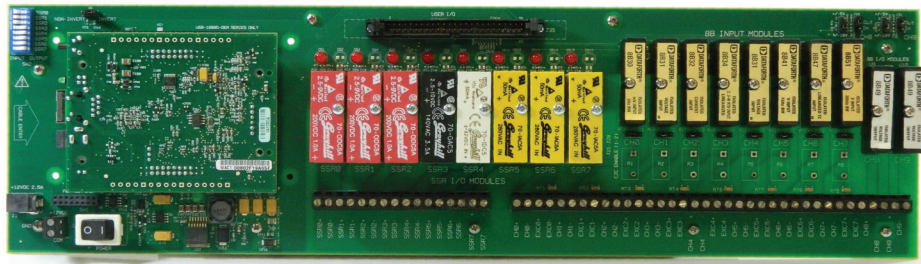


SC-1608 Series

USB and Ethernet DAQ Devices with Isolated Analog and Digital Signal Conditioning



The SC-1608X-2AO-USB (above) is populated with eight SSR digital modules and 10 8B analog modules installed (modules are sold separately).

Features

- USB and Ethernet DAQ devices with analog (8B) and digital (SSR) signal conditioning
- Directly measure voltage, strain, temperature, current, and frequency using 8B modules
- 500 V channel-to-channel isolated I/O signal conditioning
- Digital sense and switch up to 280 VAC using solid state relay (SSR) modules
- Sample rates up to 500 kS/s
- One or two 32-bit counters
- Up to two 16-bit analog outputs, isolated using 8B output modules
- Screw terminals plus 50-pin header connector
- External 12 volt power supply
- Rack mount enclosure available

Supported Operating Systems

- Windows 10/8/7/Vista® 32/64-bit
- Android™

Overview

The SC-1608 Series provides an all-in-one solution to measure and condition analog signals (voltage, temperature, current, frequency, strain, and so on), as well as high voltage and relay digital signals.

The SC-1608 Series is available with three USB versions and one Ethernet version. Each version provides mounting connectors for eight 8B analog input modules, two 8B analog output modules (if AO is supported), and eight digital I/O modules. If a product does not support analog outputs, two additional voltage input modules can be installed.

Conditioned signals are brought out to screw terminals. Users can access all signals via the 50-pin header connector. Any non-conditioned input or output can be used as a *non-isolated* channel.

SC-1608X-2AO-USB, SC-1608X-USB, and SC-1608-USB

SC-1608 Series USB products provide eight conditioned analog inputs via the front screw terminal (10 if the product does not support analog outputs). Eight additional single-ended channels, eight DIO, counter inputs, trigger input, and external clocking are available via the 50-pin header.

SC-1608-2AO-ENET

The SC-1608-2AO-ENET provides eight conditioned analog inputs via the front screw terminal. Two analog outputs, eight DIO, a counter input, a trigger input, and external clocking are available via the 50-pin header. The communication port is 10/100 BASE-T.

8B Analog I/O Signal Conditioning Modules

8B analog I/O modules provide 500 V channel-to-channel isolated I/O signal conditioning. Users mix and match on a per-channel basis between supported voltage, TC, RTD, strain gage, current, and frequency modules.

The SC-1608 Series provides mounting locations for eight 8B input modules and two 8B output modules. With SC-1608 Series devices that do not support analog outputs, two additional voltage input modules can be installed. Positive, negative, and excitation signals are brought out to screw terminals for field wiring connections.

SC-1608 Series Selection Chart					
Series Product	Analog Input	Sample Rate, max	Analog Output	Digital I/O	Counter Input
SC-1608-2AO-ENET	8 8B input locations	250 kS/s	2 8B output locations	8	1
SC-1608X-2AO-USB	8 8B input locations	500 kS/s	2 8B output locations	8	2
SC-1608X-USB	8 8B input locations*	500 kS/s	0	8	2
SC-1608-USB	8 8B input locations*	250 kS/s	0	8	2

* Alternatively, two voltage input modules can be installed in the analog output location for these products, for a total of 10 8B input locations.

SC-1608 Series

General Information



Cold Junction Compensation (CJC)

Users can enable CJC functionality with onboard jumpers for each 8B thermocouple input module installed.

Current Shunt Resistors

Sockets are available for users to install plug-in shunt resistors to monitor a 4-20 mA current loop or to measure current using 8B analog voltage input modules.

SSR Digital I/O Control Modules

SSR digital I/O modules are isolated relay control modules. The SC-1608 Series provides mounting locations for eight DIO

Digital Output Logic Control

The control logic polarity for each digital output module is configurable with an onboard jumper for inverted logic (active high, default) or non-inverted logic (active low). This jumper setting has no effect on digital input modules.

Signal Connections

The eight analog inputs, two analog outputs, and eight digital I/O that interface with the 8B analog I/O modules and digital I/O modules are brought out to screw terminals and to a 50-pin header connector for field wiring connections.

Non-Isolated Channels

Any unconditioned input or output can be accessed on the header connector as a non-isolated channel.

External Power Supply

External power is required. An external 12 VDC supply ships with each SC-1608 Series product; users can alternately connect their own supply to an onboard screw terminal.

Mounting Options

The SC-1608 Series can be used on a bench or installed in a rack mount enclosure (MCC p/n ENC-19X5X5).



modules. Users set the input/output type of each module with a DIP switch. Positive and negative relay contacts are brought out to screw terminals for field wiring connections.




