USB-1608FS

Analog Input and Digital I/O

User's Guide

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-1608FS 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   **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

italic text   *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

For additional information relevant to the operation of your hardware, refer to the Documents subdirectory where you installed the MCC DAQ software (C:\Program Files\Measurement Computing\DAQ by default), or search for your device on our website at www.mccdaq.com.

Introducing the USB-1608FS

The USB-1608FS is an analog input and digital I/O data acquisition device providing the following features:

- Eight 16-bit single-ended (SE) analog input channels

  Each input channel has a dedicated A/D converter for simultaneous sampling.

  Software-selectable analog input ranges of ±10 V, ±5 V, ±2 V, and ±1 V
- Eight individually configurable digital I/O channels
- One 32-bit event counter
- One external digital trigger input
- Bidirectional external clock for synchronous operations with a second device.
- Screw terminals for field wiring connections

The device is powered by the +5V USB supply from the computer, and requires no external power.

The USB-1608FS is a full-speed device that is compatible with both USB 1.1 and USB 2.0 ports. The speed of the device may be limited when using a USB 1.1 port due to the difference in transfer rates on the USB 1.1 versions of the protocol (low-speed and full-speed).

Functional block diagram

USB-1608FS functions are illustrated in the block diagram shown here.
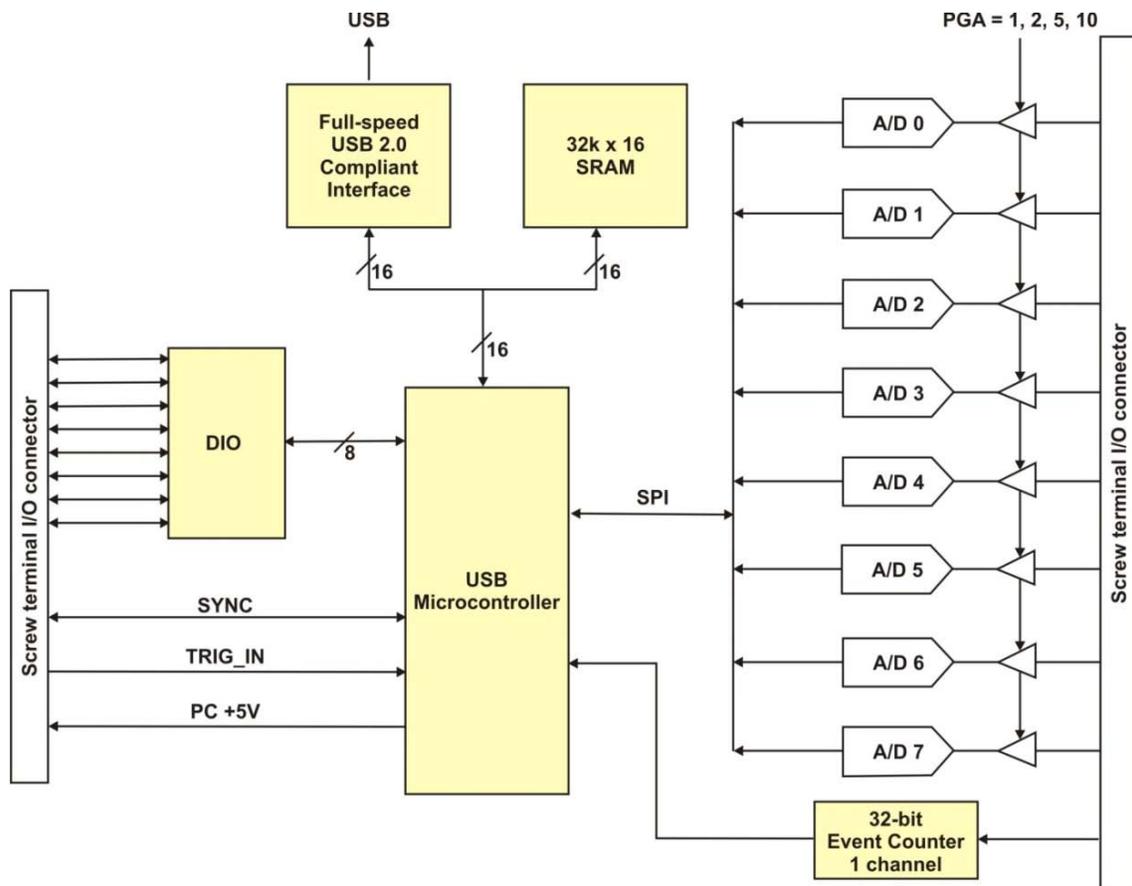

Figure 1. Functional block diagram

Installing the USB-1608FS

What comes with your USB-1608FS shipment?

The following items are shipped with the USB-1608FS.

Hardware

- USB-1608FS
- USB cable

Software

- MCC DAQ CD

Documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide*. This booklet provides an overview of the MCC DAQ software you received with the device, and includes information about installing the software. Please read this booklet completely before installing any software or hardware.

