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Digital Signal Conditioning Accessories

SSR Series

- Per-channel digital signal conditioning
- Digital input and digital output modules
- 8, 16, 24, and 32-channel backplanes
- 4000 V_{rms} Isolation

NI SC-206x

- 8 channels of isolated digital input, digital output, or electromechanical relays
- Rack-mount solutions

NI ER-8, NI ER-16

- 8 or 16 independent SPDT nonlatching relays
- Switching capacity
  - 3 A at 250 V_{rms}
  - 3 A at 30 VDC
- Expandable to 32 channels
- Switch motors, lamps, small fans, or solenoids



Accessory	Description	Sensor/Signal Type
ER-8/16	8/16 channel electromechanical relay	3A at 250 Vrms or 30 VDC
SC-2060	8-channel optically isolated digital input	TTL/CMOS
SC-2061	8-channel optically isolated digital output	TTL/CMOS
SC-2062	8-channel electromechanical relay	6A at 250 Vrms or 30 VDC
SSR	Per-channel optically isolated digital input and digital output	120 VAC, 240 VAC 3 to 32 VDC (input only) 3 to 60 VDC (output only)

Table 1. Digital Signal Conditioning Accessory Descriptions

SSR Series

Input Modules

SSR input modules (SSR-IAC-5, SSR-IAC-5A, and SSR-IDC-5) sense voltages from a field source, converting AC and DC voltages to a TTL logic signal. The SSR modules use negative logic. If a voltage within the selected input range for the SSR module is present, the SSR module returns a logic low. Otherwise, the SSR module returns a logic high.

Output Modules

SSR output modules (SSR-OAC-5, SSR-OAC-5A, and SSR-ODC-5) use a logic TTL signal from a DAQ device to switch AC and DC loads. They control up to 240 VAC at 3.5 A in a manner similar to conventional relays. If the DAQ device is sending a logic low, then the SSR module is turned on and current can flow. If the DAQ device sends a logic high, the SSR module is turned off and current is stopped.

Unlike conventional relays, SSR modules have zero voltage turn-on of the load. Also, a load voltage and minimum current must be present to maintain a SSR output module in the on state.

Note: The output modules (SSR-OAC-5, SSR-OAC-5A, and SSR-ODC 5) do not work with 6503 (DIO-24), 6508 (DIO-96), or the extended digital I/O lines of E Series devices (such as PXI-6025E).

Backplanes

Available with 8, 16, 24, or 32-channel capacity, the backplanes include a 50-pin connector for direct connection of TTL digital I/O signals to the DAQ device. Table 2 describes cabling options.

INFO CODES

For more information or to order products online, visit *ni.com/info* and enter:

ssr
er816
sc2060
sc2061
sc2062

BUY ONLINE!

ER-8, ER-16

Relay Channels

The contacts are break-before-make when operated within the specified switching speed. Each relay provides three connections – normally open (NO), normally closed (NC), and common (COM). As a result, all three contacts are never connected at the same time.

DAQ Device	8-Channel Backplane	16-Channel Backplane	24-Channel Backplane	32-Channel Backplane
68-pin E Series	SC-205x Adapter[1]	–	–	–
100 pin, extended DIO E Series: 6025, AT-MIO-16E-10	R1005050 cable or SC-205x Adapter1	R1005050 cable	R1005050 cable	–
PC-DIO-24 PCI-6503	NB1 cable or SC-205x Adapter1	NB1	NB1	–
DAQCard-DIO-24	PSH27-50F-D1 cable or SC-205x Adapter1	PSH27-50F-D1 cable	PSH27-50F D1 cable	–
PCI-DIO-32HS, PXI-6533, AT-DIO-32HS	SC-205x Adapter[1]	–	–	R6850-D[1]
DAQCard-6533 for PCMCIA	SC-205x Adapter[1]	–	–	PSHR68-68M and R6850-D1
6508 (DIO-96)	SC-205x Adapter[1]	SC-205 adapter[1]	SC-205 adapter[1]	–

[1] See page 349 for configuration and cabling information with the SC-205X cable adapters.

Table 2. SSR Backplane Cabling Guide

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Digital Signal Conditioning Accessories

The ER-8 has eight SPDT relays controlled by eight digital lines and the ER-16 has 16 SPDT relays controlled by 16 digital lines. You can set or reset each relay without affecting the other relays or all relays can change state at the same time. Each relay is fully isolated for a working common-mode voltage of 250 V_{rms}. The coil-to-contact breakdown voltage is 2,000 V_{rms}. The contact-to-contact breakdown voltage is 750 V_{rms}.

