

# USB-1208 Series and USB-1408FS

## USB Multifunction Modules



### Features

- Low cost, 12-bit, 13-bit, and 14-bit multifunction USB modules
- Acquisition rates ranging from 1.2 kS/s to 1 MS/s
- 4 differential (DIFF) or 8 single-ended (SE) analog inputs (software-selectable)
- Up to 4 analog outputs
- 16 digital I/O lines
- Up to two 32-bit counter input channels
- One timer output on USB-1208HS Series modules

### 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
- Comprehensive drivers for DASyLab® and NI LabVIEW™
- Supported by MATLAB® Data Acquisition Toolbox™
- InstaCal software utility for install, calibration, and testing
- Supported Operating Systems:
- Windows® 7/Vista/XP SP2, 32-bit or 64-bit

### Overview

USB-1208 Series and USB-1408FS modules are low-cost, PC-based analog and digital I/O devices available in USB high-speed (USB-1208HS Series), full-speed (USB-1208FS/1408FS), and low-speed (USB-1208LS) models. All of these modules offer up to four DIFF or eight SE analog inputs, up to 16 digital I/O channels, and up to two counter inputs.

The USB-1208LS offers two, 10-bit analog output channels with DAC rates up to 100S/s. The USB-1208FS/1408FS both offer two, 12-bit analog output channels with DAC rates up to 10 kS/s. The USB-1208HS-2AO offers two 12-bit analog outputs and the USB-1208HS-4AO offers four, 12-bit analog outputs, each with DAC rates up to 1 MS/s.



The USB-1208LS, USB-1208FS (shown here), and USB-1408FS all offer eight singled-ended or four differential analog inputs, two analog outputs, and 16 digital I/O.

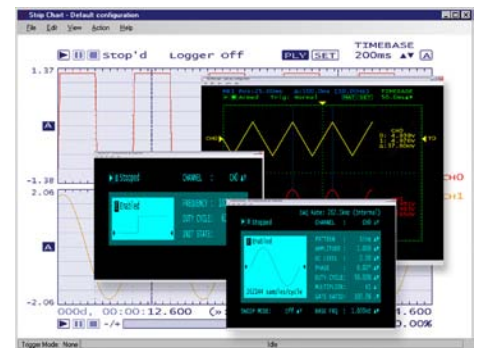
USB-1208 Series and USB-1408FS Selection Chart					
Model	Analog Inputs	Sampling Rate	Analog Outputs	Digital I/O	Counters
USB-1208LS	8 SE (11-bit) 4 DIFF (12-bit)	Up to 1.2 kS/s	2	16	1
USB-1208FS	8 SE (11-bit) 4 DIFF (12-bit)	Up to 50 kS/s	2	16	1
USB-1408FS	8 SE (13-bit) 4 DIFF (14-bit)	Up to 48 kS/s	2	16	1
USB-1208HS	8 SE/4 DIFF (13-bit)	Up to 1 MS/s	0	16	2
USB-1208HS-2AO	8 SE/4 DIFF (13-bit)	Up to 1 MS/s	2	16	2
USB-1208HS-4AO	8 SE/4 DIFF (13-bit)	Up to 1 MS/s	4	16	2

Everything you need to begin acquiring, viewing, and storing data is included with USB-1208 Series and USB-1408FS modules, including comprehensive software support.

### Analog Input

You can configure all USB-1208 Series and USB-1408FS modules for a DIFF range or a SE range.

**USB-1208LS/1208FS:** These modules both provide eight, 11-bit SE analog inputs or four, 12-bit DIFF analog inputs.



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

# USB-1208 Series and USB-1408FS

## General Information



**USB-1408FS:** The USB-1408FS provides eight, 13-bit SE analog inputs or four, 14-bit DIFF analog inputs. All of these devices also support software programmable ranges that provide inputs from  $\pm 1$  V to  $\pm 20$  V in a DIFF configuration, and  $\pm 10$  V in a SE configuration.

**USB-1208HS Series:** All three USB-1208HS modules provide 13-bit resolution, and eight SE analog inputs or four DIFF analog inputs. These modules support software programmable ranges from  $\pm 5$  V to  $\pm 20$  V in a DIFF configuration, and  $\pm 2.5$  V to  $\pm 10$  V, and 0 V to 10 V in a SE configuration.

## Sampling Rate

**USB-1208LS:** In software-paced mode, this module can sample at a maximum of 50 S/s. In hardware-paced mode, the module can sample at a maximum of 1.2 kS/s. Burst mode to the 4 kS FIFO is also available at rates up to 8 kS/s.

**USB-1208FS/1408FS:** In software-paced mode, these modules can sample at a maximum of 250 S/s. In hardware-paced mode, the USB-1208FS can sample at a maximum of 50 kS/s, and the USB-1408FS can sample at a maximum of 48 kS/s.

**USB-1208HS Series:** In software-paced mode, these modules can sample at a maximum of 4 kS/s. In hardware-paced mode, they can sample at a maximum of 1 MS/s.

