

# USB-1616FS-Plus

## Simultaneous Sampling Multifunction DAQ Device



The USB-1616FS-Plus features simultaneous sampling of 16 single-ended analog inputs, 8 DIO lines, and a 32-bit event counter

### Features

- 16 single-ended analog inputs
- 16-bit resolution
- Up to 500 kS/s throughput
- Simultaneous sampling
- 8 digital I/O
- 32-bit counter
- USB expansion port for multi-unit daisy-chaining
- External power adapter
- Rugged enclosure
- DIN rail or bench mountable

### Supported Operating Systems

- Windows® 10/8/7/Vista®XP, 32/64-bit

### Overview

The USB-1616FS-Plus provides simultaneous sampling with a sample rate of 100kS/s maximum for any one channel, and up to 500 kS/s aggregate for multiple channels. The device also features a 32-bit event counter and 8 digital I/O lines.

The USB-1616FS-Plus design features a heavy-duty chassis with integrated mounting slots, ensuring that the device is rugged enough for any DAQ application.

The combination of the USB-1616FS-Plus and Measurement Computing DAQ software suite gives you a complete data acquisition solution that will have you taking measurements in minutes. The device is fully USB plug and play. An external power adapter is included.

### Analog Input

The USB-1616FS-Plus provides 16 single-ended analog inputs. Users can set up a scan list of up to 16 different analog input channels to sample analog inputs at different gains (ranges).

### Simultaneous Sampling

Each analog input channel has a dedicated 16-bit A/D converter for true simultaneous sampling of all 16 inputs.

### Sample Rates

With hardware paced mode, the maximum throughput rate is 100 kS/s for any one channel, up to about 500 kS/s aggregate for multiple channels.

Use burst scan mode to run any number of channels at the maximum rate of 100 kS/s up to the full capacity of the 32K sample FIFO. The maximum sampling rate is 1.6 MS/s aggregate for all channels.

### Digital I/O

Eight digital IO lines are independently selectable as input or output. All pins are configurable with an onboard jumper for +5V or ground via 47 k $\Omega$  resistors.

### Counter Input

The 32-bit event counter accepts frequency inputs up to 10 MHz, and increments when the TTL level transitions from low to high.

### Trigger Input

The external digital trigger input is configurable with software for rising (default) or falling edge.

### External Clock I/O

A bidirectional SYNC (synchronization) control line can be configured to externally clock A/D conversions, or to synchronize with a second USB-1616FS-Plus to acquire data from 32 channels.

### Calibration

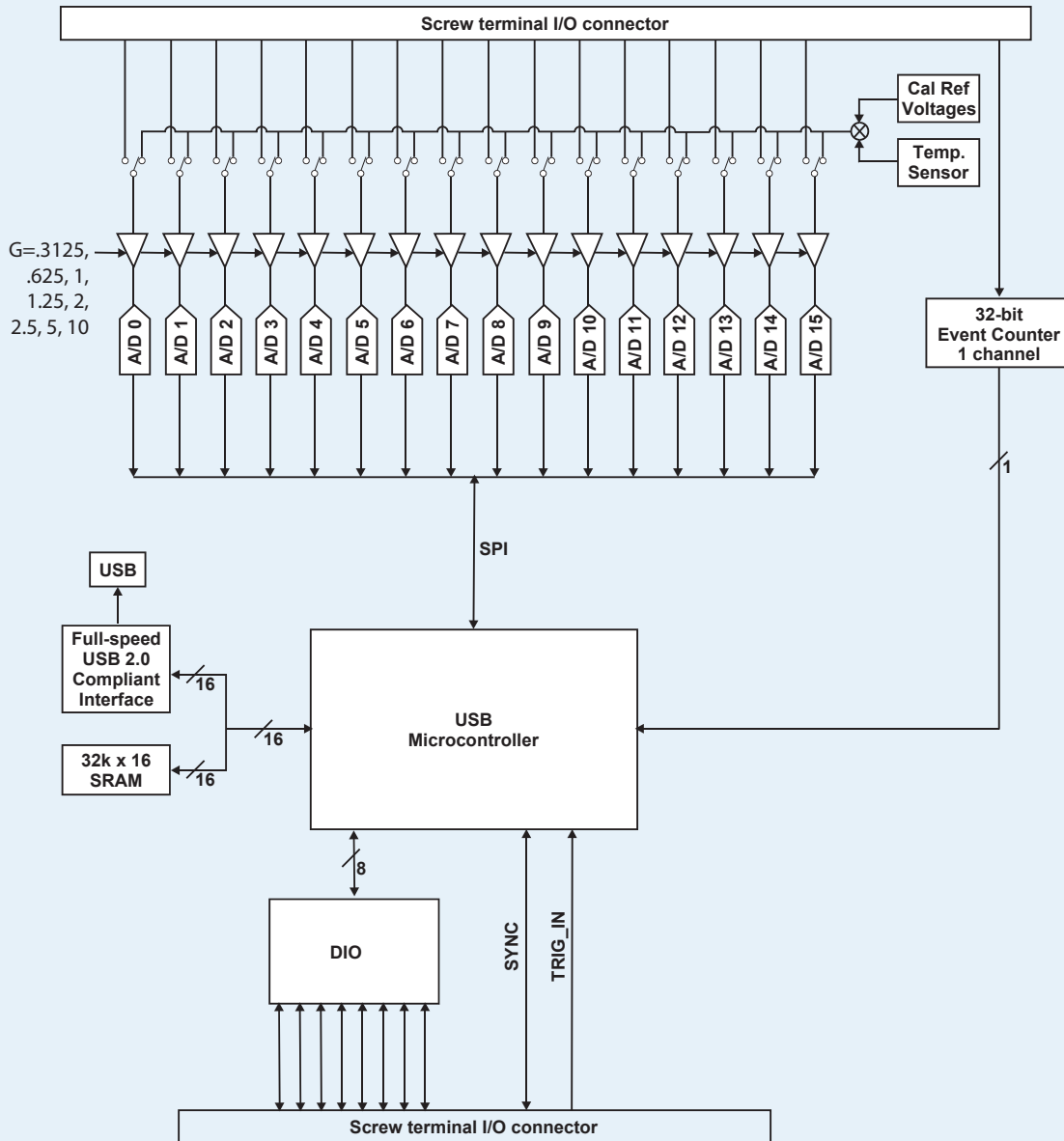
USB-1616FS-Plus devices are factory-calibrated using a NIST-traceable calibration process. Specifications are guaranteed for one year. After one year, return the device to the factory for recalibration.

