

CALIBRATING THE SCXI™-1121 WITH CALIBRATION EXECUTIVE USER GUIDE

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Introduction

This document contains step-by-step instructions for loading and running a calibration procedure for the SCXI-1121 using Calibration Executive.

What Is Calibration?

Calibration determines the measurement accuracy of a device and corrects for any measurement error. It consists of verification, adjustment, and reverification procedures. Verification measures the performance of a device and compares the results to the factory specifications of the device. National Instruments Calibration Executive automates the verification and adjustment of NI measurement devices and modules.

Why Should You Calibrate?

The accuracy of electronic components drifts with time and temperature, which can affect measurement accuracy of the module. Calibration restores the specified accuracy of the module and ensures that it still meets NI standards.

How Often Should You Calibrate?

The measurement accuracy requirements of your application determine how often you should calibrate the SCXI-1121. NI recommends that you perform a complete calibration at least once every year. You can shorten this interval to 90 days or six months based on the demands of your application.

Equipment and Other Test Requirements

This section describes the equipment, documentation, and test conditions required for calibrating the SCXI-1121.

Test Equipment

Calibration requires using a high-precision voltage standard with an accuracy of at least 50 ppm, a multiranging 5 1/2 digit digital multimeter (DMM) with an accuracy of 500 ppm, and an E Series data acquisition (DAQ) device.

The calibration procedure runs in automated mode if you use National Instruments IVI-supported DMMs and calibrators. NI recommends you use the following equipment:

- Calibrator—Fluke 5700A
- DMM—HP34401A

- 16-bit National Instruments E Series DAQ device
- 800 Ω precision resistor
- 120 Ω precision resistor with temperature coefficient < 5 ppm

If you do not have these instruments, use the accuracy requirements listed above to select a substitute calibration standard.



Note For an explanation of automated versus manual calibration, refer to Chapter 2, *Calibration Executive System Overview*, of the *Calibration Executive Software User Manual*.

Connectors

Although you can perform the calibration procedure without any special connectors, connecting and disconnecting calibration hardware is easier with the correct equipment. If you do not have custom connection hardware, you may need the following connectors:

- Terminal block such as the National Instruments SCXI-1320, SCXI-1327, or SCXI-1328
- SCXI-1349 shielded cable assembly, which includes an SH68-68-EP shielded cable and a cable adapter
- 50-pin ribbon cable
- 50-pin connector block such as the CB-50

Documentation

This section describes the documentation you need to calibrate the SCXI-1121. The following documents contain information on installing and using Calibration Executive and the SCXI-1121 module:

- *Calibration Executive Software User Manual*
- *Getting Started with SCXI*
- *DAQ Quick Start Guide*
- *SCXI Quick Start Guide*
- *SCXI-1121 User Manual*

You can download these documents from the NI Web site at ni.com/manuals.

Software

Complete the following steps to install Calibration Executive:

1. Verify that the computer and monitor are powered on and you have installed Windows 2000/NT/Me/9x.
2. Close all open applications.
3. Insert the installation Calibration Executive CD into the CD drive.
4. Choose **Run** from the **Start** menu on the desktop task bar.
5. In the command line box, type `x:\setup.exe` (where *x* is the letter of the CD drive you are using), and then click **OK**.
6. Follow the instructions that appear in the dialog boxes.

The setup program installs Calibration Executive as well as the associated files listed in Table 1.

Table 1. Calibration Executive Directories and Supporting Files

Directory Name	Contents
Calibration Executive\Procedures\SCXI-1121\Limits	Microsoft Access database that stores the calibration limits
Calibration Executive\Procedures\SCXI-1121\Support Files	Directory structure that contains the calibration procedures
Calibration Executive\Procedures\SCXI-1121\Support Files	Required support files

Test Conditions

Follow these guidelines to optimize the connections and the environment during calibration:

- Keep connections to the SCXI module as short as possible. Long cables and wires act as antennae, which conduct extra noise that can affect measurements.
- Use shielded copper wire for all cable connections to the module. Use twisted-pair wire to eliminate noise and thermal offsets.
- Maintain a temperature between 18 and 28 °C.
- Keep relative humidity below 80%.
- Allow a warm-up time of at least 30 minutes for the SCXI module and the E Series DAQ device to ensure that the measurement circuitry is at a stable operating temperature.

