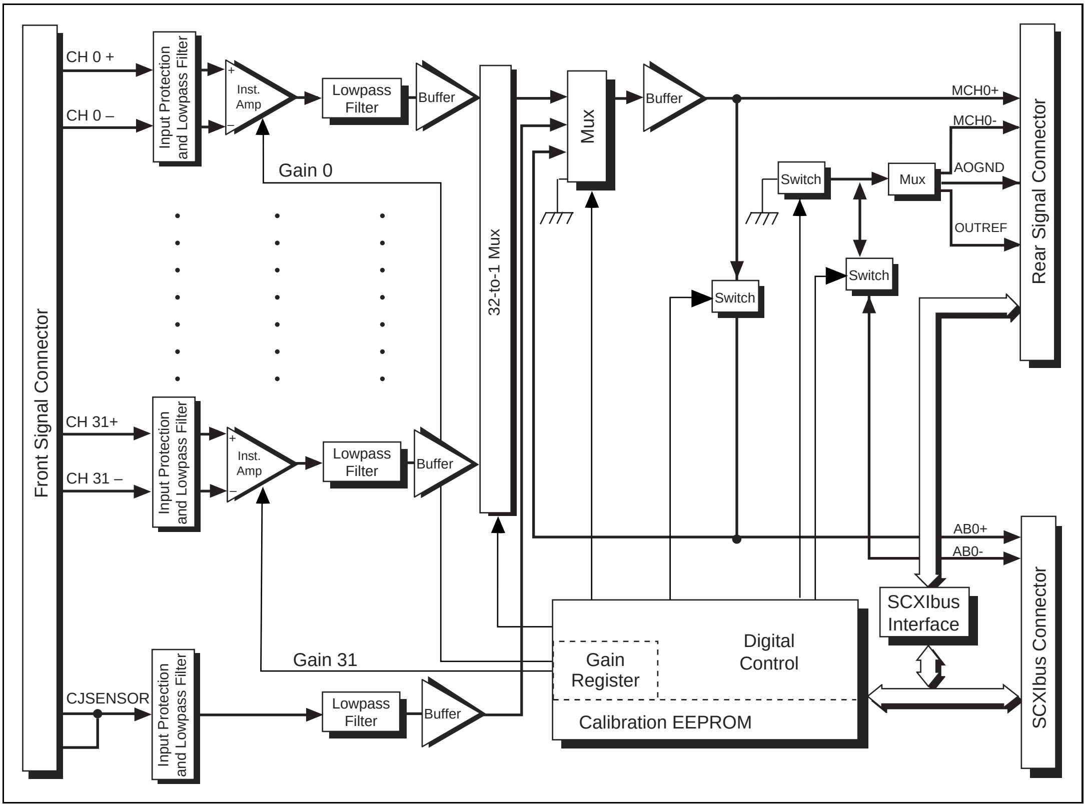


Figure 4-1. SCXI-1102/B/C Module Block Diagram

The major components of the SCXI-1102/B/C modules are as follows:

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

The SCXI-1102/B/C 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-1102/B/C modules also have 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/B/C module. The SCXIbus interface connects the rear signal connector to the SCXIbus, allowing a DAQ device to control the SCXI-1102/B/C module 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 a code unique to each type of SCXI-1102 module:

- ♦ SCXI-1102—The Module ID is 30 decimal.
- ♦ SCXI-1102B—The Module ID is 31 decimal.
- ♦ SCXI-1102C—The Module ID is 62 decimal.

The Configuration Register configures the SCXI-1102/B/C modules 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*, 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 three-pole lowpass filter.

☞ **Note:** ***Because of the 2 Hz bandwidth of the SCXI-1102 module 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. For the SCXI-1102B and SCXI-1102C modules, this time is approximately 100 ms and 1 ms, respectively.***

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 the SCXI-1102/B/C thermocouples. The CJSENSOR channel also passes through a 2 Hz lowpass filter to reject unwanted noise on the SCXI-1102/B/C. Along with the other 32 input channels, the CJSENSOR is multiplexed to the output buffer, where it can be read by the DAQ device.

