USB-1608HS-2AO

16-Bit Multifunction DAQ with Simultaneous Sampling

User's Guide

April 2019. Rev 5

MEASUREMENT COMPUTING™

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About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-1608HS-2AO data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

Bold text is used for the names of objects on a screen, such as buttons, text boxes, and checkboxes.

Italic text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

Additional information about the USB-1608HS-2AO is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation by phone, fax, or email with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Introducing the USB-1608HS-2AO

This user's guide contains all of the information you need to connect the USB-1608HS-2AO to your computer and to the signals you want to measure.

The USB-1608HS-2AO is a USB 2.0 high-speed device supported under popular Microsoft® Windows® operating systems. The USB-1608HS-2AO is fully compatible with both USB 1.1 and USB 2.0 ports.

The USB-1608HS-2AO features the following:

- With one A/D converter per channel, the USB-1608HS-2AO offers true simultaneous-sampling of up to eight channels of 16-bit single-ended or differential analog input at 250 kHz per channel.

  Each channel can be independently-configured with software for either single-ended or differential input. The input range of each channel can also be configured independently with software.
- Two independent 16-bit analog output channels can be configured with a remote sensing option to compensate for voltage drop errors that may occur at the field device.
- Eight digital input lines and eight digital output lines.

  The digital output lines are driven low on power up and reset. Each digital line has an associated LED indicator that lights for the logic 1 (high) state. You can disable all input or output LEDs with a jumper–one jumper disables all input LEDs. A second jumper disables all output LEDs.
- A 32-bit counter capable of counting TTL pulses.
- A 5 V, 2 A, AC adapter (MCC p/n PS-5V2AEPS) powers the USB-1608HS-2AO. This adapter ships with the device.
- A synchronization input line (SYNC_IN) allows you to provide an external sampling clock for the analog inputs. A synchronization output line (SYNC_OUT) lets you output the internal or external sampling clock of the USB-1608HS-2AO analog inputs.
- An analog trigger lets you start analog input conversions based on the value of a digital or analog signal.

The USB-1608HS-2AO is shown in Figure 1. I/O connections are made to the screw terminals on the device.

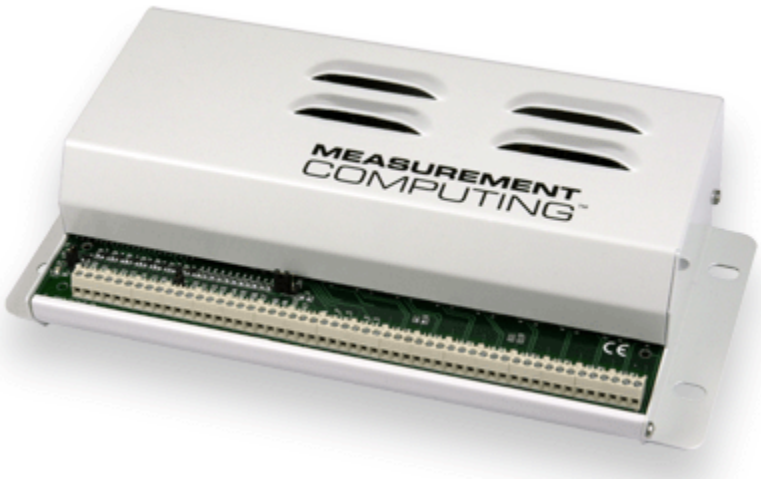


Figure 1. USB-1608HS-2AO

Functional block diagram

USB-1608HS-2AO functions are illustrated in the block diagram shown here.

