

# Analog Signal Conditioning Modules

## 5B Series

- For low-channel-count systems requiring isolation
- Isolated input and output modules available
- Requires module carrier (see page 346)

### Solutions

- Temperature and strain measurements
- Voltage measurements from  $\pm 10$  mV range to  $\pm 20$  V range
- Process Control
- Design Validation



## Overview

The 5B Series modules perform single-channel analog signal conditioning for National Instruments E Series and basic multifunction DAQ devices. These modules are mounted in an 8 or 16-channel backplane or the 8-channel NI SC-2311 shielded carrier

for assorted signal conditioning on a channel-by-channel basis. The 5B Series provides isolation, noise rejection, and amplification for millivolt sources, volt sources, 4 to 20 mA sources, 0 to 20 mA sources, RTDs, thermocouples, strain gauges, potentiometer, and frequency inputs. Analog voltage and current output modules are also available.

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5b

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## 5B30/31/40/41 Specifications

|                              |  |
|------------------------------|--|
| Output range.....            | $\pm 5$ V  |
| Accuracy                     |  |
| 5B30, 5B40.....              | $\pm 0.05\%$ FSR $\pm 10$ $\mu$ V  |
| 5B31, 5B41.....              | $\pm 0.05\%$ FSR $\pm 0.2$ $\mu$ V   |
| CMRR (50 or 60 Hz)           |  |
| 5B30, 5B31.....              | 160 dB   |
| 5B40.....                    | 100 dB   |
| 5B41.....                    | 90 dB  |
| Input offset stability.....  | $\pm 1$ $\mu$ V/ $^{\circ}$ C for 5B30, 5B40<br>$\pm 20$ $\mu$ V/ $^{\circ}$ C for 5B31, 5B41  |
| Output offset stability..... | $\pm 20$ $\mu$ V/ $^{\circ}$ C for SB30, SB31<br>$\pm 40$ $\mu$ V/ $^{\circ}$ C for 5B40, 5B41 |
| Gain stability.....          | $\pm 25$ ppm/ $^{\circ}$ C for 5B30, 5B40<br>$\pm 50$ ppm/ $^{\circ}$ C for 5B31, 5B41         |
| Power requirement.....       | 30 mA at +5 VDC  |

## 5B32 Specifications

|                         |                                       |
|-------------------------|---------------------------------------|
| Accuracy.....           | $\pm 0.05\%$ FSR                      |
| CMRR (50 or 60 Hz)..... | 160 dB                                |
| Offset stability.....   | $\pm 25$ ppm/ $^{\circ}$ C of $I_i^1$ |
| Gain stability.....     | $\pm 25$ ppm/ $^{\circ}$ C            |
| Resistor stability..... | $\pm 10$ ppm/ $^{\circ}$ C            |
| Power requirement.....  | 30 mA at +5 VDC                       |

<sup>1</sup> $I_i$  is the nominal input current that results in a 0 V output.

| Model | Input Range  | Bandwidth | Part Number |
|-------|--------------|-----------|-------------|
| 5B30  | $\pm 10$ mV  | 4 Hz      | 776228-01   |
|       | $\pm 50$ mV  | 4 Hz      | 776228-05   |
|       | $\pm 100$ mV | 4 Hz      | 776228-10   |
| 5B31  | $\pm 1$ V    | 4 Hz      | 776229-01   |
|       | $\pm 5$ V    | 4 Hz      | 776229-05   |
|       | $\pm 10$ V   | 4 Hz      | 776229-10   |
|       | $\pm 20$ V   | 4 Hz      | 776229-20   |
| 5B40  | $\pm 10$ mV  | 10 kHz    | 776230-01   |
|       | $\pm 50$ mV  | 10 kHz    | 776230-05   |
|       | $\pm 100$ mV | 10 kHz    | 776230-10   |
| 5B41  | $\pm 1$ V    | 10 kHz    | 776231-01   |
|       | $\pm 5$ V    | 10 kHz    | 776231-05   |
|       | $\pm 10$ V   | 10 kHz    | 776231-10   |
|       | $\pm 20$ V   | 10 kHz    | 776231-20   |

Table 1. 5B30/31/40/41 Voltage Input

| Input Range | Output Range | Bandwidth | Part Number |
|-------------|--------------|-----------|-------------|
| 4 to 20 mA  | 0 to +5 V    | 4 Hz      | 776232-01   |
| 0 to 20 mA  | 0 to +5 V    | 4 Hz      | 776232-02   |