Calibration Procedures

This section explains how to configure and set up the module for calibration, and how to run the Calibration Executive procedure. In automated mode, the calibration procedure takes approximately one hour. In manual mode, the procedure can take as long as two hours.

Configuring the SCXI-1121 for Calibration

This section describes the analog input jumpers, gain jumpers, filter jumpers, and excitation jumpers on the SCXI-1121 module and explains how to configure these jumpers for calibration. Refer to Figures 1 and 2 to locate the jumpers on the SCXI-1121 module.

The jumpers on the SCXI-1121 are used as follows:

- Jumpers W3, W19, W29, and W41 configure the first-stage gain of input channels 0 through 3, respectively.
- Jumpers W4, W20, W30, and W42 configure the second-stage gain of input channels 0 through 3, respectively.
- Jumpers W5, W21, W31, and W43 configure the first-stage filtering of input channels 0 through 3, respectively.
- Jumpers W6 and W7, W8 and W9, W10 and W11, and W12 and W13 configure the second-stage filtering of input channels 0 through 3, respectively.
- Jumpers W14 and W15, W22 and W23, W34 and W35, and W46 and W47 configure the voltage or current mode of operation for excitation channels 0 through 3, respectively.
- Jumpers W16 and W26, W24 and W25, W36 and W37, and W48 and W49 configure the level of excitation for excitation channels 0 through 3, respectively.
- Jumpers W1 and W2, W17 and W18, W27 and W28, and W39 and W40 configure the half-bridge completion network for channels 0 through 3, respectively.



Note If you move any jumpers, be sure to restore them to their original positions after calibration.

The SCXI-1121 has five digital signal connection jumpers and 45 analog configuration jumpers. The jumper configurations for each input channel and each excitation channel are similar—only the jumper numbers are different. Therefore, when you learn how to set up one channel pair, you can set up the other channel pairs as well. The following sections describe how to configure the digital signal connection jumpers, the gain and filter

jumpers, and the excitation jumpers. Refer to Figures 1 and 2 to locate the jumpers on the SCXI-1121.

