

# USB-1608FS-Plus-OEM

Analog and Digital I/O

## User's Guide

## Trademark and Copyright Information

Measurement Computing Corporation, InstaCal, Universal Library, and the Measurement Computing logo are either trademarks or registered trademarks of Measurement Computing Corporation. Refer to the Copyrights & Trademarks section on [mccdaq.com/legal](http://mccdaq.com/legal) for more information about Measurement Computing trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies.

© 2014 Measurement Computing Corporation. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form by any means, electronic, mechanical, by photocopying, recording, or otherwise without the prior written permission of Measurement Computing Corporation.

### Notice

Measurement Computing Corporation does not authorize any Measurement Computing Corporation product for use in life support systems and/or devices without prior written consent from Measurement Computing Corporation. Life support devices/systems are devices or systems that, a) are intended for surgical implantation into the body, or b) support or sustain life and whose failure to perform can be reasonably expected to result in injury. Measurement Computing Corporation products are not designed with the components required, and are not subject to the testing required to ensure a level of reliability suitable for the treatment and diagnosis of people.

---

# Table of Contents

<b>Preface</b>	
<b>About this User's Guide .....</b>	<b>5</b>
What you will learn from this user's guide .....	5
Conventions in this user's guide .....	5
Where to find more information .....	5
<b>Chapter 1</b>	
<b>Introducing the USB-1608FS-Plus-OEM .....</b>	<b>6</b>
Functional block diagram .....	7
<b>Chapter 2</b>	
<b>Installing a USB-1608FS-Plus-OEM.....</b>	<b>8</b>
Unpacking.....	8
Downloading the software.....	8
Installing the hardware .....	8
Installing on a Windows platform.....	8
Installing on an Android platform.....	8
Calibrating the hardware.....	8
<b>Chapter 3</b>	
<b>Functional Details .....</b>	<b>9</b>
Analog input modes .....	9
Software paced.....	9
Hardware paced .....	9
BURSTIO .....	9
Board components .....	10
USB connector.....	10
LED .....	10
Header connectors.....	11
Signal connections.....	11
Analog input .....	11
Channel-Gain queue .....	11
Digital I/O.....	12
Pull-up/down configuration .....	12
Counter input .....	13
SYNC I/O .....	13
Trigger input .....	13
Reserved .....	13
Ground.....	13
Power output.....	13
Accuracy.....	14
Synchronized operations.....	16
Mechanical drawings.....	16
<b>Chapter 4</b>	
<b>Specifications .....</b>	<b>17</b>
Analog input .....	17
Accuracy.....	17
Analog input DC voltage measurement accuracy .....	17
Noise performance.....	18
Digital input/output.....	18
External trigger.....	19
External clock input/output.....	19
Counter section .....	20

Memory .....	20
Microcontroller .....	20
Power .....	21
General .....	21
Environmental .....	21
Mechanical .....	21
Header connector and pinout .....	21

---

## About this User's Guide

### What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-1608FS-Plus-OEM 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

Additional information about the USB-1608FS-Plus-OEM is available on our website at [www.mccdaq.com](http://www.mccdaq.com). You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.[mccdaq.com](http://www.mccdaq.com)
- Tech support form: [www.mccdaq.com/support/support\\_form.aspx](http://www.mccdaq.com/support/support_form.aspx)
- Email: [techsupport@mccdaq.com](mailto: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](http://www.mccdaq.com/International).

---

## Introducing the USB-1608FS-Plus-OEM

The USB-1608FS-Plus-OEM is a USB 2.0 full-speed 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  $\pm 10$  V,  $\pm 5$  V,  $\pm 2$  V, and  $\pm 1$  V
- Eight individually configurable digital I/O channels
- One 32-bit event counter
- One external digital trigger input
- Bidirectional external clock for synchronous operation with more than one device.
- Two header connectors for field wiring connections

The USB-1608FS-Plus-OEM device 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).

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

**Caution!** There are no product safety, electromagnetic compatibility (EMC), or CE marking compliance claims made for the USB-1608FS-Plus-OEM. The USB-1608FS-Plus-OEM is intended for use as a component of a larger system. MCC can help developers meet their compliance requirements. The end product supplier, however, is responsible for conforming to any and all compliance requirements.

