USB-1608HS Series
16-Bit Simultaneous Sampling DAQ Devices

Overview
With one A/D converter per channel, the USB-1608HS Series offers true simultaneous sampling of up to eight 16-bit analog inputs at 250 kHz per channel.

The USB-1608HS Series is housed in a heavy-duty chassis with integrated mounting slots, ensuring that the hardware is rugged enough for any DAQ application. A required external power supply is included.

Analog Input
The USB-1608HS Series provides eight single-ended or eight differential analog inputs. Users can mix SE and DIFF channels. Each input has a dedicated 16-bit A/D converter for true simultaneous sampling per channel. The input range is software-selectable, and the sample rate is 250 kS/s per channel. Users can pace operations with an internal or external clock.

Users can enable remote sensing for each output to compensate for any voltage drop error that may occur.

Analog Output
The USB-1608HS-2AO provides two independent, 16-bit analog voltage outputs. The throughput rate is 70 kS/s for one channel, and 35 kS/s for two channels. Users can clock output operations with the onboard scan clock.

Users can configure the pull-up/down configuration with onboard jumpers. Each DIO pin has an associated LED to indicate the digital input/output state.

Digital I/O
The 16 digital I/O lines are configured as 8 inputs and 8 outputs. The digital I/O transfer rate is up to 8000 port or single bit reads/writes per second, system-dependent.

Features
- Simultaneous analog sampling
- Sample rates up to 250 kS/s per channel
- Eight SE or DIFF analog inputs
- Up to two analog outputs
- 8 digital inputs and 8 digital outputs
- One trigger input
- One event counter
- External 5 V power adapter and DIN rail clips included

Supported Operating Systems
- Windows® 10/8/7/Vista®/XP 32/64-bit
- Linux®

Counter Input
The counter channel is a TTL-level input to a 32-bit event counter. The counter increments when the TTL level transitions from low to high. The counter can count frequencies of up to 1 MHz.

Clock I/O
Users can pace operations with the internal clock or with an external source. Two terminals are provided for external clocking and multi-unit synchronization:
- SYNC_IN externally paces A/D conversions. TTL-level input signals of up to 250 kHz are supported.
- SYNC_OUT outputs the clock for A/D conversions.

Users can connect the SYNC_OUT pin on one device to the SYNC_IN pin of a second device and acquire data synchronously from 16 analog input channels.

USB-1608HS Series Selection Chart

<table>
<thead>
<tr>
<th>Model</th>
<th>Analog Input</th>
<th>Sample Rate per Channel (max)</th>
<th>Analog Output</th>
<th>Digital I/O</th>
<th>Counter Input</th>
<th>Clock Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB-1608HS</td>
<td>8 SE/8 DIFF</td>
<td>250 kS/s</td>
<td>0</td>
<td>8 input/8 output</td>
<td>1</td>
<td>Internal, external input and output</td>
</tr>
<tr>
<td>USB-1608HS-2AO</td>
<td>8 SE/8 DIFF</td>
<td>250 kS/s</td>
<td>2</td>
<td>8 input/8 output</td>
<td>1</td>
<td>Internal, external input and output</td>
</tr>
</tbody>
</table>
USB-1608HS Series

Features

**Power**
The USB-1608HS Series requires external power. A 5 V power adapter (PS-5V2AEPS) is included with each shipment.

**Calibration**
The USB-1608HS Series is factory-calibrated using a NIST-traceable calibration process. Specifications are guaranteed for one year. The USB-1608HS Series also supports field calibration for users to calibrate the device locally with the InstaCal utility.

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USB-1608HS Series Block Diagram

[Diagram showing the components of the USB-1608HS Series, including USB, High-speed USB 2.0 Compliant Interface, 32k x 16 SRAM, USB Microcontroller, Digital Input and Output, 32-bit event counter, DACs, and Screw terminal I/O connector]
Software Support
The USB-1608HS Series is supported by the software in the table below.

<table>
<thead>
<tr>
<th>Ready-to-Run Applications</th>
<th></th>
</tr>
</thead>
</table>
| **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. 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. |
| **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.
| TracerDAQ Pro is available as a purchased software download. |

<table>
<thead>
<tr>
<th>General-Purpose Programming Support</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Universal Library™ (UL) for Windows</strong></td>
<td>Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python on Windows. The UL for Windows is included with the free MCC DAQ Software bundle. The UL Python API for Windows is available on GitHub (<a href="https://github.com/mccdaq/mcculw">github.com/mccdaq/mcculw</a>).</td>
</tr>
</tbody>
</table>
| **UL for Linux®** | Library for developing applications in C, C++, and Python on Linux. UL for Linux is available on GitHub ([github.com/mccdaq/uldaq](https://github.com/mccdaq/uldaq)).
| Open-source, third-party Linux drivers are also available for supported MCC devices. |

<table>
<thead>
<tr>
<th>Application-Specific Programming Support</th>
<th></th>
</tr>
</thead>
</table>
| **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. |
| **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** | 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](https://www.mathworks.com) for more information about the Data Acquisition Toolbox. |
USB-1608HS Series
Specifications

All specifications are subject to change without notice. These specifications apply to both standard and OEM versions unless noted.

Analog Input
A/D converter type: 16-bit successive approximation type
Number of channels: Eight differential or 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 AGND; recommended configuration for unused inputs.
- Single-ended: CHx_H inputs are connected directly to their screw terminal pins.
- Differential: CHx_H and CHx_L inputs are connected directly to their screw terminal pins.