Unpacking

As with any electronic device, take care while handling to avoid damage from static electricity. Before removing the USB-1608FS from its packaging, ground yourself using a wrist strap or touch either the computer chassis or other grounded object to eliminate any stored static charge.

If the device is damaged, notify Measurement Computing Corporation immediately by phone, fax, or email.

- Knowledgebase: kb.mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

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

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the MCC DAQ CD. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

> **Be sure you are using the latest system software**
>
> Before installing the device, run Windows Update to update your operating system with the latest HID and USB drivers.

To connect the USB-1608FS to your system, connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer.

The USB-1608FS installs as a composite device with separate devices attached. When you connect the device for the first time, a **Found New Hardware** dialog opens as each device interface is detected. This is normal. After the device is installed its LED will blink and then remain on. This indicates that communication is established between the USB-1608FS and your computer.

If the LED turns off

If communication is lost between the device and the computer, the device LED turns off. Disconnect the USB cable from the computer and then reconnect it. This should restore communication, and the LED should turn on.

Calibrating the hardware

You can calibrate the USB-1608FS with InstaCal. Perform calibration whenever the ambient temperature changes by more than ±10 °C from the last calibration.

The Measurement Computing Manufacturing Test department performs the initial factory calibration. Contact Measurement Computing if you want to have the factory calibration coefficients restored.

Functional Details

Analog input acquisition modes

The USB-1608FS can acquire analog input data in three modes – software paced, hardware paced, and BURSTIO.

Software paced

The USB-1608FS acquires data one analog sample at a time using software-paced mode. You initiate the A/D conversion by calling a software command. The analog value is converted to digital and returned to the computer. You can repeat this procedure until you have the total number of samples that you want.

The USB-1608FS can attain throughput rates up to 500 S/s using a software loop. This rate is system-dependent.

Hardware paced

The USB-1608FS can acquire data from up to eight channels simultaneously in hardware-paced mode. The analog data is acquired, converted to digital values, and written to an onboard FIFO buffer on the USB-1608FS until you stop the scan. Data is transferred from the USB-1608FS FIFO buffer to the memory buffer on your computer.

The A/D converter is paced by either an internal or external clock source.

The maximum sample rate is an aggregate rate. The total sample rate for all channels is 100 kS/s divided by the number of channels, with a maximum rate of 50 kS/s for any channel. Using this equation, the USB-1608FS can acquire data from one channel at 50 kS/s, two channels at 50 kS/s each, four channels at 25 kS/s each, and so on, up to eight channels at 12.5 kS/s each. You start a hardware-paced scan with a software command. Optionally, hardware-paced scans can be delayed by an external hardware trigger event.

BURSTIO

When using BURSTIO, the USB-1608FS can acquire data at higher rates using the full capacity of the 32 kilosample FIFO. The acquired data is then read from the FIFO and transferred to a user buffer in the computer after the acquisition is complete. You can initiate a single acquisition sequence of one, two, four, or eight channels with a software command. Optionally, BURSTIO scans can be delayed by an external hardware trigger event.

When BURSTIO is enabled, the number of samples acquired in a scan is limited to the depth of the onboard memory. The maximum sample rate in BURSTIO mode is an aggregate rate is 200 kS/s. The maximum sample rate for all channels is 200 kS/s divided by the number of channels, with a maximum rate of 50 kS/s for any channel.

The maximum sample rate that you can acquire data using BURSTIO is 50 kS/s each for one, two, or four channels, and 25 kS/s each for eight channels.

External components

The external components – screw terminal banks, LED, and USB connector –are shown in Figure 2.
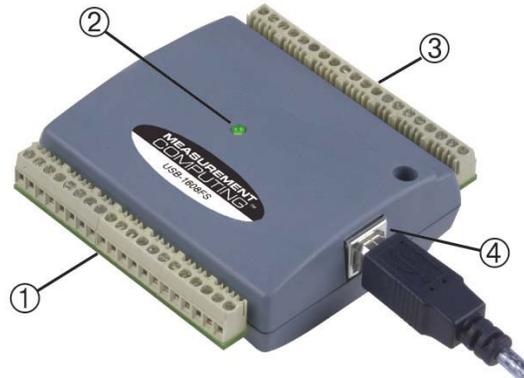
1	Screw terminal pins 21 to 40	3	Screw terminal pins 1 to 20
2	LED	4	USB connector

Figure 2. USB-1608FS components

USB connector

The USB connector provides +5 V power and communication. No external power supply is required.

LED

The LED indicates the communication status; it cannot be disabled. LED states are listed in the table below.

LED behavior

LED state	Indication
On – steady green	The device is connected to a computer or external USB hub.
Blinks once	A USB command is received.
Blinks continuously	Data is being transferred.
Blinks three times	Initial communication is established between the USB-1608FS and the computer.
Blinks at a slow rate	The analog input is configured for external trigger. The LED stops blinking and illuminates steady green when the trigger is received.

