

DAQ

BNC-2090A User Manual

Rack-Mount Connector Accessory for E/M Series DAQ Devices

Worldwide Technical Support and Product Information

ni.com

National Instruments Corporate Headquarters

11500 North Mopac Expressway Austin, Texas 78759-3504 USA Tel: 512 683 0100

Worldwide Offices

Australia 1800 300 800, Austria 43 662 457990-0, Belgium 32 (0) 2 757 0020, Brazil 55 11 3262 3599,
Canada 800 433 3488, China 86 21 6555 7838, Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 385 (0) 9 725 72511, France 33 (0) 1 48 14 24 24, Germany 49 89 7413130, India 91 80 41190000,
Israel 972 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970, Korea 82 02 3451 3400,
Lebanon 961 (0) 1 33 28 28, Malaysia 1800 887710, Mexico 01 800 010 0793, Netherlands 31 (0) 348 433 466,
New Zealand 0800 553 322, Norway 47 (0) 66 90 76 60, Poland 48 22 3390150, Portugal 351 210 311 210,
Russia 7 495 783 6851, Singapore 1800 226 5886, Slovenia 386 3 425 42 00, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 (0) 8 587 895 00, Switzerland 41 56 2005151, Taiwan 886 02 2377 2222,
Thailand 662 278 6777, Turkey 90 212 279 3031, United Kingdom 44 (0) 1635 523545

For further support information, refer to the *Technical Support and Professional Services* appendix. To comment on National Instruments documentation, refer to the National Instruments Web site at ni.com/info and enter the info code `feedback`.

Important Information

Warranty

The BNC-2090A is warranted against defects in materials and workmanship for a period of one year from the date of shipment, as evidenced by receipts or other documentation. National Instruments will, at its option, repair or replace equipment that proves to be defective during the warranty period. This warranty includes parts and labor.

The media on which you receive National Instruments software are warranted not to fail to execute programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. National Instruments will, at its option, repair or replace software media that do not execute programming instructions if National Instruments receives notice of such defects during the warranty period. National Instruments does not warrant that the operation of the software shall be uninterrupted or error free.

A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. National Instruments will pay the shipping costs of returning to the owner parts which are covered by warranty.

National Instruments believes that the information in this document is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, National Instruments reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult National Instruments if errors are suspected. In no event shall National Instruments be liable for any damages arising out of or related to this document or the information contained in it.

EXCEPT AS SPECIFIED HEREIN, NATIONAL INSTRUMENTS MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S RIGHT TO RECOVER DAMAGES CAUSED BY FAULT OR NEGLIGENCE ON THE PART OF NATIONAL INSTRUMENTS SHALL BE LIMITED TO THE AMOUNT THEREOF PAID BY THE CUSTOMER. NATIONAL INSTRUMENTS WILL NOT BE LIABLE FOR DAMAGES RESULTING FROM LOSS OF DATA, PROFITS, USE OF PRODUCTS, OR INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY THEREOF. This limitation of the liability of National Instruments will apply regardless of the form of action, whether in contract or tort, including negligence. Any action against National Instruments must be brought within one year after the cause of action accrues. National Instruments shall not be liable for any delay in performance due to causes beyond its reasonable control. The warranty provided herein does not cover damages, defects, malfunctions, or service failures caused by owner's failure to follow the National Instruments installation, operation, or maintenance instructions; owner's modification of the product; owner's abuse, misuse, or negligent acts; and power failure or surges, fire, flood, accident, actions of third parties, or other events outside reasonable control.

Copyright

Under the copyright laws, this publication may not be reproduced or transmitted in any form, electronic or mechanical, including photocopying, recording, storing in an information retrieval system, or translating, in whole or in part, without the prior written consent of National Instruments Corporation.

National Instruments respects the intellectual property of others, and we ask our users to do the same. NI software is protected by copyright and other intellectual property laws. Where NI software may be used to reproduce software or other materials belonging to others, you may use NI software only to reproduce materials that you may reproduce in accordance with the terms of any applicable license or other legal restriction.

Trademarks

National Instruments, NI, ni.com, and LabVIEW are trademarks of National Instruments Corporation. Refer to the *Terms of Use* section on ni.com/legal for more information about National Instruments trademarks.

Other product and company names mentioned herein are trademarks or trade names of their respective companies.

Members of the National Instruments Alliance Partner Program are business entities independent from National Instruments and have no agency, partnership, or joint-venture relationship with National Instruments.

Patents

For patents covering National Instruments products, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your CD, or ni.com/patents.

WARNING REGARDING USE OF NATIONAL INSTRUMENTS PRODUCTS

(1) NATIONAL INSTRUMENTS PRODUCTS ARE NOT DESIGNED WITH COMPONENTS AND TESTING FOR A LEVEL OF RELIABILITY SUITABLE FOR USE IN OR IN CONNECTION WITH SURGICAL IMPLANTS OR AS CRITICAL COMPONENTS IN ANY LIFE SUPPORT SYSTEMS WHOSE FAILURE TO PERFORM CAN REASONABLY BE EXPECTED TO CAUSE SIGNIFICANT INJURY TO A HUMAN.

(2) IN ANY APPLICATION, INCLUDING THE ABOVE, RELIABILITY OF OPERATION OF THE SOFTWARE PRODUCTS CAN BE IMPAIRED BY ADVERSE FACTORS, INCLUDING BUT NOT LIMITED TO FLUCTUATIONS IN ELECTRICAL POWER SUPPLY, COMPUTER HARDWARE MALFUNCTIONS, COMPUTER OPERATING SYSTEM SOFTWARE FITNESS, FITNESS OF COMPILERS AND DEVELOPMENT SOFTWARE USED TO DEVELOP AN APPLICATION, INSTALLATION ERRORS, SOFTWARE AND HARDWARE COMPATIBILITY PROBLEMS, MALFUNCTIONS OR FAILURES OF ELECTRONIC MONITORING OR CONTROL DEVICES, TRANSIENT FAILURES OF ELECTRONIC SYSTEMS (HARDWARE AND/OR SOFTWARE), UNANTICIPATED USES OR MISUSES, OR ERRORS ON THE PART OF THE USER OR APPLICATIONS DESIGNER (ADVERSE FACTORS SUCH AS THESE ARE HEREAFTER COLLECTIVELY TERMED "SYSTEM FAILURES"). ANY APPLICATION WHERE A SYSTEM FAILURE WOULD CREATE A RISK OF HARM TO PROPERTY OR PERSONS (INCLUDING THE RISK OF BODILY INJURY AND DEATH) SHOULD NOT BE RELIANT SOLELY UPON ONE FORM OF ELECTRONIC SYSTEM DUE TO THE RISK OF SYSTEM FAILURE. TO AVOID DAMAGE, INJURY, OR DEATH, THE USER OR APPLICATION DESIGNER MUST TAKE REASONABLY PRUDENT STEPS TO PROTECT AGAINST SYSTEM FAILURES, INCLUDING BUT NOT LIMITED TO BACK-UP OR SHUT DOWN MECHANISMS. BECAUSE EACH END-USER SYSTEM IS CUSTOMIZED AND DIFFERS FROM NATIONAL INSTRUMENTS' TESTING PLATFORMS AND BECAUSE A USER OR APPLICATION DESIGNER MAY USE NATIONAL INSTRUMENTS PRODUCTS IN COMBINATION WITH OTHER PRODUCTS IN A MANNER NOT EVALUATED OR CONTEMPLATED BY NATIONAL INSTRUMENTS, THE USER OR APPLICATION DESIGNER IS ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY OF NATIONAL INSTRUMENTS PRODUCTS WHENEVER NATIONAL INSTRUMENTS PRODUCTS ARE INCORPORATED IN A SYSTEM OR APPLICATION, INCLUDING, WITHOUT LIMITATION, THE APPROPRIATE DESIGN, PROCESS AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION.

Compliance

Compliance with FCC/Canada Radio Frequency Interference Regulations

Determining FCC Class

The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). All National Instruments (NI) products are FCC Class A products.

Depending on where it is operated, this Class A product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.) Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products.

All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

Consult the FCC Web site at www.fcc.gov for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE marking Declaration of Conformity*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by NI could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at their own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Compliance with EU Directives

Users in the European Union (EU) should refer to the Declaration of Conformity (DoC) for information* pertaining to the CE marking. Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

* The CE marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

Conventions

The following conventions are used in this manual:

<>

Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, AO <3..0>.

»

The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash. When this symbol is marked on a product, refer to the *Read Me First: Safety and Radio-Frequency Interference* document, available on ni.com/manuals, for information about precautions to take.

bold

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

italic

Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.

monospace

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

Contents

Chapter 1

BNC-2090A Overview

What You Need to Get Started	1-2
Installing the BNC-2090A	1-3
Setting the BNC-2090A Shield Ground Jumper.....	1-7

Chapter 2

Connecting Signals

Connecting Analog Input Signals	2-1
Connecting Differential Analog Input Signals	2-2
Measuring Floating Signals in Differential Input Mode.....	2-2
Measuring Ground-Referenced Signals in Differential Input Mode	2-3
Connecting Single-Ended Analog Input Signals	2-3
Measuring Floating Signals in Single-Ended Input Mode.....	2-4
Measuring Ground-Referenced Signals in Single-Ended Input Mode	2-5
Connecting AO, APFI 0, and PFI 0 Signals	2-5
Connecting Digital Signals	2-6
Using the USER 1 and USER 2 BNC Connectors	2-7

Chapter 3

Signal Conditioning

Analog Input Signal Conditioning	3-1
Building Lowpass Filters.....	3-5
Example	3-6
Building Highpass Filters	3-7
Example	3-8
Building Attenuators (Voltage Dividers)	3-10
Analog Output Signal Conditioning	3-12
Building Lowpass Filters.....	3-13
Building Highpass Filters	3-13
Adding Signal Conditioning Components	3-14
Soldering and Desoldering on the BNC-2090A.....	3-15
Installing Bias Resistors	3-15

**Appendix A
Specifications**

**Appendix B
Frequently Asked Questions**

**Appendix C
Technical Support and Professional Services**

Index

BNC-2090A Overview

This user manual contains in-depth information about using the National Instruments BNC-2090A.

The BNC-2090A is a desktop or rack-mount analog breakout accessory you can connect to E/M Series multifunction DAQ devices¹. The BNC-2090A has the following features:

- 16 analog input (AI) BNC connectors for eight differential or 16 single-ended channels
- Two analog output (AO) BNC connectors
- Two user-defined BNC connectors
- One APFI BNC connector
- One PFI BNC connector
- Spring terminal block for digital input/output (DIO) and Programmable Function Interface (PFI) connections
- Silkscreened component locations for resistors and capacitors for building single-pole highpass and lowpass filters and voltage dividers
- Two 68-pin input/output (I/O) connectors for DAQ device connection

Refer to the *BNC-2090A Quick Start Guide* for basic installation and signal connection instructions.

Figure 1-1 shows the front panel and enclosure back of the BNC-2090A.

¹ You can also use the BNC-2090A with PCI-6013 and PCI-6014 B Series devices.