## Analog Output (All Modules Except for the USB-1208HS)

For all USB-1208 Series and USB-1408FS modules, the maximum update rate for the analog outputs depends on several factors, including the speed of your USB port.

**USB-1208LS:** This module offers two 10-bit analog outputs with a range of 0 V to +5 V.

One analog output updates at a maximum rate of 10 kS/s continuously from PC memory; two analog outputs update simultaneously at a maximum rate 5 kS/s each.

**USB-1208FS/1408FS:** Both modules offer two 12-bit analog outputs with a range of 0 V to +4.096 V.

In software paced mode, one analog output updates at a maximum rate of 250 S/s. In hardware-paced mode, one analog output updates at a maximum rate of 10 kS/s continuously from PC memory; two analog outputs update simultaneously at a maximum rate of 5 kS/s each.

**USB-1208HS-2AO/1208HS-4AO:** The USB-1208HS-2AO provides two 12-bit analog outputs, and the USB-1208HS-4AO provides four 12-bit analog outputs. Both modules offer an output range of  $\pm 10$  V.

Analog outputs update at a maximum rate of 5 kS/s in software-paced mode; in hardware-paced mode, each analog output updates at a maximum rate of 1 MS/s.



*All USB-1208HS Series modules provide eight singled-ended or four differential analog inputs at up to 1 MS/s sampling, 16 digital I/O, and extensive software support. The USB-1208HS-2AO includes two analog output channels, and the USB-1208HS-4AO includes four analog output channels.*

## Digital I/O

Sixteen TTL-level digital I/O lines are included in all USB-1208 Series and USB-1408FS modules.

**USB-1208LS/1208FS/1408FS:** On these modules, digital I/O can be programmed in 8-bit ports for either input or output.

**USB-1208HS Series:** On these modules, digital I/O can be programmed on each individual bit as either inputs or outputs.

## Counter Input

**USB-1208LS/1208FS/1408FS:** Each module supports one 32-bit TTL-level counter that accepts frequency inputs up to 1 MHz.

**USB-1208HS Series:** Each module supports two 32-bit TTL-level counters that accept frequency inputs of up to 20 MHz.

## Software

Included with the USB-1208 Series and USB-1408FS modules is TracerDAQ, an out-of-the-box application that allows data to be generated, acquired, analyzed, displayed and exported within seconds of installing Measurement Computing data acquisition hardware. TracerDAQ includes a Strip Chart, Oscilloscope, Function Generator, and Rate Generator, all of which are accessed via a common, easy-to-use menu page.

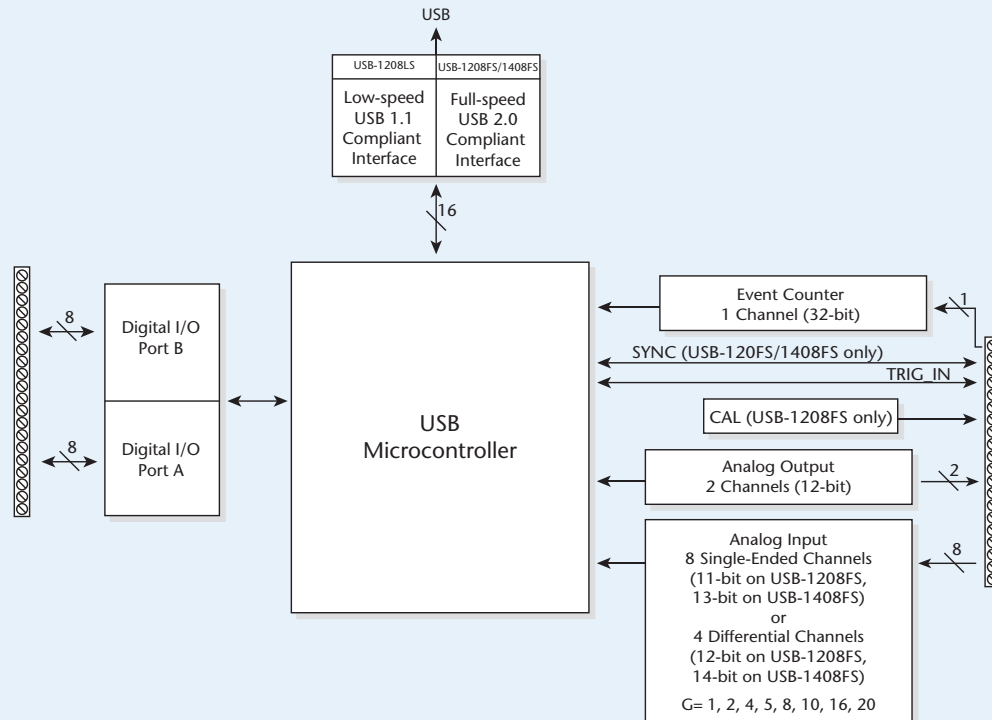
Also included is a complete set of drivers and detailed example programs for the most popular programming languages and software packages. Driver support includes Universal Library programming libraries for Windows Visual Studio® programming languages, and other languages, DASyLab® support, and ULx for NI LabVIEW®.