## Functional block diagram

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

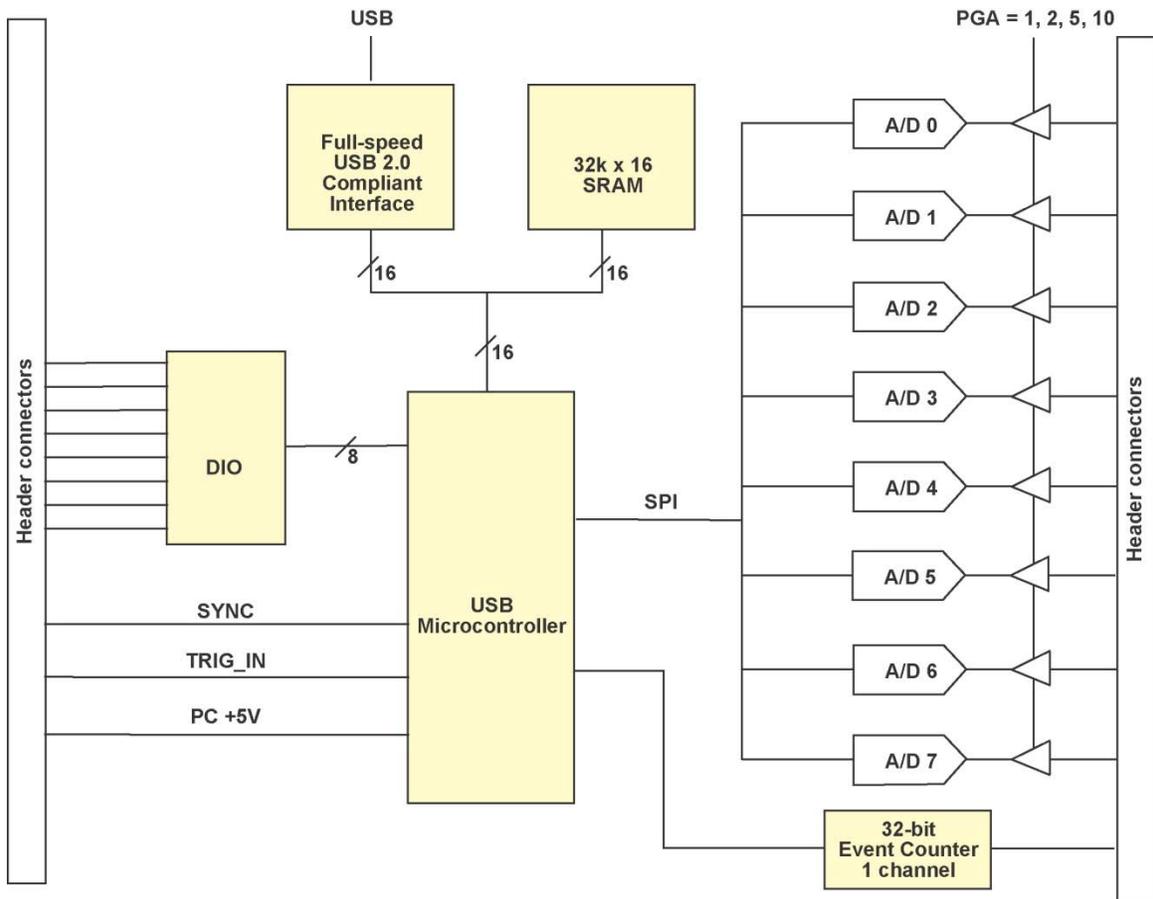


Figure 1. Functional block diagram

---

# Installing a USB-1608FS-Plus-OEM

## Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the board 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.

## Downloading the software

Refer to the USB-1608FS-Plus-OEM product page on the Measurement Computing website for information about the supported software you can download.

### **Install the software before you install the hardware**

The driver needed to run the device is installed when you install the software. Therefore, you need to install the software package you plan to use before you install the hardware.

## Installing the hardware

### Installing on a Windows platform

Connect the USB-1608FS-Plus-OEM to a to an available USB port on the computer running Windows, 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 cable to the USB connector on the device. No external power is required.

When connected for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. When the dialog closes, the installation is complete. The device LED turns on after the device is successfully installed.

### **If the LED turns off**

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

### Installing on an Android platform

Many Android devices include a standard A-type USB port to connect to the USB-1608FS-Plus-OEM. If your device does not have a USB port, you may need a USB OTG cable in order for your Android device to host a USB device. Refer to your Android device documentation for more information.