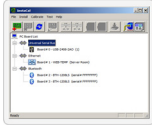




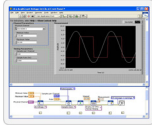


SC-1608 Series

Software



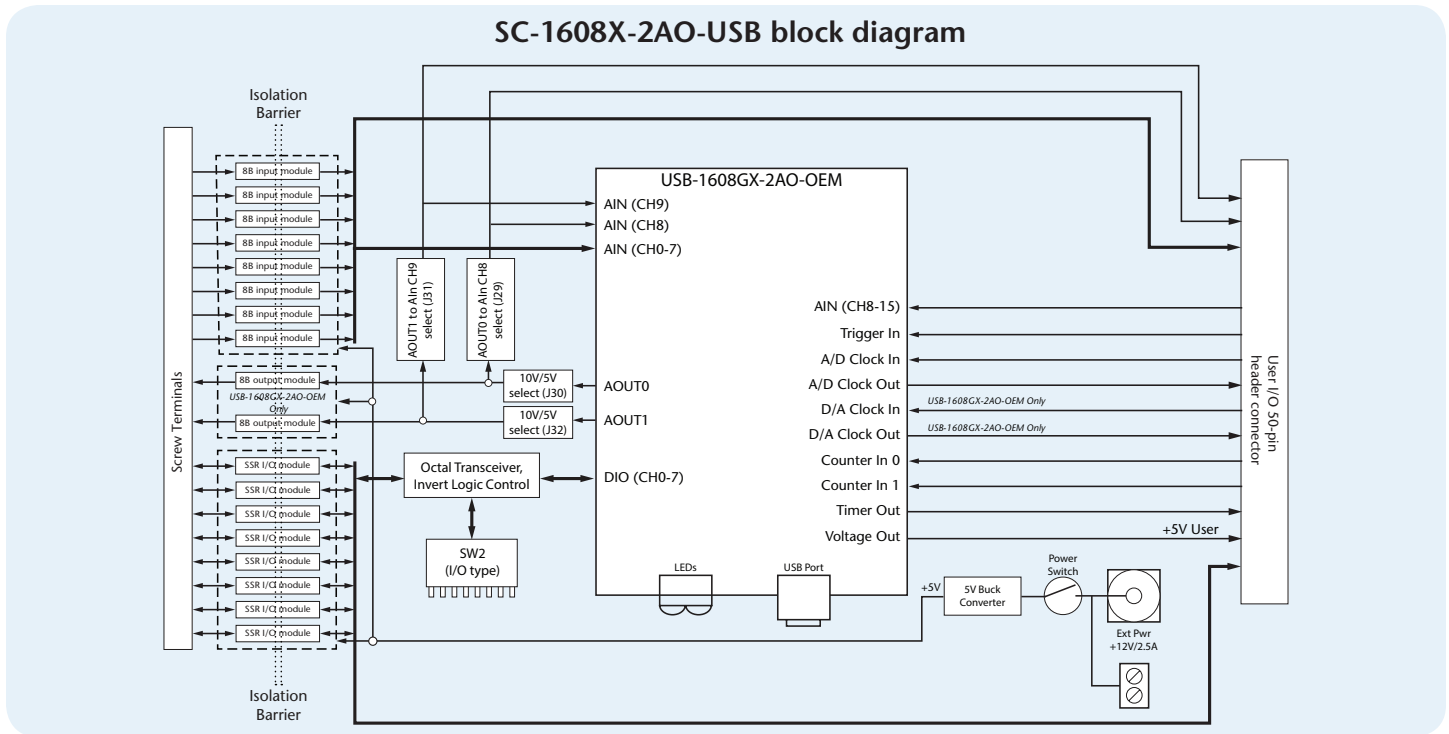
Software Support

SC-1608 Series devices are supported by the software in the table below.

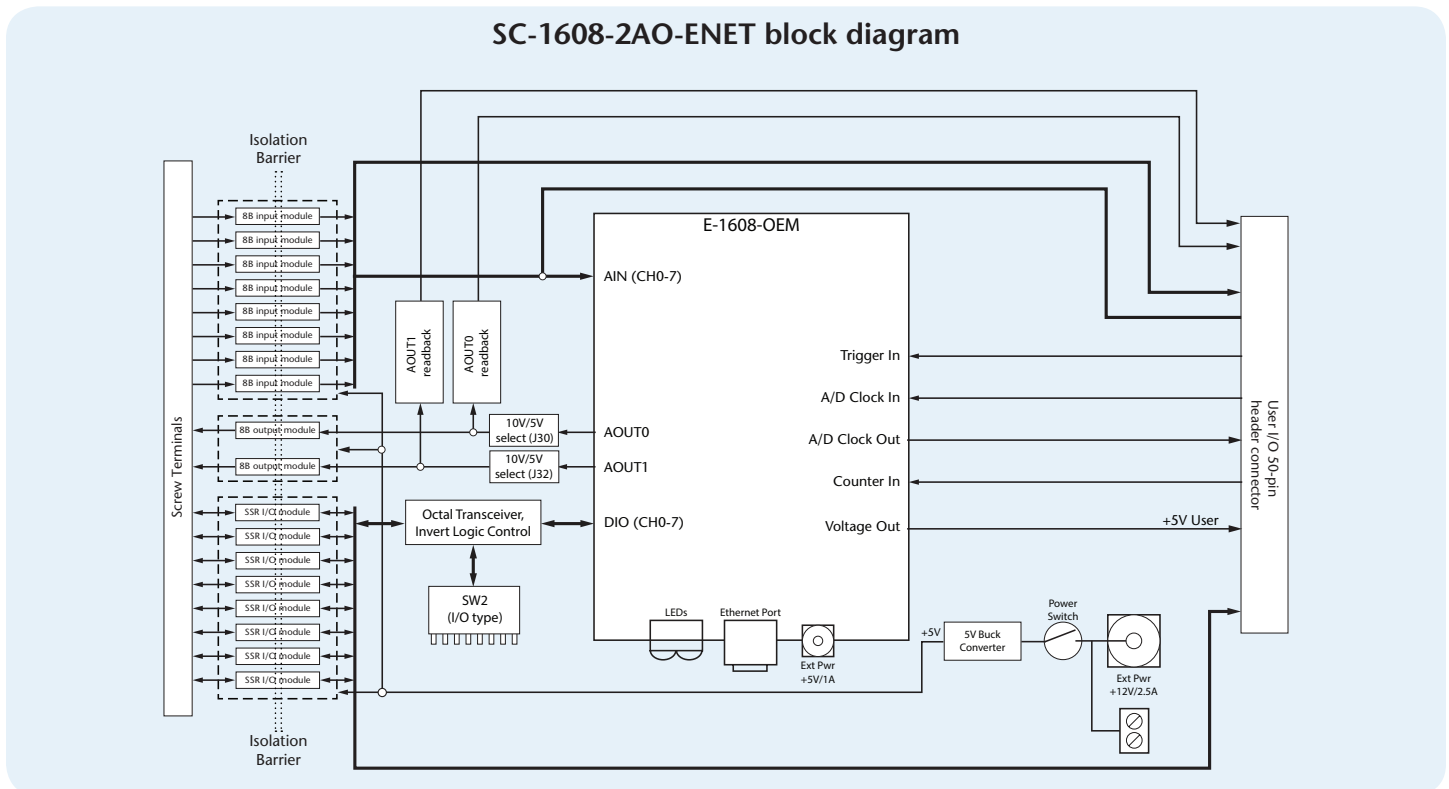
Ready-to-Run Applications	
DAQami™ 	Data acquisition companion software with drag-and-drop interface that is used to acquire, view, and log data, and generate signals. DAQami can be configured to log analog, digital, and counter channels, and to view that data in real-time or post-acquisition on user-configurable displays. Logged data can be exported for use in Excel® or MATLAB®. Windows OS DAQami is included with the free MCC DAQ Software bundle (CD/download). Install DAQami and try the fully-functional software for 30 days. After 30 days, all features except for data logging and data export will continue to be available – data logging and data export features can be unlocked by purchasing the software.
InstaCal™ 	An interactive installation, configuration, and test utility for MCC hardware. Windows OS InstaCal is included with the free MCC DAQ Software bundle (CD/download).
TracerDAQ™ and TracerDAQ Pro 	Virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. Supported features may vary by hardware. The Pro version provides enhanced features. Windows OS TracerDAQ is included with the free MCC DAQ Software bundle (CD/download). TracerDAQ Pro is available as a purchased software download.
General-Purpose Programming Support	
Universal Library™ (UL) 	Programming library of function calls for C, C++, VB, C# .Net, and VB .Net using Visual Studio and other IDEs. Windows OS The UL is included with the free MCC DAQ Software bundle (CD/download).
UL for Android™ 	Programming library of Java classes for programmers who develop apps for Android-based tablets and phones. UL for Android communicates with select MCC DAQ devices. Supports Android project development on Windows, Linux, Mac OS X UL for Android is included with the free MCC DAQ Software bundle (CD/download).
Linux® driver 	Open-source Linux drivers are available for most MCC devices. Example programs are also provided.
Application-Specific Programming Support	
ULx for NI LabVIEW™ 	A comprehensive library of VIs and example programs for NI LabVIEW that is used to develop custom applications that interact with most MCC devices. Windows OS ULx for NI LabVIEW is included with the free MCC DAQ Software bundle (CD/download).
DASYLab® 	Icon-based data acquisition, graphics, control, and analysis software that allows users to create complex applications in minimal time without text-based programming. Windows OS DASYLab is available as a purchased software download. An evaluation version is available for 28 days.
MATLAB® driver (SC-1608 Series USB products only) 	High-level language and interactive environment for numerical computation, visualization, and programming. The Mathworks Data Acquisition Toolbox™ allows users to acquire data from most MCC PCI and USB devices. Visit www.MathWorks.com for more information about the Data Acquisition Toolbox.