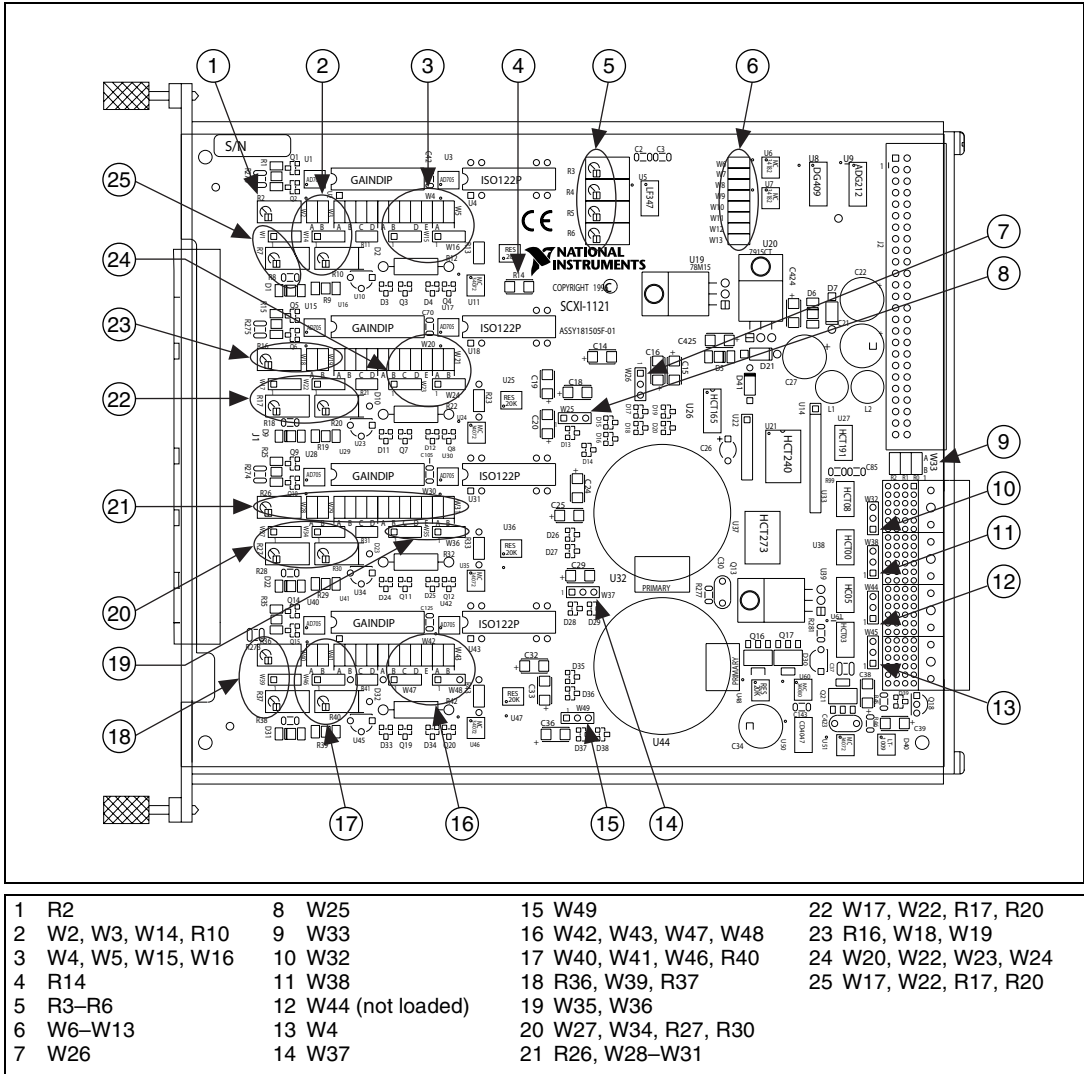


Figure 1. SCXI-1121 Jumper Locator Diagram

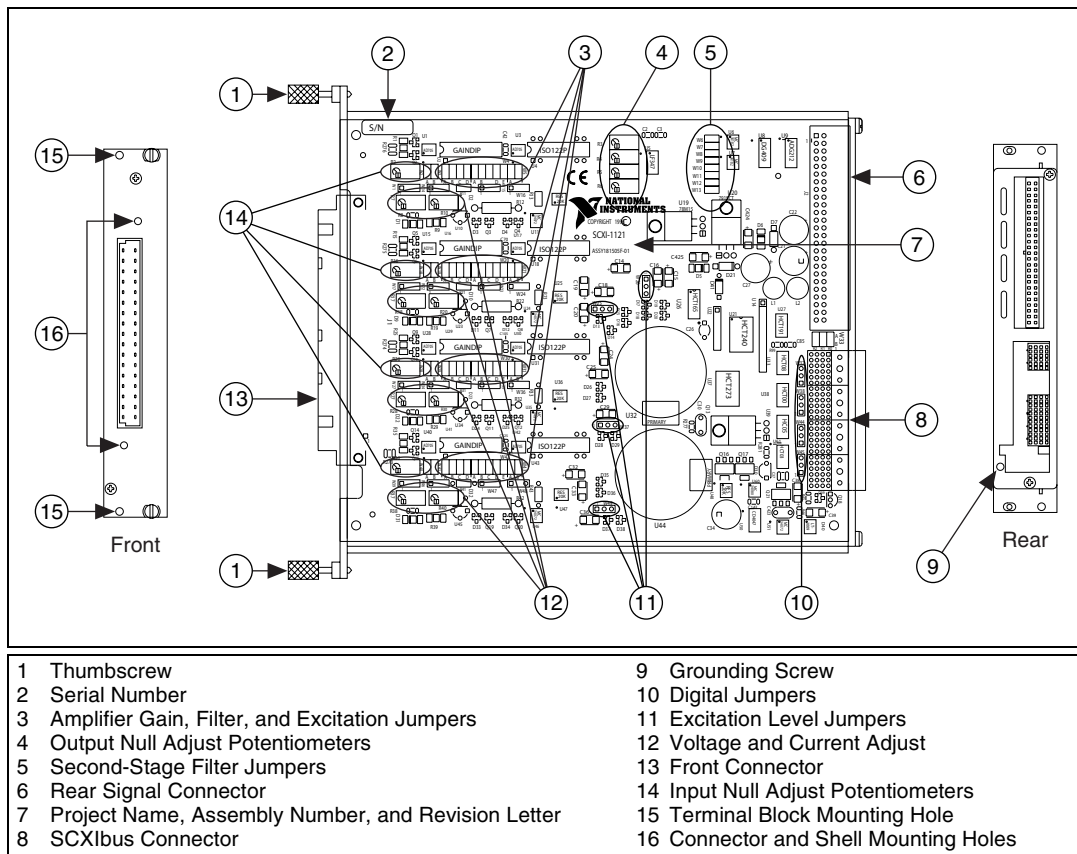








Figure 2. SCXI-1121 Parts Locator Diagram

Configuring Digital Signal Connection Jumpers

Configure the digital signal connection jumpers on the module as shown in Table 2.

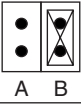

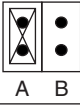

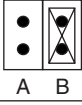

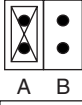

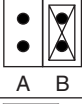

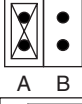

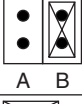

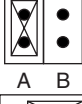

Table 2. Digital Signal Connections, Jumper Settings

Jumper	Description	Configuration
W38	Factory setting; connects MISO to SERDATOUT	
W38	Parking position	
W45	Factory setting	
W44	Factory setting (Revision A and B modules only)	
W32	Factory-default setting; connects pull-up to SERDATOUT (Revision C and later)	
W32	Parking position (not connected on Revision A or B modules)	

Disabling the Bridge Completion Network

Record the settings of jumpers W1, W2, W17, W18, W27, W28, W39, and W40 so that you can restore them after calibration. Disable the bridge completion network by setting these jumpers to the settings listed in the *Disable Network* column in Table 3. After you complete the calibration, restore the jumpers to the settings you recorded previously.