Screw terminals

The screw terminals provide the following connections:

- Eight analog inputs (**CH0 IN** to **CH7 IN**)
- Eight digital I/O lines(**DIO0** to **DIO7**)
- One external event counter input (**CTR**)
- One SYNC I/O terminal for external clocking and multi-unit synchronization (**SYNC**)
- One external trigger input (**TRIG_IN**)
- One calibration output (**CAL**)
- One power output (**PC +5 V**)
- analog ground (**AGND**) and digital ground (**GND**) connections

Use 16 AWG to 30 AWG wire when making connections to the screw terminals. Pinout locations are shown in Figure 3 below.

Digital ground	GND	40		20	AGND	Analog ground
Power output	PC +5V	39		19	AGND	Analog ground
Counter input	CTR	38		18	AGND	Analog ground
Trigger input	TRIG_IN	37		17	CAL	Calibration output
Sync I/O	SYNC	36		16	AGND	Analog ground
DIO channel 7	DIO7	35		15	CH7 IN	AI channel 7
Digital ground	GND	34		14	AGND	Analog ground
DIO channel 6	DIO6	33		13	CH6 IN	AI channel 6
Digital ground	GND	32		12	AGND	Analog ground
DIO channel 5	DIO5	31		11	CH5 IN	AI channel 5
Digital ground	GND	30		10	AGND	Analog ground
DIO channel 4	DIO4	29		9	CH4 IN	AI channel 4
Digital ground	GND	28		8	AGND	Analog ground
DIO channel 3	DIO3	27		7	CH3 IN	AI channel 3
Digital ground	GND	26		6	AGND	Analog ground
DIO channel 2	DIO2	25		5	CH2 IN	AI channel 2
Digital ground	GND	24		4	AGND	Analog ground
DIO channel 1	DIO1	23		3	CH1 IN	AI channel 1
Digital ground	GND	22		2	AGND	Analog ground
DIO channel 0	DIO0	21		1	CH0 IN	AI channel 0

Figure 3. Screw terminal pinout

Signal connections

Analog input

You can connect up to eight analog input connections to **CH0 IN** through **CH7 IN**. Connect unused analog input terminals to ground terminals during operation. For example, if you are not using terminal 15 (**CH7 IN**), connect this terminal to terminal 16 (**AGND**).

The analog input channels are configured for single-ended input mode. Each analog signal is referenced to signal ground (AGND), and requires two wires:

▪ Connect the wire carrying the signal to be measured to **CH# IN**.
▪ Connect the second wire to **AGND**.

The input voltage ranges are ±10 V, ±5 V, ±2.0 V, ±1.0 V.

For more information on analog signal connections
For more information on single-ended inputs, refer to the *Guide to Signal Connections* (this document is available on our web site at www.mccdaq.com/signals/signals.pdf).

Channel-Gain queue

The channel-gain queue feature allows you to configure a different gain setting for each analog input channel. The gain settings are stored in a channel-gain queue list that is written to local memory on the device.

The channel-gain queue list must contain all eight channels listed in consecutive order. An example of the channel-gain queue list is shown in the table below.

Sample channel-gain queue list

Element	Channel	Range
0	CH0	BIP10V
1	CH1	BIP5V
2	CH2	BIP10V
3	CH3	BIP1V
4	CH4	BIP2V
5	CH5	BIP10V
6	CH6	BIP1V
7	CH7	BIP5V

Carefully match the gain to the expected voltage range on the associated channel or an over range condition may occur. Although this condition does not damage the device, it does produce a useless full-scale reading, and can introduce a long recovery time due to saturation of the input channel.

Digital I/O

You can connect up to eight digital I/O lines to **DIO0** through **DIO7**. Each digital channel is individually configurable for input or output. During initial power on or reset the digital pins are set for input.

The digital I/O terminals can detect the state of any TTL-level input. Refer to the schematic shown in Figure 4.
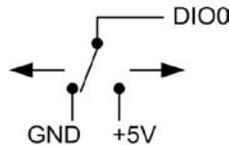

Figure 4. Schematic showing switch detection by digital channel DIO0

If you set the switch to the +5 V input, DIO0 reads *TRUE* (1). When set to GND, DIO0 reads *FALSE* (0).

Pull-up/down configuration

Boards designed with hardware revision E and later have a user-configurable internal jumper to configure the digital bits for pull-up (default) or pull-down. The hardware revision is listed with the part number on the bottom of the device, for example P/N 193334E.

If the p/n of your board is earlier than hardware revision E, the default configuration is pull-up. To configure for pull-down, the board must be modified at the factory.

If your board has a user-configurable jumper, complete the following steps to set the pull-up/down configuration:

1. Unplug the device from the computer.
2. Turn the device over and rest the top of the housing on a flat, stable surface.

Caution! The discharge of static electricity can damage some electronic components. Before removing the USB-1608FS from its housing, ground yourself using a wrist strap or touch the computer chassis or other grounded object to eliminate any stored static charge.

3. Remove the three screws from the bottom of the device using a #1 Philips head screwdriver.
4. Hold both the top and bottom sections together, turn the device over and rest it on the surface, then carefully remove the top section of the case to expose the circuit board.

