

# USB-2020

12-bit, Ultra High-Speed USB Device

## User's Guide

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## About this User's Guide

### What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-2020 data acquisition device and lists device specifications.

### Conventions in this user's guide

#### For more information

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

**Caution!** Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

**bold text**      **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

*italic text*      *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

### Where to find more information

Additional information about the USB-2020 is available on our website at [www.mccdaq.com](http://www.mccdaq.com). You can also contact Measurement Computing Corporation by phone, fax, or email with specific questions.

- Knowledgebase: [kb.mccdaq.com](http://kb.mccdaq.com)
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support
- Fax: 508-946-9500 to the attention of Tech Support
- Email: [techsupport@mccdaq.com](mailto:techsupport@mccdaq.com)

## Introducing the USB-2020

The USB-2020 is a high-speed data acquisition USB board supported under the Windows® operating system.

The USB-2020 is compatible with both USB 1.1 and USB 2.0 ports. The speed of the device may be limited when using a USB 1.1 port due to the difference in transfer rates on the USB 1.1 versions of the protocol (low-speed and full-speed).

The USB-2020 device provides the following features:

- two 20 MS/s analog inputs
  - simultaneous sampling
  - 1 A/D per channel
  - 12-bit resolution
  - $\pm 10$  V,  $\pm 5$  V,  $\pm 2$  V,  $\pm 1$  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 (20 MS/s per channel)
  - 8 MS/s throughput to host computer
- Analog and digital triggering (level and edge )
- Analog and digital gating
- Eight digital I/O lines
- Internal or external pacing of analog scans
- Eight digital I/O lines
- BNC connectors and 40-pin auxiliary connector for signal connections

## Functional block diagram

USB-2020 functions are illustrated in the block diagram shown here.

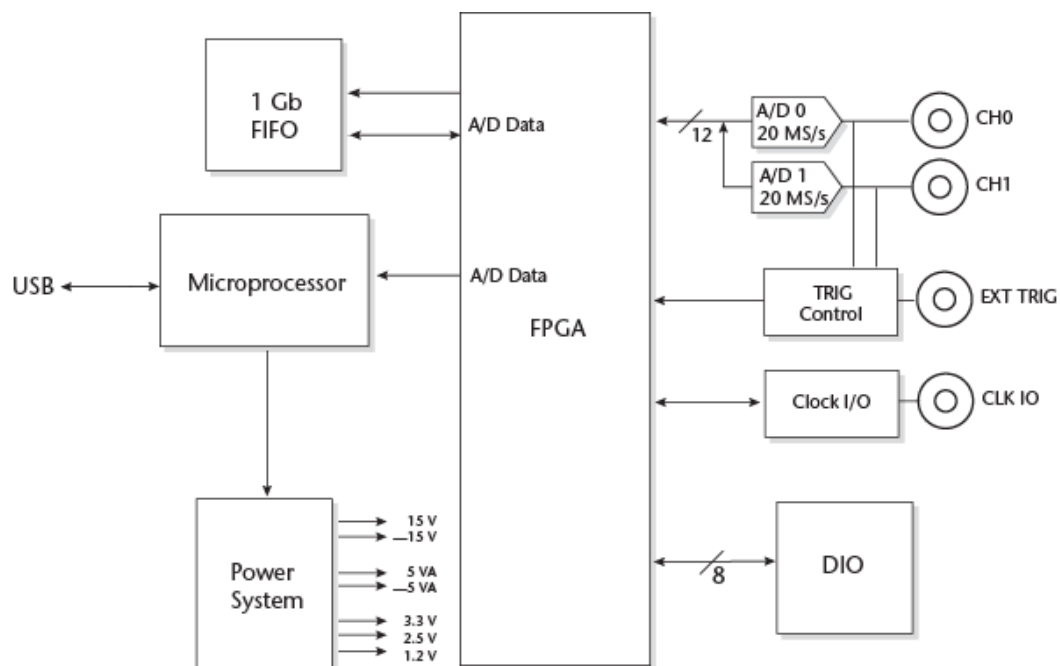


Figure 1. Functional block diagram

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# Installing the USB-2020

## What comes with your USB-2020 shipment?

### Hardware

- USB-2020
- USB cable (2-meter length)
- External power supply and cord: 9 VDC, 3 A power adapter. MCC part number CB-PWR-9
- Four nylon standoffs

### Software

MCC DAQ Software CD

### Documentation

#### MCC DAQ Quick Start Guide

The Quick Start Guide booklet provides an overview of the MCC DAQ software you received with the device, and includes information about installing the software. Please read this booklet completely before installing any software or hardware.

