

CALIBRATING THE SCXI™-1121 WITH CALIBRATION EXECUTIVE

Contents

Introduction	2
What Is Calibration?	2
Why Should You Calibrate?	2
How Often Should You Calibrate?	2
Equipment and Other Test Requirements	3
Test Equipment	3
Connectors	3
Documentation	4
Software	4
Test Conditions	5
Calibration Procedures	5
Configuring Your Module for Calibration	5
Configuring Digital Signal Connection Jumpers	9
Configuring Gain Jumpers	10
Configuring Filter Jumpers	11
Configuring Excitation Jumpers	11
Setting Up Your Module for Calibration	14
Connecting Your Calibrator, DMM, and SCXI Module	15
Running the Calibration Procedure	15
Technical Support Resources	19
NI Web Support	19
Worldwide Support	19

Introduction

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

What Is Calibration?

Calibration consists of verifying the measurement accuracy of a module and adjusting for any measurement error. *Verification* is measuring performance of a module and comparing the results to the factory specifications. National Instruments Calibration Executive automates the verification and adjustment of your National Instruments 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 National Instruments standards.

How Often Should You Calibrate?

The measurement accuracy requirements of your application determine how often you should calibrate your SCXI-1121. National Instruments 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. National Instruments 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 the *Automated Versus Manual Calibration* section in Chapter 2, *Calibration Executive System Overview*, of your *Calibration Executive Software User Manual*.

Connectors

Although you can perform the calibration procedure without any special connectors, connecting and disconnecting your 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 your SCXI-1121. The following documents contain information on installing and using Calibration Executive and your 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 National Instruments Web site at ni.com/manuals

Software

Complete the following steps to install Calibration Executive:

1. Make sure that your computer and monitor are powered on and that you have installed Windows 2000/NT/Me/9x.
2. Close all open applications.
3. Insert the installation CD into the CD-ROM drive.
4. Choose the **Run** option 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-ROM drive you are using), and 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 your module for calibration, and how to run the Calibration Executive procedure. In automated mode, the calibration procedure should take approximately one hour. In manual mode, the procedure can take as long as two hours.

