USB-1608FS Series

USB DAQ Devices with 8 Simultaneous Analog Inputs

Features

- 16-bit resolution
- 8 single-ended analog input channels
- Simultaneous sampling (1 A/D converter per input)
- Up to 400 kS/s overall throughput (100 kS/s max for any channel)
- 8 digital I/O
- 1 event counter
- External clock I/O
- External digital trigger input
- No external power required

Software

- TracerDAQ® software included for acquiring and displaying data
- Universal Library includes support for Visual Studio® and Visual Studio® .NET, including examples for Visual C++®, Visual C#®, Visual Basic®, and Visual Basic® .NET
- InstaCal software utility for installing, calibrating, and testing
- ULx for NI LabVIEW™
- DAQFlex open-source software framework – includes support for Linux®, and Mac® platforms (USB-1608FS-Plus only)
- Comprehensive drivers for DASYLab®
- USB-1608FS supported by MATLAB® Data Acquisition Toolbox™
- Supported Operating Systems: Windows® 8/7/Vista®/XP SP2, 32-bit or 64-bit

Overview

USB-1608FS Series consists of the following low-cost, analog and digital I/O devices:

- USB-1608FS
- USB-1608FS-Plus

These devices provide eight single-ended (SE), simultaneous-sampling 16-bit analog inputs, eight DIO, one event counter, one external digital trigger input, and one bidirectional external clock.

Everything you need to begin acquiring, viewing, and storing data is included with each USB-1608FS Series device, including comprehensive software support.

The USB-1608FS-Plus offers 8 simultaneous analog inputs at up to 100 kS/sec per channel (400kS/sec overall), 8 digital I/O, and one event counter input.

USB-1608FS Series Selection Chart

Specification	USB-1608FS	USB-1608FS-Plus
Analog Inputs	8 Single-Ended	8 Single-Ended
A/D Sampling Rate (Continuous Scan to Computer Memory)	(100 kS/s) ÷ (# of channels) 50 kS/s max for any channel	(400 kS/s) ÷ (# of channels) 100 kS/s max for any channel
Channel-Gain Queue	Up to 8 unique, consecutive elements	Up to 8 unique, ordered elements; consecutive not required
Digital Output Current	±2.5 mA per pin	±24 mA per pin
Calibration	Factory and user calibration	Factory calibration only
External Clock Input	50 kHz max	100 kHz max
TriggerSensitivity	Edge sensitive	Edge or level sensitive
Counter Input	One 32-bit event counter; 1 MHz input frequency max	
DAQFlex Support	–	✔

Analog Input

Both devices provide eight SE 16-bit analog input channels with a dedicated A/D converter per channel for simultaneous sampling. The devices offer software-selectable analog input ranges for ±10 V, ±5 V, ±2 V, and ±1 V.

Sampling Rate

USB-1608FS Series devices offer the following sampling rates when scanning continuously to computer memory (hardware-paced mode):

- USB-1608FS-Plus - Total rate of 400 kS/s divided by the number of channels sampled; maximum rate of 100 kS/s per channel.
- USB-1608FS - Total rate of 100 kS/s divided by the number of channels sampled; maximum rate of 50 kS/s per channel.

USB-1608FS Series
General Information

Simultaneous Sampling
In hardware paced mode, both devices can acquire data from up to eight channels simultaneously. The analog data is continuously acquired, converted to digital values, temporarily stored in the onboard FIFO buffer, and periodically uploaded to the computer.

Channel-Gain Queue
The channel-gain queue lets you configure a list of channels and gains for each scan. Each channel can have a different gain setting. 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 for both devices can contain up to eight unique channels.

On the USB-1608FS, the channels must be consecutive and listed in increasing order.

On the USB-1608FS-Plus, the channels can be non-consecutive, but still must be listed in increasing order.

Digital I/O
Both devices provide eight digital I/O connections. Each digital channel is individually-configurable for input or output. When configured for input, you can use the digital I/O terminals to detect the state of any TTL-level input.