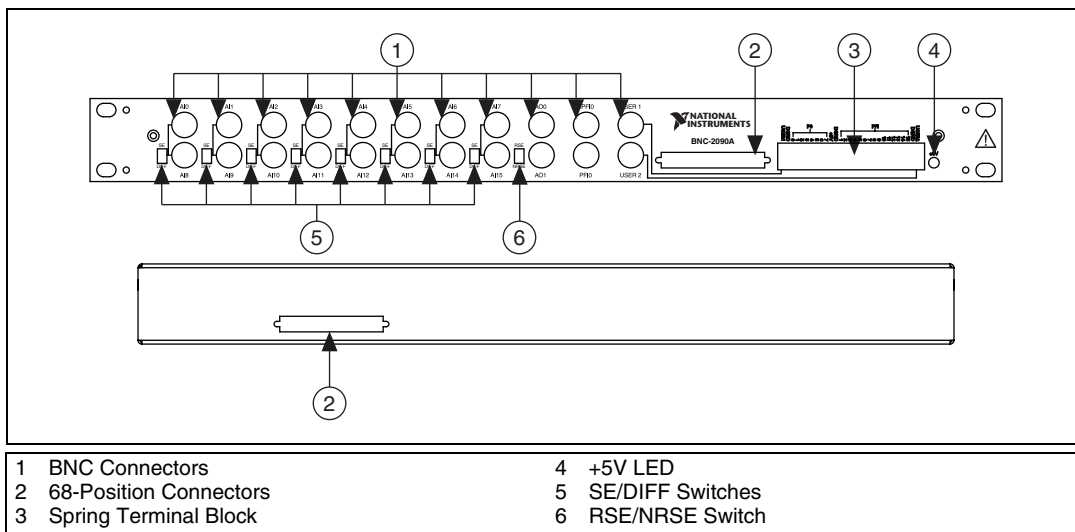


Figure 1-1. BNC-2090A Front Panel and Back of Enclosure

What You Need to Get Started

To set up and use your BNC-2090A accessory, you need the following:

- BNC-2090A accessory
- BNC-2090A Quick Start Guide* and *BNC-2090A User Manual*
- One of the following DAQ devices:
 - 68-pin M Series device (with one or two I/O connectors)
 - 68-pin E Series device
 - 100-pin E Series device
- 68-position¹ or 100-position cable(s)
- The *E Series User Manual* or the *M Series User Manual*
- BNC cables
- 20 AWG wire or smaller
- Wire strippers

¹ Two-connector M Series devices can be cabled to two BNC-2090A accessories with two cables.

- ❑ Small flathead screwdriver
- ❑ Four adhesive rubber feet (supplied)

You can find detailed specifications for the BNC-2090A in Appendix A, [Specifications](#).

Installing the BNC-2090A

The *BNC-2090A Quick Start Guide* contains general installation information for the BNC-2090A. To connect the BNC-2090A to your DAQ device, refer to Figure 1-2 as you complete the following steps. Consult your computer user manual or technical reference manual for specific instructions and warnings.



Note If you have not already installed your DAQ device, refer to the *DAQ Getting Started Guide* for instructions.

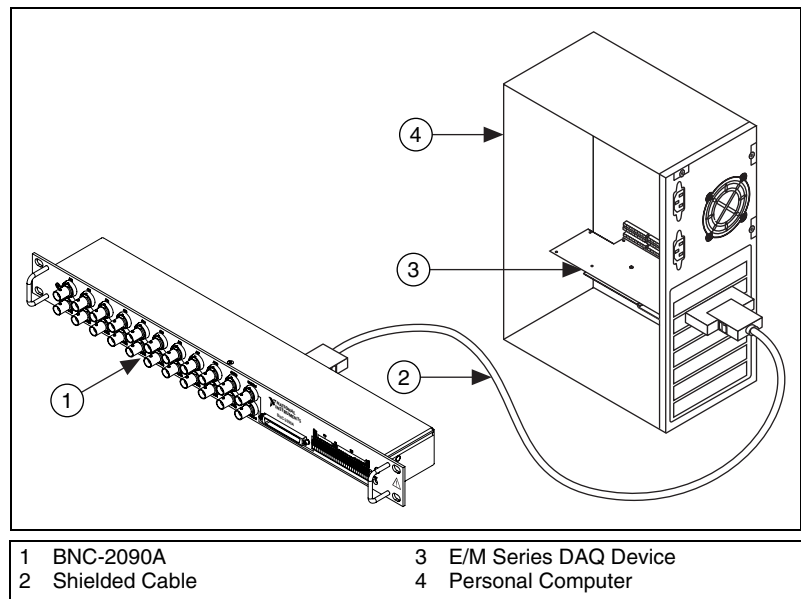


Figure 1-2. Connecting the BNC-2090A to Your DAQ Device

1. Verify that the SE/DIFF switches and RSE/NRSE switch are set correctly for your current application, as described in Chapter 2, [Connecting Signals](#).

2. (Optional) If you need to connect the BNC-2090A shield directly to digital ground (D GND), verify that the shield ground jumper is set correctly for your current application. Refer to the [Setting the BNC-2090A Shield Ground Jumper](#) section for more information.
3. (Optional) If you are performing signal conditioning, determine what signal conditioning you need for analog inputs and install the necessary components into the open component positions. Refer to the [Adding Signal Conditioning Components](#) section of Chapter 3, [Signal Conditioning](#) for more information.
4. Place the BNC-2090A near the host computer or mount the BNC-2090A into a 19 inch rack. If you do not rack-mount the accessory, attach the four adhesive rubber feet included in the BNC-2090A kit to the bottom of the accessory.



Caution Do *not* connect the BNC-2090A to any device other than a National Instruments E Series or M Series DAQ device. Doing so can damage the BNC-2090A, the DAQ device, or host computer. National Instruments is *not* liable for damages resulting from these connections.

5. Connect the BNC-2090A to the DAQ device using the front or rear 68-position connector, as shown in Figure 1-1.

Figure 1-3 shows the BNC-2090A connected directly to different M Series DAQ systems.

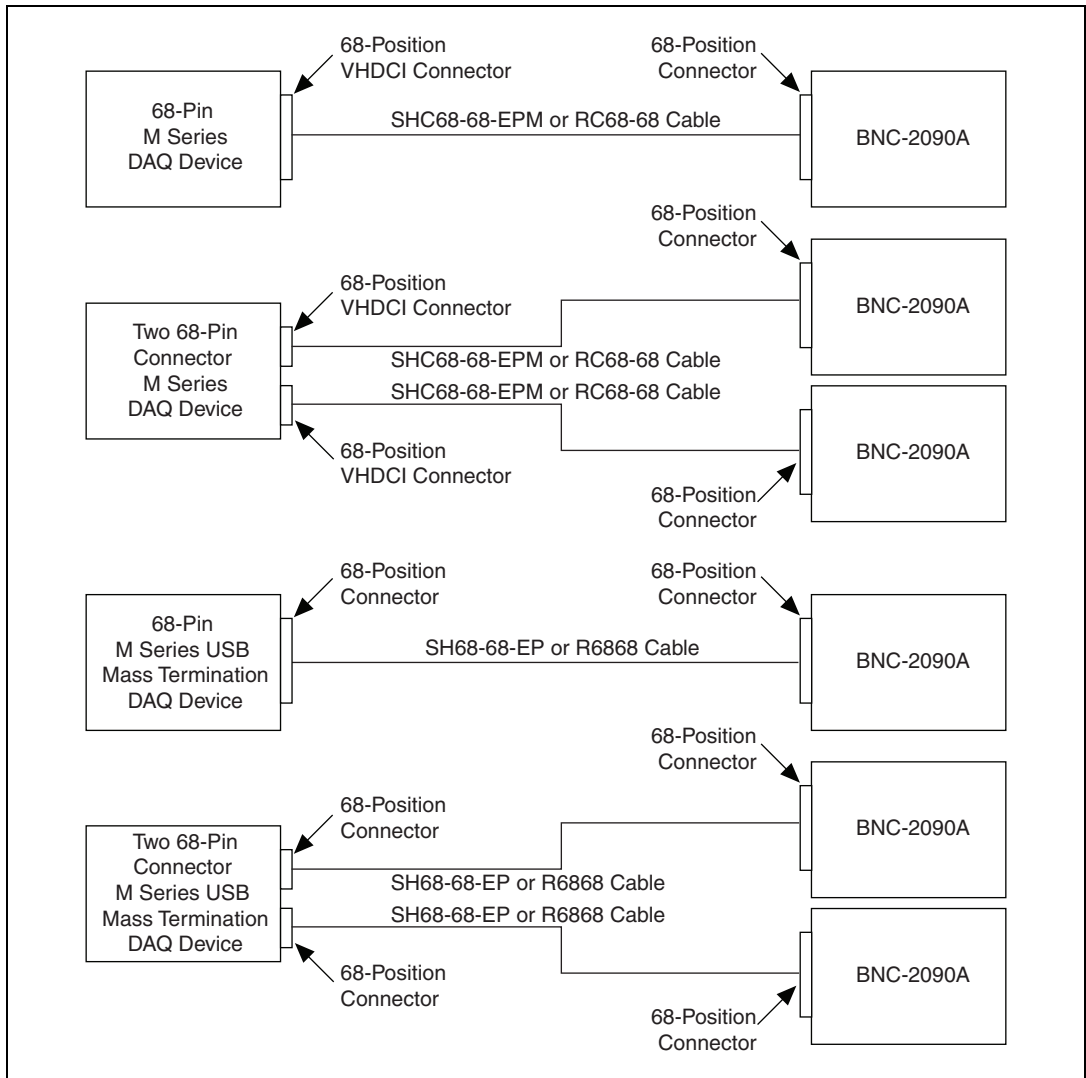


Figure 1-3. Direct Connection of M Series DAQ Devices to the BNC-2090A

Figure 1-4 shows the BNC-2090A connected directly to different E Series DAQ systems.

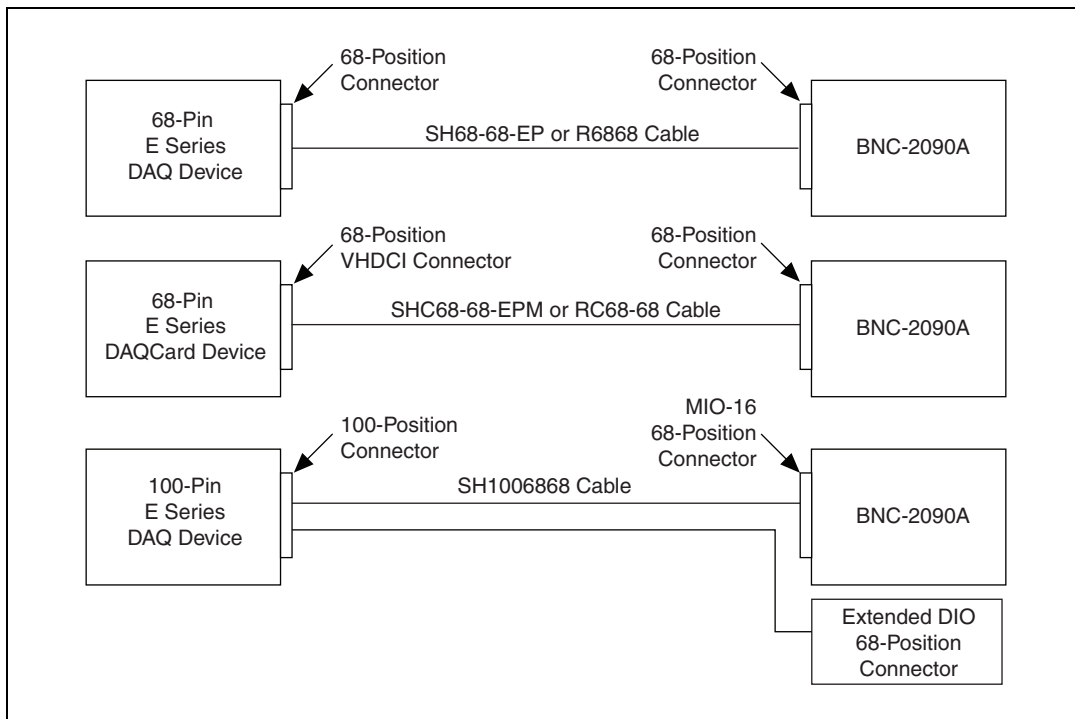


Figure 1-4. Direct Connection of E Series DAQ Devices to the BNC-2090A

If the +5V LED does not light, check the cable connections.