SC-1608 Series

Functional Block Diagrams



The SC-1608X-USB and SC-1608-USB provide the same functionality as the SC-1608X-2AO-USB diagram above without the analog output capability.



SC-1608 Series

Specifications



8B Analog I/O Signal Conditioning Modules

Voltage Input Modules (3 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B30-01	±10 mV	±5 V
SC-8B30-02	±50 mV	±5 V
SC-8B30-03	±100 mV	±5 V
SC-8B31-01	±1 V	±5 V
SC-8B31-02	±5 V	±5 V
SC-8B31-03	±10 V	±5 V
SC-8B31-07	±20 V	±5 V
SC-8B31-09	±40 V	±5 V
SC-8B31-12	±60 V	±5 V

Current Input Modules (3 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B32-01	4 mA to 20 mA	0 V to 5 V
SC-8B32-02	0 mA to 20 mA	0 V to 5 V

Isolated True RMS Input Modules (10 kHz Bandwidth)		
MCC part number	Input range	Output range
SC-8B33-04	0 V to 150 V	0 V to 5 V
SC-8B33-05	0 V to 300 V	0 V to 5 V
SC-8B33-06	0 A to 1 A	0 V to 5 V

Linearized 2- or 3-Wire RTD Modules (3 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B34-01	±100 °C	0 V to 5 V
SC-8B34-02	0 °C to 100 °C	0 V to 5 V
SC-8B34-03	0 °C to 200 °C	0 V to 5 V
SC-8B34-04	0 °C to 600 °C	0 V to 5 V

Linearized 4-Wire RTD Modules (3 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B35-01	±100 °C	0 V to 5 V
SC-8B35-02	0 °C to 100 °C	0 V to 5 V
SC-8B35-03	0 °C to 200 °C	0 V to 5 V
SC-8B35-04	0 °C to 600 °C	0 V to 5 V

Strain Gage Input Modules					
MCC part number	Input range	Excitation voltage	Sensitivity	Output range	Bandwidth
SC-8B38-01	±10 mV	3.333 V	3 mV/V	±5 V	8 kHz
SC-8B38-02	±30 mV	10.0 V	3 mV/V	±5 V	8 kHz
SC-8B38-05	±20 mV	10.0 V	2 mV/V	±5 V	8 kHz
SC-8B38-31	±10 mV	3.333 V	3 mV/V	±5 V	3 Hz
SC-8B38-32	±30 mV	10.0 V	3 mV/V	±5 V	3 Hz
SC-8B38-35	±20 mV	10.0 V	2 mV/V	±5 V	3 Hz

Current Output Modules (100 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B39-02	±5 V	4 mA to 20 mA
SC-8B39-04	±5 V	0 mA to 20 mA
SC-8B39-07	±5 V	±20 mA

SSR Digital I/O Modules

Digital Input Sensing Modules						
MCC part number	Input type	Isolation voltage	Input voltage range	Input current @ max line	Turn-on time	Turn-off time
SSR-IAC-05	AC	4000 Vrms	90-140 VAC/DC	8 mA	20 mS	20 mS
SSR-IAC-05A	High voltage AC	4000 Vrms	180-280 VAC/DC	6 mA	20 mS	20 mS
SSR-IDC-05	DC	4000 Vrms	3-32 VDC	18 mA	0.20 mS	0.40 mS
SSR-IDC-05NP	Non-polarized, AC or DC	4000 Vrms	15-32 VAC, 10-32 VDC	18 mA	5 mS	5 mS

Voltage Input Modules (1 kHz Bandwidth)		
MCC part number	Input range	Output range
SC-8B40-01	±10 mV	±5 V
SC-8B40-02	±50 mV	±5 V
SC-8B40-03	±100 mV	±5 V
SC-8B41-01	±1 V	±5 V
SC-8B41-02	±5 V	±5 V
SC-8B41-03	±10 V	±5 V
SC-8B41-07	±20 V	±5 V
SC-8B41-09	±40 V	±5 V
SC-8B41-12	±60 V	±5 V

Frequency Input Modules			
MCC part number	Input range	Output range	Bandwidth
SC-8B45-01	0 Hz to 500 Hz	0 V to 5 V	500 Hz
SC-8B45-02	0 kHz to 1 kHz	0 V to 5 V	1 kHz
SC-8B45-03	0 kHz to 2.5 kHz	0 V to 5 V	2.5 kHz
SC-8B45-04	0 kHz to 5 kHz	0 V to 5 V	5 kHz
SC-8B45-05	0 kHz to 10 kHz	0 V to 5 V	10 kHz
SC-8B45-06	0 kHz to 25 kHz	0 V to 5 V	25 kHz
SC-8B45-07	0 kHz to 50 kHz	0 V to 5 V	50 kHz
SC-8B45-08	0 kHz to 100 kHz	0 V to 5 V	100 kHz