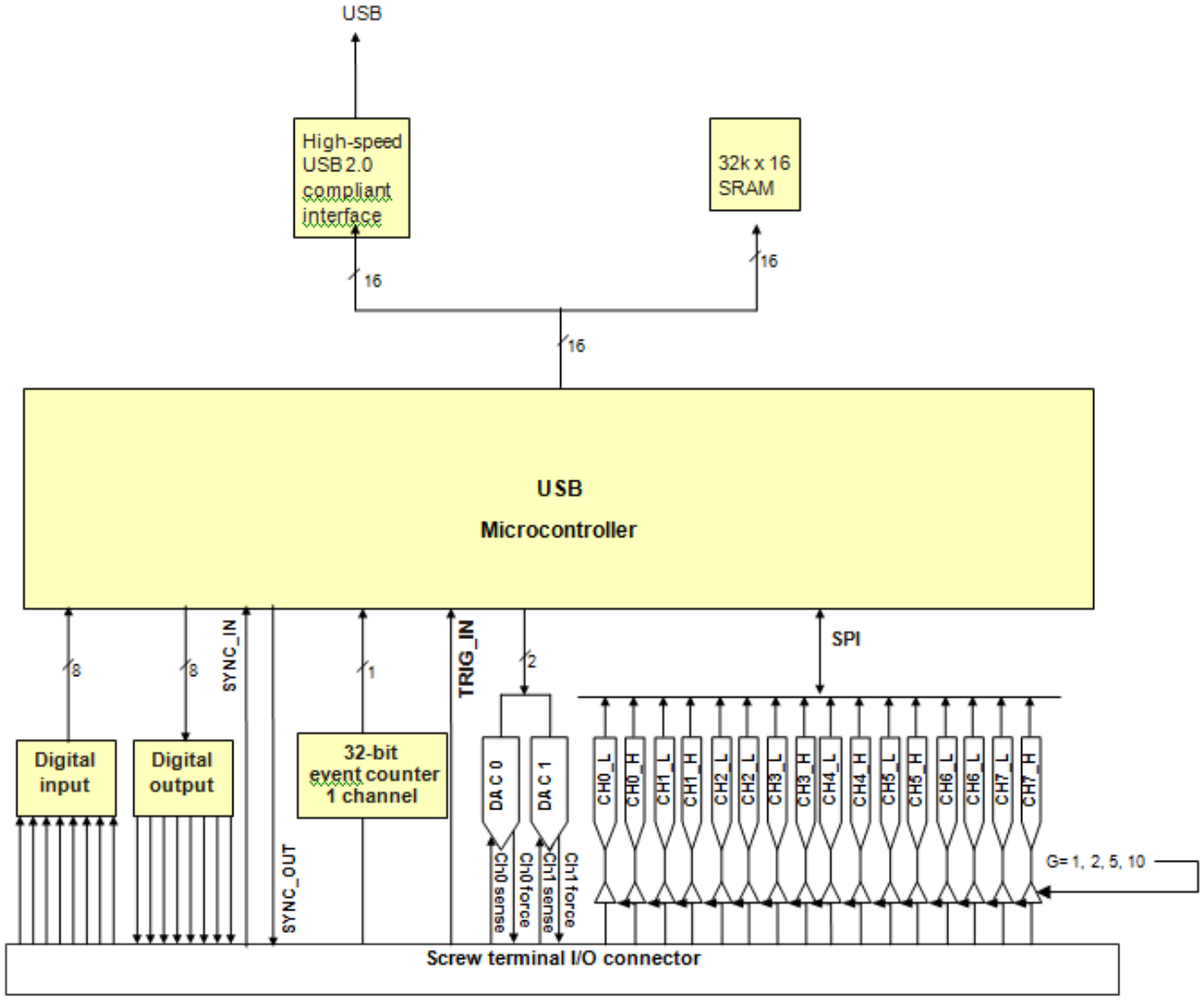


Figure 2. USB-1608HS-2AO functional block diagram

Installing the USB-1608HS-2AO

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

Contact us immediately if any components are damaged.

Installing the software

Refer to the *MCC DAQ Quick Start* and the USB-1608HS-2AO product page on our website for information about the software that supports the device.

Install the software before you install your device

The driver needed to run the USB-1608HS-2AO is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Installing the hardware

Connecting the AC power adapter

Power to the USB-1608HS-2AO is provided with the 5 V adapter (PS-5V2AEPS). Connect the power adapter cord to the power connector on the USB-1608HS-2AO, and plug the AC adapter into a power outlet.

The power LED on the device turns on when the USB-1608HS-2AO is receiving power from the AC power adapter.

Connecting the USB-1608HS-2AO to your system

To connect a USB-1608HS-2AO to your system, turn your computer on and connect the USB cable to an available USB port on the computer or to an external USB hub connected to the computer. Connect the other end of the USB cable to the USB connector on the device.

When you connect the device for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. The dialog closes after the device is installed. The activity LED (**ACT**) will blink and then remain on, indicating the USB-1608HS-2AO is communicating with your computer.

If the ACT LED turns off

If the ACT (active) LED turns on but then turns off, the computer has lost communication with the USB-1608HS-2AO. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should turn on again.

Calibrating the USB-1608HS-2AO

The USB-1608HS-2AO is shipped fully-calibrated. Calibration coefficients are stored in EEPROM.

You can calibrate the analog inputs on the USB-1608HS-2AO with InstaCal. The normal calibration interval is once per year. Calibrate the device whenever the ambient temperature changes by more than ±10 °C. Allow the USB-1608HS-2AO to warm up for at least 30 minutes before starting the calibration.

Functional Details

Theory of operation - analog input acquisition modes

The USB-1608HS-2AO can acquire analog input data in two basic modes – software paced and continuous scan.

Software paced mode

You can acquire one analog sample at a time in software paced mode. You initiate the A/D conversion by calling a software command. The analog value is converted to digital data and returned to the computer. You can repeat this procedure until you have the total number of samples that you want.

The maximum throughput sample rate in software paced mode is system-dependent.

Continuous scan mode

You can acquire data from up to eight channels simultaneously in continuous scan mode. The analog data is continuously acquired, converted to digital values, and written to an onboard FIFO buffer on the USB-1608HS-2AO until you stop the scan. The FIFO buffer is serviced in blocks as the data is transferred from the USB-1608HS-2AO FIFO buffer to the memory buffer on your computer.

The maximum sampling rate is 250 kS/s per channel for one-to-eight channels. You can start a continuous scan with either a software command or with an external hardware trigger event.

External components

The USB-1608HS-2AO has the following external components, as shown in Figure 3.

- Status LEDs – USB activity (ACT) and Power (PWR)
- Screw terminals
- USB connector
- Power connector

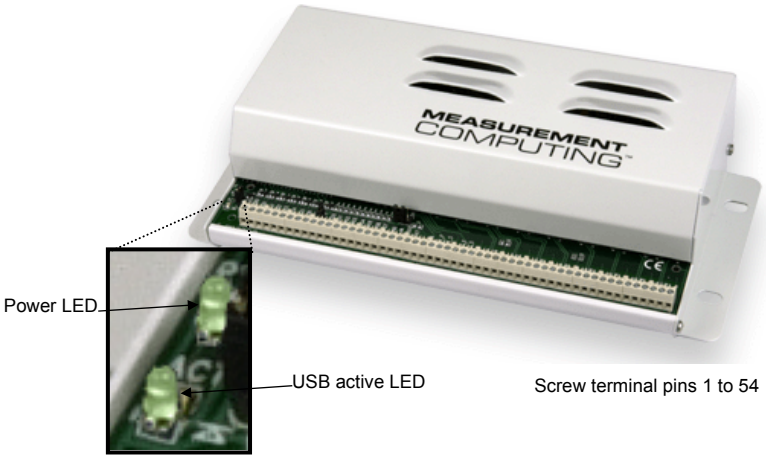


Figure 3. USB-1608HS-2AO external components – front view

Status LEDs

USB active LED (ACT)

The **ACT** LED indicates the communication status of the USB-1608HS-2AO. The table below defines the function of the **ACT** LED.

LED Illumination

LED Illumination	Indication
Steady green	The USB-1608HS-2AO is connected to a computer or external USB hub.
Blinks continuously	Data is being transferred.

Power LED (PWR)

The PWR LED turns on when the USB-1608HS-2AO is receiving +5 V of power from the AC power adapter.

Screw terminals

The USB-1608HS-2AO has one row of screw terminals that provide the following connections:

- 16 analog inputs (**CH0_L** to **CH7_L** and **CH0_H** to **CH7_H**) for eight analog input connections
- 10 analog ground terminals (**AGND**)
- Eight digital inputs (**DI0** to **DI7**)
- Eight digital outputs (**DO0** to **D07**)
- Four analog outputs (**VDAC0_F**, **VDAC0_S**, **VDAC1_F**, **VDAC1_S**) for two DAC channels—only two connections (**VDAC0_F** and **VDAC1_F**) are needed if remote sensing is disabled
- One external trigger input (**TRIG_IN**)
- Two SYNC terminals for external clocking and multi-unit synchronization (**SYNC_IN** and **SYNC_OUT**)
- One event counter input (**CTR**)
- One power output (**+5 V EXT**)
- Three digital ground terminals (**GND**)

The pinout is shown in Figure 4.