### Optional components

- Cables
  - Standard BNC cable
  - C40FF-*x*
  - C40-37F-*x*
- Screw termination boards
  - CIO-MINI40
  - CIO-MINI37
  - SCB-37

## Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-2020 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your USB-2020 arrives already damaged, notify Measurement Computing Corporation immediately by phone, fax, or email.

- Knowledgebase: [kb.mccdaq.com](http://kb.mccdaq.com)
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support
- Fax: 508-946-9500 to the attention of Tech Support
- Email: [techsupport@mccdaq.com](mailto:techsupport@mccdaq.com)

For international customers, contact your local distributor. Refer to the International Distributors section on our website at [www.mccdaq.com/International](http://www.mccdaq.com/International).

## Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the MCC DAQ CD. This booklet is available in PDF at [www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf](http://www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf).

## Installing the hardware

Before you connect the USB-2020 to your computer, connect the external power supply that was shipped with the device.

### Disconnect USB, then power supply

When disconnecting the USB-2020, disconnect the USB cable first, and then disconnect the power supply.

### Connecting the external power supply

Refer to Figure 8 on page 12 for the location of the connectors and LEDs mentioned in the following procedure.

Power to the USB-2020 is provided with the 9 VDC external power supply (CB-PWR-9). Connect the external power supply *before* connecting the USB cable to the USB-2020 and your computer.

Complete the following steps to connect the power supply to the USB-2020:

1. Connect the external power cord to the USB-2020-power connector.
2. Plug the power supply into a power outlet.

The top (**Device Ready**) LED is on (blue) when 9 VDC power is supplied the USB-2020 and a USB connection is established. If the voltage supply is less than 7.3 V and/or a USB connection is not established, the **Device Ready** LED is off.

To connect the USB-2020 to your system, complete the following steps:

3. Connect the USB cable that was shipped with the device to the USB connector on the USB-2020.  
The USB cable supplied with the USB-2020 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 of the USB-2020.
4. Connect the other end of the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The bottom (**USB Activity**) LED turns on. The USB cable only provides communication to the USB-2020.

If you are running Windows XP and connect the device to a USB 1.1 port, a balloon displays the message **Your USB device can perform faster if you connect to a USB 2.0 port**. You can ignore this message. The USB-2020 functions properly when connected to a USB 1.1 port, although USB bandwidth is limited.

### If the Device Ready LED turns off

If communication is lost between the device and the computer, the **Device Ready** LED turns off. Disconnect the USB cable from the computer and then reconnect it. This should restore communication, and the **Device Ready** LED should turn on.

### If your system does not detect the USB-2020

If a **USB device not recognized** message appears when you connect the USB-2020, complete the following steps:

1. Unplug the USB cable from the USB-2020.
2. Unplug the external power cord from the power connector.
3. Plug the external power cord back into the power connector.
4. Plug the USB cable back into the USB-2020.

Your system should now properly detect the USB-2020 hardware. Contact technical support if your system still does not detect the USB-2020.



## Removing USB-2020 boards from Windows XP systems

Device Manager may require up to 30 seconds to detect the removal of a USB-2020 board from a Windows XP system with Service Pack 2 installed. This time increases with each additional connected device. If you remove four devices from your system, the time required for Device Manager to update may be almost two minutes.

If you re-attach the USB-2020 to your system before Device Manager updates, the bottom LED does not turn on. Your system does not detect new hardware until Device Manager first detects that hardware has been removed. The InstaCal software is unresponsive during this re-detection time. Wait until Device Manager updates with the new hardware before running InstaCal. The USB-2020 is detected by the system when the top (Device Ready) LED is on.

## Calibrating the hardware

The Measurement Computing Manufacturing Test department performs the initial factory calibration. The calibration coefficients are stored in non-volatile RAM.

You can use InstaCal to recalibrate the USB-2020. No external equipment or user adjustments are required.

At run time, the calibration factors are loaded into system memory and are automatically retrieved each time a different ADC range is specified. A full calibration typically takes less than two minutes.

Before you calibrate the device, turn your computer on and allow at least 30 minutes for the surrounding temperature to stabilize. For best results, calibrate the device immediately before making critical measurements. The high resolution analog components on the board are sensitive to temperature. Pre-measurement calibration insures that your device is operating with optimum calibration values.

## Connecting the board for I/O operations

### Connectors, cables, and accessory products

The following table lists the board connectors, applicable cables, and compatible accessory products for the USB-2020.