Table 2. 5B32 Process Current Input

# Analog Signal Conditioning Modules

| Sensor                    | Range          | Part Number |
|---------------------------|----------------|-------------|
| 100 $\Omega$ Pt*          | -100 to 100 °C | 776233-P1   |
| 100 $\Omega$ Pt*          | 0 to 100 °C    | 776233-P2   |
| 100 $\Omega$ Pt*          | 0 to 200 °C    | 776233-P3   |
| 100 $\Omega$ Pt*          | 0 to 600 °C    | 776233-P4   |
| 10 $\Omega$ Cu (at 0 °C)  | 0 to 120 °C    | 776233-C1   |
| 10 $\Omega$ Cu (at 25 °C) | 0 to 120 °C    | 776233-C2   |
| 120 $\Omega$ Ni           | 0 to 300 °C    | 776233-N1   |

\*a = 0.00385

Table 3. 5B34 RTD Input – Isolated 2 or 3-Wire RTD

| Sensor           | Range          | Part Number |
|------------------|----------------|-------------|
| 100 $\Omega$ Pt* | -100 to 100 °C | 778015-01   |
| 100 $\Omega$ Pt* | 0 to 100 °C    | 778015-02   |
| 100 $\Omega$ Pt* | 0 to 200 °C    | 778015-03   |
| 100 $\Omega$ Pt* | 0 to 600 °C    | 778015-04   |

\*a = 0.00385

Table 4. 5B35 RTD Input – Isolated 4-Wire RTD

| Input Range        | Output Range | Part Number |
|--------------------|--------------|-------------|
| 0 to 100 $\Omega$  | 0 to +5 V    | 778016-01   |
| 0 to 500 $\Omega$  | 0 to +5 V    | 778016-02   |
| 0 to 1 k $\Omega$  | 0 to +5 V    | 778016-03   |
| 0 to 10 k $\Omega$ | 0 to +5 V    | 778016-04   |

Table 5. 5B36 Potentiometer Input

| Thermocouple Type | Temperature Range | Part Number |
|-------------------|-------------------|-------------|
| J                 | -100 to 760 °C    | 776289-J    |
| K                 | -100 to 1350 °C   | 776289-K    |
| T                 | -100 to 400 °C    | 776289-T    |
| E                 | 0 to 900 °C       | 776289-E    |
| R                 | 0 to 1750 °C      | 776289-R    |
| S                 | 0 to 1750 °C      | 776289-S    |
| B                 | 0 to 1800 °C      | 776289-B    |

Cold junction compensation sensor not included

Table 6. 5B37 Thermocouple Input with Cold-Junction Compensation

| Input       | Transducer Impedance          | Excitation | Sensitivity | Part Number |
|-------------|-------------------------------|------------|-------------|-------------|
| Full Bridge | 100 $\Omega$ to 10 k $\Omega$ | 3.333 V    | 3 mV/V      | 776342-01   |
| Full Bridge | 300 $\Omega$ to 10 k $\Omega$ | 10 V       | 3 mV/V      | 776342-02   |
| Half Bridge | 100 $\Omega$ to 10 k $\Omega$ | 3.33 V     | 3 mV/V      | 776342-03   |
| Half Bridge | 300 $\Omega$ to 10 k $\Omega$ | 10 V       | 3 mV/V      | 776342-04   |
| Full Bridge | 300 $\Omega$ to 10 k $\Omega$ | 10 V       | 2 mV/V      | 776342-05   |

Table 7. 5B38 Strain Gauge Input

## 5B34 Specifications

|                              |   |
|------------------------------|---|
| Output range.....            | 0 to +5 V   |
| Bandwidth.....               | 4 Hz  |
| Accuracy 2 .....             | $\pm 0.05\%$ FSR $\pm 0.1 \Omega$<br>( $\pm 0.025 \Omega$ for 10 $\Omega$ Cu) |
| CMRR (50 or 60 Hz).....      | 160 dB  |
| Excitation current.....      | 0.25 mA (1.0 mA for 10 $\Omega$ Cu)   |
| Input offset stability.....  | $\pm 0.02$ °C/°C  |
| Output offset stability..... | $\pm 20$ $\mu$ V/°C   |
| Gain stability.....          | $\pm 50$ ppm/°C   |
| Power requirement.....       | 30 mA at +5 VDC   |

<sup>2</sup> Includes the combined effects of repeatability, hysteresis, and nonlinearity.