6. Connect signals to the BNC connectors and spring terminal block as described in Chapter 2, [Connecting Signals](#).

When you have finished using the BNC-2090A, power off any external signals connected to the BNC-2090A before you power off your computer.



Note You can connect 68-pin cables to both the front connector and the rear connector of the BNC-2090A to create a pass-through.



Caution Do *not* connect input voltages greater than $42.4 V_{pk}/60 VDC$ to the BNC-2090A. The BNC-2090A is not designed for any input voltages greater than $42.4 V_{pk}/60 VDC$, even if a user-installed voltage divider reduces the voltage to within the input range of the DAQ device. Input voltages greater than $42.4 V_{pk}/60 VDC$ can damage the BNC-2090A,

all devices connected to it, and the host computer. Overvoltage can also cause an electric shock hazard for the operator. National Instruments is *not* liable for damage or injury resulting from such misuse.

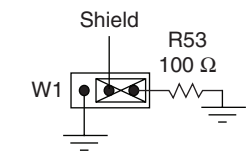
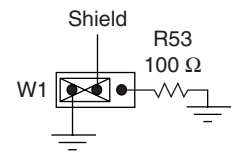
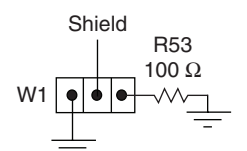
Setting the BNC-2090A Shield Ground Jumper

The BNC-2090A shield ground jumper, labeled W1 on the PCB, is factory-configured to connect the shield of the 68-position connectors and BNC-2090A metal case through a 100 Ω resistor to D GND.

You must reconfigure the jumper if you want to connect the BNC-2090A shield directly to digital ground (D GND).

Table 1-1 shows the shield ground jumper setting options.

Table 1-1. Shield Ground Jumper Settings

Setting	Description
 <p>Factory Default</p>	<p>100 Ω to Digital Ground—Use this setting to reduce any potential ground loop current, thereby improving the system noise performance. When the BNC-2090A is rack-mounted, it is connected to a different ground.</p> <p>This is the factory default setting.</p>
 <p>Digital Ground</p>	<p>Digital Ground—Use this setting when the BNC-2090A metal case is <i>not</i> connected to any other ground through a rack mount or connected to the DAQ ground through a shielded cable. Use this setting when using unshielded cables.</p>
 <p>Disconnected</p>	<p>You can also disconnect the shield from the DAQ ground by removing shield ground jumper, which prevents the ground loop current from being carried in the D GND return of the shielded cable. This option is best for rack-mount configurations where the BNC-2090A metal case is already grounded.</p>

To access and reconfigure the shield ground jumper, complete the following steps while referring to Figure 1-5.

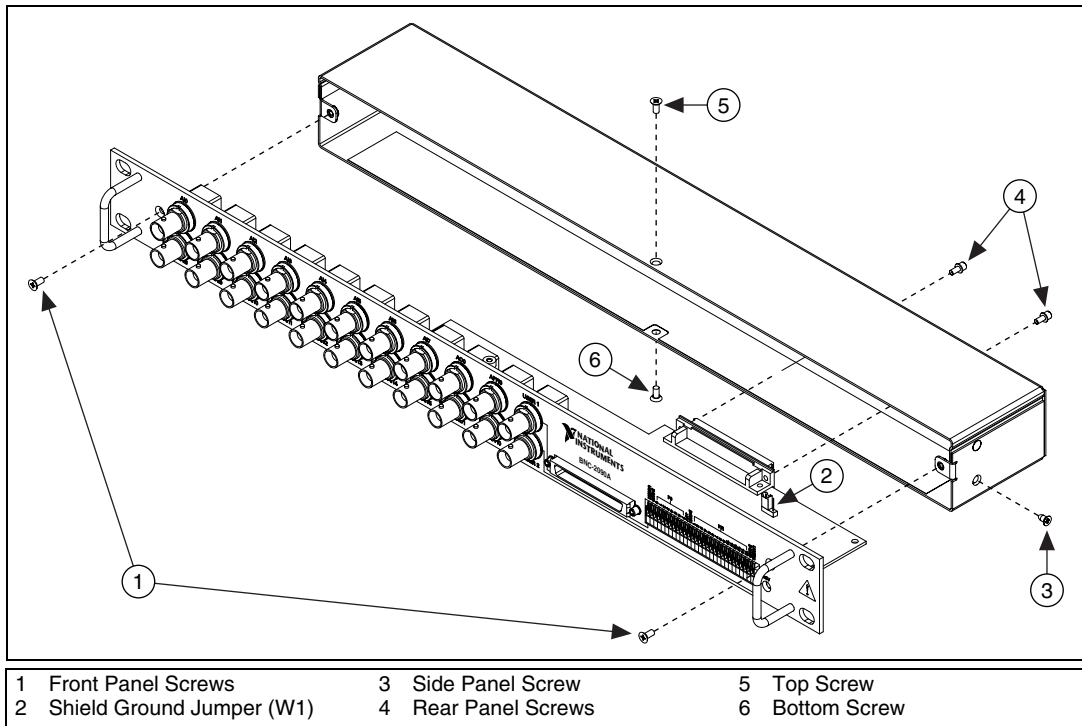


Figure 1-5. Accessing the Shield Ground Jumper

1. Remove the two rear panel screws and one side panel screw.
2. Remove the top and bottom screws and two front panel screws.
3. Hold the front panel and slide the unit out of the metal case.
4. Set the shield ground jumper, labeled W1 on the PCB, as needed.
5. Reassemble the BNC-2090A in reverse order.

Connecting Signals

The BNC-2090A features 22 BNC connectors and a spring terminal block for analog and digital signal connection. Refer to the *E Series User Manual* or the *M Series User Manual* for information about the use of these signals.

Figure 2-1 shows an overview of the BNC-2090A circuitry.

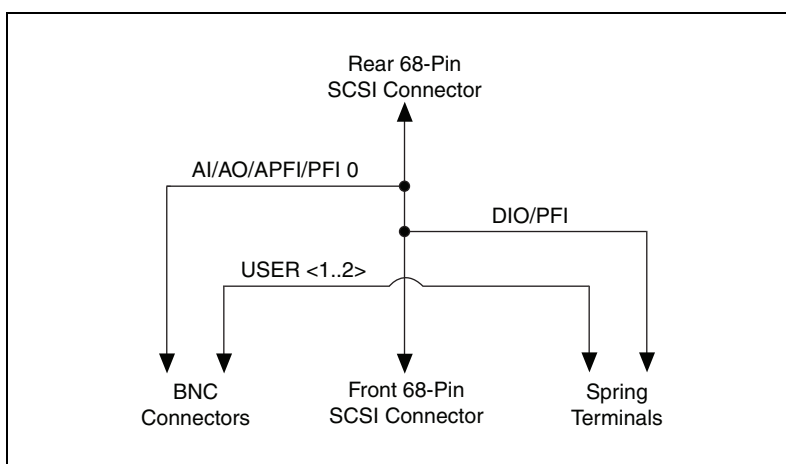


Figure 2-1. BNC-2090A Circuitry Overview

Connecting Analog Input Signals

The BNC-2090A can be configured in three analog input modes:

- Differential (factory-default setting)
- Referenced single-ended
- Nonreferenced single-ended

For more information about choosing an analog input mode, refer to *E Series User Manual* or the *M Series User Manual*.

Connecting Differential Analog Input Signals

Complete the following steps to measure a differential (DIFF) analog input signal.

1. Connect the BNC cable to one of the AI <0..7> BNC connectors on the front panel.
Do not connect anything to the corresponding AI <8..15> BNC connector below the AI <0..7> BNC connector you use.
2. Move the corresponding SE/DIFF switch to the DIFF position. On the BNC-2090A front panel, a line indicates which SE/DIFF switch corresponds to each AI <0..7> BNC connector.
3. Configure your software to measure this channel differentially.

Figure 2-2 shows how differential AI signals are routed to the DAQ device.

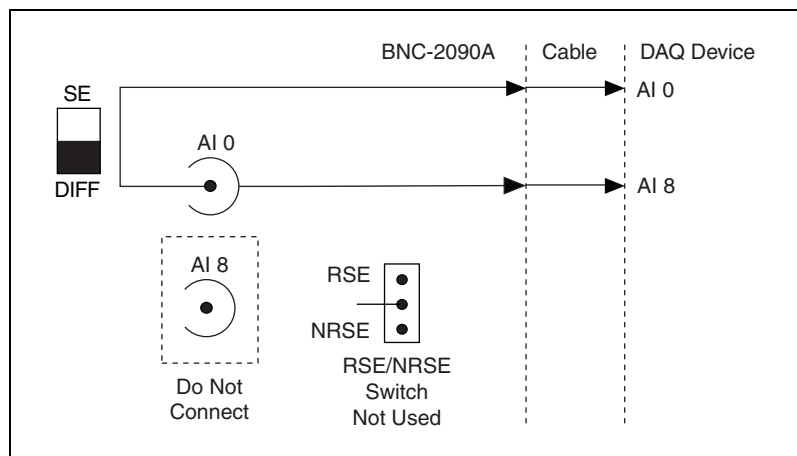


Figure 2-2. Analog Input Differential Mode

The BNC-2090A is configured for differential mode by default.

Measuring Floating Signals in Differential Input Mode

A *floating signal source* is a signal source that is not connected in any way to the building ground system, but has an isolated ground-reference point. If an instrument or device has an isolated output, that instrument or device falls into the floating signal source category. Some examples of floating signal sources are thermocouples, transformers, battery-powered devices,

optical isolators, and isolation amplifiers. The ground reference of a floating source must be tied to the ground of the DAQ device to establish a local or on-device reference for the signal.

To provide a return path for the instrumentation amplifier bias currents, floating sources must have a 10–100 k Ω resistor to AI GND on one input if DC-coupled, or both inputs if AC-coupled. For more information about connections to floating signal sources and differential inputs, refer to *E Series User Manual* or the *M Series User Manual*. Refer to the [Installing Bias Resistors](#) section of Chapter 3, [Signal Conditioning](#), for information about installing bias resistors.

Measuring Ground-Referenced Signals in Differential Input Mode

A *grounded signal source* is connected in some way to the building system ground; therefore, the signal source is already connected to a common ground point with respect to the DAQ device (assuming the host computer is plugged into the same power system). The non-isolated outputs of instruments and devices that plug into the building power system fall into this category.

If the DAQ device is configured for differential inputs, ground-referenced signal sources connected to the BNC-2090A need no special components added to the BNC-2090A. You can leave the inputs of the BNC-2090A in the factory-default configuration, with the 0 Ω jumpers in the two series positions, C and D, as listed in Table 3-1, [Channel Component Positions](#). Refer to Chapter 3, [Signal Conditioning](#), for information about building signal-conditioning circuitry, such as filters and attenuators, in the open-component positions.

Connecting Single-Ended Analog Input Signals

Complete the following steps to measure a single-ended (SE) analog input signal.