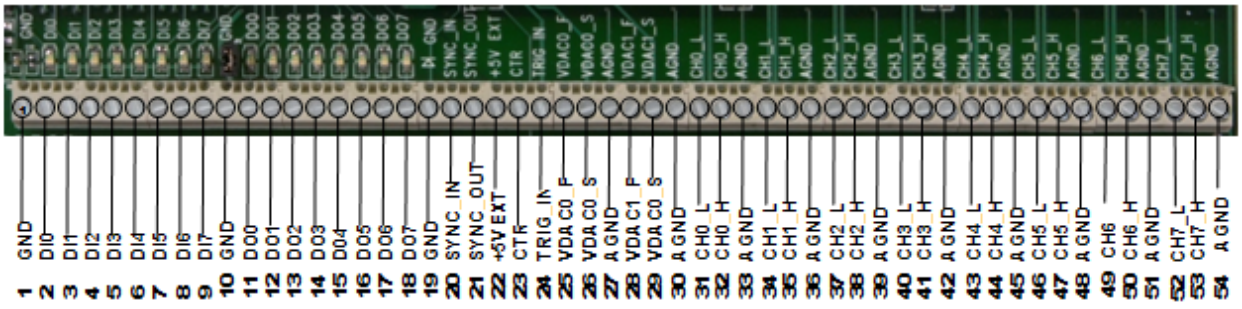


Figure 4. USB-1608HS-2AO screw terminal functions

USB connector

The USB connector is on the rear of the USB-1608HS-2AO. This connector provides communication..

Power connector

Connect the external power adapter (MCC part number PS-5V2AEPS) to the power connector on the rear of the USB-1608HS-2AO.

Figure 5. USB-1608HS-2AO external components – rear view

Signal connections

Analog input terminals (CH0_L - CH7_H)

You can connect up to eight analog input connections to these screw terminal pins:

- CH0_H and CH0_L
- CH1_H and CH1_L
- CH2_H and CH2_L
- CH3_H and CH3_L
- CH4_L and CH4_H
- CH5_L and CH5_H
- CH6_L and CH6_H
- CH7_L and CH7_H

Refer to the Figure 4 on page 10 for the location of these pins.

Input configuration

Analog signals are referenced to analog ground (AGND). Single-ended mode requires two wires:

- The wire carrying the signal to be measured connects to CHx_H.
- The second wire connects to AGND.

Differential mode requires three wires:

- The wire carrying the positive portion of the differential signal to be measured connects to CHx_H.
- The wire carrying the negative portion of the differential signal to be measured connects to CHx_L.
- The analog ground reference wire connects to AGND.

The input voltage ranges are ±10 V, ±5 V, ±2.0 V, ±1.0 V. The following image illustrates a typical single-ended measurement connection.

The following image depicts a voltage source connected to a USB-1608HS-2AO configured for single-ended mode.

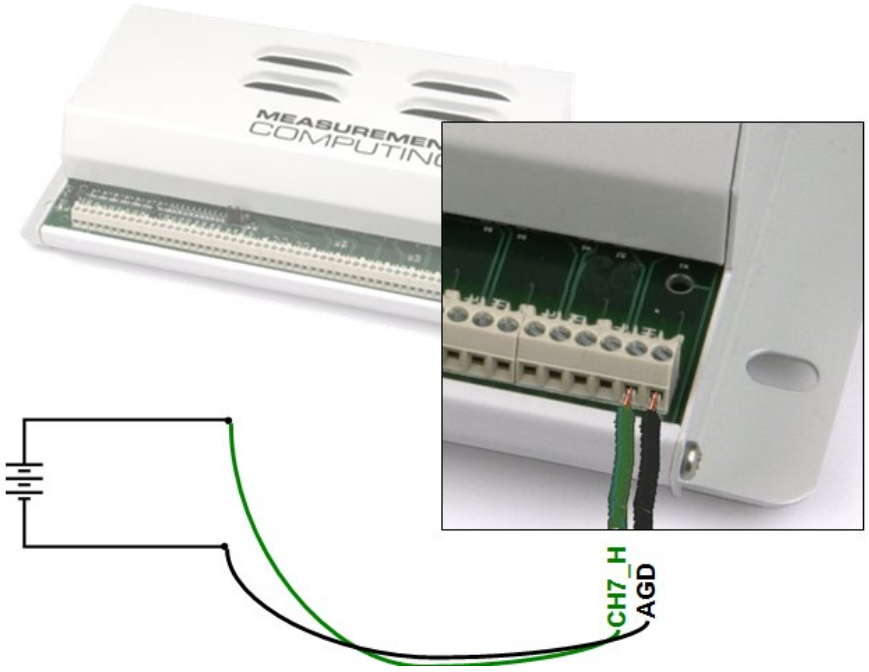


Figure 6. Single-ended measurement connection

The following image depicts a Wheatstone bridge signal source connected to a USB-1608HS-2AO configured for differential mode.

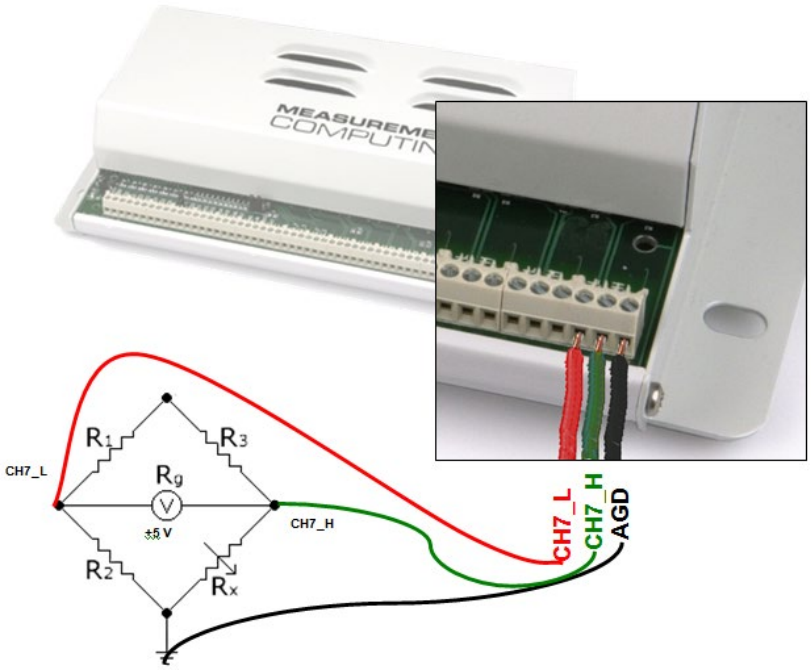


Figure 7. Differential measurement connection

Information on signal connections

For general information about signal connections, refer to the *Guide to DAQ Signal Connections* (available for download on our website at www.mccdaq.com/support/DAQ-Signal-Connections.aspx).