# USB-1208 Series and USB-1408FS

## USB-1208LS/1208FS/1408FS Specifications



USB-1208LS/1208FS/1408FS Block Diagram



## Specifications

### USB-1208LS, USB-1208FS, and USB-1408FS

#### General

##### Environment

Operating Temperature: 0 °C to +70 °C  
 Storage Temperature: -40 °C to 70 °C  
 Relative Humidity: 0% to 90% non-condensing

##### Communications

USB-1208LS: USB 1.1 low-speed mode (1.5 Mbps)  
 USB-1208FS/1408FS: USB 2.0 full-speed mode (12 Mbps)

Acquisition Data Buffer (USB-1208LS Only): 4 kS

Signal I/O Connector: 2 banks of screw-terminal blocks

Dimensions (L x W x H): 127 x 88.9 x 35.56 mm (5.0 x 3.5 x 1.4 in)

#### Analog Input

A/D Converter Type: Successive approximation

Channels: 8 SE or 4 DIFF, programmable as SE or DIFF

Input Common-Mode Voltage Range for Linear Operation

Single-ended Mode: CHx to GND, ±10 V max

DIFF Mode: CHx to GND, -10 V min, +20 V max

Absolute Maximum Input Voltage

USB-1208LS: CHx to GND, ±40 V max

USB-1208FS/1408FS: CHx to GND, ±28 V max

Input Impedance: 122 kΩ

#### Input Current

Input current is a function of applied voltage on the analog input channels.

For a given input voltage,  $V_{in}$ , the input leakage is approximately equal to  $(8.181 * V_{in} - 12) \mu A$ .

$V_{in} = +10 V$ , 70  $\mu A$  typ

$V_{in} = 0 V$ , -12  $\mu A$  typ

$V_{in} = -10 V$ , -94  $\mu A$  typ

Ranges: Software or selectable on a per-channel basis

SE Mode: ±10 V

DIFF Mode: ±20 V, ±10 V, ±5 V, ±4 V, ±2.5 V, ±2.0 V, ±1.25 V, ±1.0 V

#### Throughput

Maximum throughput scanning to PC memory depends on the computer you are using. The rates specified are for Windows XP only.

##### USB-1208LS

Software Paced: 50 S/s typ, PC-dependent

Hardware Paced: 1.2 kS/s

Burst Scan to 4 kS FIFO: 8 kS/s

##### USB-1208FS

Software Paced: 250 S/s typ, PC-dependent

Hardware Paced: 50 kS/s

##### USB-1408FS

Software Paced: 250 S/s typ, PC-dependent

Hardware Paced: 48 kS/s

#### Channel Gain Queue

USB-1208LS: Up to 8 elements, software configurable channel and range

USB-1208FS/1408FS: Up to 16 elements, software configurable channel and range

#### Resolution

##### USB-1208LS/1208FS

DIFF: 12 bits, no missing codes

SE: 11 bits (the AD7870 converter only returns 11-bits (0-2047 codes) in SE mode)

##### USB-1408FS

DIFF: 14 bits, no missing codes

SE: 13 bits (the AD7871 converter only returns 13-bits (0-8192 codes) in SE mode)

#### CAL Accuracy

USB-1208LS: CAL = 2.5 V, ±0.05% typ, ±0.25% max

USB-1208FS: CAL = 2.5 V, ±36.25 mV max

#### Integral Linearity Error

USB-1208LS/1208FS: ±1 least significant bit (LSB) typ

USB-1408FS: ±2 LSB typ

# USB-1208 Series and USB-1408FS

## USB-1208LS/1208FS/1408FS Specifications



Analog Input Accuracy: USB-1208LS/1208FS	
Range	Accuracy (LSB)
Differential mode	
±20 V	5.1
±10 V	6.1
±5 V	8.1
±4 V	9.1
±2.5 V	12.1
±2 V	14.1
±1.25 V	20.1
±1 V	24.1
Single-ended mode	
±10 V	4.0

Analog Input Accuracy: USB-1408FS		
Range	Absolute Accuracy 25°C	Absolute Accuracy 0 to 50°C
Differential mode		
±20 V	±10.98 mV	±49.08 mV
±10 V	±7.32 mV	±33.42 mV
±5 V	±3.66 mV	±20.76 mV
±4 V	±2.92 mV	±19.02 mV
±2.5 V	±1.83 mV	±14.97 mV
±2 V	±1.70 mV	±14.29 mV
±1.25 V	±1.21 mV	±12.18 mV
±1 V	±1.09 mV	±11.63 mV
Single-ended mode		
±10 V	±10.98 mV	±49.08 mV