Board connectors, cables, and compatible hardware

Parameter	Specification
Connector types	<ul style="list-style-type: none"> <li>■ Four standard BNC female connectors for analog input, clock I/O, and digital trigger input</li> <li>■ 40-pin IDC connector</li> </ul>
Compatible cable for the BNC connectors	Standard BNC cable
Compatible cables	C40FF-x: 40-conductor ribbon cable, female both ends, x = length in feet.
	C40-37F-x: 40-pin IDC to 37-pin female D connector, x = length in feet.
Compatible accessory products (using the C40FF-x cable)	CIO-MINI40
Compatible accessory products (using the C40-37F-x cable)	CIO-MINI37 SCB-37

## Cabling

For signal connections and termination, you can use the CIO-MINI40 screw terminal board and C40FF-x cable.

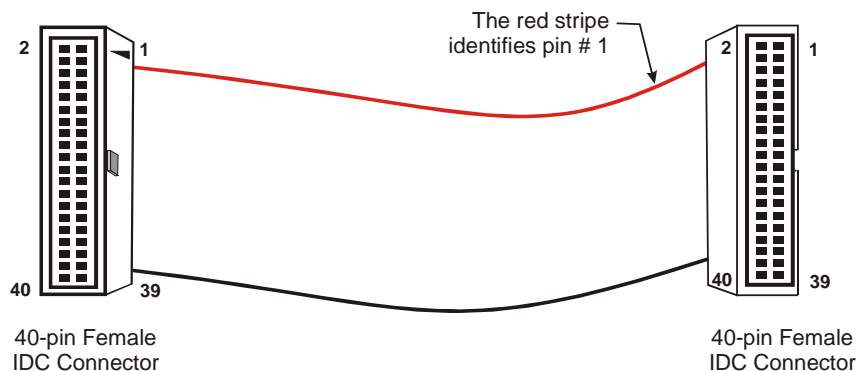


Figure 2. C40FF-x cable

For connections to 37-pin connectors or boards, you can use the C40-37F-x or C40F-37M-x cable.

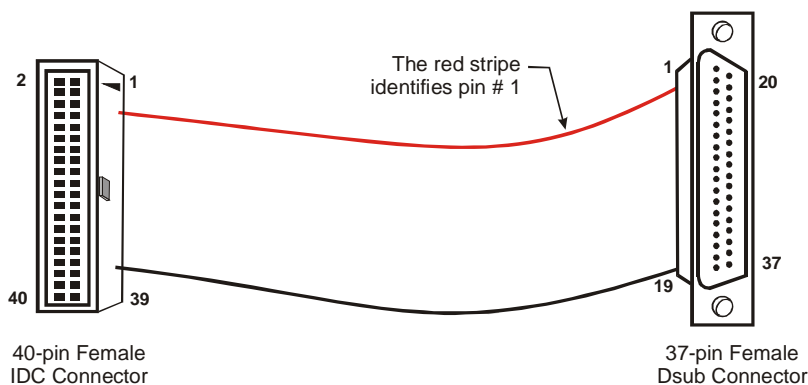


Figure 3. C40-37F-x cable

## Field wiring, signal termination and conditioning

You can use the 40-pin CIO-MINI40 universal screw terminal board to terminate field signals and route them into the USB-2020 using the C40FF-x cable:

You can use the following MCC screw terminal boards to terminate field signals and route them into the USB-2020 using the C40-37F-x cable directly:

- **CIO-MINI37** – 37-pin universal screw terminal board.
- **SCB-37** – 37-conductor, shielded signal connection/screw terminal box.

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## Functional Details

### Analog input acquisition modes

The USB-2020 can acquire analog input data in three different modes – software paced, continuous scan (hardware paced), and BURSTIO.

#### Software paced

In software paced mode, you can acquire one analog sample at a time. You initiate the A/D conversion by calling a software command. The analog value is converted to digital and returned to the computer. You repeat this procedure until you have the total number of samples that you want from one channel.

The typical throughput sample rate in software paced mode is 4 kS/s (system-dependent).

#### Continuous scan (hardware paced)

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..

#### BURSTIO

When using BURSTIO, the USB-2020 can acquire data at the maximum rate of 20 MS/s per channel to the internal memory buffer (up to 64 megasamples)<sup>1</sup>. The acquired data is read from the FIFO and transferred to a user buffer in the computer. You can initiate a single acquisition sequence of one to two channels with either a software command or an external hardware trigger event.

When BURSTIO is enabled, scans are limited to the depth of the onboard memory, as the data is acquired at a rate faster than it can be transferred to the computer. Time must be allowed between scans for the acquisition *and* the transfer of the data.

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<sup>1</sup> In some situations, the available memory is restricted below 64 megasamples. Refer to *Buffer size limitations on Windows systems* on page 15 for more information.