Absolute maximum input voltage:
CHx_IN to GND: ±25 V max (power on)
TRIG_IN to GND: ±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 range (software-selectable per channel): ±10 V, ±5 V, ±2 V, ±1 V
A/D pacing: Onboard A/D clock, external source (SYNC_IN). Refer to "External Clock Input/Output" on page 5.
A/D trigger source: TRIG_IN input. Refer to "External Trigger" on page 5.
Maximum working voltage (signal + common mode): FSR ±0.05% FSR max
Sampling rate: 0.009 S/s to 250 kS/s, software-selectable
Throughput
- Software paced: 33 to 8000 S/s all channels, system dependent
- Scan to PC memory: 250 kS/s per channel max (limited on USB 1.1 ports)
Resolution: 16 bits
Differential non-linearity
- Calibrated: ±2.0
- Uncalibrated: ±0.5 LSB typ, ±1.0 LSB max (applies to the entire 0 °C to 55 °C temperature range)
CMRR (60 Hz)
- ±10 V: 81 dB min
- ±5 V: 81 dB min
- ±2 V: 92 dB min
- ±1 V: 92 dB min

Calibrated Absolute Accuracy

<table>
<thead>
<tr>
<th>Range (V)</th>
<th>Accuracy (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10</td>
<td>±7.019</td>
</tr>
<tr>
<td>±5</td>
<td>±3.509</td>
</tr>
<tr>
<td>±2</td>
<td>±1.403</td>
</tr>
<tr>
<td>±1</td>
<td>±0.702</td>
</tr>
</tbody>
</table>

Accuracy Components

<table>
<thead>
<tr>
<th>Range (V)</th>
<th>Integral Non-Linearity (% FSR)</th>
<th>Gain Error at FS (mV)</th>
<th>Offset (mV)</th>
<th>Gain Tempo (ppm/°C)</th>
<th>Offset Tempo (µV/°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10</td>
<td>0.00915</td>
<td>4.578</td>
<td>1.526</td>
<td>3.8</td>
<td>19.5</td>
</tr>
<tr>
<td>±5</td>
<td>0.00915</td>
<td>2.289</td>
<td>0.763</td>
<td>7.0</td>
<td>19.5</td>
</tr>
<tr>
<td>±2</td>
<td>0.00915</td>
<td>0.916</td>
<td>0.305</td>
<td>16.5</td>
<td>24.3</td>
</tr>
<tr>
<td>±1</td>
<td>0.00915</td>
<td>0.458</td>
<td>0.153</td>
<td>40.1</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Digital Input/Output
Digital type: 5 V CMOS
Number of I/O: 16
Configuration: Eight input, eight output
Pull-up/down configuration: The eight input pins have 47 kΩ resistors that may be configured to either pull-up or pull-down with a jumper.
Digital I/O transfer rate: 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 state turns the LED on. The LEDs may be disabled with jumpers JP1 (input LEDs) and JP2 (output LEDs).
USB-1608HS Series

Ordering

External Trigger
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: ±10 V/4096; software-selectable.
Input impedance: 1 MΩ (power on), 1.5 kΩ (power off)
Trigger modes: Positive/negative slope, edge/level sensitive, retrigger on/off
Threshold resolution: 12 bits, 1 in 4096
Threshold accuracy: ±2.5% FSR
Hysteresis: ±5 mV
Full power bandwidth (~3 dB): 640 kHz

External Clock Input/Output
Pin names: SYNC_IN, SYNC_OUT
Pin type
SYNC_IN: Input; receives the A/D pacer clock signal from an external source; rising edge sensitive.
SYNC_OUT: Output; outputs the A/D pacer clock signal. Over-current protected with a 200 Ω series resistor.
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: 10H = −2.5 mA: 3.3 V min
No load: 3.8 V min
Output low voltage: 10L = 2.5 mA: 1.1 V max
No load: 0.6 V max

Counter
Pin name: CTR
Counter type: Event counter; Schmitt trigger input protected with a 1 kΩ series resistor.
Number of channels: 1
Input type: TTL, rising edge triggered
Input source: CTR screw terminal
Resolution: 32 bits
Schmitt 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

Power
Supply current
Continuous mode: 920 mA. This is the total current requirement, and does not include any additional contribution due to the power output pin current, analog output source current, or DIO loading.
+5V EXT pin output voltage range: 4.5 V min, 5.25 V max. Output voltage range assumes that the input power supply is within specified limits.
+5V EXT pin output current: ±10 mA max. This is the total amount of current that can be sourced for general use from the power output pin.
External power input: +5.0 VDC
External power adapter: +5 V, ±5% @ 2 A (MCC p/n PS-5V2AEPS included)

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

Mechanical
Dimensions (L × W × H)
Board: 203.2 × 121.9 × 15.2 mm (8.0 × 4.8 × 0.6 in.)
Enclosure: 241.3 × 125.7 × 58.9 mm (9.50 × 4.95 × 2.32 in.)

Order Information
Hardware

<table>
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<th>Part No.</th>
<th>Description</th>
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<td>PS-5V2AEPS</td>
<td>Replacement power supply; interchangeable plugs are available separately.</td>
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Software also Available from MCC

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<td>TracerDAQ Pro</td>
<td>Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version</td>
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<td>DASYLab</td>
<td>Icon-based data acquisition, graphics, control, and analysis software</td>
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Measurement Computing (508) 946-5100