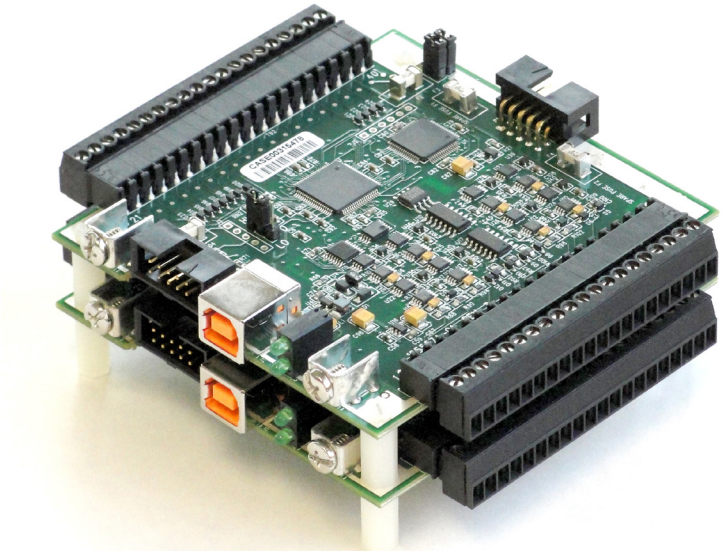
USB-7000 Series

Multifunction OEM DAQ Devices



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

Features

- Eight analog inputs
- 12- or 16-bit resolution
- Up to 100 kS/s hardware paced throughput to host device
- Two analog outputs (USB-7204 only)
- Eight digital I/O
- One 32-bit event counter
- No external power required
- Compact and stackable USB/104 form factor

Supported Operating Systems

- Windows 10/8/7/Vista® 32/64-bit
- Android™

Overview

The USB-7000 Series multifunction DAQ devices are ideally suited for OEM and embedded applications.

The USB-7202 is a 16-bit DAQ board that provides 8 simultaneous analog inputs and 8 digital I/O bits. The USB-7204 is a 12-bit DAQ board that provides 8 single-ended or 4 differential analog inputs, 2 analog outputs, and 16 digital I/O bits.

Everything you need to begin acquiring, viewing, and storing data is included with USB-7000 Series devices, including comprehensive software support.

Analog Input

The USB-7202 has eight single-ended (SE) analog input channels. Each analog input features an A/D per channel for simultaneous sampling, 16-bit resolution, and input ranges up to ±10 V.

The USB-7204 can be configured with up to eight SE or up to four differential (DIFF) analog inputs. The USB-7204 provides 11-bit resolution in SE mode, 12-bit resolution in DIFF mode, and up to ±20 V input ranges.

Sample Rate

The USB-7202 has a 100 kS/s maximum rate (200 kS/s throughput rate to onboard memory with BURSTIO enabled). Both USB-7000 Series devices sample at up to 50 kS/s on any one channel.

Analog Output (USB-7204 Only)

Two 12-bit analog outputs are included with the USB-7204. Each output has a 0 V to 4.096 V range.

Digital I/O

The USB-7202 provides one 8-bit digital port. Each bit is configurable for input or output.

The USB-7204 provides 16 digital bits configured as two 8-bit ports. Each port is configurable for input or output.

Counters

One 32-bit counter is included with each USB-7000 Series module. The TTL-level input has a 1 MHz max input frequency.

Calibration

USB-7000 Series devices are factory-calibrated. Specifications are guaranteed for one year. For calibration beyond one year, return the device to the factory for recalibration.

USB-7000 Series Selection Chart

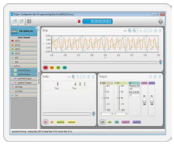
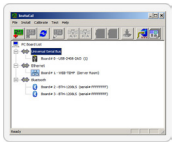
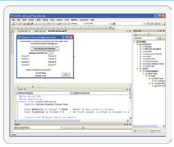
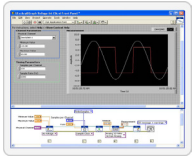
Model	Analog Inputs	Throughput Rate	Sample Rate Per Channel	Simultaneous Sampling	Analog Outputs	Digital I/O	Event Counters
USB-7202	8 SE	100 kS/s max (200 kS/s BURSTIO)	50 kS/s max	✔	–	8	1
USB-7204	8 SE/4 DIFF	50 kS/s max	50 kS/s max	–	2	8	1

USB-7000 Series

Software

Software Support

USB-7000 Series 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. 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.
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)		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.
UL for Android		Programming library of function calls for Java programmers who develop apps for Android-based tablets and phones. UL for Android communicates with select MCC DAQ devices. Supports Android project development on Windows, Linux, Mac OS X UL for Android is included with the free MCC DAQ Software bundle.
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. DASYLab is available as a purchased software download. Windows OS

USB-7000 Series

Specifications

USB-7202

All specifications are subject to change without notice.
Typical for 25 ˚C unless otherwise specified.