Table 3. Completion Network Jumpers

Channel	Jumpers	Enable Completion	Disable Network (Factory Setting)
0	W1 and W2	 W2  W1 1 2 3	 W2  W1 1 2 3
1	W17 and W18	 W18  W17 1 2 3	 W18  W17 1 2 3
2	W27 and W28	 W28  W27 1 2 3	 W28  W27 1 2 3
3	W39 and W40	 W40  W39 1 2 3	 W40  W39 1 2 3

Configuring Gain Jumpers

Each input channel has two user-configurable gain stages. The first-stage gain provides gains of 1, 10, 50, and 100, and the second-stage gain provides gains of 1, 2, 5, 10, and 20. To change the gain setting of a specified channel on the module, move the appropriate jumper on the module to the position indicated in Table 4.

Table 4. SCXI-1121 Gain Jumper Positions

Gain	Setting	Jumper Position
First-Stage	1	D
	10	C
	50	B
	100	A (factory setting)
Second-Stage	1	A
	2	B
	5	C
	10	D (factory setting)
	20	E

Refer to Table 5 for gain jumper allocation on the module.

Table 5. SCXI-1121 Gain Jumper Allocation

Input Channel Number	First-Stage Gain Jumper	Second-Stage Gain Jumper
0	W3	W4
1	W19	W20
2	W29	W30
3	W41	W42

To determine the overall gain of a given channel, use the following formula:

$$\text{overall gain} = \text{first-stage gain} \times \text{second-stage gain}$$

The order of the settings for the first and second stages does not matter as long as the first-stage gain multiplied by the second-stage gain equals the desired final gain value.