## Calibrating the hardware

The Measurement Computing Manufacturing Test department performs the initial factory calibration. Return the device to Measurement Computing Corporation when calibration is required. The recommended calibration interval is one year.

Field calibration is not supported.

---

## Functional Details

### Analog input modes

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

#### Software paced

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

#### Hardware paced

The USB-1608FS-Plus-OEM 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 device until you stop the scan. Data is transferred in blocks from the device to the memory buffer on your computer.

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

The maximum sampling rate is an aggregate rate. The total sample rate using hardware-paced mode is 400 kS/s divided by the number of channels, with a maximum rate of 100 kS/s for any channel. You can acquire data from one to four channels at 100 kS/s each, six channels at 66.7 kS/s each, and so on, up to eight channels at 50 kS/s each. You can start a hardware-paced scan with a software command. Optionally, hardware-paced scans can be delayed by an external hardware trigger event.

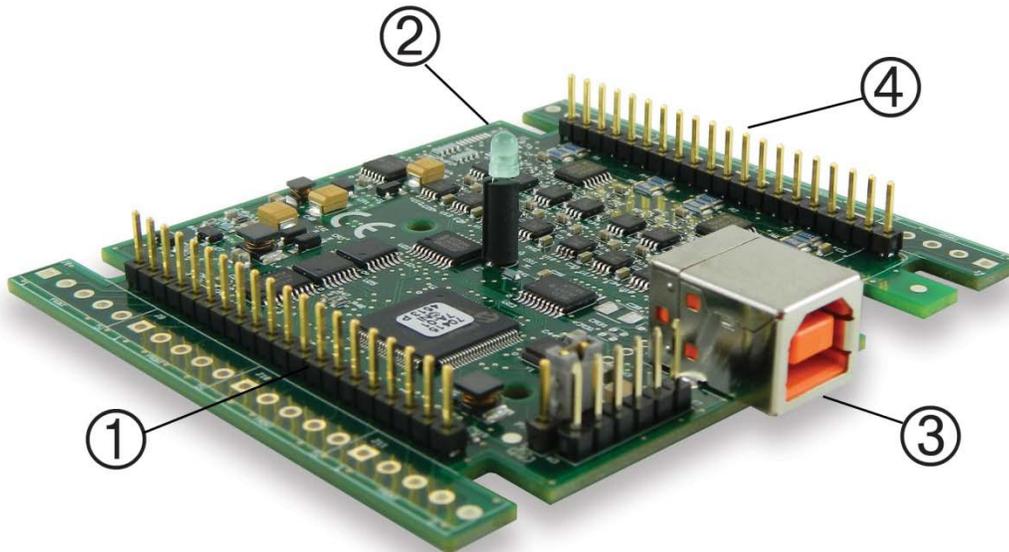
#### BURSTIO

When using BURSTIO, the USB-1608FS-Plus-OEM can acquire data at a higher rate using the full capacity of the 32 kilosample FIFO. The acquired data is 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 to 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 of 800 kS/s. The maximum per channel sample rate is 100 kS/s for any or all channels.

## Board components

Board components are shown in Figure 2.



- |   |                            |   |                           |
|---|----------------------------|---|---------------------------|
| 1 | Header connectors 21 to 40 | 3 | USB connector             |
| 2 | LED                        | 4 | Header connectors 1 to 20 |

Figure 2. Board components

### USB connector

Receives the supplied USB cable. When connected to a computer or USB hub, the cable provides +5 V power and communication. No external power supply is required.

### LED

The LED indicates the USB communication status; it cannot be disabled.

#### 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	An analog input scan is in progress.

## Header connectors

The header connectors provide connections for the analog inputs, analog ground, DIO, clock I/O, trigger, counter, power output, and digital ground reference.

Header connector pinout (refer to Figure 2 for pin numbering)

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

## Signal connections

### Analog input

You can connect up to eight analog input connections to the header connector containing pins 1 to 20 (**CH0 IN** through **CH7 IN**.) Connect unused analog inputs to ground connectors during operation. For example, if you are not using **CH7 IN**, ground this connector to **AGND**.