Linearized Thermocouple Input Modules (3 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B47-J-01	0 °C to 760 °C	0 V to 5 V
SC-8B47-J-02	-100 °C to 300 °C	0 V to 5 V
SC-8B47-J-03	0 °C to 500 °C	0 V to 5 V
SC-8B47-J-12	-100 °C to 760 °C	0 V to 5 V
SC-8B47-K-04	0 °C to 1000 °C	0 V to 5 V
SC-8B47-K-05	0 °C to 500 °C	0 V to 5 V
SC-8B47-K-13	-100 °C to 1350 °C	0 V to 5 V
SC-8B47-K-14	0 °C to 1200 °C	0 V to 5 V
SC-8B47-T-06	-100 °C to 400 °C	0 V to 5 V
SC-8B47-T-07	0 °C to 200 °C	0 V to 5 V

Voltage Output Modules (100 Hz Bandwidth)		
MCC part number	Input range	Output range
SC-8B49-02	±5 V	±5 V
SC-8B49-03	±5 V	0 V to 5 V
SC-8B49-05	±10 V	±10 V
SC-8B49-06	±10 V	0 V to 10 V

Voltage Input Modules (20 kHz Bandwidth)		
MCC part number	Input range	Output range
SC-8B50-01	±20 mV	±5 V
SC-8B50-02	±50 mV	±5 V
SC-8B50-03	±100 mV	±5 V
SC-8B51-01	±1 V	±5 V
SC-8B51-02	±5 V	±5 V
SC-8B51-03	±10 V	±5 V
SC-8B51-07	±20 V	±5 V
SC-8B51-09	±40 V	±5 V
SC-8B51-12	±60 V	±5 V

Digital Output Switching Modules						
MCC part number	Output type*	Isolation voltage	Load voltage range	Load current range	Turn-on time	Turn-off time
SSR-OAC-05	AC	4000 Vrms	24-140 VAC	0.03-3.5 A	8.33 mS	8.33 mS
SSR-OAC-05A	AC	4000 Vrms	24-280 VAC	0.03-3.5 A	8.33 mS	8.33 mS
SSR-ODC-05	DC	4000 Vrms	3-60 VDC	0.02-3.5 A	20 µS	50 µS
SSR-ODC-05A	DC	4000 Vrms	4-200 VDC	0.02-3.5 A	75 µS	750 µS

* SPST, normally open

SC-1608 Series

Specifications



Specifications

The specifications on this page are common to all SC-1608 Series products.

8B Analog Input Module Control

8B module CJC sensor: Vishay-Dale TFPT1206L1002DM

8B input module locations CH0 to CH7 include a CJC sensor and three-pin header with jumper control (J21-J28).

CJC jumper configuration:

Position 1-2: CJC enabled

Position 2-3: CJC disabled

8B Analog Output Module Control

8B module analog output jumper configuration (J29 and J31):

J29 position 1-2: No function (default)

J29 position 2-3: Connects DAQ AOUT0 to DAQ analog input CH8 (J35 pin 13), or converts 8B I/O location CH8 to an 8B input module location.

J31 position 1-2: No function (default)

J31 position 2-3: Connects DAQ AOUT1 to DAQ analog input CH9 (J35 pin 14), or converts 8B I/O location CH9 to an 8B input module location.

J29 and J31 can be configured to read the analog output control voltage at 8B I/O locations CH8 (pin 6) and CH9 (pin 6) using analog input CH8 and CH9 when using the SC-1608X-2AO-USB. When using the SC-1608-2AO-ENET, the AOUTx voltage can be read at J35 (pins 25 and pins 27) using a voltmeter or other DAQ board.

When using a DAQ board that does not have analog output capability, such as the SC-1608X-USB and SC-1608-USB, configuring J29 and J31 for position 2-3 converts 8B I/O module locations CH8 and CH9 to an 8B input module location (for a total of 10 8B input locations). Voltage input modules installed in CH8 and CH9 must be 2-wire types that don't require excitation terminals.

8B I/O module voltage divider jumper configuration (J30 and J32):

2x4.99 k Ω resistor, 0.1% tolerance, 25 ppm

J30 position 1-2: DAQ AOUT0 outputs ± 10 V output range (default)

J30 position 2-3: DAQ AOUT0 outputs ± 5 V output range

J32 position 1-2: DAQ AOUT1 outputs ± 10 V output range (default)

J32 position 2-3: DAQ AOUT1 outputs ± 5 V output range

SSR Digital I/O Module Control

Number of I/O logic control: 8

SSR default configuration: OUTPUT type; SW2 default

Configuration: Each module location (SSR0-SSR7) is individually configurable as INPUT or OUTPUT using SW2 DIP switch positions.

Logic inversion control: Configurable for inverting or non-inverting logic with jumper W1; set by default to INVERT. Inverting logic is applied to SSR digital output modules only. The W1 setting has no effect on digital input modules.

LED: Each module location (SSR0-SSR7) has a dedicated LED for indicating the module status.

Input modules: Set SW2 DIP switch to INPUT for use with digital input modules such as Grayhill 70IDC5. Use your software application to configure the SC-1608 Series USB or Ethernet board for digital input mode.

Output modules: Set the SW2 DIP switch to OUTPUT for use with digital output modules such as Grayhill 70ODC5. Use your software application to configure the SC-1608 Series USB or Ethernet board for digital output mode.

Digital I/O

These digital specifications are specific to the SCC-8-8-2 baseboard.

Digital type: 5V TTL

Number of I/O: 8

Configuration: Bidirectional: each bit individually configurable as digital input or output using SW2 DIP switch positions. Avoid creating a digital I/O logic contention state between the digital bits on the data acquisition board and the digital bits on the SC-1608 Series baseboard.

Connector location: J35

Input high voltage threshold: 2.0 V min

Input high voltage limit: 5.5 V absolute max

Input low voltage threshold: 0.8 V max

Input low voltage limit: -0.5 V absolute min, 0 V recommended min

Output high voltage: 4.4 V min (IOH = -50 μ A), 3.76 V min, (IOH = -24 mA)

Output low voltage: 0.1 V max (IOL = 50 μ A), 0.44 V max (IOL = 24 mA)

Power On default state: Digital output, +5 V logic level

Power

External power input connectors:

J1: barrel type.

J2: 2-pole terminal block, (16 AWG to 30 AWG)

The baseboard can be powered from either of the external power connectors J1 or J2. Do not attempt to apply power to both external power connectors simultaneously.

External power input voltage range: +10 V to +14 V

This specification applies to the actual voltage level present at the input to the external power connector (J1 or J2), as any significant loading of the external supply will cause a voltage drop across the power supply cable.

External power supply current: 25 mA typical; this is the total quiescent current requirement for the device, and does not include any potential 8B/SSR module loading or loading of the DIO bits, or +VO terminal.

1700 mA max, including all external loading.