Configuring Filter Jumpers

Table 6 shows the filter jumper allocation on the SCXI-1121. Two filter bandwidths are available—10 kHz and 4 Hz. Always make sure to set both stages to the same bandwidth to ensure that you achieve the required bandwidth.

Table 6. SCXI-1121 Filter Jumper Allocation

Input Channel Number	First Filter Jumper		Second Filter Jumper	
	4 Hz (Factory Setting)	10 kHz	4 Hz (Factory Setting)	10 kHz
0	W5-A	W5-B	W6	W7
1	W21-A	W21-B	W8	W9
2	W31-A	W31-B	W10	W11
3	W43-A	W43-B	W12	W13

Configuring Excitation Jumpers

Configure each excitation channel of the SCXI-1121 for both voltage and current excitation modes. Each channel has two jumpers for this purpose. Set both jumpers in the same mode for correct operation of the excitation channel. During the calibration procedure, the program prompts you to set up the module. Refer to Table 7 for the correct jumper setup for both voltage mode and current mode.

Table 7. Voltage and Current Mode Excitation Jumper Setup

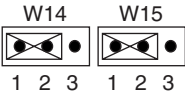
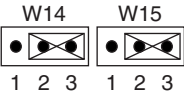
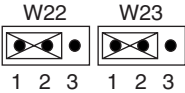
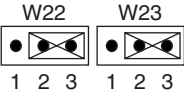
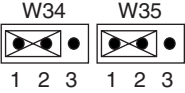
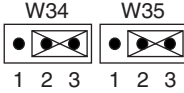
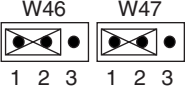
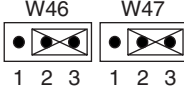
Excitation Channel	Jumpers	Voltage Mode (Factory Setting)	Current Mode
0	W14 and W15		
1	W22 and W23		

Table 7. Voltage and Current Mode Excitation Jumper Setup (Continued)

Excitation Channel	Jumpers	Voltage Mode (Factory Setting)	Current Mode
2	W34 and W35		
3	W46 and W47		

Each excitation channel of the SCXI-1121 has two different current or voltage levels. Set a given channel to the following level modes:

- in the current mode—0.150 or 0.4501 mA
- in the voltage mode—3.333 or 10 V

After selecting the excitation mode of operation you want—voltage or current—use Table 8 to set the level of operation of the SCXI-1121.

Table 8. Excitation Level Jumper Selection

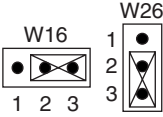
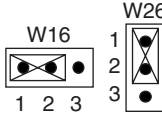
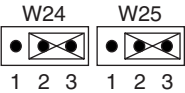
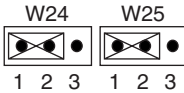
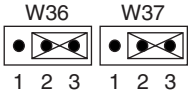
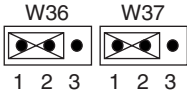
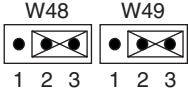
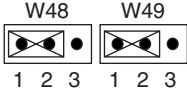
Excitation Channel	Jumpers	3.333 V or 0.150 mA (Factory Setting)	10 V or 0.450 mA
0	W16 and W26		
1	W24 and W25		

Table 8. Excitation Level Jumper Selection (Continued)

Excitation Channel	Jumpers	3.333 V or 0.150 mA (Factory Setting)	10 V or 0.450 mA
2	W36 and W37		
3	W48 and W49		

You have completed configuring the jumper settings on the SCXI-1121 for the Calibration Executive procedure.



Note Refer to the *Getting Started with SCXI*, the *DAQ Quick Start Guide*, and the *SCXI Quick Start Guide* if you need additional configuration information.

Setting Up the SCXI-1121 for Calibration

To make sure the module is ready for calibration, refer to Figures 3 and 4 as you complete the following steps:

1. Remove the side plate of the SCXI chassis and the cover of the SCXI-1121 module to access the potentiometers and jumpers, as shown in Figure 3.