Analog Input Accuracy Components: USB-1208LS/1208FS				
Range	% of Reading	Gain Error at FS	Offset	Accuracy at FS
Differential mode				
±20 V	0.2	40 mV	9.766 mV	49.766 mV
±10 V	0.2	20 mV	9.766 mV	29.766 mV
±5 V	0.2	10 mV	9.766 mV	19.766 mV
±4 V	0.2	8 mV	9.766 mV	17.766 mV
±2.5 V	0.2	5 mV	9.766 mV	14.766 mV
±2 V	0.2	4 mV	9.766 mV	13.766 mV
±1.25 V	0.2	2.5 mV	9.766 mV	12.266 mV
±1 V	0.2	2 mV	9.766 mV	11.766 mV
Single-ended mode				
±10 V	0.2	20 mV	19.531 mV	39.531 mV

DIFF Linearity Error: ±0.5 LSB typ  
 Repeatability: ±1 LSB typ

#### CAL Current

##### USB-1208LS

Source: 5 mA max  
 Sink: 20 µA min, 200 nA typ

##### USB-1208FS

Source: 5 mA max  
 Sink: 20 µA min, 100 µA typ

#### Absolute Accuracy Long Term Drift (USB-1408FS Only)

Extrapolating the long term drift accuracy specifications provides the approximate long term drift of the USB-1408FS intermediate input ranges.

±20 V Range: ±3LSB typ (delta t = 1000 hrs)

±4 V Range: ±6LSB typ (delta t = 1000 hrs)

±1 V Range: ±8LSB typ (delta t = 1000 hrs)

#### 2.5VREF Accuracy (USB-1408FS Only)

±36.25 mV max

#### 2.5VREF Output Current (USB-1408FS Only)

Source: 5 mA max  
 Sink: 20 µA min, 100 µA typ

#### Trigger Source (software-selectable)

External Digital: TRIG\_IN

#### Pacer Source (USB-1028FS Only) (software-selectable)

Internal  
 External (SYNC), Rising Edge Triggered  
 Programmed IO

### Analog Output

#### Resolution

USB-1208LS: 10-bits, 1 in 1024

USB-1208FS/1408FS: 12-bits, 1 in 4096

#### Output Range

USB-1208LS: 0 V to 5 V

USB-1208FS/1408FS: 0 V to 4.096 V, 1 mV per LSB.

#### Number of Channels: 2

#### Throughput

Maximum throughput scanning to computer memory depends on the computer being used. The rates specified are for Windows XP only.

##### USB-1208LS

###### Software Paced

Single Channel: 100 S/s

Dual channel, simultaneous update: 50 S/s

##### USB-1208FS/1408FS

Software Paced: 250 S/s single channel typ, PC dependent

###### Hardware Paced

Single Channel: 10 kS/s

Dual Channel, Simultaneous Update: 5 kS/s

#### Power On and Reset Voltage

USB-1208LS/1208FS: Initializes to 000h code

USB-1408FS: 0 V, ±20 mV typ, initializes to 000h code)

#### Output Drive: Each D/A OUT:15 mA

#### Slew Rate: 0.8 V/µs typ

#### Accuracy (LSB)

Range 0 V to 4.096 V: 4.0 typ, 45.0 max

#### Analog Output Accuracy Components (all values are ±)

Range: 0 V to 4.096 V

% of FSR: 0.1 typ, 0.9 max

Gain Error at Full Scale (FS): 4.0 mV typ, 36.0 mV max

Offset: ±1.0 mV typ, ±9.0 mV max

Negative offsets result in a fixed zero-scale error or *dead band*. At the maximum offset of -9 mV, any input code of less than 0x009 does not produce a response in the output.

Accuracy at FS: ±4.0 mV typ, ±45.0 mV max



# USB-1208 Series and USB-1408FS

## USB-1208LS/1208FS/1408FS Specifications



### Digital I/O

#### Digital Type

USB-1208LS: 82C54

USB-1208FS/1408FS: CMOS

**Number of I/O:** 16 (Port A0 through A7, Port B0 through B7)

**Configuration:** 2 banks of 8

**Pull Up/Pull-Down Configuration:** All pins pulled up to  $V_s$  through 47 k $\Omega$  resistors (default). Positions available for pull-down to ground. Hardware selectable through 0  $\Omega$  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 (IOH = -2.5 mA)**

USB-1208LS: 3.0 V min

USB-1208FS: 3.8 V min

**Output Low Voltage (IOL = 2.5 mA)**

USB-1208LS: 0.4 V max

USB-1208FS/1408FS: 0.7 V max

**Power On and Reset State:** Input

### External trigger

**Trigger Source:** External digital, TRIG\_IN (Schmitt trigger input protected with a 1.5 k $\Omega$  series resistor)

**Trigger Mode** (software selectable)

USB-1208LS: Level sensitive; user configurable for TTL level high or low input

USB-1208FS: Edge sensitive; user configurable for CMOS-compatible rising or falling edge