## Connectors and LEDs

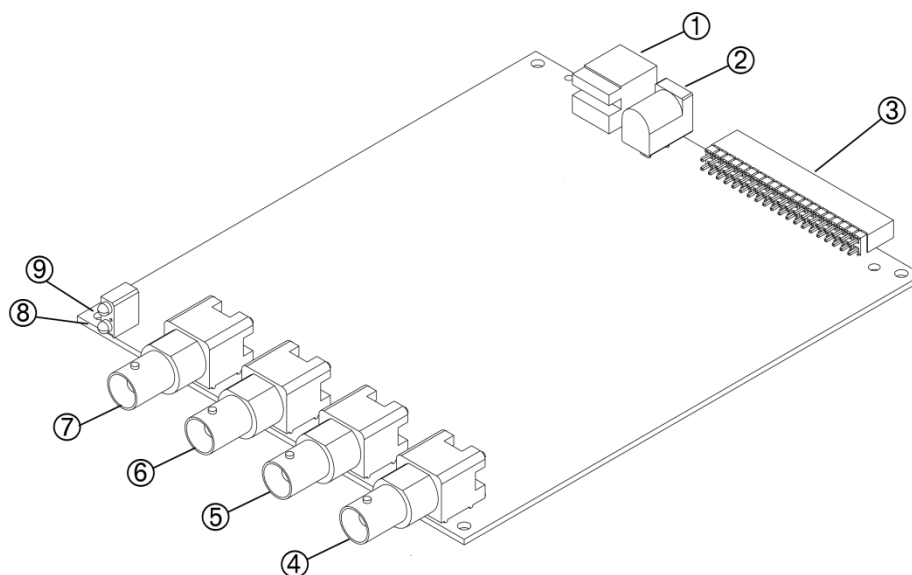


Figure 4. Location of connectors and LEDs

1	USB connector	4	Clock I/O BNC connector ( <b>CLK IO</b> )	7	Analog input channel 0 BNC connector ( <b>CH0</b> )
2	External power connector	5	External digital trigger input BNC connector ( <b>TRIG IN</b> )	8	<b>USB Activity</b> LED
3	40-pin IDC connector	6	Analog input channel 1 BNC connector ( <b>CH1</b> )	9	<b>Device Ready</b> LED

### BNC connectors

The USB-2020 has four BNC connectors that provide connections for the following signals:

- Two single-ended analog inputs
- One external digital trigger input
- One clock input/output

The external digital trigger input signal is also available on the 40-pin IDC connector.

### Status LEDs

The **Device Ready** LED turns on after the device is enumerated by the system and is associated with a hardware driver.

The **USB Activity** LED turns on when the USB-2020 is transmitting or receiving data.

### USB connector

The USB connector provides power to the USB-2020 and communication with the host computer.

### External power connector

The USB-2020 requires external power. Connect the CB-PWR-9 power supply to the external power connector. This power supply provides 9 VDC, 3 A power, and plugs into a standard 120 VAC outlet.

## 40-pin auxiliary connector (J9)

The 40-pin auxiliary connector provides the following connections for all I/O signals except for analog input and clock I/O:

- Eight digital I/O (**DIO0** to **DIO7**)
- Digital trigger input (**TRIG IN**)
- 12 ground connections (**GND**)
- Two +5V power outputs (**+VO**)

The signals that are available on the 40-pin IDC connector are listed below. Connect signals on the 40-pin IDC connector using a C40FF-*x* cable or C40-37F-*x* cable.

40-pin IDC connector pin out

Pin Description	Signal Name	Pin		Pin	Signal Name	Pin Description
Ground	GND	1	• •	2	+VO	Power output
Ground	GND	3	• •	4	N/C	Do not connect
Digital I/O bit 7	DIO7	5	• •	6	N/C	Do not connect
Digital I/O bit 6	DIO6	7	• •	8	N/C	Do not connect
Digital I/O bit 5	DIO5	9	• •	10	TRIG IN	External digital trigger input
Digital I/O bit 4	DIO4	11	• •	12	GND	Ground
Digital I/O bit 3	DIO3	13	• •	14	GND	Ground
Digital I/O bit 2	DIO2	15	• •	16	GND	Ground
Digital I/O bit 1	DIO1	17	• •	18	GND	Ground
Digital I/O bit 0	DIO0	19	• •	20	GND	Ground
Ground	GND	21	• •	22	N/C	Do not connect
Do not connect	N/C	23	• •	24	N/C	Do not connect
Ground	GND	25	• •	26	N/C	Do not connect
Do not connect	N/C	27	• •	28	N/C	Do not connect
Ground	GND	29	• •	30	N/C	Do not connect
Do not connect	N/C	31	• •	32	N/C	Do not connect
Ground	GND	33	• •	34	N/C	Do not connect
Power output	+VO	35	• •	36	N/C	Do not connect
Ground	GND	37	• •	38	N/C	Do not connect
Do not connect	N/C	39	• •	40	N/C	Do not connect

### 40-pin to 37-pin signal mapping

Signal mapping on the C40-37F-x cable is not a one-to-one ratio. The following table lists the pin numbers of the signals on the 40-pin end and the pin numbers of the associated signals on the 37-pin end.