All analog input channels are configured for single-ended input mode. All analog input signals are referenced to ground (**AGND**):

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

The input voltage ranges are  $\pm 10$  V,  $\pm 5$  V,  $\pm 2.0$  V,  $\pm 1.0$  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](http://www.mccdaq.com/signals/signals.pdf)).

### Channel-Gain queue

The channel-gain queue feature allows you to configure a different gain setting for each 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 can contain up to eight unique elements. The channel list must be in increasing order. An example of a five element list is shown in the table below.

Sample channel-gain queue list

Element	Channel	Range
0	CH0	BIP1V
1	CH2	BIP2V
2	CH4	BIP10V
3	CH6	BIP1V
4	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 3.

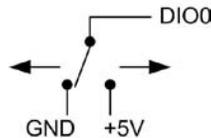


Figure 3. Schematic showing switch detection by digital channel DIO0

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

All digital I/O lines are pulled up to USB +5V (HI) with a 47 kΩ resistor (default). You can change the pull-up/down configuration using the internal jumper labeled **DIO**. You must remove the device housing to access the jumper on the circuit board.

To set the jumper for pull-up or pull-down, complete the following steps.

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-Plus-OEM 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.

Figure 4 shows the location of the **DIO** jumper on the circuit board.

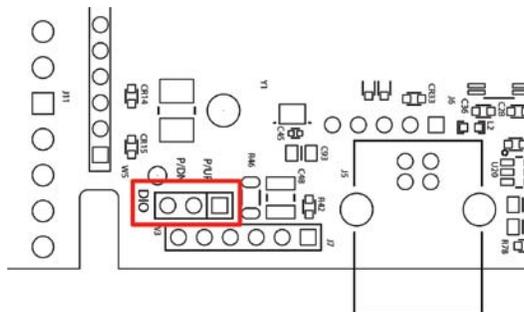


Figure 4. Pull-up/down jumper location

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

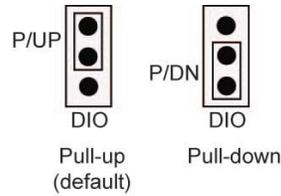


Figure 5. Pull-up/down jumper configuration

- 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](http://www.mccdaq.com/signals/signals.pdf)).

## Counter input

The **CTR** connector 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.

## SYNC I/O

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

- Configure as an external clock input to pace the A/D conversions from an external source. The SYNC connector supports TTL-level input signals of up to 100 kHz.
- Configure as an output that may be used to pace conversions on a second device and acquire data from 16 channels. Refer to page 16 for more information about synchronized operations.

## Trigger input

The **TRIG\_IN** connector is an external digital trigger input. The trigger mode is software-selectable for edge or level sensitive. Edge sensitive mode is selectable for rising or falling. Level sensitive mode is selectable for high or low.

## Reserved

The **RSVD** connector is reserved for future use.

## Ground

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

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

## Power output

The **PC +5V** output connector can output up to 200 mA maximum. You can use this connector to supply power to external devices or circuitry.

**Caution!** The PC +5V connector is an output. Do not connect it to an external power supply or you may damage the device and possibly the computer.

The maximum output current that can be drawn by the USB-1608FS-Plus-OEM 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. 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.

When running applications with the device, each DIO bit can source up to 24 mA. The total amount of current that can be sourced from the PC +5V, SYNC, and digital outputs is 200 mA max.

## 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-Plus-OEM. [Accuracy specifications](#) are listed on page 17.

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

- offset
- gain
- nonlinearity

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

Figure 6 shows an ideal, error-free transfer function. The typical calibrated accuracy of a USB-1608FS-Plus-OEM is range-dependent. We use a  $\pm 10$  V range as an example of what you can expect when performing a measurement in this range.

