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# SCXI Terminal Blocks

## SCXI Terminal Blocks

- Terminal blocks for quick, easy connections
- Strain-relief clamps for reliable wiring
- Connectivity options including BNC and thermocouple plugs
- Shielded front-mount terminal blocks
- Rack-mount and DIN-rail-mount options available
- Terminal block options for specific measurement types
- Onboard temperature sensor for cold-junction compensation
- Isothermal construction for high-accuracy thermocouple measurements
- High-voltage attenuation
- AC/DC coupling
- Bridge offset nulling, shunt calibration
- Current inputs



## Overview

National Instruments SCXI terminal blocks provide a convenient method for connecting and disconnecting signals to your system. The SCXI-13xx front-mount terminal blocks provide direct connections to transducers at the screw terminals located within a fully shielded enclosure or at front-mounted BNC connectors. Strain-relief clamps hold the signal wires safely in place. You can also choose either the TC-2095 or BNC-2095 rack-mount terminal blocks for minithermocouple connectors or BNC connectors. These terminal blocks are ideal solutions for large-channel-count temperature or voltage applications.

TBX DIN-rail mount terminal blocks are an alternative to the SCXI-13xx terminal blocks which, attach directly to the front of an SCXI module. The TBX system includes shielded cables that connect the front I/O connector of an SCXI module to a TBX terminal block.

Some terminal blocks are designed for specific input types, such as thermocouples, strain gauges, and high-voltage inputs. See Tables 1, 2, and 3 to determine which SCXI terminal blocks are compatible with your SCXI module.

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*Table 1. Terminal Block Configuration*

| Terminal Block | Compatible SCXI Modules | Cabling | CJC | Special Features |
|---|---|---|---|---|
| TBX-1303 | SCXI-1100, SCXI-1102, SCXI-1102B/C, SCXI-1181 | SH96-96 or R96-96 | ✔ | Open TC detection Isothermal construction, selectable ground referencing |
| TBX-1316 | SCXI-1120/D, SCXI-1125, SCXI-1126 | SH32-32-A | – | 200:1 attenuation (up to 1,000 VDC) |
| TBX-1325 | SCXI-1124 | SH48-48-A | – | High-voltage 250 VDC |
| TBX-1326 | SCXI-1162, SCXI-1162HV, SCXI-1163, SCXI-1163R | SH48-48-B | – | High-voltage 250 VDC |
| TBX-1328 | SCXI-1120, SCXI-1120D, SCXI-1121,SCXI-1125, SCXI-1126 | SH32-32-A | ✔ | Sockets for current input resistors, Isothermal construction, High-voltage 250 VDC |
| TBX-1329 | SCXI-1120, SCXI-1120D, SCXI-1121, SCXI-1125, SCXI-1126 | SH32-32-A | – | Selectable AC coupling (rejects up to 250 VDC) |
| TBX-96 | SCXI-1100, SCXI-1102, SCXI-1102B/C, SCXI-1104, SCXI-1181, SCXI-1104C | SH96-96 or R96-96 | – | – |
| TBX-24F | All modules | User-supplied wiring | – | – |
| CB-50 | SCXI-1180 | NB1 | – | – |

* The TBX-24F is a general-purpose feedthrough terminal block that you can use with any SCXI module or front mounting terminal blocks.

*Table 1. TBX Terminal Block Selection Guide*



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# SCXI Terminal Blocks



## TBX Terminal Block Selection Guide

Use the following steps to select the correct combination of TBX terminal blocks and cables for your SCXI system:

1. Select the required terminal blocks – for each SCXI module, use Table 1 to select the proper TBX terminal block. If a TBX-13xx terminal block is not available for your SCXI module, select the appropriate number of general-purpose TBX-24F feedthrough terminal blocks.
2. Select cabling – for each TBX terminal block, Table 1 lists the cable needed to connect the TBX terminal block to the SCXI module. Shielded cables are available in lengths of 1, 2, and 5 m. If using the TBX-1303, you also have the option to build a custom cable using the SBS-96F backshell kit. For each TBX-1303 for which you will build a custom cable, select two SBS-96F kits. If using the TBX-24F, you will use discrete wires to connect the TBX-24F to an SCXI front-mounting terminal block. Therefore, select the appropriate SCXI front-mounting terminal block for each SCXI module that will use the TBX-24F.
3. Rack-mount accessory (optional). If mounting for 19 in. rack enclosures is needed, use Table 2 to select the appropriate number of TBX-RM1 rack-mount kits.