The user-configurable jumper is labeled **DIO**. Figure 5 shows the location of the jumper on the circuit board.
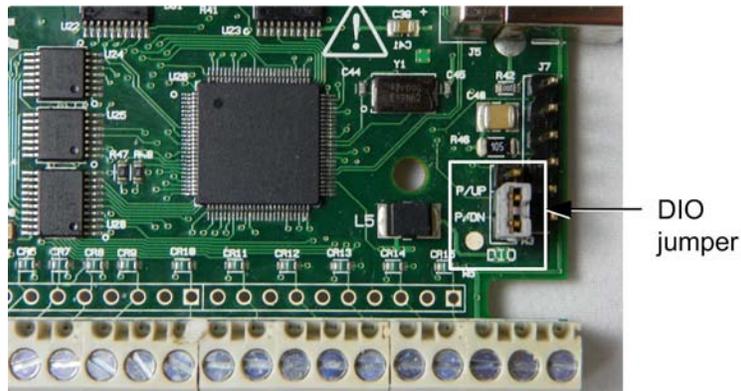
Figure 5. Pull-up/down jumper location

5. Configure the jumper for pull-up or pull-down, as shown in Figure 6.
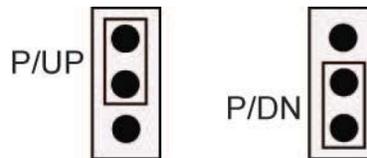
Figure 6. Pull-up/down jumper configuration

6. Replace the top section of the housing, and fasten it to the bottom section with the three screws.

For more information on digital signal connections

For general information regarding digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at www.mccdaq.com/signals/signals.pdf).

Counter input

The **CTR** terminal is a 32-bit event counter that can accept frequency inputs up to 1 MHz. The internal counter increments when the TTL levels transition from low to high.

Trigger input

The **TRIG_IN** terminal is an external digital trigger input. The trigger mode is set for edge sensitive, and is configurable for rising or falling edge. On power up and reset the trigger mode is set for rising edge.

SYNC I/O

The **SYNC** terminal is a bidirectional I/O signal that can be configured as an input (default) or an output.

- Configure as an external clock input to externally source the A/D conversions. The SYNC terminal supports TTL-level input signals of up to 50 kHz.
- Configure as an output to pace conversions on a second USB-1608FS device and acquire data from 16 channels. For more information about synchronized operations see page 17.

Calibration output

The **CAL** terminal is an output that is used to calibrate the USB-1608FS. Do not use this pin for any other purpose. Calibration is software-controlled by InstaCal.

Ground

The analog ground (**AGND**) terminals provide a common ground for all analog channels.

The digital ground (**GND**) terminals provide a common ground for the digital, trigger, counter, sync and power terminals.

Power output

The **PC +5V** terminal is a 5 volt output that is supplied by the computer. You can use this terminal to supply power to external devices or circuitry.

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

The maximum total output current that can be drawn from all USB-1608FS connections (power, analog, and digital outputs) is 500 mA. This maximum applies to most personal computers and self-powered USB hubs. Bus-powered hubs and notebook computers may limit the maximum available output current to 100 mA. **Note**: If the current requirement of the device exceeds the current available from the computer, connect to a self-powered hub or power the computer with an external power adapter.

The USB-1608FS can draw up to 150 mA max of current from the USB +5V supply. When running applications with the device, each DIO bit can source up to 2.5 mA. With all outputs at their maximum output current, the total current requirement of the **PC +5V** terminal is calculated as follows:

Total current requirement = (USB-1608FS @ 150 mA) + (8 DIO @ 2.5 mA ea) = 170 mA

The maximum available excess current is the difference between the allowed current draw of the computer platform and the total output current requirement of the device. For an application running on a computer or powered hub, the maximum available excess current is calculated as follows:

Maximum excess current = 500 mA – 170 mA = 330 mA

Measurement Computing highly recommends that you figure in a safety factor of 20% below this maximum current loading for your applications. A conservative, safe user maximum in this case would be in the 250 mA to 300 mA range.

Accuracy

The overall accuracy of any instrument is limited by the error components within the system. Resolution is often used incorrectly to quantify the performance of a measurement product. While "16-bits" or "1 part in 65,536" does indicate what can be resolved, it provides little insight into the quality, or accuracy, of an absolute measurement. Accuracy specifications describe the actual measurement achievable with a USB-1608FS.

There are three types of errors which affect the accuracy of a measurement system:

- offset
- gain
- nonlinearity

The primary error sources in the USB-1608FS are offset and gain. Nonlinearity is small, and is not significant as an error source with respect to offset and gain.

