SCXI Universal Strain Gage Input

NI SCXI-1520

- 8 simultaneously sampled analog input channels
- Programmable excitation (0 to 10 V) per channel
- Programmable gain (1 to 1000) per channel
- Programmable 4-pole Butterworth filter (10 Hz, 100 Hz, 1 kHz, 10 kHz) per channel
- Quarter-, half-, and full-bridge completion
- 2 shunt calibration circuits per channel
- Remote sensing
- Random scanning
- Onboard calibration reference
- NI-DAQ driver software simplifies configuration, offset nulling, shunt calibration, scaling, and measurement

Operating Systems
- Windows XP/2000/NT

Recommended Software
- LabVIEW
- LabWindows™/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQ 7.0

Calibration Certificate (included)
ni.com/calibration

Overview

The NI SCXI-1520 is an 8-channel universal strain gage input module that offers all of the features you need for simple or advanced strain- and bridge-based sensor measurements. With this single module, you can read signals from strain, load, force, torque, and pressure sensors. Each SCXI-1520 is shipped with a NIST-traceable calibration certificate, and includes an onboard reference for automatic calibration in changing environments.

For accurate strain measurements, the SCXI-1520 offers a programmable amplifier and programmable 4-pole Butterworth filter on each channel. Each channel also has an independent 0 to 10 V programmable excitation source with remote sense per channel. In addition, the SCXI-1520 system offers a half-bridge completion resistor network in the module and a socketed 350 Ω quarter-bridge completion resistor in the SCXI-1314 terminal block. A 120 Ω quarter-bridge completion resistor is also included with the terminal block. The SCXI-1520 offers an automatic null compensation circuit, remote sensing, and two shunt calibration circuits per channel. In addition, the SCXI-1520 includes the simultaneous sample-and-hold feature using track-and-hold (T/H) circuitry for simultaneous sampling applications.

Each SCXI-1520 can multiplex its signals into a single channel of the controlling data acquisition device, and you can add modules to increase channel count. In NI-DAQ 7.0, parallel mode operation is available for high-speed acquisitions. In this mode, each channel is routed to a unique analog input channel of the data acquisition device to which it is cabled. Parallel mode is not available in NI-DAQ Traditional (Legacy).

Analog Input

Each of the eight SCXI-1520 analog inputs consists of a programmable instrumentation amplifier, 4-pole Butterworth filter, and simultaneous sample-and-hold circuit.You can program the gain of each channel individually to one of 49 input ranges from ±10 mV to ±10 V. You can also program each lowpass filter individually for 10 Hz, 100 Hz, 1 kHz, 10 kHz, or bypass mode. The 4-pole Butterworth filters provide a sharp cutoff to block noise while maintaining maximum flatness in the passband. Finally, the SCXI-1520 provides random scanning capability, so you acquire data from the channels you select in any order, thereby reducing your overall scan times. For applications requiring fewer than eight strain gages, you can use the extra analog input channels for general-purpose analog signals.

Simultaneous Sampling

Each SCXI-1520 channel includes T/H circuitry so you can digitize simultaneous events with negligible skew time between channels. The outputs of the T/H amplifiers follow their inputs until they receive a hold signal from the data acquisition device (typically at the start of a scan). At the hold signal, the T/H amplifiers simultaneously freeze, holding the input signal levels constant. The data acquisition device then digitizes each frozen signal sequentially, giving you simultaneous sampling between channels.

Module	Quarter-Bridge (120 Ω, 350 Ω)	Half-Bridge (120 Ω, 350 Ω)	Full-Bridge (120 Ω, 350 Ω)	Force, Load, Torque, Pressure
SCXI-1520	✓	✓	✓	✓

