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Signal Conditioning

SC-2311 User Manual

Connectivity for 5B and SSR Modules

February 2001 Edition
Part Number 322906A-01

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Conventions

The following conventions appear in this manual:



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.

bold

Bold text denotes items that you must select or click on 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. This font 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, and code excerpts.

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1 Introduction

This manual describes the electrical and mechanical aspects of the SC-2311 shielded carrier, 5B Series modules, SSR Series modules, and accessory terminal blocks. It also describes how to configure, connect, and customize the SC-2311 for use with National Instruments E Series data acquisition (DAQ) devices.

The SC-2311 shielded carrier interfaces with the following signal conditioning modules:

- Analog signal conditioning
  - 5B30, 5B31, 5B40, 5B41 voltage input modules
  - 5B32 process-current input modules
  - 5B34 RTD input, isolated 2- or 3-wire RTD modules
  - 5B35 RTD input, isolated 4-wire RTD modules
  - 5B36 potentiometer input modules
  - 5B37 thermocouple input with cold-junction compensation modules
  - 5B42 process-current input with regulated 20 VDC loop modules
  - 5B47 linearized thermocouple input with cold-junction compensation modules
  - 5B38 strain-gauge input modules
  - 5B45/46 frequency input modules
- Digital signal conditioning
  - SSR-IAC-5 input module (120 VAC)
  - SSR-IAC-5A input module (240 VAC)
  - SSR-IDC-5 input module (3 to 32 VDC)
  - SSR-OAC-5 output module (120 VAC)
  - SSR-OAC-5A output module (240 VAC)
  - SSR-ODC-5 output module (3 to 60 VDC)

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About the SC-2311, 5B Series Modules, and SSR Series Modules

This section describes the SC-2311 shielded carrier, 5B Series modules, and SSR Series modules. It also lists what you need to get started, and explains how to unpack your SC-2311 and signal conditioning modules.

The SC-2311 connects signals to E Series DAQ devices. The SC-2311 can interface up to eight 5B Series modules and eight SSR Series modules simultaneously. When used with the 5B Series modules, SSR Series modules, and a shielded 68-pin E Series cable, the SC-2311 offers a clean, easy-to-use solution to analog and digital signal conditioning that is both portable and rugged. The SC-2311 also provides 50 terminal block connections for non-isolated measurements. This feature allows you direct access to the I/O signals from the E Series DAQ device.

The SC-2311 has internal terminal blocks for connecting to the 5B Series modules as well as the SSR Series modules. The SC-2311 allows you to optimize connectivity to the terminal blocks through the use of panelettes. The SC-2311 shielded carrier has a portable enclosure, and is ideal for laptop and desktop applications.

The 5B Series modules along with the SC-2311 provide a high-performance, inexpensive means of analog signal conditioning. You can insert the 5B Series modules into any of the eight available slots on the carrier. The 5B Series modules, along with the SC-2311, provide analog input measurements such as voltage, current, resistance, temperature, strain, and frequency.

The SSR Series modules along with the SC-2311 provide an easy-to-use means of digitally controlling or sensing voltages from field devices. The SSR Series modules are high-performance, fully encapsulated devices that you can insert into any of the eight available slots on the SC-2311. The SC-2311 also has light emitting diodes (LEDs) that indicate the status of each SSR Series module.

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What You Need to Get Started

To set up and use the SC-2311 you need the following items:

- ❑ SC-2311 shielded carrier
- ❑ Up to eight of the following 5B Series modules for analog signal conditioning
  - 5B30/31
  - 5B32
  - 5B34
  - 5B35
  - 5B36
  - 5B37
  - 5B38
  - 5B40/41
  - 5B42
  - 5B45/46
  - 5B47
- ❑ Up to eight of the following SSR Series modules for digital signal conditioning
  - SSR-IAC-5
  - SSR-IAC-5A
  - SSR-IDC-5
  - SSR-OAC-5
  - SSR-OAC-5A
  - SSR-ODC-5
- ❑ *SC-2311 User Manual*
- ❑ External power supply (supplied)
- ❑ 68-pin E Series DAQ device, documentation, and 68-pin E Series cable
- ❑ Flathead screwdriver 0.1 in. (supplied)
- ❑ Number 1 and 2 Phillips-head screwdrivers

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- ❑ Wire-insulation strippers
- ❑ NI-DAQ 6.9 or later (driver software)
- ❑ One or more I/O panelettes and label sheet

Unpacking

Your SC-2311 shielded carrier is shipped in a cardboard box. The 5B and SSR Series modules are shipped in antistatic packaging to prevent electrostatic damage to the modules. Electrostatic discharge can damage several components on these products. To avoid such damage when you handle the products, take the following precautions:

- Ground yourself by using a grounding strap or by touching a grounded object.
- Touch the antistatic package to a metal part of your computer chassis before removing the modules from the packaging.

Caution *Never* touch the exposed pins of connectors.

- Remove the modules from the packaging and inspect the modules for any sign of damage. Notify National Instruments if the modules appear damaged in any way. Do *not* install a damaged module into your system.

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2

Configuring and Setting Up the SC-2311

This chapter explains how to configure the SC-2311, provides safety information, and explains how to install I/O panelettes and mounting accessories.

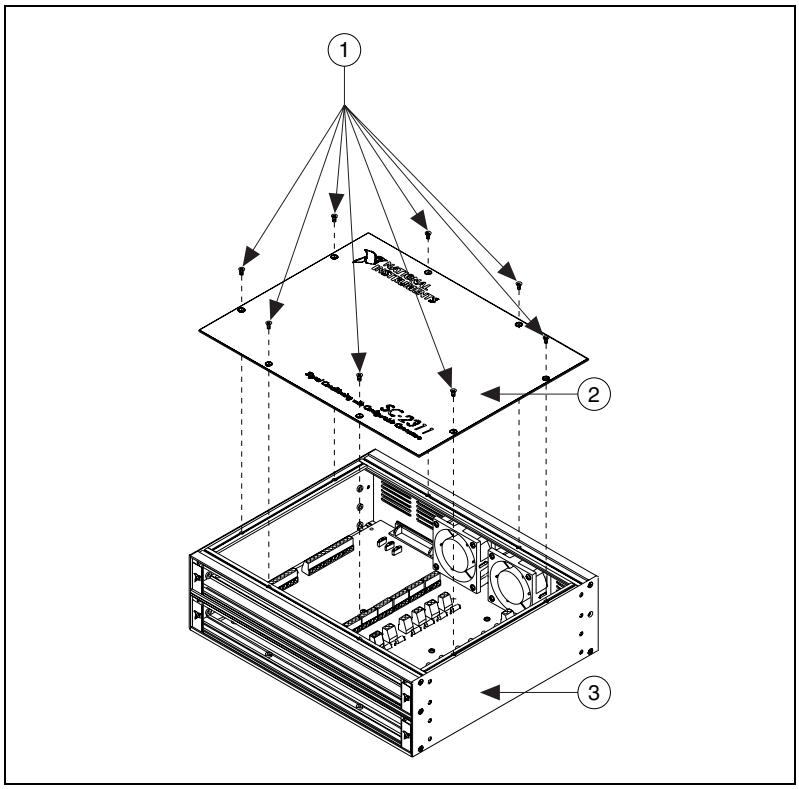
Configuring the SC-2311

The SC-2311 contains the following slide switches that are used to configure the device:

- SW5
- SW4
- SW3
- SW2

You must configure these slide switches prior to operating the SC-2311. To access the slide switches, remove the eight top cover screws and the top cover as shown in Figure 2-1. See Figure 2-2 for switch locations.

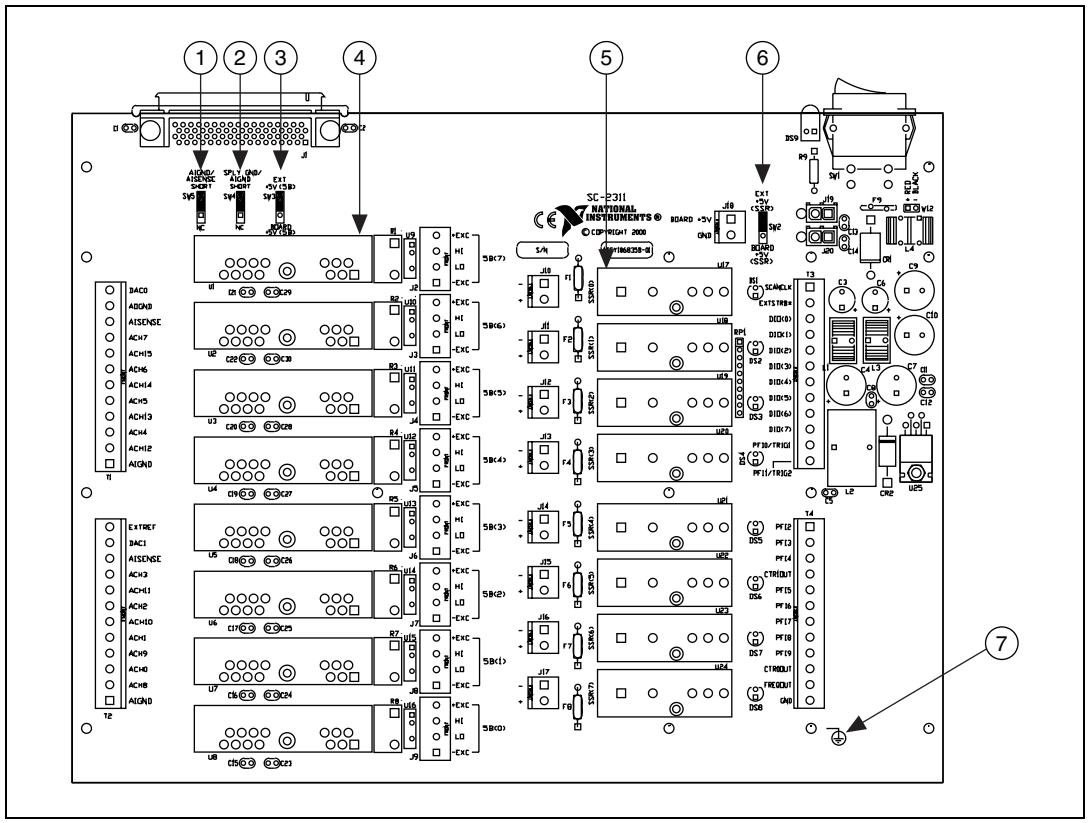
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1 Top Cover Screws 2 Top Cover 3 SC-2311

Figure 2-1. SC-2311 Top Cover Removal

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1	SW5	3	SW3	5	SSR Series Modules	7	Safety Ground
2	SW4	4	5B Series Modules	6	SW2		

Figure 2-2. SC-2311 Parts Locator Diagram

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Setting SW5

Setting SW5 to the AIGND/AISENSE SHORT position allows the E Series DAQ device to operate in nonreferenced single-ended (NRSE) mode. Use this switch setting when you are using 5B Series modules to take measurements. In this mode, AIGND connects the negative input to the PGIA on the E Series DAQ device through the AISENSE pin as shown in Figure 2-3.

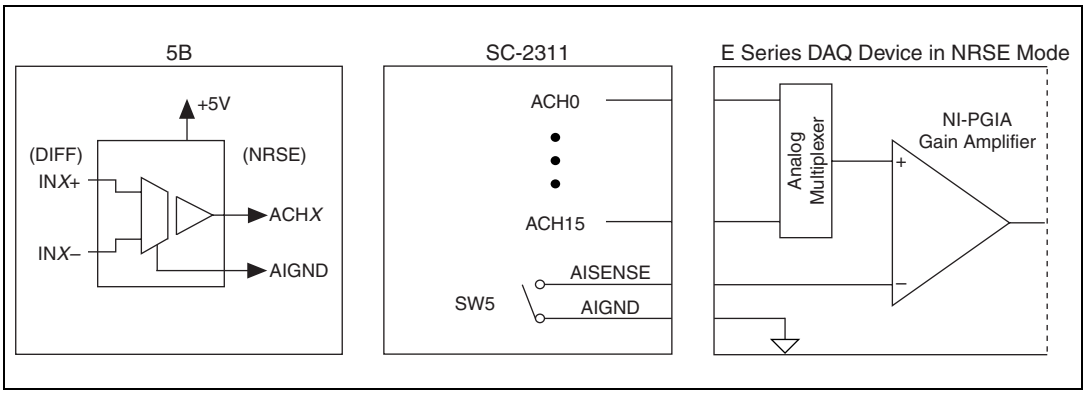


Figure 2-3. NRSE, and RSE or DIFF Mode Circuits

When the E Series DAQ device operates in referenced single-ended (RSE) or differential (DIFF) mode, set SW5 to NC. When SW5 is in the NC position it breaks the connection between AISENSE and AIGND as shown in Figure 2-3. Use this setting if you are not using 5B modules to take measurements.

Setting SW4

Setting SW4 to the SPLY GND/AIGND SHORT position allows the 5B Series modules to function properly when using the external power supply. This switch setting short circuits the external supply ground to the AIGND of the E Series DAQ device. In most cases, SW4 should remain in the SPLY GND/AIGND SHORT position.

Setting SW3

Setting SW3 to the EXT +5V (5B) position powers the 5B modules using the external power supply. In this mode, it is necessary to connect the external power supply to power the 5B Series modules. For the best performance, set SW3 to the EXT +5V (5B) position and use the external power supply.

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Setting SW3 to the Board +5V (5B) position powers the 5B modules using the E Series DAQ device +5 V supply. In this mode, you can power the 5B Series modules directly from the E Series DAQ device.

Note The maximum current that the DAQ device can deliver depends on which DAQ device you have selected. When using the Board +5V (5B) setting, it is necessary to know the current requirements of the 5B Series modules and the current available from the DAQ device you are using. See Appendix C, *Power Requirements for the SC-2311 with 5B and SSR Series Modules*, for more details.

Setting SW2

Setting SW2 to the EXT +5V (SSR) position powers the SSR modules using the external power supply. In this mode, you must connect the external power supply to power the SSR Series modules.

Setting SW2 to the Board +5V (SSR) position powers the SSR modules using the E Series DAQ device +5 V supply. In this mode, you can power the SSR Series modules directly from the E Series DAQ device.

Note The maximum current that the DAQ device can deliver depends on which DAQ device you have selected. When using the Board +5V (SSR) setting, it is necessary to know the current requirements of the SSR Series modules and the current available from the DAQ device you are using.

Safety Information

Cautions Do *not* operate the device in an explosive atmosphere or where there may be flammable gases or fumes.

Keep away from live circuits. Do *not* remove equipment covers or shields unless you are trained to do so. If signal wires are connected to the device, hazardous voltages can exist even when the equipment is turned off. To avoid a shock hazard, do *not* perform procedures involving cover or shield removal unless you are qualified to do so and disconnect all field power prior to removing covers or shields.

Equipment described in this document must be used in an Installation Category II[1] environment per IEC 60664-1.

Do *not* operate damaged equipment. The safety protection features built into this device

[1] Category II refers to local-level power distribution, such as that provided by a standard wall outlet.

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can become impaired if the device becomes damaged in any way. If the device is damaged, turn the device off and do *not* use it until service-trained personnel can check its safety. If necessary, return the device to National Instruments for service and repair to ensure that its safety is not compromised.

Do *not* operate this equipment in a manner that contradicts the information specified in this document. Misuse of this equipment could result in a shock hazard.

Do *not* substitute parts or modify equipment. Because of the danger of introducing additional hazards, do *not* install unauthorized parts or modify the device. Return the device to National Instruments for service and repair to ensure that its safety features are not compromised.

You *must* insulate all of your signal connections to the highest voltage with which the SC-2311 can come in contact.

When using the device with high common-mode voltages, you *must* insulate your signal wires for the highest input voltage. National Instruments is *not* liable for any damages or injuries resulting from inadequate signal wire insulation. Use only 26–14 AWG wire with a minimum voltage rating of 300 V and a temperature value of 60 °C for measuring up to 300 V.

When connecting or disconnecting signal lines to the SC-2311 screw terminals, make sure the lines are powered off. Potential differences between the lines and the SC-2311 ground can create a shock hazard while you connect the lines.

Connections, including power signals to ground and vice versa, that exceed any of the maximum signal ratings on the SC-2311 device can create a shock or fire hazard, or can damage any or all of the boards connected to the SC-2311, the host computer, and the SC-2311 device. National Instruments is *not* liable for any damages or injuries resulting from incorrect signal connections.

If hazardous voltages (≥30 V_{rms} and 42.4 V_{peak} or 60 VDC) are present, you *must* connect a safety earth-ground wire to the safety-ground screw terminal, shown in Figure 2-2. This complies with safety agency requirements and protects against electric shock when the SC-2311 is not connected to an installed DAQ device. To connect the safety earth-ground to the safety-ground screw terminal, run an earth-ground wire from the signal source to the screw terminal. National Instruments is *not* liable for any damages or injuries resulting from inadequate safety earth-ground connections.

Clean the SC-2311 and accessories by brushing off light dust with a soft nonmetallic brush. Remove other contaminants with a stiff nonmetallic brush. The unit *must* be completely dry and free from contaminants before returning it to service.

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Using the I/O Panelettes

Select configurable I/O panelettes appropriate for the I/O connectivity needs of your application. The I/O panelettes have standard prewired I/O connectors. You can install I/O panelettes on the front of the SC-2311 enclosure.