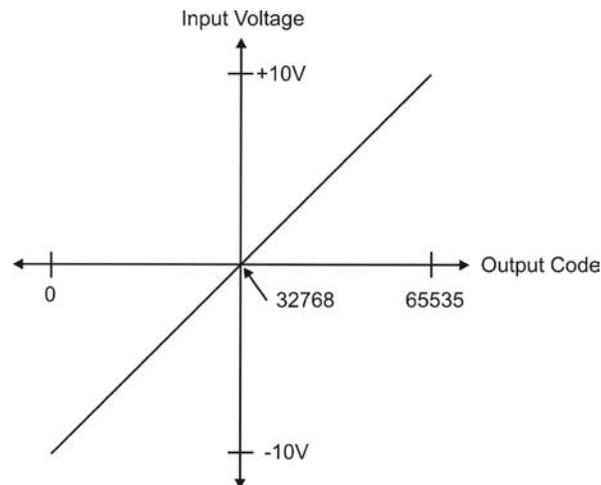


Figure 6. Ideal ADC transfer function

The offset error is measured at mid-scale. Ideally, a zero volt input should produce an output code of 32,768. Any deviation from this is an offset error. Figure 7 shows the transfer function with an offset error. The typical offset error specification for a USB-1608FS-Plus-OEM on the  $\pm 10$  V range is  $\pm 1.66$  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 7 are drawn for clarity and are not drawn to scale.

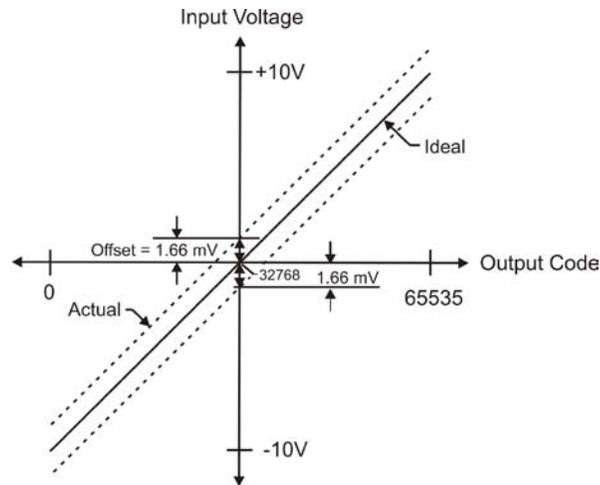


Figure 7. ADC transfer function with offset error

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 8 shows the USB-1608FS-Plus-OEM transfer function with gain error. Gain error is easily converted to voltage by multiplying the full-scale input ( $\pm 10\text{ V}$ ) by the error.

The accuracy plots in Figure 8 are drawn for clarity and are not drawn to scale.

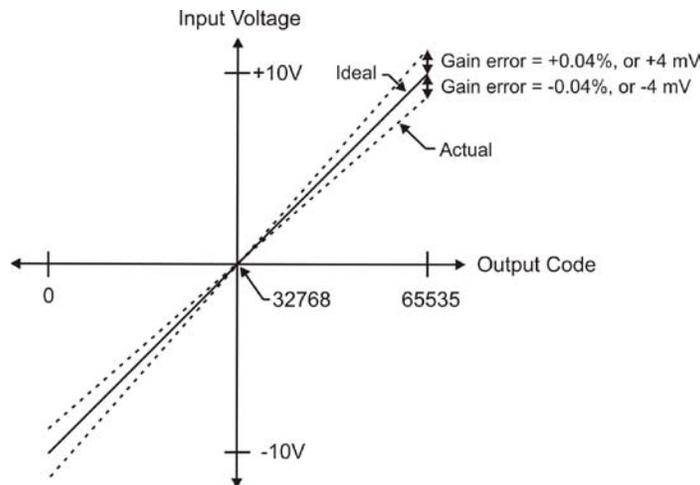


Figure 8. ADC Transfer function with gain error

For example, a USB-1608FS-Plus-OEM exhibits a typical calibrated gain error of  $\pm 0.04\%$  on all ranges. For the  $\pm 10\text{ V}$  range, this would yield  $10\text{ V} \times \pm 0.0002 = \pm 4\text{ mV}$ . 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  $\pm\text{FS}$  ( $\pm 10\text{ V}$ ) 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 9, we have a plot of the error band at  $\pm$ full scale ( $\pm 10\text{ V}$ ). This plot is a graphical version of the typical accuracy specification of the product.

The accuracy plots in Figure 9 are drawn for clarity and are not drawn to scale.