| Terminal Block | Width Required (of TBX-RM1 Rack-Mount) |
|---|---|
| TBX-1303 | One-half |
| TBX-1325, TBX-1326, TBX-1328, TBX-1329, TBX-24F, CB-50 | One-third |

*Table 2. Rack-Mount Widths of TBX Terminal Blocks*

| Module | Terminal Blocks | CJC[1] Sensor | Other Terminal Block Functions |
|---|---|---|---|
| SCXI-1100 | SCXI-1303[2] | ✔ | Isothermal, signal ground referencing, and open thermocouple detection |
| SCXI-1102 | SCXI-1300 | ✔ | – |
| SCXI-1102B | SCXI-1308 | – | Current Input, 249 Ω resistor across each input |
| SCXI-1102C | BNC-2095 | – | BNC connectors, signal ground referencing |
| | TC-2095 | ✔ | Thermocouple plugs, signal ground referencing, Isothermal |
| SCXI-1104/C | SCXI-1300 | – | – |
| SCXI-1120 | SCXI-1305 | – | BNC connectors, AC/DC coupling and ground referencing |
| SCXI-1120D | SCXI-1320 | ✔ | – |
| SCXI-1126 | SCXI-1327 | ✔ | Extends signal input range to 250 $V_{rms}$, switch configurable per channel |
| | SCXI-1328 | ✔ | Isothermal, high-accuracy design for thermocouples |
| | SCXI-1338 | ✔ | Current Input, 249 Ω resistor across each input |
| SCXI-1125 | SCXI-1305 | – | BNC connectors, AC/DC coupling and ground referencing |
| | SCXI-1313 | ✔ | Extends signal input range to 300 $V_{rms}$, programmable per channel |
| | SCXI-1320 | ✔ | – |
| | SCXI-1327 | ✔ | Extends signal input range to 250 $V_{rms}$, switch configurable per channel |
| | SCXI-1328 | ✔ | Isothermal, high-accuracy design for thermocouples |
| | SCXI-1338 | ✔ | Current Input, 249 Ω resistor across each input |
| SCXI-1121 | SCXI-1320 | ✔ | – |
| | SCXI-1321 | ✔ | Offset nulling and shunt calibration for strain gauges |
| | SCXI-1327 | ✔ | Extends signal input range to 250 $V_{rms}$, switch configurable per channel |
| | SCXI-1328 | ✔ | Isothermal, high-accuracy design for thermocouples |
| | SCXI-1305 | – | BNC connectors, AC/DC coupling and signal ground referencing |
| SCXI-1122 | SCXI-1322 | ✔ | – |
| SCXI-1124 | SCXI-1325 | – | – |
| SCXI-1127 | SCXI-1331 | ✔ | – |
| SCXI-1128 | SCXI-1332 | – | Set up an 8 column by 4 row matrix |
| SCXI-1129 | SCXI-1333 | – | Configures SCXI-1129 as quad, 4 x 16 (2-wire) matrix |
| | SCXI-1334 | – | Configures SCXI-1129 as 4 x 64 (2-wire) matrix |
| | SCXI-1335 | – | Configures SCXI-1129 as 8 x 32 (2-wire) matrix |
| | SCXI-1336 | – | Configures SCXI-1129 as 16 x 16 (2-wire) matrix |
| | SCXI-1337 | – | Configures SCXI-1129 as a dual 8 x 16 (2-wire) matrix |
| | SCXI-1339 | – | Configures SCXI-1129 as a dual 4 x 32 (2-wire) matrix |
| SCXI-1140 | SCXI-1301 | – | – |
| | SCXI-1304 | – | AC/DC coupling and signal ground referencing (configurable per channel) |
| | SCXI-1305 | | BNC connectors, AC/DC coupling and signal ground referencing |
| SCXI-1141 | SCXI-1304 | – | AC/DC coupling and signal ground referencing (configurable per channel) |
| SCXI-1142 | SCXI-1305 | – | BNC connectors, AC/DC coupling and signal ground referencing |
| SCXI-1143 | | | |
| SCXI-1160 | SCXI-1324 | – | – |
| SCXI-1161 | – | – | Screw terminals located in module |
| SCXI-1162/HV | SCXI-1326 | – | – |
| SCXI-1163/R | | | |
| SCXI-1180 | SCXI-1302 | – | 50-Pin terminal block |
| SCXI-1181 | SCXI-1300 | ✔ | – |
| SCXI-1181K | SCXI-1301 | – | – |
| SCXI-1520 | SCXI-1314 | – | Quarter-bridge completion/shunt resister |
| SCXI-1540 | SCXI-1315 | – | – |
| SCXI-1581 | SCXI-1300 | – | – |

[1] Cold-junction compensation (CJC) sensor for thermocouple measurements.
[2] Recommended for thermocouples; includes isothermal design and high-precision CJC sensor.

