USB-2020

12-bit, 20 MS/s, Simultaneous Sampling, Ultra High-Speed USB Board

Features

- **Two 20 MS/s analog inputs**
  - **Simultaneous sampling**
  - **1 A/D per channel**
  - **12-bit resolution**
  - **±10 V, ±5 V, ±2 V, ±1 V voltage ranges (software-selectable)**
  - **17 MHz input bandwidth**
- **64 megasample onboard memory**
  - **40 MS/s overall rate to onboard memory when acquiring from both channels**
  - **8 MS/s throughput to host computer**
- **Analog and digital triggering**
  - **Level and edge**
- **Analog and digital gating**
- **Internal or external pacing of analog scans**
- **Eight digital I/O lines**
- **BNC connectors and 40-pin auxiliary connector for signal connections**
- **Includes USB cable[1], power supply (required), and nylon stand-offs**
- **Small, compact design (7.1" x 5.6") for OEM and embedded applications**

Software

- **Universal Library includes support for Visual Studio® and Visual Studio® .NET, including examples for Visual C++®, Visual C#®, Visual Basic®, and Visual Basic® .NET**
- **InstaCal software utility for installing, configuring, and testing**
- **ULx for NI LabVIEW™**
- **TracerDAQ® software for acquiring and displaying data and generating analog signals**
- **Supported Operating Systems: Windows® 8/7/Vista®/XP, 32-bit or 64-bit**

The USB-2020 offers high-speed simultaneous sampling at rates up to 20 MS/s per channel to onboard memory.

Overview

The USB-2020 is a high-speed two-channel data acquisition board that provides simultaneous sampling at rates up to 20 MS/s per channel. Users can sample data from both channels at an overall rate of 40 MS/s to the 64 megasample onboard memory, or continuously stream data to a host computer at up to 8 MS/s for one or both channels over a high-speed USB connection.

Each channel has its own A/D converter for simultaneous sampling to eliminate channel skew and ensure phase information between channels is maintained.

Flexible triggering and gating ensures data is acquired when needed. The clock I/O input allows acquisitions to be controlled by the onboard clock or by an external clock source for applications that require user-supplied pacing.

The board provides signal connections through four standard BNC connectors and a 40-pin auxiliary connector.

Analog Input Acquisition Modes

The USB-2020 can acquire analog data using BURSTIO or continuous scan mode.

BURSTIO

BURSTIO enables a device to acquire data at higher rates than are supported by the USB data transfer rate.

In BURSTIO, the USB-2020 can sample data to onboard memory at rates up to 20 MS/s per channel.

Because each channel has its own A/D converter, an overall sample rate of 40 MS/s is achieved when sampling both channels. The simultaneous sampling eliminates channel skew and maintains phase coherence between the two channels.

The memory buffer can store up to 64 megasamples at the maximum rate for transfer to the computer after the acquisition is complete.

Continuous Scan Mode

Continuous scan mode enables data to be directly transferred to the host computer during acquisition. The maximum rate in continuous scan mode is 8 MS/s for all acquired data (one channel or two channels). The maximum rate achieved depends on the host computer.

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1 The included USB cable has a higher gauge wire (24 AWG minimum VBUS/GND, 28 AWG minimum D+/D–) than generic USB cables, and is required for proper enumeration.