Analog voltage output terminals (VDAC0_F, VDAC0_S, VDAC1_F, and VDAC1_S)

You can connect up to two analog voltage outputs to screw terminal pins **VDAC0_F** and **VDAC1_F.**

You may also use the **VDAC0_S** and **VDAC1_S** when you enable the remote sensing option for the output channel. Refer to the pinout diagram on page 10 for the location of these pins.

You can enable remote sensing for each analog output on the USB-1608HS-2AO with *Insta*Cal.

The remote sensing feature compensates for the voltage drop error that occurs in applications where the USB-1608HS-2AO's analog outputs are connected to its load through a long wire- or cable-type interconnect.

Wire- and cable-type interconnects have some amount of associated series resistance. To calculate the total series resistance, multiply the overall length by the manufacturer's specified resistance per unit length (Ω). If the series resistance becomes large enough, a voltage drop error occurs along the wire when supplying current to the load resistance. The remote sensing feature compensates for the voltage drop error that occurs along the wire.

Connecting the USB-1608HS-2AO when using the remote sensing feature

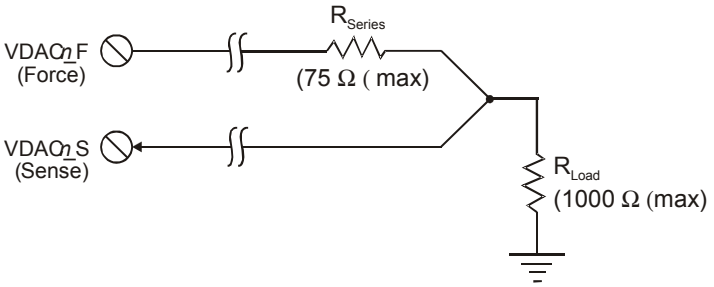
To connect the USB-1608HS-2AO for remote sensing, connect two separate output wires—one from the **VDACn_F** (force) output terminal, and one from the **VDACn_S** (sense) input terminal—to the high side or positive input terminal of the field device (load). The "n" in the terminal name refers to the number of the analog output terminal (0 or 1).

For best results, these two wires should have identical length and gauge. The use of a twisted pair is highly recommended.

In this configuration, the sense wire detects the voltage at the end of the force wire, and compensates for the *I*R* loss along the wire due to the wire resistance.

R_{load} should not exceed the specified 1000 Ω, and the R_{series} should not exceed its specified limit of 75 Ω.

$$V_{compliance} = ((R_{load} + R_{series}) * AOUT)/R_{load}$$



Connecting the USB-1608HS-2AO when *not* using the remote sensing feature

If you are *not* using the remote sensing feature, connect a single output wire or cable from the **VDACn_F** (force) output terminal(s) to the load, and leave the **VDACn_S** (sense) terminals unconnected.

The voltage output range for each channel is ±10 V. The current output is a maximum of ±10 mA per channel.

Analog ground terminals

The 10 analog ground (**AGND**) connections provide a common ground for all analog input channels, output channels, and the analog trigger (**TRIG_IN**).

Refer to the pinout diagram on page 10 for the location of the **AGND** terminal pins.

Digital input terminals (DI0 to DI7) and digital output terminals (DO0 to DO7)

You can connect up to eight digital input lines to screw terminals **DI0** through **DI7**.

You can connect up to eight digital output lines to screw terminals **DO0** to **DO7**.

Refer to the pinout diagram on page 10 for the location of these pins.

The eight input pins have 47 k resistors that you can configure to either pull-up or pull-down, or disconnected with a jumper.

You can use the USB-1608HS-2AO digital I/O terminals to detect the state of any TTL-level input. Refer to the switch circuit shown in Figure 8 and the schematic shown in Figure 9. If you set the switch to the +5V EXT input, DI0 reads *TRUE* (1). If you move the switch to GND, DI0 reads *FALSE* (0).

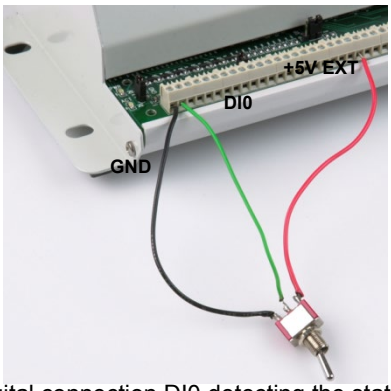


Figure 8. Digital connection DI0 detecting the state of a switch

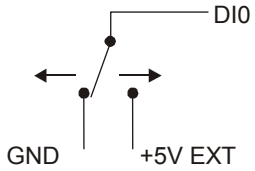


Figure 9. Schematic showing switch detection by digital channel DI0

Each digital input and output pin has an associated LED status indicator. A high at the pin turns the LED on. You can disable the LEDs with jumpers. There is a jumper for the input LEDs, and one for the output LEDs.

Information on signal connections

For general information about signal connections, refer to the *Guide to DAQ Signal Connections* (available for download on our website at www.mccdaq.com/support/DAQ-Signal-Connections.aspx).

Power output (+5V EXT)

You can use the **+5V EXT** connection to supply power to external devices or circuitry. This terminal can output up to 10 mA. Refer to the pinout diagram on page 10 for the location of this pin.

Caution! The **+5V EXT** terminal is an output. Do not connect to an external power supply or you may damage the USB-1608HS-2AO and possibly the computer.

Counter terminal (CTR)

The **CTR** terminal is a TTL-level input to a 32-bit event counter. Refer to the pinout diagram on page 10 for the location of this pin. The internal counter increments when the TTL level transitions from low to high. The counter can count frequencies of up to 1 MHz.