You can install up to 18 single-width I/O panelettes in the SC-2311 enclosure. You can mix all types of I/O panelettes to produce custom I/O combinations.

Note The strain-relief and 9-pin D-subminiature I/O panelettes require two panelette spaces. The dual 9-pin D-sub I/O panelette requires three panelette spaces.

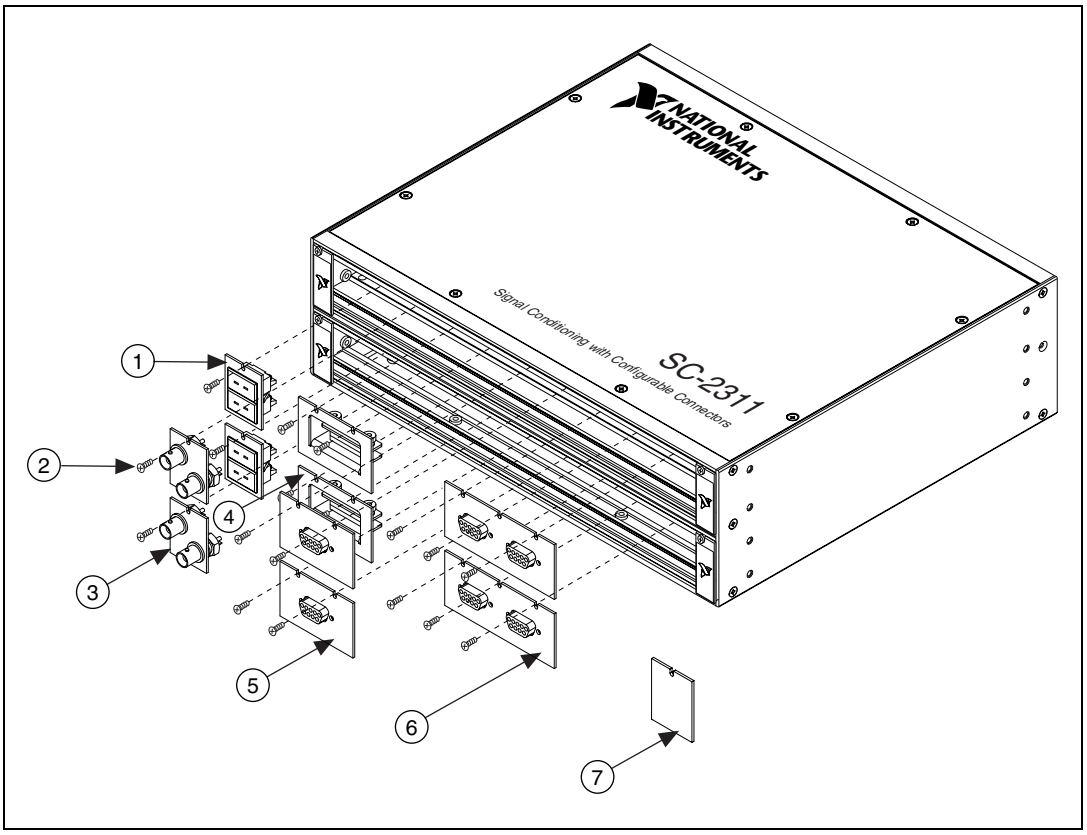
Each thermocouple and BNC I/O panelette accommodates two connectors. Use the strain-relief I/O panelettes to connect large numbers of wires directly to your internal accessory. You can machine the blank I/O panelettes to make custom I/O panelettes to suit your application. Use the preconfigured I/O panelettes to quickly connect and disconnect standard connectors.

Note For RF emission compliance, you cannot use BNC panelettes.

Refer to Figure 2-4 and use the following steps to install any of the I/O panelettes:

1. Choose one of the I/O panelettes to install.
2. Place the lower edge of the I/O panelette in the groove at the bottom of the enclosure opening.
3. Tilt the I/O panelette top back into the enclosure.
4. Secure the I/O panelette with either one, two, or three of the M2.5 × 6 panhead screws (depending on the type of I/O panelette) that are included with the panelette.
5. Repeat steps 1 through 4 until you have installed all your non-blank I/O panelettes.
6. Install a blank I/O panelette in any unused panelette opening.

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1	Thermocouple I/O Panelette	4	Strain-Relief I/O Panelette	6	Dual D-Sub I/O Panelette
2	M2.5 × 6 Screw	5	D-Sub I/O Panelette	7	Blank I/O Panelette
3	BNC I/O Panelette				

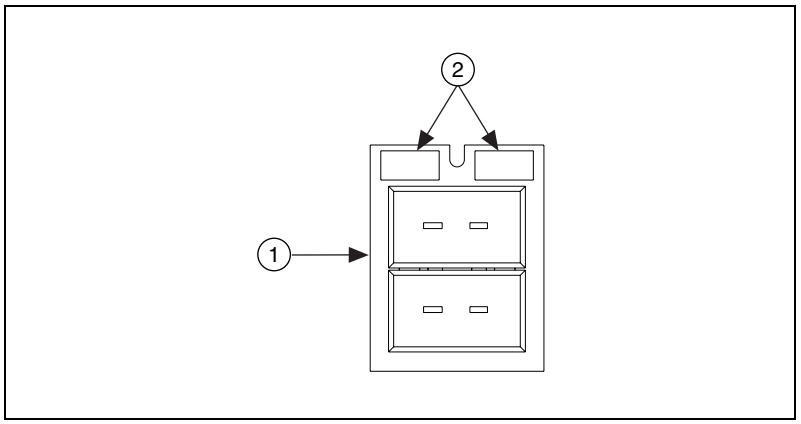
Figure 2-4. Installing an I/O Panelette

I/O Panelette Labels

Each SC-2311 ships with a sheet of labels for you to apply to your I/O panelettes as shown in Figure 2-5. The label sheet has both preprinted and blank labels. You can customize the blank labels to suit your application. You can use two labels on single-width I/O panelettes and three or more labels on wider panelettes.

Caution Do *not* use a panelette for signals that exceed the panelette rating.

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1 I/O Panelette 2 Label

Figure 2-5. Installing an I/O Panelette Label

Mounting the SC-2311

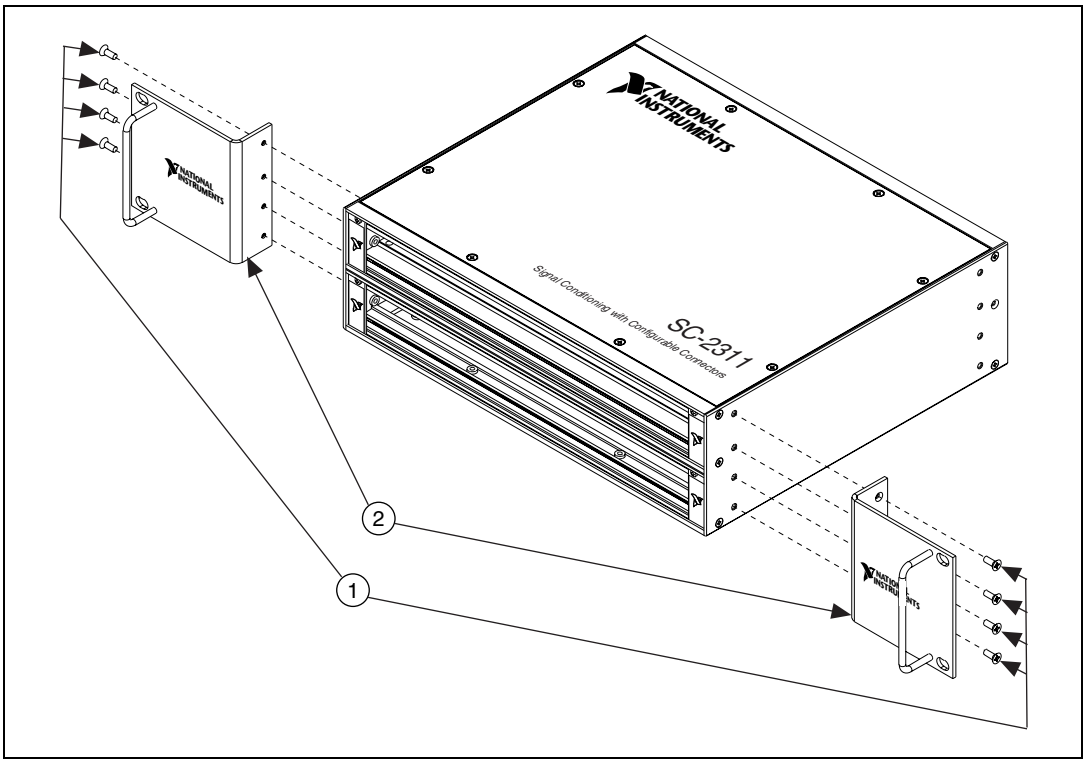
To install your SC-2311 enclosure in a standard 19 in. rack, install the optional rack-mount kit. To use your SC-2311 enclosure in a desktop stacking configuration install the optional stack-mount kit.

Refer to Figure 2-6 and use the following steps to install the rack-mount kit on your SC-2311 enclosure:

1. Attach a rack-mount bracket to one side of the enclosure with four 4-40 × 1/4 in. screws from the rack-mount kit.
2. Attach a rack-mount bracket to the other side of the enclosure with four 4-40 × 1/4 in. screws from the rack-mount kit.

Note You must remove the rubber feet from the bottom of the SC-2311 enclosure for use in rack-mount applications.

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1 4-40 x 1/4 in. Screws	2 Rack-Mount Brackets

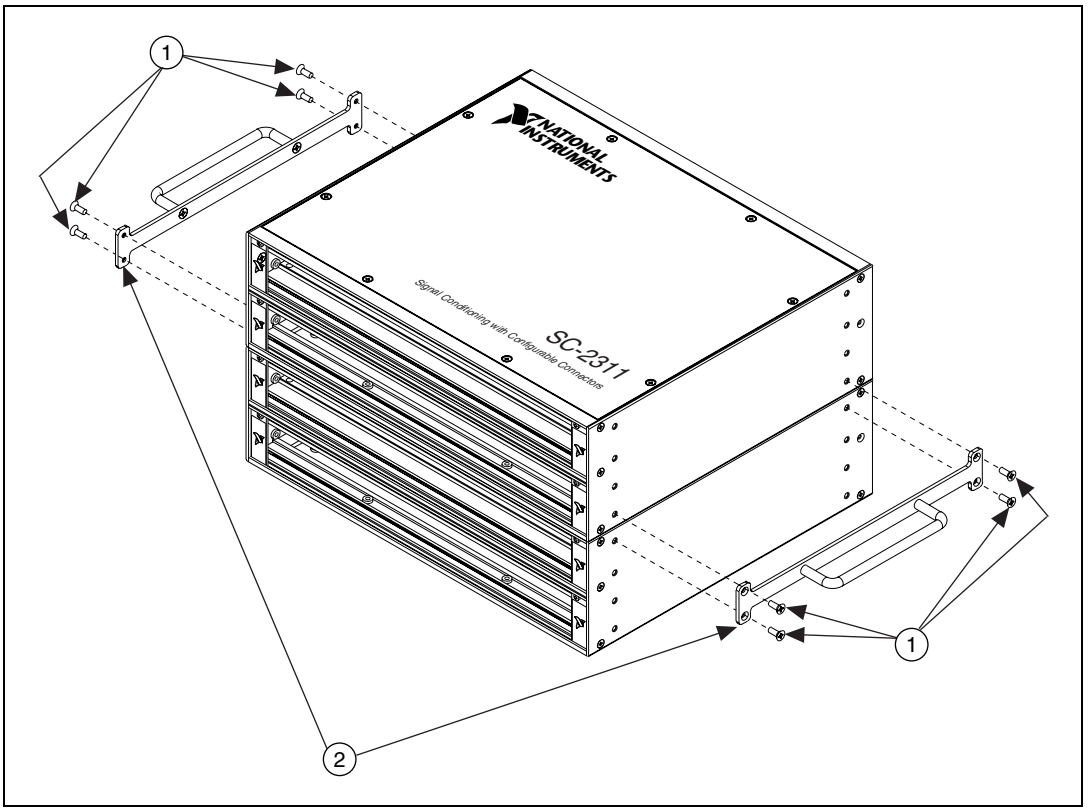
Figure 2-6. Rack-Mount Option

Refer to Figure 2-7 and use the following steps to install the stack-mount kit on your SC-2311 configurable connector enclosure:

1. Attach the stack-mount brackets to both ends of the lower enclosure with the 4-40 × 1/4 in. flathead screws from the stack-mount kit.
2. Place the upper enclosure on top of the lower enclosure.
3. Attach the stack-mount brackets to both ends of the upper enclosure with the 4-40 × 1/4 in. flathead screws from the stack-mount kit.

Note You must remove the rubber feet from all but the bottom enclosure before stacking the enclosures.

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1	4-40 × 1/4 in. Flathead Screws	2	Stack-Mount Brackets

Figure 2-7. Stack-Mount Option

You can stack additional enclosures by using additional stack-mount kits. You can remove the stack-mount kit handles, if necessary, by removing the two screws that attach the handle.

Note You can also use the stack-mounting brackets as handles.

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3

5B Series Modules

This chapter describes the 5B Series modules you can use with the SC-2311.

Overview

You can use 5B Series modules with the SC-2311 to perform per-channel analog signal conditioning with National Instruments E Series DAQ devices. The 5B Series modules are inserted in an eight-channel backplane within the SC-2311. The 5B Series modules provide isolation, noise rejection, and amplification for millivolt sources, volt sources, 4–20 mA sources, 0–20 mA sources, RTDs, thermocouples, strain gauges, potentiometers, and frequency inputs.

Install panelettes in the front of the SC-2311 to connect to your I/O signals. Connect the panelettes to the input terminal blocks of corresponding 5B channels. After the signals are conditioned, they are routed through a shielded 68-position cable to an E Series DAQ device for measurement.

The 5B Series modules include the following:

- 5B30, 5B31, 5B40, 5B41 voltage input modules
- 5B32 process current input modules
- 5B34 RTD input—isolated 2- or 3-wire RTD modules
- 5B35 RTD input—isolated 4-wire RTD modules
- 5B36 potentiometer input modules
- 5B37 thermocouple input modules with cold-junction compensation
- 5B38 strain gauge input modules
- 5B42 process current input modules with regulated 20 VDC loop
- 5B45/46 frequency input modules
- 5B47 linearized thermocouple input modules with cold-junction compensation

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See Appendix C, *Power Requirements for the SC-2311 with 5B and SSR Series Modules*, to calculate the power requirements for your 5B Series modules.

5B30, 5B31, 5B40, 5B41 Voltage Input Module

The 5B Series voltage input modules can accept input measurement ranges from ±10 mV to ± 20 V. These modules scale the input voltage to a ±5 V range that is routed from the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B Series voltage input modules in any of the eight 5B channels inside the SC-2311.

5B32 Process Current Input Module

The 5B32 process current input modules can accept either 4–20 mA or 0–20 mA and scale this current to a 0–5 V signal. This measurement is accomplished by reading the voltage across a precision 20 Ω resistor that is included with the 5B32 module. These modules scale the input current to a 0–5 V output signal that is routed from the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B32 process current input modules in any of the eight 5B channels inside the SC-2311.

5B34 RTD Input—Isolated 2- or 3-Wire RTD Module

The 5B34 RTD input modules are capable of making isolated 2- or 3-wire RTD measurements and can accept a large variety of different RTD types. The 5B34 modules scale the RTD temperature measurement to a 0–5 V output signal that is routed from the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B34 RTD input modules in any of the eight 5B channels inside the SC-2311.

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5B35 RTD Input—Isolated 4-Wire RTD Module

The 5B35 RTD input modules are capable of making isolated 4-wire RTD measurements. Like the 5B34, the 5B35 scales the RTD temperature measurement into a 0–5 V output signal that the E Series DAQ device can measure.

You can insert and use the 5B35 RTD input modules in any of the eight 5B channels inside the SC-2311.

5B36 Potentiometer Input Module

The 5B36 potentiometer input modules accept a wide variety of 3-wire potentiometers and 2-wire rheostats. The 5B36 scales the potentiometer measurement into an accurate 0–5 V output signal that is routed from the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B36 potentiometer input modules in any of the eight 5B channels inside the SC-2311.

5B37 Thermocouple Input Module with Cold-Junction Compensation

The 5B37 thermocouple input module is capable of accepting input signals from J, K, T, E, R, S, and B type thermocouples. The 5B37 also uses cold-junction compensation circuitry, which is part of the SC-2311 accessory, to compensate for the parasitic thermocouples formed at the input screw terminals of the SC-2311. The 5B37 scales the input signals from the thermocouples into a 0–5 V output signal that is routed from the SC-2311to the E Series DAQ device for measurement.

You can insert and use the 5B37 thermocouple input modules in any of the eight 5B channels inside the SC-2311.

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5B38 Strain-Gauge Input Module

The 5B38 strain-gauge input module features a bandwidth of 10 kHz. The 5B38 accepts input signals from full- and half-bridge 300 Ω to 10 kΩ transducers. The 5B38 also provides a +10 V excitation and produces an output signal of –5 to +5 V that is routed from the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B38 strain-gauge input modules in any of the eight 5B channels inside the SC-2311.