When using the Series USB product, the total current available for 8B analog I/O modules and SSR digital I/O modules is 1612 mA, maximum.

When using the Series Ethernet product, the total current available for 8B analog I/O modules and SSR digital I/O modules is 1292 mA, maximum. For example, this current limitation would restrict the number of 8B38 strain gage modules that can be installed on the SC-1608-2AO-ENET to six (when SSR modules are installed), or seven (when no SSR modules are installed). Refer to the SC-1608 Series User's Guide for details.

External power supply:

MCC p/n PS-12V30WEPS (included): +12 VDC, 30 Watt, 5% regulation

+VO output voltage range:

Header connector J35, pin 29: 4.50 V min to 5.25 V max

+VO output current: 10 mA max

Power LED:

3 V < Vext < 15 V: LED is ON

Vext > 15 V: LED OFF (power fault)

Mechanical

Dimensions (L x W x H):

With 8B analog modules installed:

101.6 x 426.72 x 42.16 mm (4.0 x 16.8 x 1.66 in), including standoffs

With SSR digital modules installed:

101.6 x 426.72 x 48.50 mm (4.0 x 16.8 x 1.91 in), including standoffs

Standoff height is 0.38 inches. The height of the header connector is the same height as a SC-1608 Series product.

Environmental

Operating Temperature Range: 0 $^{\circ}$ C to 55 $^{\circ}$ C max

Storage Temperature Range: -40 $^{\circ}$ C to 85 $^{\circ}$ C max

Humidity: 0% to 90% non-condensing max

SC-1608 Series

Specifications



SC-1608X-2AO-USB, SC-1608X-USB, SC-1608-USB

The analog and digital specifications apply to non-isolated channels.

Analog Input

A/D Converter Type: Successive approximation

ADC Resolution: 16 bits

Number of Channels: 8 DIFF, 16 SE; software-selectable

Input Voltage Range: ± 10 V, ± 5 V, ± 2 V, ± 1 V; software-selectable per channel

Absolute Maximum Input Voltage

CHx Relative to AGND: ± 25 V max (power on); ± 15 V max (power off)

Input Impedance: 1 G Ω (power on); 820 Ω (power off)

Input Bias Current: ± 10 nA

Input Bandwidth

All Input Ranges, Small Signal (-3 dB)

SC-1608-USB: 750 kHz

SC-1608X-2AO-USB, SC-1608X-USB: 870 kHz

Input Capacitance: 60 pF

Maximum Working Voltage (Signal + Common Mode)

± 10 V Range: ± 10.2 V max relative to AGND

± 5 V Range: ± 10.2 V max relative to AGND

± 2 V Range: ± 9.5 V max relative to AGND

± 1 V Range: ± 9.0 V max relative to AGND

Common Mode Rejection Ratio: $f_{IN} = 60$ Hz, All Input Ranges: 86 dB Crosstalk

Adjacent Differential Mode Channels, DC to 100 kHz: -75 dB

Input Coupling: DC

Sampling Rate (Software-Selectable)

SC-1608-USB: 0.0149 Hz to 250 kHz

SC-1608X-2AO-USB, SC-1608X-USB: 0.0149 Hz to 500 kHz

Trigger Source: TRIG pin

Sample Clock Source: Internal A/D clock or external A/D clock (AICKI terminal)

Burst Mode: Software-selectable using the internal A/D clock; always enabled when using the external clock (AICKI terminal):

SC-1608-USB: 4 μ s

SC-1608X-2AO-USB, SC-1608X-USB: 2 μ s

Throughput

Software Paced: 33 to 4000 S/s typ, system dependent

Hardware Paced

SC-1608-USB: 250 kS/s max

SC-1608X-2AO-USB, SC-1608X-USB: 500 kS/s max

Channel Gain Queue: Up to 16 elements; software-selectable range for each channel

Warm-up Time: 15 minutes min

Analog Input DC Voltage Measurement						
All Values are (\pm)						
Range	Gain Error (% of Reading)	Offset Error (μ V)	INL Error (% of Range)	Absolute Accuracy at Full Scale (μ V)	Gain Temperature Coefficient (% reading/ $^{\circ}$ C)	Offset Temperature Coefficient (μ V/ $^{\circ}$ C)
± 10 V	0.024	915	0.0076	4075	0.0014	47
± 5 V	0.024	686	0.0076	2266	0.0014	24
± 2 V	0.024	336	0.0076	968	0.0014	10
± 1 V	0.024	245	0.0076	561	0.0014	5

Noise Performance*		
Range	Counts	LSBrms
± 10 V	6	0.91
± 5 V	6	0.91
± 2 V	7	1.06
± 1 V	9	1.36

* For the peak-to-peak noise distribution test, a differential input channel is connected to AGND at the input terminal block, and 32,000 samples are acquired at the maximum rate available at each setting.

Settling Time**			
SC-1608-USB			
Range	4 μ S settling accuracy (% FSR)	6 μ S settling accuracy (% FSR)	10 μ S settling accuracy (% FSR)
± 10 V	0.0061	0.0031	0.0015
± 5 V	0.0061	0.0031	0.0015
± 2 V	0.0061	0.0031	0.0015
± 1 V	0.0061	0.0031	0.0015
SC-1608X-2AO-USB, SC-1608X-USB			
Range	2 μ S settling accuracy (% FSR)	4 μ S settling accuracy (% FSR)	9 μ S settling accuracy (% FSR)
± 10 V	0.1251	0.0031	0.0015
± 5 V	0.0687	0.0031	0.0015
± 2 V	0.0687	0.0031	0.0015
± 1 V	0.0687	0.0031	0.0015

** Settling time is defined as the expected accuracy after one conversion when switching from a channel with a DC input at one extreme of full scale to another channel with a DC input at the other extreme of full scale. Both input channels are configured for the same input range.

Analog Output (SC-1608X-2AO-USB only)

Number of Channels: 2 (leave unused analog output channels disconnected)

Resolution: 16 bits

Output Range: ± 10 V (calibrated)

Output Transient: Host computer is reset, powered on, suspended, or a reset command is issued to the device.