Configuring Your Module for Calibration

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

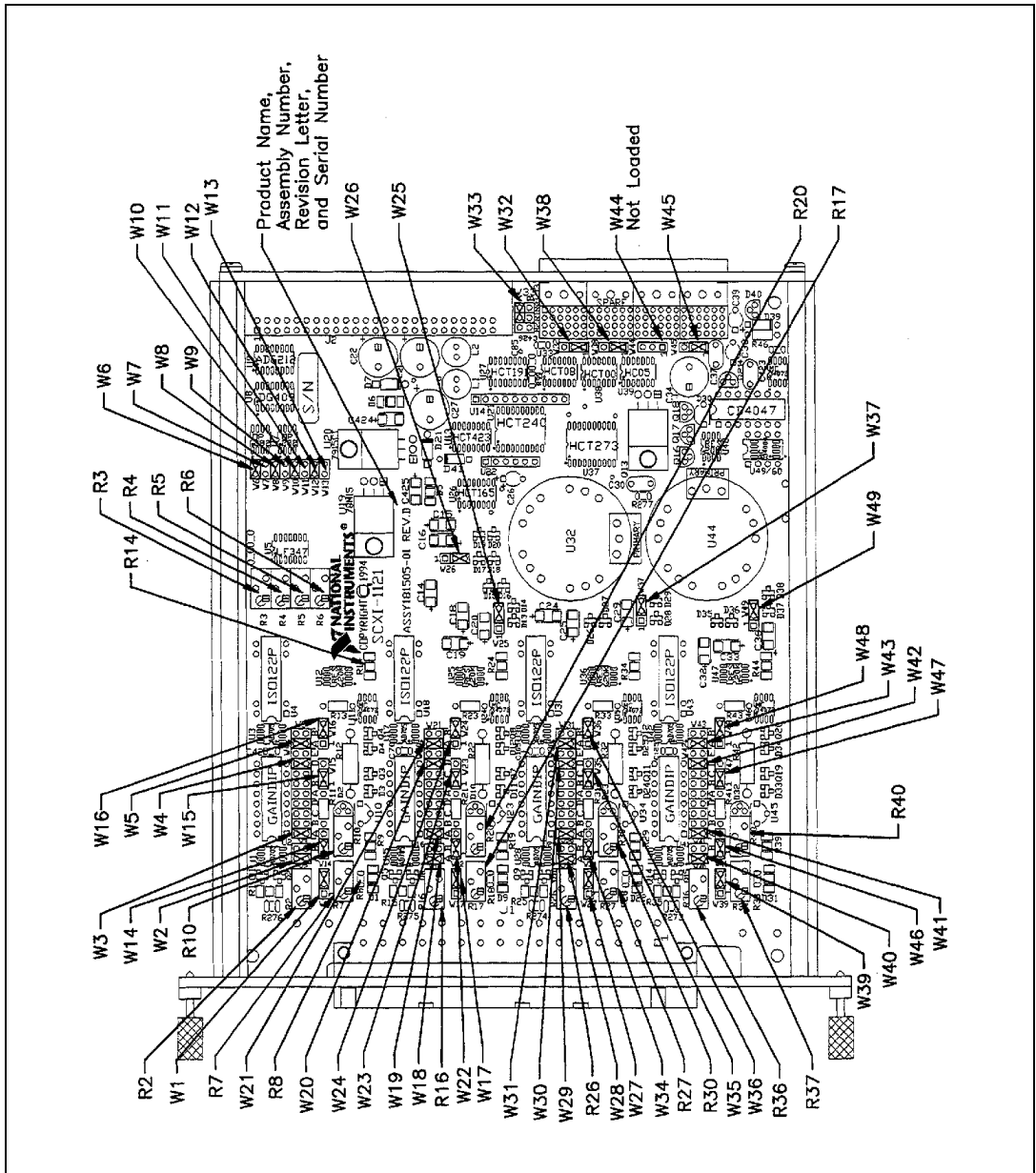


Figure 1. SCXI-1121 Jumper Locator Diagram

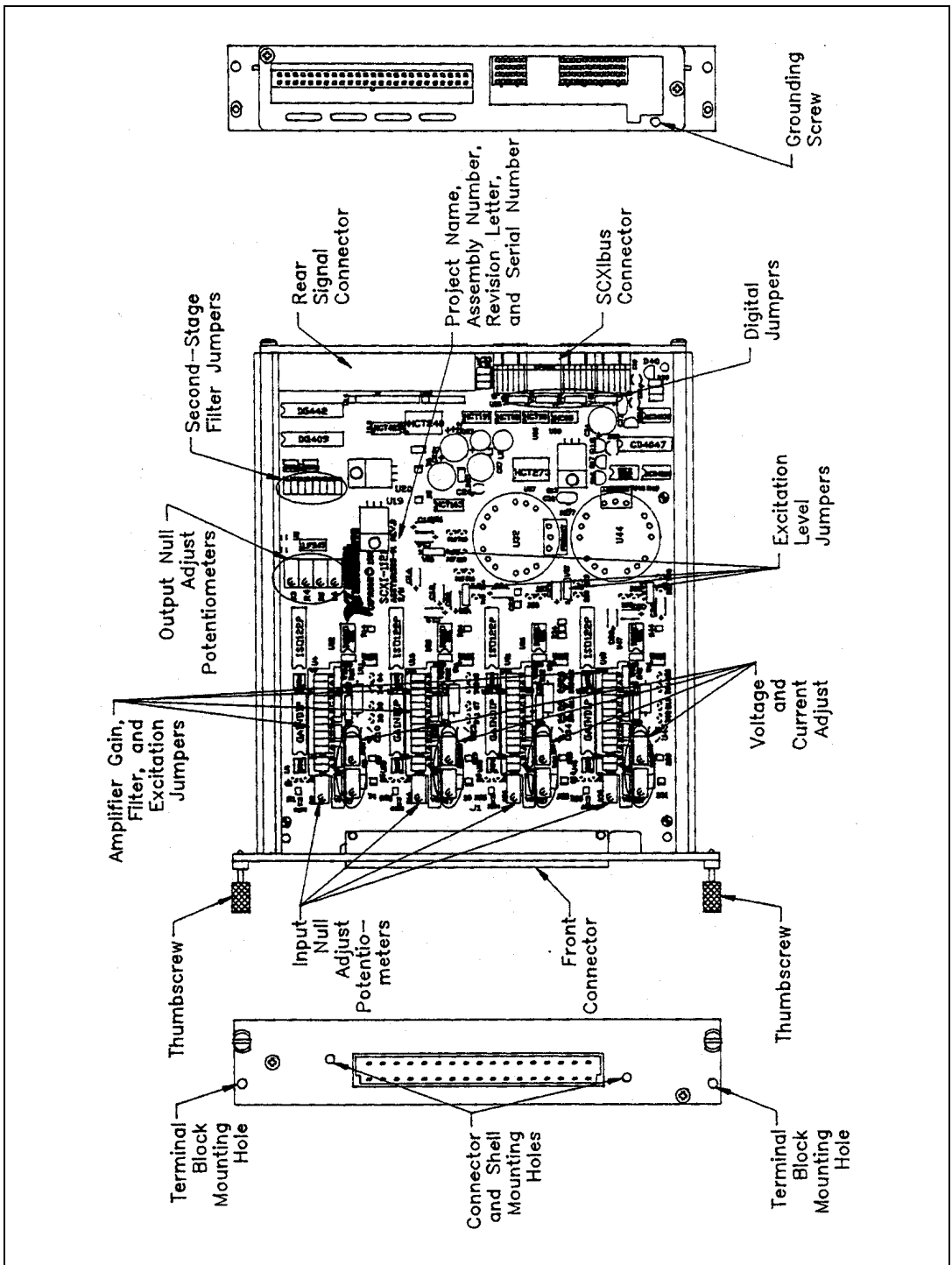


Figure 2. SCXI-1121 Parts Locator Diagram

Configuring Digital Signal Connection Jumpers

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

Table 2. Digital Signal Connection Jumper Settings

Jumper	Description	Configuration
W32	Factory-default setting; connects pullup to SERDATOUT (Revision C and later).	
W33	Factory setting in parking position.	
W38	Factory setting; connects MISO to SERDATOUT.	
W44	Factory setting (Revision A and B modules only).	
W45	Factory setting.	

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 your module to the position indicated in Table 3.

Table 3. 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 4 for gain jumper allocation on the module.

Table 4. 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-stage and second-stage 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 5 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.

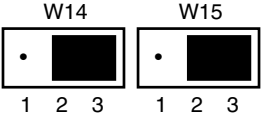
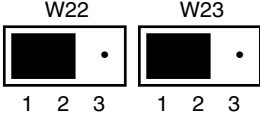
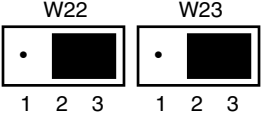
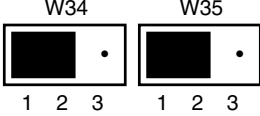
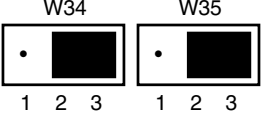
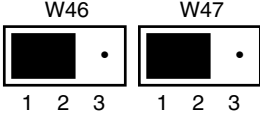
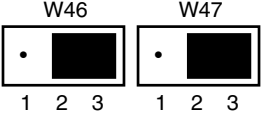
Table 5. SCXI-1121 Filter Jumper Allocation

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 your 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 your module. Refer to Table 6. for the correct jumper setup for both voltage mode and current mode.

Table 6. Voltage and Current Mode Excitation Jumper Setup

Excitation Channel	Jumpers	Voltage Mode (Factory Setting)	Current Mode
0	W14 and W15		
1	W22 and W23		
2	W34 and W35		
3	W46 and W47		

Each excitation channel of your 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 7 to set the level of operation of your SCXI-1121.

Table 7. 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		
2	W36 and W37		
3	W48 and W49		
0	W16 and W26		

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



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

Setting Up Your Module for Calibration

To make sure your module is ready for calibration, refer to Figure 3 as you complete the following steps:

1. Remove the side plate of the SCXI chassis and the cover of the SCXI-1120/1120D module to access the potentiometers and jumpers.
2. Install the SCXI-1121 in slot 1 of the SCXI chassis.
3. Install the E Series DAQ device in your host computer.
4. Connect a 68-to-68-pin cable between the SCXI module and the E Series DAQ device installed in your 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.