1. Connect the BNC cable to one of the AI <0..15> BNC connectors on the front panel.
2. Move the corresponding SE/DIFF switch to the SE position. On the BNC-2090A front panel, a line indicates which SE/DIFF switch corresponds to each AI <0..15> BNC connector.
3. Move the RSE/NRSE switch to select how the ground signal is routed. All single-ended signals share the one RSE/NRSE switch. For more information about non-referenced single-ended (NRSE) and

referenced single-ended (RSE) modes, refer to the *E Series User Manual* or the *M Series User Manual*.

4. Configure your software to measure this channel in RSE or NRSE mode.

Figure 2-3 shows how single-ended AI signals are routed to the DAQ device.

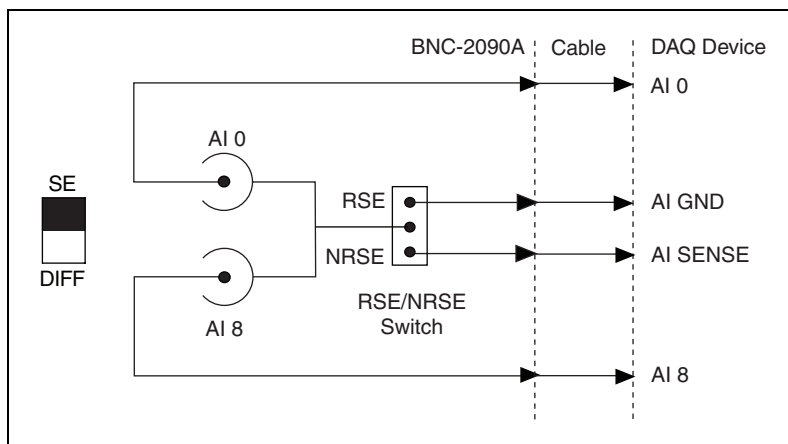


Figure 2-3. Analog Input Single-Ended Mode

Moving the RSE/NRSE switch to RSE, connects the BNC shields to AI GND. Moving the RSE/NRSE switch to NRSE connects the BNC shields to AI SENSE.

Measuring Floating Signals in Single-Ended Input Mode

A *floating signal source* is a signal source that is not connected in any way to the building ground system, but has an isolated ground-reference point. If an instrument or device has an isolated output, that instrument or device falls into the floating signal source category. Some examples of floating signal sources are thermocouples, transformers, battery-powered devices, optical isolators, and isolation amplifiers. The ground reference of a floating source must be tied to the ground of the DAQ device to establish a local or on-device reference for the signal.

When measuring floating signal sources, configure the DAQ device to supply a ground reference by placing the device in referenced single-ended (RSE) mode. This mode ties the negative input of the DAQ device instrumentation amplifier and the BNC shield to the analog ground.

Refer to Chapter 3, *Signal Conditioning*, for information about building additional signal-conditioning circuitry, such as filters and attenuators, in the open-component positions.

Measuring Ground-Referenced Signals in Single-Ended Input Mode

A *grounded signal source* is connected in some way to the building system ground; therefore, the signal source is already connected to a common ground point with respect to the DAQ device (assuming the host computer is plugged into the same power system). The non-isolated outputs of instruments and devices that plug into the building power system fall into this category.

When measuring ground-referenced signals, the external signal supplies its own reference ground point and the DAQ device should not supply one. Therefore, configure the DAQ device for the nonreferenced single-ended (NRSE) mode, in which all of the signal grounds are tied to AI SENSE, which connects to the negative input of the instrumentation amplifier on the DAQ device.

Refer to Chapter 3, *Signal Conditioning*, for information about building additional signal-conditioning circuitry, such as filters and attenuators, in the open-component positions.

Connecting AO, APFI 0, and PFI 0 Signals

Use the BNC-2090A BNC connectors on the front panel to connect AO <0..1>, APFI 0, and PFI 0 signals to your DAQ device. Refer to the *E Series User Manual* or the *M Series User Manual* for information about the use of these signals.

Figure 2-4 shows how AO 0, AO 1, APFI 0, and PFI 0 signals are routed to the DAQ device.

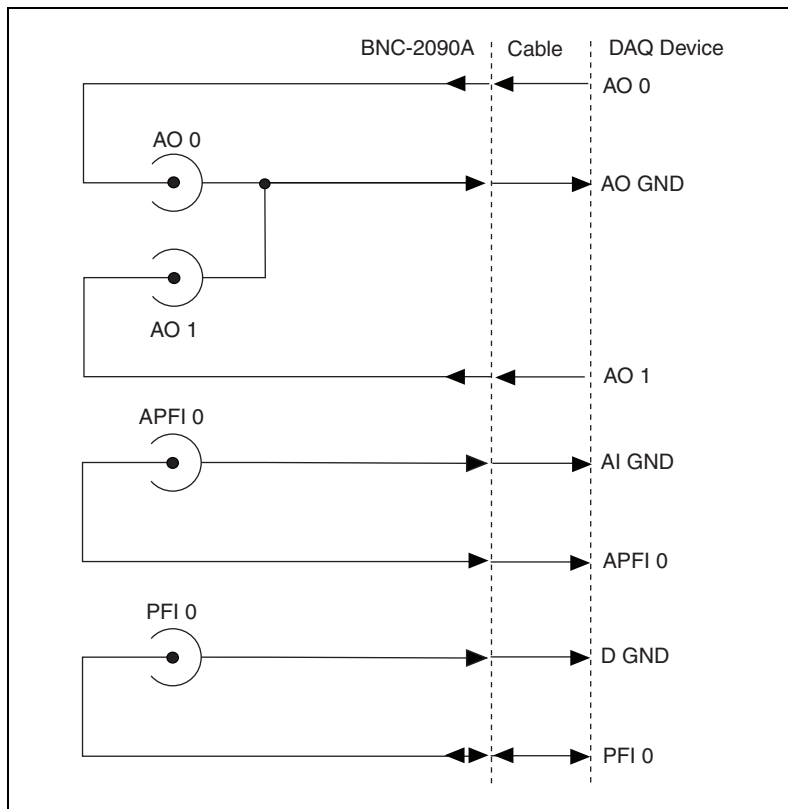


Figure 2-4. Analog Output, APFI 0, and PFI 0

Refer to Chapter 3, *Signal Conditioning*, for information about building additional signal-conditioning circuitry.

Connecting Digital Signals

Use the BNC-2090A spring terminal block on the front panel to connect digital signals to your DAQ device. Refer to the *E Series User Manual* or the *M Series User Manual* for information about the use of these signals.

When connecting signals to the spring terminal blocks, you can use up to 20 AWG wire with the insulation stripped to 0.5 in.

Using the USER 1 and USER 2 BNC Connectors

The USER 1 and USER 2 BNC connectors allow you to use a BNC connector for a digital or timing I/O signal of your choice. The USER 1 and USER 2 BNC connectors are routed (internal to the BNC-2090A) to the USER1 and USER2 spring terminals, as shown in Figure 2-5.

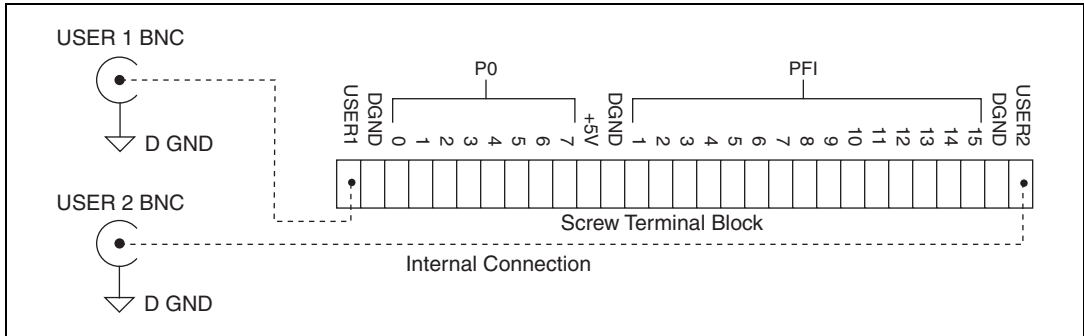


Figure 2-5. USER <1..2> BNC Connections

Figure 2-6 shows an example of how to use the USER <1..2> BNCs. To access the PFI 5 signal from a BNC, connect USER1 on the spring terminal block to PFI 5 with a wire.

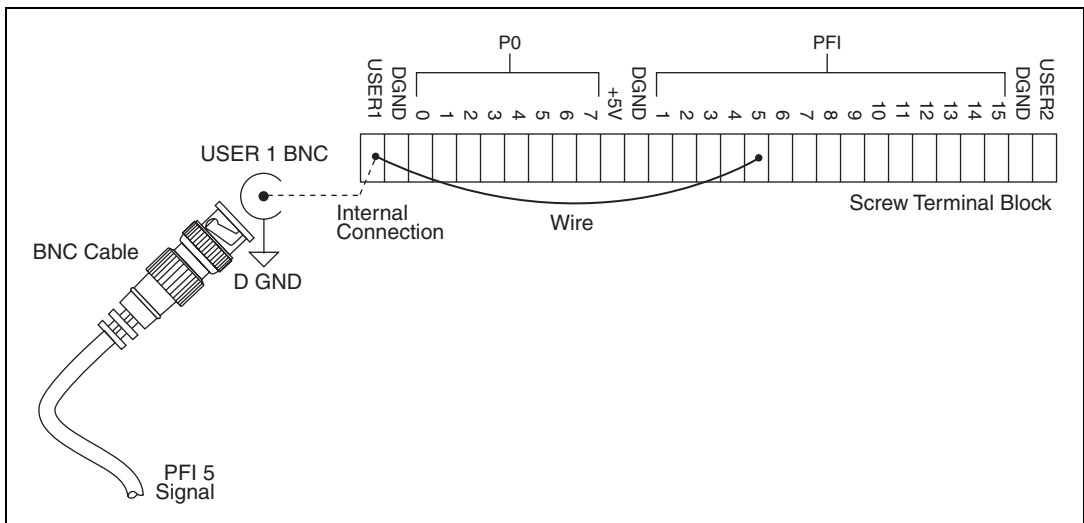


Figure 2-6. Connecting PFI 5 to USER 1 BNC

Signal Conditioning

This chapter contains information about adding signal conditioning components to the BNC-2090A and signal conditioning examples for using the BNC-2090A with your DAQ device.

Analog Input Signal Conditioning

Each analog input signal has several open positions for passive signal conditioning components. The factory-default positions for the 0 Ω jumpers are the C and D positions of the input network, as shown in Figure 3-1. You can remove these 0 Ω jumpers to build analog input signal conditioning circuits. You can also add passive analog input signal conditioning, such as filters and dividers.

Figure 3-1 shows the onboard components for differential mode.