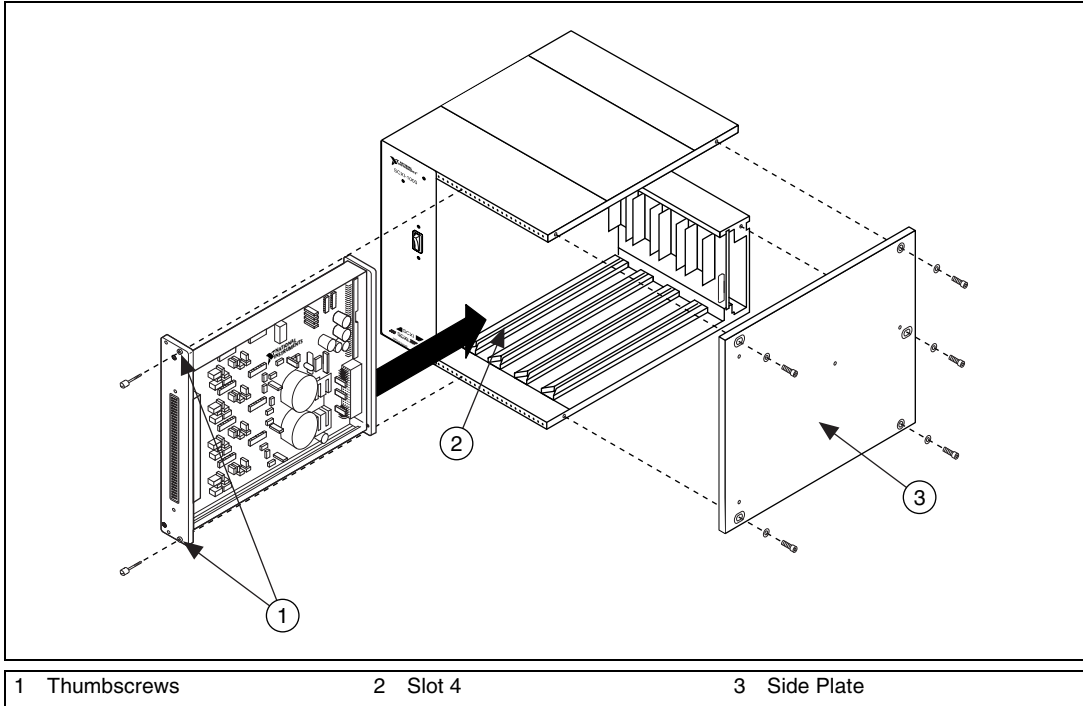


Figure 3. Side Plate Removal and Module Installation

2. Install the SCXI-1121 in slot 1 of the SCXI chassis.
3. Install the E Series DAQ device in the host computer.
4. Connect a 68-to-68-pin cable between the SCXI module and the E Series DAQ device installed in the host computer using the SCXI-1349 cable adapter.
5. Connect the terminal block to the 50-pin breakout on the adapter device.
6. Configure the hardware with Measurement & Automation Explorer (MAX).
 - a. In the MAX Help file, select **Help»Help Topics»NI-DAQ**.
 - b. Double-click **SCXI Devices**.

- c. Double-click the correct file for the hardware you want to configure and follow the displayed instructions.



Note Refer to the *Getting Started with SCXI*, the *DAQ Quick Start Guide*, and the *SCXI Quick Start Guide* if you need additional configuration information.