USB-2020
General Information

USB-2020 Block Diagram
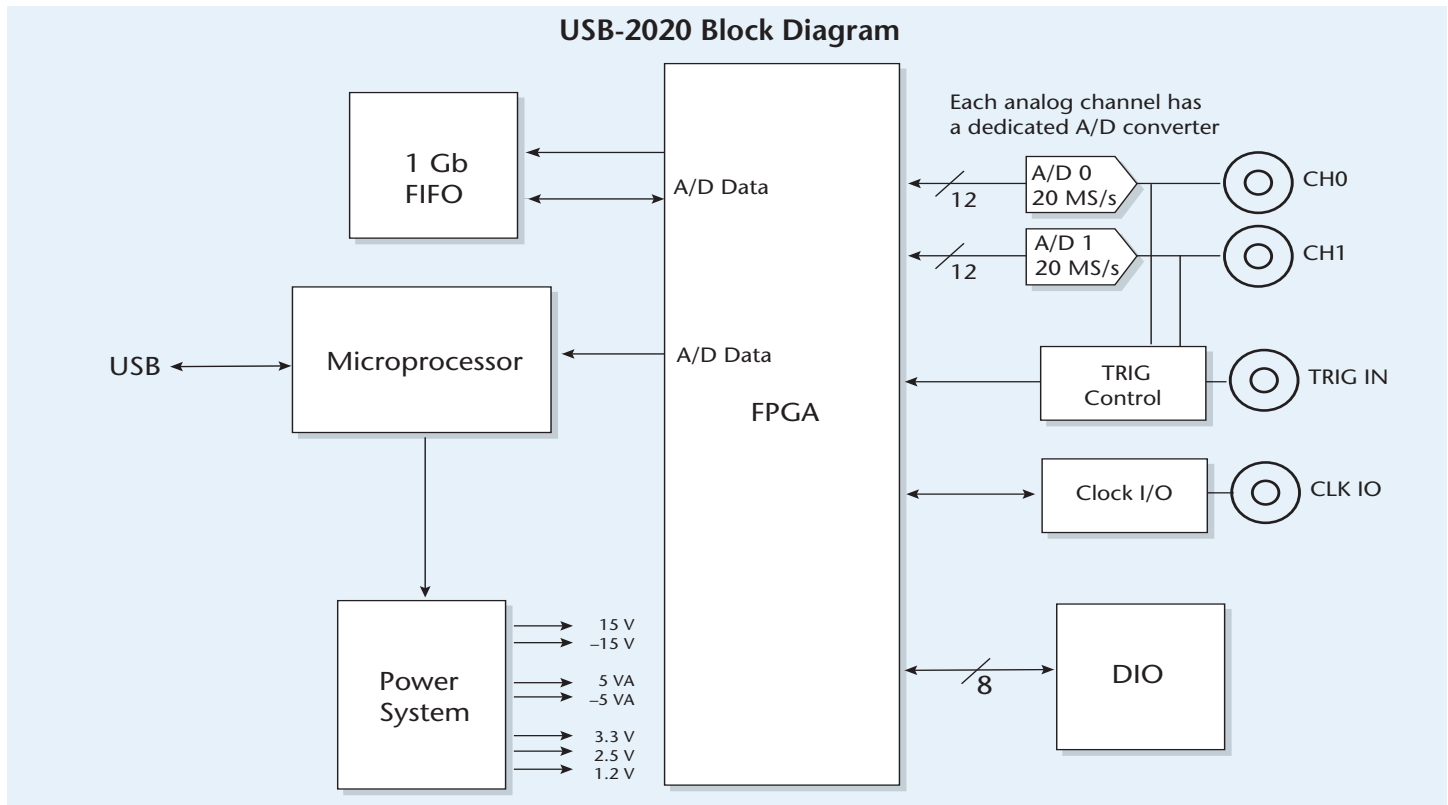
External Clock I/O

USB-2020 analog input scanning operations can be paced with the internal A/D clock or with an external clock source.

The CLK IO connector can be configured through software for input (default) for external pacing, or for output to pace a connected device.

Trigger Input

The USB-2020 supports digital and analog triggers and gates, and each type has software-selectable configurations.

- Digital triggers can be configured for rising or falling edge, or for high or low level.
- Analog triggers can be configured for above or below software-selectable level, or for rising or falling edge with software-selectable hysteresis.
- Digital gates can be configured for high or low level.
- Analog gates can be configured for software-selectable high or low level, or for in or out of software-selectable window.

An analog scan can have a trigger *or* a gate, but not both. For example, an analog trigger cannot be used at the same time as the TRIG IN BNC connector is being used to gate.

Digital I/O

The USB-2020 provides eight digital I/O lines on the 40-pin auxiliary connector. When a bit is configured for input, it can detect the state of any TTL-level input.

Each DIO channel is an open-drain, which can sink up to 150 mA for direct drive applications when used as an output.