SYNC terminals (SYNC_IN and SYNC_OUT)

You can use the **SYNC_IN** connection to externally pace the A/D conversions. The **SYNC_IN** terminal supports TTL-level input signals of up to 250 kHz.

Use the **SYNC_OUT** connection to output the clock used for A/D conversions.

One example of the use of these two pins would be to synchronize with a second USB-1608HS-2AO and acquire synchronized data from 16 channels. You can connect the **SYNC_OUT** pin of one USB-1608HS-2AO to the **SYNC_IN** pin of another USB-1608HS-2AO to acquire data synchronously from 16 channels.

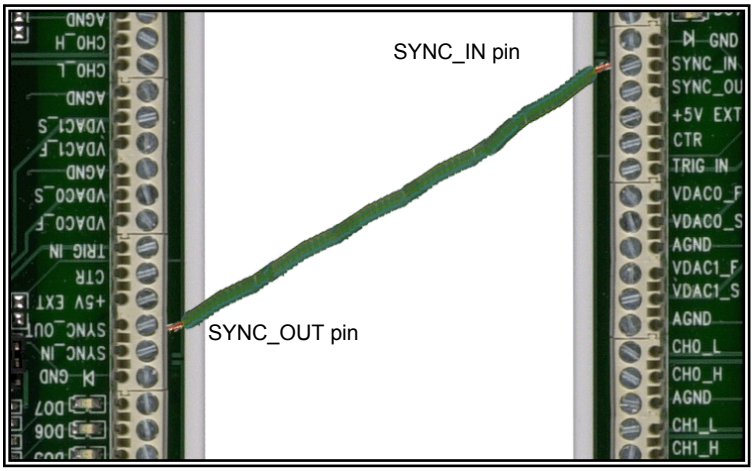


Figure 10. Configuring for synchronous data acquisition

Trigger terminal (TRIG_IN)

The **TRIG_IN** connection is an external analog/digital trigger input.

With the analog trigger function, you can start and control acquisitions with an analog signal. The analog trigger threshold is from -10 V to +10 V on the TRIG_IN pin. A 12-bit DAC sets the level for the threshold. The threshold resolution in this mode is 4.88 mV.

The USB-1608HS-2AO has three trigger options that you must set.

- Trigger above or trigger below
- Level-sensitive or edge-sensitive
- Retrigger on or retrigger off

Each trigger operation mode is explained next. In each case, a ±2 V triangle waveform is used as the **TRIG_IN** input source. The *high threshold* is set to 1.0 V, and the *low threshold* signal is set to –1.0 V.

In the following analog trigger signal diagrams, the bold portion of the waveform indicates the data acquired for the given analog trigger mode.

Trigger above, level-sensitive

The acquisition begins when the **TRIG_IN** signal is above the threshold level. If the **TRIG_IN** signal is above the threshold at the start of the scan, the acquisition begins immediately

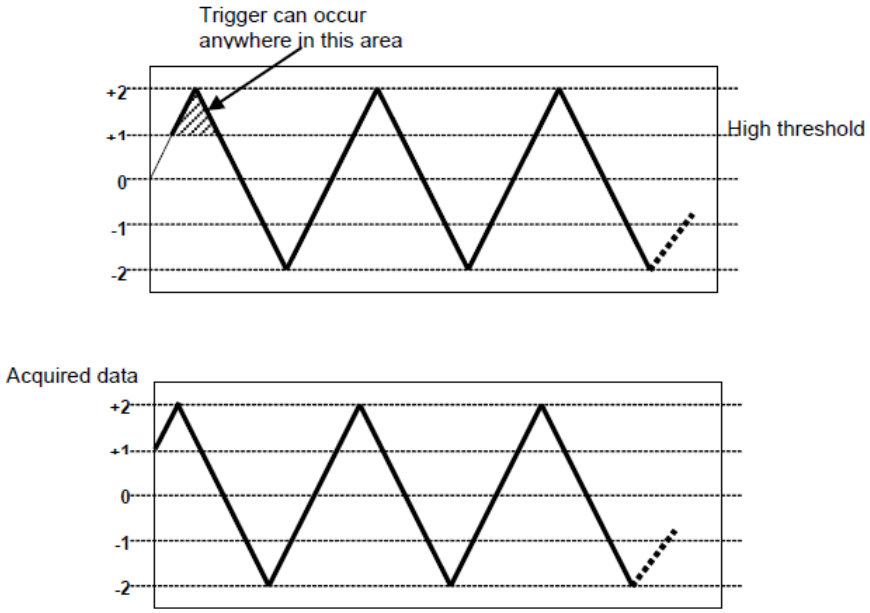


Figure 11. Trigger above, level-sensitive

Trigger below, level-sensitive

The acquisition begins when **TRIG_IN** receives a signal that is below the low threshold (-1.0 V). If the **TRIG_IN** signal is below the threshold level at the start of the scan, the acquisition begins immediately.

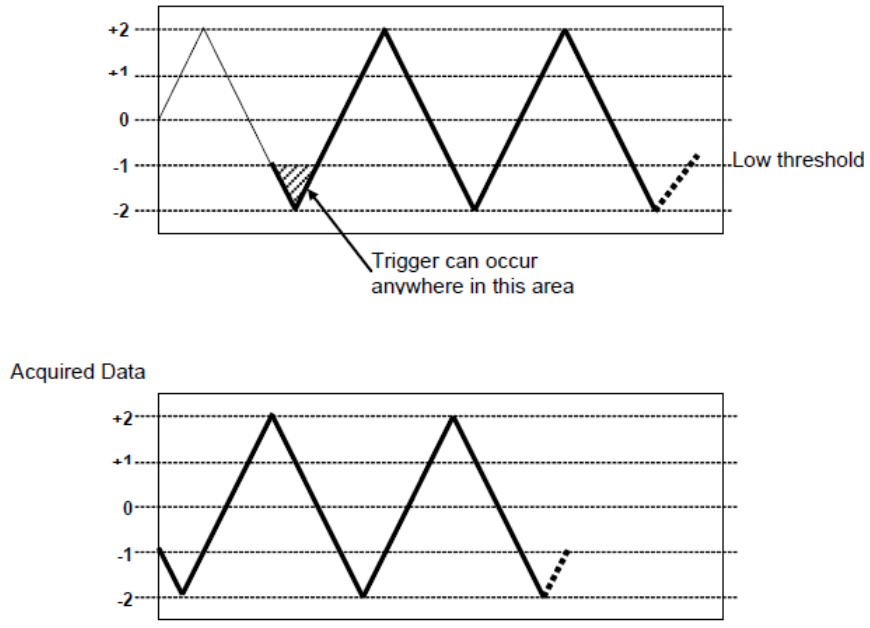


Figure 12. Trigger below, level-sensitive

Trigger above, edge-sensitive

The acquisition begins the first time the **TRIG_IN** signal goes above the high threshold (1.0 V). The **TRIG_IN** signal must transition from below to above the high threshold to begin the acquisition.