Signal mapping on the C40-37F-x cable

40-pin cable end		37-pin cable end	
Pin	Signal Name	Pin	Signal Name
1	GND	1	GND
2	+VO	20	+VO
3	GND	2	GND
4	N/C	21	N/C
5	DIO7	3	DIO7
6	N/C	22	N/C
7	DIO6	4	DIO6
8	N/C	23	N/C
9	DIO5	5	DIO5
10	TRIG IN	24	TRIG IN
11	DIO4	6	DIO4
12	GND	25	GND
13	DIO3	7	DIO3
14	GND	26	GND
15	DIO2	8	DIO2
16	GND	27	GND
17	DIO1	9	DIO1
18	GND	28	GND
19	DIO0	10	DIO0
20	GND	29	GND
21	GND	11	GND
22	N/C	30	N/C
23	N/C	12	N/C
24	N/C	31	N/C
25	GND	13	GND
26	N/C	32	N/C
27	N/C	14	N/C
28	N/C	33	N/C
29	GND	15	GND
30	N/C	34	N/C
31	N/C	16	N/C
32	N/C	35	N/C
33	GND	17	GND
34	N/C	36	N/C
35	+VO	18	+VO
36	N/C	37	N/C
37	GND	19	GND
38	N/C		
39	N/C		
40	N/C		

## Signal connections

### Analog input

The USB-2020 has two single-ended simultaneous sampling analog inputs that provide sampling at rates of up to 20 MS/s to internal memory when using BURSTIO and at rates of up to 8 MS/s (system-dependent) to the host computer in continuous scan mode. The input ranges are software-selectable for  $\pm 10$  V,  $\pm 5$  V,  $\pm 2$  V,  $\pm 1$  V.

When using BURSTIO, the internal memory can store up to 64 megasamples at the maximum rate for transfer to the computer after the acquisition is complete. Data is transferred to the host computer at a maximum rate of 8 MS/s (system-dependent).

### Buffer size limitations on Windows systems

When creating very large buffers in Windows, you may receive the message **The requested amount of Windows page-locked memory is not available** when you try to start a scan. This error occurs when there is enough memory to create the buffer, but the memory cannot be locked down. For example, the driver can only lock a maximum buffer size of 67,107,800 bytes (33,553,900 samples) on Windows XP systems. A workaround for this is available when BURSTIO is enabled, allowing you to transfer the entire 64 MS of data from the onboard memory to the Windows buffer. For more information, refer to the *USB-2020* topic (*Hardware Considerations* section) in the *Universal Library Help* (*User's Guide* section).

You can pace analog input operations with the internal A/D clock or with an external clock source. When using an external input scan clock, connect the clock source to the **CLK IO** BNC connector.

### 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.

### Digital I/O

You can connect up to eight digital I/O lines to DIO0 through DIO7 on the 40-pin IDC connector. When a bit is configured for input, it can detect the state of any TTL-level input.

Digital input voltage ranges of up to 0 to 15 V are permitted, with thresholds of 0.8 V (low) and 2.0 V (high).

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

Figure 6 shows an example of a typical digital output connection.

Typical DIO channel

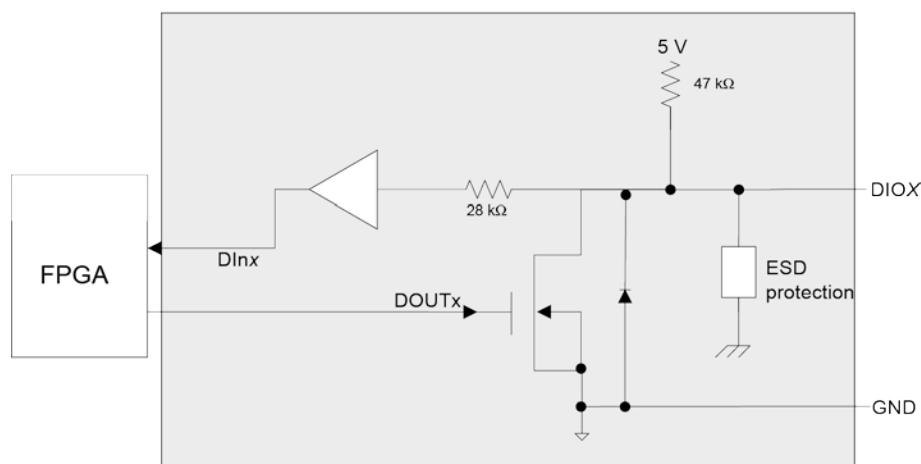
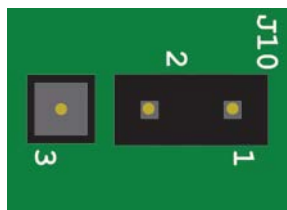