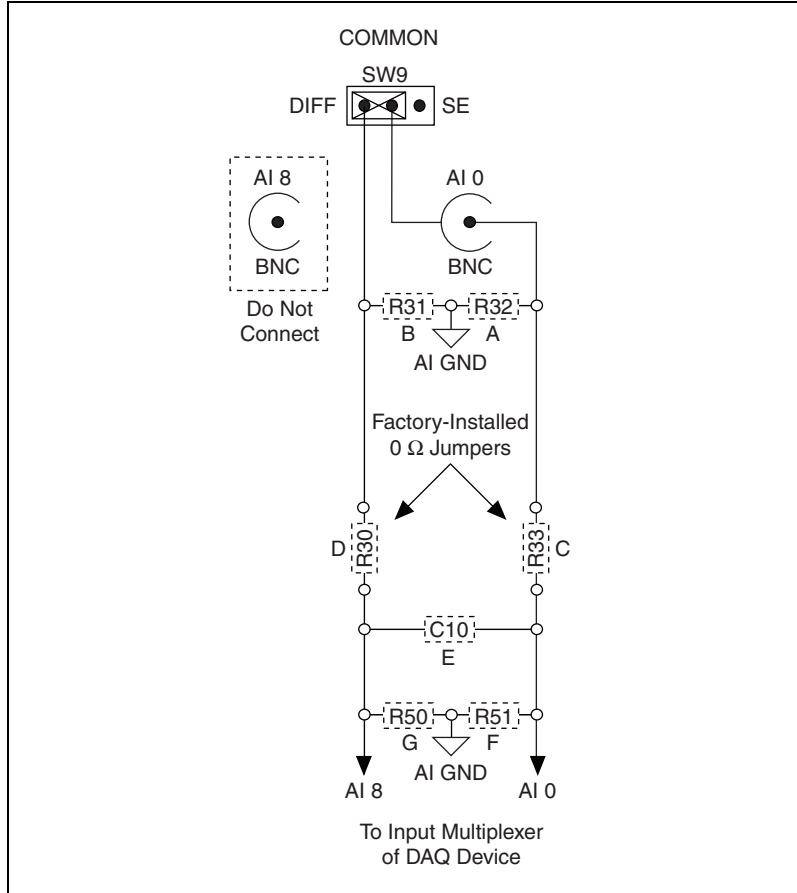


Figure 3-1. Channel 0 Differential Mode Onboard Components

Figure 3-2 shows the onboard components for single-ended mode.

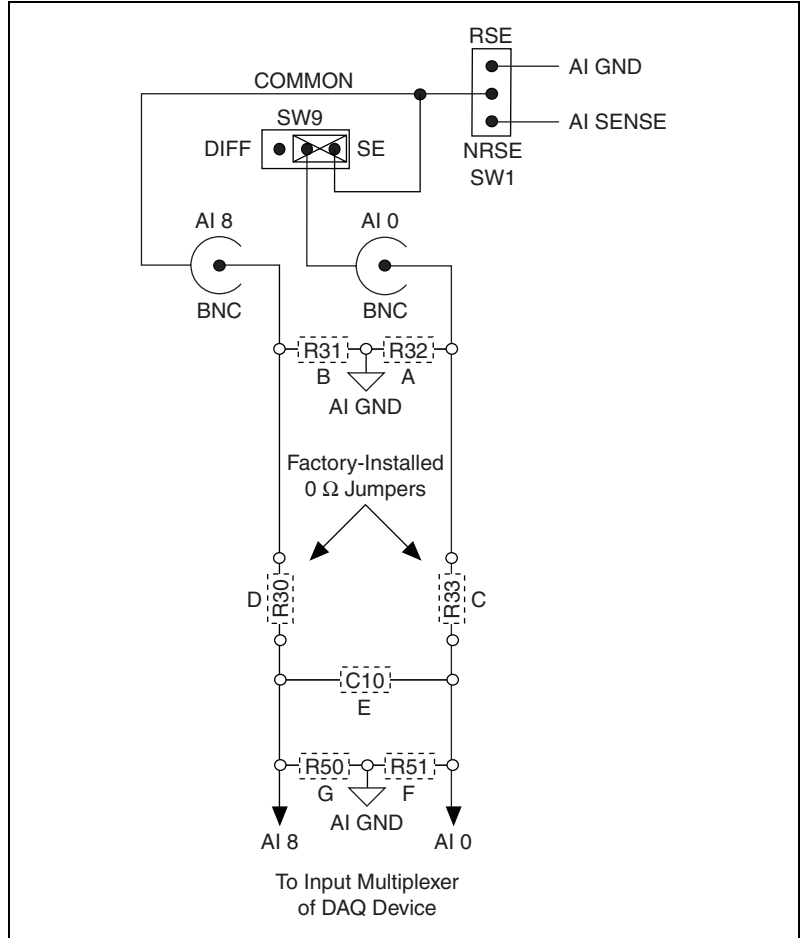


Figure 3-2. Channel 0 and Channel 8 Single-Ended Mode Onboard Components

Table 3-1 lists the different component positions for each channel.

Table 3-1. Channel Component Positions

Channel		Position in Figures 3-1 and 3-2						
Differential	Single-Ended	A	B	C*	D*	E	F	G
0	0, 8	R32	R31	R33	R30	C10	R51	R50
1	1, 9	R28	R27	R29	R26	C9	R49	R48
2	2, 10	R24	R23	R25	R22	C8	R47	R46
3	3, 11	R20	R19	R21	R18	C7	R45	R44
4	4, 12	R16	R15	R17	R14	C6	R43	R42
5	5, 13	R12	R11	R13	R10	C5	R41	R40
6	6, 14	R8	R7	R9	R6	C4	R39	R38
7	7, 15	R4	R3	R5	R2	C3	R37	R36
* Factory-installed 0 Ω jumpers.								

Table 3-2 lists population options for passive signal conditioning components.

Table 3-2. Signal Conditioning Component Population Options

Configuration		Normal	Attenuator	Lowpass Filter	Highpass Filter	AC Couple	Termination
Single-Ended	A	Open	Open	Open	Open	Open	Resistor
	B	Open	Open	Open	Open	Open	Resistor
	C*	0 Ω Jumper	Resistor	Resistor	Capacitor	Capacitor	0 Ω Jumper
	D*	0 Ω Jumper	Resistor	Resistor	Capacitor	Capacitor	0 Ω Jumper
	E	Open	Open	Open	Open	Open	Open
	F	Open	Resistor	Capacitor	Resistor	Open	Open
	G	Open	Resistor	Capacitor	Resistor	Open	Open
Differential	A	Open	Open	Open	Open	Open	Resistor
	B	Open	Open	Open	Open	Open	Resistor
	C*	0 Ω Jumper	Resistor	Resistor	Capacitor	Capacitor	0 Ω Jumper
	D*	0 Ω Jumper	Resistor	Resistor	Capacitor	Capacitor	0 Ω Jumper
	E	Open	Resistor	Capacitor	Resistor	Open	Open
	F	Open	Open	Open	Open	Open	Open
	G	Open	Open	Open	Open	Open	Open

* Factory-installed 0 Ω resistor.

Building Lowpass Filters

You can install simple, RC lowpass filters on any input channel of the BNC-2090A. The filters are useful for accurate measurement and noise rejection. By substituting resistance and capacitance values into Equation 3-1, you can calculate a simple, one-pole RC filter to have a -3 dB cutoff frequency (f_c):

$$f_c = \frac{1}{(2\pi RC)} \quad (3-1)$$

The frequency response rolls off at a rate of -20 dB per decade of increase thereafter. Figure 3-3 shows a Bode plot of the amplitude versus normalized frequency.

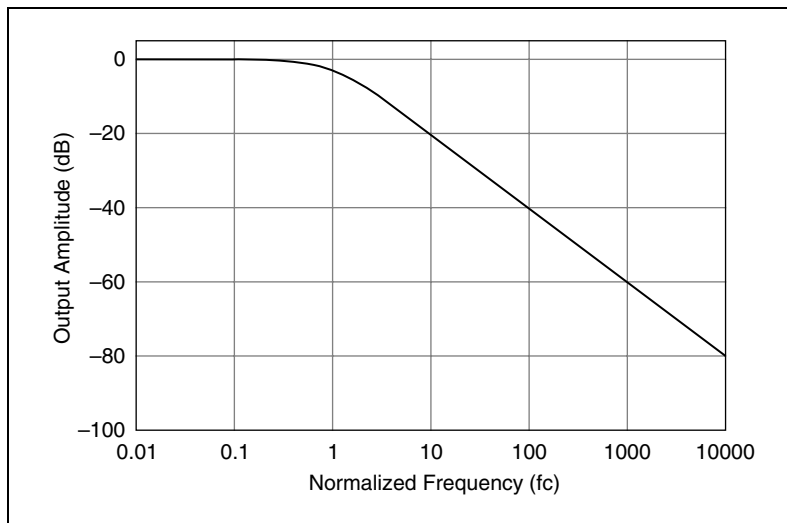


Figure 3-3. Normalized Frequency Response of Lowpass Filter

Example

When measuring low-frequency signals (about 4 Hz), if you have 400 Hz noise on your input signals, you can add a lowpass filter with a cutoff frequency of 4 Hz. The 400 Hz noise then attenuates by 40 dB. Notice that your 4 Hz signal also attenuates, by 3 dB. Do not neglect any potential attenuation of signals of interest by this low-order filter.

You must also choose the filter component values. You can select the resistance or the capacitance arbitrarily; one value determines the other. Picking the capacitor first and letting its value determine the resistance required is preferable because more standard resistor values are available. If a capacitance of 1 μ F is available, the resistance is (by substitution into Equation 3-1) about 39.8 k Ω . This resistance must be split evenly between each input of a differential channel. Therefore, in this example, each input channel has a 19.89 k Ω resistor (or the closest standard value) in its series positions, C and D. NI recommends using 1% or better tolerance resistors in this application because differences between the resistor values degrade the common-mode rejection ratio (CMRR).

Figure 3-4 shows both the schematic and the component placement for a 4 Hz lowpass filter placed on differential input channel 1. If the input signal source is floating, you must place a bias return resistor in positions A and/or B (R28 and R27, respectively).

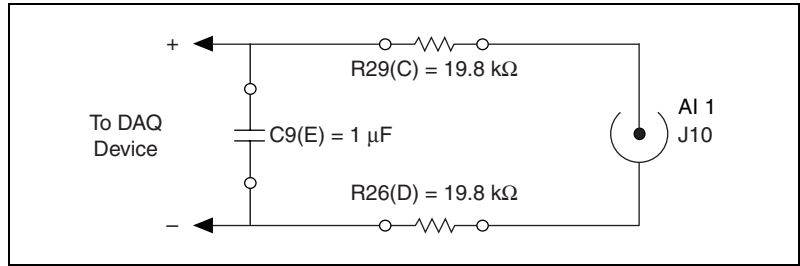


Figure 3-4. Lowpass Filter on Differential Channel 1

Figure 3-5 shows both the schematic and the component placement for a 4 Hz lowpass filter placed on single-ended input channel 1. Refer to the [Installing Bias Resistors](#) section for information about installing bias resistors.

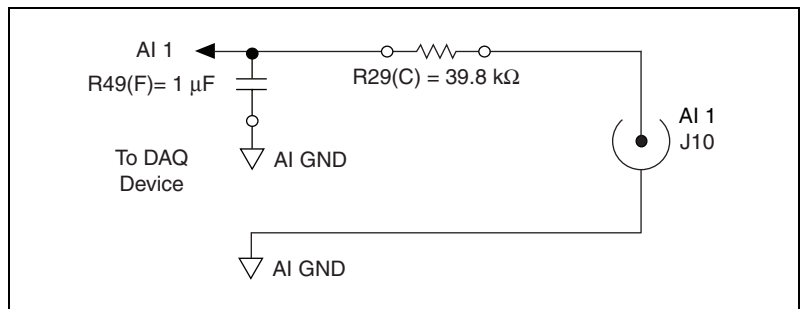


Figure 3-5. Lowpass Filter on Single-Ended Channel 1

Building Highpass Filters

You can install simple, RC highpass filters on any input channel of the BNC-2090A. The filters are useful for accurate high-frequency measurement and low-frequency noise rejection. By substituting resistance and capacitance values into Equation 3-1, you can calculate a simple, one-pole RC filter to have a -3 dB cutoff frequency, f_c . The frequency response rolls off at a rate of -20 dB per decade decrease thereafter. Figure 3-6 shows a Bode plot of the amplitude versus normalized frequency.