*Table 3. SCXI-13xx, TC, and BNC Selection Guide*

| Module | Connector and Shell Assembly |
|---|---|
| SCXI-1100, SCXI-1102B/C, SCXI-1140, SCXI-1141, SCXI-1181 | SCXI-1310 |
| SCXI-1120, SCXI-1120D, SCXI-1121, SCXI-1126, and SCXI-1181 | SCXI-1330 |

*Table 4. Custom-Cabling Accessories*



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# SCXI Terminal Blocks



*Figure 1. SCXI-1303 Terminal Block*



*Figure 2. SCXI-1305 Terminal Block*



*Figure 3. SCXI-1310 Connector and Shell Assembly*

**SCXI-1300** .....777687-00
The SCXI-1300 connects input signals to the SCXI-1100, SCXI-1102/B/C, and SCXI-1104/C modules. The SCXI-1300 is a general-purpose terminal block with an onboard temperature sensor for cold-junction compensation. Also works with SCXI-1181 and SCXI-1181K modules.

**SCXI-1301** .....777687-01
20-screw terminal block for the SCXI-1140, SCXI-1181, and SCXI-1181K modules.

**SCXI-1302** .....777687-02
50-screw terminal block for SCXI-1180 feedthrough panel.

**SCXI-1303 (Figure 1)** .....777687-03
Terminal block for use with the SCXI-1100 and SCXI-1102/B/C modules. Designed especially for high-accuracy thermocouple measurements, the SCXI-1303 includes isothermal construction that minimizes errors caused by thermal gradients between terminals and the cold-junction sensor. The SCXI-1303 also includes circuitry for open-thermocouple detection as well as automatic ground referencing for floating (nongrounded) thermocouples.

**SCXI-1304** .....777687-04
The SCXI-1304, for the SCXI-114x modules, includes AC coupling circuitry, with switches on each channel. Each channel also includes a switchable connection to ground through a 100 kΩ bias resistor to provide a reference for floating input sources.

**SCXI-1305 (Figure 2)** .....777687-05
Includes convenient BNC connectors for use with the SCXI-1120/D, SCXI-1121, SCXI-1125, SCXI-1126, and SCXI-114x. Functionally equivalent to the SCXI-1304 terminal block, the SCXI-1305 includes switchable AC coupling circuitry and ground referencing on each channel.

**SCXI-1308** .....777687-08
Current input terminal block for the SCXI-1100 and SCXI-1102/B/C analog input modules. Each input includes a 249 Ω precision resistor, so you can read 0 to 20 mA and 4 to 20 mA current inputs.

**SCXI-1310 (Figure 3)** .....777687-10
Connector and shell assembly used to create custom cabling solutions from the SCXI-1100, SCXI-1102/B/C, SCXI-1104/C, SCXI-114x, and SCXI-1181 to custom terminations. A low-cost alternative to SCXI terminal blocks, it consists of a hardened plastic enclosure and one connector with solder pins for signal connections.

**SCXI-1313** .....777687-13
Extends the input range of the SCXI-1125 to 300 $V_{rms}$ or 300 VDC, on a per-channel basis programmatically through software commands. The SCXI-1313 also includes an onboard temperature sensor for thermocouples cold-junction compensation.

**SCXI-1314** .....777687-14
Front-mounting terminal block for the SCXI-1520 module. With factory-installed and socketed 350 Ω quarter-bridge completion resistors for each channel. Eight 120 Ω resistors for use with 120 Ω quarter-bridge strain gauges are included, but not installed. It also includes two factory-installed, socketed 100 kΩ shunt calibration resistors per channel.



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# SCXI Terminal Blocks



**SCXI-1315**.....777687-15
8-channel front-mounting terminal block for the SCXI-1540 LVDT with six terminals for each LVDT channel – CH+, CH-, EX+, EX-, Synch, and GND.

