USB-7000 Series

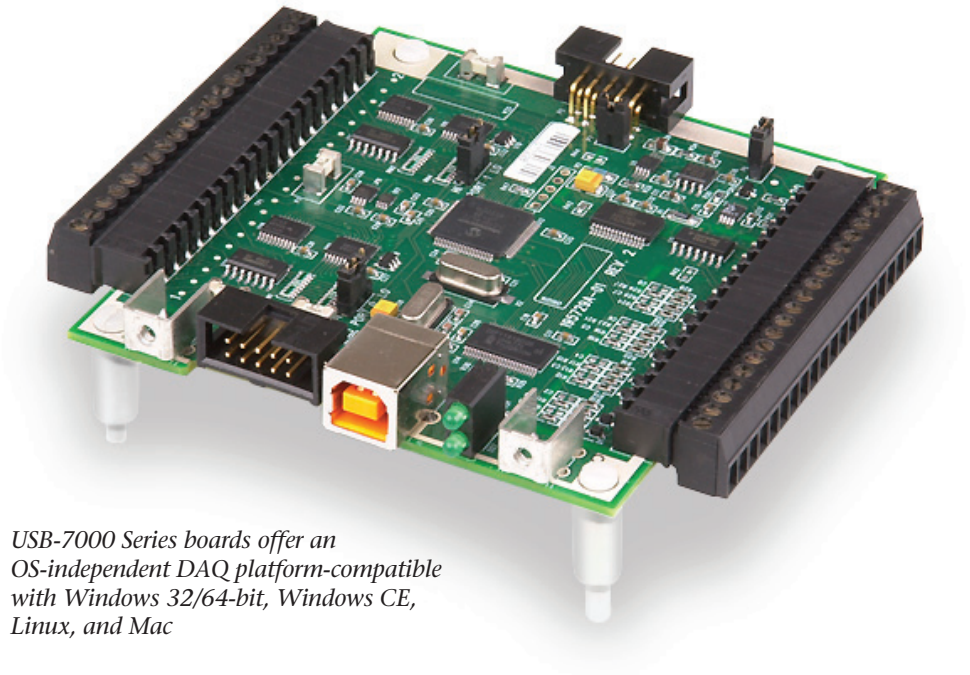
USB/104-Based DAQ Boards with DAQFlex Open-Source Software Framework

Features

- Platform-compatible with Windows® 32/64, Windows CE, Linux®, and Mac
- 8 analog inputs
- USB/104 form factor
- Up to 100 kS/s sampling
- 12 or 16-bit resolution (ADC per channel)
- 8 digital I/O
- Up to 2 analog outputs
- Ideal for OEM and Embedded applications

Software

- DAQFlex open-source software framework included
- Simple message-based programming interface
- OS independent with a single API
- Support for Windows 32/64, Windows CE, Linux, and Mac



USB-7000 Series boards offer an OS-independent DAQ platform-compatible with Windows 32/64-bit, Windows CE, Linux, and Mac

Summary

The USB-7000 Series of data acquistion products is designed specifically for DAQFlex, Measurement Computings new OS-independent protocol that allows DAQ devices to be programmed with a simple message-based API.

The DAQFlex protocol greatly simplifies driver and application development. All DAQ operations are programmed through a common command interface composed of a consistent, cross-platform API, and an small footprint open-source driver.

Analog Input

The USB-7202 includes eight single-ended analog input channels. Each analog input features an A/D per channel for simultaneous sampling, and 16-bit resolution. Input ranges up to ±10 V are provided. The USB-7204 can be configured as eight single-ended or four differential analog inputs. In single-ended mode, the USB-7204 provides 11-bit resolution, 12-bit in differential mode. Up to ±20 V input ranges are provided on the USB-7204.

Sample Rate

The USB-7202 has a 100 kS/s max total throughput rate (200 kS/s in burst mode), and can sample at up to 50 kS/s on any one channel. The USB-7204 can sample at up to 50 kS/s per channel.

Digital I/O

Eight digital I/O channels are included with the USB-7202, 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 board. The TTL level input has a 1 MHz maximum input frequency.