Table 1. Signal Compatibility

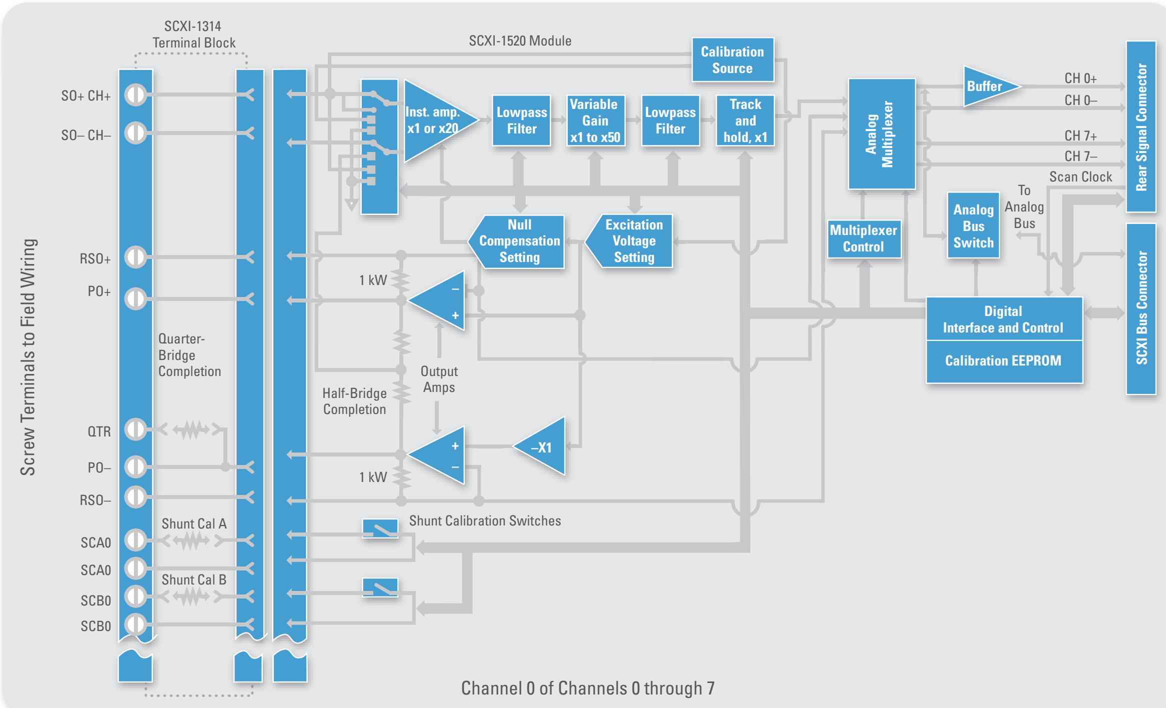

Figure 1. SCXI-1520 Block Diagram

Excitation

All SCXI-1520 channels have an independent voltage excitation source. You can program each excitation channel to one of 17 voltage excitation levels from 0 to 10 V. These sources can drive a 350 Ω full bridge to the maximum 10 V level. Each excitation channel incorporates remote sensing circuitry to automatically compensate for voltage drops due to lead resistance. This circuitry corrects the excitation level on the fly so the programmed excitation level is accurately applied at the sensor. You can also monitor these excitation sources to detect open or fault situations.

Strain Gage	Quarter-Bridge	Half-Bridge	Full-Bridge
120 Ω	6.25 V	6.9 V	3.125 V
350 Ω	10.00 V	10.0 V	10.000 V

Table 2. Excitation Values

Automatic Null Compensation

Each input channel of the SCXI-1520 includes a circuit to remove bridge offset voltage. Driver software nulls the offset voltage to zero in seconds. You do not need to manually adjust a potentiometer. By removing this offset through the measurement hardware, you can increase your system gain to achieve better measurement sensitivity and resolution.

Bridge Completion

The SCXI-1520 accepts quarter-, half-, and full-bridge sensors. Half-bridge completion is provided in the SCXI-1520, and you can enable it through software. The RN-55 style quarter-bridge completion resistors are provided in the SCXI-1314 front-mounting terminal block. They are socketed, so you can replace them with your own resistors.

Shunt Calibration

Each input channel of the SCXI-1520 includes two independent shunt calibration circuits, with which you can simulate two separate loading effects on your strain-based device and compensate for any possible gain errors. The RN-55 style shunt calibration resistors are in sockets and located in the SCXI-1314 front-mounting terminal block. You enable or disable the shunt resistors through software commands.

Calibration

The SCXI-1520 provides simple yet powerful calibration capabilities. Each module includes a precision onboard calibration source, which you can programmatically route to any analog input channel. By using simple software commands, you perform calibrations to compensate for environmental changes without connecting external hardware. Each module has an onboard calibration EEPROM that stores calibration constants for each channel; factory calibration constants are stored in a protected area of the EEPROM. Additional user-modifiable locations mean calibration can occur under your exact operating conditions. NI-DAQ Traditional (Legacy) and NI-DAQ 7.0 transparently use the calibration constants to correct for gain and offset errors for each channel.