## 5B35 Specifications

|                              |                  |
|------------------------------|------------------|
| Output range.....            | 0 to +5 V        |
| Bandwidth.....               | 4 Hz             |
| Accuracy .....               | $\pm 0.05$ FSR   |
| CMRR (50 or 60 Hz).....      | 190 dB           |
| Excitation current.....      | 0.25 mA          |
| Input offset stability.....  | $\pm 0.01$ °C/°C |
| Output offset stability..... | $\pm 20$ mV/°C   |
| Gain stability.....          | $\pm 30$ ppm/°C  |
| Power requirement.....       | 15 mA at +5 VDC  |

## 5B36 Specifications

|                              |  |
|------------------------------|--|
| Accuracy.....                | $\pm 0.08\%$ FSR   |
| Bandwidth.....               | 4 Hz   |
| CMRR (50 or 60 Hz).....      | 170 dB   |
| Input offset stability.....  | $\pm 0.004 \Omega$ /°C $\pm 0.010 \Omega$ /°C (for 10 k $\Omega$ ) |
| Output offset stability..... | $\pm 20$ mV/°C   |
| Gain stability.....          | $\pm 30$ ppm/°C  |
| Excitation current.....      | 0.25 mA 0.1 mA (for 10 k $\Omega$ )                                |
| Power requirement.....       | 15 mA at +5 VDC  |

## 5B37 Specifications

|                              |   |
|------------------------------|---|
| Output range.....            | 0 to +5 V   |
| Bandwidth.....               | 4 Hz  |
| Accuracy .....               | $\pm 0.05\%$ FSR $\pm 10$ $\mu$ V + CJC<br>sensor error |
| CJC sensor error.....        | $\pm 0.25$ °C (at 25 °C), $\pm 0.5$ °C<br>(5 to 45 °C)  |
| CMRR (50 or 60 Hz).....      | 160 dB  |
| Input offset stability.....  | $\pm 1$ $\mu$ V/°C                                      |
| Output offset stability..... | $\pm 20$ $\mu$ V/°C                                     |
| Gain stability.....          | $\pm 25$ ppm/°C   |
| Power requirement.....       | 30 mA at +5 VDC   |

## 5B38 Specifications

|                              |                                   |
|------------------------------|-----------------------------------|
| Output range.....            | $\pm 5$ V                         |
| Bandwidth.....               | 10 kHz                            |
| Accuracy .....               | $\pm 0.08\%$ FSR $\pm 10$ $\mu$ V |
| CMRR (50 or 60 Hz).....      | 100 dB                            |
| Input offset stability.....  | $\pm 1$ $\mu$ V/°C                |
| Output offset stability..... | $\pm 40$ $\mu$ V/°C               |
| Gain stability.....          | $\pm 25$ ppm/°C                   |
| Excitation stability.....    | $\pm 15$ ppm/°C                   |
| Power requirement.....       | 200 mA at +5 VDC (full load)      |

# Analog Signal Conditioning Modules

| Model | Input Range | Output Range | Part Number |
|-------|-------------|--------------|-------------|
| 5B39  | 0 to +5 V   | 4 to 20 mA   | A776365-01  |
| 5B49  | ±5 V        | ± V          | 777234-02   |
|       | ±10 V       | ±10 V        | 777234-05   |

\* Analog output modules require an SC-205x Series adapter for connection to two analog output channels of a DAQ device. Only available for use with the 5B01 16-channel backplane.

Table 8. 5B39/49 Current and Voltage Output\*

| Input Range | Output Range | Bandwidth | Part Number |
|-------------|--------------|-----------|-------------|
| 4 to 20 mA  | +1 to +5 V   | 100 Hz    | 778017-01   |
| 0 to 20 mA  | +2 to +10 V  | 100 Hz    | 778017-02   |

Table 9. 5B42 Process Current Input with external regulated 20 VDC loop

| Input Range  | Output Range | Part Number |
|--------------|--------------|-------------|
| 0 to 500 Hz  | 0 to +5 V    | 776977-01   |
| 0 to 1 kHz   | 0 to +5 V    | 776977-02   |
| 0 to 2.5 kHz | 0 to +5 V    | 776977-03   |
| 0 to 5 kHz   | 0 to +5 V    | 776977-04   |
| 0 to 10 kHz  | 0 to +5 V    | 776977-05   |
| 0 to 25 kHz  | 0 to +5 V    | 776978-01   |
| 0 to 50 kHz  | 0 to +5 V    | 776978-02   |
| 0 to 100 kHz | 0 to +5 V    | 776978-03   |