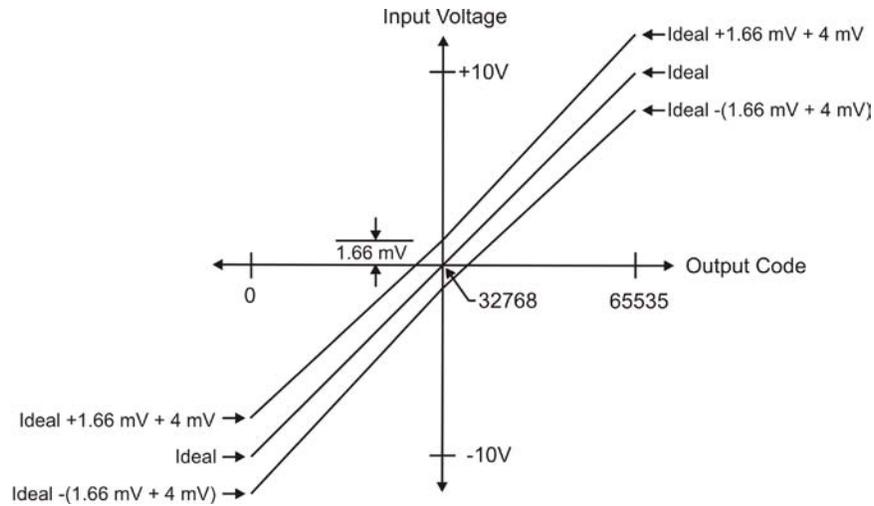


Figure 9. Error band plot

### Synchronized operations

You can connect the SYNC pin of multiple devices together in a master/slave configuration and acquire data from the analog inputs of all devices using one clock.

When the SYNC pin is configured as an output, the internal A/D pacer clock signal is sent to the header connector. You can output the clock to the SYNC pin of another device that is configured for A/D pacer input.

### Mechanical drawings

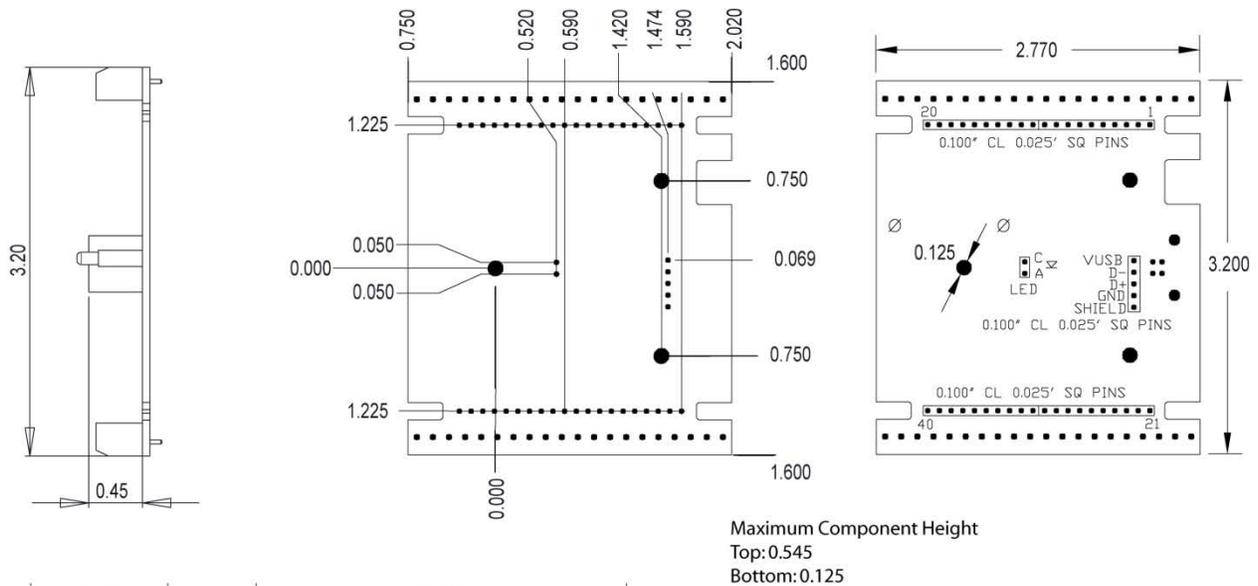


Figure 10. USB-1608FS-Plus-OEM circuit board dimensions

## 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. General 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
<i>Absolute maximum input voltage</i>	<i>CHx IN relative to GND</i>	<i>±15 V max</i>
Input impedance		100 MΩ min
Input ranges	Software-selectable per channel	±10 V, ±5 V, ±2 V, ±1 V
Sampling rate	Hardware paced	0.01 S/s to 100 kS/s, software-selectable
Throughput	Software paced	500 S/s all channels
	Hardware paced (Note 1)	(400 kS/s) / (# of channels) max, 100 kS/s max for any channel
	BURSTIO ≤ 32,768 total samples (uses onboard FIFO)	(800 kS/s) / (# of channels) max, 100 kS/s max for any channel
Gain queue		Software configurable. Up to eight elements – one gain element per unique, ordered channel.
Resolution		16 bits
<i>No missing codes</i>		<i>16 bits</i>
Crosstalk	Signal DC to 25 kHz	-80 dB
Trigger source	Software-selectable	External digital: TRIG_IN