Terminal Block	Type	CJ Sensor	Compatible Modules	Cabling	Special Functions
SCXI-1314 (777687-14)	Screw terminals	–	SCXI-1520 Front-mounting	–	Quarter-bridge completion

Table 3. Terminal Block Options for the SCXI-1520

Ordering Information

NI SCXI-1520 777966-20

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For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/scxi**.

Specifications

Typical for 25 °C unless otherwise noted.

Complete Accuracy Table, Voltage

					System Noise (peak, 3 sigma)[1]		Temperature Drift	
Module	Nominal Range[1]	Overall Gain[1]	Percent of Reading[1]	Offset[1]	Single Point	100-Point Average	Gain Drift (%/°C)	Offset (µV/°C)
SCXI-1520	±10.0 V	1.0	±0.1	±3.0 mV	10.0 mV	1.0 mV	±0.03	±25
	±5.0 V	2.0	±0.1	±1.5 mV	5.0 mV	0.5 µV	±0.03	±25
	±1.8 V	4.2	±0.1	±0.5 mV	2.0 mV	0.2 mV	±0.03	±25
	±1.0 V	10.0	±0.1	±0.3 mV	1.0 mV	0.1 mV	±0.03	±25
	±500.0 mV	20.0	±0.1	±150.0 µV	0.5 mV	50.0 µV	±0.03	±5
	±180.0 mV	42.0	±0.1	±75.0 µV	0.2 mV	20.0 µV	±0.03	±5
	±100.0 mV	100.0	±0.1	±50.0 µV	100.0 µV	10.0 µV	±0.03	±5
	±50.0 mV	200.0	±0.1	±50.0 µV	50.0 µV	5.0 µV	±0.03	±5
	±18.0 mV	420.0	±0.1	±50.0 µV	20.0 µV	2.0 µV	±0.03	±5
	±10.0 mV	1000.0	±0.1	z±50.0 µV	20.0 µV	2.0 µV	±0.03	±5

[1]Absolute Accuracy (15 to 35 °C). Absolute accuracy is (voltage reading) x (% of reading) + (offset error) + (system noise). To include the effects of temperature drift outside the range 15 to 25 °C, add the term ΔT x (gain drift) x (range) + ΔT x (offset drift), where ΔT is the temperature difference between the module temperature and 15 or 35 °C, whichever is smaller. Bandwidth setting is 10 Hz and scan rate for 100-point averages is 200 scans/s. Excitation is set to zero volts. To calculate the absolute accuracy for the SCXI-1520, visit **ni.com/accuracy**.

Complete Accuracy Table, Strain, GF = 2.0, Excitation = 5 V

						System Noise (peak, 3 sigma)[1]		Temperature Drift	
Module	Bridge	Range	Gain	Percent of Reading[1]	Hardware Nulling Range	Single Point	100-Point Average	Gain Drift (%/°C)	Offset (µε/°C)
SCXI-1520	Quarter-bridge	±40,000 µε	100	±0.1	±80,000 µε	±40 µε	±4 µε	±0.03	±80
		±7,000 µε	560	±0.1	±80,000 µε	±7 µε	±2 µε	±0.03	±16
		±4,000 µε	1000	±0.1	±80,000 µε	±4 µε	±1 µε	±0.03	±8
	Half-bridge	±2,500 µε	1000	±0.1	±40,000 µε	±2 µε	±0.5 µε	±0.03	±4
	Full-bridge	±1,250 µε	1000	±0.1	±20,000 µε	±1 µε	±0.2 µε	±0.03	±2

[1]Absolute Accuracy (15 to 35 °C). Absolute accuracy is (voltage reading) x (% of reading) + (offset error) + (system noise). To include the effects of temperature drift outside the range 15 to 25 °C, add the term ΔT x (gain drift) x (range) + ΔT x (offset drift), where ΔT is temperature difference between the module temperature and 15 or 35 °C, whichever is smaller. Bandwidth setting is 10 Hz and scan rate for 100-point averages is 200 scans/s. To calculate the absolute accuracy for the SCXI-1520, visit **ni.com/accuracy.**