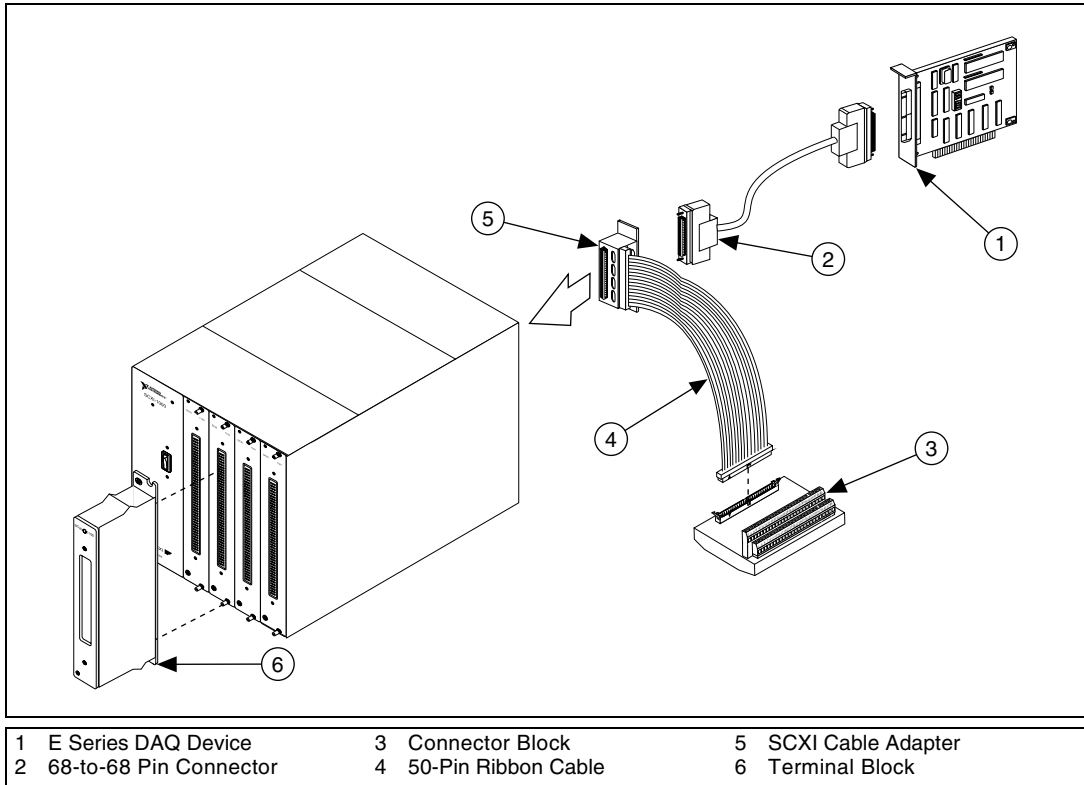


Figure 4. Connecting an SCXI Module to an E Series DAQ Device and a Terminal Block

Connecting the Calibrator, DMM, and SCXI Module

After you launch Calibration Executive, the calibration procedure guides you through the connections between the calibrator, DMM, and SCXI-1121 module. The first connections are as follows:

1. Connect all negative inputs of each SCXI-1121 channel together on the SCXI-1320, SCXI-1327, or SCXI-1328 terminal block.
2. Connect all positive inputs of each channel together on the terminal block. Refer to Table 9 for the correct signal connections.
3. Connect the calibrator positive output to CH0+ of the same terminal block.

4. Connect the calibrator negative output to CH0– of the same terminal block.
5. Connect the terminal block to the front of the SCXI-1121.
6. Connect the DMM HI voltage input to pin 3 of the 50-pin connector block.
7. Connect the DMM LO voltage input to pin 4 of the 50-pin connector block.

You have completed setting up the SCXI-1121 module and equipment for the Calibration Executive procedure.

Loading and Running the Calibration Procedure

To run the Calibration Executive calibration procedure, complete the following steps:

1. Launch Calibration Executive and follow the instructions in the Calibration Configuration Wizard to load the SCXI-1121 calibration procedure. Refer to Chapter 1, *Introduction to Calibration Executive*, of the *Calibration Executive Software User Manual* if you need more information on configuring and loading a calibration procedure.
2. When you verify the operation of the excitation channels, connect the 120 Ω (3.333 V level) and the 800 Ω (10 V level) resistors to the output of the excitation channel you are testing. If you have a terminal block such as the SCXI-1320, the excitation channel connections are labeled on the terminal block.