On the USB-1608FS-Plus, the digital I/O channels are high-drive (24 mA) connections.

Pull-Up/Pull-Down Configuration
Recent revisions of USB-1608FS Series devices have a user-configurable internal jumper to configure the digital bits for pull-up (default) or pull-down.

Counter Input
The USB-1608FS-Plus has a 32-bit event counter that can accept a signal up to 1 MHz. The internal counter increments when the TTL levels transition from low to high.

External Clock I/O
Each USB-1608FS Series device has a bidirectional external clock terminal. When configured for input, A/D conversions can be paced by an external source.

The USB-1608FS supports TTL-level input signals up to 50 kHz.

The USB-1608FS-Plus supports TTL-level input signals up to 100 kHz.

When configured for output, both devices can pace A/D conversions on a second device and acquire data from all input channels simultaneously.

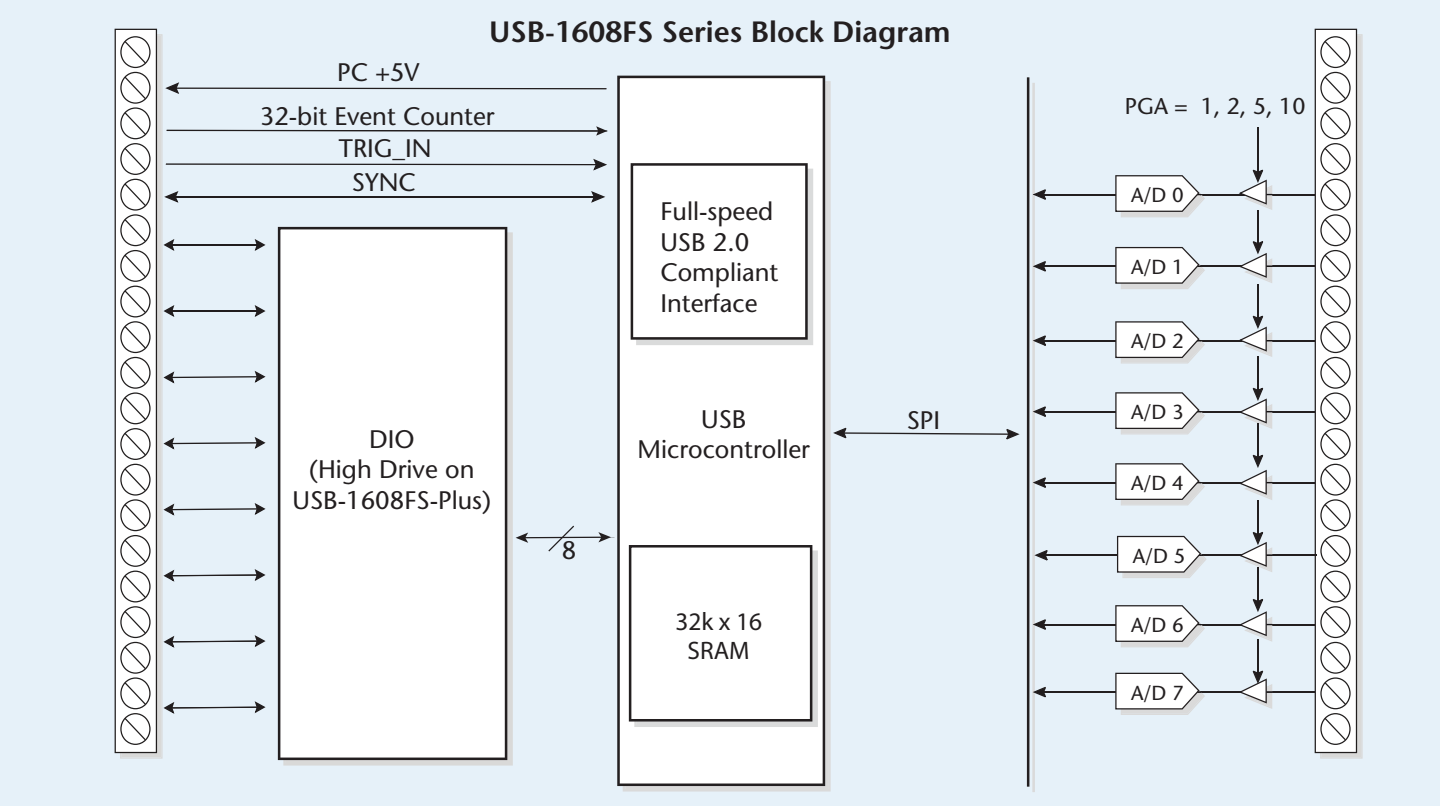
Trigger Input
USB-1608FS Series devices provide an external digital trigger input.