Power

For most applications, you can power the ER-8/16 relays from the host DAQ device. Compare the power available on the +5 V pin of the DAQ device with the power requirements of your ER-8/16 and any other SC-2060 or SSR Series devices that will connect to the DAQ device. If the DAQ device cannot provide enough power, then you must use an external 5 VDC supply.

See page 349 for details regarding configurations using SC-205x adapters.

SC-206x

SC-2060

The SC-2060 has eight optically isolated digital inputs that are routed back to NI DAQ devices. These inputs have independent voltage reference connections and use optocoupler technology to sense digital signals with up to 400 V_{rms} of common-mode voltage. A digital signal 9 V below the reference is registered as a logical low. A digital signal 3 V below the reference reads as a logical high. The maximum current rating for each input is 20 mA. For applications with higher currents, use a resistor to limit the current.

SC-2061

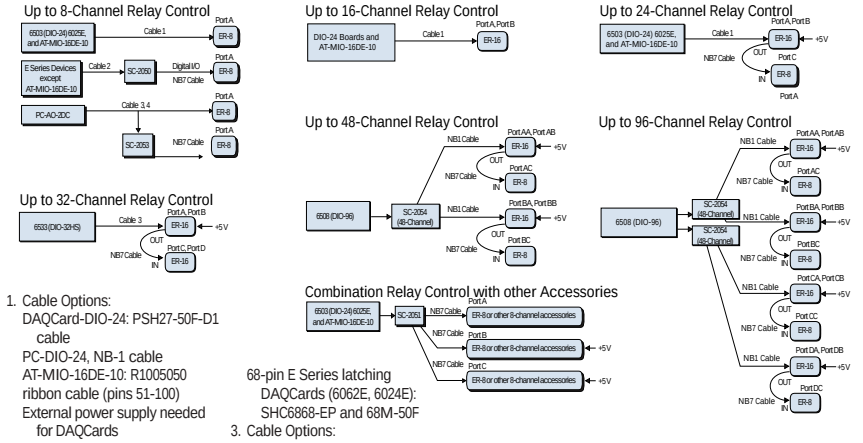
The SC-2061 has eight optically isolated digital outputs for controling high-voltage digital signals with an NI DAQ device. Each output has an independent ground reference and digital output line with 250 V_{rms} of isolation between channels and 400 V_{rms} between channel and ground. To use the SC-2061, you must supply an external +5 VDC signal with respect to your reference and a pull-up resistor (suggested 4.7 kΩ) on each output.

SC-2062

The SC-2062 (Figure 4) has eight electromechanical relays controlled by digital output signals from NI DAQ devices. These relays switch many loads that require more power than is available with DAQ device digital lines. Each SC-2062 has screw terminals connected to eight sets of SPDT relay contacts. These contacts can handle 6 A at 30 VDC or 250 V_{rms}. When the digital output line from the device is in the low (0) state, the contact labeled NC (normally closed) is connected inside the relay to the contact labeled COM (common). When the digital output line is in the high (1) state, the NO (normally open) contact is connected to the COM contact.

Compatibility

You can connect the SC-206x Series devices to any 8-bit digital port of most National Instruments DAQ devices using the SC-205x Series cable adapter devices (Refer to page 349). The applicable DAQ devices include the 60xxE (E Series), 6503 (DIO-24) , 6533 (DIO-32HS), and 6508 (DIO-96).



1. Cable Options:
   DAQCard-DIO-24: PSH27-50F-D1 cable
   PC-DIO-24, NB-1 cable
   AT-MIO-16DE-10: R1005050 ribbon cable (pins 51-100)
   External power supply needed for DAQCards
2. Cable Options:
   All 68-pin PCI/PXI E Series devices: SH6850 shielded cable or R6850 ribbon cable
   All 100-pin E Series boards: R1005050 ribbon cable (pins 1-50)
   68-pin E Series nonlatching DAQCards (AI-16E-4, AI-16XE-50): PSHR6850
   68-pin E Series latching DAQCards (6062E, 6024E): SHC6868-EP and 68M-50F
3. Cable Options:
   AT-DIO-32HS; PCI-DIO-32HS; PXI-6533; R6850-D1
   DAQCard-6533 (PCMCIA): PSHR68M and 68F-50M DIO adapter
4. DAQCard AO-2DC uses PSH 27-50F-D1, PC-AO-2DC uses NBI

Figure 2. Configuration Options for ER-8, ER-16

Mounting

The SC-2060 Series devices have metal standoffs so that they can sit on a workbench close to the host computer. You can also mount them in rack-mount chassis that you can fit with a flat acrylic plastic cover or metal wraparound cover. The SC-206x Series and SC-205x Series devices are designed to share a single 19 in. rack-mount chassis when used together. You can ground each device to the rack through the standoffs and chassis.

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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 ±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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