**SCXI-1320 (Figure 4)** .....777687-20
General-purpose terminal block for connecting signals to the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules. It includes an onboard temperature sensor for cold-junction compensation using thermocouples, but the SCXI-1328 is recommended for precision thermocouple measurements.



*Figure 4. SCXI-1320 Terminal Block*

**SCXI-1321 (Figure 5)** .....777687-21
Adds nulling and shunt calibration to SCXI-1121 strain guage applications. With a front-panel trimming potentiometer, you can manually null out the offset voltage of bridge transducers. Each channel includes shunt calibration circuits. When activated, a switch connects a 301 kΩ shunt resistor in parallel with the strain gauge. Both the nulling resistor and the shunt resistor are socketed for easy customization.



*Figure 5. SCXI-1321 Terminal Block*

**SCXI-1322**.....777687-22
Terminal block required to connect signals to the SCXI-1122 module that includes an onboard temperature sensor for cold-junction compensation.

**SCXI-1324**.....777687-24
High-voltage terminal block with 48 screw terminals for the SCXI-1160 relay module.

**SCXI-1325**.....777687-25
26-screw terminal block for the SCXI-1124 module.

**SCXI-1326**.....777687-26
High-voltage terminal block with 48 screw terminals for the SCXI-1162 Series and SCXI-1163 Series modules.



*Figure 6. SCXI-1327 Terminal Block*

**SCXI-1327 (Figure 6)** .....777687-27
With the SCXI-1327 (Figure 6) you can extend the input range of the SCXI-1120/D and SCXI-1121 to ±250 V, and extend the threshold level of the SCXI-1126 module from 5 V up to 300 V. The extended input voltage range is enabled or disabled on a per-channel basis using switches located within the SCXI-1327. The SCXI-1327 also includes an onboard temperature sensor for cold-junction compensation with thermocouples. Using the SCXI-1327 reduces the input impedence of your SCXI module to 1 MΩ.



*Figure 7. SCXI-1328 Terminal Block*

**SCXI-1328 (Figure 7)** .....777687-28
Isothermal terminal block with a high-precision cold-junction sensor for high-accuracy thermocouple applications with the SCXI-1120/D, SCXI-1121, or SCXI-1125.

**SCXI-1330**.....777687-30
Connector and shell assembly (hardened plastic enclosure and solder pins) used to create custom cabling solutions from the SCXI-1120/D, SCXI-1121, SCXI-1125, SCXI-1126, and SCXI-1181 to custom terminations.





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# SCXI Terminal Blocks



*Figure 8. SCXI-1331Terminal Block*

**SCXI-1331 (Figure 8)** .....777687-31
General-purpose terminal block for the SCXI-1127 multiplexer/matrix module with 64 generic screw terminals and a cold-junction compensation sensor. For SCXI-1127 multiplexer applications or matrix configurations other than a multiple of 8 columns by 4 rows. Includes sockets for matrix expansion cables.

**SCXI-1332 (Figure 9)** .....777687-32
Multiplexer/matrix terminal block for the SCXI-1127 configures the SCXI-1127 as an 8 column by 4 row switching matrix. You can connect signals to both the columns and rows using screw terminals.



*Figure 9. SCXI-1332 Terminal Block*

**SCXI-1333** .....777687-33
**SCXI-1334** .....777687-34
**SCXI-1335** .....777687-35
**SCXI-1336** .....777687-36
**SCXI-1337** .....777687-37
**SCXI-1339** .....777687-39
These terminal blocks are designed for use with the SCXI-1129 high-density matrix switching module. Each of these terminal blocks gives the high-density matrix a different configuration. See page 486 for more information on how to choose the appropriate series of terminal blocks for the SCXI-1129.



*Figure 10. BNC-2095*

**SCXI-1338** .....777687-38
Current input terminal block for the SCXI-1120/D, SCXI-1125, and SCXI-1126. Each input includes a 249 Ω precision resistor for reading 0 to 20 mA or 4 to 20 mA current inputs.

**BNC-2095 (Figure 10)** .....777508-01
The BNC-2095 has 32 labeled BNC connectors, one for each input channel of the SCXI-1100, or SCXI-1104/C. The BNC-2095 also includes circuitry for configurable signal referencing. You can enable or disable both the pull-up and pull-down resistors on a per-channel basis using switches.