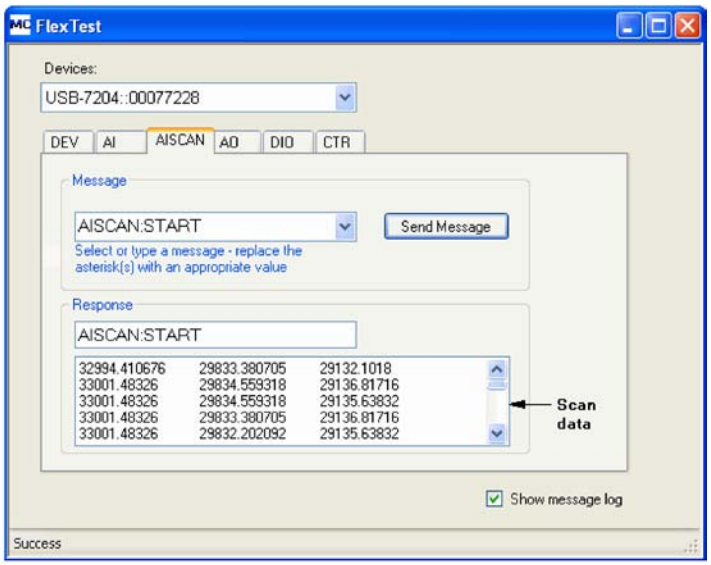
Analog Output

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

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

Software

Included with the USB-7000 Series is DAQFlex, an OS-independent, open-source software framework. DAQFlex can be used with multiple operating systems and includes one programming API which supports all platforms. DAQFlex uses a simple message-based programming interface and features full DAQ functionality with easy-to-learn methods.



The small footprint framework greatly simplifies driver and application development, making it ideal for OEM and embedded applications. DAQFlex is compatible with multiple operating systems including Windows 32/64-bit, Windows CE, Linux, and Mac.

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 MOhm min
Input Ranges: Software selectable, ±10 V, ±5 V, ±2 V, ±1 V
Sampling Rate
Scan to PC Memory: 0.6 S/s to 50 kS/s, software programmable
Burst Scan to 32 kSample FIFO: 20 S/s to 50 kS/s, software programmable
Throughput
Software Paced: 500 S/s all channels, system-dependent
Scan to PC Memory: (100 kS/s)/(# of channels); max of 50 kS/s for any channel; max throughput scanning to PC memory is machine dependent
BURSTIO Scan to 32 kSample FIFO: (200 kS/s) / (# of channels), max of 50 kS/s for any channel
Resolution: 16 bits
No Missing Codes: 15 bits
Crosstalk: Signal DC-25 kHz, -80 dB
Trigger Source: Software selectable, external digital TRIG_IN
Calibration: Cal factors stored in firmware, factors must be applied to data via application software

Calibrated Absolute Accuracy

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

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

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

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 via jumper (JP1) to Vs or Ground via 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 kOhm series resistor
TriggerMode: 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 kOhm 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 kOhm 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

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 PC's USB host Controller. The USB port(s) on your PC are root port hubs. All externally-powered root port hubs (desktop PC's) 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. If your laptop PC 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 VUSER and digital outputs.

General

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

Environmental

Operating Temperature Range: 0 to 70 ˚C
Storage Temperature Range: -40 to 70 ˚C
Humidity: 0 to 90% non-condensing

Mechanical

Dimensions: 3.55" (L) x 3.75" (W) x 0.5" (H),
4.40" (L) 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
Absolute Maximum Input Voltage: CHx to GND, ±28 V max
Input Impedance: 122 kOhm
Input Current
Vin = +10 V, 70 microamperes (µA) typical
Vin = 0 V, -12 µA typical
Vin = -10 V, -94 µA typical
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*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
Throughput
Software Paced: 250 samples per second (S/s) typical, PC dependent
Scan to System Memory: 0.56 S/s to 50 kS/s
Note: Maximum throughput scanning to PC memory is machine dependent. The rates specified are for Windows XP only.
Channel Gain Queue: Up to 16 elements, software configurable 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 single-ended mode; firmware shifts it to 12-bit.
Integral Linearity Error: ±1 least significant bit (LSB) typical
Differential Linearity Error: ±0.5 LSB typical
Repeatability: ±1 LSB typical
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 via 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