Duration: 500 μ s

Amplitude: 2 V pk-pk

Powered Off

Duration: 10 ms

Amplitude: 7 V peak

Differential Non-Linearity: ± 0.25 LSB typ; ± 1 LSB max

Output Current: AOUTx: ± 3.5 mA max

Output Short-Circuit Protection

Analog Output Connected to AGND: Unlimited duration

Output Coupling: DC

Power On and Reset State

DACs Cleared to Zero-Scale: 0 V, ± 50 mV (AOUTx defaults to 0 V when the host PC is reset, powered on, suspended, or reset command issued)

Output Noise: 30 μ Vrms

Trigger Source: TRIG

Sample Clock Source: Internal D/A clock or external D/A clock (AOCKI pin)

Output Update Rate: 500 kHz/number of channels in the scan

Settling Time To Rated Accuracy, 10 V Step: 40 μ s

Slew Rate: 9 V/ μ s

Throughput

Software Paced: 33 S/s to 4000 S/s typ, system-dependent

Hardware Paced: 500 kS/s max, system-dependent

SC-1608 Series

Specifications



Calibrated Absolute Accuracy

Range: ± 10 V

Absolute Accuracy (\pm LSB): 16.0

Calibrated Absolute Accuracy Components

Range: ± 10 V

% of Reading: ± 0.0183

Offset (\pm mV): 1.831

Offset Tempco (μ V/ $^{\circ}$ C): 12.7

Gain Tempco (ppm of Range/ $^{\circ}$ C): 13

Analog Output Relative Accuracy

Range: ± 10 V

Relative Accuracy (INL): 4.0 typ

Analog Input/Output Calibration

Recommended Warm-Up Time: 15 minutes min

Calibration Method: Self-calibration (firmware)

Calibration Interval: 1 year (factory calibration)

AI Calibration Reference

+5 V, ± 2.5 mV max (actual measured values stored in EEPROM)

Tempco: 5 ppm/ $^{\circ}$ C max

Long Term Stability: 15 ppm/1000 hours

AOUTx Calibration Procedure (SC-1608X-2AO-USB only)

The AOUTx terminals are internally routed to the analog input circuit. For best calibration results, disconnect any AOUTx connections at the terminal block prior to performing AOUT calibration.

Digital I/O

Digital Type: CMOS

Number of I/O: 8

Configuration: Bit-configurable as input (power on default) or output

Pull-Up Configuration: The port has 47 k Ω resistors configurable as pull-ups or pull-downs (default) via internal jumper (W1).

Digital I/O Transfer Rate (System-Paced): 33 to 8000 port reads/writes or single bit reads/writes per second typ, system dependent.

Input High Voltage: 2.0 V min, 5.5 V absolute max

Input Low Voltage: 0.8 V max, -0.5 V absolute min, 0 V recommended min

Output High Voltage: 4.4 V min (IOH = -50 μ A), 3.76 V min (IOH = -2.5 mA)

Output Low Voltage: 0.1 V max (IOL = 50 μ A), 0.44 V max (IOL = 2.5 mA)

Output Current: ± 2.5 mA max

External Trigger

Trigger Source: TRIG input

Trigger Mode: Software configurable for edge or level sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.

Trigger Latency: 1 μ s + 1 clock cycle max

Trigger Pulse Width: 100 ns min

Input Type: Schmitt trigger, 33 Ω series resistor and 49.9 k Ω pull-down to ground

Schmitt Trigger Hysteresis: 0.4 V to 1.2 V

Input High Voltage: 2.2 V min, 5.5 V absolute max

Input Low Voltage: 1.5 V max, -0.5 V absolute min, 0 V recommended min

External Clock I/O

SC-1608X-USB, SC-1608-USB: AICKI, AICKO

SC-1608X-2AO-USB: AICKI, AICKO AOCKI, AOCKO

Terminal Types

AxCKI: Input, active on rising edge

AxCKO: Output, power on default is 0 V, active on rising edge

Terminal Descriptions

AxCKI: Receives sampling clock from external source

AxCKO: Outputs the internal sampling clock (D/A or A/D clock) or the pulse generated from AxCKI when in external clock mode.

Input Clock Rate

SC-1608-USB: 250 kHz max

SC-1608X-2AO-USB, SC-1608X-USB: 500 kHz max

Clock Pulse Width

AxCKI: 400 ns min

AxCKO: 400 ns min

Input Type: Schmitt trigger, 33 Ω series resistor, 47 k Ω pull-down to ground

Schmitt Trigger Hysteresis: 0.4 V to 1.2 V

Input High Voltage: 2.2 V min, 5.5 V absolute max

Input Low Voltage: 1.5 V max, -0.5 V absolute min, 0 V recommended min

Output High Voltage: 4.4 V min (IOH = -50 μ A), 3.76 V min (IOH = -2.5 mA)

Output Low Voltage: 0.1 V max (IOL = 50 μ A), 0.44 V max (IOL = 2.5 mA)

Output Current: ± 2.5 mA max

Counter Input

Terminal Names: CTRO, CTR1

Number of Channels: 2 channels

Resolution: 32-bit

Counter Type: Event counter

Input Type: Schmitt trigger, 33 Ω series resistor, 47 k Ω pull-down to ground

Input Source:

CTRO (terminal 52)

CTR1 (terminal 51)

Counter Read/Writes Rates (Software-Paced): 33 to 8000 reads/writes per second typ, system dependent

Input High Voltage: 2.2 V min, 5.5 V max

Input Low Voltage: 1.5 V max, -0.5 V min

Schmitt Trigger Hysteresis: 0.4 V min, 1.2 V max

Input Frequency: 20 MHz, max

High Pulse Width: 25 ns, min

Low Pulse Width: 25 ns, min

Timer Output

Timer Terminal Name: TMR

Timer Type: PWM output with count, period, delay, and pulse width registers

Output Value: Default state is idle low with pulses high, software-selectable output invert

Internal Clock Frequency: 64 MHz

Register Widths: 32-bit

High Pulse Width: 15.625 ns min

Low Pulse Width: 15.625 ns min

Output High Voltage: 4.4 V min (IOH = -50 μ A), 3.76 V min (IOH = -2.5 mA)

Output Low Voltage: 0.1 V max (IOL = 50 μ A), 0.44 V max (IOL = 2.5 mA)

Output Current: ± 2.5 mA max

Memory

Data FIFO:

SC-1608X-USB, SC-1608-USB: 4 kS analog input

SC-1608X-2AO-USB: 4 kS analog input, 2 kS analog output

Non-Volatile Memory: 32 KB (28 KB firmware storage, 4 KB calibration/user data)

Power

Supply Current

This is the total quiescent current requirement and includes up to 10 mA for the Status LED; this does not include any potential loading of the digital I/O bits, +5 V terminal, or SC-1608X-2AO-USB analog outputs.

Quiescent Current

SC-1608X-USB, SC-1608-USB: 230 mA

SC-1608X-2AO-USB: 260 mA

+5 V User Output Voltage Range: 4.5 V min to 5.25 V max

+5 V User Output Current: 10 mA max

SC-1608 Series

Specifications



SC-1608-2AO-ENET

The analog and digital specifications apply to non-isolated channels.