**TC-2095** .....777509-01
The TC-2095 has 32 miniature uncompensated thermocouple plugs, one for each input channel of the SCXI-1100 or SCXI-1102/B/C and a thermistor for accurate cold-junction compensation. In addition, the TC-2095 includes circuitry for configurable signal referencing. You can enable or disable both the pull-up and pull-down resistors on a per-channel basis using switches located on the rear of the TC-2095. The TC-2095 is not recommended for use with the SCXI-1104/C. The TC-2095 requires the SH96-96 or R96-96 for connection to a SCXI module.





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# SCXI TBX Terminal Blocks



**TBX-1303 (Figure 11)** .....777207-03
Designed for thermocouples, with isothermal construction with a plastic cover to minimize thermal gradients, open-thermocouple detection circuitry, and automatic ground-referencing circuitry. With the SCXI-1102B/C, the TBX-1303 provides a high-impedance path to ground, so that systems work reliably with either floating or ground-referenced thermocouples. For applications with the SCXI-1100, you can configure the channels as ground-referenced or floating in blocks of eight channels. The TBX-1303 also works with the SCXI-1181 breadboard module.

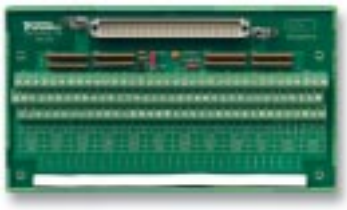


*Figure 11. TBX-1303*

**TBX-96**.....777264-01
Mass termination terminal block that provides a generic solution for the SCXI-1100, SCXI-1102B/C, SCXI-1104/C, and the SCXI-1140 Series.

**TBX-1316 (Figure 12)** .....777207-16
High-voltage terminal block, for extending the input range of the SCXI-1120/D, SCXI-1125, or SCXI-1126 modules to ±1000 VDC (680 $V_{rms}$) Each input channel includes a 200:1 attenuation circuit, and offers a positive, negative, and ground terminal for up to 12 AWG wire. You can panel mount this enclosure or simply place it on a desktop. The hinged lid makes accessing the signals easier and key locked for safety. The TBX-1316 is rated for Category III installations.



*Figure 12. TBX-1316*

**TBX-1325** .....777207-25
Terminal block with 30 screw terminals for signal connections to the SCXI-1124 module. You cable the TBX-1325 to the SCXI-1124 with the SH48-48-A shielded cable.

**TBX-1326 (Figure 13)** .....777207-26
High-voltage terminal block with 48 screw terminals for signal connections to the SCXI-1162, SCXI-1162HV, SCXI-1163, and SCXI-1163R modules. You can cable the TBX-1326 to the SCXI module with the SH48-48-B shielded cable. Warning: The TBX-1326 and SH48-48-B limit the maximum working common-mode voltage between banks or between banks and earth ground to 250 $V_{rms}$ maximum.



*Figure 13. TBX-1326*

**TBX-1328 (Figure 14)** .....777207-28
Terminal block for the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules. The TBX-1328 includes a total of 24 screw terminals, including three terminals (CH+, CH-, and chassis ground) for each input channel and sockets for the installation of resistors for 4 to 20 mA inputs. When used with thermocouples, the TBX-1328 maximizes measurement accuracy with an isothermal construction and a plastic cover that minimizes thermal gradients across the terminal block and the resulting errors.



*Figure 14. TBX-1328*

**TBX-1329 (Figure 15)** .....777207-29
Provides selectable AC coupling for the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules.

**TBX-24F** .....777276-01
The TBX-24F is a general-purpose screw terminal block with feedthrough connections for 24 signal lines. You connect the TBX-24F to the SCXI module with discrete wires connected to a standard SCXI terminal block.



*Figure 15. TBX-1329*





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# SCXI-13xx, TBX, and BNC/TC Terminal Block Specifications

## Specifications

### SCXI-13xx

Typical for 25 °C unless otherwise noted.