Analog Input Characteristics

Number of channels 8
Voltage gain settings .... X1 to X1000 with the following gain settings: 1; 1.15; 1.3; 1.5; 1.8; 2; 2.2; 2.4; 2.7; 3.1; 3.6; 4.2; 5.6; 6.5; 7.5; 8.7; 10; 11.5; 13; 15; 18; 20; 22; 24; 27; 31; 36; 42; 56; 65; 75; 87; 100; 115; 130; 150; 180; 200; 220; 240; 270; 310; 360; 420; 560; 650; 750; 870; 1,000
Input signal ranges .... See Complete Accuracy table
Input coupling .... DC
Maximum working voltage .... Either input should remain within ±10 V of ground. Both inputs should be within ±10 V of one another.
Overvoltage protection .... ±35 V powered on, ±25 V powered off
Inputs protected .... <0...7>

Transfer Characteristics

Nonlinearity... Better than 0.02%
Gain error .... ±.35% of setting, +0.1% of EEPROM value

Offset error
  Gain>20... 150 µV maximum
  Gain<20... 3 mV maximum

Amplifier Characteristics

Input impedance (DC).......................... >1 G
Input bias current .... ±20 nA maximum
Input offset current .... ±20 nA maximum
Output range .... ±10 V
Output impedance
  Parallel 200
  Mux 91

NMR (Normal-Mode Rejection Ratio)

Filter	NMR at 60 Hz
10 Hz	-62 dB typical

CMRR (Common-Mode Rejection Ratio)

Gain	CMRR DC to 60 Hz
<20	60 dB
≥20	85 dB

Dynamic Characteristics

Multiplexer performance

	Scan Interval (Per Channel, Any Gain and Multiplexed Mode)		
Module	Settle to ±0.0125%	Settle to ±0.006%	Settle to ±0.0015%
SCXI-1520	3 µs	10 µs	20 µs

System noise....................................... Complete Accuracy table
Noise RTI, gain=200, 0.1 to 10 Hz ...... 2.0 μV_{pp}
Spot noise RTI, gain=200, 1000 Hz..... $16\ nV/\sqrt{Hz}$

Filter Characteristics

Lowpass filter type	4-pole Butterworth (24 dB octave rolloff)
Lowpass filter settings	10 Hz, 100 Hz, 1 kHz, 10 kHz, or bypass
Bandwidth, filter bypassed	-3 dB at 20 kHz

Track and Hold Characteristics

Hold mode settle time	1 µs typical
Interchannel skew	±200 ns typical
Intermodule skew	±250 ns typical
Droop rate	30 mV/s typical, 100 mV/s maximum

Analog Input Stability

Recommended warm-up time	15 minutes
Gain drift	±40 ppm/°C maximum
Offset drift	
Gain≥20	±2 µV/°C typical, ±5 µV/°C maximum
Gain<20	±10 µV/°C typical, ±25 µV/°C maximum

Null Compensation Characteristics

Range	±4% of excitation voltage, 20,000 counts of resolution (±80,000 µε, 4 µε resolution for quarter-bridge, GF = 2.0)

Excitation Characteristics

Type	Constant voltage
Settings	0.0 to 10.0 V in 0.625 V increments
Error	±20 mV +.3% absolute ±0.1% of EEPROM setting
Short circuit current limit	50 mA minimum
Regulation, no load to 120 Ω load	
With remote sense	±0.003%
Without remote sense	±0.08%
Temperature Drift	±0.005%/°C ±30 µV/C maximum
Noise	DC to 10 kHz: 200 µV
Remote sense	Error less than ±0.02%/ Ω of lead resistance, both leads
Protection	Surge arrestors in parallel with excitation terminals, shunt to ground

Bridge Completion[1]

Half-bridge	5 kΩ precision resistor network internal to module
Quarter-bridge	Resistor in SCXI-1314 accessory terminal block

Shunt Calibration[2]

Type	2 independent points
Resistor	In terminal block
Switch resistance	32 Ω
Switch off leakage	<1 nA
Switch breakdown voltage	±60 VDC

Physical

Dimensions	3.0 by 17.2 by 20.3 cm (1.2 by 6.9 by 8.0 in.)