Figure 5. Digital output connection

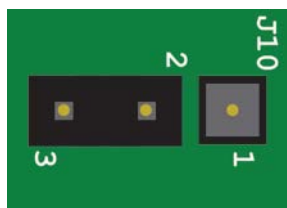
### External pull-up capability

Inputs are pulled high by default to 5 V through 47 k $\Omega$  resistors on the circuit board. The pull-up voltage is common to all 47 k $\Omega$  resistors.

You can configure the pull-up/pull-down state by changing the placement of the shorting block located at the three-pin header J10. Pull-up is the default factory configuration



**Pull-up default configuration (factory default)**



**Pull-down configuration**

Figure 6. Pull-up and pull-down jumper configurations (J10)

An external pull-up resistor can be used to pull the DIO bit up to a voltage that exceeds the internal 5 V pull-up voltage (15 V maximum). Be aware that this would place the 47k internal pull up resistor in a parallel resistance configuration that could offset the logic high voltage level.

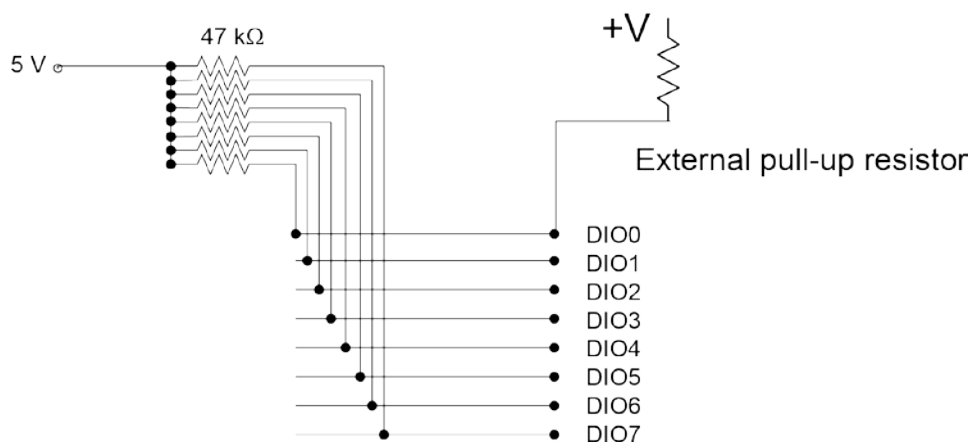


Figure 7. Digital I/O external resistor configuration

## Trigger input

Both the **TRIG IN** BNC connector and the **TRIG IN** IDC pin are external digital trigger/gate inputs that you can configure through software.

An analog scan can have a trigger *or* a gate, but not both. For example, you cannot use an analog trigger and use the **TRIG IN** BNC connector to gate at the same time.

A trigger or gate can be digital or analog.

- Digital triggers can be configured for rising or falling edge, or for high or low level.
- Analog triggers can be configured for software-selectable high or low 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.



Each configuration is explained below:

- High or low level – Trigger or gate an acquisition when an input signal is higher or lower than the specified voltage.
- Rising or falling edge – Trigger an acquisition when input signals cross a specified voltage (rising or falling)
- Window – Gate an acquisition when the input signal is within or outside two specified voltages (in/out of window)
- Hysteresis – After the input signal has passed through one specified voltage, trigger an acquisition when the input signal passes through a second voltage (positive or negative). For example, once the signal goes below 5 V, a rising edge that crosses 4 V must occur to trigger an acquisition.