**Trigger Latency**

USB-1208LS: Burst, 25  $\mu$ s min, 50  $\mu$ s max

USB-1208FS: 10  $\mu$ s max

**Trigger Pulse Width**

USB-1208LS: Burst, 40  $\mu$ s min

USB-1208FS: 1  $\mu$ s min

**Input High Voltage**

USB-1208LS: 3.0 V min, 15.0 V absolute max

USB-1208FS: 4.0 V min, 5.5 V absolute max

**Input Low Voltage**

USB-1208LS: 0.8 V max

USB-1208FS: 1.0 V max, -0.5 V absolute min

**Input Leakage Current:**  $\pm 1.0 \mu$ A

### External Acquisition Scan Clock Input (USB-1208FS/1408FS only)

**Pin Name:** SYNC (Schmitt trigger input that is over-current protected with a 200  $\Omega$  series resistor)

**Pin Type:** Bidirectional

**Software-Selectable Direction**

**Output (default):** Outputs internal A/D pacer clock.

**Input:** Receives A/D pacer clock from external source.

**Input Clock Rate**

USB-1208FS: 50 kHz, max

USB-1408FS: 48 kHz, max

**Clock Pulse Width**

**Input Mode:** 1  $\mu$ s min

**Output Mode:** 5  $\mu$ s min

**Input Leakage Current:** Input mode,  $\pm 1.0 \mu$ A

**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

### Counter

**Pin name:** CTR (Schmitt trigger input protected with a 1.5 k $\Omega$  series resistor)

**Counter Type:** Event counter

**Number of Channels:** 1

**Input Type:** TTL, rising edge triggered

**Input Source:** CTR screw terminal

**Resolution:** 32 bits

**Schmitt Trigger Hysteresis:** 20 mV to 100 mV

**Input Leakage Current:**  $\pm 1 \mu$ A

**Maximum Input Frequency:** 1 MHz

**High Pulse Width:** 500 ns min

**Low Pulse Width:** 500 ns 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

### Memory

#### USB-1208LS

**Memory Size:** 8192 bytes

**Memory Configuration**

0x0000 to 0x17FF: read/write, A/D data (4 K samples)

0x1800 to 0x1EFF: read/write, user data area

0x1F00 to 0x1FEF: read/write, calibration data

0x1FF0 to 0x1FFF: read/write, system data

#### USB-1208FS

**EEPROM:** 1,024 bytes

**EEPROM Configuration**

0x000-0x07F: reserved, 128 bytes system data

0x080-0x1FF: read/write, 384 bytes cal data

0x200-0x3FF: read/write, 512 bytes user area

### Power

Self-powered USB hubs and hosts have their own power supply.

The USB port(s) on your computer are root port hubs. All externally powered root port hubs (desktop computers) provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub.

Bus-powered USB hubs and hosts do not have their own power supply.

