USB-1616FS

Simultaneous Sampling Multifunction DAQ Device

The USB-1616FS 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 200 kS/s throughput
- Simultaneous sampling
- 8 digital I/O
- 32-bit counter
- Integrated temperature sensor
- USB expansion port for multi-unit daisy-chaining
- External power adapter
- Rugged enclosure
- DIN rail or bench mountable

Supported Operating Systems

- Windows® 11/10/8/7/ Vista®XP, 32/64-bit

Overview

The USB-1616FS provides 16 simultaneously sampled 16-bit analog inputs with sample rates up to 50 kS/s per channel, continuous throughputs of 150 kS/s, and 32 kilosample bursts up to 200 kS/s. The device also provides one 32-bit counter and 8 digital I/O lines.

The USB-1616FS 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 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 provides 16 single-ended analog inputs. A channel gain queue feature lets users set up a scan list to sample up to 16 different analog input channels 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 50 kS/s for one channel, or 9.5 kS/s per channel for all channels.

With burst scan mode, the maximum throughput rate is 50 kS/s per channel for one, two, or three channels, and 16.5 kS/s per channel for all 16 channels.

Digital I/O

Eight digital IO lines are independently selectable as input or output. All digital lines are pulled up by default with a 47 kΩ resistor.

Counter Input

The 32-bit event counter accepts frequency inputs up to 1 MHz, and increments when the TTL level transitions from low to high.

Trigger Input

The USB-1616FS has an external digital trigger input. The trigger mode is configurable with software for rising (default) or falling edge.

External Clock I/O

A bidirectional SYNC (synchronization) control line can be configured as either input or output.

Configure as an external clock input to externally clock A/D conversions, or as an output to synchronize with a second USB-1616FS and acquire data from 32 channels.

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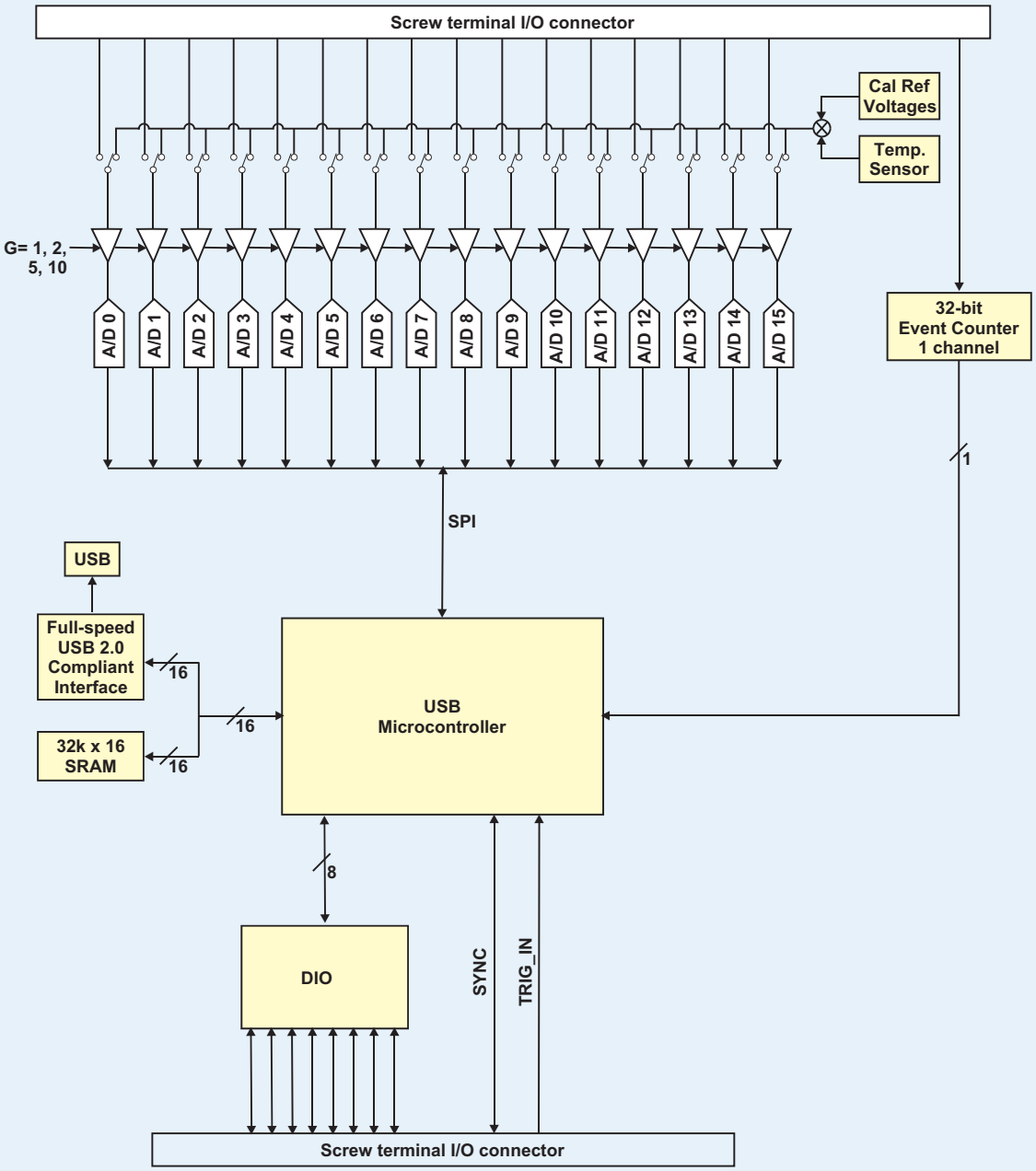
Software