Analog Input

A/D Converter Type: Successive approximation
ADC Resolution: 16 bits
Number of Channels: 4 differential, 8 single-ended (software-selectable)
Input Voltage Range: ± 10 V, ± 5 V, ± 2 V, ± 1 V (software-selectable per channel)
Absolute Max Input Voltage (CHx relative to AGND): ± 20 V max (power on), ± 12 V max (power off)
Input Impedance: 1 G Ω (power on), 1200 Ω (power off)
Input Bias Current: ± 10 nA
Input Bandwidth (All Input Ranges, small signal (-3 dB): 700 kHz
Input Capacitance: 60 pF
Max Working Voltage (Signal + Common Mode)
 ± 10 V Range: ± 10.2 V max relative to AGND
 ± 5 V Range: ± 10.2 V max relative to AGND
 ± 2 V Range: ± 9.5 V max relative to AGND
 ± 1 V Range: ± 9.0 V max relative to AGND

Accuracy

Analog Input DC Voltage Measurement Accuracy (All Values are \pm)						
Range	Gain Error (% of Reading)	Offset Error	INL Error (% of Range)	Absolute Accuracy at Full Scale	Gain Temperature Coefficient (% Reading/ $^{\circ}$ C)	Offset Temperature Coefficient
± 10 V	0.024	915 μ V	0.0076	4075 μ V	0.0014	47 μ V/ $^{\circ}$ C
± 5 V	0.024	686 μ V	0.0076	2266 μ V	0.0014	24 μ V/ $^{\circ}$ C
± 2 V	0.024	336 μ V	0.0076	968 μ V	0.0014	10 μ V/ $^{\circ}$ C
± 1 V	0.024	245 μ V	0.0076	561 μ V	0.0014	5 μ V/ $^{\circ}$ C

Noise Performance

For the peak-to-peak noise distribution test, a differential input channel is connected to AGND at the input terminal block, and 16,384 samples are acquired at the maximum rate available at each setting.

Range	Counts	LSB _{rms}
± 10 V	6	0.91
± 5 V	6	0.91
± 2 V	7	1.06
± 1 V	9	1.36

Settling Time

Settling time is defined as the accuracy that can be expected after one conversion when switching from a channel with a DC input at one extreme of full scale to another channel with a DC input at the other extreme of full scale. Both input channels are configured for the same input range.

Range	4 μ s Settling Accuracy (% FSR)	6 μ s Settling Accuracy (% FSR)	10 μ s Settling Accuracy (% FSR)
± 10 V	0.0061	0.0031	0.0015
± 5 V	0.0061	0.0031	0.0015
± 2 V	0.0061	0.0031	0.0015
± 1 V	0.0061	0.0031	0.0015

Common Mode Rejection Ratio ($f_n = 60$ Hz, All Input Ranges): 86 dB
Crosstalk (Adjacent Differential Mode Channels, DC to 10 kHz): -75 dB
Input Coupling: DC
Sample Rate: 0.019 Hz to 250 kHz, software-selectable
Trigger Source: TRIG input
Sample Clock Source: Internal A/D clock or external A/D clock (AICKI pin)
Internal Sample Clock Stability: ± 50 ppm
Internal Sample Clock Timebase: 80 MHz timer with 32-bit period (available frequencies are 80 MHz / integer period)
Throughput: Typical throughput when the device and host are connected by Ethernet to the same local network can vary significantly if a wireless connection is involved or data is sent over the internet, and is not guaranteed.
Software Paced: 1000 to 5000 S/s typ, on local network
Hardware Paced: 250 kS/s max
Channel Gain Queue (Up To 8 Elements): Software-selectable channel and range for each queue element
Warm-Up Time: 15 minutes min

Analog Output

Number Of Channels: 2
Resolution: 16 bits
Output Ranges (Calibrated): ± 10 V
Output Transient
Powered On
Duration: 5 ms
Amplitude: 2 V p-p
Powered Off
Duration: 400 ms
Amplitude: 10 V p-p
Differential Non-Linearity (16-bit Monotonic): ± 0.35 LSB typ, ± 1 LSB max
Output Current (AOUTx Pins): ± 3.5 mA max; Leave unused AOUTx output channels disconnected
Output Coupling: DC
Power On and Reset State: DACs cleared to uncalibrated zero-scale: 0 V, ± 50 mV unless the alarm function is enabled for the output. AOUTx defaults to 0 V whenever the device is powered on or a reset command is issued to the device, unless the alarm functionality is enabled for the output.
Alarm Functionality: One or both outputs may be configured for defined values when an Ethernet connection with a host is established or lost.
Slew Rate: 5 V/ μ s
Throughput (Software Paced): 1,000 to 5,000 S/s typ, on local network, when device and host are connected by Ethernet to same local network. Throughput can vary, and typical throughput is not guaranteed if a wireless connection is involved or data is sent over the internet.

Calibrated Absolute Accuracy (Analog Output)

Range: ± 10 V
Absolute Accuracy: (± 18.7 LSB)

Calibrated Absolute Accuracy Components (Analog Output)

Range: ± 10 V
% of Reading: ± 0.024
Offset: ± 2.2 mV
Offset Tempco: 30.1 μ V/ $^{\circ}$ C
Gain Tempco: 13.2 ppm of range/ $^{\circ}$ C

SC-1608 Series

Specifications



Relative Accuracy (Analog Output)

Range: ± 10 V

Relative Accuracy (INL): ± 4.0 LSB typ

Analog Input/Output Calibration

Recommended Warm-Up Time: 15 minutes min

Calibration Method: Factory

Calibration Interval: 1 year (factory calibration)

Digital Input/Output

Digital Type: 5 V TTL input/advanced BiCMOS output

Number of I/O: 8

Configuration: Independently-configured for input or output

Pull-Up Configuration: All pins pulled up to 5 V using 47 k Ω resistors (default).

Can be changed to pull-down using an internal jumper.

Digital I/O Transfer Rate (System-Paced): 100 to 5000 port reads/writes or single bit reads/writes per sec typ, on local network. Typical throughput when the device and host are connected by Ethernet to the same local network.

Alarm Functionality: DIO bits may be configured for output and go to defined values when an Ethernet connection with a host is established or lost.