External Pull-Up Capability

Digital inputs are pulled high by default to 5 V through 47 kΩ resistors on the circuit board. The pull-up voltage is common to all 47 kΩ resistors. The pull-up/pull-down state can be changed from a header on the board.

An external pull-up resistor can also be used to pull the DIO bit up to a voltage that exceeds the internal 5 V pull-up voltage (15 V maximum).

USB-2020
General Information

BNC and 40-Pin Auxiliary Connectors

The USB-2020 provides four standard BNC connectors for both analog inputs, trigger input, and clock I/O. Use standard BNC cables to connect the BNC female connectors.

The board also includes a 40-pin auxiliary connector for the eight digital I/O, two 5 V power outputs, and an alternate trigger input connection. The signals available from the 40-pin auxiliary connector require a separately-purchased cable.

Cables and Accessories for Field Wiring and Signal Termination

Use the following cables and accessories to connect to the signals available from the 40-pin auxiliary connector:

- **C40FF-x**: This 40-conductor ribbon cable can connect the 40-pin auxiliary connector to a **CIO-MINI40** universal screw-terminal board to terminate field signals and route them into the USB-2020.
- **C40-37F-x**: This 40-pin connector can connect the 40-pin auxiliary connector to a **CIO-MINI37** universal screw-terminal board or **SCB-37** signal connector box to terminate field signals and route them into the USB-2020.

MCC DAQ Software

The USB-2020 ships with the MCC DAQ software CD, which includes InstaCal, a software utility for installing, calibrating, and testing Measurement Computing hardware on a Windows platform.

In addition to InstaCal, MCC DAQ software also includes the following software packages:

TracerDAQ

TracerDAQ is an out-of-the-box application that can generate, acquire, analyze, display, and export data within seconds of installing Measurement Computing data acquisition hardware. TracerDAQ includes a strip chart, an oscilloscope, a function generator, and a rate generator, all of which are accessed through a common, easy-to-use interface.

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

Universal Library

The Universal Library (UL) is a set of programming libraries for developing applications with Visual Studio programming languages (and others) for use with Measurement Computing hardware. UL includes a complete function library that simplifies the configuration and operation of your measurement device. UL supports Visual Studio and Visual Studio .NET, and includes 64-bit driver support for Windows 8/7/Vista/XP.

ULx for NI LabVIEW

ULx for NI LabVIEW is a comprehensive library of graphical functions and example programs comprising all the power of the Universal Library and InstaCal. ULx for NI LabVIEW is compatible with NI LabVIEW 8.5 and later, and allows quick development of NI LabVIEW instrumentation, acquisition, and control applications with Measurement Computing hardware.

Software Available Separately

TracerDAQ Pro

TracerDAQ Pro is available as a purchased upgrade to TracerDAQ. TracerDAQ Pro supports more active channels, more samples per channel, and a selection of options and enhancements designed to address many test and measurement applications.

MEASUREMENT COMPUTING

Specifications

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

Analog Input

A/D Converter Type: AD9225
Number of Channels: 2
Resolution: 12-bits
Input Configuration: Single-ended, individual A/D per channel
Sampling Method: Simultaneous
Input Ranges: ±10 V, ±5 V, ±2 V, ±1 V, software-selectable
Connection Type: BNC
Input Coupling: DC
Absolute Maximum Input Voltage: ±15 V max (power on)
Input Impedance: 1.5 MΩ typ
Input Leakage Current: 2 uA typ, 10 uA max
Input Bandwidth (3 db): All input ranges, 17 MHz typ
Crosstalk: DC to 10 kHz, –90 dB
Trigger Source
   Digital: TRIG IN (BNC connector or 40-pin connector)
   See External Trigger for more information
   Analog: CH0 or CH1
Sample Clock Source
   Internal: 1 kHz to 20 MHz max
   External: CLK IO (BNC connector)
   See External Clock Input/Output for more information
Throughput
   Continuous Scan: 1 kS/s min to 8 MS/s max to host computer (maximum rate is system-dependent)
   BURSTIO: 1 kS/s min to 20 MS/s max to 64 MS onboard memory
Signal-to-Noise Ratio (SNR): 66.6 dB
Signal-to-Noise and Distortion Ratio (SINAD): 66.5 dB
Spurious Free Dynamic Range (SFDR): 80 dB
Total Harmonic Distortion (THD): 80 dB

Noise Performance

For the peak-to-peak noise distribution test, a single-ended input channel is connected to AGND at the input BNC connector and 20,000 data samples are acquired at the maximum rate.