Analog Input

A/D converter type: 16-bit successive approximation type
Number of channels: 8 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 ranges: ±10 V, ±5 V, ±2 V, ±1 V, software-selectable
Sample rate
  Hardware paced: 0.6 S/s to 50 kS/s, software-selectable
  BURSTIO to 32 kS FIFO: 20 S/s to 50 kS/s, software-selectable
Throughput
  Software paced: 500 S/s all channels, system-dependent
  Hardware paced: (100 kS/s) / (# of channels); max of 50 kS/s for any channel; max throughput scanning to computer memory is system-dependent
  BURSTIO to 32 kS FIFO: (200 kS/s) / (# of channels), 50 kS/s max for any channel
Resolution: 16 bits
No missing codes: 15 bits
Crosstalk: Signal DC to 25 kHz: –80 dB
Trigger source: Software-selectable, external digital TRIG_IN
Calibration: Cal factors stored in firmware

Calibrated Absolute Accuracy

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

Noise distribution is determined by gathering 50 kilosamples with inputs tied to ground at the user connector at the max specified sample rate of 50 kS/s.

Accuracy Components - All Values (±)

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

Noise Performance

Range (V)	Typical Counts	Least Significant Bit Root Mean Square (LSBRMS)
±10	10	1.52
±5	10	1.52
±2	11	1.67
±1	14	2.12

Digital Input/Output

Digital type: CMOS
Number of I/O: 8 (DIO0 through DIO7)
Configuration: Independently configured for input or output; all pins are jumper configurable for pull up/down with 47 kΩ resistors
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

External Trigger

Trigger source: External digital, TRIG_IN
  TRIG_IN is a Schmitt trigger input that is protected with a 1.5 kΩ series resistor
Trigger mode: Software-selectable for rising or falling edge
Trigger latency: 10 µs max
Trigger pulse width: 1 µs 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
Input leakage current: ±1.0 µA

External Clock Input/Output

Pin name: SYNC;
  SYNC is a Schmitt trigger input that is over-current protected with a 1.5 kΩ series resistor.
Pin type: Bidirectional
Software-selectable direction
  Output: Outputs internal A/D pacer clock
  Input: Receives A/D pacer clock from external source
Input clock rate: 50 kHz max
Clock pulse width: 1 µs min input; 5 µs min output
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

Counter

Pin name: CTR
  CTR is a Schmitt trigger input protected with a 1.5 kΩ series resistor
Counter type: Event counter
Number of channels: 1
Input type: TTL, rising edge triggered
Input source: CTR screw terminal
Resolution: 32 bits
Schmidt trigger hysteresis: 20 mV to 100 mV
Input leakage current: ±1 µA
Input frequency: 1 MHz max
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

Data FIFO: 32,768 samples, 65,536 bytes
EEPROM: 1,024 bytes
EEPROM configuration
  0x000-0x1FF, reserved, 512 bytes system and Cal data
  0x200-0x3FF, read/write, 512 bytes user area

Power

Supply current
  USB enumeration: <100 mA
  Continuous mode: 150 mA; this is the total current requirement, which includes up to 10 mA for the status LED.
+5 VUSER power available
  Connected to self-powered hub or externally-powered root port hub: 4.0 V min, 5.25 V max
Output current: 300 mA max; this value is the total amount of current that can be sourced from the +5 VUSER and digital outputs.

Environmental

Operating temperature range: 0 V to 70 ˚C
Storage temperature range: –40 to 70 ˚C
Humidity: 0% to 90% non-condensing

Mechanical

Dimensions (L × W × H): 90.17 × 95.25 × 12.70 mm (3.55 × 3.75 × 0.5 in.), 111.76 mm (4.40 in.) long with detachable screw terminals connected
USB cable length: 3 meters (9.84 ft) max
User connection length: 3 meters (9.84 ft) max

USB-7000 Series

Specifications

USB-7204

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.