The USB-1608FS trigger mode is edge sensitive and software-selectable for rising or falling edge

The USB-1608FS-Plus trigger mode is edge or level sensitive. Edge sensitive is software-selectable for rising or falling edge. Level sensitive is software-selectable for high or low level.

Calibration
Each USB-1608FS Series device ships fully calibrated and can be re-calibrated at the factory.

The USB-1608FS also supports user calibration.



MCC DAQ Software

Each device ships with the MCC DAQ software CD, which includes InstaCal, a software utility for installing, calibrating, and testing Measurement Computing hardware, along with the following software packages:

TracerDAQ

TracerDAQ is an out-of-the-box application that can generate, acquire, analyze, display, and export data within seconds of installing Measurement Computing data acquisition hardware. TracerDAQ includes a strip chart, an oscilloscope, a function generator, and a rate generator, all of which are accessed through a common, easy-to-use interface.

TracerDAQ provides four virtual instrument applications used to graphically display and store input data.

USB-1608FS Series
General Information & Specifications

Universal Library
The Universal Library (UL) is a set of programming libraries for developing applications with Visual Studio programming languages (and others) for use with Measurement Computing hardware. UL includes a complete function library that simplifies the configuration and operation of your measurement device. UL supports Visual Studio and Visual Studio .NET, and includes 64-bit driver support for Windows 8, 7 and Vista.

ULx for NI LabVIEW
ULx for NI LabVIEW is a comprehensive library of graphical functions and example programs comprising all the power of the Universal Library. ULx for NI LabVIEW is compatible with NI LabVIEW 8.5 and later, and allows quick development of NI LabVIEW instrumentation, acquisition, and control applications with Measurement Computing hardware.

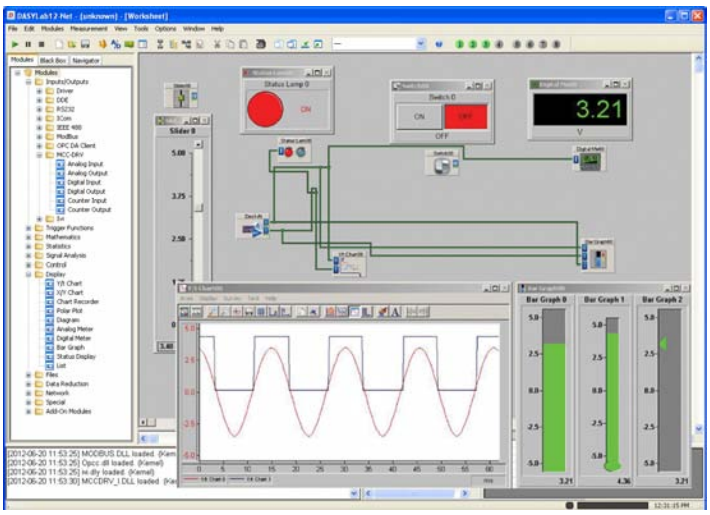
Software Available Separately

DAQFlex (USB-1608FS-Plus Only)
The DAQFlex framework is available as a free download from www.mccdaq.com. For DAQ programming in virtually any OS – including Linux and Mac platforms – DAQFlex combines a small footprint driver with a message-based command protocol. The simplicity of the driver is enabled with a message-based protocol that offers an efficient yet powerful interface to DAQ devices and a common command set that simplifies application development.