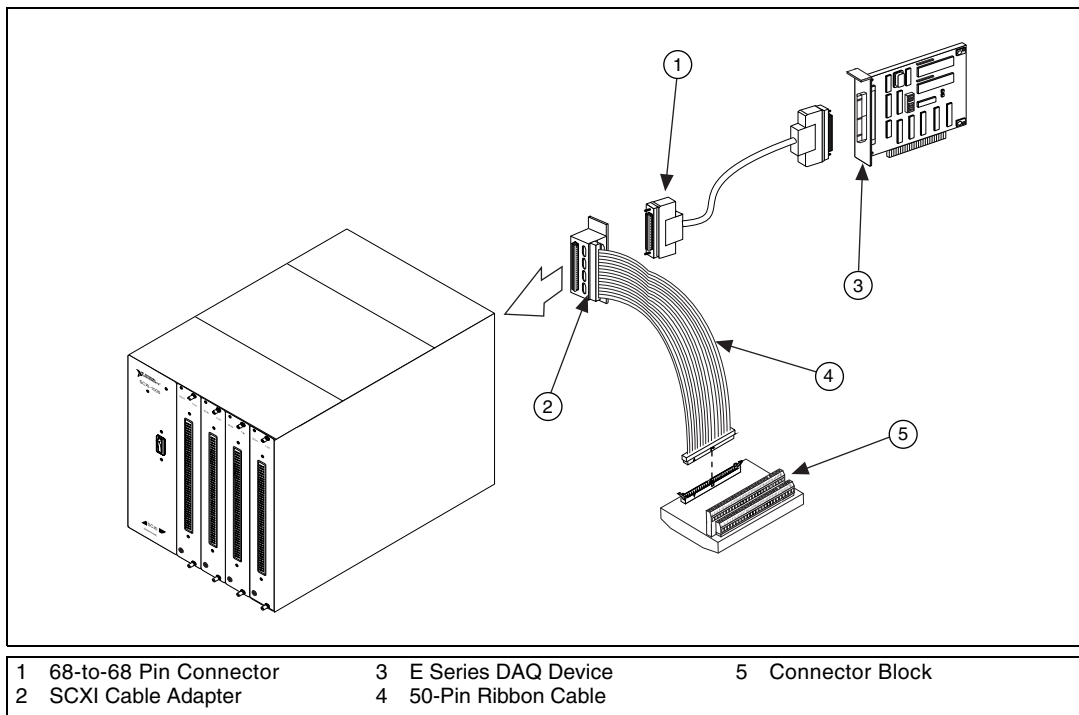


Figure 3. Connecting an SCXI Module to an E Series DAQ Device and a Terminal Block



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

Connecting Your Calibrator, DMM, and SCXI Module

After you launch Calibration Executive, the calibration procedure steps you through the connections between your 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 same terminal block. Refer to Figure 4 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 your SCXI-1121 module and equipment for the Calibration Executive procedure.

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*, in 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, as shown in Figure 4.

Pin Number	Signal Name	Column			Signal Name
		A	B	C	
32	CH0+	○	○	○	CH0-
31		○	○	○	
30	EX0+	○	○	○	EX0+
29		○	○	○	
28	EGND0	○	○	○	
27		○	○	○	
26	CH1+	○	○	○	CH1-
25		○	○	○	
24	EX1+	○	○	○	EX1-
23		○	○	○	
22	EGND1	○	○	○	
21		○	○	○	
20	CH2+	○	○	○	CH2-
19		○	○	○	
18	EX2+	○	○	○	EX2-
17		○	○	○	
16	EGND2	○	○	○	
15		○	○	○	
14	CH3+	○	○	○	CH3-
13		○	○	○	
12	EX3+	○	○	○	EX3-
11		○	○	○	
10	EGND3	○	○	○	
9		○	○	○	
8		○	○	○	RSVD
7		○	○	○	
6	SCAL	○	○	○	RSVD
5		○	○	○	
4	+5 V	○	○	○	MTEMP
3		○	○	○	
2	CGND	○	○	○	DTEMP
1		○	○	○	

Figure 4. SCXI-1121 Front Connector Pin Assignments

3. When you adjust the analog inputs of your SCXI-1121, refer to Table 8 for the potentiometer reference designators.

Table 8. 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 your SCXI-1121, refer to Table 9 for the potentiometer reference designators.

Table 9. 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 your E Series DAQ device
 - **MIO Channel**—The analog input channel that your E Series DAQ device uses to communicate with your SCXI module. This value can typically be left at 0.
 - **SCXI Chassis ID**—The ID number that MAX assigns for your SCXI chassis
 - **SCXI Module Slot**—The SCXI slot where the SCXI-1121 is installed
 - **MIO Resolution**—The resolution of your E Series DAQ device; the device user manual tells you the resolution of your 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 your report.
Your calibration report appears as a printable HTML file.

You have completed calibrating your 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, e-mail addresses, and current events.

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China (ShenZhen) 0755 3904939, 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 91805275406, Israel 03 6120092, Italy 02 413091,
Japan 03 5472 2970, Korea 02 596 7456, Malaysia 603 9596711,
Mexico 5 280 7625, Netherlands 0348 433466, New Zealand 09 914 0488,
Norway 32 27 73 00, Poland 0 22 528 94 06, Portugal 351 1 726 9011,
Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00,
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United Kingdom 01635 523545