#### USB-1208LS

**Supply Current:** 20 mA (total current requirement; includes up to 5 mA for the status LED)

**+5 V USB Power Available**

**Connected to Self-powered Hub:** 4.5 V min, 5.25 V max

**Connected to Bus-powered Hub:** 4.1 V min, 5.25 V max

**Output Current** (total amount of current that can be sourced from the USB +5 V, analog outputs and digital outputs)

**Connected to Self-powered Hub:** 450 mA min, 500 mA max

**Connected to Bus-powered Hub:** 50 mA min, 100 mA max

#### USB-1208FS

**Supply Current:** 80 mA (total current requirement; includes up to 10 mA for the status LED)

**+5 V USB Power Available**

**Connected to Self-powered Hub:** 4.5 V min, 5.25 V max

**Connected to Bus-powered Hub:** 4.1 V min, 5.25 V max

**Output Current** (total amount of current that can be sourced from the USB +5 V, analog outputs and digital outputs)

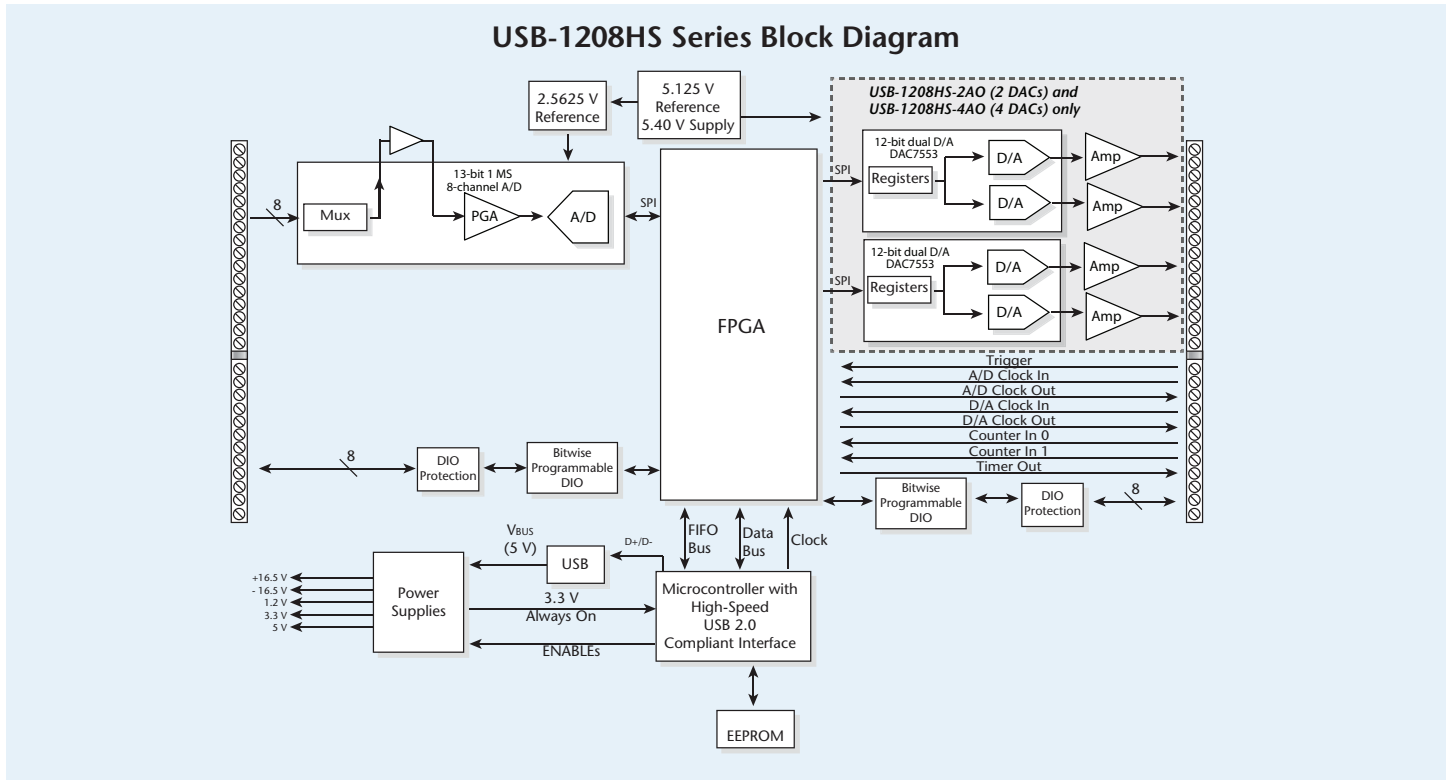
**Connected to Self-powered Hub or Externally Powered**

**Root Port Hub:** 420 mA max

**Connected to Bus-powered Hub:** 20 mA max

# USB-1208 Series and USB-1408FS

## USB-1208HS Series Specifications



### USB-1208HS Series (USB-1208HS/1208HS-2AO/1208HS-4AO)

#### General

##### Environment

Operating Temperature Range: 0 °C to 50 °C  
 Storage Temperature Range: -40 °C to 85 °C  
 Humidity: 0% to 90% non-condensing

Communications: USB 2.0 (high-speed)

Acquisition Data Buffer: 4 kS

Vibration: MIL STD 810E Category 1 and 10

Signal I/O Connector: 2 banks of screw-terminal blocks

Dimensions (L x W x H): 79 x 82 x 25 mm (3.11 x 3.23 x 0.98 in.)

Weight: 431 g (0.95 lbs)

#### Analog Inputs

A/D Converter: Successive approximation type

Input Ranges: Software-selectable per channel

DIFF: ±20 V, ±10 V, ±5 V (the voltage level on each individual AIN input is limited to ±14 V.)

SE: ±10 V, ±5 V, ±2.5 V, 0 – 10 V

Number of Channels: 4 DIFF/8 SE (software-selectable)

Input Configuration: Multiplexed

Channel Gain Queue: 8 unique consecutive elements, software-configurable range for each channel

Absolute Maximum Input Voltage: CHx IN to GND

Power On: ±25 V max

Power Off: ±12 V max

Input Impedance: 35 MΩ min.

Input Bandwidth (-3 dB): All input ranges, 2 MHz typ

Input Leakage Current: ±250 nA typ

Input Capacitance: 32 pF typ

Offset Error Drift: 5 ppm/°C typ

Gain Error Drift: 25 ppm/°C typ

Maximum Working Voltage (Signal + Common Mode)

±20 V: ±14 V

±10 V: ±11 V

±5 V: ±5.5 V

Voltage Range	Calibrated Absolute Accuracy (LSB)	Noise Performance*	
		Typical Counts	LSBrms
DIFF mode			
±20 V	±9.55 typ, ±13.18 max	3	0.45
±10 V	±4.59 typ, ±6.23 max	3	0.45
±5 V	±2.25 typ, ±2.75 max	3	0.45
SE mode			
±10 V	±5.10 typ, ±8.06 max	5	0.91
±5 V	±2.63 typ, ±4.03 max	5	0.91
±2.5 V	±1.59 typ, ±2.70 max	5	0.91
0 V to 10 V	±3.29 typ, ±5.13 max	5	0.91

\* 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 rate of 1 MS/s.