Analog Input

A/D converter type: Successive approximation type
Input modes: Single-ended or differential (default)
Input voltage range for linear operation, single-ended mode: CHx to GND, ±10 V max
Input common-mode voltage range for linear operation, differential mode: CHx to GND, –10 V min, +20 V max
Configuration: Single A/D
Sampling method: Multiplexed
Absolute maximum input voltage: CHx to GND, ±28 V max
Input impedance: 122 kΩ
Input current:
Vin = 10 V: 70 microamperes (µA) typ
Vin = 0 V: –12 µA typ
Vin = –10 V: –94 µA typ

Input current is a function of applied voltage on the analog input channels. For a given input voltage (Vin) the input leakage is approximately equal to (8.181*Vin – 12) µA

Number of channels: 8 SE / 4 DIFF, software-selectable
Input ranges
Single-ended mode: ±10 V, G=2
Differential mode: ±20 V, G=1; ±10 V, G=2 (default); ±5 V, G=4; ±4 V, G=5; ±2.5 V, G=8; ±2.0 V, G=10; ±1.25 V, G=16; ±1.0 V, G=20; software-selectable
Sample rate
Hardware paced: 50 kS/s, software-selectable
Throughput
Software paced: 250 S/s typ, system-dependent
Hardware paced: 0.596 S/s to 50 kS/s; max throughput scanning to computer memory is system-dependent.
Channel gain queue: Up to 16 elements, software-selectable channel and range
Resolution
Differential: 12 bits, no missing codes
Single-ended: 11 bits (shifted for 12-bit representation, even numbers only)
The AD7870 converter returns 11 bits (0-2047 codes) in SE mode, and 12 bits in DIFF mode. Firmware prior to version 2.04 have LSB-justified data. Firmware version 2.04 and later have MSB-justified data.
Integral linearity error: ±1 LSB typ
Differential linearity error: ±0.5 LSB typ
Repeatability: ±1 LSB typ
Trigger source: Software-selectable, external digital: TRIG_IN
Pacer source: Software-selectable; internal; external (SYNC), rising edge triggered; external Gated (SYNC); programmed IO
External Gated Sync delays the first clock pulse after setting up a scan to ensure adequate setup time for the first conversion.
Calibration: Factory Cal factors stored in firmware. Cal factors must be applied using application software.

Accuracy

Differential Mode	
Range (V)	Accuracy (LSB)
±20	5.1
±10	6.1
±5	8.1
±4	9.1
±2.5	12.1
±2	14.1
±1.25	20.1
±1	24.1
Single-Ended Mode	
±10	4.0

Accuracy Components

Differential Mode - All Values are (±)				
Range (V)	% of Reading	Gain Error at Full Scale (FS) (mV)	Offset (mV)	Accuracy at FS (mV)
±20	0.2	40 mV	9.766	49.766
±10	0.2	20 mV	9.766	29.766
±5	0.2	10 mV	9.766	19.766
±4	0.2	8 mV	9.766	17.766
±2.5	0.2	5 mV	9.766	14.766
±2	0.2	4 mV	9.766	13.766
±1.25	0.2	2.5 mV	9.766	12.266
±1	0.2	2 mV	9.766	11.766
Single-Ended Mode - All Values are (±)				
±10	0.2	20	19.531	39.531

Noise Performance

Differential Mode		
Range (V)	Typical Counts	LSBRMS
±20	2	0.30
±10	2	0.30
±5	3	0.45
±4	3	0.45
±2.5	4	0.61
±2	5	0.76
±1.25	7	1.06
±1	8	1.21
Single-Ended Mode		
±10	2	0.30

Analog Output

Resolution: 12-bits, 1 in 4096
Output range: 0 V to 4.096 V, 1 mV per LSB
Number of channels: 2
Throughput
Software paced: 250 S/s single channel typ, system-dependent
Hardware paced
Single channel: 10 kS/s
Dual channel, simultaneous update: 5 kS/s
Maximum hardware paced throughput is system-dependent.
Power on and reset voltage: Initializes to 000h code
Output drive: Each D/A OUT, 15 mA
Slew rate: 0.8 V/µs typ

Analog Output Accuracy (All Values (±))

Range: 0 V to 4.096 V
Accuracy (LSB): 4.0 typ, 45.0 max

Analog Output Accuracy Components (All Values (±))

Range (V)	% of FSR	Gain Error at FS (mV)	Offset (mV)	Accuracy at FS (mV)
0 to 4.096	0.1 typ, 0.9 max	4.0 typ, 36.0 max	see note	4.0 typ, 45.0 max

Note: 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.