Table 10. 5B45/46 Frequency Input

| Thermocouple Type | Temperature Range | Accuracy* | Part Number |
|-------------------|-------------------|-----------|-------------|
| J                 | 0 to 760 °C       | ±1.1 °C   | 776234-J1   |
| J                 | -100 to 300 °C    | ±0.5 °C   | 776234-J2   |
| J                 | 0 to 500 °C       | ±0.6 °C   | 776234-J3   |
| K                 | 0 to 1000 °C      | ±1.3 °C   | 776234-K1   |
| K                 | 0 to 500 °C       | ±0.6 °C   | 776234-K2   |
| T                 | -100 to 400 °C    | ±1.4 °C   | 776234-T1   |
| T                 | 0 to 200 °C       | ±0.5 °C   | 776234-T2   |
| E                 | 0 to 1000 °C      | ±1.7 °C   | 776234-E    |
| R                 | 500 to 1750 °C    | ±2.5 °C   | 776234-R    |
| S                 | 500 to 1750 °C    | ±2.4 °C   | 776234-S    |
| B                 | 500 to 1800 °C    | ±5.1 °C   | 776234-B    |

\* Does not include accuracy of cold-junction compensation (CJC) sensor. Cold junction compensation sensor not included

Table 11. 5B47 Linearized Thermocouple Input with Cold-Junction Compensation

## 5B39/49 Specifications

|                        |                  |
|------------------------|------------------|
| Bandwidth.....         | 400 Hz           |
| Accuracy .....         | ±0.05% FSR       |
| CMRR .....             | 90 dB            |
| Offset stability.....  | ±25 ppm/°C       |
| Gain stability .....   | ±20 ppm/°C       |
| Power requirement..... | 170 mA at +5 VDC |

## 5B42 Specifications

|                              |                      |
|------------------------------|----------------------|
| Accuracy .....               | ±0.05% FSR ±4 µA RTI |
| CMRR (50 or 60 Hz).....      | 140 dB               |
| Input offset stability.....  | ±0.5 µV/°C           |
| Output offset stability..... | ± 5 mV/°C            |
| Gain stability .....         | ± 25 ppm/°C          |
| Loop supply voltage.....     | 20 V @ 4 to 20 mA    |
| Power requirement.....       | 200 mA at +5 VDC     |

## 5B45/46 Specifications

|                             |                             |
|-----------------------------|-----------------------------|
| Input threshold.....        | TTL-level and zero crossing |
| Input voltage (pk-pk) ..... | 60 V max, 100 mV min        |
| Minimum pulsewidth.....     | 4 µs                        |
| Accuracy .....              | ± 0.05% FSR                 |
| CMRR (50 or 60 Hz).....     | 120 dB                      |
| Offset stability.....       | ±40 ppm/°C                  |
| Gain stability .....        | ±40 ppm/°C                  |
| Power requirement.....      | 110 mA at +5 VDC            |

## 5B47 Specifications

|                              |  |
|------------------------------|--|
| Output range.....            | 0 to +5 V                                  |
| Bandwidth.....               | 4 Hz                                       |
| CJC sensor error.....        | ±0.25 °C (at 25 °C), ±0.5 °C (5° to 45 °C) |
| CMRR (50 or 60 Hz).....      | 160 dB                                     |
| Input offset stability.....  | ±1 mV/°C                                   |
| Output offset stability..... | ±20 mV/°C                                  |
| Gain stability .....         | ±25 ppm/°C                                 |
| Power requirement.....       | 30 mA at +5 VDC                            |

## Common Module Specifications

|                                   |   |
|-----------------------------------|---|
| Nonlinearity.....                 | ±0.02% FSR                                      |
| Common-mode voltage isolation     |   |
| Input to output, continuous.....  | 1,500 V <sub>rms</sub> maximum                  |
| Normal-mode input protection..... | 240 V <sub>rms</sub> continuous                 |
| Transient protection .....        | Meets IEEE STD 472 (SWC)                        |
| Module power.....                 | +5 VDC  |
| Hold down .....                   | Captive, metric screw                           |
| Packaging .....                   | Hard potted in plastic case                     |
| Module size.....                  | 5.7 by 5.7 by 1.5 cm (2.25 by 2.25 by 0.60 in.) |
| Operating temperature.....        | -25 to 85 °C                                    |

