USB-1608FS-Plus
USB DAQ Device 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 800 kS/s overall throughput (100 kS/s max for any channel)**
- **8 digital I/O**
- **1 event counter**
- **External digital trigger input**
- **No external power required**

Software
- **TracerDAQ® software included for acquiring and displaying data and generating signals**
- **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 installation, calibration, and test**
- **ULx for NI LabVIEW™**
- **DAQFlex open-source software framework; compatible with Windows® 7/Vista®/XP SP2, 32-bit or 64-bit, Linux®, and Mac® platforms**
- **Comprehensive drivers for DASYLab®**
- **Supported by MATLAB® Data Acquisition Toolbox™**
- **Supported Operating Systems: Windows 7/Vista®/XP SP2, 32-bit or 64-bit; Linux and Mac supported by the DAQFlex framework**

Overview
The USB-1608FS-Plus is a full-speed simultaneous-sampling USB device that provides eight single-ended 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-Plus device, including comprehensive software support.

The USB-1608FS-Plus provides eight single-ended analog inputs, a maximum sampling rate of 100 kS/s, simultaneous sampling, 8 digital I/O, and one counter input.

Analog Input
Each of the eight single-ended 16-bit analog input channels has a dedicated A/D converter for simultaneous sampling. The device offers software-selectable analog input ranges for ±10 V, ±5 V, ±2 V, and ±1 V.

Sampling Rate
The USB-1608FS-Plus acquires analog input data using software paced, hardware paced, or burst scan mode.

In software paced mode, the typical throughput sampling rate is 500 S/s (system-dependent).

In hardware paced mode, the total sampling rate is 400 kS/s divided by the number of channels being sampled, with a maximum rate of 100 kS/s for any channel.

In burst scan mode, the total sampling rate is 800 kS/s divided by the number of channels being sampled, with a maximum rate of 100 kS/s for any channel. Burst scan mode is limited to acquisitions up to 32,768 samples, which is the capacity of the USB-1608FS-Plus FIFO.

Simultaneous Sampling
In hardware paced mode, the USB-1608FS-Plus can acquire data from up to eight channels simultaneously. The analog data is continuously acquired, converted to digital values, and written to the onboard FIFO buffer until the scan stops. Data is then transferred in blocks from the device to the computer.

Channel-Gain Queue
The channel-gain queue feature 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 USB-1608FS-Plus channel-gain queue list can contain up to eight unique channels. The channels can be non-consecutive, but must be listed in increasing order.

USB-1608FS-Plus
General Information

Digital I/O

The USB-1608FS-Plus provides eight high-drive (24 mA) 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.

Pull-Up/Pull-Down Configuration

USB-1608FS-Plus 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 frequency inputs up to 1 MHz. The internal counter increments when the TTL levels transition from low to high.

External Clock

Each USB-1608FS-Plus device has a bidirectional external clock terminal.

When configured for input, A/D conversions can be paced by an external source. The USB-1608FS-Plus supports TTL-level input signals up to 100 kHz.

When configured for output, the USB-1608FS-Plus can pace A/D conversions on a second device and acquire data from all input channels simultaneously.

Trigger Input

The USB-1608FS-Plus provides an external digital trigger input with a trigger mode that is edge sensitive or level sensitive. Edge sensitive is software-selectable for rising or falling edge. Level sensitive is software-selectable for high or low level.

Calibration

The USB-1608FS-Plus ships fully calibrated and can be re-calibrated at the factory.

MCC DAQ Software

Each USB-1608FS-Plus 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.
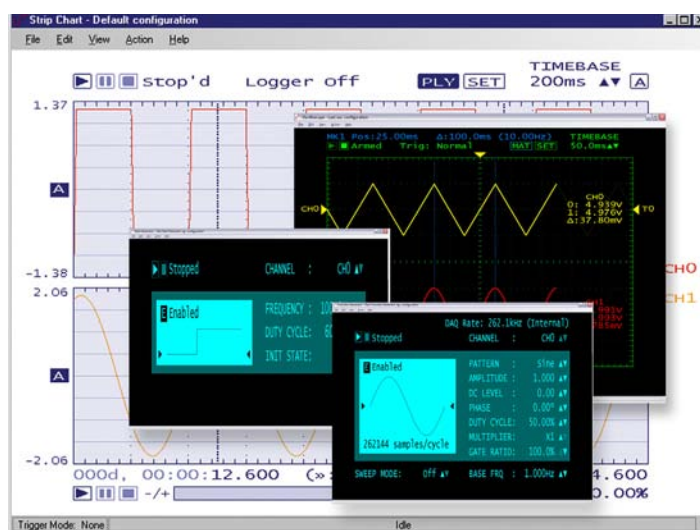
TracerDAQ provides four virtual instrument applications used to graphically display and store input data

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 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 and InstaCal. 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.