Figure 7 shows an ideal, error-free, USB-1608FS transfer function. The typical calibrated accuracy of the USB-1608FS is range-dependent, as explained in the "Specifications" chapter. We use a ±10 V range as an example of what you can expect when performing a measurement in this range.
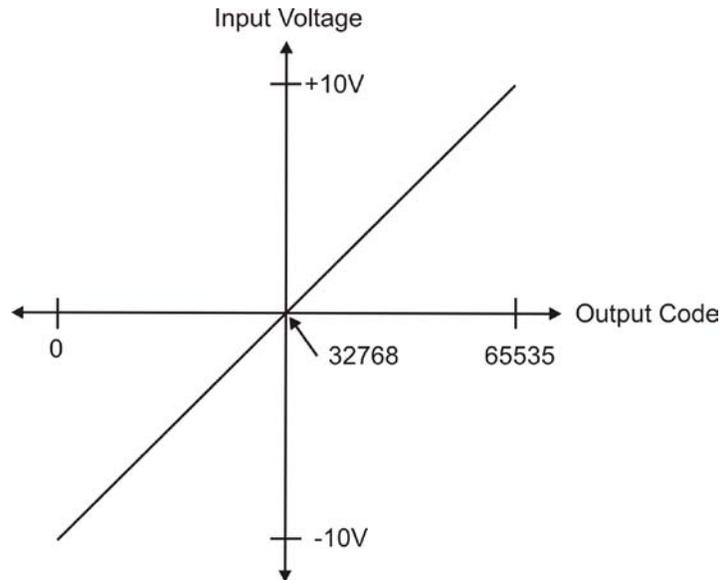

Figure 7. Ideal ADC transfer function

The USB-1608FS offset error is measured at mid-scale. Ideally, a zero volt input should produce an output code of 32768. Any deviation from this is an offset error. Figure 8 shows the USB-1608FS transfer function with an offset error. The typical offset error specification for the USB-1608FS on the ±10 V range is ±1.66 mV. Offset error affects all codes equally by shifting the entire transfer function up or down along the input voltage axis.

The accuracy plots in Figure 8 are drawn for clarity and are not drawn to scale.
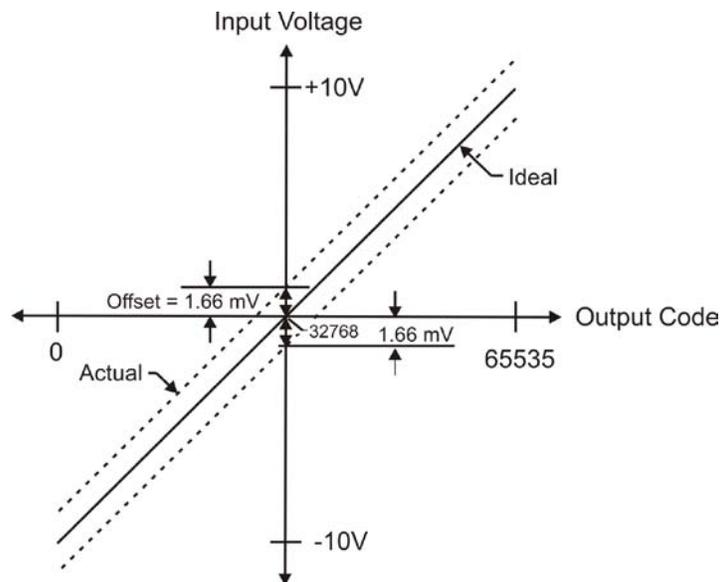
Figure 8. ADC transfer function with offset error

Gain error is a change in the slope of the transfer function from the ideal, and is typically expressed as a percentage of full-scale. Figure 9 shows the USB-1608FS transfer function with gain error. Gain error is easily converted to voltage by multiplying the full-scale input (±10 V) by the error.

The accuracy plots in Figure 9 are drawn for clarity and are not drawn to scale.
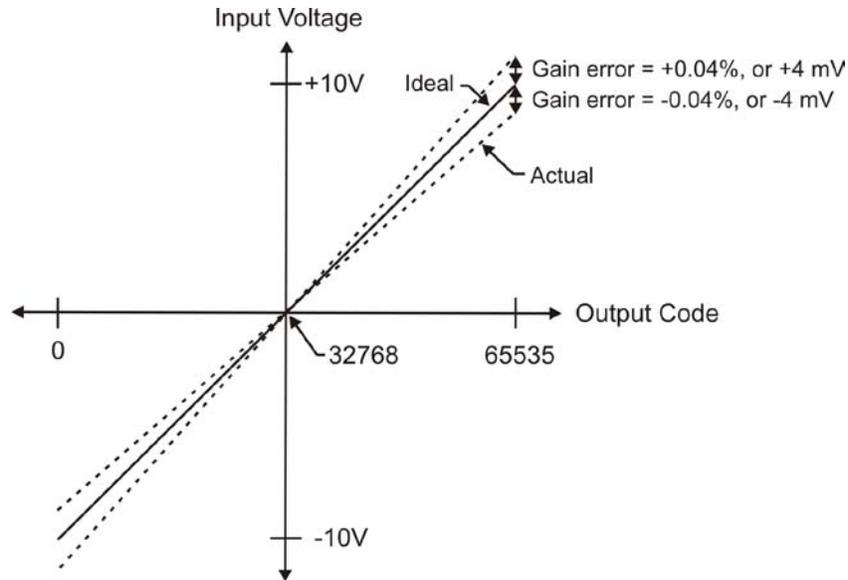
Figure 9. ADC Transfer function with gain error