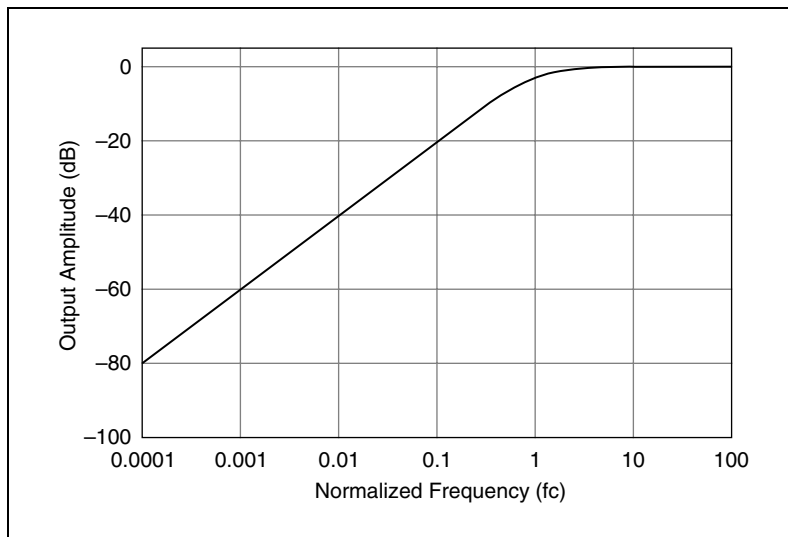


Figure 3-6. Normalized Frequency Response of Highpass Filter

Example

When measuring high-frequency signals (about 50 kHz), if you have 50 Hz noise on your input signals, you can add a highpass filter with a cutoff frequency of 50 kHz. The 50 Hz noise then attenuates by 60 dB. Notice that your 50 kHz signal also attenuates, by 3 dB. Do not neglect any potential attenuation of signals of interest if you add a low-order filter.

You must also choose the filter component values. You can select the resistance or the capacitance arbitrarily; one value determines the other. Picking the capacitor first and letting its value determine the resistance required is preferable because more standard resistor values are available. The filter circuit has one series capacitor on each input signal of the differential channel. Because the two capacitors are in series, the capacitance value that must be substituted into Equation 3-1 is the series capacitance of the two capacitors. For two capacitors in series, the net capacitance is the reciprocal of the sum of the reciprocals of the two capacitances. For example, two 0.001 μF capacitors in series have a net capacitance of 0.0005 μF . The two capacitors should be the same value, or the CMRR is degraded. If capacitors of 0.001 μF are available, the resistance is (by substitution into Equation 3-1) about 6.4 k Ω . Therefore, in this example, the input channel has a 6.34 k Ω resistor (or the closest standard value) in position E.



Note Highpass filters generally exhibit poorer common-mode rejection characteristics than lowpass filters because capacitors are in the series input paths. Capacitors have poorer tolerances than resistors, and matching the input impedances is crucial for good common-mode rejection.

Figure 3-7 shows both the schematic and the component placement for a 50 kHz highpass filter placed on differential input channel 1. If the input signal source is floating, you must place a bias return resistor in positions A and/or B position (R28 and R27, respectively). Refer to the [Installing Bias Resistors](#) section for information about installing bias resistors.

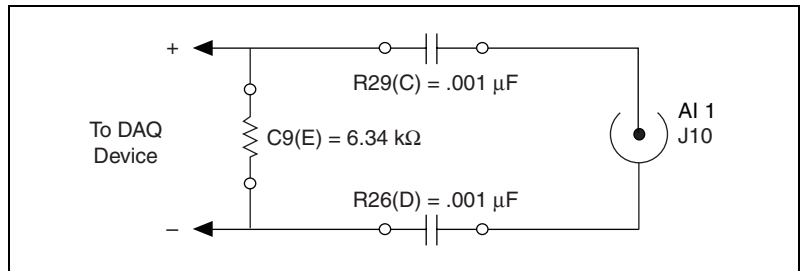


Figure 3-7. Highpass Filter on Differential Channel 1

Figure 3-8 shows both the schematic and the component placement for a 50 kHz highpass filter placed on single-ended input channel 1. Refer to the [Installing Bias Resistors](#) section for information about installing bias resistors.

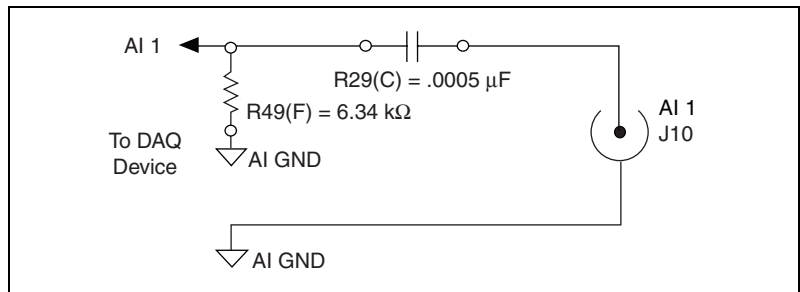


Figure 3-8. Highpass Filter on Single-Ended Channel 1

Building Attenuators (Voltage Dividers)

Attenuators or voltage dividers allow voltage measurements larger than the maximum input range of DAQ devices. For example, voltage signals in the ± 20 V range can be measured by building a 2:1 voltage divider circuit.

You can connect attenuators to the analog inputs of the BNC-2090A when the inputs from its DAQ device are in differential or single-ended mode.



Caution Do *not* connect input voltages greater than $42.4 V_{pk}/60$ VDC to the BNC-2090A. The BNC-2090A is not designed for any input voltages greater than $42.4 V_{pk}/60$ VDC, even if a user-installed voltage divider reduces the voltage to within the input range of the DAQ device. Input voltages greater than $42.4 V_{pk}/60$ VDC can damage the BNC-2090A, all devices connected to it, and the host computer. Overvoltage can also cause an electric shock hazard for the operator. National Instruments is *not* liable for damage or injury resulting from such misuse.

The gain in differential mode, G_{DIFF} , of this attenuator is given by the Equation 3-2.

$$G_{DIFF} = \frac{R_E}{(R_C + R_D + R_E)} \quad (3-2)$$

The gain in single-ended mode, G_{SE} , of this attenuator is given by the Equation 3-3.

$$G_{SE} = \frac{R_F}{R_C + R_F} \quad (3-3)$$

Therefore, the input to the DAQ device (V_{MIO}) for Equation 3-2 or 3-3 is as follows:

$$V_{MIO} = V_{in} \cdot G \quad (3-4)$$

where V_{in} is the voltage applied to the BNC connectors of the BNC-2090A. The accuracy of this gain equation depends on the tolerances of the resistors used.

Figure 3-9 shows a resistor circuit for attenuating voltages at the differential inputs of the BNC-2090A. It also shows the placement of the resistors on the open-component positions for channel 1.

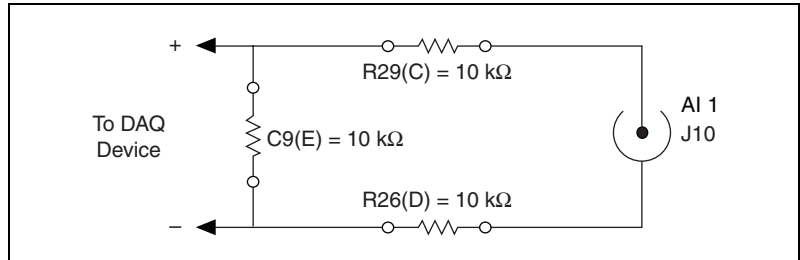


Figure 3-9. Attenuator for Use with Differential Inputs

Figure 3-10 shows a resistor circuit for attenuating voltages at the single-ended inputs of the BNC-2090A. It also shows the placement of the resistors on the open-component positions for channel 1.

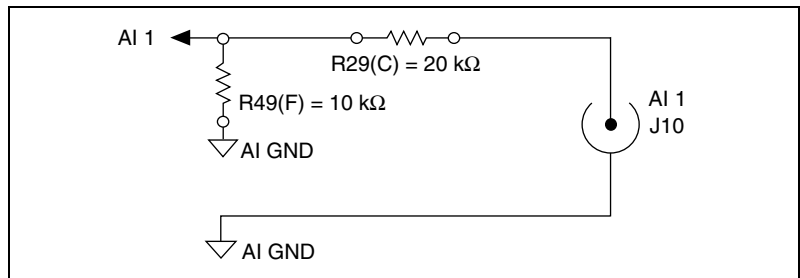


Figure 3-10. Attenuator for Use with Single-Ended Inputs

Using the values in Figure 3-9,

$$G_{DIFF} = \frac{10 \text{ k}\Omega}{10 \text{ k}\Omega + 10 \text{ k}\Omega + 10 \text{ k}\Omega} = \frac{1}{3} \quad (3-5)$$

or Figure 3-10,

$$G_{SE} = \frac{10 \text{ k}\Omega}{20 \text{ k}\Omega + 10 \text{ k}\Omega} = \frac{1}{3} \quad (3-6)$$

Therefore in either case,

$$V_{MIO} = V_{in} \cdot \frac{1}{3} \quad (3-7)$$

When the DAQ device is configured for ± 10 V input signals, the device can acquire ± 30 V signals with this attenuator circuit.

Notice that the input impedance for the channels employing voltage dividers circuit is reduced. In the differential example in Figure 3-9, the input impedance has been reduced to:

$$10\text{ k}\Omega + 10\text{ k}\Omega + 10\text{ k}\Omega = 30\text{ k}\Omega$$

The reduced input impedance can cause loading errors for signal sources with large source impedance. In general, the input impedance presented by the voltage divider circuit must be much larger than the source impedance of the signal source to avoid signal loading errors.

Analog Output Signal Conditioning

Each analog output has two open-component positions for passive signal conditioning components. One is designated as a resistor and one is designated as a capacitor. Factory-default positions for the $0\ \Omega$ jumpers are R34 and R1 as shown in Figure 3-11.

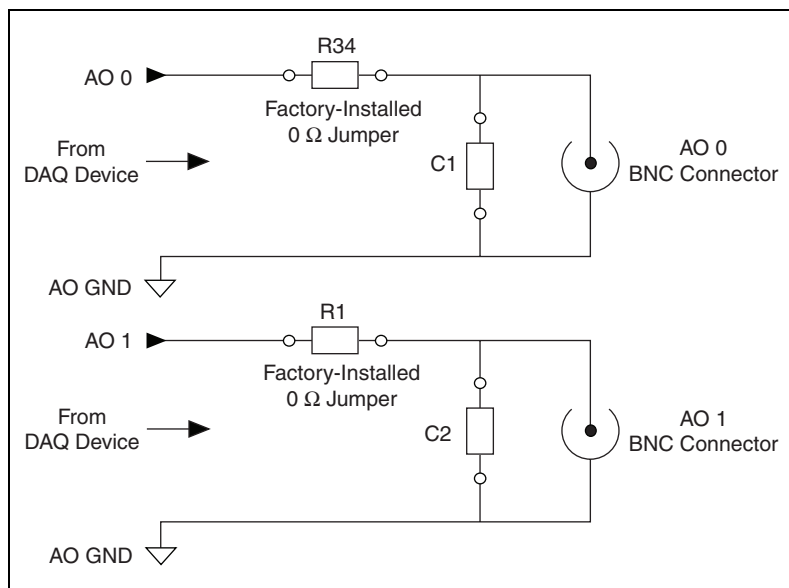


Figure 3-11. AO 0 and AO 1

You can remove and/or install components in these locations to build highpass and lowpass filters. Refer to the [Adding Signal Conditioning Components](#) section for instructions.