Calibration

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

Power

The USB-1616FS receives power from the +9 V unregulated power supply that is shipped 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.



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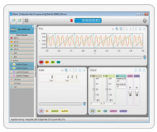
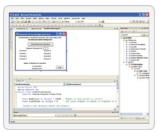
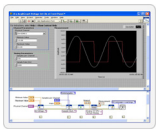
Software

Software Support

USB-1616FS devices are 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.
InstaCal™		An interactive installation, configuration, and test utility for MCC hardware. Windows OS InstaCal is included with the free MCC DAQ Software bundle.
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. TracerDAQ Pro is available as a purchased software download.
General-Purpose Programming Support		
Universal Library™ (UL) for Windows		Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python on Windows. The UL for Windows is included with the free MCC DAQ Software bundle. The UL Python API for Windows is available on GitHub (github.com/mccdaq/mcculw).
Linux® driver		Open-source Linux drivers are available for most MCC devices. Example programs are also provided.
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.
DASYLab®		Icon-based data acquisition, graphics, control, and analysis software that allows users to create complex applications in minimal time without text-based programming. Windows OS DASYLab is available as a purchased software download. An evaluation version is available for 28 days.
MATLAB® driver		High-level language and interactive environment for numerical computation, visualization, and programming. The Mathworks Data Acquisition Toolbox™ allows users to acquire data from most MCC PCI and USB devices. Visit www.MathWorks.com for more information about the Data Acquisition Toolbox.

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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 ±15 V max
Input impedance: 100 MΩ, min
Input bandwidth (–3 dB): 50 kHz typ
Input leakage current: ±1 µA typ
Input capacitance: 50 pf typ
Offset temperature drift: 15 ppm/°C typ
Gain temperature drift: All ranges 35 ppm/°C typ
Input ranges: ±10 V, ±5 V, ±2 V, ±1 V; Software selectable
Sampling rate
Scan to PC memory: up to 50 kS/s, software selectable
Burst scan to 32 k sample FIFO: 20 S/s to 50 kS/s, software selectable
Throughput: Software paced; 30 S/s to 500 S/s all channels; system dependant
Scan to PC memory: Refer to the throughput tables below.
Burst scan to 32 k sample FIFO: (200 kS/s)/(# of channels); 50 kS/s max for any channel
Gain queue: Queue list may contain up to 16 unique, consecutive channels paired with any valid range; software configurable
Resolution: 16 bits
No missing codes: 15 bits
Crosstalk
DC – 25 kHz (sine): –80 dB min
Calibration voltages: 0 V, ±0.625 V, ±1.25 V, ±2.5 V, ±5.0 V, software selectable
Calibration voltage accuracy (Note 1): ±0.5% typ, ±1.0% max
Temperature sensor range: 0 °C to +70 °C max
Temperature sensor accuracy: ±3 °C typ
Trigger source: External digital; TRIG_IN; software selectable

Single Board Throughput

An integral USB hub allows up to four USB-1616FS devices to be daisy chained and connected to a single USB port on the host computer. We recommend using a 2.0 or higher USB adapter when daisy chaining devices. Data in the following table reflects typical throughput for a single board system.

Single-Board Throughput; Scan to PC Memory	
Number of Input Channels	Per channel throughput (kS/s)
1	50000
2	50000
3	36000
4	30000
5	25000
6	22000
7	19000
8	17000
9	15000
11	14000
12	12500
13	11250
14	10500
15	10000
16	9500

The throughput rates apply applies to a single board system. Actual rates are system-dependent and may vary.

Multiple board throughput

An integral USB hub allows up to four USB-1616FS devices to be daisy chained and connected to a single USB port on the host computer. Revision F and later are compatible with USB 3.0. Older revisions can be daisy chained from a Revision F device attached to a USB 3.0 adapter. Refer to "Board Revision" below for revision information.
Data transfer over the USB bus is CPU intensive and system dependent. Multiple board performance is limited by an overall aggregate sample rate. The maximum throughput is the number of samples taken per second, regardless of the number of channels sampled or number of devices installed. The maximum sample rate of any one channel is limited to 50 kS/s.
For example, if the maximum throughput is 150,000 S/s, you may sample 20 channels at 7.5 kS/s, 30 channels at 5 kS/s, 40 channels at 3.75 kS/s, and so on.