For example, the USB-1608FS exhibits a typical calibrated gain error of ±0.04% on all ranges. For the ±10 V range, this would yield 10 V × ±0.0002 = ±4 mV. This means that at full scale, neglecting the effect of offset for the moment, the measurement would be within 4 mV of the actual value. Note that gain error is expressed as a ratio. Values near ±FS (±10 V) are more affected from an absolute voltage standpoint than are values near mid-scale, which see little or no voltage error.

Combining these two error sources in Figure 10, we have a plot of the error band of the USB-1608FS at ±full scale (±10 V). This plot is a graphical version of the typical accuracy specification of the product.

The accuracy plots in Figure 10 are drawn for clarity and are not drawn to scale.
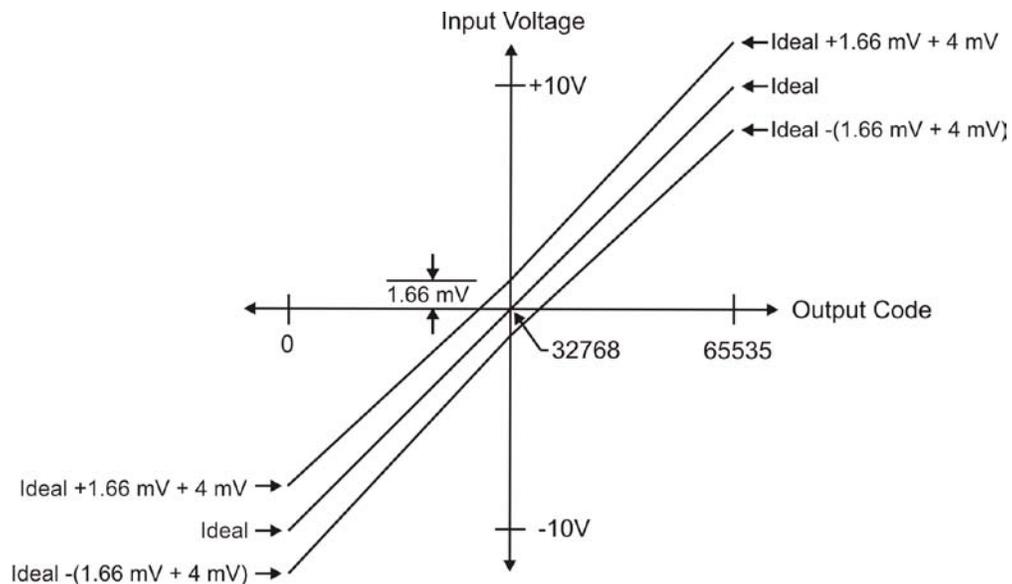
Figure 10. Error band plot

Synchronized operations

You can run up to two USB-1608FS devices on most computers. You can connect the SYNC pin of two devices together in a master/slave configuration and acquire data from the analog inputs of both devices using one clock. When the SYNC pin is configured as an output, the internal A/D pacer clock signal is sent to the screw terminal. You can output the clock to the SYNC pin of a second device that is configured for A/D pacer input.

Change to SYNC pin setting not implemented until first scan

When you change the setting of the SYNC pin to input or to output using InstaCal, the change does not take place until you run a scan with a USB-1608FS.

Consequently, if you change the SYNC pin from output to input, the SYNC pin remains an output, and connections to this pin are connections to an output until the first scan runs. This will not damage the USB-1608FS.

To update the SYNC pin setting before connecting to the SYNC pin, run the InstaCal analog **Scan Test**.