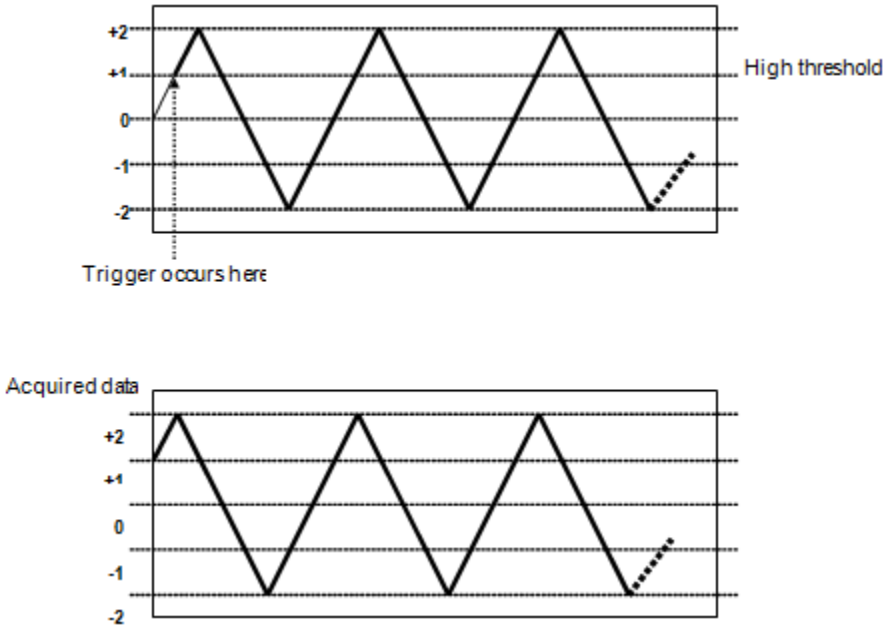


Figure 13. Trigger above, edge-sensitive

Trigger below, edge-sensitive

The acquisition begins when **TRIG_IN** signal first goes below the low threshold (-1.0 V). A transition from above to below the threshold is necessary to begin acquisition. The **TRIG_IN** signal must transition from above to below the low threshold to begin the acquisition.

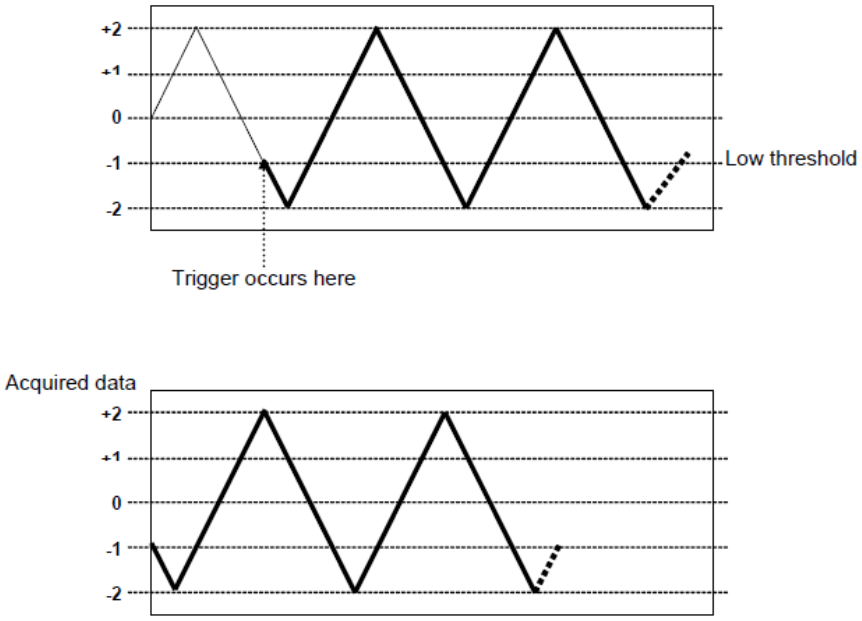


Figure 14. Trigger below, edge-sensitive

Retrigger

The acquisition uses the trigger settings for positive edge/negative edge and level-sensitive/edge-sensitive, but automatically rearms the trigger after acquiring the specified number of samples.

Common ground terminals (GND)

Three ground (**GND**) connections provide a common ground for the **DIx**, **DOx**, **CTR**, **SYNC_IN** and **SYNC_OUT,** and **+5V EXT** connections.

Refer to the pinout diagram on page 10 for the location of the **GND** terminals.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. Analog input specifications

Parameter	Conditions	Specification
A/D converter type		16-bit successive approximation type
Number of channels		Eight differential Eight single-ended
Input configuration		Individual A/D per channel
Sampling method		Simultaneous
Analog input modes	Power up and reset state	CHx_H and CHx_L inputs are disconnected from their screw terminal pins and internally connected to GND (recommended configuration for unused inputs).
	Single-ended	CHx_H inputs are connected directly to their screw terminal pins. CHx_L inputs are disconnected from their screw terminal pins and internally connected to GND.
	Differential	CHx_H and CHx_L inputs are connected directly to their screw terminal pins.
Absolute maximum input voltage	*CHx IN to GND* *TRIG_IN to GND*	*±25 V max (power on)* *±15 V max (power off)*
Input impedance	*CHx IN*	*1 GΩ (power on)* *1.5 kΩ (power off)*
Input bandwidth (-3 dB)	All input ranges	330 kHz
Input leakage current		*±25 pA*
Input capacitance		*50 pf*
Input ranges	Software-selectable per channel	±10 V, ±5 V, ±2 V, ±1 V
A/D pacing		Onboard A/D clock, external source (SYNC_IN). See Table 9 on page 23.
A/D trigger source		TRIG_IN input. See Table 8 on page 22.
A/D trigger modes		External analog. See Table 8 on page 22.
Maximum working voltage (signal + common mode)		FSR ±0.05% FSR max
Sampling rate		0.009 S/s to 250 kS/s, software-programmable
Throughput	Software-paced	33 to 8000 S/s all channels, system-dependent
	Scan to PC memory	250 kS/s per channel max; throughput rate may be limited on USB 1.1 ports.
Resolution		16 bits
Differential non-linearity (Note 1)	Calibrated	±2.0
	Un-calibrated	± 0.5 LSB typ ±1.0 LSB max
CMRR (60 Hz)	*±10 V range*	*81 db min*
	±5 V range	*81 db min*
	±2 V range	*92 db min*
	±1 V range	*92 db min*