Input settling time in μs, typical ±full-scale channel switch, same-range to same-range			
Range	±1 LSB	±4 LSB	±8 LSB
±10 V	1.5	1.1	1.0
±5 V	2.1	1.1	1.0
±2.5 V	2.2	1.1	1.0
0 V to 10 V	2.6	1.1	1.0

# USB-1208 Series and USB-1408FS

## USB-1208HS Series Specifications



**Sampling Rate:** 1 S/s to 1 MS/s, software programmable  
**Sample Clock Source:** Internal A/D clock or AICKI  
**Burst Mode:** Software-selectable, burst rate = 1  $\mu$ s  
**Throughput**  
    **Software-Paced:** 33 S/s to 4000 S/s typ, system-dependent  
    **Hardware-Paced:** 1 MS/s max  
**Resolution:** 13 bits  
**A/D No Missing Codes (Uncalibrated)**  
    **DIFF Mode:** 13 bits  
    **SE Mode:** 12 bits  
**CMRR:** 60 Hz, 74 dB typ  
**Crosstalk**  
    **SE Mode (All Ranges, 250 kHz Input Signal):** -62 dB typ  
    **DIFF Mode (All Ranges, 250 kHz Input Signal):** -78 dB typ

### Analog Output

**D/A Converter:** Texas Instruments DAC7553  
**Number of Channels:** 4 independent  
**Resolution:** 12 bits  
**Output range**  
    **Calibrated:**  $\pm 10$  V  
    **Uncalibrated:**  $\pm 10.2$  V  
**Output Transient:** Host PC is reset, powered on, suspended, or a reset command is issued to device.  
    **Duration:** 3 ms typ  
    **Amplitude:** 6 V p-p typ  
**D/A Update Rate**  
    **Software Paced:** 33 S/s to 5000 S/s typ, system dependent  
    **Hardware Paced:** 1 MHz max (per channel)  
**Sample Clock Source:** Internal D/A clock or AOCKI (AO external clock input pin)  
**Monotonicity:** 12 bits  
**Output Current:**  $\pm 3$  mA max per channel  
**Output Short-Circuit Protection:** Output connect to GND, unlimited duration (10 mA typ)  
**Output Coupling:** DC  
**Power Up and Reset State:** 0 V  
**Output noise:** 0.53 mV rms  
**Settling Time (to 0.05%):** 20 V output step, (RL=5 k $\Omega$ , CL=200 pF), 5  $\mu$ s max.  
**Absolute Accuracy:**  $\pm 0.1\%$   
**Slew Rate:** 6.7 V/ $\mu$ s typ  
**Offset Error Drift:** 10 ppm/ $^{\circ}$ C typ  
**Gain Error Drift:** 65 ppm/ $^{\circ}$ C typ

### Digital I/O

**Digital Type:** CMOS  
**Number of I/O:** 16  
**Configuration:** Each bit may be configured as input (power on default) or output  
**Pull-Up Configuration:** The port has 47 k $\Omega$  resistors configurable as pull-ups or pull-downs by an internal jumper (default setting is pull-down.)  
**Digital I/O Transfer Rate (System Paced):** 33 to 8000 port reads/writes or single-bit reads/writes per second typ, system dependent.  
**Input High Voltage:** 2.0 V min, 5.5 V absolute max  
**Input Low Voltage:** 0.8 V max, -0.5 V absolute min, 0 V recommended 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)  
**Output Current:**  $\pm 24$  mA max per terminal  
(see *Power* section for additional information)

### External trigger

**Trigger Source:** TRIG input  
**Trigger Mode:** Software configurable for edge- or level-sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.  
**Trigger Latency:** 1  $\mu$ s + 1 clock cycle max  
**Trigger Pulse Width:** 100 ns min  
**Input Type:** Schmitt Trigger, 33  $\Omega$  series resistor and 47 k $\Omega$  pull-down to ground  
**Schmitt Trigger Hysteresis:** 0.4 V to 1.2 V  
**Input High Voltage:** 2.2 V min, 5.5 V absolute max  
**Input Low Voltage:** 1.5 V max, -0.5 V absolute min, 0 V recommended min

### External Acquisition Scan Clock I/O

**Terminal names:** AICKI, AICKO, AOCKI, AOCKO

#### Terminal Types

**AxCKI:** Input, active on rising edge  
**AxCKO:** Output, power on default is 0 V, active on rising edge

#### Terminal Descriptions

**AxCKI:** Receives sampling clock from external source  
**AxCKO:** Outputs internal sampling clock (D/A or A/D clock) or pulse generated from AxCKI when in external clock mode

**Input Clock Rate:** 1 MHz max

#### Clock Pulse Width

**AxCKI:** 400 ns min  
**AxCKO:** 400 ns min

**Input Type:** Schmitt trigger, 33  $\Omega$  series resistor, 47 k $\Omega$  pull-down to ground

**Schmitt Trigger Hysteresis:** 0.4 V to 1.2 V

**Input High Voltage:** 2.2 V min, 5.5 V absolute max

**Input Low Voltage:** 1.5 V max, -0.5 V absolute min, 0 V recommended 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)