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 higher than the bandwidth of a single SCXI-1102/B/C channel, you can sample multiple channels on multiple SCXI modules without undersampling one of the SCXI-1102/B/C channels.

Analog Bus Switch

The SCXI-1102/B/C modules contain switches to place their analog output on the SCXIbus to pass the output to the SCXI module cabled to the DAQ device. The SCXI-1102/B/C modules also contain 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 device 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*.

Calibration

Chapter 5

This chapter discusses the calibration procedures for the SCXI-1102/B/C modules.

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.

In order to calibrate the SCXI-1102/B/C modules, 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/B/C module should be 10 times as accurate as the SCXI-1102/B/C module. Calibration equipment with four times the accuracy of the SCXI-1102/B/C is generally considered acceptable.

To calibrate the SCXI-1102/B/C module, 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/B/C module 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 `input2` 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 device binary unit. You must take into consideration the polarity of your DAQ device, 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:

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

For other DAQ devices, refer to your DAQ device 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 documentation.

Note: ***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.

For an example of how to calibrate your module, refer to Appendix B, *Calibration Sample Program*.

Appendix
A

Specifications

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

SCXI-1102/B/C

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 of CGND

Input damage level ....±42 VAC peak or VDC
    Inputs protected............................CH<0..31>, CJSENSOR

Transfer Characteristics

Nonlinearity..0.005% FSR

Offset error
    Gain = 1
        After calibration ....300 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.................... 0.020% 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

	1102	1102B	1102C
50 to 60 Hz, either gain	110 dB	90 dB	90 dB
DC, gain 1	75 dB min	75 dB min	75 dB min
DC, gain 100	100 dB min	100 dB min	100 dB min

Output range ....±10 V

Output impedance .... 91 Ω

Dynamic Characteristics

Bandwidth... 2 Hz (1102)
200 Hz (1102B)
10 kHz (1102C)

Scan interval (per channel, any gain)

0.012% .... 3 µs

0.0061% .... 10 µs

System noise (related to input)

	1102	1102B	1102C
Gain = 1	50 µVrms	50 µVrms	70 µVrms
Gain = 100	5 µVrms	5 µVrms	10 µVrms

Filters

Cutoff frequency (–3 dB)....................2 Hz (1102)
200 Hz (1102B)
10 KHz (1102C)

NMR (60 Hz)......................................40 dB (1102)

Step response (either gain)

	1102	1102B	1102C
To 0.1%	1 s	10 ms	200 µs
To 0.01%	10 s	100 ms	1 ms

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...115 by 273 mm
(4.54 by 10.75 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

Power Requirements

5 V supply.. 15 mA max

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

Appendix B

Calibration Sample Program

This appendix contains a sample program to help you calibrate your submodule.