TracerDAQ Pro
TracerDAQ Pro is available as a purchased upgrade to TracerDAQ. TracerDAQ Pro supports more active channels, more samples per channel, and a selection of options and enhancements designed to address many test and measurement applications.

DASYLab
Customers needing more performance than TracerDAQ Pro provides can purchase DASYLab, an icon-based data acquisition, graphics, control, and analysis software package. DASYLab offers real-time analysis and control, and provides the ability to create custom graphical user interfaces without programming.

Compared to other graphical programming environments, DASYLab has a very short user-learning curve. Many applications can be configured in a few minutes, rather than days or weeks.



DASYLab gives users the ability to create applications by simply dragging-and-dropping functional icons on a worksheet, connecting the icons together, and running the program. DASYLab supports most MCC data acquisition hardware.

The USB-1608FS is also supported by the MATLAB Data Acquisition Toolbox.

Specifications

General
Environment
- **Operating Temperature Range:** 0 °C to 70 °C
- **Storage Temperature Range:** –40 °C to 70 °C
- **Humidity:** 0% to 90% non-condensing

Dimensions (L × W × H): 79 × 82 × 27 mm (3.10 × 3.20 × 1.05 in.)
Microcontroller Type: High performance 32-bit RISC
Communications: USB 2.0 full-speed; USB 1.1 compatible
Signal I/O Connector Type: Screw terminal
USB Cable Length: 3 m (9.84 ft) max
User Connection Length: 3 m (9.84 ft) max

Analog Input
A/D Converter Type: 16-bit successive approximation type
Channels: 8 single-ended
Input Configuration: Individual A/D per channel
Sampling Method: Simultaneous
Absolute Maximum Input Voltage
- **CHx IN Relative to GND:** ±15 V max

Input Impedance: 100 MΩ min
Input Ranges: ±10 V, ±5 V, ±2 V, ±1 V; software-selectable per channel
Sampling Rate (Hardware Paced)
- **USB-1608FS:** 0.6 S/s to 50 kS/s, software-selectable
- **USB-1608FS-Plus:** 0.01 S/s to 100 kS/s, software-selectable

USB-1608FS Series
Specifications

Throughput
- **Software Paced:** 500 S/s all channels
- **Hardware Paced (System-Dependent)**
  - **USB-1608FS:** (100 kS/s)/(# of channels) max, 50 kS/s max for any channel
  - **USB-1608FS-Plus:** (400 kS/s)/(# of channels) max, 100 kS/s max for any channel
- **Burst Scan ≤ 32,768 Total Samples (Uses Onboard FIFO)**
  - **USB-1608FS:** (200 kS/s)/(# of channels) max, 50 kS/s max for any channel
  - **USB-1608FS-Plus:** (800 kS/s)/(# of channels) max, 100 kS/s max for any channel

Gain Queue
- **USB-1608FS:** Up to eight elements; one gain element per unique, consecutive channel; software-selectable
- **USB-1608FS-Plus:** Up to eight elements; one gain element per unique, ordered channel; software-selectable
- **Resolution:** 16 bits

No Missing Codes
- **USB-1608FS:** 15 bits
- **USB-1608FS-Plus:** 16 bits

Crosstalk
- **Signal DC to 25 kHz:** –80 dB

CAL Output (USB-1608FS Only): 0.625 V, 1.25 V, 2.5 V, 5 V
CAL Output Accuracy (USB-1608FS Only): 0.5% typ, 1.0% max (actual values used for calibration are measured and stored in EEPROM)
CAL Current (USB-1608FS Only): ±5 mA max
Trigger Source (Software-Selectable)
- **External Digital:** TRIG_IN

Accuracy

Analog Input DC Voltage Measurement Accuracy

Calibrated Absolute Accuracy	
Range	**Accuracy**
±10 V	5.66 mV
±5 V	2.98 mV
±2 V	1.31 mV
±1 V	0.68 mV