**Output Current:**  $\pm 24$  mA max per terminal (see *Power* section for additional information)

### Counters

**Counter Terminal names:** CTRO, CTRI

**Counter Type:** Event counter

**Number of Channels:** 2

**Input Type:** Schmitt trigger, 33  $\Omega$  series resistor, 47 k $\Omega$  pull-down to ground

**Schmitt Trigger Hysteresis:** 0.4 V to 1.2 V

**Input High Voltage:** 2.2 V min, 5.5 V absolute max

**Input Low Voltage:** 1.5 V max, -0.5 V absolute min, 0 V recommended min

**Resolution:** 32 bits

**Max Input Frequency:** 20 MHz

**Counter Read/Write Rates (Software Paced):** 33 to 8000 reads/writes per second typ, system dependent

**High Pulse Width:** 25 ns min

**Low Pulse Width:** 25 ns min

### Timer

**Timer Terminal Name:** TMR

**Timer Type:** PWM output with count, period, delay, and pulse width registers

**Output Value:** Default state is idle low with pulses high, software-selectable output invert

**Internal Clock Frequency:** 40 MHz

**Register Widths:** 32 bits

**High Pulse Width:** 20 ns min

**Low Pulse Width:** 20 ns 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)

**Output Current:**  $\pm 24$  mA max per pin (see *Power* section for additional information)

### Memory

**Data FIFO:** 4 kS analog input/4 kS analog output

**Non-Volatile Memory:** 32 KB (16 KB firmware storage, 16 KB calibration/user data)

# USB-1208 Series and USB-1408FS

## USB-1208HS Series Specifications & Ordering



### Power

**Operating Modes:** Bus-powered, USB 5 V supply

**Supply Current** (total current consumption for the USB-1208HS Series, including +5 V, and digital output and analog output currents)

**Suspend Mode:** <2.5 mA

**Enumeration:** <100 mA

**Run Mode:** <500 mA

**Power Consumption Excluding Analog and Digital Outputs**

**Run Mode:** 1.175 W max (235 mA input current)

**Power Available for +5 V, AICKO, AOCKO, TMR, Analog Outputs, Digital I/O**

**Run Mode:** 1.325 W max

The total power consumption for all external loads must be less than this value and each load must meet the individual specification for the terminal.

**Digital Output Power Calculation:** Power per output =  $I_{out} * 5 V$  (for example, @ 24 mA,  $P = 0.024 * 5 = 120 \text{ mW/output}$ )

**Analog Output Power Calculation:** Power per output =  $(I_{out} * 16.5 V)/0.78$  (for example, @ 3 mA,  $P = (0.003 * 16.5)/0.78 = 63.5 \text{ mW/output}$ )

**+5 V Output Power Calculation:** Power (W) =  $I_{out} * 5 V$

**+5 V Output Voltage Range** (output voltage range assumes input power is within specified limits)

**Run Mode:** 4.5 V min, 5.25 V max

**Suspend Mode, Enumeration:** 0 V

**+5 V Output Current**

**Run Mode, No Other Output Loads:** 265 mA max (1.325 W).

**Fuses (on USB Supply):** 0452.750 - Littelfuse 0.750A NANO2® Slo-Blo®

Subminiature Surface Mount Fuse. Spare fuse mounted in holder on PCB.

### USB Specifications

**USB Device Type:** USB 2.0 (high-speed)

**USB Device Compatibility:** USB 1.1, 2.0

**USB Cable Length:** 5 meters max

**USB Cable Type (included):** A-B cable, UL type AWM 2527 or equivalent (min 24 AWG VBUS/GND, min 28 AWG D+/D-)

### Ordering Information

Description	Part No.
Low-speed USB-based DAQ module with eight SE (11-bit) or four DIFF (12-bit) analog inputs, two 10-bit analog outputs, one 32-bit external event counter, an external trigger input, and 16 digital I/O lines.	USB-1208LS
Full-speed USB-based DAQ module with eight SE (11-bit) or four DIFF (12-bit) analog inputs, two 12-bit analog outputs, one 32-bit external event counter, an external trigger input, and 16 digital I/O lines.	USB-1208FS
Full-speed USB-based DAQ module with eight SE (13-bit) or four DIFF (14-bit) analog inputs, two 12-bit analog outputs, one 32-bit external event counter, an external trigger input, and 16 digital I/O lines.	USB-1408FS
High-speed USB-based 13-bit DAQ module with eight SE or four DIFF analog inputs, two 32-bit external event counters, a 32-bit PWM timer output, and 16 digital I/O lines.	USB-1208HS
High-speed USB-based 13-bit DAQ module with eight SE or four DIFF analog inputs, two 12-bit analog outputs, two 32-bit external event counters, a 32-bit PWM timer output, and 16 digital I/O lines.	USB-1208HS-2AO
High-speed USB-based 13-bit DAQ module with eight SE or four DIFF analog inputs, four 12-bit analog outputs, two 32-bit external event counters, a 32-bit PWM timer output, and 16 digital I/O lines.	USB-1208HS-4AO

### 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

**Note:** USB-7000 Series devices – functionally similar to the USB-1408FS – are ideal for OEM and embedded applications and feature support for Windows, CE, Linux and Mac.



*Multiple USB-7000 Series boards can be stacked to increase channel count and capability.*