5B42 Process Current Input Module with 20 VDC Loop

The 5B42 process current input module interfaces with 2-wire transmitters and provides an isolated, regulated 20 V supply for current measurement. The module filters and amplifies the 4–20 mA process-current input to produce an accurately scaled, low-noise, low-impedance output of +1 to +5 V or +2 to +10 V.

You can insert and use the 5B42 process current input modules in any of the eight 5B channels inside the SC-2311.

5B45/46 Frequency Input Module

The 5B45 frequency input modules accept full-scale frequency signals ranging from 500 Hz to 20 kHz. The 5B46 frequency input modules accept full-scale frequency signals from 20 kHz to 275 kHz. Each module scales the frequency input to a 0–5 V output signal that is routed from the SC-2311 to the DAQ device for measurement.

You can insert and use the 5B45/46 frequency input modules in any of the eight 5B channels inside the SC-2311.

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5B47 Linearized Thermocouple Input Module with Cold-Junction Compensation

The 5B47 linearized thermocouple input module is capable of accepting input signals from J, K, T, E, R, S, and B type thermocouples. The 5B47 also uses cold-junction compensation circuitry, which is part of the SC-2311 accessory, to compensate for the parasitic thermocouples formed at the input screw terminals of the SC-2311. The 5B47 linearly scales the thermocouples temperature into a 0–5 V signal that is routed form the SC-2311 to the E Series DAQ device for measurement.

You can insert and use the 5B47 linearized thermocouple input modules in any of the eight 5B channels inside the SC-2311.

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4

SSR Series Modules

This chapter describes the SSR Series modules you can use with the SC-2311.

Overview

SSR Series modules optically isolate field signals from the E Series DAQ device, preventing computer damage caused by overvoltage transients in your field wiring.

Note All SSR Series modules use negative logic.

The SSR Series modules include the following:

- Input modules
  - SSR-IAC-5, 120 VAC
  - SSR-IAC-5A, 240 VAC
  - SSR-IDC-5, 3 to 32 VDC
- Output modules
  - SSR-OAC-5, 120 VAC
  - SSR-OAC-5A, 240 VAC
  - SSR-ODC-5, 3 to 60 VDC

See Appendix C, *Power Requirements for the SC-2311 with 5B and SSR Series Modules*, to find the power requirements for your SSR Series modules.

Input Modules

Input SSR Series modules sense voltages from a field source and return a logic value to the E Series DAQ device. If a voltage within the selected input range for the input module is present, it returns a logic low signal to the DAQ device, otherwise it returns a logic high signal.

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SSR-IAC-5, 120 VAC

The SSR-IAC-5 input module senses 90–140 VAC/DC from a field source and converts it into a TTL logic signal. When a signal in this voltage range is detected at its input, the SSR generates a logic low signal on the corresponding DIO line of the E Series DAQ device. Otherwise, the SSR returns a logic high signal. Figure 4-1 shows the SSR-IAC circuit diagram.

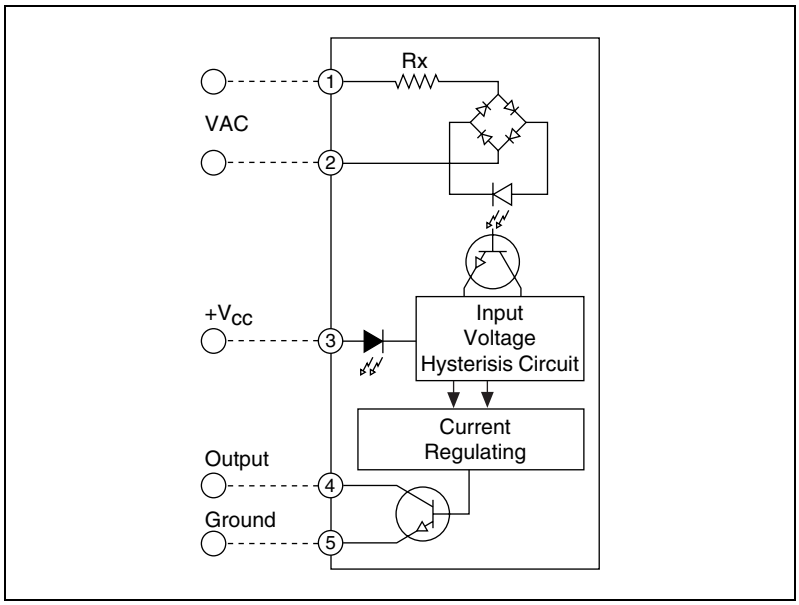


Figure 4-1. SSR-IAC AC Input Diagram

You can insert and use the SSR-IAC-5 in any of the eight SSR sockets inside the SC-2311.

SSR-IAC-5A, 240 VAC

The SSR-IAC-5A input module senses 180–280 VAC/DC from a field source and converts it into a TTL logic signal. When a signal in this voltage range is detected at its input, the SSR generates a logic low signal on the corresponding DIO line of the E Series DAQ device. Otherwise, the SSR returns a logic high signal. Figure 4-1 shows the SSR-IAC circuit diagram.

You can insert and use the SSR-IAC-5A in any of the eight SSR sockets inside the SC-2311.

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SSR-IDC-5, 3–32 VDC

The SSR-IDC-5 input module senses 3–32 VDC from a field source and converts it into a TTL logic signal. When a signal in this voltage range is detected at its input, the SSR generates a logic low signal on the corresponding DIO line of the E Series DAQ device. Otherwise, the SSR returns a logic high signal. Figure 4-2 shows the SSR-IDC circuit diagram.

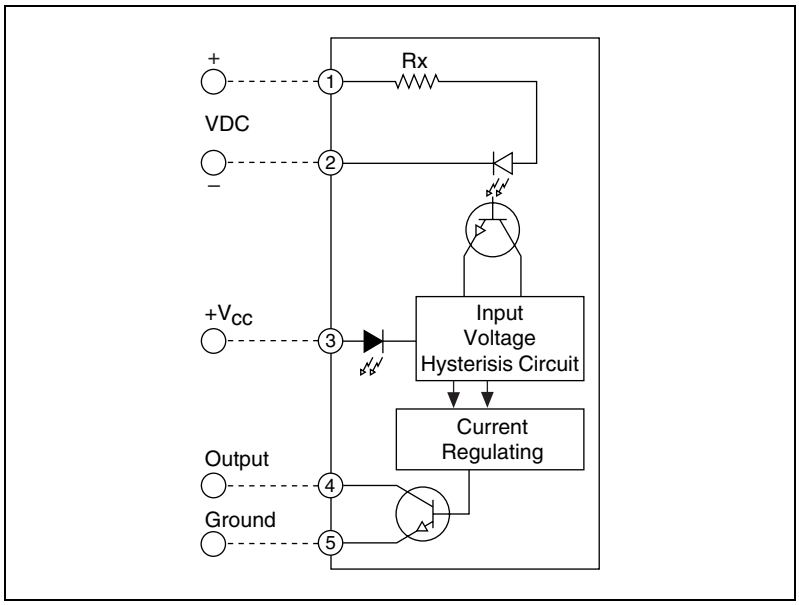


Figure 4-2. SSR-IDC DC Input Diagram

You can insert and use the SSR-IDC-5 in any of the eight SSR sockets inside the SC-2311.

Output Modules

SSR Series output modules use DIO lines on an E Series DAQ device to control external devices. If a DIO line sends a logic low signal, the output module turns on and current flows. If the DIO line sends a logic high signal, the output module turns off.

SSR Series output modules are similar to conventional relays, but there are some important differences. Unlike conventional relays, solid state relays require voltage on the load side. Current needs to flow through them in the on state, or they turn off even if a logic low signal is at their input. This

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occurrence is referred to as *dropout*. If a solid state relay drops out, you must turn it off with a logic high signal before you can turn it on again.

The dropout voltage and current specifications for the output modules are given in Appendix A, *Specifications*. For most control applications, such as controlling motors or lamps, these requirements are not difficult to meet.

Another difference between these output modules and conventional relays is that they do not turn off completely. A small leakage current flows all the time, even in the off state. For most control applications, this current causes no problems.

SSR-OAC-5, 120 VAC

The SSR-OAC-5 output module uses a DIO line from the E Series DAQ device to switch an external 24–140 VAC load at up to 3.5 A. When the E Series DAQ device DIO line sends a logic low, this turns on the corresponding SSR-OAC-5 module and allows current to flow. If a logic high is sent, the module turns off. Figure 4-3 shows the SSR-OAC circuit diagram.

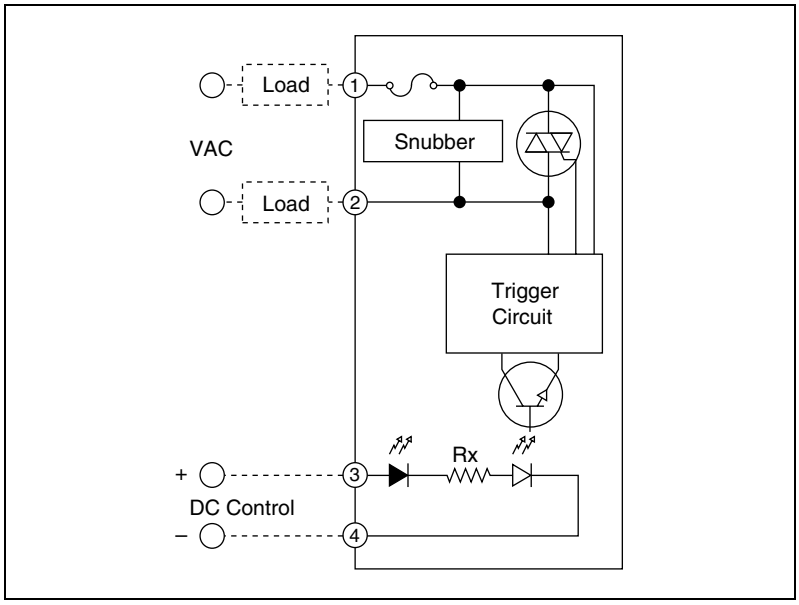


Figure 4-3. SSR-OAC AC Output Diagram

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Unlike conventional relays, the SSR-OAC-5 output module has a zero voltage turn-on of the load. The SSR-OAC-5 also requires a minimum output voltage and current to remain in the on state.

You can insert and use the SSR-OAC-5 in any of the eight SSR sockets inside the SC-2311.

SSR-OAC-5A, 240 VAC

The SSR-OAC-5A output module uses a DIO line from the E Series DAQ device to switch an external 24–280 VAC load at up to 3.5 A. When the E Series DAQ device DIO line sends a logic low, this turns on the corresponding SSR-OAC-5A module and allows current to flow. If a logic high is sent, the module turns off.

You can insert and use the SSR-OAC-5A in any of the eight SSR sockets inside the SC-2311.

SSR-ODC-5, 3–60 DVC

The SSR-ODC-5 output module uses a DIO line from the E Series DAQ device to switch an external 3–60 VDC load at up to 3 A. When the E Series DAQ device DIO line sends a logic low, this turns on the corresponding SSR-ODC-5 module and allows current to flow. If a logic high is sent, the module turns off. Figure 4-4 shows the SSR-ODC circuit diagram.

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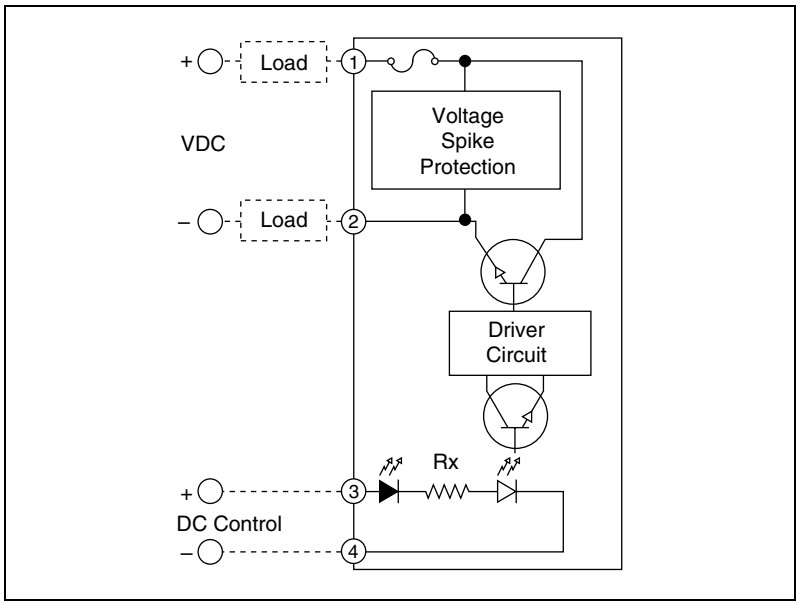


Figure 4-4. SSR-ODC DC Output Diagram

You can insert and use the SSR-ODC-5 in any of the eight SSR sockets inside the SC-2311.

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A

Specifications

All specifications are typical at 25 °C unless otherwise specified.

SC-2311

Analog Inputs

Number of channels	Eight 5B Series modules (NRSE) inputs or Eight unconditioned differential inputs or 16 unconditioned single-ended inputs
Input characteristics	See Appendix B, *5B Series Module Data Sheets*

Digital I/O

Number of channels	8 SSR Series modules or 8 unconditioned DIO lines
I/O characteristics	See the *SSR Series* section in this appendix

Physical

Dimensions	30.7 by 25.4 by 8.6 cm (12.1 by 10 by 3.4 in.)
Weight (without modules or panelettes)	2.0 kg (4.3 pounds)

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Environment

Operating temperature .....0 to 55 °C

Storage temperature .....–20 to 70 °C

Relative humidity .....10 to 90% noncondensing

Safety

Designed in accordance with IEC61010-01, UL 3111-1, and CAN/CSA C22.2 No.1010.1 for electrical measuring and testing equipment.

For use at altitudes up to 2000 m

Installation Category II

Pollution Degree 2

Electromagnetic Compatibility

EMC/EMI .....CE, C-Tick, and FCC Part 15 (Class A) Compliant

Electrical emissions .....EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

Electrical immunity .....Evaluated to EN 61326-1:1997 A1:1998, Table 1

Safety .....EN 61010-1

Note For full EMC and EMI compliance, you must operate this device with shielded cabling. See the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, click **Declaration of Conformity** at `http://www.ni.com/hardref.nsf/`. This website lists the DoCs by product family. Select the appropriate product family, followed by your product, and a link to the DoC (in Adobe Acrobat format) appears. Click the Acrobat icon to download or read the DoC. In addition, you cannot use BNC panelettes for full CE compliance.

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SSR Series

Input/Output Modules

Logic levels ..... 0 to 5 V

Input-to-output capacitance..... 8 pF max

Operating temperature..... 0 to 55 °C

Storage temperature ..... –20 to 70 °C

Maximum working voltage..... 300 V Category II

SSR Series input module characteristics

Characteristic	SSR-IDC-5	SSR-IAC-5	SSR-IAC-5A
Nominal input	5 VDC	120 VAC	240 VAC
Voltage range	3–32 VDC	90–140 VAC	180–280 VAC
Voltage level ON state, min OFF state, min	 3 VDC 1 VDC	 90 VAC 25 VAC	 180 VAC 50 VAC
Supply current	10 mA	10 mA	10 mA
Input impedance	1.8 kΩ	22 kΩ	60 kΩ
Delay time Turn-on, max Turn-off, max	 0.20 mS 0.40 mS	 20 mS 20 mS	 20 mS 20 mS

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SSR Series output module characteristics

Characteristic	SSR-ODC-5	SSR-OAC-5	SSR-OAC-5A
Voltage range	3–60 VDC	24–140 VAC	24–280 VAC
Voltage drop	0.9 V at 3.25 A	1.2 V at 2.0 A	1.2 V at 2.0 A
Current rating (one module populated)	3.25 A at 25 °C 2.8 A at 40 °C 2.25 A at 55 °C	2.0 A at 25 °C 1.6 A at 40 °C 1.1 A at 55 °C	2.0 A at 25 °C 1.6 A at 40 °C 1.1 A at 55 °C
Current rating (four modules populated)	2.75 A at 25 °C 2.35 A at 40 °C 2.0 A at 55 °C	1.7 A at 25 °C 1.3 A at 40 °C 0.9 A at 55 °C	1.7 A at 25 °C 1.3 A at 40 °C 0.9 A at 55 °C
Current rating (eight modules populated)	2.1 A at 25 °C 1.75 A at 40 °C 0.8 A at 55 °C	1.2 A at 25 °C 0.8 A at 40 °C 0.6 A at 55 °C	1.2 A at 25 °C 0.8 A at 40 °C 0.6 A at 55 °C
Supply current	10 mA	10 mA	10 mA
Leakage current, max	1.5 mA	2.0 mA	4.0 mA
Delay time Turn-on, max Turn-off, max	 0.20 µS 0.40 µS	 8.33 mS 8.33 mS	 8.33 mS 8.33 mS

5B Series

For 5B Series modules specifications, see Appendix B, *5B Series Module Data Sheets*.

Maximum working voltage .....300 V Category II

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B

5B Series Module Data Sheets

This appendix contains the manufacturing data sheets of Analog Devices Corporation[1].