Table 9. SCXI-1121 Front Connector Pin Assignments

Pin Number	Signal Name		
	Column A	Column B	Column C
32	CH0+	NC	CH0–
31	NC	NC	NC
30	EX0+	NC	EX0–
29	NC	NC	NC
28	EGND0	NC	NC
27	NC	NC	NC
26	CH1+	NC	CH1–
25	NC	NC	NC
24	EX1+	NC	EX1–

Table 9. SCXI-1121 Front Connector Pin Assignments (Continued)

Pin Number	Signal Name		
	Column A	Column B	Column C
23	NC	NC	NC
22	EGND1	NC	NC
21	NC	NC	NC
20	CH2+	NC	CH2-
19	NC	NC	NC
18	EX2+	NC	EX2-
17	NC	NC	NC
16	EGND2	NC	NC
15	NC	NC	NC
14	CH3+	NC	CH3-
13	NC	NC	NC
12	EX3+	NC	EX3-
11	NC	NC	NC
10	EGND3	NC	NC
9	NC	NC	NC
8	NC	NC	RSVD
7	NC	NC	NC
6	SCAL	NC	RSVD
5	NC	NC	NC
4	+5V	NC	MTEMP
3	NC	NC	NC
2	CGND	NC	DTEMP
1	NC	NC	NC

3. When you adjust the analog inputs of the SCXI-1121, refer to Table 10 for the potentiometer reference designators.

Table 10. Calibration Potentiometers Reference Designators

Input Channel Number	Input Null	Output Null
0	R02	R03
1	R16	R04
2	R26	R05
3	R36	R06

4. When you adjust the excitation levels of the SCXI-1121, refer to Table 11 for the potentiometer reference designators.

Table 11. Excitation Calibration Potentiometer Reference Designators

Input Channel Number	Excitation Channel	
	Voltage Mode	Current Mode
0	R10	R7
1	R20	R17
2	R30	R27
3	R40	R37

5. Enter the following information about the installed hardware when prompted by Calibration Executive:
 - **MIO Device Number**—the device number assigned by MAX for the E Series DAQ device.
 - **MIO Channel**—the analog input channel that the E Series DAQ device uses to communicate with the SCXI module. This value can typically be left at 0.
 - **SCXI Chassis ID**—the ID number that MAX assigns for the SCXI chassis.
 - **SCXI Module Slot**—the SCXI slot where the SCXI-1121 is installed.
 - **MIO Resolution**—the resolution of the E Series DAQ device; the device user manual tells you the resolution of the device.

- **Terminal Block**—the SCXI terminal block that you are using.
 - **Channels to Verify and Adjust**—the SCXI-1121 channels you are testing; refer to the *Calibration Executive Software User Manual* to learn how to perform verification only.
6. When the procedure is loaded, click **Run Procedure** to begin. Follow any instructions you receive when prompted by Calibration Executive.

After the procedure finishes, complete the following steps to view the calibration report:

1. Click **View»Reports**.
2. Select **View** to launch your browser and view the report.
The calibration report appears as a printable HTML file.

You have completed calibrating the SCXI-1121 with Calibration Executive.

Technical Support Resources

NI Web Support

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

Worldwide Support

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

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20,
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Canada (Montreal) 514 288 5722, Canada (Ottawa) 613 233 5949,
Canada (Québec) 514 694 8521, Canada (Toronto) 905 785 0085,
China (Shanghai) 021 6555 7838, China (ShenZhen) 0755 3904939,
Czech Republic 02 2423 5774, Denmark 45 76 26 00,
Finland 09 725 725 11, France 01 48 14 24 24, Germany 089 741 31 30,
Greece 30 1 42 96 427, Hong Kong 2645 3186, India 91 80 4190000,
Israel 03 6393737, Italy 02 413091, Japan 03 5472 2970,
Korea 02 3451 3400, Malaysia 603 9596711, Mexico 001 800 010 0793,
Netherlands 0348 433466, New Zealand 09 914 0488,
Norway 32 27 73 00, Poland 0 22 3390 150, Portugal 351 210 311 210,
Russia 095 238 7139, Singapore 6 2265886, Slovenia 386 3 425 4200,
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