Environment

Operating temperature	0 to 50 °C
Storage temperature	-20 to 70 °C
Relative humidity	10 to 90% noncondensing

Certifications and Compliances

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

Australia and New Zealand Compliance

EMC	AS/NZS 2064.1/2 (CISPR-11)

[1]Half-bridge completion is inside the module and configured under software control. Quarter-bridge completion resistor is in SCXI-1314 terminal block and socketed. Resistors shipped with SCXI-1314 are 120 Ω and 350 Ω RN-55 style (0.25 W). Tolerance is ±0.1%. Temperature coefficient is ±10 ppm/°C max. 2Shunt calibration resistors are in SCXI-1314 terminal block and socketed. Resistors shipped with SCXI-1314 are 100 kΩ RN-55 style (0.25 W). Tolerance is ±0.1%. Temperature coefficient is ±10 ppm/°C max. For a definition of specific terms, visit ni.com/glossary.

Every Measurement Counts

There is no room for error in your measurements. From sensor to software, your system must deliver accurate results. NI provides detailed specifications for its products so you do not have to guess how they will perform. Along with traditional data acquisition specifications, NI E Series multifunction data acquisition (DAQ) devices and SCXI signal conditioning modules include accuracy tables to assist you in selecting the appropriate hardware for your application. To calculate the accuracy of NI measurement products, visit **ni.com/accuracy**.

Absolute Accuracy

Absolute accuracy is the specification you use to determine the overall maximum tolerance of your measurement. Absolute accuracy specifications apply only to successfully calibrated DAQ devices and SCXI modules. There are four components of an absolute accuracy specification:

- Percent of Reading – a gain uncertainty factor that is multiplied by the actual input voltage for the measurement.
- Offset – a constant value applied to all measurements.
- System Noise – based on random noise and depends on the number of points averaged for each measurement (includes quantization error for DAQ devices).
- Temperature Drift – based on variations in your ambient temperature.
- Input Voltage – absolute magnitude of the voltage input for this calculation. The full-scale voltage is most commonly used. Based on these components, the formula for calculating absolute accuracy is:

Absolute Accuracy = ±[(Input Voltage X % of Reading) + (Offset + System Noise + Temperature Drift)]

Absolute Accuracy RTI1 = (Absolute Accuracy Input Voltage)
1RTI = relative to input

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

Temperature Drift = Temperature Difference x % Drift per °C x Input Voltage

Absolute Accuracy for DAQ Devices

Absolute Device Accuracy at Full Scale is a calculation of absolute accuracy for DAQ devices for a specific voltage range using the maximum voltage within that range taken one year after calibration, the Accuracy Drift Reading, and the System Noise averaged value.

Following is the Absolute Accuracy at Full Scale calculation for the NI PCI-6052E DAQ device after one year using the ±10 V input range while averaging 100 samples of a 10 V input signal. In all the Absolute Accuracy at Full Scale calculations, assume that the ambient temperature is between 15 and 35 °C. Using Table 5, note that the calculation for the ±10 V input range for Absolute Accuracy at Full Scale yields 4.747 mV. This calculation is done using the parameters in the same row for one year Absolute Accuracy Reading, Offset and Noise + Quantization, as well as a value of 10 V for the input voltage value. You can then see that the calculation is as follows:

Absolute Accuracy = ±[(10 X 0.00037) + 947.0 µV + 87 µV] = ±4.747 mV

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 = (±0.004747/10) = ±0.0475%

The following example assumes the same conditions except that the ambient temperature is 40 °C. You can begin with the calculation above and add in the Drift calculation using the % Drift per °C from Table 2.

Absolute Accuracy = 4.747 mV + (40 – 35 °C) x 0.000006 /°C X 10 V) = ±5.047 mV

Absolute Accuracy RTI = (±0.005047/10) = ±0.0505%

Absolute Accuracy for SCXI Modules

Below is an example for calculating the absolute accuracy for the NI 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. At **ni.com/accuracy**, you find the following numbers for the calculation:

Input Voltage = 0.014
% 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

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

For both data acquisition devices and SCXI modules, you should use the single-point system noise specification from the accuracy tables when you are making single-point measurements. If you are averaging multiple points for each measurement, the value for system noise changes. The averaged system noise in the accuracy tables assumes that you average 100 points per measurement. If you are averaging a different number of points, use the following equation to determine your Noise + Quantization:

$$\text{System Noise} = \text{Average System Noise from table} \times \sqrt{(100/\text{number of points})}$$

For example, if you are averaging 1,000 points per measurement with the PCI-6052E in the ±10 V (±100 mV for the SCXI-1102) input range, system noise is determined by:

PCI-6052E[1]
System Noise = 87.0 μV x (100/1000) = 27.5 μV

SCXI-1102
System Noise = 5 μV x SQRT (100/1000) = 1.58 μV

[1]The system noise specifications assume that dithering is disabled for single-point measurements and enabled for averaged measurements.