Accuracy Components All values are (±)			
Range	**Gain Error (% of Reading)**	**Gain Error at Full Scale**	**Offset**
±10 V	0.04	4.00 mV	1.66 mV
±5 V	0.04	2.00 mV	0.98 mV
±2 V	0.04	0.80 mV	0.51 mV
±1 V	0.04	0.40 mV	0.28 mV

Noise Performance*		
Range	**Typical Counts**	**Least Significant Bit Root Mean Square (LSB_{RMS})**
±10 V	10	1.52
±5 V	10	1.52
±2 V	11	1.67
±1 V	14	2.12

* Summarizes the noise performance for USB-1608FS Series devices. 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 rates of 50 kS/s (USB-1608FS) and 100 kS/s (USB-1608FS-Plus).

Digital Input/Output

Digital Type
- **USB-1608FS:** CMOS
- **USB-1608FS-Plus:** 5 V 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 5 V via 47 kΩ resistors (default). May be changed to pull-down using an internal jumper.[1]
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
- **USB-1608FS (IOH = –2.5 mA):** 3.8 V min
- **USB-1608FS-Plus:** 4.4 V min (IOH = –50 µA); 3.76 V min (IOH = –24 mA)

Output Low Voltage
- **USB-1608FS (IOL = 2.5 mA):** 0.44 V max
- **USB-1608FS-Plus:** 0.1 V max (IOL = 50 µA); 0.44 V max (IOL = 24 mA)

Power On and Reset State: Input

External Trigger

Trigger Source
- **External Digital:** TRIG_IN

Trigger Mode (Software-Selectable)
- **USB-1608FS:** Edge sensitive: user configurable for CMOS compatible rising or falling edge
- **USB-1608FS-Plus:** Edge sensitive or level sensitive: user configurable for CMOS compatible rising or falling edge, high or low level.

Trigger Latency
- **USB-1608FS:** 10 µs max
- **USB-1608FS-Plus:** 2 µs + 1 pacer clock cycle max

Trigger Pulse Width: 1 µs 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, 3.1 V 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 I/O

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
- **USB-1608FS:** 50 kHz max
- **USB-1608FS-Plus:** 100 kHz max

Clock Pulse Width
- **Input:** 1 µs min
- **Output**
  - **USB-1608FS:** 5 µs min
  - **USB-1608FS-Plus:** 4 µs min

Input Clock Mode: Edge sensitive, rising edge
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, 3.1 V 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)

1 **USB-1608FS** 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.

Counter

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, 3.1 V 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
High Pulse Width: 500 ns min
Low Pulse Width: 500 ns min

Power

Supply Current
  USB Enumeration: < 100 mA
  Including DIO and SYNC Output Loading: < 500 mA
+5 V USB Power Available (Connected to Externally-Powered Root Port Hub or a Self-Powered Hub): 4.5 V min, 5.25 V max
Output Current (Total Amount of Current that can be Sourced from the USB +5 V and Digital Outputs): 300 mA max

Memory

Data FIFO: 32,768 samples, 65,536 bytes
USB-1608FS
  EEPROM: 1,024 bytes
  EEPROM Configuration
  Address 0x000 to 0x07F: Reserved access,128 bytes system data
  Address 0x080 to 0x1FF: Read/write access, 84 bytes cal data
  Address 0x200 to 0x3FF: Read/write access, 512 bytes user area
USB-1608FS-Plus:
  EEPROM: 2,048 bytes (768 bytes calibration, 256 bytes user,1,024 bytes DAQFlex)

Ordering Information

Description	Part No.
USB-based DAQ device with 8 simultaneous 16-bit 100 kS/s analog inputs and 8 digital I/O	USB-1608FS
USB-based DAQ device with 8 simultaneous 16-bit 100 kS/s analog inputs, 8 high-current digital I/O, and DAQFlex support	USB-1608FS-Plus

Software

Icon-based data acquisition, graphics, control, and analysis software	DASYLab
Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version	TracerDAQ Pro