

USB-1608FS

USB-based Analog and Digital I/O Module

User's Guide



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Introducing the USB-1608FS

This user's guide contains all of the information you need to connect the USB-1608FS to your computer and to the signals you want to measure. The USB-1608FS is part of the Measurement Computing brand of USB-based data acquisition products.

The USB-1608FS is a USB 2.0 full-speed device supported under popular Microsoft® Windows® operating systems. It is designed for USB 1.1 ports, and was tested for full compatibility with both USB 1.1 and USB 2.0 ports.

The USB-1608FS offers true simultaneous sampling of up to eight channels of 16-bit single-ended analog input. This is accomplished through the use of one A/D converter per channel. The range of each channel is independently configurable via software. Eight digital IO lines are independently selectable as input or output. A 32-bit counter is capable of counting TTL pulses. The USB-1608FS is powered by the +5 volt USB supply from your computer. No external power is required.

A SYNC (synchronization) control line allows you to synchronize two USB-1608FS modules together to acquire data synchronously from 16 analog inputs.

The USB-1608FS is shown in Figure 1-1. I/O connections are made to the screw terminals located along each side of the USB-1608FS.



Figure 1-1. USB-1608FS

External components

The USB-1608FS has the following external components, as shown in Figure 3-1.

- USB connector
- LED
- Screw terminal banks (2)

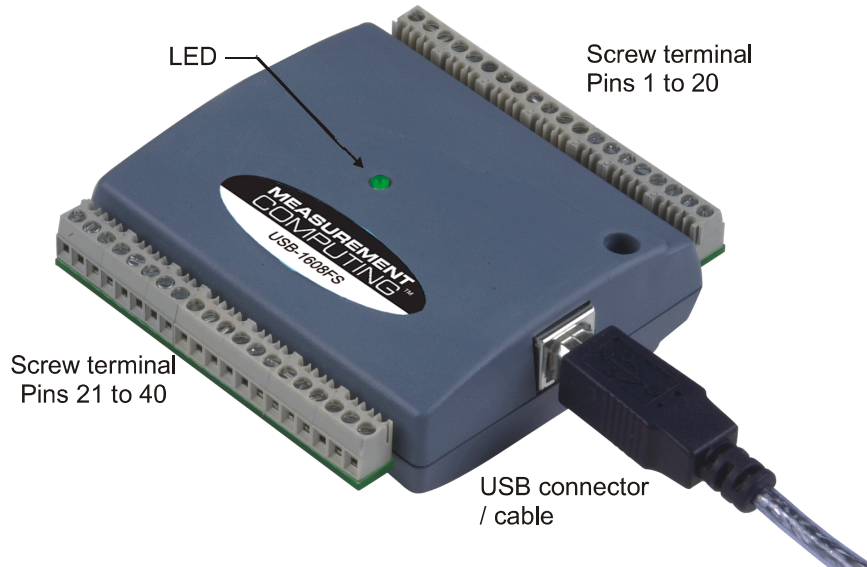


Figure 3-1. USB-1608FS

USB connector

The USB connector is on the right side of the USB-1608FS. This connector provides +5 V power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than 5 V. No external power supply is required.

LED

The LED on the front of the USB-1608FS indicates the communication status. It uses up to 5 mA of current and cannot be disabled. Table 3-1 explains the function of the USB-1608FS LED.

Table 3-1 LED Illumination

When the LED is...	It indicates...
Steady green	The USB-1608FS is connected to a computer or external USB hub.
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 terminal wiring

The USB-1608FS has two rows of screw terminals—one row on the top edge of the housing, and one row on the bottom edge. Each row has 20 connections. Pin numbers are identified in Figure 3-2.