### Power

The USB-1616FS-Plus receives power from the +9 V unregulated power supply that ships with the device. Power and USB connectors let you power and control multiple MCC USB Series products from one external power source and one USB port in a daisy chain fashion.

# USB-1616FS-Plus

## Block Diagram

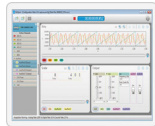


### Software Support

The USB-1616FS-Plus is supported by the software in the table below.

#### Ready-to-Run Applications

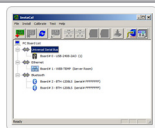
[DAQami™](#)



Data acquisition companion software with drag-and-drop interface that is used to acquire, view, and log data, and generate signals. DAQami can be configured to log analog, digital, and counter channels, and to view that data in real-time or post-acquisition on user-configurable displays. Logged data can be exported for use in Excel® or MATLAB®. Windows OS

DAQami is included with the free MCC DAQ Software bundle (CD/download). Install DAQami and try the fully-functional software for 30 days. After 30 days, all features except for data logging and data export will continue to be available – data logging and data export features can be unlocked by purchasing the software.

[InstaCal™](#)



An interactive installation, configuration, and test utility for MCC hardware. Windows OS

InstaCal is included with the free MCC DAQ Software bundle (CD/download).

[TracerDAQ™](#) and  
[TracerDAQ Pro](#)



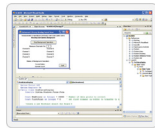
Virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. Supported features may vary by hardware. The Pro version provides enhanced features. Windows OS

TracerDAQ is included with the free MCC DAQ Software bundle (CD/download).

TracerDAQ Pro is available as a purchased software download.

#### General-Purpose Programming Support

[Universal Library™](#)  
(UL)

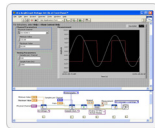


Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python. Windows OS

The UL is included with the free MCC DAQ Software bundle (CD/download).

#### Application-Specific Programming Support

[ULx for](#)  
[NI LabVIEW™](#)



A comprehensive library of VIs and example programs for NI LabVIEW that is used to develop custom applications that interact with most MCC devices. Windows OS

ULx for NI LabVIEW is included with the free MCC DAQ Software bundle (CD/download).