Mechanical drawings

Maximum Component Height
Top: 0.545
Bottom: 0.125
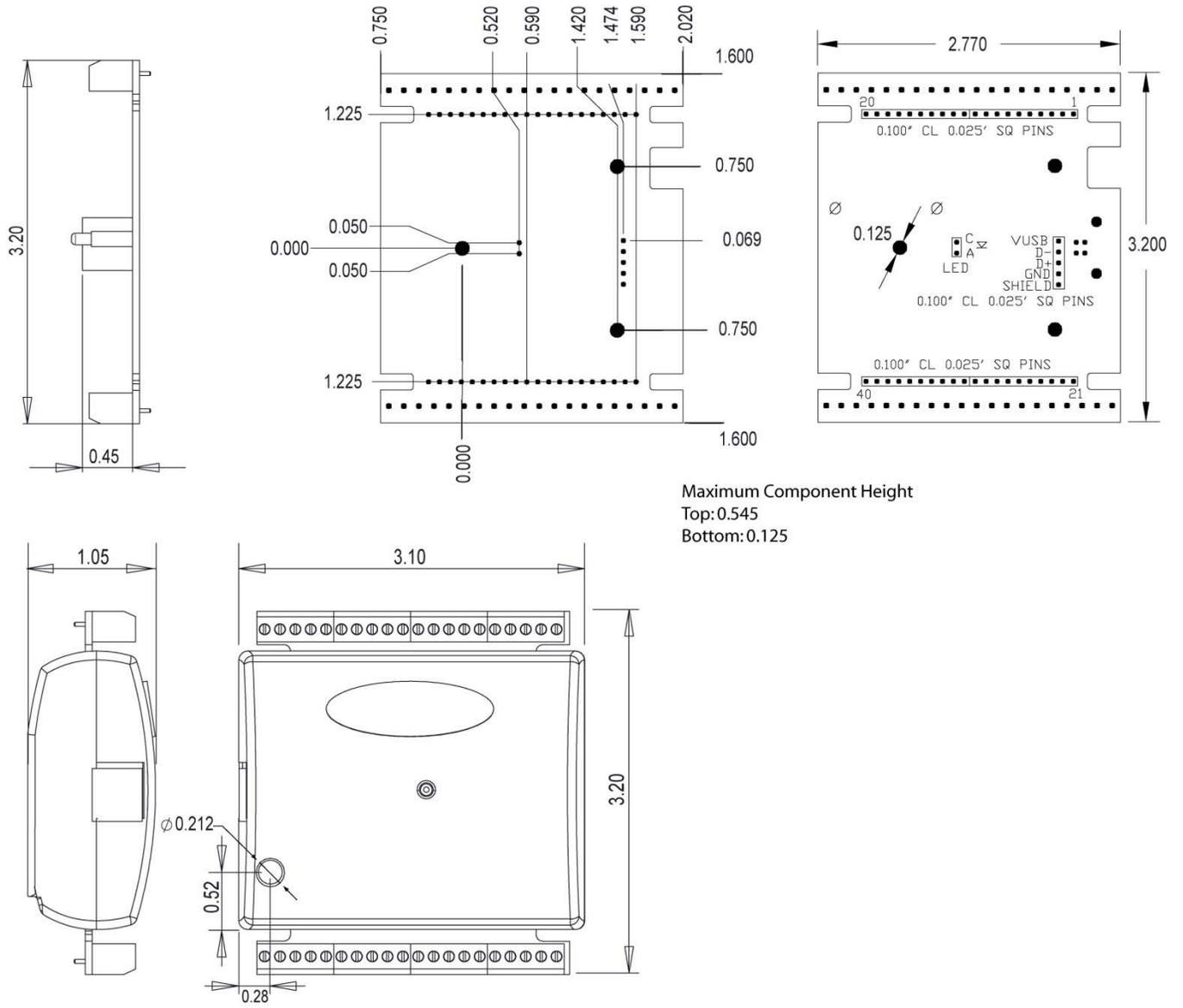
Figure 11. Circuit board (top) and enclosure dimensions

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	Condition	Specification
A/D converter type		16-bit successive approximation type
Number of channels		8 single-ended
Input configuration		Individual A/D per channel
Sampling method		Simultaneous
Absolute maximum input voltage	*CHx IN to GND*	*±15 V max*
Input impedance		100 MΩ, min
Input ranges	Software-selectable	±10 V, ±5 V, ±2 V, ±1 V
Sampling rate	Scan to PC memory	0.6 S/s to 50 kS/s, software-selectable
	Burst scan to 32 k sample FIFO	20 S/s to 50 kS/s, software- selectable
Throughput	Software paced	500 S/s all channels
	Hardware paced (Note 1)	(100 kS/s) / (# of channels), 50 kS/s max for any channel
	BURSTIO ≤ 32,768 total samples (uses onboard FIFO)	(200 kS/s) / (# of channels), 50 kS/s max for any channel
Gain queue		Software configurable.. Eight unique, consecutive elements – one gain element per channel.
Resolution		16 bits
No missing codes		*15 bits*
Crosstalk	Signal DC to 25 kHz	–80 dB
CAL output	User calibration source	0.625 V, 1.25 V, 2.5 V, 5.0 V, software-selectable
CAL output accuracy (Note 2)		±0.5% typ, ±1.0% max
CAL current		±5 mA max
Trigger source	Software-selectable	External digital: TRIG_IN

Note 1: Maximum throughput when scanning in hardware paced mode is machine dependent.

Note 2: Actual values used for calibration are measured and stored in EEPROM.