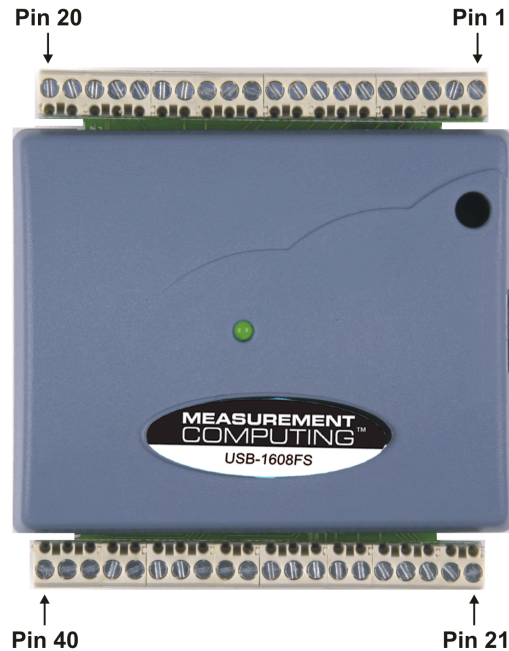


Figure 3-2. USB-1608FS screw terminal pin numbers

Screw terminal – pins 1-20

The screw terminals on the top edge of the USB-1608FS (pins 1 to 20) provide the following connections:

- Eight analog input connections (**CH0 IN** to **CH7 IN**)
- Eleven analog ground connections (**AGND**)
- One calibration output terminal (**CAL**)

Screw terminal – pins 21-40

The screw terminals on the bottom edge of the USB-1608FS (pins 21 to 40) provide the following connections:

- Eight digital I/O connections (**DIO0** to **DIO7**)
- One external trigger source (**TRIG_IN**)
- One external event counter connection (**CTR**)
- One power connection (**PC+5 V**)
- One SYNC terminal for external clocking and multi-unit synchronization (**SYNC**)
- Eight ground connections (**GND**)

Main connector and pin out

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

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Analog input section

Table 1. Analog input specifications

Parameter	Conditions	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 to GND.</i>	<i>±15 V max</i>
Input impedance		100 MOhm, 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 programmable
	Burst scan to 32 k sample FIFO	20 S/s to 50 kS/s, software programmable
Throughput	Software paced	500 S/s all channels
	Scan to PC memory (Note 1)	= (100 kS/s) / (# of channels), max of 50 kS/s for any channel
	Burst scan to 32 k sample FIFO	= (200 kS/s) / (# of channels), max of 50 kS/s for any channel
Gain queue		Software configurable. Eight elements, one gain element per channel.
Resolution		16 bits
<i>No missing codes</i>		<i>15 bits</i>
Crosstalk	Signal DC-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 scanning to PC memory is machine dependent. While the majority of XP equipped PC's we tested allowed acquisition at the maximum rates, a few would not. The lowest maximum rate we observed on an XP equipped PC during multi-channel testing was 95 kS/s, aggregate. The rates specified are for Windows XP only. Maximum rates on operating systems that predate XP may be less and must be determined through testing on your machine.

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 (\pm)

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 input/output

Table 5. Digital I/O specifications

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 V_s via 47 K resistors (default). Positions available for pull down to ground. Hardware selectable via zero ohm resistors as a factory option.
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 ($I_{OH} = -2.5$ mA)	3.8 V min
Output low voltage ($I_{OL} = 2.5$ mA)	0.7 V max
Power on and reset state	Input

External trigger

Table 6. External trigger specifications

Parameter	Conditions	Specification
Trigger source (Note 3)	External digital	TRIG_IN
Trigger mode	Software selectable	Edge sensitive: user configurable for CMOS compatible rising or falling edge.
Trigger latency		10 μ s max
Trigger pulse width		1 μ s min
Input high voltage		4.0 V min, 5.5 V absolute max
Input low voltage		1.0 V max, -0.5 V absolute min
Input leakage current		$\pm 1.0 \mu$ A

Note 3: TRIG_IN is a Schmitt trigger input protected with a 1.5K Ohm series resistor.

Main connector and pin out

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

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