USB-1608FS-Plus
General Information & Specifications

USB-1608FS-Plus Block Diagram
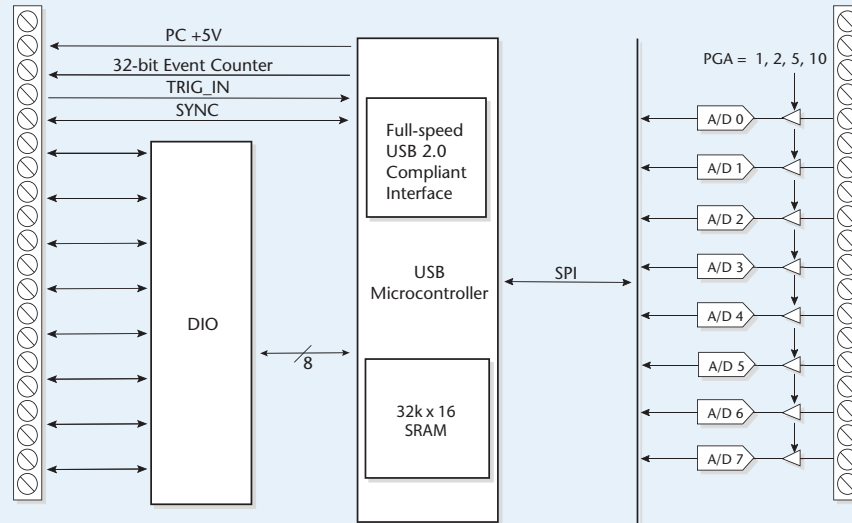
DAQFlex

For DAQ programming in virtually any OS, the DAQFlex framework 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.

Software Available Separately

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.

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

Specifications

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): 0.01 S/s to 100 kS/s, software-selectable

Throughput
  Software Paced: 500 S/s all channels
  Hardware Paced (System-Dependent): (400 kS/s)/(# of channels) max, 100 kS/s max for any channel
  Burst Scan ≤ 32,768 Total Samples (Uses Onboard FIFO): (800 kS/s)/(# of channels) max, 100 kS/s max for any channel
Gain Queue: Up to eight elements; one gain element per unique, ordered channel; software-selectable
  Resolution: 16 bits
No Missing Codes: 16 bits
Crosstalk
  Signal DC to 25 kHz: –80 dB
Trigger Source: External digital; software-selectable

Accuracy

Analog Input DC Voltage Measurement Accuracy

Calibrated Absolute Accuracy	
Range	**Accuracy (mv)**
±10 V	5.66
±5 V	2.98
±2 V	1.31
±1 V	0.68

Accuracy Components All values are (±)			
Range	**Gain Error (% 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

USB-1608FS-Plus
Specifications & Ordering

Noise Performance*		
Range	Typical Counts	LSBrms
±10 V	10	1.52
±5 V	10	1.52
±2 V	11	1.67
±1 V	14	12.12

* Summarizes the noise performance for the USB-1608FS-Plus. 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

Digital Type: 5 V TTL
Number of I/O: 8
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.
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 µA); 3.76 V min (IOH = –24 mA)
Output Low Voltage: 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): Edge sensitive or level sensitive: user configurable for CMOS compatible rising or falling edge, high or low level.
Trigger Latency: 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: 100 kHz, max
Clock Pulse Width
 Input: 1 µs min
 Output: 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)

Counter

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, 3.1 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
EEPROM: 2,048 bytes (768 bytes calibration, 256 bytes user, 1,024 bytes DAQFlex)

General

Environmental
 Operating Temperature Range: 0 °C to 70 °C
 Storage Temperature Range: –40 °C to 70 °C
 Humidity: 0% to 90% non-condensing
Mechanical Dimensions (L × W × H): 79 × 82 × 27 mm (3.10 × 3.20 × 1.05 in.)
Microcontroller Type: High performance 32-bit RISC
Signal I/O Connector Type: Screw terminal

USB Specifications

Device Type: USB 2.0 full-speed; USB 1.1 compatible
USB Cable Length: 3 m (9.84 ft) max
User Connection Length: 3 m (9.84 ft) max

Ordering Information

Description	Part No.
USB-based DAQ device with 8 simultaneous 16-bit analog inputs and 8 digital I/O	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