The Analog Devices 5B Series modules data sheets included are the following:

- 5B30
- 5B31
- 5B32
- 5B34
- 5B35
- 5B36
- 5B37
- 5B38
- 5B40
- 5B41
- 5B42
- 5B45
- 5B46
- 5B47

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5B30/5B31 Millivolt and Voltage Input

Functional Description



The 5B30 and 5B31 are single-channel signal conditioning modules that amplify, protect, filter and isolate analog input voltages.

The 5B30 and 5B31 protect the computer side from damage due to field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage thereby shielding computer-side circuitry from field-side overvoltage conditions. In addition, 5B30 and 5B31 Series modules are mix-and-match and hot swappable, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside 5B30/5B31 Modules

A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input voltage is subtracted from the input signal to set the zero-scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3dB) enhances normal-mode (noise on signal) and common-mode (noise on signal return) rejection at 50/60 Hz, enabling accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ±3 V of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched.

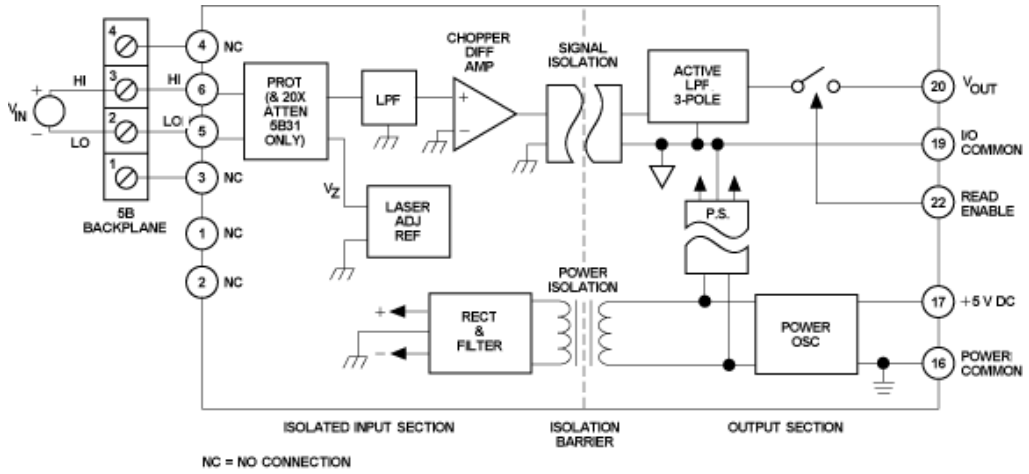


Figure 1. 5B30 and 5B31 Functional Block Diagram

Input Ranges

- 5B30 mV Input:
  ±10 to ±100 mV
  (±5 to ±500 mV - custom)
- 5B31 V Input:
  ±1 to ±20 V
  (±0.5 to ±20 V - custom)

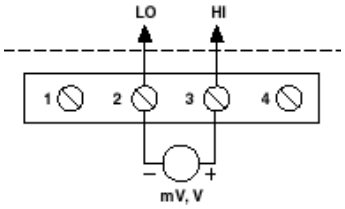


Figure 2. 5B30 and 5B31 Input Field Connections

Output Ranges

- 5B30/5B31:
  -5 V to +5 V or 0 to +5 V

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5B30 and 5B31 Specifications

Description	Model 5B30	Model 5B31
Input Ranges		
Standard Ranges	±10 mV to ±100 mV	±1 V to ±20 V
Custom Ranges	±5 mV to ±500 mV	±0.5 V to ±20 V
Output Ranges (R_L > 50 kΩ)[4]	-5 V to +5 V or 0 V to +5 V	*
Accuracy[2]		
Initial @ +25˚C	±0.05% Span ±10 µV RTI ±0.05% (Vz[1])	±0.05% Span ±0.2 mV RTI ±0.05% (Vz[1])
Nonlinearity	±0.02% Span	*
Input Offset vs. Temperature	±1 µV/˚C	±20 µV/˚C
Output Offset vs. Temperature	±20 µV/˚C	*
Gain vs. Temperature	±25 ppm of Reading/˚C	±50 ppm of Reading/˚C
Input Bias Current	±3 nA	±0.2 nA
Input Resistance		
Power On	5 MΩ	650 kΩ
Power Off	40 kΩ	650 kΩ
Overload	40 kΩ	650 kΩ
Noise		
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms	2 µV rms
Output, 100 kHz Bandwidth	200 µV rms	*
Bandwidth, -3 dB	4 Hz	*
Output Rise Time, 10% to 90% Span	200 ms	*
Common-Mode Voltage (CMV)[3]		
Input-to-Output, Continuous	1500 V rms maximum	*
Output-to-Power, Continuous	±3 V maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Common-Mode Rejection (CMR)		
1 kΩ Source Imbalance, 50/60 Hz	160 dB (all ranges)	160 dB (span < ±2 V) 150 dB (span = ±10 V)
Normal Mode Rejection, 50/60 Hz	60 dB	*

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Input Protection		
Continuous	240 V rms maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Output Resistance[4]	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF	*
Output Enable Control		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Current	30 mA	*
Power Supply Sensitivity, RTI	±2 µV/Vs%	±0.4 mV/Vs%
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)	*
Environmental		
Temperature Range		
Rated Performance	-25˚C to +85˚C	*
Operating	-40˚C to +85˚C	*
Storage	-40˚C to +85˚C	*
Relative Humidity	0 to 93% @ +40˚C noncondensing	*
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft	*

* Specifications same as model 5B30.
[1] Vz is the nominal input voltage that results in a 0 V output.
[2] Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes RL > 50 kΩ.
[3] The output common must be kept within ±3 V of power common.
[4] Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.
Specifications subject to change without notice.

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5B32 Isolated Current Input

Functional Description



The 5B32 is a single-channel signal conditioning module that amplifies, protects, filters and isolates its analog input. The module measures a process-current input signal of 4-20 mA or 0-20 mA by reading the voltage across an external precision 20 Ω resistor (supplied) and generating an output of 0 to +5 V. Extra current conversion resistors are available as accessories (See Model AC1362 in the Accessories section).

Note that the 5B32 module circuitry can withstand 240 V rms at the input screw-terminals, thereby shielding computer-side circuitry from field-side overvoltage conditions. In addition, all 5B32 Series modules are mix-and-match and hot swappable, so can be inserted or removed from any socket in the same backplane without powering down the system.

Inside the 5B32 Series Module

A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input offset is subtracted from the input signal to set the zero-scale value for the 4-20 mA range. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger than the total span for precise expanded-scale measurements.

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3dB) enhances normal-mode (noise on signal) and common-mode (noise on signal return) rejection at 50/60 Hz, enabling accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ±3 Vdc of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to power common as it is on the 5B01 and 5B08 backplanes.

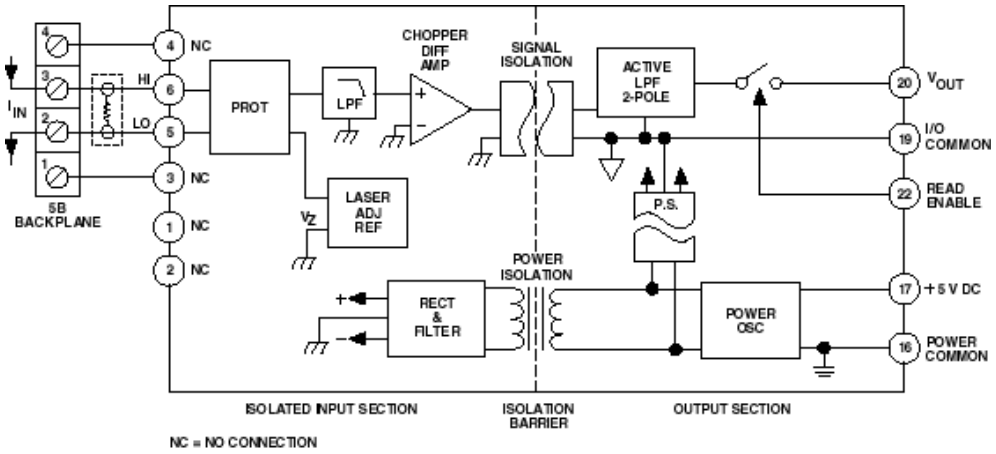


Figure 1. 5B32 Functional Block Diagram

Input Ranges

- 4 mA to 20 mA

Output Ranges

- 0 to +5 V
  (-5 V to +5 V - custom)



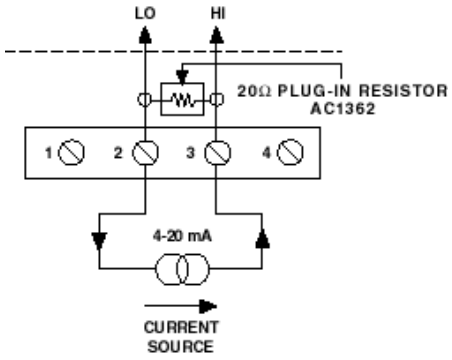


Figure 2. 5B32 Input Field Connections

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5B32 Specifications

Description	Model 5B32
Input Ranges	
Standard Ranges	0 mA to 20 mA or 4 mA to 20 mA
Custom Ranges	0 mA to 20 mA (refer to ordering section)
Output Ranges (R_L > 50 kΩ)[4]	-5 V to +5 V or 0 V to +5 V
Accuracy[2]	
Initial @ +25˚C	±0.05% Span ±0.05% Iz[1]
Nonlinearity	±0.02% Span
Input Offset vs. Temperature	±0.0025 of Iz/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.0025% of Reading/˚C
Input Resistor[5]	
Value	20.0 Ω
Accuracy	±0.1%
Stability vs. Temperature	±0.001%/˚C
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	10 nA rms
Output, 100 kHz Bandwidth	200 µV rms
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	200 ms
Common-Mode Voltage (CMV)[3]	
Input-to-Output, Continuous	1500 V rms maximum
Output-to-Power, Continuous	±3 V maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	160 dB
Normal Mode Rejection 50/60 Hz	60 dB

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Input Protection	
Continuous	240 V rms maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance[4]	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF
Output Enable Control	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Power Supply Voltage	+5 V ±5%
Power Supply Current	30 mA
Power Supply Sensitivity, RTI	±2 µV/Vs%
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
Environmental	
Temperature Range	
Rated Performance	-25˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

[1]Iz is the nominal input current that results in a 0 V output.

[2]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes R_L > 50 kΩ. Does not include current-to-voltage input resistor (AC1362) error.

[3]The output common must be kept within ±3 V of power common.

[4]Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.

[5]The current-to-voltage conversion resistor (AC1362) is supplied as a plug-in component for mounting external to the module. All backplanes and mounting cards provide pin sockets for mounting the AC1362 resistor.

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5B34 Isolated, Linearized RTD Input

Functional Description



The 5B34 is a single-channel signal conditioning module that amplifies,protects, filters, linearizes and isolates a wide variety of two- and three-wire RTDs. For true four-wire RTD measurements please refer to the 5B35 section.

The 5B34 protects the computer side from damage due to field-side overvoltage faults. The module withstands 240 V rms at the input terminals without damage thereby shielding the internal computer-side circuitry from field-side overvoltage conditions. In addition, the 5B34 is mix-and-match and hot swappable with all other 5B Series input modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside the 5B32 Series Module

Two identical sources provide excitation current for the RTD. For three-wire RTDs, the second current flows through the third RTD lead so as to cancel the effects of (equal) lead resistance; this current also flows through a stable resistor laser-trimmed to the RTD value that sets the differential amplifier input and (module) output to zero volts at that scale point. The current sources and the amplifier input are protected to withstand input overvoltage up to 240 V rms.

A differential chopper-stabilized input amplifier provides stable gain and exceptionally low drift. This allows the use of very low RTD excitation current to minimize self-heating and preserve measurement accuracy. Along with module gain and zero settings, a feedback linearizer is laser-trimmed. Custom versions of 5B34 can be laser-trimmed to meet special requirements.

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3dB)enhances normal-mode (noise on signal) and common-mode (noise on signal return) rejection at 50/60 Hz, enabling accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ±3 V of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to power common as it is on the 5B01 and 5B08 backplanes.

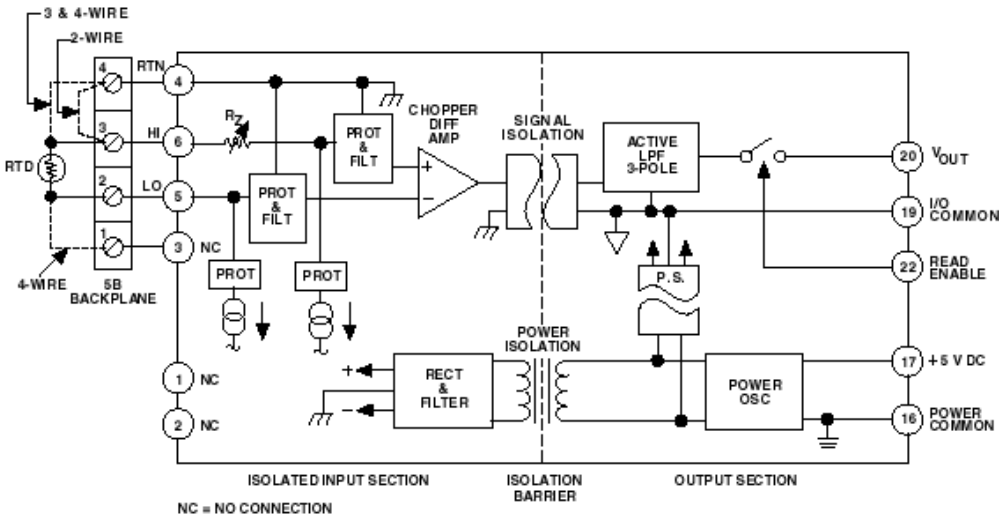


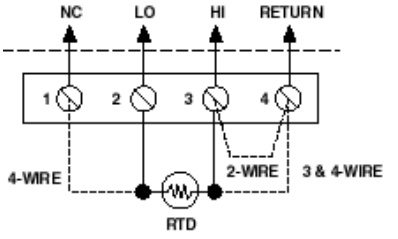
Figure 1. 5B34 Functional Block Diagram

Input Types

- 100 Ω Platinum RTD
- 10 Ω Copper RTD
- 120 Ω Nickel RTD

Output Range

- 0 to +5 V



NOTE: 4-WIRE RTD SENSORS MAY BE USED WITH THE 5B34 AS SHOWN. FOR HIGHEST ACCURACY, MODEL 5B35 SHOULD BE USED WITH 4-WIRE RTD.

Figure 2. 5B34 Input Field Connections

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5B34 Specifications

(typical @ +25˚C and V_s = +5 V dc)

Description	Model 5B34
Input Ranges	
Standard Ranges	Refer to Model Table
Custom Ranges	-200˚C to +850˚C (100 Ω Platinum) -80˚C to +320˚C (120 Ω Nickel) -100˚C to +260˚C (10 Ω Copper)
Output Range (R_L > 50 kΩ)	0 V to +5 V
Accuracy[2]	
Initial @ +25˚C	±0.05% Span ±0.04 Ω* ±0.05 (Rz^1)
Conformity Error[3]	±0.05% Span
Input Offset vs. Temperature	±0.02˚C/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.005% of Reading/˚C
Input Bias Current	±3 nA
Input Resistance	
Power On	5 MΩ
Power Off	40 kΩ
Overload	40 kΩ
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms
Output, 100 kHz Bandwidth	200 µV rms
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	200 ms
Common-Mode Voltage (CMV)	
Input-to-Output, Continuous	1500 V rms, maximum
Output-to-Power, Continuous[4]	±3 V, maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	160 dB
Normal Mode Rejection 50/60 Hz	60 dB

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Sensor Excitation Current	
100 Ω Pt, 120 Ω Ni	0.25 mA
10 Ω Cu	1.0 mA
Lead Resistance Effect	
100 Ω Pt, 120 Ω Ni	±0.02˚C/Ω
10 Ω Cu	±0.2˚C/Ω
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF
Output Enable Control	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Power Supply Voltage	+5 V ±5%
Power Supply Current	30 mA
Power Supply Sensitivity, RTI	
100 Ω Pt, 120 Ω Ni	±0.05˚C/V
10 Ω Cu	±0.5˚C/V
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)

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Environmental	
Temperature Range	
Rated Performance	-25˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

* ±0.025 Ω For Cu RTD's; ±0.1 Ω For Ni RTD's.
[1]Rz is the value of the RTD resistance at the lowest point of the measurement range.
[2]Includes the combined effects of repeatability, hysteresis,
and conformity error. Loads heavier than 50 k Ω will degrade conformity and gain temperature
coefficient.
[3]For Pt RTD's only; other types may vary.
[4]The output common must be kept within ±3 V of power
common.
Specifications subject to change without notice.

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5B35 Isolated, Linearized 4-Wire RTD Input

Functional Description



The 5B35 is a single-channel signal conditioning module that amplifies, filters, isolates and protects a wide variety of four-wire RTDs. The module provides a linearized, highly accurate output of 0 to +5V.

Accurate and Stable Performance

The four-wire configuration of the 5B35 supplies RTD excitation from a precision, protected current source: two RTD wires carry the excitation current and two wires serve as signal-input leads that measure the voltage across the RTD. Because no excitation current flows through the signal-input leads, the length or resistance of the leads creates little or no RTD measurement error. A low-drift chopper-stabilized differential amplifier allows use of very low excitation current to minimize error due to RTD self-heating. The amplifiers low input offset drift of ±0.01˚C/˚C and gain drift of ±30 ppm/˚C assure accuracy over the full operating temperature range.