Sample Program for Calibration

The following is a sample C program that implements the procedure discussed in the *Gain and Offset Calibration* section and `SCXI_Cal_Constants` in Chapter 5, *Calibration*:

```
/*   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
     programed must run the NI-DAQ Configuration Utility 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 C

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a fax-on-demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at (512) 418-1111.

E-Mail Support (currently U.S. only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

	Telephone	Fax
Australia	03 9879 5166	02 9874 4455
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 5734815	03 5734816
Italy	02 413091	06 57284309
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	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	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
United States	512 794 0100	512 794 8411
United Kingdom	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 (include version number) ______________________________

Clock 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 reproduce the problem:______________________________

____

____

____

____

____

SCXI-1102/B/C 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

DAQ hardware ________________________________

Interrupt level of hardware ________________________________

DMA channels of hardware ________________________________

Base I/O address of hardware ________________________________

Programming choice ________________________________

National Instruments application software version ________________________________

Other boards in system ________________________________

Base I/O address of other boards ________________________________

DMA channels of other boards ________________________________

Interrupt level of other boards ________________________________

Other Products

Computer make and model ________________________________

Microprocessor ________________________________

Clock frequency or speed ________________________________

Type of video board installed ________________________________

Operating system version ________________________________

Operating system mode ________________________________

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/B/C User Manual*

Edition Date: August 1997

Part Number: 320975B-01

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

____
____
____
____
____
____
____

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

____
____
____
____
____
____
____

Thank you for your help.

Name ____

Title ____

Company ____

Address ____

____

Phone (___)_____________________________ Fax (___)_______________________________

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National Instruments Corporation
6504 Bridge Point Parkway
Austin, TX 78730-5039

Fax to: Technical Publications
National Instruments Corporation
(512) 794-5678

Glossary

Prefix	Meanings	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}

Numbers/Symbols

+5 V	+5 volt signal
°	degrees
Ω	ohms
%	percent
±	plus or minus

A

A	amperes
AC	alternating current
ACH	analog input channel signal

A/D	analog-to-digital
ADC	analog-to-digital converter–an electronic device, often an integrated circuit, that converts an analog voltage to a digital number
AIGND	analog input ground signal
AOGND	analog output ground signal
AWG	American Wire Gauge

B

BCD	binary-coded decimal
bus	the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the AT bus, NuBus, Micro Channel, and EISA bus.

C

C	Celsius
CE	card enable signal
CGND	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.
CJSENSOR	cold-junction sensor
CLK	clock input signal
CMOS	complementary metallic oxide semiconductor
CMRR	common-mode rejection ratio

D

D/A	digital-to-analog
DAQ	data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D and/or DIO boards plugged into a computer, and possibly generating control signals with D/A and/or DIO boards in the same computer
DAQD*/A	data acquisition digital to analog signal
dB	decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: dB=20log10 V1/V2, for signals in volts
DC	direct current
device	a plug-in data acquisition board, card, or pad that can contain multiple channels and conversion devices. Plug-in boards, PC cards, and devices such as the DAQPad-1200, which connects to your computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices, with the exception of the SCXI-1200, which is a hybrid.
DGND	digital ground signal
DIFF	differential configuration
differential input	an analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured
DIN	Deutsche Industrie Norme
DMA	direct memory access—a method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.
DMM	digital millimeter