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

### Accuracy

#### Analog input DC voltage measurement accuracy

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 ( $\pm$ )

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

## Noise performance

Table 4. Noise performance

Range	Typical counts	LSBrms
$\pm 10$ V	10	1.52
$\pm 5$ V	10	1.52
$\pm 2$ V	11	1.67
$\pm 1$ V	14	2.12

Table 4 summarizes the noise performance for the USB-1608FS-Plus-OEM. 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 100 kS/s.

## Digital input/output

Table 5. Digital I/O specifications

Parameter	Specification
Digital type	5V TTL
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 K resistors (default). May be changed to pull-down using an internal jumper.
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 $\mu$ A) 3.76 V min (IOH = -24 mA)
Output low voltage	0.1 V max (IOL = 50 $\mu$ A) 0.44 V max (IOL = 24 mA)
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 or level sensitive: user configurable for CMOS compatible rising or falling edge, high or low level.
Trigger latency		2 $\mu$ s + 1 pacer clock cycle max
Trigger pulse width		1 $\mu$ s min
Input type		Schmitt trigger, 47 k $\Omega$ 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		100 kHz, max
Clock pulse width	Input	1 $\mu$ s min
	Output	4 $\mu$ s min
Input clock mode		Edge sensitive, rising
Input type		Schmitt trigger, 47 k $\Omega$ 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
Output high voltage		4.4 V min (IOH = -50 $\mu$ A) 3.80 V min (IOH = -8 mA)
Output low voltage		0.1 V max (IOL = 50 $\mu$ A) 0.44 V max (IOL = 8 mA)

## Counter section

Table 8. Counter specifications

Parameter	Specification
Pin name	CTR
Counter type	Event counter
Number of channels	1
Input type	Schmitt trigger, 47 k $\Omega$ pull-down to ground
Input source	CTR header pin
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
Input frequency	1 MHz max
<i>High pulse width</i>	<i>500 ns min</i>
<i>Low pulse width</i>	<i>500 ns min</i>

## Memory

Table 9. Memory specifications

Parameter	Specification
Data FIFO	32,768 samples, 65,536 bytes
EEPROM	2,048 bytes (768 bytes calibration, 256 bytes user, 1,024 bytes DAQFlex)

## Microcontroller

Table 10. Microcontroller specifications

Parameter	Specification
<i>Type</i>	<i>High performance 32-bit RISC microcontroller</i>

## Power

Table 11. Power specifications

Parameter	Condition	Specification
Supply current	USB enumeration	< 100 mA
Supply current	Including DIO and SYNC output loading	< 500 mA
+5V power available (Note 2)	Connected to externally-powered root port hub or a self-powered hub	4.5 V min, 5.25 V max
Output current (Note 3)		200 mA max

**Note 2:** "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 3:** Output current is the total amount of current that can be sourced from the PC +5V, SYNC, 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)	81.28 × 73.66 × 15.24 mm (3.20 × 2.9 × 0.6 in.)
USB cable length	3 m (9.84 ft) max
User connection length	3 m (9.84 ft) max

## Header connector and pinout

Table 15. Connector specifications

Parameter	Specification
Connector type	Two 20-pin, 0.1 in. pitch headers

Table 16. Header connectors

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	RSVD	37	TRIG_IN
18	AGND	38	CTR
19	AGND	39	+VO
20	AGND	40	GND

**Measurement Computing Corporation**  
**10 Commerce Way**  
**Suite 1008**  
**Norton, Massachusetts 02766**  
**(508) 946-5100**  
**Fax: (508) 946-9500**  
**E-mail: [info@mccdaq.com](mailto:info@mccdaq.com)**  
**[www.mccdaq.com](http://www.mccdaq.com)**