True Three-Port Isolation

The floating, differential input circuit on the field side eliminates the need for any input grounding. Signal and power isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. True three-port isolation (Input-Output-Power) includes common-mode ratings of : 1500 V rms between input and output and input and power; 250 V rms between power and output - no return path is required between the power and signal output commons.

Filtering and Protection

An optimized five-pole Butterworth filter (with a 4-Hz bandwidth) provides 116 dB of normal-mode rejection (noise on signal) at 60 Hz and 108 dB at 50 Hz. Output noise is an exceptionally low 0.3 mV p-p in a 100 kHz bandwidth and 6 mV p-p in a 5 MHz bandwidth.

The 5B35 protects the computer side from damage due to field-side overvoltage faults. The module withstands 240 V rms at the input terminals without damage, thereby shielding the internal computer-side circuitry from field-side overvoltage conditions. In addition, the 5B35 is mix-and-match and hot swappable with all other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be connected to output common.

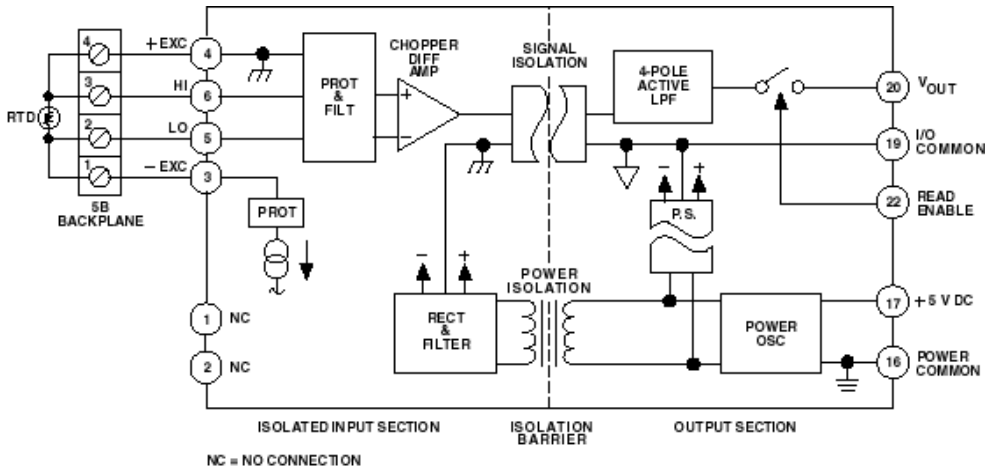


Figure 1. 5B35 Functional Block Diagram

Input Types

- 100 Ω Platinum RTD
- 10 Ω Copper RTD
- 120 Ω Nickel RTD

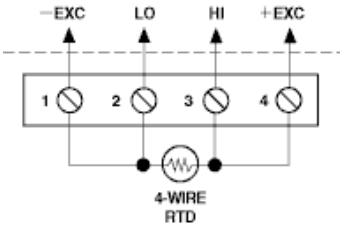


Figure 2. 5B35 Input Field Connections

Output Range

- 0 to +5 V



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5B35 Specifications

(typical @ +25˚C and V_s = +5 V dc)

Description	Model 5B35
Input Ranges	
Standard Ranges	Refer to Model Table
Custom Ranges	-200˚C to +850˚C (100 Ω Platinum, α = 0.00385) -80˚C to +320˚C (120 Ω Nickel, α = 0.00672) -100˚C to +260˚C (10 Ω Copper, α = 0.004274)
Output Range (R_L > 50 kΩ)	0 V to +5 V
Accuracy[1]	
Initial @ +25˚C	Refer to Model Table
Conformity Error	±0.05% Span
Input Offset vs. Temperature	±0.01˚C/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.003% of Reading/˚C
Input Resistance	
Power On	> 1000 MΩ
Power Off	200 kΩ
Overload	200 kΩ
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms
Output, 100 kHz Bandwidth	100 µV rms (0.3 mV peak-peak)
Output, 1 MHz Bandwidth	1.5 mV peak-peak
Output, 5 MHz Bandwidth	6 mV peak-peak
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	100 ms
Common-Mode Voltage (CMV)	
Input-to-Output, Continuous	1500 V rms, maximum
Input-to-Power, Continuous	1500 V rms, maximum
Output-to-Power, Continuous[2]	250 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989

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Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	190 dB (180 dB, Model 5B35-04)
Normal Mode Rejection (NMR)	116 dB @ 60 Hz; 108 dB @ 50 Hz
Sensor Excitation Current	
100 Ω Pt, 120 Ω Ni	0.25 mA
10 Ω Cu	1.0 mA
Lead Resistance Effect	
100 Ω Pt, 120 Ω Ni	±0.00001˚C/Ω
10Ω Cu	±0.0001˚C/Ω
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	25 Ω
Voltage Output Protection	Continuous Short to Ground
Output Current Limit	±9 mA
Output Selection Time	6 µs to ±1 mV of V_{out} @ C_{load} = 0 to 2,000 pF
Output Enable Control[2]	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+100 V
Input Current "0", "1"	0.5 µA
Power Supply Voltage	+5 V dc ±5%
Power Supply Current	15 mA
Power Supply Sensitivity, RTI	±0.2˚C/% of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)

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Environmental	
Temperature Range	
Rated Performance	-40˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

[1]Includes the combined effects of repeatability, hysteresis, and conformity error. Loads heavier than 50 kΩ will degrade conformity and gain temperature coefficient.
[2]The user's board layout must separate Power Common from Output Common. When the output switch is not used, connect the Enable Input to the Output Common. Output Common is connected to power common when the 5B35 is installed on a 5B Series backplane.
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5B36 Isolated, Potentiometer Input

Functional Description



The 5B36 is a single-channel signal conditioning module that amplifies, filters, and buffers a wide variety of three-wire potentiometers and two-wire rheostats (slidewires). The module provides an accurately scaled, low-noise low-impedance output of 0 to +5 V.

Accurate and Stable Performance

The 5B36 supplies protected potentiometer/slidewire excitation from a pair of closely matched precision current sources designed to cancel errors due to lead resistances.

A low-drift chopper-stabilized differential amplifier allows use of a very low excitation current to minimize error due to potentiometer self-heating. The amplifiers low input offset drift (±0.004 Ω/˚C) and gain drift of 30 ppm/˚C assure accuracy over the full operating temperature range.

True Three-Port Isolation

The floating, differential input circuit on the field side eliminates the need for any input grounding. Signal and power isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. True three-port isolation (Input-Output-Power) includes common-mode ratings of : 1500 V rms between input-output and input-power; 250 V rms between power and output - no return path is required between the power and signal output commons.

Filtering and Protection

An optimized five-pole Butterworth filter (with a 4-Hz bandwidth) provides 116 dB of normal-mode rejection (noise on signal) at 60 Hz and 108 dB at 50 Hz. Output noise is an exceptionally low 0.3 mV pk-pk in a 100 kHz bandwidth and 6 mV pk-pk in a 5 MHz bandwidth.

The 5B36 protects the computer side from damage due to field-side overvoltage faults. The module withstands 240 V rms at the input terminals without damage, thereby shielding the internal computer-side circuitry from field-side overvoltage conditions. In addition, the 5B36 is mix-and-match and hot swappable with all other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to output common as it is on the 5B01 and 5B08 backplanes.

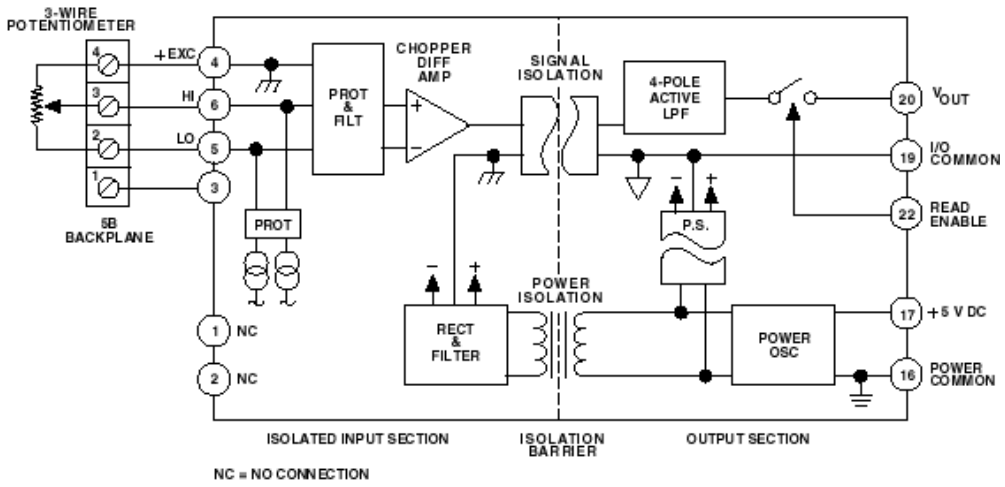


Figure 1. 5B36 Functional Block Diagram

Input Types

- Potentiometers/ Slidewires to 10kΩ

Output Range

- 0 to +5 V

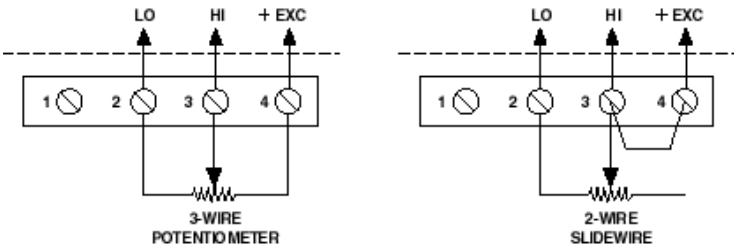


Figure 2. 5B36 Input Field Connections

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5B36 Specifications

(typical @ +25˚C and V_s = +5 V dc)

Description	Model 5B36
Input Ranges	
Standard Ranges	0 Ω to 10 kΩ (Refer to Model Table)
Custom Ranges	0 Ω to 10 kΩ (Refer to Ordering Section)
Output Range (R_L > 50 kΩ)	0 V to +5 V
Accuracy[1]	
Initial @ +25˚C	±0.08% Span
Input Offset vs. Temperature	
100 Ω, 500 Ω, 1 kΩ Sensors	±0.004 Ω/˚C
10 kΩ Sensor	±0.01 Ω/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.003% of Reading/˚C
Input Resistance	
Power On	> 1000 MΩ
Power Off	200 kΩ
Overload	200 kΩ
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms
Output, 100 kHz Bandwidth	100 µV rms (0.3 mV peak-peak)
Output, 1 MHz Bandwidth	1.5 mV peak-peak
Output, 5 MHz Bandwidth	6 mV peak-peak
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	100 ms

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Common-Mode Voltage (CMV)	
Input-to-Output, Continuous	1500 V rms, maximum
Input-to-Power, Continuous	1500 V rms, maximum
Output-to-Power, Continuous[2]	250 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	170 dB
Normal Mode Rejection (NMR)	116 dB @ 60 Hz; 108 dB @ 50 Hz
Sensor Excitation Current	
100 Ω, 500 Ω, 1 kΩ Sensors	0.25 mA
10 kΩ Sensor	0.1 mA
Lead Resistance Effect	
100 Ω, 500 Ω, 1 kΩ Sensors	±0.005 Ω/Ω
10 kΩ Sensor	±0.01 Ω/Ω
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	25 Ω
Voltage Output Protection	Continuous Short to Ground
Output Current Limit	±9 mA
Output Selection Time	6 µs to ±1 mV of V_{out} @ C_{load} = 0 to 2,000 pF
Output Enable Control[2]	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+100 V
Input Current "0", "1"	0.5 µA
Power Supply Voltage	+5 V dc ±5%
Power Supply Current	15 mA
Power Supply Sensitivity, RTI	±2 µV/% of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)

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Environmental	
Temperature Range	
Rated Performance	-40˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

* ±0.025 Ω For Cu RTD's; ±0.1 Ω For Ni RTD's.
[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity error. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.
[2]The user's board layout must separate Power Common from Output Common. When the output switch is not used, connect the Enable Input to the Output Common. Output Common is connected to power common when the 5B36 is installed on a 5B Series backplane.
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5B37 Isolated Thermocouple Input

Functional Description



The 5B37 is a single-channel signal conditioning module that interfaces, amplifies and filters J, K, T, E, R, S, N, and C-type thermocouple and provides an isolated and protected precision output of 0 to +5 V.

Accurate and System-Ready

Internal cold-junction compensation largely corrects errors arising from parasitic thermocouples formed by thermocouple connection to the input screw terminals, providing an accuracy of ±0.25˚C @ +25˚C ambient temperature. The module generates a predictable upscale signal to indicate an open thermocouple; for a downscale response, connect a 47 MΩ, 0.25 W resistor across screw terminals 1 and 3.

The 5B37 protects the computer side from damage due to field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage, thereby shielding computer-side circuitry from field-side overvoltage conditions. Further, the 5B37 is mix-and-match and hot-swappable with other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside the 5B37 Module

A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input voltage is subtracted from the input signal to set the zero-scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3 dB) provides 60 dB of normal-mode rejection (noise on signal) and enhancement of common-mode rejection (noise on signal return) at 60 Hz, enabling accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within 3 V of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched, as on the 5B01 and 5B08 backplanes.

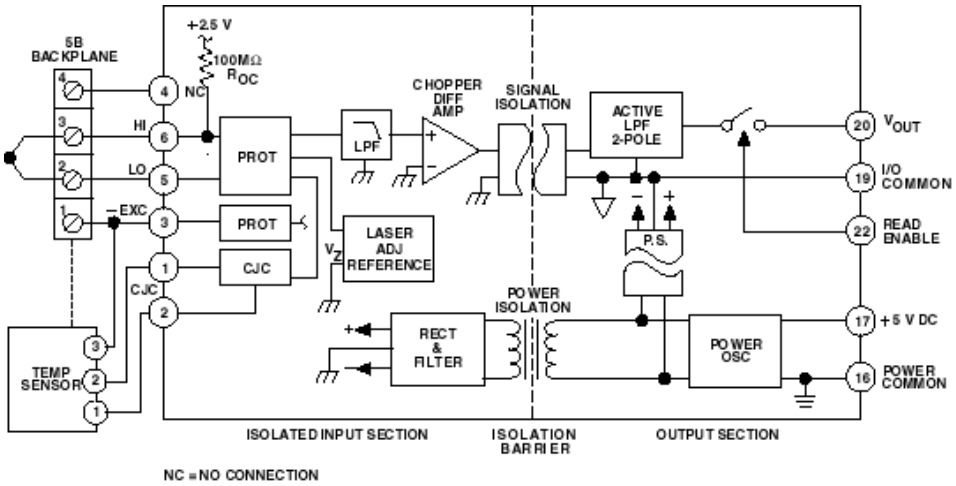


Figure 1. 5B37 Functional Block Diagram

Input Types

- Thermocouple Types :
  J, K, T, E, R, S, B, N, C

Output Range

- 0 to +5 V
  (-5 V to +5 V - custom)

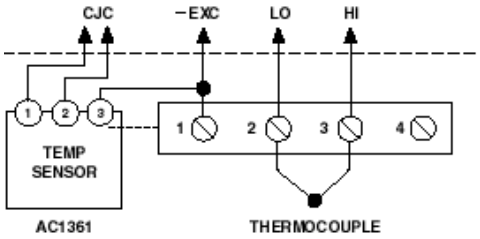


Figure 2. 5B37 Input Field Connections

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5B37 Specifications

(typical @ +25˚C and V_s = +5 V dc)

Description	Model 5B37
Input Ranges	
Standard Ranges	Refer to Model Table
Custom Ranges	±5 mV to ±500 mV
Output Range (R_L > 50 kΩ)[4]	-5 V to +5 V or 0 to +5 V
Accuracy[2]	
Initial @ +25˚C	±0.05% Span ±10 µV RTI ±0.05% of Vz[1] +CJC Sensor Error
Nonlinearity	±0.02% Span
Input Offset vs. Temperature	±1 µV/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.0025% of Reading/˚C
Cold Junction Compensation	
Initial Accuracy @ +25˚C[3]	±0.25˚C (±0.75˚C, maximum)
Accuracy, +5˚C to +45˚C	±0.5˚C (±0.0125˚C/˚C)
Input Bias Current	-25 nA
Input Resistance	
Power On	5 MΩ
Power Off	40 kΩ
Overload	40 kΩ
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms
Output, 100 kHz Bandwidth	200 µV rms
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	200 ms
Common-Mode Voltage (CMV)[4]	
Input-to-Output, Continuous	1500 V rms, maximum
Output-to-Power, Continuous	±3 V, maximum
Transient	ANSI/IEEE C37.90.1-1989

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Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	160 dB
Normal Mode Rejection (NMR), 50/60 Hz	60 dB
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF
Output Enable Control	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Open Input Response	Upscale
Open Input Response Time	10 seconds
Power Supply Voltage	+5 V ±5%
Power Supply Current	30 mA
Power Supply Sensitivity, RTI	±2 µV/% of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
Environmental	
Temperature Range	
Rated Performance	-25˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

[1]Vz is the nominal input voltage that results in a 0 V output.