## Mechanical drawing

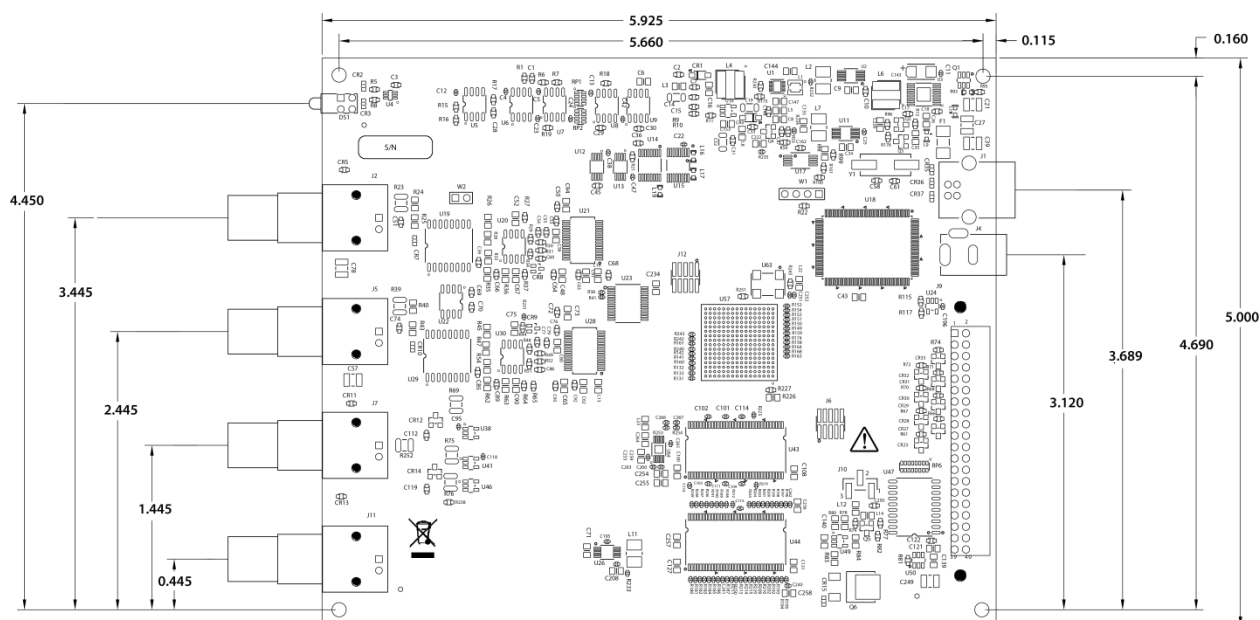


Figure 8. USB-2020 board dimensions

# Specifications

All specifications are subject to change without notice.

Typical at 25 °C unless otherwise specified

Specifications in *italic text* are guaranteed by design.

## Analog input

Table 1. Analog input specifications

Parameter	Condition	Specification
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		$\pm 10$ V, $\pm 5$ V, $\pm 2$ V, $\pm 1$ V, software-selectable
Connection type		BNC
Input coupling		DC
Absolute maximum input voltage		$\pm 15$ V max (power on)
Input impedance		1.5 M $\Omega$ typ
<i>Input leakage current</i>		2 $\mu$ A typ, 10 $\mu$ A 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 and 40-pin connector) See External <a href="#">trigger</a> for more information
	Analog	CH0 or CH1
Sample clock source	Internal	1 kHz to 20 MHz max
	External	CLK IO (BNC connector) See External <a href="#">clock input/output</a> for more information
Throughput	Software paced	33 S/s to 4 kS/s typ; system-dependent
	Continuous scan	1 kS/s to 8 MS/s, system-dependent
	BURSTIO	1 kS/s to 20 MS/s to 64 MS onboard memory
Data transfer rate	From onboard memory	10 MS/s typ
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

## Accuracy

Table 2. DC Accuracy components and specifications. All values are ( $\pm$ )

Range	Gain error (% of reading)	Offset error (mV)	INL error (% of range)	Absolute accuracy at Full Scale (mV)	Gain temperature coefficient (% reading/ $^{\circ}$ C)	Offset temperature coefficient ( $\mu$ V/ $^{\circ}$ C)
$\pm 10$ V	0.11	5.2	0.0976	35.72	0.0035	30
$\pm 5$ V	0.11	5.2	0.0488	20.46	0.0035	110
$\pm 2$ V	0.11	1.1	0.0244	8.18	0.0035	10
$\pm 1$ V	0.11	1.1	0.0122	4.64	0.0035	25

## 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.

Table 3. Noise performance specifications

Range	Counts	LSBrms
$\pm 10$ V	5	0.76
$\pm 5$ V	5	0.76
$\pm 2$ V	7	1.06
$\pm 1$ V	7	1.06