Note 1: The maximum differential non-linearity specification applies to the entire 0 °C to 55 °C temperature range of the USB-1608HS-2AO. This specification also accounts for the maximum errors due to the software calibration (in Calibrated mode only) and the AD7685 analog to digital converter non-linearities.

Table 2. Calibrated absolute accuracy

Range	Accuracy (mV)
±10 V	± 7.019
±5 V	± 3.509
±2 V	± 1.403
±1 V	± 0.702

Table 3. Accuracy components - All values are (±)

Range	Integral Non Linearity (% FSR)	Gain error at FS (mV)	Offset (mV)	Gain tempco (ppm/°C)	Offset tempco (µV/°C)
±10 V	0.00915	4.578	1.526	3.8	19.5
±5 V	0.00915	2.289	0.763	7.0	19.5
±2 V	0.00915	0.916	0.305	16.5	24.3
±1 V	0.00915	0.458	0.153	40.1	29.2

Note 2: When connecting differential inputs to floating input sources, the user must provide a DC return path from each differential input to ground. This can be accomplished by simply connecting a resistor from each of the differential inputs to AGND. A value of approximately 100 kΩ can be used for most applications.

Table 4. Noise performance – all values are (±)

Range	Peak to Peak Noise (counts)	RMS noise LSBrms
±10 V	8	1.21
±5 V	8	1.21
±2 V	8	1.21
±1 V	8	1.21

Table 4 summarizes the noise performance for the USB-1608HS-2AO. Noise distribution is determined by gathering 50 kS with inputs tied to ground at the user connector. Samples are gathered at the maximum specified sampling rate of 250 kS/s.

Analog output

Table 5. Analog output specifications

Parameter	Conditions	Specifications
Number of channels		Two independent
Resolution		16 bits
Output range		±10 V
Throughput	Single channel	70 kS/s
	Two channel	35 kS/s
Pacer source		Onboard D/A clock
Monotonicity		*16 bits*
Glitch energy		*200 nV/s*
Current output (Note 3)		±10 mA max single channel ±20 mA max two channels
Output short-circuit protection	Output connect to GND	100 mS max
Output coupling		DC
Power up and reset state		DACs clear to midscale, (0 V, ±20 mV). Remote sense is disabled.
Remote sense configuration		Enabled or disabled through software control.
Remote sense compliance voltage (Note 4)		±10.75 V max
Remote sense compensation range (Note 5)		0 to 75 Ω max
Output noise		*100 nV/Hz*
Settling time (to 0.003%)	*20 V output step, (RL=5 kΩ, CL=200 pf)*	*5 µS max*
Slew rate		10 V/µs
Absolute accuracy		±0.25% of FSR max
Offset error drift		±4 ppm/°C
Gain error drift		±10 ppm/°C

Note 3: The maximum load that the analog output can drive is calculated by dividing the full-scale output voltage by the current output specification or (10 V/10 mA) = 1000 Ω. This calculation is valid whether the Remote Sense feature is enabled or disabled.

Note 4: The USB-1608HS-2AO Remote Sense feature can compensate for any series resistance up to 75 Ω between its force terminal pins and its output load.

Note 5: Rload should not exceed the specified 1000 Ω, and the Rseries should not exceed its specified limit of 75 Ω.

Analog input calibration

Table 6. Analog input calibration specifications

Parameter	Specifications
Recommended warm-up time	15 minutes min
Calibration method	Software calibration
Calibration interval	1 year
Calibration reference	+10.000 V, ±5 mV max. Actual measured values stored in EEPROM
	Tempco: 5 ppm/°C max
	Long term stability: 30 ppm/1000 h

Digital input/output

Table 7. Digital I/O specifications

Digital type	5 V CMOS
Number of I/O	16
Configuration	Eight input, eight output
Pull-up/pull-down configuration	The eight input pins have 47 k resistors that may be configured to either pull-up or pull-down with a jumper
Digital I/O transfer rate (system-paced)	System-dependent, 33 to 8000 port reads/writes or single bit reads/writes per second.
Input high voltage	2.0 V min, 5.5 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output high voltage (IOH = –2.5 mA)	3.8 V min
Output low voltage (IOL = 2.5 mA)	0.7 V max
Power on and reset state	Outputs: driven low
LED indicators	Each I/O pin has an associated LED status indicator. A high at the pin will cause the LED to be on. The LEDs may be disabled with jumpers - one jumper for the input LEDs (JP1), and one jumper for the output LEDs (JP2).

External trigger

Table 8. External trigger specifications

Parameter	Conditions	Specification
Trigger source		TRIG_IN input
Trigger input range		±10 V max
Absolute maximum input voltage	*TRIG_IN to GND*	*±25 V max (power on)* *±15 V max (power off)*
Trigger threshold levels		±10V/4096; Software configurable
Input impedance		*1 MΩ (power on)* *1.5 kΩ (power off)*
Trigger modes		Software configurable for: ■ Positive or negative slope ■ Edge/level ■ Retrigger
Threshold resolution		12 bits, 1 in 4096
Threshold accuracy		±0.25% FSR
Hysteresis		±5 mV
Full power bandwidth (–3 dB)		640 kHz

External clock input/output

Table 9. External clock I/O specifications

Parameter	Conditions	Specification
Pin names		SYNC_IN, SYNC_OUT
Pin type		SYNC_IN: Input SYNC_OUT: Output
Pin descriptions	SYNC_OUT	Outputs A/D pacer clock.
	SYNC_IN	Receives A/D pacer clock from external source. Rising edge sensitive.
Input clock rate		250 kHz max
Clock pulse width	SYNC_IN	1 µs min
	SYNC_OUT	2 µs min
Input leakage current		*±2.0 µA*
Input high voltage		3.5 V min, 6.5 V absolute max
Input low voltage		1.5 V max, –0.5 V absolute min
Output high voltage (Note 6)	IOH = –2.5 mA	3.3 V min
	No load	3.8 V min
Output low voltage (Note 6)	IOL = 2.5 mA	1.1 V max
	No load	0.6 V max

Note 6: SYNC_OUT is over-current protected with a 200 Ω series resistor.