[2]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes R_L > 50 kΩ. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.

[3]When used with the model AC1361 CJC sensor (see Accessories section), which is provided on each channel of 5B Series backplanes and mounting cards.

[4]The output common must be kept within ±3 V of power common.

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5B38 Isolated, Wide-Bandwidth Strain Gage Input

Functional Description



The 5B38 is a wide-bandwidth single-channel signal conditioning module that interfaces, amplifies, and filters signals from full-bridge and half-bridge strain-gage transducers between 300 Ω and 10 kΩ. The module provides an isolated bridge excitation of +10 V and a protected, isolated precision output of -5 V to +5 V. The 10 kHz bandwidth of the module ideally suits to measure signals that vary rapidly with time, such as strain on an automobile chassis during a crash test.

The 5B38 protects the computer side from damage due to field-side overvoltage faults. The module withstands 240 V rms at its input terminals without damage, thereby shielding computer-side circuitry from field-side overvoltage conditions. In addition, the 5B38 is mix-and-match and hot-swappable with all 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

The 5B38-04 contains bridge completion circuitry, so can function with half-bridge strain gages. For quarter-bridge requirements, the user must complete the bridge input to the half-bridge level externally. The factory can configure the module for a wide range of input ranges (sensitivities).

Inside the 5B38 Module

A single-pole anti-aliasing filter resides at each modules input. A three-pole, low-pass filter in the output stage sets the bandwidth and yields optimal noise performance for accurate measurement of small signals in high electrical noise. A chopper-stabilized input amplifier provides low drift and stable gain.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. An additional benefit, the output section acts as a third floating port, eliminating possible problems from ground loops and power-supply noise. The output common must be kept within ±3 V of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched, as on the 5B01 and 5B08 backplanes.

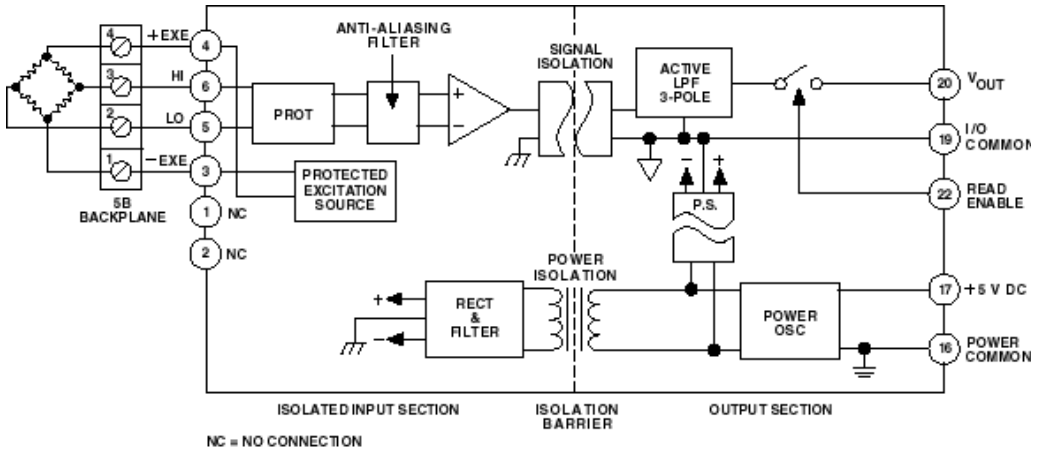


Figure 1. 5B38 Functional Block Diagram

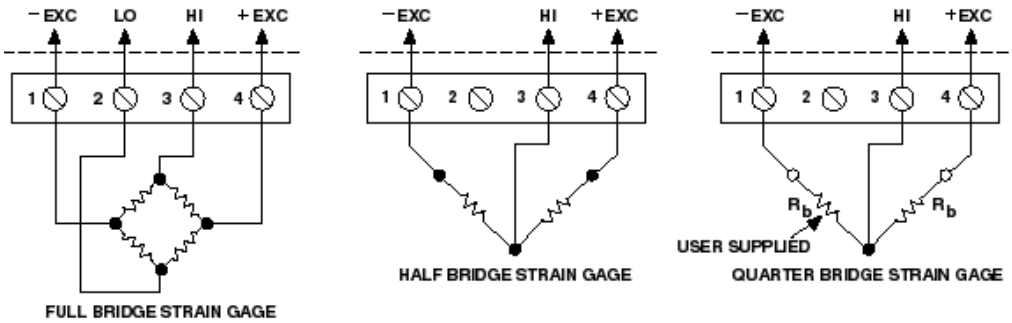


Figure 2. 5B38 Input Field Connections

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Input Type

- Strain Gage: Full-Bridge/Half-Bridge

Output Ranges

- -5 V to +5 V



5B38 Specifications

Description	Model 5B38 Full Bridge	Model 5B38 Half Bridge
Input Ranges		
Standard Ranges	±20 mV (2 mV/V Sensitivity) ±30 mV (3 mV/V Sensitivity)	±30 mV (3 mV/V Sensitivity)
Custom Ranges	±10 mV to ±500 mV	*
Output Ranges (R_L > 50 kΩ)	-5 V to +5 V	*
Accuracy[2]		
Initial @ +25˚C	±0.08% Span ±10 µV RTI	±0.08% Span ±1 mV RTI
Nonlinearity	±0.02% Span	*
Input Offset vs. Temperature	±1 µV/˚C	*
Output Offset vs. Temperature	±40 µV/˚C	*
Gain vs. Temperature	±25 ppm of Reading/˚C	*
Excitation Voltage Output @ full load	+10 V ±3 mV	*
Load Range	10 kΩ, minimum; 300 Ω, maximum	*
Load Regulation	±5 ppm/mA	*
vs. Temperature	±15 ppm/˚C	*
Half Bridge Voltage Level	N/A	+5 V ±1 mV
Half Bridge Voltage vs. Temperature	N/A	±15 ppm/˚C
Input Bias Current	±3 nA	*

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Input Resistance		
Power On	20 MΩ, minimum	*
Power Off	40 kΩ, minimum	*
Overload	40 kΩ, minimum	*
Noise		
Input, 0.1 Hz to 10 Hz Bandwidth	0.4 µV rms	2 µV rms
Input, 10 kHz Bandwidth	±70 nV/√Hz	±250 nV/√Hz
Output, 100 kHz Bandwidth	10 mV peak-peak	*
Bandwidth, -3 dB	10 kHz	*
Output Rise Time, 10% to 90% Span	40 µs	*
Output Settling Time, to 0.1%	250 µs	7 ms
Common-Mode Voltage (CMV)		
Input-to-Output, Continuous	1500 V rms, maximum	*
Output-to-Power, Continuous[2]	±3 V, maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Common-Mode Rejection (CMR)		
1 kΩ Source Imbalance, 50/60 Hz	100 dB	*
Normal Mode Rejection, 50/60 Hz	-3 dB @ 10 kHz	*
Input Protection, Signal and Excitation Voltage		
Continuous	240 V rms maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Output Resistance	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF	*

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Output Enable Control		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Current	200 mA, Full Load; 120 mA, No Load	*
Power Supply Sensitivity	25 ppm reading/% ±2.5µV RTI/%	*
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)	*
Environmental		
Temperature Range		
Rated Performance	-25˚C to +85˚C	*
Operating	-40˚C to +85˚C	*
Storage	-40˚C to +85˚C	*
Relative Humidity	0 to 93% @ +40˚C noncondensing	*
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft	*

* Same as full-bridge version.

[1] Includes the combined effects of repeatability, hysteresis, and nonlinearity. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.

[2] The output common must be kept within ±3 V of power common.

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5B40/5B41 Isolated, Wide Bandwidth Millivolt and Voltage Input

Functional Description



The 5B40 and 5B41 are wide-bandwidth single-channel signal conditioning modules that amplify, protect, filter and isolate analog input voltages. Both modules provide a 10 kHz bandwidth which ideally suits them to measuring signals that vary rapidly with time. Examples include pressure inside a plastic injection molding machine, strain on an automobile chassis during a crash test and vibrations on a machine bearing shortly before failure.

The 5B40 and 5B41 protect the computer side from damage due to field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage thereby shielding computer-side circuitry from field-side overvoltage conditions. In addition, 5B40 and 5B41 Series modules are mix-and-match and hot swappable, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside 5B40/5B41 Modules

A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input voltage is subtracted from the input signal to set the zero-scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger than the total span for precise expanded-scale measurements.

A single-pole anti-aliasing filter resides at each modules input. A three-pole, low-pass filter in the output stage sets the bandwidth and yields optimal noise performance for accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within 3 Vdc of power common.

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Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched.

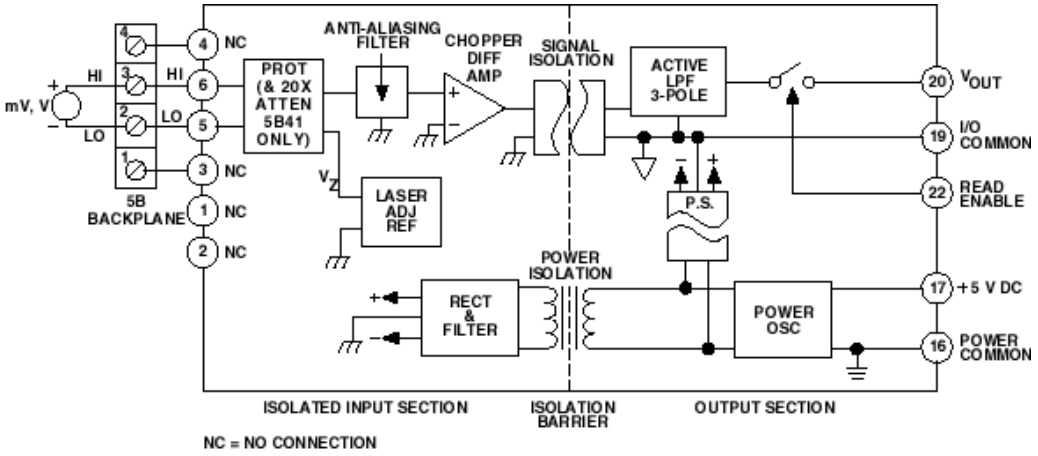


Figure 1. 5B40 and 5B41 Functional Block Diagram

Input Ranges

- 5B40 mV Input:
  ±10 mV to ±100 mV
  (±5 mV to ±500 mV - custom)
- 5B41 V Input:
  ±1 V to ±20 V
  (±0.5 V to ±20 V - custom)

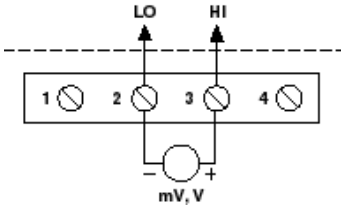


Figure 2. 5B40 and 5B41 Input Field Connections

Output Ranges

- 5B40/5B41:
  -5 V to +5 V or 0 to +5 V

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5B40 and 5B41 Specifications

Description	Model 5B40	Model 5B41
Input Ranges		
Standard Ranges	±10 mV to ±100 mV	±1 V to ±20 V
Custom Ranges	±5 mV to ±500 mV	±0.5 V to ±20 V
Output Ranges (R_L > 50 kΩ)[4]	-5 V to +5 V or 0 V to +5 V	*
Accuracy[2]		
Initial @ +25˚C	±0.05% Span ±10 µV RTI ±0.05% (Vz[1])	±0.05% Span ±0.05% (Vz[1])
Nonlinearity	±0.02% Span	*
Input Offset vs. Temperature	±1 µV/˚C	±20 µV/˚C
Output Offset vs. Temperature	±40 µV/˚C	*
Gain vs. Temperature	±25 ppm of Reading/˚C	±50 ppm of Reading/˚C
Input Bias Current	±3 nA	±0.2 nA
Input Resistance		
Power On	200 MΩ	650 kΩ
Power Off	40 kΩ	650 kΩ
Overload	40 kΩ	650 kΩ
Noise		
Input, 0.1 Hz to 10 Hz Bandwidth	0.4 µV rms	2 µV rms
Output, 100 kHz Bandwidth	10 mV peak-peak	*
Bandwidth, -3 dB	10 kHz	*
Output Rise Time, 10% to 90% Span	35 µs	*
Common-Mode Voltage (CMV)[3]		
Input-to-Output, Continuous	1500 V rms, maximum	*
Output-to-Power, Continuous	±3 V maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Common-Mode Rejection (CMR)		
1 kΩ Source Imbalance, 50/60 Hz	100 dB	90 dB
Normal Mode Rejection	-3 dB @ 10 kHz	*

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Input Protection		
Continuous	240 V rms, maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Output Resistance	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF	*
Output Enable Control		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Current	30 mA	*
Power Supply Sensitivity, RTI	±2 µV/Vs%	±0.4 mV/Vs%
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)	*
Environmental		
Temperature Range		
Rated Performance	-25˚C to +85˚C	*
Operating	-40˚C to +85˚C	*
Storage	-40˚C to +85˚C	*
Relative Humidity	0 to 93% @ +40˚C noncondensing	*
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft	*

* Specifications same as model 5B40.

[1] Vz is the nominal input voltage that results in a 0 V output.

[2] Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes RL > 50 kΩ. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.

[3] The output common must be kept within ±3 V of power common.

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5B42 Isolated, Process Current Input

Functional Description



The 5B42 is a single-channel signal conditioning module that interfaces with two-wire transmitters, providing an isolated, regulated 20 V supply voltage. The module filters and amplifies the 4-to-20 mA process-current input to produce an accurately scaled, low-noise low-impedance output of +1 to +5 V or +2 to +10 V.

True Three-Port Isolation

The floating, differential input circuit on the field side eliminates the need for any input grounding. Signal and power isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. True three-port isolation (Input-Output-Power) includes common-mode ratings of: 1500 V rms between input and output and input and power; 250 V rms between power and output - no return path is required between the power and signal output commons.

Accurate and Stable Performance

The 5B42 maintains accuracy over the wide operating temperature range of -40˚C to +85˚C through design for low parameter drift. This enables the module to provide output offset drift of only ±5 µV/˚C and gain drift of just ±25 ppm/˚C.

Why an Internal Current Sense Resistor

The 5B42 offers significant advantages over signal conditioners that require an external current sense resistor. First, an external resistor is not protected from accidental connection to a 240 V rms power line. Next, the external resistor tolerance must be added to the conditioners specified errors. In contrast, the 5B42 is calibrated and specified with its internal 25 Ω sense resistor. Further, the 5B42 signal input, loop supply and the sense resistor are all protected against accidental application of excess voltages up to 240 V rms. Finally, there is no need to install an external sense resistor on the backplane, but if one is installed it will not affect 5B42 performance.

Filtering and Protection

The 5B42 contains an optimized five-pole low-pass filter with a -3 dB bandwidth at 100-Hz that provides a low-overshoot step response and exceptionally low noise of 200 µV pk-pk in a 100 kHz bandwidth. Attenuation (normal mode rejection) increases at a 90 dB/decade rate beyond 100 Hz.

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The module protects the computer side from damage due to field-side overvoltage faults. The module withstands 240 V rms at the input terminals without damage, thereby shielding the internal computer-side circuitry from field-side overvoltage conditions. In addition, the 5B42 is mix-and-match and hot-swappable with all other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to output common as it is on the 5B01 and 5B08 backplanes.