Table 2. Calibrated absolute accuracy

Range	Accuracy (mV)
±10 V	5.66
±5 V	2.98
±2 V	1.31
±1 V	0.68

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

Range	% of Reading	Gain error at FS (mV)	Offset (mV)
±10 V	0.04	4.00	1.66
±5 V	0.04	2.00	0.98
±2 V	0.04	0.80	0.51
±1 V	0.04	0.40	0.28

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

Table 4. Noise performance

Range	Typical counts	LSBrms
±10 V	10	1.52
±5 V	10	1.52
±2 V	11	1.67
±1 V	14	2.12

Digital I/O

Table 5. Digital I/O specifications

Parameter	Specification
Digital type	CMOS
Number of I/O	8 (DIO0 through DIO7)
Configuration	Independently configured for input or output
Pull-up/pull-down configuration	All pins pulled up to 5V via 47 kΩ resistors (default). Hardware revisions E and later may be changed to pull-down using an internal user-configurable jumper. Previous revisions can be configured for pull-down at the factory.
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 (IOH = –2.5 mA)	3.8 V min
Output low voltage (IOL = 2.5 mA)	0.44 V max
Power on and reset state	Input

External trigger

Table 6. External trigger specifications

Parameter	Condition	Specification
Trigger source	External digital	TRIG_IN
Trigger mode	Software-selectable	Edge sensitive: user configurable for CMOS compatible rising or falling edge.
Trigger latency		10 µs max
Trigger pulse width		1µs min
Input type		Schmitt trigger, 47 kΩ 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 3.1V 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

Table 7. External clock I/O specifications

Parameter	Condition	Specification
Pin name		SYNC
Pin type		Bidirectional
Direction, software-selectable	Input	Receives A/D pacer clock from external source
	Output	Outputs internal A/D pacer clock
Input clock rate		50 kHz, maximum
Clock pulse width	Input	1µs min
	Output	5µs min
Input clock mode		Edge sensitive: rising edge
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 3.1V 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 µA) 3.80 V min (IOH = –8 mA)
Output low voltage		0.1 V max (IOL = 50 µA) 0.44 V max (IOL = 8 mA)

Counter

Table 8. Counter specifications

Parameter	Specification
Pin name	CTR
Counter type	Event counter
Number of channels	1
Input type	Schmitt trigger, 47 kΩ 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 3.1V 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
Maximum input frequency	1 MHz
High pulse width	*500 ns min*
Low pulse width	*500 ns min*

Memory

Table 9. Memory specifications

Parameter	Specification		
Data FIFO	32,768 samples, 65,536 bytes		
EEPROM	1,024 bytes		
EEPROM configuration	**Address range**	**Access**	**Description**
	0x000-0x07F	Reserved	128 bytes system data
	0x080-0x1FF	Read/write	384 bytes cal data
	0x200-0x3FF	Read/write	512 bytes user area

Microcontroller

Table 10. Microcontroller specifications

Parameter	Specification
Type	*High performance 32-bit RISC microcontroller*

Power

Table 11. Power specifications

Parameter	Condition	Specification
Supply current	USB enumeration	< 100 mA
Supply current (Note 3)	Continuous mode	150 mA
PC +5 V voltage range (Note 4)	■ Connected to self-powered hub ■ Connected to externally-powered root port hub	4.25 V min, 5.25 V max
PC +5V output current (Note 5)		300 mA max

Note 3: This is the total current requirement for the USB-1608FS which includes up to 10 mA for the status LED.

Note 4: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the PC USB host Controller. The USB port(s) on your PC are root port hubs. All externally-powered root port hubs, such as a desktop PC, provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop PC is constrained to the 100 mA maximum, you need to purchase a self-powered hub.

Note 5: This refers to the total amount of current that can be sourced from the USB +5 V and digital outputs.

General

Table 12. General specifications

Parameter	Specification
Device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0

Environmental

Table 13. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 70 °C
Storage temperature range	–40 °C to 70 °C
Humidity	0% to 90% non-condensing

Mechanical

Table 14. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	3.10 × 3.20 × 1.05 in. (79 × 82 × 27 mm)
USB cable length	3 m (9.84 ft) max
User connection length	3 m (9.84 ft) max

Screw terminal connector and pinout

Table 15. Connector specifications

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

Table 16. Connector pinout

Pin	Signal Name	Pin	Signal Name
1	CH0 IN	21	DIO0
2	AGND	22	GND
3	CH1 IN	23	DIO1
4	AGND	24	GND
5	CH2 IN	25	DIO2
6	AGND	26	GND
7	CH3 IN	27	DIO3
8	AGND	28	GND
9	CH4 IN	29	DIO4
10	AGND	30	GND
11	CH5 IN	31	DIO5
12	AGND	32	GND
13	CH6 IN	33	DIO6
14	AGND	34	GND
15	CH7 IN	35	DIO7
16	AGND	36	SYNC
17	CAL	37	TRIG_IN
18	AGND	38	CTR
19	AGND	39	PC +5V
20	AGND	40	GND

$C\epsilon$ Declaration of Conformity

Manufacturer:	Measurement Computing Corporation
Address:	10 Commerce Way
	Suite 1008
	Norton, MA 02766
	USA
Category:	Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

USB-1608FS

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.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in May, 2004. Test records are outlined in Chomerics Test Report #EMI3876.04. Further testing was conducted by Chomerics Test Services, Woburn, MA. 01801, USA in December, 2008. Test records are outlined in Chomerics Test report #EMI5215B.08.

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

Carl Haapaoja, Director of Quality Assurance