Note Channels that use these filters have greater output impedance. This can result in loading errors if the connected load impedance is not much higher than the filter's output impedance.

Building Lowpass Filters

Building lowpass filters for the analog output signals is the same as for the analog inputs. Refer to the *Analog Input Signal Conditioning* section for more detailed information about lowpass filters and how to calculate values for lowpass filters. Refer to Figure 3-14 for component locations. Figure 3-12 shows a 4 Hz lowpass filter for AO 0.

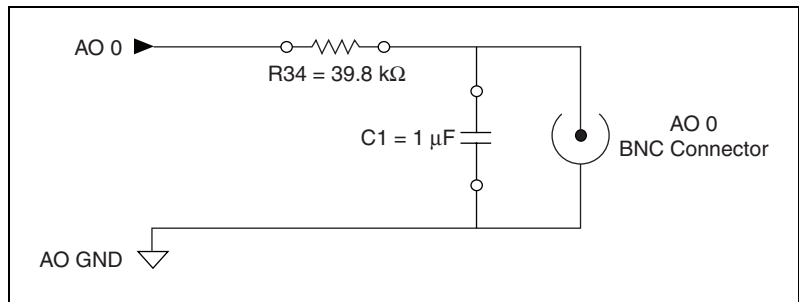


Figure 3-12. Lowpass Filter on AO 0

Building Highpass Filters

Building highpass filters for analog output is the same as for analog input. Refer to the *Analog Input Signal Conditioning* section for more detailed information about highpass filters and how to calculate values for them. Refer to Figure 3-14 for component locations. Figure 3-13 shows a 50 kHz highpass filter for AO 0.

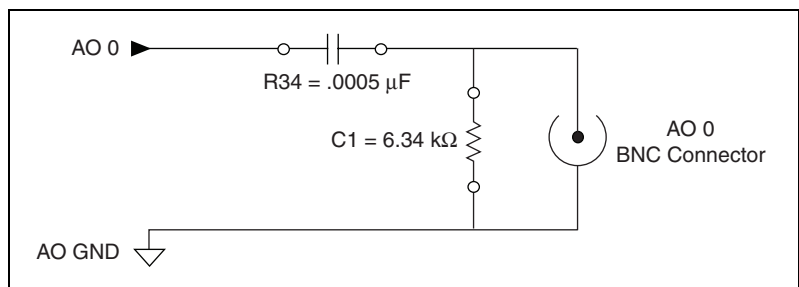


Figure 3-13. Highpass Filter on AO 0

Adding Signal Conditioning Components

The BNC-2090A has open-component positions in the input paths into which you can insert resistors and capacitors for conditioning the 16 single-ended or eight differential analog input signals and the two analog output signals. You can also use the BNC-2090A in conjunction with other signal conditioning accessories.

Figures 3-1 through 3-13 give examples using a specific channel. If you want to install the circuit in a different channel, consult Table 3-1 to determine the equivalent component positions for the other channels.

Complete the following steps to add signal conditioning components to the BNC-2090A, as shown in Figure 3-14.

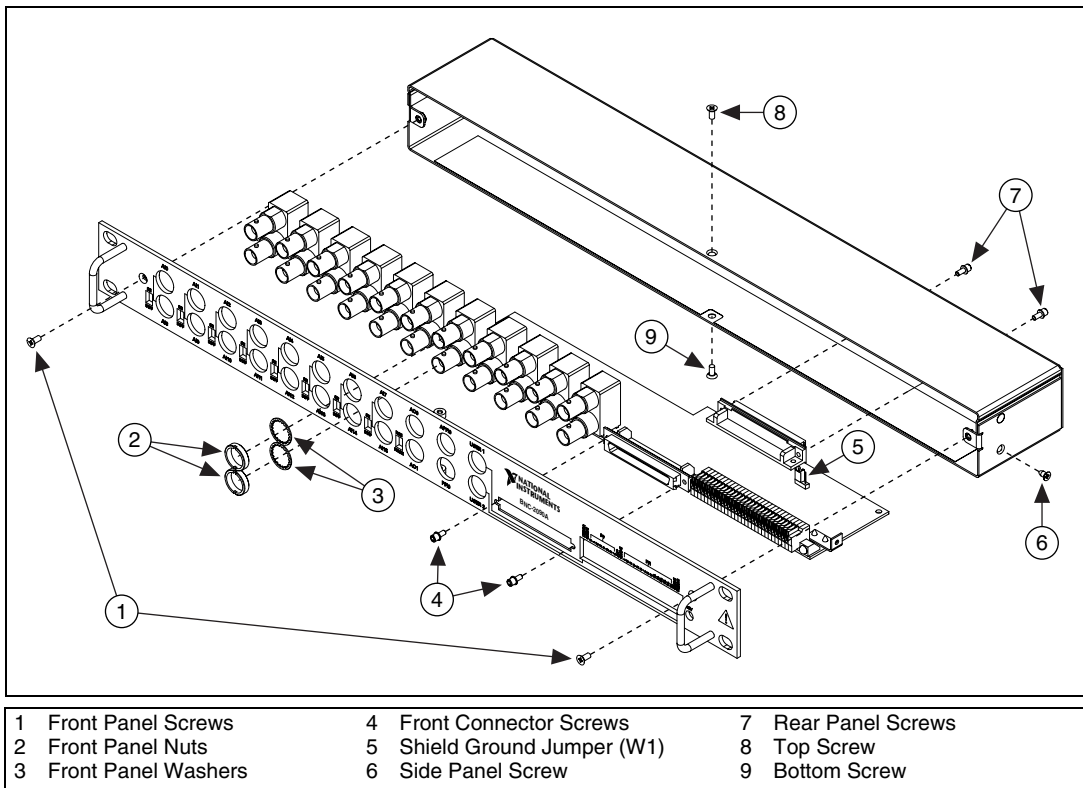


Figure 3-14. Disassembly of the BNC-2090A

1. Remove the two rear panel screws, the side panel screw, the top screw, and the bottom screw.

2. Remove the two front panel screws.
3. Hold the front panel and slide the unit out of the metal case.
4. Install and/or remove components as necessary. Refer to the *Soldering and Desoldering on the BNC-2090A* section for more information.
5. Reassemble the BNC-2090A in reverse order.

Soldering and Desoldering on the BNC-2090A



Caution Use a low-wattage (20 to 30 W) soldering iron when soldering to the device. You should use only rosin-core, electronic-grade solder. Acid-core solder damages the printed circuit device and components. Use vacuum-type tools when desoldering on the BNC-2090A to avoid damaging component pads.

Some applications require you to modify the PWB, usually by removing 0 Ω jumpers and adding components. The BNC-2090A is shipped with 0 Ω jumpers in the C and D positions, as listed in Table 3-1 and shown in Figure 3-1.



Note This product is RoHS-compliant. If you require that the product remain RoHS-compliant, ensure that you use RoHS-compliant solder and components. Visit ni.com/rohs for more information.

Installing Bias Resistors

You can install bias resistors in positions A and B on the BNC-2090A, as listed in Table 3-1 and shown in Figure 3-1. Refer to the steps in the *Adding Signal Conditioning Components* section for instructions about accessing the resistors on the BNC-2090A.

Figure 3-15 shows both the schematic and the component placement for a single 100 k Ω bias return resistor on the negative input from a floating source connected to channel 1, the B position in Table 3-1. Refer to the *Analog Input Signal Conditioning* section for information about building additional signal conditioning circuitry, such as filters and attenuators, in the open component positions.

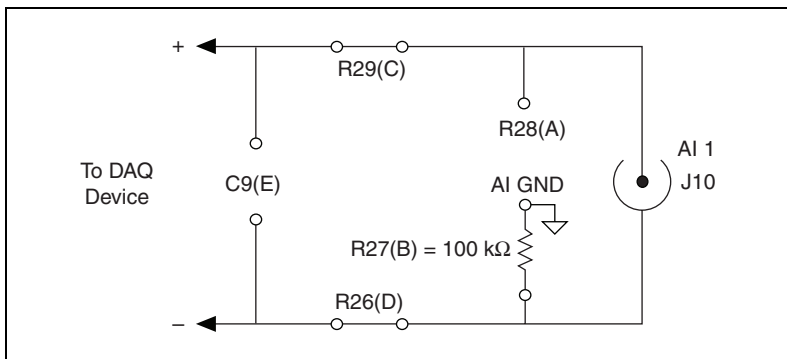


Figure 3-15. Bias Return Resistor for DC-Coupled Floating Source on Channel 1 in DIFF Mode

Figure 3-16 shows both the schematic and the component placement for an optional user-installed bias resistor, R35, between AI SENSE and AI GND.

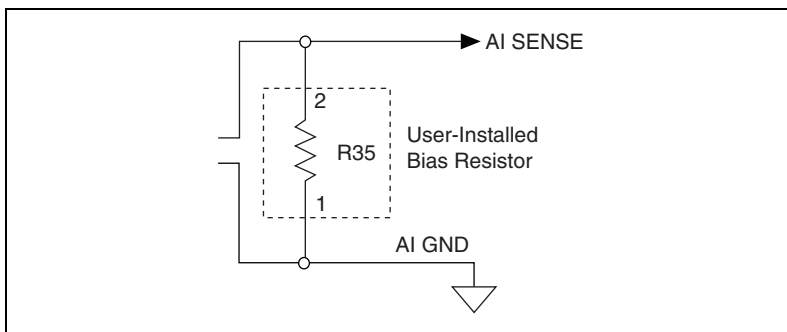


Figure 3-16. User-Installed Bias Resistor between AI SENSE and AI GND

Specifications

This appendix lists the specifications of the BNC-2090A. These specifications are typical at 25 °C unless otherwise specified.

Analog Input

Channels	8 differential (default), 16 single-ended
Field connections	16 BNC connectors
Signal conditioning	7 component positions per differential channel

Analog Output

Channels	2 single-ended
Field connections	2 BNC connectors for AO, 1 BNC connector for APFI 0 input
Signal conditioning	2 component positions per output channel

Digital Input and Output

Channels	8 digital I/O, 16 PFI
Field connections	1 BNC connector for PFI 0. 2 BNC connectors for user-defined, spring terminals for all other digital I/O and PFI
Signal conditioning	2 component positions per output channel

Power Requirement

+5 VDC ($\pm 5\%$) provided by DAQ device	
Typical power consumed by BNC-2090A.....	10 mA
Maximum power available at +5 V spring terminal.....	1 A (fuse-limited by host DAQ device)

Physical

Dimensions	4.39 \times 48.26 \times 9.7 cm (1.73 \times 19 \times 3.82 in.)
Weight	700 g (24.69 oz)
I/O connector	Two 68-position male connectors
BNC connectors.....	22
Spring terminal block	29 positions

Environment

The BNC-2090A is intended for indoor use only.	
Operating temperature	0 to 70 °C
Storage temperature	-55 to 125 °C
Relative humidity	5 to 90% RH, noncondensing
Pollution Degree (indoor use only)	2
Maximum Altitude	2,000 m

Safety

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

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1



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

Electromagnetic Compatibility

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

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



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

CE Compliance

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

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



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

Waste Electrical and Electronic Equipment (WEEE)



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

Frequently Asked Questions

How does the BNC-2090A differ from the BNC-2090?

The BNC-2090A is based on the BNC-2090. The main differences between these two accessories are listed in Table B-1.

