USB-7000 Series
Multifunction OEM DAQ Devices

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 (3.55" × 3.75"), stackable USB/104 form factor — ideal for OEM and embedded applications**

Software

Supported Operating Systems

- **Windows 8/7/Vista®/XP 32/64-bit**
  - **Universal library (UL), ULx for NI LabVIEW™**
- **Android™**
 - **UL for Android**

Ready-to-Run Applications

- **InstaCal™ (install, configure, and test)**
- **DAQami™ Advanced Data Logging Application (acquire, view, and log)**
- **TracerDAQ® (acquire, view, log, and generate)**

Supported Programming Environments

- **Visual Studio® and Visual Studio .NET, including examples for Visual C++®, Visual C#®, Visual Basic®, and Visual Basic .NET , and other IDEs**
- **Java® (Android only) including examples and demo apps**
- **LabVIEW (Windows only)**
- **DASYLab®**

Overview

The USB-7000 Series are multifunction DAQ devices physically designed for OEM and embedded applications. These USB full-speed devices are available in models that offer 12-bit and 16-bit resolution.
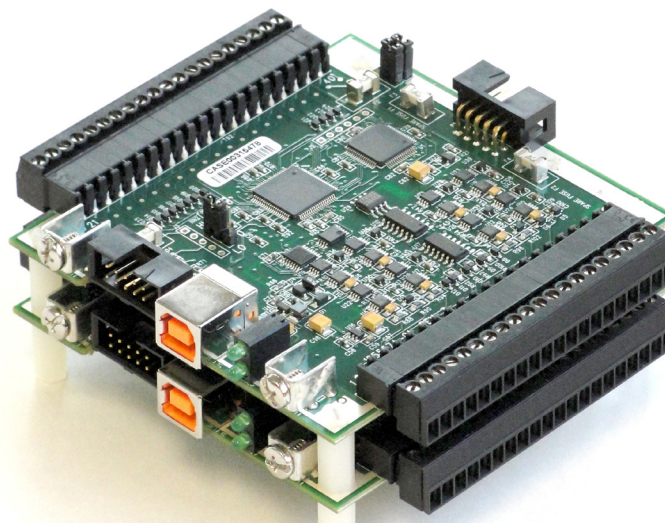
Multiple USB-7000 Series devices can be stacked to increase channel count and capability.

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 offers eight digital I/O lines, and each line is individually-configurable as an input or output. The USB-7204 offers 16 digital I/O lines.

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-700 Series devices are factory-calibrated. Specifications are guaranteed for one year. For calibration beyond one year, return the device to the factory for recalibration. Field calibration is not supported.

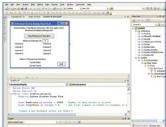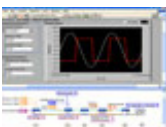| USB-7000 Series Selection Chart							
Model	**Analog Inputs**	**Throughput Rate**	**Sample Rate Per Channel**	**Simultaneous Sampling**	**Analog Outputs**	**Digital I/O**	**Event Counters**
USB-7202	8 SE	100 kS/s max (200 kS/s BURSTIO)	50 kS/s max	✔	–	8	1
USB-7204	8 SE/4 DIFF	50 kS/s max	50 kS/s max	–	2	8	1
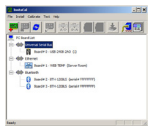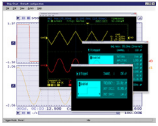
USB-7000 Series
Software Support

Software Support

USB-7000 Series devices are supported by the software in the table below.

Ready-to-Run Applications		
InstaCal		An interactive utility that configures and tests MCC hardware. Windows OS InstaCal is included with the free MCC DAQ Software bundle (CD/download).
DAQami		Advanced data logging application with drag-and-drop software interface that is used to acquire, view, and log data. DAQami can be configured to log analog channels and to view that data in real-time or post-acquisition on user-configurable displays. Windows OS DAQami is available as a purchased software download.
TracerDAQ and TracerDAQ Pro		A virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. 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)		Programming library of function calls for C, C++, VB, C# .Net, and VB .Net using Visual Studio and other IDEs. Windows OS The UL is included with the free MCC DAQ Software bundle (CD/download).
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 (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 is included with the free MCC DAQ Software bundle (CD/download).
DASYLab Driver		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

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; apply factors to data through application software

Calibrated Absolute Accuracy

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

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

Accuracy Components - All Values (±)

Range	% 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

Noise Performance

Range	Typical Counts	LSBrms
±10 V	10	1.52
±5 V	10	1.52
±2 V	11	1.67
±1 V	14	2.12

Digital Input/Output

Digital Type: CMOS
Number of I/O: 8 (DIO0 through DIO7)
Configuration: Independently configured for input or output
Pull-Up/Pull-Down Configuration: All pins configurable from a jumper (JP1) to Vs or Ground through 47 k 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
    Note: TRIG_IN is a Schmitt trigger input protected with a 1.5 kΩ series resistor
Trigger Mode: Software-selectable; edge sensitive, user-configurable for CMOS-compatible 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
    Note: SYNC is a Schmitt trigger input and 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
    Input: 1 µs min
    Output: 5 µs min
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
    Note: 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
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

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

USB-7000 Series
Specifications

MEASUREMENT COMPUTING

Microcontroller

Type: High performance 8-bit RISC microcontroller
Program Memory: 32,768 words
Data Memory: 3,936 bytes

Power

Supply Current
  USB Enumeration: <100 mA
  Continuous Mode: 150 mA
  Note: This is the total current requirement for the USB-7202, which includes up to 10 mA for the status LED.
+5 VUSER Power Available
  Connected to Self-Powered Hub: 4.5 V min, 5.25 V max
  Connected to Externally-Powered Root Port Hub: 4.5 V min, 5.25 V max
  Note: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the USB host controller in the computer. The USB port(s) on your computer are root port hubs. All externally-powered root port hubs (desktop computer) 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 computer that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop is constrained to the 100 mA max, you need to purchase a self-powered hub.
Output Current: 350 mA max
  Note: This is the total amount of current that can be sourced from the +5 V$_{USER}$ and digital outputs.