Accuracy, Single-Ended Mode

Range	Accuracy (LSB)
±10 V	4.0

Accuracy Components, Differential Mode - All Values (±)

Range	% of Reading	Gain Error at Full Scale (FS) (millivolts (mV))	Offset (mV)	Accuracy at FS (mV)
±20 V	0.2	40	9.766	49.766
±10 V	0.2	20	9.766	29.766
±5 V	0.2	10	9.766	19.766
±4 V	0.2	8	9.766	17.766
±2.5 V	0.2	5	9.766	14.766
±2 V	0.2	4	9.766	13.766
±1.25 V	0.2	2.5	9.766	12.266
±1 V	0.2	2	9.766	11.766

Accuracy Components, Single-Ended Mode - All Values (±)

Range	% of Reading	Gain Error at FS (mV)	Offset (mV)	Accuracy at FS (mV)
±10 V	0.2	20	19.531	39.531

Noise Performance, Differential Mode

Range	Typical Counts	Least Significant bitroot mean square (LSBrms)
±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

Noise Performance, Single-Ended Mode

Range	Typical Counts	LSBrms
±10 V	2	0.30

Analog Output

Resolution: 12-bits, 1 in 4096
Output Range: 0-4.096 V, 1 mV per LSB
Number of Channels: 2
Throughput Software Paced: 50 S/s single channel typical, PC dependent
Single channel, continuous scan: 10 kS/s
Dual channel, continuous scan, simultaneous update: 5 kS/s
Note: Maximum throughput scanning to PC memory is machine dependent. The rates specified are for Windows XP only. Maximum rates on operating systems that predate XP may be less and must be determined through testing on your machine.
Power On and Reset Voltage: Initializes to 000h code
Output Drive: Each D/A OUT, 15 mA
Slew Rate: 0.8V/microsecond (µs) typical

Analog Output Accuracy, all Values (±)

Range	Accuracy (LSB)
0-4.096 V	4.0 typical, 45.0 max

Analog Output Accuracy Components, all Values (±)

Range	% of FSR	Gain Error at FS (mV)	Offset (mV)	Accuracy at FS (mV)
0-4.096 V	0.1 typical, 0.9 max	4.0 typical, 36.0 max	1.0 typical, 9.0 max	4.0 typical, 45.0 max

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

Digital Input/Output

Digital Type: CMOS
Number of I/O: 16 (Port 0 bit 0 through bit 7, Port 1 bit 0through 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 kilohm (kOhm) 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 kOhm 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 kOhm 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 area

Microcontroller

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

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.

+5V$_{USER}$ Power Available: Connected to self-powered 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 PC's USB host controller. The USB port(s) on your PC are root port hubs. All externally powered root port hubs (desktop PCs) 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 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.

Connected to Externally-Powered Root Port Hub: 4.5 V min, 5.25 V max
Connected to Bus-Powered Hub: 4.1 V min, 5.25 V max

Output Current: Connected to self-powered hub, 4.5 V min, 5.25 V 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

General

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

Environmental

Operating Temperature Range: 0 to 70 ˚C
Storage Temperature Range: -40 to 70 ˚C
Humidity: 0 to 90% non-condensing

Mechanical

Dimensions: 3.55″ (L) x 3.75″ (W) x 0.5″ (H),
4.40″ (L) with detachable screw terminals connected
USB Cable Length: 3 meters max
User Connection Length: 3 meters max

Ordering Information

Description	Part No.
USB-based DAQ module with eight, 16-bit analog inputs and eight digital I/O lines; for DAQFlex - Designed for OEMs	USB-7202
USB-based DAQ module with 8 analog inputs, up to 12-bit resolution, 50 kS/s, 2 D/A outputs, and 16 digital I/O lines; for DAQFlex - Designed for OEMs	USB-7204

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