Digital Input/Output

Digital Type: CMOS
Number of I/O: 16, (Port 0 bits 0 to 7, Port 1 bits 0 to 7)
Pull-up/down configuration: all pins jumper-configurable with 47 kΩ resistors.
Input high voltage threshold: 2.0 V max
Input high voltage limit: 5.0 V recommended max, 5.5 V absolute max
Input low voltage threshold: 0.8 V min
Input low voltage limit: 0 V recommended min, –0.5 V absolute min
Power on and reset state: Input
Revisions C and earlier[1]:
- **Output high voltage (IOH = –2.5 mA):** 3.8 V min
- **Output low voltage (IOL = 2.5 mA):** 0.7 V max

Revisions D and later[1]:
- **Output high voltage (IOH = –6 mA):** 3.84 V min
- **Output low voltage (IOL = 6 mA):** 0.33 V max

External Trigger

Trigger source: External digital, TRIG_IN
TRIG_IN is a Schmitt trigger input protected with a 1.5 kΩ series resistor.
Trigger mode: Edge sensitive; software-selectable for rising or falling edge
Trigger latency: 10 µs max
Trigger pulse width: 1 µs min
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
Revisions C and earlier[1]
- **Input type:** Schmitt trigger, 1.5 kΩ series resistor
- **Schmitt trigger hysteresis:** 20 mV min, 100 mV max
- **Input high voltage threshold:** 4.0 V max
- **Input low voltage threshold:** 1.0 V min
- **Input leakage current:** ±1.0 µA

Revisions D and later[1]:
- **Input type:** Schmitt trigger, 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

External Clock Input/Output

Pin name: SYNC
Pin type: Bidirectional
Software selectable direction
- **Output (default):** Outputs the internal A/D pacer clock.
- **Input:** Receives A/D pacer clock from an external source.

Input clock rate: 50 kHz, max
Clock pulse width: 1 µs min input, 5 µs min output
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
Revisions C and earlier[1]:
- **Input type:** Schmitt trigger, 1.5 kΩ series resistor
- **Schmitt trigger hysteresis:** 20 mV min, 100 mV max
- **Input leakage current:** input mode ±1.0 µA
- **Input high voltage threshold:** 4.0 V max
- **Input low voltage threshold:** 1.0 V 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 D and later[1]
- **Input type:** Schmitt trigger, 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
- **Output high voltage**
  - **IOH = –8 mA**: 3.8 V min
  - **No load:** 4.4 V min
- **Output low voltage**
  - **IOL = 8 mA**: 0.44 V max
  - **No load**: 0.1 V max

Counter

Pin name: CTR
Counter type: Event counter
Number of channels: 1
Resolution: 32 bits
Input frequency: 1 MHz max
High pulse width: 500 ns min
Low pulse width: 500 ns min
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
Revisions C and earlier[1]:
- **Input type:** Schmitt trigger, 1.5 kΩ series resistor
- **Schmitt trigger hysteresis:** 20 mV min, 100 mV max
- **Input leakage current:** ±1.0 µA
- **Input high voltage threshold:** 4.0 V max
- **Input low voltage threshold:** 1.0 V min

Revisions D and later[1]:
- **Input type:** Schmitt trigger, 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

Power

Supply current: 80 mA; the total current requirement includes up to 10 mA for the status LED.
+5 VUSER power available
Connected to self-powered hub or externally-powered root port hub: 4.0 V min, 5.25 V max
Output current
Connected to self-powered hub or externally-powered root port hub: 420 mA max; **Connected to bus-powered hub:** 20 mA max
The output current value is the total current that can be sourced from the +5V user output, analog outputs and digital outputs.

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): 90.17 × 95.25 × 12.70 mm (3.55 × 3.75 × 0.5 in.), 111.76 mm (4.40 in.) long with detachable screw terminals connected
USB cable length: 3 meters (9.843 ft) max
User connection length: 3 meters (9.843 ft) max

1 The board revision is on the board label that states "195725X-01L," where X is the board revision.

Ordering Information

Part No.	Description
USB-7202	USB DAQ board with eight 16-bit analog inputs and eight digital I/O lines. Designed for OEMs.
USB-7204	USB DAQ board with eight 11-bit SE/12-bit DIFF analog inputs, two analog outputs, and 16 digital I/O lines. Designed for OEMs.

Software also Available from MCC

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