Power On and Reset State: All bits input unless alarm functionality is enabled

Input High Voltage Threshold: 2.0 V min

Input High Voltage Limit: 5.5 V absolute max

Input Low Voltage Threshold: 0.8 V max

Input Low Voltage Limit: -0.5 V absolute min, 0 V recommended min

Output High Voltage: 3.8 V typ at no load, 3.0 V min (IOH = -3 mA), 2.0 V min (IOH = -32 mA)

Output Low Voltage 0.15 V typ at no load, 0.55 V max (IOL = 64 mA)

Power On and Reset State: Input

External Trigger

Trigger Source (External Digital): TRIG

Trigger Mode: Software-selectable edge or level sensitive; user configurable for CMOS-compatible rising or falling edge, high or low level

Trigger Latency: 2 μ s + 1 pacer clock cycle max

Trigger Pulse Width: 1 μ s min

Input Type: Schmitt trigger, 47 k Ω pull-down to ground

Schmitt Trigger Hysteresis: 1.01 V typ, 0.6 V min, 1.5 V max

Input High Voltage Threshold: 2.43 V typ, 1.9 V min, 3.1 V max

Input High Voltage Limit: 5.5 V absolute max

Input Low Voltage Threshold: 1.42 V typ, 1.0 V min, 2.0 V max

Input Low Voltage Limit: -0.5 V absolute min, 0 V recommended min

External Clock Input/Output

Terminal Names: AICKI, AICKO

Terminal Types

AICKI: Input (receives A/D pacer clock from external source)

AICKO: Output (outputs internal A/D pacer clock)

Input Clock Rate: 250 kHz max

Clock Pulse Width

AICKI: 1 μ s min

AICKO: 1.8 μ s min

Clock Mode: Edge-sensitive, rising

Input Type: Schmitt trigger, 47 k Ω pull-down to ground

Schmitt Trigger Hysteresis: 1.01 V typ, 0.6 V min, 1.5 V max

Input High Voltage Threshold: 2.43 V typ, 1.9 V min, 3.1 V max

Input High Voltage Limit: 5.5 V absolute max

Input Low Voltage Threshold: 1.42 V typ, 1.0 V min, 2.0 V max

Input Low Voltage Limit: -0.5 V absolute min, 0 V recommended min

Output High Voltage: 4.4 V min (IOH = -50 μ A), 3.80 V min (IOH = -8 mA)

Output Low Voltage 0.1 V max (IOL = 50 μ A), 0.44 V max (IOL = 8 mA)

Counter

Pin Name: CTR

Counter Type: Event counter

Number of Channels: 1

Input Type: Schmitt trigger, 47 k Ω pull-down to ground

Input Source: CTR screw terminal

Resolution: 32 bits

Schmitt Trigger Hysteresis: 1.01 V typ, 0.6 V min, 1.5 V max

Input High Voltage Threshold: 2.43 V typ, 1.9 V min, 3.1 V max

Input High Voltage Limit: 5.5 V absolute max

Input Low Voltage Threshold: 1.42 V typ, 1.0 V min, 2.0 V max

Input Low Voltage Limit: -0.5 V absolute min, 0 V recommended min

Input Frequency: 10 MHz max

High Pulse Width: 50 ns min

Low Pulse Width: 50 ns min

Memory

Data FIFO (Analog Input): 49,152 samples

Non-Volatile Memory: 2,048 bytes for calibration, 256 bytes for user, 1,024 bytes for network settings)

Power

This product receives power ONLY from the SCC-8-8-2 baseboard; refer to the "Power" on page 6. Do not connect a power supply to the barrel connector on the E-1608-OEM board.

Supply current:

Quiescent current: 330 mA typ; 710 mA max including all external loading

This is the total quiescent current requirement that includes the LEDs; does not include potential loading of the DIO bits, +VO pin, or AOUTx outputs.

User output voltage range (available at +VO pin): 4.40 V min to 5.25 V max, assumes supplied AC adapter is used

User output current (available at +VO pin): 10 mA max

Network

Ethernet Connection

Ethernet Type: 100 Base-TX, 10 Base-T

Communication Rates: 10/100 Mbps, auto-negotiated

Connector: RJ-45, 8 position

Cable Length: 100 meters max

Additional Parameters: HP Auto-MDIX support

Network Interface

Protocols Used: TCP/IP (IPv4 only), UDP

Network Ports Used: UDP:54211 (discovery), UDP:6234 (bootloader only), TCP:54211 (commands), TCP:54212 (scan data)

Network IP Configuration: DHCP + link-local, DHCP, static, link-local

Network Name: E-1608-xxxxxx, where xxxxxx are the lower 6 digits of the device MAC address

Network Name Publication: By NBNS

Network Factory Default Settings

Factory Default IP Address: 192.168.0.101

Factory Default Subnet Mask: 255.255.255.0

Factory Default Gateway: 192.168.0.1

Factory Default DHCP Setting: DHCP + link-local enabled

Network Security

Security Implementation: TCP sockets not opened unless application sends the correct PIN code (non-volatile memory, changed by user, default value 0000)

Number of Concurrent Sessions: 1

Vulnerabilities: TCP Sequence Number Approximation Vulnerability

LED Displays and the Factory Reset Button

Power LED (Top)

$3.3 \text{ V} < V_{\text{ext}} < 5.9 \text{ V}$: On

$V_{\text{ext}} < 3.3 \text{ V}$, $V_{\text{ext}} > 5.9 \text{ V}$: Off (power fault)

Activity LED (Bottom): On when there is a valid host connection and blinks when a command is received or an AInScan is running.

Ethernet Connector LEDs

Left, Green: Link/activity indicator; on when there is a valid Ethernet link and blinks when network activity is detected.

Right, Yellow: Speed indicator; on for 100 Mbps, off for 10 Mbps or no link.

Factory Reset Button: Used to reset the network configuration settings to the factory default values.

SC-1608 Series

Ordering



Order Information

Hardware

Part No.	Description
SC-1608-2AO-ENET	Ethernet-based DAQ device with eight analog inputs, 250 kS/s sample rate, two analog outputs, one 32-bit counter input, and eight DIO lines. Includes an external power supply and accessory kit.
SC-1608X-2AO-USB	USB-based DAQ device with 16 analog inputs, 500 kS/s sample rate, two analog outputs, two 32-bit counter inputs, one timer output, and eight DIO lines; compatible with 8B analog modules and SSR digital modules. Includes an external power supply and accessory kit.
SC-1608X-USB	USB-based DAQ device with 16 analog inputs, 500 kS/s sample rate, two 32-bit counter inputs, one timer output, and eight DIO lines; compatible with 8B analog modules and SSR digital modules. Includes an external power supply and accessory kit.
SC-1608-USB	USB-based DAQ device with 16 analog inputs, 250 kS/s sample rate, two 32-bit counter inputs, one timer output, and eight DIO lines; compatible with 8B analog modules and SSR digital modules. Includes an external power supply and accessory kit.

Accessories

Part No.	Description
8B analog I/O modules	Refer to the Specifications on page 5 for the part number and description of compatible 8B analog I/O signal conditioning modules.
SSR digital I/O modules	Refer to the Specifications on page 5 for the part number and description of compatible SSR digital I/O modules.
ENC-19X5X5	Rack mount enclosure. (L × H × W): 19 × 5.25 × 5 in. (482.6 × 133.4 × 127.0 mm)
C50FFx cable	50-conductor ribbon cable, female to female. Connect to the SC-1608 Series header connector.
CIO-MINI50	50-pin universal screw-terminal board. Connect to the SC-1608 Series header connector with a C50FF-x cable.