# USB-1616FS-Plus

## Specifications



### Specifications

#### Analog Input

A/D converters: 16-bit, SAR type  
 Number of channels: 16 single-ended  
 Input configuration: Individual A/D per channel  
 Sampling method: Simultaneous  
 Absolute maximum input voltage: CHx IN to GND,  $\pm 15$  V max  
 Input impedance: 100 M $\Omega$ , min  
 Input bandwidth (-3 dB): 170 kHz typ  
 Input leakage current:  $\pm 1$   $\mu$ A typ  
 Input capacitance: 50 pf typ  
 Offset temperature drift: 15 ppm/ $^{\circ}$ C typ  
 Gain temperature drift: All ranges 35 ppm/ $^{\circ}$ C typ  
 Input ranges:  $\pm 10$  V,  $\pm 5$  V,  $\pm 2.5$  V,  $\pm 2$  V,  $\pm 1.25$  V,  $\pm 1$  V,  $\pm 0.625$  V,  $\pm 0.3125$  V;  
 Software selectable

#### Sample rate

Hardware paced: 0.018 S/s to 100 kS/s per channel, software programmable  
 Burst scan to 32 kilosample FIFO: 0.018 S/s to 100 kS/s per channel, software programmable

#### Throughput

Software paced: 30 S/s to 500 S/s all channels; system dependent  
 Hardware paced: Max of 500 kS/s aggregate sample rate (# of channels \* per channel rate)  
 Burst scan to 32 k sample FIFO: Max of 16 \* 100 kS/s  
 Gain queue: Software configurable. Up to 16 elements – one gain element per unique, ordered channel.

Resolution: 16 bits

No missing codes: 15 bits

Crosstalk: DC – 25 kHz (sine): -80 dB min

Trigger source: Software selectable. External digital TRIG\_IN

Calibrated Absolute Accuracy	
Range (V)	Accuracy (mV)
$\pm 10$	$\pm 6.25$
$\pm 5$	$\pm 3.15$
$\pm 2.5$	$\pm 1.55$
$\pm 2$	$\pm 1.35$
$\pm 1.25$	$\pm 1.02$
$\pm 1$	$\pm 0.90$
$\pm 0.625$	$\pm 0.75$
$\pm 0.3125$	$\pm 0.62$

Accuracy components			
Range (V)	% of Reading	Gain Error at FS (mV)	Offset (mV)
$\pm 10$	0.04	4.000	2.25
$\pm 5$	0.04	2.000	1.15
$\pm 2.5$	0.04	1.000	0.55
$\pm 2$	0.04	0.800	0.55
$\pm 1.25$	0.04	0.500	0.52
$\pm 1$	0.04	0.400	0.50
$\pm 0.625$	0.04	0.250	0.50
$\pm 0.3125$	0.04	0.125	0.50

All values are ( $\pm$ )

Noise Performance		
Range (V)	Typical Counts	LSBrms
$\pm 10$	10	1.52
$\pm 5$	10	1.52
$\pm 2.5$	10	1.52
$\pm 2$	11	1.67
$\pm 1.25$	12	1.81
$\pm 1$	14	2.12
$\pm 0.625$	20	3.03
$\pm 0.3125$	38	5.75

Noise distribution is determined by gathering 50 k samples with analog inputs tied to ground (AGND) at the user connector. Samples are gathered at the maximum specified sampling rate of 100 kS/s.

#### Analog input calibration

Recommended warm-up time: 30 minutes min

Calibration method: Factory

Calibration interval: 1 year (factory calibration)

#### Digital I/O

Digital type: 5 V TTL input / CMOS output

Number of I/O: 8 (DIO0 through DIO7)

Configuration: Independently configured for input or output

Digital I/O transfer rate (software paced) System dependent, 33 port reads to 1000 port reads/writes or single bit reads/writes per second, typ

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: 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

Pull up/pull-down configuration: All pins are configurable via jumper W1 to 5 V or ground via 47 k $\Omega$  resistors

#### External Trigger

Trigger source: External digital TRIG\_IN

Trigger mode: Software selectable. Edge sensitive – user configurable for CMOS compatible rising (default) or falling edge

Trigger latency: 2  $\mu$ s max

Trigger pulse width: 1  $\mu$ s min

Input type: Schmitt trigger, 47 k $\Omega$  pull-down to ground and 1.5 k $\Omega$  series resistor

Schmitt trigger hysteresis: 0.6 V min, 1.5 V max

Input high voltage threshold: 3.1 V max

Input low voltage threshold: 1.0 V min

#### External Clock I/O

Pin name: SYNC

Pin type: Bidirectional

Software selectable direction

Output: Outputs internal A/D pacer clock

Input: Receives A/D pacer clock from external source; rising edge sensitive.