**Cold-Junction Sensor**

Accuracy and repeatability[1]

| Terminal Block | Accuracy | | Repeatability |
|---|---|---|---|
| | 15 to 35 °C | 0 to 15 °C and 35 to 55 °C | |
| SCXI-1300 | 1.3 °C | 1.3 °C | 0.5 °C |
| SCXI-1303[2] | 0.5 °C | 0.85 °C | 0.35 °C |
| SCXI-1320 | 1.3 °C | 1.3 °C | 0.5 °C |
| SCXI-1321 | 1.3 °C | 1.3 °C | 0.5 °C |
| SCXI-1322 | 0.8 °C | 1.2 °C | 0.4 °C |
| SCXI-1327 | 0.9 °C | 1.3 °C | 0.5 °C |
| SCXI-1328 | 0.5 °C | 0.9 °C | 0.2 °C |

Sensor output
- SCXI-1300, SCXI-1320, SCXI-1321 ..... ±10 mV/°C
- SCXI-1303/1322/1327/1328..... 1.91 V (at 0 °C) to 0.58 V (at 55 °C) (thermistor)

Maximum field wire gauge
- SCXI-1300/1302/1303/1314/1322/1324 ..... 26-16 AWG
- SCXI-1301/1304/1313/1315/1320/1321/1325/1327/1328/1331/1332 ..... 26-14 AWG

AC coupling (SCXI-1304 and SCXI-1305)

The AC coupling circuitry on each channel has a corner frequency of 0.16 Hz, rejection capacity of ±50 VDC, and input impedance of 2 MΩ differential, 1 MΩ common mode.
- Corner frequency..... 0.16 Hz 1-pole RC
- DC rejection capacity..... ±50 VDC

Current input SCXI-1308 and SCXI-1338 ..... 0 to 20 mA

### BNC-2095, TC-2095

Input connectors
- BNC-2095 ..... 32 BNC connectors
- TC-2095 ..... 32 thermocouple plugs, uncompensated

Output (to SCXI module) ..... 96-pin DIN

Cold-junction sensor (TC-2095)
- Output ..... 1.91 V (0 °C) to 0.58 V (55 °C)
- Accuracy (15 to 35 °C)[3] ..... 0.5 °C for SCXI-1102/B/C; 0.65 °C for SCXI-1100
- Repeatability (15 to 35 °C)[3] ..... 0.35 °C for SCXI 1102/B/C; 0.5 °C for SCXI-1100

Signal referencing
- CH+ input ..... 10 MΩ to +5 V, user switchable
- CH- input ..... 10 MΩ or +10 Ω to ground, user switchable 1-pole RC

**Physical**

Dimensions ..... 49.3 x 4.3 x 18.8 cm (19.0 by 1.7 by 7.4 in.)

### TBX Series

Typical for 25° C unless otherwise noted.

Maximum working voltage (signal + common mode)
- TBX-1316 ..... 1000 VDC, 680 $V_{rms}$
- TBX-1325 ..... 250 $V_{rms}$
- TBX-1326/1328/1329/24F ..... 300 $V_{rms}$

Signal referencing on TBX-1303
- CH+ input ..... 10 MΩ to +5 V (socketed)
- CH- input ..... 10 MΩ or 10 Ω to ground (user configurable, socketed)

Input Inpedance for TBX-1316
- Differential ..... 40 MΩ
- Single-Ended..... 20 MΩ

Absolute accuracy for TBX-1316
- Gain error..... 1%
- Temperature drift..... 20 ppm/°C

AC Coupling (TBX-1329 only)
- Corner frequency..... 0.072 Hz 1-pole RC
- DC rejection capacity..... 250 VDC

Wire resistance of cables ..... 0.21 Ω/m per conductor

**Cold-Junction Sensor (TBX-1303 and TBX-1328)**

Accuracy and repeatability[4]

| Terminal Block | Accuracy | | Repeatability |
|---|---|---|---|
| | 15 to 35 °C | 0 to 15 °C and 35 to 55 °C | |
| TBX-1303[3] | 0.5 °C | 0.85 °C | 0.35 °C |
| TBX-1328 | 0.5 °C | 0.9 °C | 0.2 °C |

Sensor output ..... 1.91 V (at 0 °C) to 0.58 V (at 55 °C) (thermistor)

## General

**Physical**

Compatible DIN rails[5] ..... DIN EN 50 022, DIN EN 50 035

Screw terminal size
- TBX-1316..... 26-12 AWG
- Others..... 26-14 AWG

**Dimensions**
- TBX-1303[6]..... 19.7 by 11.2 by 7.62 cm (7.8 by 4.4 by 3.0 in.)
- TBX-1316 ..... 30 by 20 by 8.1 cm (11.8 by 7.9 by 3.2 in.)
- TBX-1325/1326/1328/1329[6]..... 12.7 by 11.2 by 7.62 cm (5.0 by 4.4 by 3.0 in.)
- TBX-24F ..... 12.4 by 4.3 by 5.1 cm (4.9 by 1.7 by 2.0 in.)
- TBX-96 ..... 19.8 by 12.6 by 6.3 cm (7.8 by 4.9 by 2.5 in.)