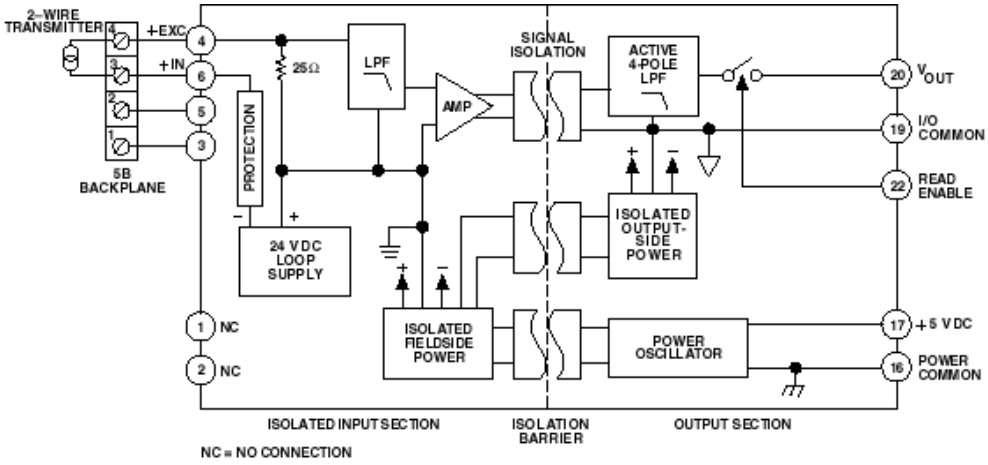


Figure 1. 5B42 Functional Block Diagram

Input Types

- Two-Wire Transmitters 4 to 20 mA (0 to 20 mA - custom)

Output Range

- +1 to +5 V or +2 to +10 V (0 to +10 V - custom)

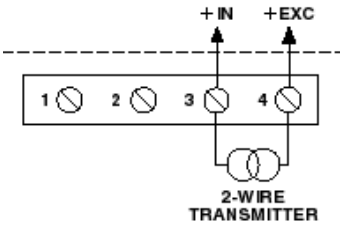


Figure 2. 5B42 Input Field Connections

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5B42 Specifications

(typical @ +25˚C and V_s = +5 V dc)

Description	Model 5B42
Input Ranges	
Standard Ranges	4 mA to 20 mA (Refer to Model Table)
Custom Ranges	0 mA to 20 mA (Refer to Ordering Section)
Isolated Loop Supply Voltage	20 V @ 4 mA to 20 mA Input
Output Ranges (R_L > 50 kΩ)	+1 V to +5 V; +2 V to +10 V
Accuracy[1]	
Initial @ +25˚C	±0.05% Span ±4 µA RTI
Nonlinearity	±0.01% Span
Input Offset vs. Temperature	±0.5 µV/˚C
Output Offset vs. Temperature	±5 µV/˚C
Gain vs. Temperature	±0.0025% of Reading/˚C
Input Sense Resistor[2]	25 Ω
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	10 nA rms
Output, 100 kHz Bandwidth	200 µV peak-peak
Bandwidth, -3 dB	100 Hz
Output Step Rise Time, 10% to 90% Span	4 ms
Common-Mode Voltage (CMV)	
Output-to-Input, Continuous	1500 V rms, maximum
Input-to-Power, Continuous	1500 V rms, maximum
Output-to-Power, Continuous[3]	250 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	140 dB
Normal Mode Rejection (NMR)	-3 dB @ 100 Hz (90 dB per decade > 100 Hz)
Input, Excitation, and Sense Resistor Protection	
Continuous	240 V rms, maximum

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Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	25 Ω
Voltage Output Protection	Continuous Short to Ground
Output Current Limit	±20 mA
Output Selection Time	6 µs to ±1 mV of V_{out} @ C_{load} = 0 to 2,000 pF
Output Enable Control[3]	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+36 V
Input Current "0", "1"	0.5 µA
Power Supply Voltage	+5 V dc ±5%
Power Supply Current	
@ Transmitter Load of 20 mA	200 mA
@ Transmitter Load of 4 mA	100 mA
Power Supply Sensitivity, RTI	±1 µV/% of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
Environmental	
Temperature Range	
Rated Performance	-40˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 95% @ +60˚C, noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity error. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.
[2]A precision 25 Ω current-sense input resistor is internal to the 5B42 - refer to block diagram.
[3]The user's board layout must separate Power Common from Output Common. When the output switch is not used, connect the Enable Input to the Output Common. Output common is connected to power common when the 5B42 is installed on a 5B Series backplane.
Specifications subject to change without notice.

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5B45/5B46 Isolated, Frequency Input

Functional Description



The 5B45 and 5B46 are single-channel isolated frequency input modules that produce a 0 to +5 V output proportional to input frequency. Model 5B45 accepts full-scale inputs ranging from 500 Hz to 20 kHz. Model 5B46 accepts full-scale inputs ranging from 20 kHz to 275 kHz. Both models allow the user to set the threshold to either 0 V (for zero crossing signals) or +1.4 V (for positive level signals), and the hysteresis to either ±25 mV or ±400 mV (all input types).

The 5B45 and 5B46 protect the computer side from field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage, thereby shielding computer-side circuitry from field-side overvoltage conditions. In addition, all 5B45 and 5B46 models are mix-and-match and hot-swappable, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside 5B45/5B46 Modules

The 5B45/46 internal circuitry compares the input signal to the user-selected threshold (V_T) and hysteresis (V_H). Signals of virtually any wave shape that exceed the combined threshold and hysteresis levels ($V_T \pm V_H$) will trigger a comparator at a rate determined by the input frequency. The comparator output is then transmitted across a proprietary transformer-coupled isolation barrier and converted to a high-level analog signal. This signal is then filtered by a multi-pole low pass Butterworth filter and buffered to provide a low-noise, low-impedance output signal that is accurately proportional to input frequency.

Simple Setup and Versatile Choices

Setting the threshold and hysteresis values is a simple matter of externally wiring to the backplane screw terminals. The threshold for measuring a zero-crossing voltage waveform (such as sine waves) is set to 0 volts by connecting the input signal across screw-terminals 4 and 3. The threshold for a positive level signal (such as a TTL or pulse train waveform) is set at +1.4 V by connecting the input signal across terminals 3 and 2. Hysteresis for both input signal types is set at ±400 mV, but can be changed to ±25 mV by adding a jumper between screw terminals 1 and 4.

Response time is a function of a modules rated input frequency range.

Convenience Features

The input circuit is fully floating and isolated from the output and power commons. In addition, the output section acts as a third floating port towards eliminating possible problems from ground loops and power supply noise. The output common must be held within ±3 V of power common.

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A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched as it is on the 5B01 and 5B08 backplanes.

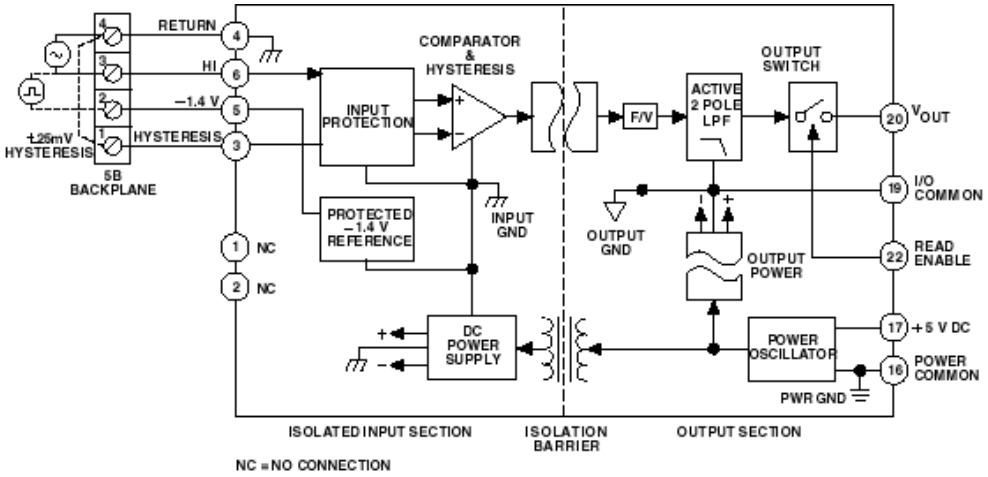


Figure 1. 5B45 and 5B46 Functional Block Diagram

Input Ranges

- 5B45: 0 to 10 kHz (0 to 20 kHz - custom)
- 5B46: 0 to 250 kHz (0 to 275 kHz - custom)

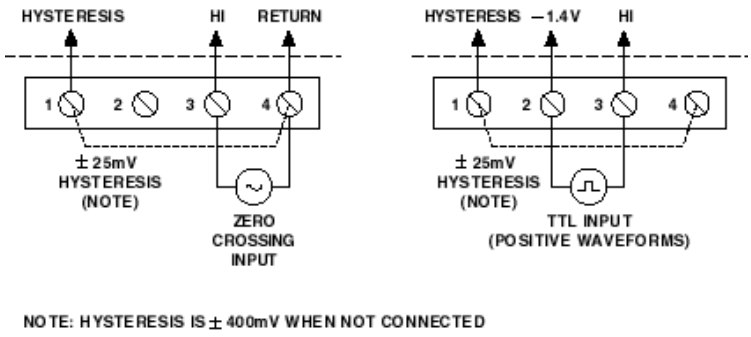


Figure 2. 5B45 and 5B46 Input Field Connections

Output Ranges

- 0 V to +5 V (-5 V to +5 V - custom)

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5B45 and 5B46 Specifications

Description	Model 5B45	Model 5B46
Frequency Input		
Standard Ranges	Refer to Model Table	Refer to Model Table
Custom Ranges	500 Hz span, min.; 20 kHz span, max.	20 kHz span, min.; 275 kHz span, max.
Overrange	20% of Span	*
Voltage Range	70 mV rms min. 240 V rms max.	*
Waveforms	Sine, Square, Triangle, Pulse Train	*
Pulse Width (Pulse Train Inputs)	2 µs min.	*
Threshold Options	Zero Crossing or TTL (+1.4 V)	*
TTL Input, Low (-40˚C to +85˚C)	0.8 V max.	*
TTL Input, High (-40˚C to +85˚C)	2.0 V min.	*
Hysteresis Options[1]	±25 mV or ±400 mV	*
Output Ranges (R_L > 50 kΩ)	-5 V to +5 V or 0 V to +5 V	*
Accuracy[2]		
Initial @ +25˚C	±0.05% Span (±0.1% Span, max.)	*
Nonlinearity	±0.005% Span (±0.015% Span, max.)	*
Output Offset vs. Temperature	±20 µV/˚C	*
Gain vs. Temperature	±20 ppm/˚C	*
Input Bias Current, V_{in} < 5 V peak-peak	100 µA	*
Input Impedance		
Small Signal, V_{in} < 5 V peak-peak	5 MΩ	*
Large Signal, V_{in} > 5 V peak-peak	40 kΩ ‖ 330 pF	*
Power Off	40 kΩ ‖ 330 pF	*

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Noise		
Output, 100 kHz Bandwidth	0.7 mV peak-peak	*
Output, 5 MHz Bandwidth	7 mV peak-peak	*
Output Ripple	10 mV peak-peak @ (10% F_{span} +$F_{\text{-full scale}}$)	*
Bandwidth, -3 dB	10 Hz	190 Hz
Output Step Response Time	Refer to Model Table	*
Common-Mode Voltage (CMV)		
Input-to-Output, Continuous	1500 V rms, maximum	*
Output-to-Power, Continuous[3]	±3 V, maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Common-Mode Rejection (CMR)		
1 kΩ Source Imbalance, 50/60 Hz	120 dB	*
Input Protection		
Continuous	240 V rms, maximum	*
Transient	ANSI/IEEE C37.90.1-1989	*
Output Resistance	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF	*
Output Enable Control		
Max Logic "0"	+1.0 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Current	70 mA	*
Power Supply Sensitivity, RTO	±0.005% of Span/% of V_S	*
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)	*

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Environmental		
Temperature Range		
Rated Performance	-40˚C to +85˚C	*
Operating Performance	-40˚C to +85˚C	*
Storage	-40˚C to +85˚C	*
Relative Humidity	0 to 93% @ +40˚C noncondensing	*
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft	*

* Specifications same as model 5B45.
[1] Jumper selectable. Refer to Field Connection diagram.
[2] Includes the combined effects of repeatability, hysteresis, and nonlinearity. Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.
[3] The Output Common must be kept within ±3 V of Power Common.
Specifications subject to change without notice.

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5B47 Isolated, Linearized Thermocouple Input

Functional Description



The 5B47 is a single-channel signal conditioning module that interfaces, amplifies and filters J, K, T, E, R, S, and B-type thermocouple. The module provides an isolated and protected precision output of 0 to +5 V.

The 5B47 internally linearizes its input signal to provide an output that is linear with temperature. Accuracy for each type of sensor is specified in the 5B47 model table. (See Model 5B37 for non-linearized conditioning of thermocouple signals.)

Accurate and System-Ready

Internal cold-junction compensation largely corrects errors arising from parasitic thermocouples formed by thermocouple connection to the input screw terminals, providing an accuracy of ±0.25˚C @ +25˚C ambient temperature. The module generates a predictable upscale signal to indicate an open thermocouple; for a downscale response, connect a 20 M Ω, 0.25 W resistor across screw terminals 1 and 3.

The 5B47 protects the computer side from damage due to field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage, thereby shielding computer-side circuitry from field-side overvoltage conditions. Further, the 5B47 is mix-and-match and hot-swappable with other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

Inside the 5B47 Module

A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input voltage is subtracted from the input signal to set the zero-scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3 dB) provides 60 dB of normal-mode rejection (noise on signal) and enhancement of common-mode rejection (noise on signal return) at 60 Hz, enabling accurate measurement of small signals in high electrical noise.

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Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ±3 V of power common.

Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched, as on the 5B01 and 5B08 backplanes.

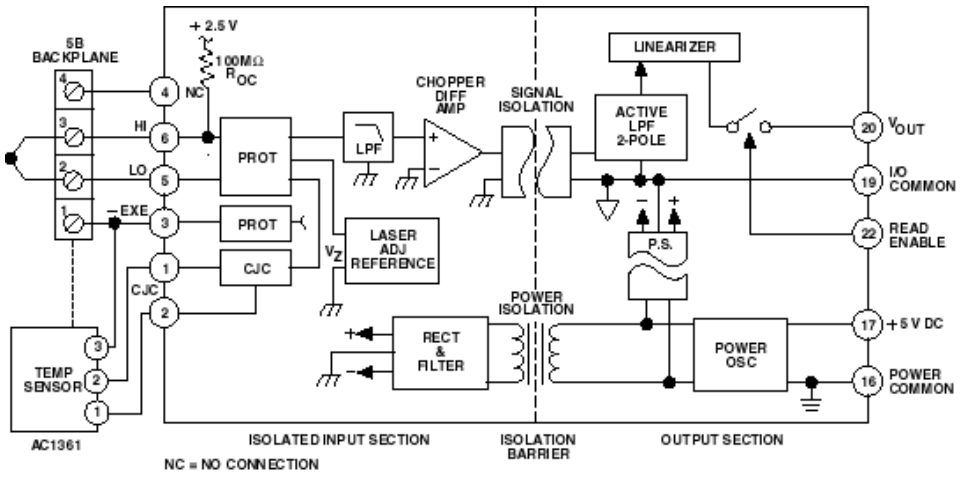


Figure 1. 5B47 Functional Block Diagram

Input Types

- Thermocouple Types:
  J, K, T, E, R, S, B

Output Ranges

- 0 to +5 V
  (+1 V to +5 V - custom)

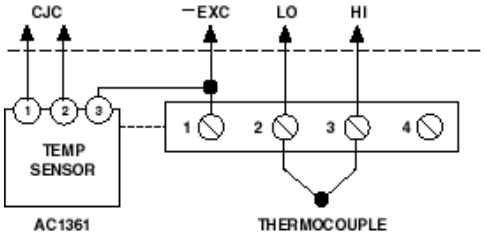


Figure 2. 5B47 Input Field Connections

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5B47 Specifications

Description	Model 5B47
Input Ranges	
Standard Ranges	Refer to Model Table
Custom Ranges	±5 mV to ±500 mV
Output Ranges (R_L > 50 kΩ)	+1 V to +5 V or 0 V to +5 V
Accuracy[1]	
Initial @ +25˚C	See Model Table
Input Offset vs. Temperature[2]	±1 µV/˚C
Output Offset vs. Temperature	±20 µV/˚C
Gain vs. Temperature	±0.0025% of Reading/˚C
Cold Junction Compensation	
Initial Accuracy @ +25˚C[3]	±0.25˚C (±0.75˚C, maximum)
Accuracy, +5˚C to +45˚C	±0.5˚C (±0.0125˚C/˚C)
Input Bias Current	-25 nA
Input Resistance	
Power On	5 MΩ
Power Off	40 kΩ
Overload	40 kΩ
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 µV rms
Output, 100 kHz Bandwidth	500 µV rms
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	200 ms
Common-Mode Voltage (CMV)	
Input-to-Output, Continuous	1500 V rms, maximum
Output-to-Power, Continuous[4]	±3 V, maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 kΩ Source Imbalance, 50/60 Hz	160 dB

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Normal Mode Rejection (NMR), 50/60 Hz	60 dB
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time	6 µs @ C_{load} = 0 to 2,000 pF
Output Enable Control	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Open Input Response	Upscale
Open Input Response Time	10 seconds
Power Supply Voltage	+5 V ±5%
Power Supply Current	30 mA
Power Supply Sensitivity, RTI	±2 µV/% of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
Environmental	
Temperature Range	
Rated Performance	-25˚C to +85˚C
Operating	-40˚C to +85˚C
Storage	-40˚C to +85˚C
Relative Humidity	0 to 93% @ +40˚C noncondensing
RFI Susceptibility	±0.5% Span error @ 400 MHz, 5 Watt, 3 ft

Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes R_L > 50 kΩ.
Loads heavier than 50 kΩ will degrade nonlinearity and gain temperature coefficient.
[2]±1 µV/˚C is equivalent to 0.02˚C/˚C for Type J thermocouples; 0.025˚C/˚C for Type K and T thermocouples; 0.016˚C/˚C for Type E thermocouples; 0.168˚C/˚C for Type R and S thermocouples.
[3]When used with the model AC1361 CJC sensor (see Accessories section), which is provided on each channel of 5B Series backplanes and mounting cards.
[4]The output common must be kept within ±3 V of power common.
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C

Power Requirements for the SC-2311 with 5B and SSR Series Modules

Use Tables C-1 and C-2 to determine how much power your SC-2311 consumes and whether or not the external power option is necessary. Most E Series DAQ devices can supply +5 V at 1 A with the exception of DAQCard E Series devices. Refer to your E Series DAQ device user manual for more details. Refer to Chapter 2, *Configuring and Setting Up the SC-2311*, to determine how to configure your SC-2311 to obtain power from either an E Series DAQ device or external power supply.