Input clock rate: 100 kHz, max

Clock pulse width

Input: 1  $\mu$ s min

Output: 5  $\mu$ s min

Input type: Schmitt trigger

Input/output resistance: 200  $\Omega$  series resistor on output driver; 1.5 k $\Omega$  series resistor on input buffer; 47 k $\Omega$  pull-down resistor to ground

Schmitt trigger hysteresis: 0.6 V min, 1.5 V max

Input high voltage threshold: 3.1 V max

Input low voltage threshold: 1.0 V min

Output high voltage

IOH = -8 mA: 3.8 V min

No load: 4.4 V min

Output low voltage

IOH = 8 mA: 0.44 V max

No load: 0.1 V max

# USB-1616FS-Plus

## Specifications and Ordering



### Counter

**Pin name:** CTR

**Counter type:** Event counter

**Number of channels:** 1

**Resolution:** 32 bits

**Maximum input frequency:** 10 MHz

**High pulse width:** 50 ns min

**Low pulse width:** 50 ns min

**Counter/timer read/write rates** (software paced)

**Counter read:** system dependent, 33 reads to 1,000 reads per second

**Counter clear:** system dependent, 33 reads to 1,000 writes per second

**Input low voltage limit:** 0 V recommended min, -0.5 V absolute min

**Input high voltage limit:** 5.0 V recommended max, 5.5 V absolute max

**Input type:** Schmitt trigger, rising edge triggered, 1.5 kΩ series resistor, 47 kΩ pull-down to ground

**Schmitt trigger hysteresis:** 0.6 V min, 1.5 V max

**Input high voltage threshold:** 3.1 V max

**Input low voltage threshold:** 1.0 V min

### Indicator LEDs

**Power LED (top):** On when the device microcontroller has power and is configured.

Both LEDs blink together in firmware update mode.

**Status LED:** On when USB connected; blinks to indicate USB communications.

### USB Specifications

**USB device type:** USB 2.0 (full-speed)

**USB compatibility:** USB 3.0, 2.0, 1.1

**USB "A" connector:** Downstream hub output port

**USB hub type:** Supports USB 2.0 high-speed, full-speed, and low-speed operating points. Self-powered, 500 mA max downstream VBUS capability

### Environmental

**Operating temperature range:** 0 °C to 70 °C

**Storage temperature range:** -40 °C to 85 °C

**Humidity:** 0% to 90% non-condensing

### Mechanical

**Card dimensions (L × W × H):** 203.2 × 121.9 × 20.0 mm (8.0 × 4.8 × 0.8 in.)

**Enclosure dimensions (L × W × H):** 241.3 × 125.7 × 58.9 mm (9.50 × 4.95 × 2.32 in.)

### Power

#### Supply current

**Continuous mode:** 350 mA typ; this is the total current requirement.

**User +5V output voltage range** (5V screw terminal): 4.0 V min, 5.25 V max; assumes input power supply voltage is within specified limits.

**User +5V output current** (5V screw terminal): 50 mA max; total amount of current that can be sourced from the 5V screw terminal for general use.

#### External Power Input

**External power input:** +6.0 VDC to 12.5 VDC; 9 VDC power supply included.

**Voltage supervisor limits – PWR LED:**

6.0 V > Vext or Vext > 12.5 V: PWR LED = Off (power fault)

6.0 V < Vext < 12.5 V: PWR LED = On

A voltage supervisory circuit monitors the external +9 V supply voltage. If the power supply exceeds its specified limit, the PWR LED will turn off, indicating a power fault condition.

**External power adapter (included):** MCC p/n CB-PWR-9V3A, +9 V ±10%, @ 3 A

#### External Power Output

**External power output**

**Current range:** 4.0 A max

**Voltage drop between power input and daisy chain power output):** 0.5 V max

**Compatible cable(s) for daisy chain:** C-MAPWR-x, x = 2, 3 or 6 feet

The daisy chain power output option allows multiple MCC USB products to be powered from a single external power source in a daisy chain fashion. The voltage drop between the device power supply input and the daisy chain output is 0.5 V max – users must plan for this drop to ensure that the last device in the chain will receive at least 6.0 VDC.

## Order Information

### Hardware

Part No.	Description
USB-1616FS-Plus	Multifunction USB DAQ device with simultaneous sampling, 16 analog inputs, 16-bit resolution, 500 kS/s throughput, 32-bit event counter, and 8 digital I/O lines. Includes external 9 volt power supply, USB cable and MCC DAQ software.
CB-PWR-9V3A	9 volt replacement power supply.

## Software also Available from MCC

Part No.	Description
DAQami	Data acquisition companion software for acquiring data and generating signals
TracerDAQ Pro	Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version
DASyLab	Icon-based data acquisition, graphics, control, and analysis software