**Certification and Compliance**
- SCXI-1320/1321/1326/1327/1328/1338 ..... 300 V, Cat II working voltage
- SCXI-1322/1324/1325 ..... 250 V, Cat II working voltage
- TBX-1316 ..1000 V, Cat III working voltage
- TBX-1328/1329 ..... 300 V, Cat II working voltage
- TBX-1325/1326 ..... 250 V, Cat II working voltage

**European Compliance**
- EMC ..... EN 61326 Group I Class A, 10 m, Table 1 Immunity
- Safety ..... EN 61010-1

**North American Compliance**
- EMC ..... FCC Part 15 Class A using CISPR
- Safety (SCXI-1320/1321/1326/1327/1328/1338/SCXI-1322/1324/1325) ..... UL Listed to UL 3111-1 CAN/CSA C22.2 No. 1010.1
- Safety (TBX-1325/1326/1328/1329) ..... UL Listed to UL 3111-1 CAN/CSA C22.2 No. 1010.1

**Australia and New Zealand Compliance**
- EMC (except TBX-1316) ..... AS/NZS 2064.1/2 (CISPR-11)

[1] Accuracy and repeatability include combined effects of sensor, circuitry, and thermal gradients between the sensor and any screw terminal. Thermal gradients for nonisothermal terminal blocks (SCXI-1300, SCXI-1320, SCXI-1321, SCXI-1322, and SCXI-1327) are assumed to be 0.4 °C.

[2] With SCXI-1102 module. With SCXI-1100 module, add error of 0.15 °C

[3] Accuracy and repeatability include combined effects of sensor, circuitry, and thermal gradients between the sensor and thermocouple connection.

[4] Accuracy and repeatability include combined effects of sensor, circuitry, and thermal gradients between the sensor and any screw terminal.

[5] TBX-1316 is not DIN-rail mountable

[6] Height dimension (7.62 cm) includes DIN-rail mounting and plastic cover.



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# Accuracy Specifications for Signal Conditioning



## Every Measurement Counts

There is little room for error in your measurements. From sensor to software, your system must deliver accurate results. NI provides detailed specifications for our products so that you do not have to guess how they perform. Along with traditional specifications, our signal conditioning products include accuracy tables to assist you in selecting the appropriate hardware for your application. These tables are found on the specification pages for each product.

## Absolute Accuracy

Absolute accuracy is the specification you must use to determine the overall maximum possible error of your measurement. Absolute accuracy does assume your signal conditioning equipment has been calibrated within the last year. There are four main components of an absolute accuracy specification:

- % of Reading is an uncertainty factor that is multiplied by the actual imput voltage for the measurement
- Offset is a constant value applied to all measurements
- System Noise is based on noise and depends on the number of points averaged for each measurement
- Temperature Drift is based on variations in your ambient temperature.

Absolute Acuracy RTI stands for relative to the input

Based on these components, the formula for calculating absolute accuracy for a given module is:

Absolute Accuracy = (Actual Input Voltage x % of Reading)
+ Offset + System Noise + Temperature Drift

Absolute Accuracy RTI = ±(Absolute Accuracy/Actual Input Voltage)

Temperature effects are already taken into account unless your ambient temperature is outside of the 15 to 35 °C range. For instance, if your ambient temperature is at 45 °C, you must account for 10 °C of drift. This is calculated by:

Temperature Drift = ± (Actual Input Voltage x % of Reading/°C + Offset/°C)
x Temperature Difference

Below is an example for calculating the absolute accuracy for the SCXI-1102 using the ±100 mV input range while averaging 100 samples of a 14 mV input signal. In this calculation, we assume the ambient temperature is between 15 and 35 °C, so Temperature Drift = 0. Using the accuracy table on pge 262, you find the following numbers for the calculation:

Actual Input Voltage = 0.014
Percent of Reading Max = 0.02% = 0.0002
Offset = 0.000025 V
System Noise = 0.000005 V

Absolute Accuracy = ±[(0.014 x 0.0002) + 0.000025 + 0.000005] V = ±32.8 µV

Absolute Accuracy RTI = ±(0.0000328 / 0.014) = ±0.234 %

The following example assumes the same conditions, except the ambient temperature is 40 °C. You can begin with the Absolute Accuracy calculation above and add in the Temperature Drift.