Range	Counts	LSBrms
±10 V	5	0.76
±5 V	5	0.76
±2 V	7	1.06
±1 V	7	1.06

Analog Input Calibration

Recommended Warm-Up Time: 15 minutes min
Calibration Method: Self calibration, with calibration factors for each range stored onboard in non-volatile memory
Calibration Interval: 1 year (factory calibration)

Digital Input/Output

Digital Type: CMOS
Number of I/O: 8
Configuration: Each bit can be independently configured as input (power on default) or output. Input bits can be read at any time whether the digital output is active or tri-stated.
Input Voltage Range: 0 V to 15 V
Input Characteristics: 47 kΩ pull-up/pull-down resistor, 28 kΩ series resistor
Abs. Maximum Input Voltage: +20 V max
Pull-Up/Pull-Down Configuration: The port has 47 kΩ resistors that can be configured as pull-up or pull-down with an internal jumper. The factory configuration is pull-up (J10 shorting block default position is pins 1 and 2)
Pull down capability is available by placing the J10 shorting block across pins 2 and 3.
Digital I/O Transfer Rate (Software Paced): 33 S/s to 4,000 S/s typ; system-dependent
Input High Voltage: 2.0 V min
Input Low Voltage: 0.8 V max
Output Characteristics: 47 kΩ pull-up, open drain (DMOS transistor, source connected to ground)
Output Voltage Range: 0 V to 5 V (using 47 KΩ internal pull up resistors); 0 V to 15 V max through optional, user-supplied external pull-up resistors
Adding external pull-up resistors connects the output bit in parallel with the internal 47 kΩ pull-up resistor. The resulting load voltage depends on the value of the external resistor value and the pull-up voltage used. In general, external 10 KΩ pull-up resistors are sufficient for most applications.

Drain to Source Breakdown Voltage: 42.5 V min (does not include the additional leakage current contribution that can occur when using an external pull-up resistor)
Off State Leakage Current: 1.0 µA
Sink Current Capability: 150 mA max (continuous) per output pin; 150 mA max (continuous), total for all eight channels
DMOS Transistor On-Resistance (Drain to Source): 4 Ω

External Trigger

Trigger Source
   Digital: TRIG IN on BNC connector and 40-pin connector)
   Analog: CH0 or CH1
Trigger Mode
   Digital: Rising or falling edge, high or low level
   Analog: Trigger above or below software-selectable level, rising or falling edge with software-selectable hysteresis
A/D Gate Source
   Digital: TRIG IN (BNC connector and 40-pin connector)
   Analog: CH0 or CH1
A/D Gate Modes
   Digital: High or low level
   Analog: Software-selectable high or low level, in or out of software-selectable window
Trigger Latency: 50 ns max
Trigger Pulse Width: 25 ns min
Input Type: 49.9 Ω series resistor
Input High Voltage: 2.0 V min
Input Low Voltage: 0.8 V max

External Clock Input/Output

Terminal Name: CLK IO (BNC connector)
Terminal Type: ADC clock input/output, software-selectable for input or output (default is input)
Terminal Description: When configured for input, receives sampling clock from external source
When configured for output, outputs the internal sampling clock
Clock Rate: 1 kHz to 20 MHz max
Stability: ±50 ppm
Input Impedance: 1 MΩ
Input Threshold
   High: 2.0 V min
   Low: 0.8 V max
Maximum Rate: 20 MHz
Input Range: 0 V to 5.5 V
Clock Pulse Width: 25 ns min
Input Type: 49.9 Ω series resistor
Input High Voltage: 2.0 V min
Input Low Voltage: 0.8 V max
Output High Voltage: 2.4 V min
Output Low Voltage: 0.4 V max
Output Current: 24 mA max