General

Device Type: USB 2.0 (full-speed)
Device Compatibility: USB 1.1, USB 2.0

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 max
User Connection Length: 3 meters max

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
Input 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
  Note: 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 $(8.181 \times Vin - 12)$ μA.
Number of Channels: 8 SE / 4 DE, 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: 0.56 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, range

Resolution
  Differential: 12 bits, no missing codes
  Single-Ended: 11 bits (shifted for 12-bit representation, even numbers only)
  Note: The AD7870 converter only returns 11 bits (0-2047 codes) in SE mode; firmware shifts it to 12-bit. 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
  Note: External Gated Sync holds off 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	**Accuracy (LSB)**
±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

Accuracy Components

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

USB-7000 Series
Specifications

Noise Performance

Differential Mode		
Range	Typical Counts	Least Significant Bit$_{\text{Root Mean Square}}$ (LSB$_{\text{RMS}}$)
±20 V	2	0.30
±10 V	2	0.30
±5 V	3	0.45
±4 V	3	0.45
±2.5 V	4	0.61
±2 V	5	0.76
±1.25 V	7	1.06
±1 V	8	1.21
Single-Ended Mode		
±10 V	0.2	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: 50 S/s single channel typ, system-dependent
   Hardware-Paced
      Single Channel: 10 kS/s
      Dual Channel, Simultaneous Update: 5 kS/s
   Note: 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/microsecond (µs) typ

Analog Output Accuracy (All Values (±))

Range: 0.0 V to 4.096 V
Accuracy (LSB): 4.0 typ, 45.0 max

Analog Output Accuracy Components (All Values (±))

Range: 0 V to 4.096 V
% of FSR: 0.1 typ, 0.9 max
Gain Error at FS: 4.0 mV typ, 36.0 mV max
Offset: 1.0 mV typ, 9.0 mV 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.

Accuracy at FS: 4.0 mV typ, 45.0 mV max

Digital Input/Output

Digital Type: CMOS
Number of I/O: 16 (Port 0 bit 0 through bit 7, Port 1 bit 0 through bit 7)
Configuration: 2 banks of 8
Pull-Up/Pull-Down Configuration: All pins configurable via jumpers (JP1 and JP2) to Vs or Ground via 47 K resistors. JP1 configures Port 1, and JP2 configures Port 0.
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 protected with a 1.5 kΩ series resistor
Trigger Mode: Software-selectable
   Edge Sensitive: User-configurable for CMOS-compatible 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
   Note: SYNC is a Schmitt trigger input and is over-current protected with a 1.5 kΩ 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: 50 kHz, max
Clock Pulse Width
   Input Mode: 1 µs min
   Output Mode: 5 µs min
Input Leakage Current
   Input Mode: ±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
   Note: 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
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

Non-Volatile Memory

EEPROM: 1,024 bytes

EEPROM Configuration		
Address Range	Access	Description
0x000-0x1FF	Reserved	512 bytes system and cal data
0x200-0x3FF	Read/Write	512 bytes user

Microcontroller

Type: High performance 8-bit RISC microcontroller
Program Memory: 32,768 words
Data Memory: 3,936 bytes

USB-7000 Series
Specifications & Ordering Information

Power

Supply Current: 80 mA
    Note: This is the total current requirement for the USB-7204 which includes up to 10 mA for the status LED.
+5 V USER Power Available
    Connected to Self-Powered Hub, Externally-Powered Root Port Hub, or Bus-Powered Hub: 4.5 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
    Note: This refers to the total amount of current that can be sourced from the USB +5 V, analog outputs and digital outputs.
    Connected to Externally-Powered Root Port Hub: 420 mA max
    Connected to Bus-Powered Hub: 20 mA max
    Note: Self-powered hub refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. Root port hubs reside in the USB host controller in the computer. 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 computer that is not connected to an external power adapter is an example of a battery-powered root port hub. Bus powered hubs receive power from a self-powered or root port hub. In this case the maximum current available from the USB +5 V is 100 mA. The minimum USB +5 V voltage level can be as low as 4.1 V. Protected by fuse F2 at 375 mA.

General

Device Type: USB 2.0 (full-speed)
Device Compatibility: USB 1.1, USB 2.0

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.) in length with detachable screw terminals connected
USB Cable Length: 3 meters max
User Connection Length: 3 meters max

Ordering Information

Part No.	Description
USB-7202	USB-based DAQ module with eight, 16-bit analog inputs and eight digital I/O lines. Designed for OEMs.
USB-7204	USB-based DAQ module with eight analog inputs, up to 12-bit resolution, 50 kS/s, 2 D/A outputs, and 16 digital I/O lines. Designed for OEMs.

Software also Available from MCC

DAQami	Easy-to-use advanced data logging software to acquire, view, and log data
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.