Absolute Accuracy = 32.8 µV + (0.014 x 0.000005 + 0.000001) x 5 = ±38.15 µV



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# Accuracy Specifications for Signal Conditioning

In many cases, it is helpful to calculate this value relative to the input (RTI). Therefore, you do not have to account for different input ranges at different stages of your system.

Absolute Accuracy RTI = ±(0.00003815 / 0.014) = ±0.273 %

If you are making single-point measurements, use the Single-Point System Noise specification from the accuracy table. If you are averaging multiple points for each measurement, the value for System Noise changes. The Average System Noise provided in the accuracy table assumes that you average 100 points per measurement. If you are averaging a different number of points, use the following equation to determine your system noise:

System Noise = Average System Noise from table x
SQRT(100/number of points)

For example, if you are averaging 1,000 points per measurement with the SCXI-1102 in the ±100 mV range, the system noise is determined by:

System Noise = 5 µV x SQRT (100/1000) = 1.58 µV

## Absolute System Accuracy

Absolute System Accuracy represents the end-to-end accuracy including the signal conditioning and DAQ device. Because absolute system accuracy includes components set for different input ranges, it is important to use Absolute Accuracy RTI numbers for each component. See page 194 for information on how to calculate the Absolute Accuracy RTI for your particular DAQ device.

Total System Accuracy RTI = ±SQRT [(Module Absolute Accuracy RTI)$^2$
+ (DAQ Device Absolute Accuracy RTI)$^2$]

The following example calculates the Absolute System Accuracy for the SCXI-1102 described in the first example, and a PCI-MIO-16XE-50 with an Absolute Accuracy RTI of 0.00368%.

Total System Accuracy RTI = ±SQRT [(0.00273)2 + (0.00003682)] = ±0.273%

## Units of Measure

In many applications, you are measuring some physical phenomenon, such as temperature. To determine the absolute accuracy in terms of your unit of measure, you must perform three steps:

(1) Convert a typical expected value from the unit of measure to voltage
(2) Calculate absolute accuracy for that voltage
(3) Convert absolute accuracy from voltage to the unit of measure

Note, it is important to use a typical measurement value in this process, because many conversion algorithms are not linearized. You may want to perform conversions for several different values in your probable range of inputs.

For an example calculation, we want to determine the absolute system accuracy of an SCXI-1102 system with a PCI-MIO-16XE-50, measuring a J-type thermocouple at 100 °C.

(1) A J-type thermocouple at 100 °C generates 5.268 mV (from a standard conversion table or formula)
(2) The absolute accuracy for the system at 5.268 mV is ±0.59%. This means the possible voltage reading is anywhere from 5.237 to 5.299 mV.
(3) Using the same thermocouple conversion table, these values represent a temperature spread of 99.4 to 100.6 °C.

Therefore, the absolute system accuracy is ±0.6 °C at 100 °C.

## Benchmarks

The calculations described above represent the maximum error you should receive from any given component in your system, and a method for determining the overall system error. However, you typically have much better accuracy values than what you obtain from these tables.

If you need an extremely accurate system, you can perform an end-to-end calibration of your system to reduce all system errors. However, you must calibrate this system with your particular input type over the full range of expected use. Accuracy depends on the quality and precision of your source.

We have performed some end-to-end calibrations for some typical configurations and achieved the results below:

| Module | Empirical Accuracy |
|---|---|
| SCXI-1102 | ±0.25 °C at 250 °C<br>±24 mV at 9.5 V |
| SCXI-1112 | ±0.21 °C at 300 °C |
| SCXI-1125 | ±2.2 mV at 2 V |

*Table 1. Possible Empirical Accuracy with System Calibration*

To maintain your measurement accuracy, you must calibrate your measurement device at set intervals. Calibration improves your accuracy and ensures that your end product meets its required specifications. We are continually updating the calibration services available for our products. For a current list of SCXI signal conditioning products with calibration services, please visit ***ni.com/calibration***





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