## Certifications and Compliances

### CE Mark Compliance

This product meets applicable EU directive(s) as follows:

|                       |                                       |
|-----------------------|---------------------------------------|
| Safety isolation..... | Low voltage directive EN 61010        |
| EMC Directive         |                                       |
| Immunity.....         | EN 50082-1:1994                       |
| Emissions.....        | EN 55011:1991 Group I Class A at 10 m |

# Carriers/Backplanes for 5B Series

## Overview

5B Series modules must be installed in a carrier or backplane, for a power source as well as for connectivity to both the raw signals and the DAQ device. The NI SC-2311 shielded carrier cables directly to an E Series device and offers a variety of connectivity options to signals and sensors. The SC-2311 is ideal for analog input applications because of its shielding. For analog output signal applications, you must use a 5B Series Backplane.

## Ordering Information

NI SC-2311

|                              |           |
|------------------------------|-----------|
| U.S. 120 VAC .....           | 778192-01 |
| Universal Euro 240 VAC ..... | 778192-04 |
| United Kingdom 240 VAC ..... | 778192-06 |
| Japan 100 VAC .....          | 778192-07 |

For ordering information on panelettes, see page 468

## Backplane/Accessories

5B Series Backplanes, (without cables)

|                                   |           |
|-----------------------------------|-----------|
| 5B08, 8-channel.....              | 777309-91 |
| 5B01, 16-channel.....             | 776291-91 |
| 5B01 Rack-mount accessory.....    | 776236-01 |
| CA-1000 Rack Mount Kit (2U) ..... | 187374-01 |
| Power supplies, +5 VDC, 1 A       |           |
| 115 VAC source.....               | 776237-01 |
| 220 VAC source.....               | 776237-31 |
| ±5 VDC, 5 A                       |           |
| 85 to 250 VAC .....               | 776237-35 |

## Cables

|                          |           |
|--------------------------|-----------|
| NB7 (5B to SC-205x)      |           |
| 20 cm .....              | 180924-02 |
| 40 cm .....              | 180924-04 |
| NB9 (5B to 50-pin MIO)   |           |
| 1 m .....                | 180555-10 |
| 68F-50M MIO adapter..... | 183139-01 |

## SC-2311 Shielded Carrier

- Holds up to 8 5B Series analog input modules and up to 8 SSR Series digital conditioning modules
- Cables directly to your E Series or basic multifunction DAQ device
- Custom connectivity options via panelettes
- Rack-mount accessory available
- 120/240 VAC power options

The SC-2311 is a shielded carrier that holds up to eight 5B analog input signal conditioning modules and eight SSR digital signal conditioning modules. Modules are installed vertically into the SC-2311, which makes it easy to remove or replace modules. The SC-2311 includes its own power supply.

The SC-2311 includes a user-configurable signal connection and interface scheme using panelettes. You can mount up to 18 panelettes, choosing different types of panelettes, including BNC, SMB, LEMO (B-Series), MIL-Spec, banana jack, thermocouple jack, 9-pin D-Sub connectors, rocker switches, toggle switches, momentary switches, potentiometers, and LEDs. You can connect each panelette to any I/O signal available in the SC-2311.



### INFO CODES

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sc2311  
5b

## 5B Series Backplanes

For applications requiring analog output conditioning modules, choose an 8-channel or 16-channel backplane.

You must provide power to the 5B Series backplanes from a 5 VDC power supply, available from NI. An optional rack-mount bracket is available for these backplanes, and it includes a space for a power supply.

| DAQ Device   | SC-2311 Shielded Carrier     | 5B 8-Channel and 16-Channel Backplanes           |                       |
|--|------------------------------|--|-----------------------|
|  |                              | Direct Cabling<br>(used with input modules only) | Using SC-205x Adapter |
| 68-pin E Series ( except DAQCards)                     | SH68-68-EP                   | 68F-50M MIO adapter and NB9 cable                | Page 349              |
| 100-pin E Series                                       | SH1006868                    | SH1006868, 68F-50M MIO adapter and NB9 cable     | Page 349              |
| Latching E Series DAQCards:<br>6062E, 6024E            | SHC6868-EP                   | Not Available                                    | Page 349              |
| Nonlatching E Series DAQCards:<br>AI-16E-4, AI-16XE-50 | PSHR68-68 Shielded Cable Kit | PSHR68-68M, 68F-50M MIO adapter and NB9 cable    | Page 349              |