Board Revision

The board revision may be determined from the part number label on the board that states "193337X-01L", where X is the board revision.

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

Accuracy components			
Range (V)	% of Reading	Gain Error at FS (mV)	Offset (mV)
±10	0.04	4.00	1.66
±5	0.04	2.00	0.98
±2	0.04	0.80	0.51
±1	0.04	0.40	0.28

All values are (±)

Noise Performance		
Range (V)	Typical Counts	LSBrms
±10	10	1.52
±5	10	1.52
±2	11	1.67
±1	14	2.12

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 50 kS/s.

Digital I/O

Digital type: CMOS
Number of I/O: 8 (DIO0 through DIO7)
Configuration: Independently configurable 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 (IOH = –2.5 mA): 3.8 V min
Output low voltage (IOL = 2.5 mA): 0.7 V max
Power on and reset state: Input
Pull up/down configuration
Earlier than Revision F: All pins pulled up to USB VBUS via 47 kΩ resistors (default). Positions are available for pull-down to ground (GND). Hardware selectable via 0 Ω resistors is available as a factory option.
Revision F and later: All pins are configurable via jumper W1 to 5 V or ground via 47 kΩ resistors.
Refer to the "Board Revision" discussion above for revision information.

External Trigger

Trigger source: External digital; TRIG_IN; Schmitt trigger protected with 1.5 kΩ series resistor.
Trigger mode: Edge sensitive; software selectable for rising (default) or falling edge.
Trigger latency: 10 µs max
Trigger pulse width: 1 µs min
Earlier than Revision F
Input type: Schmitt trigger, 1.5 kΩ series resistor
Input high voltage: 4.0 V min, 5.5 V absolute max
Input low voltage: 1.0 V max, –0.5 V min
Input leakage current: ±1.0 µA
Revision F and later
Input type: Schmitt trigger, 47 kΩ pull-down to ground and 1.5 kΩ 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
Refer to the "Board Revision" on page 4 for revision information.

External Clock I/O

Pin name: SYNC; Schmitt trigger over-current protected with a 200 Ω series resistor.
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: 50 kHz, max
Clock pulse width
Input: 1 µs min
Output: 5 µs min
Earlier than Revision F
Input type: Schmitt trigger with 200 Ω series resistor
Input/output resistance: 200 Ω series resistor
Input leakage current: ±1.0 µA
Input high voltage: 4.0 V min, 5.5 V absolute max
Input low voltage: 1.0 V max, –0.5 V absolute min
Output high voltage
IOH = –2.5 mA: 3.3 V min
No load: 3.8 V min
Output low voltage
IOL = 2.5 mA: 1.1 V max
No load: 0.6 V max
Revisions F and later
Input type: Schmitt trigger
Input/output resistance: 200 Ω series resistor on output driver; 1.5 kΩ series resistor on input buffer; 47 kΩ 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
Refer to the "Board Revision" on page 4 for revision information.

Counter

Pin name: CTR
Counter typ: Event counter
Number of channels: 1
Resolution: 32 bits
Maximum input frequency: 1 MHz
High pulse width: 500 ns min
Low pulse width: 500 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
Earlier than Revision F
Input type: Schmitt trigger, rising edge triggered, 1.5 kΩ series resistor
Schmitt trigger hysteresis: 20 mV to 100 mV
Input leakage current: ±1.0 µA
Input high voltage threshold: 1.0 V min
Input low voltage threshold: 4.0 V max
Revision F and later
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
Refer to the "Board Revision" on page 4 for revision information.

Power

Supply current
Continuous mode: 350 mA typ; includes up to 10 mA for the status LEDs
User +5V output voltage: 4.0 V min, 5.25 V max; available at the 5V screw terminal; assumes input power supply voltage is within specified limits
User +5V output current: 50 mA max; available at the 5V screw terminal
USB +5V (VBUS) input voltage: 4.75 V min to 5.25 V max

External Power

External power adapter (included): CB-PWR-9V3A; +9 V ±10%, @ 3 A. If the limit is exceeded, the PWR LED turns off, indicating a power fault condition.
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
External power output – current range: 4.0 A max. The voltage drop between power input and daisy chain power 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. A user-supplied custom cable is required to daisy chain multiple devices.

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.)

USB Specifications

USB device type: USB 2.0 (full-speed)
USB compatibility: USB 3.0, 2.0, 1.1

Order Information

Hardware

Part No.	Description
USB-1616FS	Multifunction USB DAQ device with simultaneous sampling, 16-bit analog inputs, 200 kS/s sampling, 32-bit event counter, and 8 digital I/O lines.
CB-PWR-9V3A	9 volt replacement power supply.

Software also Available from MCC

Part No.	Description
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