Visit **ni.com/calibration** for more information on the importance of calibration on data acquisition device accuracy.

Absolute System Accuracy

Absolute system accuracy represents the end-to-end accuracy including the signal conditioning and data acquisition device. Because absolute system accuracy includes components set for different input ranges, it is important to use absolute accuracy RTI numbers for each component.

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 module and PCI-6052E data acquisition board described in the first examples:

$$\text{Total System Accuracy RTI} = \pm\sqrt{[(0.00273)2 + (0.000505)2]} = \pm 0.278\%$$

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, rather than just the maximum and minimum values.

For an example calculation, we want to determine the absolute system accuracy of an SCXI-1102 system with a PCI-6052E, 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 ±0.82%. This means the possible voltage reading is anywhere from 5.225 to 5.311 mV.

3. Using the same thermocouple conversion table, these values represent a temperature spread of 99.3 to 100.7 °C.

Therefore, the absolute system accuracy is ±0.7 °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 those 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 in Table 1.

To maintain your measurement accuracy, you must calibrate your measurement system at set intervals over time.

For a current list of SCXI signal conditioning products with calibration services, visit **ni.com/calibration.**

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

Table 4. Possible Empirical Accuracy with System Calibration

Multifunction DAQ and SCXI Signal Conditioning Accuracy Specifications Overview

Nominal Range (V)		Absolute Accuracy							Relative Accuracy	
		% of Reading			System Noise (mV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (mV)	Resolution (µV)	
Positive FS	Negative FS	24 Hours	1 Year	Offset (mV)	Single Point	Averaged			Single Point	Averaged
10.0	-10.0	0.0354	0.0371	947.0	981.0	87.0	0.0006	4.747	1145.0	115.0
5.0	-5.0	0.0054	0.0071	476.0	491.0	43.5	0.0001	0.876	573.0	57.3
2.5	-2.5	0.0354	0.0371	241.0	245.0	21.7	0.0006	1.190	286.0	28.6
1.0	-1.0	0.0354	0.0371	99.2	98.1	8.7	0.0006	0.479	115.0	11.5
0.5	-0.5	0.0354	0.0371	52.1	56.2	5.0	0.0006	0.243	66.3	6.6
0.25	-0.25	0.0404	0.0421	28.6	32.8	3.0	0.0006	0.137	39.2	3.9
0.1	-0.1	0.0454	0.0471	14.4	22.4	2.1	0.0006	0.064	27.7	2.8
0.05	-0.05	0.0454	0.0471	9.7	19.9	1.9	0.0006	0.035	25.3	2.5
10.0	0.0	0.0054	0.0071	476.0	491.0	43.5	0.0001	1.232	573.0	57.3
5.0	0.0	0.0354	0.0371	241.0	245.0	21.7	0.0006	2.119	286.0	28.6
2.0	0.0	0.0354	0.0371	99.2	98.1	8.7	0.0006	0.850	115.0	11.5
1.0	0.0	0.0354	0.0371	52.1	56.2	5.0	0.0006	0.428	66.3	6.6
0.5	0.0	0.0404	0.0421	28.6	39.8	3.0	0.0006	0.242	48.2	3.9
0.2	0.0	0.0454	0.0471	14.4	22.4	2.1	0.0006	0.111	27.7	2.8
0.1	0.0	0.0454	0.0471	9.7	19.9	1.9	0.0006	0.059	25.3	2.5

Table 5. NI PCI-6052E Analog Input Accuracy Specifications

Note: Accuracies are valid for measurements following an internal (self) E Series calibration. Averaged numbers assume averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature. One-year calibration interval recommended. The Absolute Accuracy at Full Scale calculations were performed for a maximum range input voltage (for example, 10 V for the ±10 V range) after one year, assuming 100-point averaging of data.

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