Accuracy

DC Accuracy Components and Specifications. All Values are (±)						
Range	Gain Error (% of reading)	Offset Error (mV)	INL Error (% of range)	Absolute Accuracy at Full Scale (mV)	Gain Temperature Coefficient (% reading/°C)	Offset Temperature Coefficient (µV/°C)
±10 V	0.11	5.2	0.0976	35.72	0.0035	30
±5 V	0.11	5.2	0.0488	20.46	0.0035	110
±2 V	0.11	1.1	0.0244	8.18	0.0035	10
±1 V	0.11	1.1	0.0122	4.64	0.0035	25

USB-2020
Specifications & Ordering

MEASUREMENT COMPUTING™

Memory

Data FIFO: 64 MS using BURSTIO, 4 kS not using BURSTIO

Non-Volatile Memory: 32 KB (30 KB firmware storage, 2 KB calibration/user data)

Power

Supply Voltage: 9 VDC to 20 VDC (only use MCC plug-in power supply - MCC p/n CB-PWR-9)

Supply Current: 0.75 A max (this is the total quiescent current requirement for the device that includes up to 10 mA for the Status LED. This value does not include potential loading of the DIO bits or the +VO pin)

Power Jack Configuration: Two conductor, barrel

Power Jack Barrel Diameter: 6.3 mm

Power Jack Pin Diameter: 2.0 mm

Power Jack Polarity: Center positive

+VO Voltage Range: 4.50 V to 5.25 V

+VO Current Sourcing: 10 mA max.

Environmental

Operating Temperature Range: 0 °C to 50 °C max

Storage Temperature Range: –40 °C to 85 °C max

Humidity: 0% to 90% non-condensing max

Mechanical

Dimensions (L × W × H): 142.24 × 180.34 × 38.09 mm (5.6 × 7.1 × 1.5 in.)

Weight: 1.5 lb

USB

USB Device Type: USB 2.0 (high-speed)

Device Compatibility: USB 2.0

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

USB Cable Length: 3 m (9.84 ft) max

Signal I/O Connectors

USB: B type

Auxiliary Connector (J9): 40-pin header connector

Compatible Cables for the 40-Pin Auxiliary Connector: C40FF-x and C40-37F-x

Compatible Accessory Products with the C40FF-x Cable: CIO-MINI40

Compatible Accessory Products with the C40-37F-x Cable: CIO-MINI37 and SCB-37

BNC Connectors

CH0: Analog input channel 0

CH1: Analog input channel 1

TRIG IN: BNC connection for external digital trigger (also available on the auxiliary connector J9)

CLK IO: BNC connection for the ADC clock I/O, software-selectable for input or output

Ordering Information

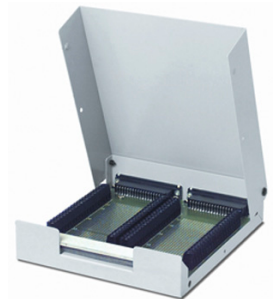| Part No.	Description
USB-2020	Ultra high-speed, simultaneous sampling USB DAQ board with 2 SE analog inputs, 20 MS/s throughput to internal memory, analog/digital triggers and gates, clock I/O, and 8 digital I/O lines. Includes power supply (MCC p/n CB-PWR-9), USB cable, and standoffs.

Accessories & Cables

Part No.	Description
C40FF-x	40-conductor ribbon cable, female to female (x = 1, 2, 3, 4, 5, 10, 15, 20, 25, and 50 foot lengths)
CIO-MINI40	Universal 40-pin screw-terminal board, connects via a C40FF-x cable
C40-37F-x	40-pin ribbon cable, female IDC to 37-pin female D shell (x = 1, 2, 3, 4, 5, 10, 15, 20, 25, and 50 foot lengths)
CIO-MINI37	Universal 37-pin screw-terminal board, connects via a C40-37F-x cable
SCB-37	Shielded 37-pin signal connection box, connects via a C40-37F-x cable

CIO-MINI40

CIO-MINI37

SCB-37

Software

Part No.	Description
TracerDAQ Pro	Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version