Table C-1. 5B Series Current Requirements

5B Series Module (Each)	Current Requirement at 5 VDC
5B30	30 mA
5B31	30 mA
5B40	30 mA
5B41	30 mA
5B32	30 mA
5B34	30 mA
5B35	15 mA
5B36	15 mA
5B37	30 mA
5B38	200 mA
5B42	200 mA

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Table C-1. 5B Series Current Requirements (Continued)

5B Series Module (Each)	Current Requirement at 5 VDC
5B45	110 mA
5B46	110 mA
5B47	30 mA

Table C-2. SSR Series Current Requirements

SSR Series Module (Each)	Current Requirement at 5 VDC
SSR-IDC-5	10 mA
SSR-IAC-5	10 mA
SSR-IAC-5A	10 mA
SSR-ODC-5	10 mA
SSR-OAC-5	10 mA
SSR-OAC-5A	10 mA

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D

Technical Support Resources

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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. Phone numbers for our worldwide offices are listed at the front of this manual.

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Glossary

Prefix	Meanings	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}
G-	giga-	10^{9}
t-	tera-	10^{12}

Numbers/Symbols

%	percent
+	positive of, or plus
–	negative of, or minus
/	per
°	degree
Ω	ohm

A

A	amperes
A/D	analog-to-digital
AC	alternating current
AC coupled	allowing the transmission of AC signals while blocking DC signals

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ACH	analog input channel signal
ADC	analog-to-digital converter—an electronic device that converts an analog voltage to a digital number
ADC resolution	the resolution of the ADC measured in bits. A 16-bit ADC has a higher resolution, and thus a higher degree of accuracy, than a 12-bit ADC.
AIGND	analog input ground signal
AISENSE	analog input sense signal
alias	a false lower frequency component that appears in sampled data acquired at too low a sampling rate
amplification	a type of signal conditioning that improves accuracy in the resulting digitized signal and reduces noise
AOGND	analog output ground signal
asynchronous	(1) hardware—a property of an event that occurs at an arbitrary time, without synchronization to a reference clock (2) software—a property of a function that begins an operation and returns prior to the completion or termination of the operation
attenuate	to decrease the amplitude of a signal
attenuation ratio	the factor by which signal amplitude is decreased
AWG	American Wire Gauge

B

b	bit—one binary digit, either 0 or 1
B	byte—eight related bits of data, an eight-bit binary number. Also used to denote the amount of memory required to store one byte of data.
bandwidth	the range of frequencies present in a signal, or the range of frequencies to which a measuring device can respond
bipolar	a signal range that includes both positive and negative values (for example, –5 V to +5 V)

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BNC	a type of coaxial signal connector
break-before-make	a type of switching contact that is completely disengaged from one terminal before it connects with another terminal
breakdown voltage	the voltage high enough to cause breakdown of optical isolation, semiconductors, or dielectric materials. *See also* working voltage.

C

C	Celsius
carrier	a main circuit board that provides multiple locations to add sub-circuits or modules, and a means to connect them
CH	channel
channel	pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
channel clock	the clock controlling the time interval between individual channel sampling within a scan. Devices with simultaneous sampling do not have this clock.
Channel Wizard	a utility incorporated into MAX that allows you to descriptively name physical channels in your system
circuit trigger	a condition for starting or stopping clocks
clock	hardware component that controls timing for reading from or writing to groups
CMRR	common-mode rejection ratio—a measure of the ability of an instrument to reject interference from a common-mode signal, usually expressed in decibels (dB)
code width	the smallest detectable change in an input voltage of a DAQ device
cold-junction compensation	a method of compensating for inaccuracies in thermocouple circuits

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common-mode noise	unwanted signals that appear in equal phase and amplitude on both the inverting and noninverting input in a differential measurement system. Ideally, but not completely in practice, the measurement device ignores this noise, because the measurement device is designed to respond to the difference between the inverting and noninverting inputs.
common-mode range	the input range over which a circuit can handle a common-mode signal
common-mode signal	the mathematical average voltage, relative to the ground of the computer, of the signals from a differential input
common-mode voltage	any voltage present at both instrumentation amplifier inputs with respect to amplifier ground
conditional retrieval	a method of triggering in which you simulate an analog trigger using software. Also called software triggering.
conversion time	the time required, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available
counter/timer	a circuit that counts external pulses or clock pulses (timing)
crosstalk	an unwanted signal on one channel due to an input on a different channel
current drive capability	the amount of current a digital or analog output channel is capable of sourcing or sinking while still operating within voltage range specifications
current sinking	the ability to dissipate current for analog or digital output signals
current sourcing	the ability to supply current for analog or digital output signals

D

D/A	digital-to-analog
DAC	digital-to-analog converter—an electronic device that converts a digital number into a corresponding analog voltage or current

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DAQ	data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D and/or DIO devices plugged into a computer, and possibly generating control signals with D/A and/or DIO devices in the same computer
dB	decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: dB=20log10 V1/V2, for signals in volts
DC	direct current
DC coupled	allowing the transmission of both AC and DC signals
default setting	a default parameter value recorded in the driver. In many cases, the default input of a control is a certain value (often 0) that means *use the current default setting*.
device	a plug-in data acquisition product, card, or pad that can contain multiple channels and conversion devices. Plug-in products, PCMCIA cards, and devices such as the DAQPad-1200, which connects to your computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices, with the exception of the SCXI-1200, which is a hybrid.
DIFF	differential mode
differential input	an analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured
differential measurement system	a way you can configure your device to read signals, in which you do not need to connect either input to a fixed reference, such as the earth ground or a building ground
digital port	*See* port.
digital trigger	a TTL level signal having two discrete levels—a high and a low level
DIN	Deutsche Industrie Norme
DIO	digital input/output
dithering	the addition of Gaussian noise to an analog input signal for the purpose of increasing the resolution of a measurement when using averaging
down counter	performing frequency division on an internal signal

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drivers	software that controls a specific hardware device such as a DAQ device or a GPIB interface
dropout voltage	the minimum sustained voltage required in order for the circuit to remain active
dynamic range	the ratio of the largest signal level a circuit can handle to the smallest signal level it can handle (usually taken to be the noise level), normally expressed in decibels

E

EMC	electromechanical compliance
EMI	electromagnetic interference
E Series	a standard architecture for instrumentation-class, multichannel data acquisition deices
event	the condition or state of an analog or digital signal
external trigger	a voltage pulse from an external source that triggers an event such as A/D conversion
EXTREF	external reference signal
EXTSTROBE	external strobe signal

F

false triggering	triggering that occurs at an unintended time
F_c	frequency cutoff
filtering	a type of signal conditioning that allows you to filter unwanted signals from the signal you are trying to measure
floating signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground. Also called nonreferenced signal sources. Some common example of floating signal sources are batteries, transformers, or thermocouples.
FREQ_OUT	frequency output signal

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G

GPCTR0_GATE	general purpose counter timer 0 gate signal
GPCTR0_OUT	general purpose counter timer 0 output signal
GPCTR0_SOURCE	general purpose counter timer 0 clock source signal
GPCTR1_GATE	general purpose counter timer 1 gate signal
GPCTR1_OUT	general purpose counter timer 1 output signal
GPCTR1_SOURCE	general purpose counter timer 1 clock source signal
grounded measurement system	*See* RSE

H

h	hour
hardware triggering	a form of triggering where you set the start time of an acquisition and gather data at a known position in time relative to a trigger signal
Hz	hertz—the number of scans read or updates written per second

I

I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces
in.	inch or inches
input impedance	the measured resistance and capacitance between the input terminals of a circuit
input offset current	the difference in the input bias currents of the two inputs of an instrumentation amplifier
instrumentation amplifier	a circuit whose output voltage with respect to ground is proportional to the difference between the voltages at its two inputs

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interval scanning	scanning method where there is a longer interval between scans than there is between individual channels comprising a scan
I_{OH}	current, output high
I_{OL}	current, output low
isolation	a type of signal conditioning in which you isolate the transducer signals from the computer for safety purposes. This protects you and your computer from large voltage spikes and makes sure the measurements from the DAQ device are not affected by differences in ground potentials.
isolation voltage	the voltage that an isolated circuit can normally withstand, usually specified from input to input and/or from any input to the amplifier output, or to the computer bus
isothermal	constructed to maintain constant temperature across area. Isothermal construction of terminal blocks increases thermocouple measurement accuracy.

K

k	kilo—the standard metric prefix for 1,000, or 10^3, used with units of measure such as volts, hertz, and meters
K	1. kelvin 2. kilo—the prefix for 1,024, or 2^{10}, used with B in quantifying data or computer memory
kbytes/s	a unit for data transfer that means 1,000 or 10^3 bytes/s
kS	1,000 samples

L

LabVIEW	a graphical programming language
latched digital I/O	a type of digital acquisition/generation where a device or module accepts or transfers data after a digital pulse has been received. Also called handshaked digital I/O.

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library	a file containing compiled object modules, each comprised of one of more functions, that can be linked to other object modules that make use of these functions. NIDAQ32.LIB is a library that contains NI-DAQ functions. The NI-DAQ function set is broken down into object modules so that only the object modules that are relevant to your application are linked in, while those object modules that are not relevant are not linked.
linearity	the adherence of device response to the equation R = KS, where R = response, S = stimulus, and K = a constant
linearization	a type of signal conditioning in which software linearizes the voltage levels from transducers, so the voltages can be scaled to measure physical phenomena
LSB	least significant bit

M

m	meters
M	(1) Mega, the standard metric prefix for 1 million or 10^6, when used with units of measure such as volts and hertz; (2) mega, the prefix for 1,048,576, or 2^{20}, when used with B to quantify data or computer memory
Measurement & Automation Explorer (MAX)	a controlled centralized configuration environment that allows you to configure all of your National Instruments DAQ, GPIB, IMAQ, IVI, Motion, VISA, and VXI devices
MIO	multifunction I/O
MS	million samples
MSB	most significant bit
mux	multiplexer—a switching device with multiple inputs that sequentially connects each of its inputs to its output, typically at high speeds, in order to measure several signals with a single analog input channel

N

NC	normally closed, or not connected
NI-DAQ	National Instruments driver software for DAQ hardware

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NO	normally open
noise	an undesirable electrical signal—noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Noise corrupts signals you are trying to send or receive.
nonlatched digital I/O	a type of digital acquisition/generation where LabVIEW updates the digital lines or port states immediately or returns the digital value of an input line. Also called immediate digital I/O or non-handshaking.
nonreferenced signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground. Also called floating signal sources. Some common example of nonreferenced signal sources are batteries, transformers, or thermocouples.
NRSE	nonreferenced single-ended mode—all measurements are made with respect to a common (NRSE) measurement system reference, but the voltage at this reference can vary with respect to the measurement system ground

O

onboard channels	channels provided by the plug-in data acquisition device
optical isolation	the technique of using an optoelectric transmitter and receiver to transfer data without electrical continuity, to eliminate high-potential differences and transients
output slew rate	the maximum rate of change of analog output voltage from one level to another

P

pad	a soldering location in the PWB used by the customer for signal connection
passband	the range of frequencies which a device can properly propagate or measure

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pattern generation	a type of handshaked (latched) digital I/O in which internal counters generate the handshaked signal, which in turn initiates a digital transfer. Because counters output digital pulses at a constant rate, this means you can generate and retrieve patterns at a constant rate because the handshaked signal is produced at a constant rate.
PC Card	a credit-card-sized expansion card that fits in a PCMCIA slot often referred to as a PCMCIA card
PCI	Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and work-stations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.
PCMCIA	an expansion bus architecture that has found widespread acceptance as a standard in notebook-size computers. It originated as a specification for add-on memory cards written by the Personal Computer Memory Card International Association.
peak to peak	a measure of signal amplitude; the difference between the highest and lowest excursions of the signal
PFI	programmable function input
PGIA	programmable gain instrumentation amplifier
pipeline	(1) a high-performance processor structure in which the completion of an instruction is broken into its elements so that several elements can be processed simultaneously from different instructions (2) also refers to pipelined ADC that requires several conversions to produce output from the ADC
Plug and Play devices	devices that do not require DIP switches or jumpers to configure resources on the devices—also called switchless devices
port	(1) a communications connection on a computer or a remote controller (2) a digital port, consisting of four or eight lines of digital input and/or output
posttriggering	the technique used on a DAQ device to acquire a programmed number of samples after trigger conditions are met
potentiometer	an electrical device the resistance of which can be manually adjusted; used for manual adjustment of electrical circuits and as a transducer for linear or rotary position

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ppm	parts per million
pretriggering	the technique used on a DAQ device to keep a continuous buffer filled with data, so that when the trigger conditions are met, the sample includes the data leading up to the trigger condition
propagation delay	the amount of time required for a signal to pass through a circuit
pulsed output	a form of counter signal generation by which a pulse is output when a counter reaches a certain value

Q

quantization error	the inherent uncertainty in digitizing an analog value due to the finite resolution of the conversion process

R

referenced signal sources	signal sources with voltage signals that are referenced to a system ground, such as the earth or a building ground. Also called grounded signal sources.
relative accuracy	a measure in LSB of the accuracy of an ADC. It includes all nonlinearity and quantization errors. It does not include offset and gain errors of the circuitry feeding the ADC.
resolution	the smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244% of full scale.
rise time	the difference in time between the 10% and 90% points of the step response of a system
rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RSE	referenced single-ended mode—all measurements are made with respect to a common reference measurement system or a ground. Also called a grounded measurement system.
RTD	resistance temperature detector—a metallic probe that measures temperature based upon its coefficient of resistivity

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RTI	referred to input
RTSI bus	real-time system integration bus—the National Instruments timing bus that connects DAQ devices directly, by means of connectors on top of the devices, for precise synchronization of functions

S

s	seconds
S	samples
S/H	sample-and-hold—a circuit that acquires and stores an analog voltage on a capacitor for a short period of time
S/s	samples per second—used to express the rate at which a DAQ device samples an analog signal
sample counter	the clock that counts the output of the channel clock, in other words, the number of samples taken. On devices with simultaneous sampling, this counter counts the output of the scan clock and hence the number of scans.
scan	one or more analog or digital input samples. Typically, the number of input samples in a scan is equal to the number of channels in the input group. For example, one pulse from the scan clock produces one scan which acquires one new sample from every analog input channel in the group.
scan clock	the clock controlling the time interval between scans. On devices with interval scanning support (for example, the PCI-6052E), this clock gates the channel clock on and off. On devices with simultaneous sampling (for example, the PCI-6110E), this clock clocks the track-and-hold circuitry.
scan rate	the number of scans per second. For example, a scan rate of 10 Hz means sampling each channel 10 times per second.
SCANCLK	scan clock signal
SE	single-ended—a term used to describe an analog input that is measured with respect to a common ground
self-calibrating	a property of a DAQ device that has an extremely stable onboard reference and calibrates its own A/D and D/A circuits without manual adjustments by the user

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sensor	a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal
settling time	the amount of time required for a voltage to reach its final value within specified limits
signal conditioning	the manipulation of signals to prepare them for digitizing
SNR	signal-to-noise ratio—the ratio of the overall rms signal level to the rms noise level, expressed in decibels
software trigger	a programmed event that triggers an event such as data acquisition
software triggering	a method of triggering in which you simulate an analog trigger using software. Also called conditional retrieval.
source impedance	a parameter of signal sources that reflects current-driving ability of voltage sources (lower is better) and the voltage-driving ability of current sources (higher is better)
SS	simultaneous sampling—a property of a system in which each input or output channel is digitized or updated at the same instant
SSR	solid-state relay
STARTSCAN	start scan signal
STC	system timing controller
strain gauge	a thin conductor, which is attached to a material, that detects stress or vibrations in that material. The resistance of the conductor is a function of the applied force.
switchless device	devices that do not require DIP switches or jumpers to configure resources on the devices—also called Plug and Play devices
synchronous	(1) hardware—a property of an event that is synchronized to a reference clock (2) software—a property of a function that begins an operation and returns only when the operation is complete
system noise	a measure of the amount of noise present in an analog circuit or when the analog inputs are grounded

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T

T/H	track-and-hold—a circuit that tracks an analog voltage and holds the value on command
TC	(1) terminal count—the highest value of a counter (2) thermocouple
TCR	temperature coefficient of resistance
thermistor	a semiconductor sensor that exhibits a repeatable change in electrical resistance as a function of temperature. Most thermistors exhibit a negative temperature coefficient.
thermocouple	a temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature.
transducer	*See* sensor
transducer excitation	a type of signal conditioning that uses external voltages and currents to excite the circuitry of a signal conditioning system into measuring physical phenomena
TRIG	trigger signal
trigger	any event that causes or starts some form of data capture
TTL	transistor-transistor logic

U

unipolar	a signal range that is always positive (for example, 0 to +10 V)
update	the output equivalent of a scan. One or more analog or digital output samples. Typically, the number of output samples in an update is equal to the number of channels in the output group. For example, one pulse from the update clock produces one update which sends one new sample to every analog output channel in the group.
UPDATE	update signal
update rate	the number of output updates per second

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V

V	volts
V_{COM}	voltage input signal reference
V_{DC}	volts direct current
VI	virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program
V_{IH}	volts, input high
V_{IL}	volts, input low
V_{in}	volts in
V_{IN}	voltage input signal
V_{OH}	volts, output high
V_{OL}	volts, output low
V_{ref}	reference voltage
V_{SS}	voltage supply signal

W

waveform	multiple voltage readings taken at a specific sampling rate
working voltage	the highest voltage that should be applied to a product during normal use, normally well under the breakdown voltage for safety margin

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