Table B-1. BNC-2090A and BNC-2090 Comparison

BNC-2090A	BNC-2090
Can be used with E/M Series devices	Can be used with E/M Series and PC-LPM-16 devices
NI-DAQmx naming conventions on front panel	Traditional NI-DAQ (Legacy) naming conventions on front panel
Extra spring terminal to access PFI 15	N/A
User-installed signal conditioning components are easy to access	N/A
More signal conditioning component options	N/A
Attenuators (voltage dividers) can be used with the DAQ device in both single-ended and differential modes	Attenuators (voltage dividers) can be used with the DAQ device in differential mode only
User-installed AI SENSE bias resistor	N/A
Clear labeling on the PCB for easier signal conditioning component installation	N/A
Easy assembly and disassembly	N/A
Smaller dimensions and weight	N/A
RoHS compliant	N/A

Can I use the SCXI resistor kit to build attenuators for my BNC-2090A?

Yes. You can use the SCXI resistor kit, which consists of four high precision 249 Ω resistors, to build attenuators (voltage dividers) for the BNC-2090A. Refer to the *Building Attenuators (Voltage Dividers)* section of Chapter 3, *Signal Conditioning*, for more information about building attenuators for the BNC-2090A.

Can I configure the BNC-2090A to measure current?

Yes. You can use a pair of channels to route current through the a sense resistor located in position E. Refer to the *Analog Input Signal Conditioning* section of Chapter 3, *Signal Conditioning*, for the exact location of this component.



Caution When adding custom signal conditioning, do *not* exceed the components' power dissipation ratings. Limit current into the BNC-2090A to ≤ 100 mA.

Set the SE/DIFF switch to SE mode and the RSE/NRSE switch to RSE. This connects the BNC shields to AI GND. Configure the DAQ device for a differential measurement across the sense resistor.

Can I attach 68-pin DAQ cables to the front and back of the BNC-2090A to make it a pass-through?

Yes.



Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources at ni.com/support include the following:
 - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.
 - **Free Technical Support**—All registered users receive free Basic Service, which includes access to hundreds of Application Engineers worldwide in the NI Discussion Forums at ni.com/forums. National Instruments Application Engineers make sure every question receives an answer.

For information about other technical support options in your area, visit ni.com/services or contact your local office at ni.com/contact.

- **Training and Certification**—Visit ni.com/training for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit ni.com/alliance.
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification.

- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

If you searched ni.com and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of ni.com/niglobal to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Index

Symbols

+5V LED, 1-6

Numerics

100 Ω to digital ground jumper setting, 1-7

A

accessing

digital/timing I/O signals from a BNC, 2-7
PCB, 3-14

signal conditioning components, 3-14
the shield ground jumper, 1-8

adding signal conditioning components, 3-14

AI. *See* analog input

analog input, 2-1

connecting differential signals, 2-2
connecting single-ended signals, 2-3
differential mode (figure), 2-2
highpass filters, 3-7
lowpass filters, 3-5
normalized frequency response, 3-6
on differential channel 1, 3-7

signal conditioning, 3-1
diagram, 3-2
differential mode diagram, 3-2

single-ended mode (figure), 2-4
specifications, A-1

analog output, 2-5

diagram, 2-6
highpass filters, 3-13
lowpass filters, 3-13
signal conditioning, 3-12
diagram, 3-12

AO. *See* analog output

APFI

diagram, 2-6
signals, 2-5

attenuators, 3-10

for use with differential inputs, 3-11

for use with single-ended inputs, 3-11
using SCXI resistor kit, B-2

B

bias resistors

adding, 3-14

for DC-coupled floating source on channel 1
in differential mode, 3-16

installing, 3-15

between AI SENSE and AI GND, 3-16

BNC connectors

accessing digital/timing I/O signals, 2-7
USER <1..2>, 2-7

BNC-2090, differences from BNC-2090A, B-1

BNC-2090A

circuitry (diagram), 2-1

connections to E Series devices, 1-6

connections to M Series devices, 1-5

differences from BNC-2090, B-1

disassembly diagram, 3-14

features, 1-1

frequently asked questions, B-1

front panel and enclosure back diagram, 1-2

getting started, 1-2

installing, 1-3

overview, 1-1

soldering and desoldering, 3-15

specifications, A-1

building

analog output highpass filters, 3-13

analog output lowpass filters, 3-13

- attenuators, 3-10
 - with SCXI resistor kit, B-2
- highpass filters, 3-7
- lowpass filters, 3-5
- voltage dividers, 3-10

C

- cabling
 - to E Series devices, 1-6
 - to M Series devices, 1-5
- calibration certificate (NI resources), C-2
- capacitor
 - adding, 3-14
 - locations, 3-4
 - locations on highpass filters on single-ended channel 1, 3-9
 - placement for lowpass filter on differential channel 1, 3-7
 - population options, 3-5
- channel component positions, 3-4
- components
 - adding, 3-14
 - location for analog output signal conditioning, 3-12
 - location for attenuator for use with single-ended inputs, 3-11
 - locations for attenuator for use with differential inputs, 3-11
 - locations on highpass filter on single-ended channel 1, 3-9
 - placement for lowpass filter on differential channel 1, 3-7
 - population options, 3-5
 - positions, 3-4
- connecting
 - analog input signals, 2-1
 - analog output signals, 2-5
 - APFI 0 signals, 2-5
 - differential analog input signals, 2-2
 - digital signals, 2-6

- digital/timing signals to a BNC, 2-7
- PFI 0 signals, 2-5
- signals, 2-1
- single-ended analog input signals, 2-3
- to E Series devices, 1-6
- to M Series devices, 1-5
- USER <1..2>, 2-7

- connectors, USER <1..2> BNC, 2-7
- conventions used in the manual, v
- current measurement, B-2

D

- Declaration of Conformity (NI resources), C-1
- desoldering, 3-15
- diagnostic tools (NI resources), C-1
- diagram
 - 100 Ω to digital ground shield ground jumper setting, 1-7
 - accessing the shield ground jumper, 1-8
 - analog input normalized frequency response of highpass filters, 3-8
 - analog input signal conditioning, 3-2
 - analog input single-ended mode signal conditioning, 3-3
 - analog output
 - signals, 2-6
 - analog output signal conditioning, 3-12
 - APFI 0 signals, 2-6
 - attenuator for use with differential inputs, 3-11
 - attenuator for use with single-ended inputs, 3-11
 - BNC-2090A circuitry, 2-1
 - BNC-2090A disassembly, 3-14
 - differential mode, 2-2
 - digital ground jumper setting, 1-7
 - disconnecting the shield from the DAQ ground jumper setting, 1-7
 - E Series device connections, 1-6

- front panel
 - and enclosure back, 1-2
- highpass filter on differential channel 1, 3-9
- highpass filter on single-ended channel 1, 3-9
- installation, 1-3
- lowpass filter on differential channel 1, 3-7
- M Series device connections, 1-5
- normalized frequency response of lowpass filter, 3-6
- PFI 0 signals, 2-6
- USER <1..2>
 - BNC connections, 2-7
 - example, 2-7
- DIFF mode. *See* differential mode
- differential mode
 - analog input signal conditioning (figure), 3-2
 - attenuators use, 3-11
 - highpass filter (figure), 3-9
 - measuring floating signals, 2-2
 - measuring ground-referenced signals, 2-3
 - signals, 2-2
- digital
 - ground jumper setting, 1-7
 - signals, 2-6
 - wire specifications, 2-6
- disconnecting the shield from the DAQ ground jumper setting, 1-7
- documentation
 - conventions used in the manual, v
 - NI resources, C-1
- drivers (NI resources), C-1

E

- E Series
 - device connections, 1-6
 - diagram, 1-6

- enclosure back, 1-2
- examples (NI resources), C-1

F

- FAQs, B-1
- features, 1-1
- filters
 - analog input lowpass, 3-5
 - analog output
 - lowpass, 3-13
 - analog output highpass, 3-13
 - highpass, 3-7
 - note, 3-9
 - highpass on single-ended channel 1, 3-9
- floating signals
 - measuring in differential mode, 2-2
 - measuring in single-ended mode, 2-4
- frequently asked questions, B-1
- front panel, 1-2
 - diagram, 1-2

G

- ground-referenced signals
 - measuring in differential mode, 2-3
 - measuring in single-ended mode, 2-5

H

- help, technical support, C-1
- highpass filters, 3-7
 - analog output, 3-13
 - normalized frequency response, 3-8
 - note, 3-9
 - on differential channel 1, 3-9
 - on single-ended channel 1, 3-9

I

- installation, 1-3
 - getting started, 1-2
 - supplies, 1-2
- installing
 - bias resistors, 3-15
 - signal conditioning components, 3-14
- instrument drivers (NI resources), C-1

J

- jumper, 1-7
 - accessing, 1-8
 - settings, 1-7

K

- KnowledgeBase, C-1

L

- lowpass filters
 - analog input normalized frequency response, 3-6
 - analog output, 3-13
 - on differential channel 1, 3-7
 - on single-ended channel 1, 3-7

M

- M Series
 - device connections, 1-5
 - diagram, 1-5
- measuring current, B-2

N

- National Instruments support and services, C-1
- non-referenced single-ended mode, measuring ground-referenced signals, 2-5

- normalized frequency response
 - of highpass filters, 3-8
- NRSE mode. *See* non-referenced single-ended mode

O

- overview, 1-1

P

- PFI, 2-5
 - connecting to USER 1 BNC, 2-7
 - diagram, 2-6
- programming examples (NI resources), C-1

R

- referenced single-ended mode
 - measuring floating signals, 2-4
- resistors
 - adding, 3-14
 - bias, 3-15
 - between AI SENSE and AI GND, 3-16
 - locations, 3-4
 - locations on highpass filters on single-ended channel 1, 3-9
 - placement for lowpass filter on differential channel 1, 3-7
 - population options, 3-5
- RSE mode. *See* referenced single-ended mode

S

- SCXI resistor kit use, B-2
- SE mode. *See* single-ended mode
- shield ground jumper, 1-7
 - accessing, 1-8
 - descriptions, 1-7
 - settings, 1-7

- signal conditioning, 3-1
 - adding components, 3-14
 - analog input, 3-1
 - highpass filters, 3-7
 - lowpass filters, 3-5
 - lowpass filters normalized frequency response, 3-6
 - analog output, 3-12
 - channel component positions (table), 3-4
 - component population options (table), 3-5
- signals
 - analog input, 2-1
 - connecting, 2-2
 - analog output, 2-5
 - APFI, 2-5
 - connecting, 2-1
 - digital, 2-6
 - PFI, 2-5
 - timing, 2-7
- single-ended mode
 - analog input signal conditioning (figure), 3-3
 - attenuator use, 3-11
 - diagram, 2-4
 - measuring floating signals, 2-4
 - measuring ground-referenced signals, 2-5
 - signals, 2-3
- software (NI resources), C-1
- soldering, 3-15
 - caution, 3-15
- specifications, A-1
- spring terminal block, using the USER<1..2> pins, 2-7
- support, technical, C-1

T

- technical support, C-1
- training and certification (NI resources), C-1
- troubleshooting (NI resources), C-1

U

- USER <1..2>
 - BNC connectors, 2-7
 - diagram, 2-7
 - using the BNC connectors, 2-7
- USER<1..2> pins, 2-7

V

- voltage
 - caution, 3-10
 - dividers, 3-10
- voltage dividers, 3-10

W

- W1, 1-7
- Web resources, C-1
- what you need to get started, 1-2
- wire
 - AWG specifications, 2-6
 - connecting USER<1..2> pins, 2-7