Counter

Table 10. Counter specifications

Pin name (Note 7)	CTR
Counter type	Event counter
Number of channels	1
Input type	TTL, rising edge triggered
Input source	CTR screw terminal
Resolution	32 bits
Schmidt trigger hysteresis	*0.58 V to 0.93 V*
Input leakage current	*±5 µA*
Maximum input frequency	1 MHz
High pulse width	*500 ns min*
Low pulse width	*500 ns min*
Input high voltage	2.4 V min, 6.5 V absolute max
Input low voltage	2.19 V max, –0.5 V absolute min

Note 7: CTR is a Schmitt trigger input protected with a 1 kΩ series resistor.

Memory

Table 11. Memory specifications

Data FIFO	65536 samples, 131,072 bytes
EEPROM	512 bytes

Microcontroller

Table 12. Microcontroller specifications

Type	*High performance 8-bit RISC microcontroller*
Program memory	*16,384 words*
Data memory	*2,048 bytes*

Power

Table 13. Power specifications

Parameter	Conditions	Specification
Supply current (Note 8)	Continuous mode	920 mA
+5V EXT output voltage range (Note 9)		4.5 V min, 5.25 V max
+5V EXT output current (Note 10)		+10 mA max

Note 8: This is the total current requirement for the USB-1608HS-2AO. This specification does not include any additional contribution due to +5VEXT output current, analog output source current, or DIO loading.

Note 9: Output voltage range assumes input power supply is within specified limits.

Note 10: This refers to the total amount of current that can be sourced from the +5VEXT terminal pin for general use.

External power input

Table 14. External power input specifications

External power input	+5.0 VDC (+5 V power supply included)
External power adapter	+5 V, ±5% @ 2 A

USB specifications

Table 15. USB specifications

USB device type	USB 2.0 (high-speed)
USB device compatibility	USB 1.1, 2.0
USB cable length	Three meters max
USB cable type	A-B cable, UL type AWM 2527 or equivalent (minimum 24 AWG VBUS/GND, minimum 28 AWG D+/D-).

Environmental

Table 16. Environmental specifications

Operating temperature range	0 to 55 °C max
Storage temperature range	–40 to 85 °C max
Humidity	0 to 90% non-condensing

Mechanical

Table 17. Mechanical specifications

Card dimensions (L × W ×H)	203.2 mm × 121.9 × 15.2 mm
	8.0 × 4.8 × 0.6 in.
Enclosure dimensions (L × W ×H)	241.3 × 125.7 × 58.9 mm
	9.50 × 4.95 × 2.32 in.

Signal connector

Table 18. Screw terminal specifications

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Screw terminal pinout

Table 19. 8-channel differential mode

Pin	Signal name	Pin	Signal name
1	GND	28	VDAC1_F
2	DI0	29	VDAC1_S
3	DI1	30	AGND
4	DI2	31	CH0_L
5	DI3	32	CH0_H
6	DI4	33	AGND
7	DI5	34	CH1_L
8	DI6	35	CH1_H
9	DI7	36	AGND
10	GND	37	CH2_L
11	DO0	38	CH2_H
12	DO1	39	AGND
13	DO2	40	CH3_L
14	DO3	41	CH3_H
15	DO4	42	AGND
16	DO5	43	CH4_L
17	DO6	44	CH4_H
18	DO7	45	AGND
19	GND	46	CH5_L
20	SYNC_IN	47	CH5_H
21	SYNC_OUT	48	AGND
22	+5V EXT	49	CH6_L
23	CTR	50	CH6_H
24	TRIG_IN	51	AGND
25	VDAC0_F	52	CH7_L
26	VDAC0_S	53	CH7_H
27	AGND	54	AGND

Table 20. 8-channel single-ended mode

Pin	Signal name	Pin	Signal name
1	GND	28	VDAC1_F
2	DI0	29	VDAC1_S
3	DI1	30	AGND
4	DI2	31	NC
5	DI3	32	CH0_H
6	DI4	33	AGND
7	DI5	34	NC
8	DI6	35	CH1_H
9	DI7	36	AGND
10	GND	37	NC
11	DO0	38	CH2_H
12	DO1	39	AGND
13	DO2	40	NC
14	DO3	41	CH3_H
15	DO4	42	AGND
16	DO5	43	NC
17	DO6	44	CH4_H
18	DO7	45	AGND
19	GND	46	NC
20	SYNC_IN	47	CH5_H
21	SYNC_OUT	48	AGND
22	+5V EXT	49	NC
23	CTR	50	CH6_H
24	TRIG_IN	51	AGND
25	VDAC0_F	52	NC
26	VDAC0_S	53	CH7_H
27	AGND	54	AGND

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Norton, MA 02766
USA

Category: Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

USB-1608HS-2AO

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions:

- EN 55011 (2007) / CISPR 11(2003): Radiated emissions: Group 1, Class A
- EN 55011 (2007) / CISPR 11(2003): Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- The host computer must be USB 2.0 compliant.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Note: Data acquisition equipment may exhibit noise or increased offsets when exposed to high RF fields (>1V/m) or transients.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in June, 2007. Test records are outlined in Chomerics Test Report #EMI4813.07. Further testing was conducted by Chomerics Test Services, Woburn, MA. 01801, USA in March, 2009. Test records are outlined in Chomerics Test Report #EMI5271.09.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

Carl Haapaoja, Director of Quality Assurance

Measurement Computing Corporation
10 Commerce Way
Norton, Massachusetts 02766
(508) 946-5100
Fax: (508) 946-9500
E-mail: info@mccdaq.com
www.mccdaq.com

NI Hungary Kft
H-4031 Debrecen, Hátar út 1/A, Hungary
Phone: +36 (52) 515400
Fax: +36 (52) 515414
http://hungary.ni.com/debrecen