## Analog input calibration

Table 4. Analog input calibration specifications

Parameter	Specification
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

Table 5. Digital I/O specifications

Parameter	Specification
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 k $\Omega$ pull-up/pull-down resistor, 28 k $\Omega$ series resistor
<i>Abs. Maximum input voltage</i>	+20 V max
Pull-up/pull-down configuration	The port has 47 k $\Omega$ 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 k $\Omega$ pull-up, open drain (DMOS transistor, source connected to ground)
Output voltage range	0 V to 5 V (using 47 K $\Omega$ internal pull up resistors) 0 V to 15 V max through optional, user-supplied external pull-up resistors (Note 1)
Drain to source breakdown voltage	42.5 V min (Note 2)
Off state leakage current	1.0 $\mu$ A
Sink current capability	<ul style="list-style-type: none"> <li>■ 150 mA max (continuous) per output pin</li> <li>■ 150 mA max (continuous), total for all eight channels</li> </ul>
DMOS transistor on-resistance (drain to source)	4 $\Omega$

**Note 1:** Adding external pull-up resistors connects the output bit in parallel with the internal 47 k $\Omega$  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 K $\Omega$  pull-up resistors are sufficient for most applications.

**Note 2:** Does not include the additional leakage current contribution that can occur when using an external pull-up resistor.

## External trigger

Table 6. External trigger specifications

Parameter	Condition	Specification
Trigger source	Digital	TRIG IN (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 $\Omega$ series resistor
Input high voltage		2.0 V min
Input low voltage		0.8 V max

## External clock input/output

Table 7. External clock I/O specifications

Parameter	Specification
Terminal name	CLK IO (BNC connector)
Terminal type	ADC clock input/output, software-selectable for input or output (default is input)
Terminal description	<ul style="list-style-type: none"> <li>■ When configured for input, receives sampling clock from external source</li> <li>■ When configured for output, outputs the internal sampling clock</li> </ul>
Clock rate	1 kHz to 20 MHz max
Stability	$\pm 50$ ppm
Input impedance	1 M $\Omega$
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 $\Omega$ 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

## Memory

Table 8. Memory specifications

Parameter	Specification
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

Table 9. Power specifications

Parameter	Specification
Supply voltage	9 VDC to 18 VDC ( MCC plug-in power supply CB-PWR-9 recommended)
Supply current	0.75 A max (Note 3)
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.

**Note 3:** 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.

## Environmental

Table 10. Environmental specifications

Parameter	Specification
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

Table 11. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	142.24 × 180.34 × 38.09 mm (5.6 × 7.1 × 1.5 in.)
Weight	1.5 lb

## USB

Table 12. USB specifications

Parameter	Specification
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

Table 13. Connector specifications

Connector	Specification
USB	B type
Auxiliary connector (J9)	40-pin header connector
Compatible cables for the 40-pin auxiliary connector	<ul style="list-style-type: none"> <li>■ C40FF-x</li> <li>■ C40-37F-x</li> </ul>
Compatible accessory products with the C40FF-x cable	CIO-MINI40
Compatible accessory products with the C40-37F-x cable	<ul style="list-style-type: none"> <li>■ CIO-MINI37</li> <li>■ SCB-37</li> </ul>

## BNC connectors

Table 14. BNC connector pinout

BNC signal name	Signal description
CH0	Analog input channel 0
CH1	Analog input channel 1
TRIG IN	BNC connection for external digital trigger (Note 4)
CLK IO	BNC connection for the ADC clock input/output, software-selectable for input or output (default is input)

**Note 4:** Also available on the auxiliary connector J9.

## Auxiliary connector

Table 15. 40-pin connector J9 pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	GND	Ground	2	+VO	Power output
3	GND	Ground	4	N/C	Do not connect
5	DIO7	Digital I/O bit 7	6	N/C	Do not connect
7	DIO6	Digital I/O bit 6	8	N/C	Do not connect
9	DIO5	Digital I/O bit 5	10	TRIG IN	External digital trigger input
11	DIO4	Digital I/O bit 4	12	GND	Ground
13	DIO3	Digital I/O bit 3	14	GND	Ground
15	DIO2	Digital I/O bit 2	16	GND	Ground
17	DIO1	Digital I/O bit 1	18	GND	Ground
19	DIO0	Digital I/O bit 0	20	GND	Ground
21	GND	Ground	22	N/C	Do not connect
23	N/C	Do not connect	24	N/C	Do not connect
25	GND	Ground	26	N/C	Do not connect
27	N/C	Do not connect	28	N/C	Do not connect
29	GND	Ground	30	N/C	Do not connect
31	N/C	Do not connect	32	N/C	Do not connect
33	GND	Ground	34	N/C	Do not connect
35	+VO	Power output	36	N/C	Do not connect
37	GND	Ground	38	N/C	Do not connect
39	N/C	Do not connect	40	N/C	Do not connect

**Note 5:** N/C = no connection, not used

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