DNL	differential nonlinearity—a measure in LSB of the worst-case deviation of code widths from their ideal value of 1 LSB

DOUT	digital output signal
drivers/driver software	software that controls a specific hardware device such as a DAQ device

E

EISA	Extended Industry Standard Architecture
ESP	Engineering Software Package
EXTCONV	external control signal to trigger A/D conversions
EXTINT	external interrupt signal

F

F	farads
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. For example, an analog input FIFO stores the results of A/D conversions until the data can be retrieved into system memory, a process that requires the servicing of interrupts and often the programming of the DMA controller. This process can take several milliseconds in some cases. During this time, data accumulates in the FIFO for future retrieval. With a larger FIFO, longer latencies can be tolerated. In the case of analog output, a FIFO permits faster update rates, because the waveform data can be stored on the FIFO ahead of time. This again reduces the effect of latencies associated with getting the data from system memory to the DAQ device.
ft	feet

G

G	gain
GATE	gate input signal

H

hex	hexadecimal
Hz	hertz—the number of scans read or updates written per second

I

in.	inches
indirect scanning	The measurement that occurs when a signal passes on the SCXIbus from the scanned SCXI module to the cabled SCXI module
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
ISA	Industry Standard Architecture

L

LED	light-emitting diode
LSB	least significant bit

M

MB	megabytes of memory
MSB	most significant bit

N

NC	not connected (signal)
NRSE	nonreferenced single-ended mode—all measurements are made with respect to a common (NRSE) measurement system reference, but the voltage at this reference can vary with respect to the measurement system ground

O

OUT	output signal
OUTREF	output reference signal

P

PCMCIA	an expansion bus architecture that has found widespread acceptance as a de facto standard in notebook-size computers. It originated as a specification for add-on memory cards written by the Personal Computer Memory Card International Association.

R

RAM	random-access memory
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
RTSI bus	real-time system integration bus—the National Instruments timing bus that connects DAQ devices directly, by means of connectors on top of the boards, for precise synchronization of functions

S

S	samples
s	seconds
SCANCLK	scan clock signal
SCXI	Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ devices in the noisy PC environment
SERCLK	serial clock signal

SERDATIN	serial data input signal
SERDATOUT	serial data output signal
signal conditioning	the manipulation of signals to prepare them for digitizing
SLOT0SEL*	Slot 0 select signal

T

TTL	transistor-transistor logic

V

V	volts
VCC	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
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

+5 V signal (table), 3-3

A

analog circuitry, 4-3 to 4-4
  analog bus switch, 4-4
  analog input channels, 4-3
analog configuration, 2-4 to 2-5
  bent and trimmed resistor (figure), 2-5
  current-loop receivers, 2-4 to 2-5
analog input signal connections, 3-3 to 3-6
  differential input signal range, 3-3 to 3-4
  exceeding input level or range (caution), 3-4
  ground-referencing of signals, 3-4 to 3-6
    floating signal connections referenced to chassis ground (figure), 3-6
    ground-referenced signal connections (figure), 3-5
  signal terminals, 3-3
analog input specifications, A-1 to A-3
  amplifier characteristics, A-2
  dynamic characteristics, A-2 to A-3
  input characteristics, A-1
  transfer characteristics, A-1 to A-2
analog output signal connections, 3-9
AOGND signal (table), 3-8

B

bent and trimmed resistor (figure), 2-5
bulletin board support, C-1

C

cables, custom, 1-6
calibration, 5-1 to 5-3
  equipment requirements, 5-1 to 5-2
  gain and offset calibration, 5-2 to 5-3
  overview, 5-1
  sample program, B-1 to B-4
CGND signal (table), 3-3
CH31+ through CH0+ signals (table), 3-3
CH31- through CH0- signals (table), 3-3
CJSENSOR signal (table), 3-3
cold-junction sensor connections, 3-6
ComponentWorks software, 1-3
configuration, 2-1 to 2-5
  analog configuration, 2-4 to 2-5
    bent and trimmed resistor (figure), 2-5
    current-loop receivers, 2-4 to 2-5
  digital configuration, 2-3 to 2-4
  hardware installation, 2-6
  parts locator diagram, 2-2
  removing SCXI module cover (figure), 2-4
current-loop receivers, 2-4 to 2-5
custom cables, 1-6
customer communication, *xii*, C-1 to C-2

D

DAQD*/A signal
  description (table), 3-8
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
DGND signal (table), 3-8
digital configuration, 2-3 to 2-4

digital control circuitry, 4-2 to 4-3
digital I/O signal connections, 3-9 to 3-10
digital signal specifications, 3-10
digital timing signal connection, 3-10
documentation
conventions used in manual, *x* to *xi*
National Instruments documentation, *xi* to *xii*
organization of manual, *ix* to *x*

E

electronic support services, C-1 to C-2
e-mail support, C-2
environment specifications, A-4
equipment, optional, 1-5

F

fax and telephone support, C-2
Fax-on-Demand support, C-2
filter specifications, A-3
floating signal connection referenced to chassis ground (figure), 3-6
front connector, 3-1 to 3-6
analog signal connections, 3-3 to 3-6
cold-junction sensor connections, 3-6
ground-referencing of signals, 3-4 to 3-6
floating signal connection referenced to chassis ground (figure), 3-6
ground-referenced signal connection (figure), 3-5
pin assignments (figure), 3-2
signal descriptions (table), 3-3
FTP support, C-1

G

gain and offset calibration, 5-2 to 5-3
ground-referencing of signals, 3-4 to 3-6
floating signal connections referenced to chassis ground (figure), 3-6
ground-referenced signal connections (figure), 3-5

I

installation. *See also* configuration.
hardware installation, 2-6
unpacking the SCXI-1102/B/C, 1-6

J

jumpers
digital configuration, 2-3 to 2-4
parts locator diagram, 2-2

L

LabVIEW software, 1-3
LabWindows/CVI software, 1-3

M

manual. *See* documentation.
MCH0+ signal (table), 3-8
MCH0- signal (table), 3-8
module configuration. *See* configuration.

N

National Instruments application software, 1-3
NI-DAQ driver software, 1-4

O

operation of SCXI-1102/B/C. *See* theory of operation.
OUTREF signal (table), 3-8

P

parts locator diagram, 2-2
physical specifications, A-3
pin assignments
  front connector (figure), 3-2
  rear connector (figure), 3-7
power requirements, A-4

R

rear signal connector, 3-8 to 3-10
  analog output signal connections, 3-9
  digital I/O signal connections, 3-9 to 3-10
  digital signal specifications, 3-10
  digital timing signal connections, 3-10
  pin assignments (figure), 3-7
  SCXIbus interface connection, 4-2
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
  signal descriptions (table), 3-8 to 3-9
register-level programming, 1-5
requirements for getting started, 1-2

S

SCANCLK signal (table), 3-8
SCXI-1102/B/C. *See also* theory of operation.
  block diagram, 4-1
  custom cables, 1-6
  features and overview, 1-1 to 1-2
  optional equipment, 1-5
  requirements for getting started, 1-2
  software programming choices, 1-3 to 1-5
    National Instruments application software, 1-3
    NI-DAQ driver software, 1-4
    register-level programming, 1-5
  unpacking, 1-6
SCXIbus connector, 4-2
SCXIbus interface, 4-2
SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
SERCLK signal
  description (table), 3-9
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
SERDATIN signal
  description (table), 3-8
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
SERDATOUT signal
  description (table), 3-8
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
settling time for channels (note), 4-3
signal connections, 3-1 to 3-10
  front connector, 3-1 to 3-6
    analog input signal connections, 3-3 to 3-6
    cold-junction sensor connections, 3-6
    ground-referencing of signals, 3-4 to 3-6
    pin assignments (figure), 3-2
    signal descriptions (table), 3-3
  rear connector, 3-7 to 3-10
    analog output signal connections, 3-9
    digital I/O signal connections, 3-9 to 3-10
    digital signal specifications, 3-10
    digital timing signal connections, 3-10
    pin assignments (figure), 3-7
    SCXIbus to SCXI-1102/B/C to DA Q board pin equivalencies (table), 3-10
    signal descriptions (table), 3-8 to 3-9
SLOT0SEL* signal
  description (table), 3-8
  SCXIbus to SCXI-1102/B/C to DAQ board pin equivalencies (table), 3-10
software programming choices, 1-3 to 1-5

National Instruments application software, 1-3
NI-DAQ driver software, 1-4
register-level programming, 1-5
specifications, A-1 to A-4
amplifier characteristics, A-2
analog input, A-1 to A-3
digital signal specifications, 3-10
dynamic characteristics, A-2 to A-3
environment, A-4
filters, A-3
input characteristics, A-1
physical, A-3
power requirements, A-4
stability, A-3
transfer characteristics, A-1 to A-2
stability specifications, A-3
system requirements, 1-2

T

technical support, C-1 to C-2
telephone and fax support, C-2
temperature sensor, 4-3
theory of operation, 4-1 to 4-4
analog circuitry, 4-3 to 4-4
analog bus switch, 4-4
analog input channels, 4-3
block diagram of SCXI-1102/B/C, 4-1
digital control circuitry, 4-2 to 4-3
functional overview, 4-1 to 4-4
rear signal connector, 4-2
SCXIbus connector, 4-2
SCXIbus interface, 4-2

V

VirtualBench software, 1-3

W

W1 jumper, configuration, 2-3 to 2-4

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