USB-231-OEM

Analog and Digital I/O

User's Guide

MEASUREMENT COMPUTING™

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Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing USB-231-OEM data acquisition device and lists device specifications.

Conventions in this user's guide

For more information
Text presented in a box signifies additional information related to the subject matter.

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 USB-231-OEM hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Introducing the USB-231-OEM

The USB-231-OEM is a USB 2.0 high-speed data acquisition board that provides the following features:

- Eight single-ended (SE) or four differential (DIFF) 16-bit analog inputs
- 50 kS/s maximum sample rate
- Two analog outputs with 5 kS/s simultaneous update rate per channel maximum
- Eight individually configurable digital I/O channels
- 32-bit counter
- Digital trigger input
- User voltage output
- One 34-pin header connector for field wiring connections

The USB-231-OEM is a USB 2.0 high speed device that is compatible with USB 3.0 ports. The device is also compatible with USB 1.1 ports, but use with this older hardware is not recommended due to longer initialization times that can occur when the USB-231-OEM is connected through USB 1.1 ports or hubs.

The USB-231-OEM is powered by the +5 V USB supply from your computer; no external power is required.

Caution! There are no product safety, electromagnetic compatibility (EMC), or CE marking compliance claims made for the USB-231-OEM. The USB-231-OEM is intended for use as a component of a larger system. MCC can help developers meet their compliance requirements. The end product supplier, however, is responsible for conforming to any and all compliance requirements.

Functional block diagram

Device functions are illustrated in the block diagram shown here.
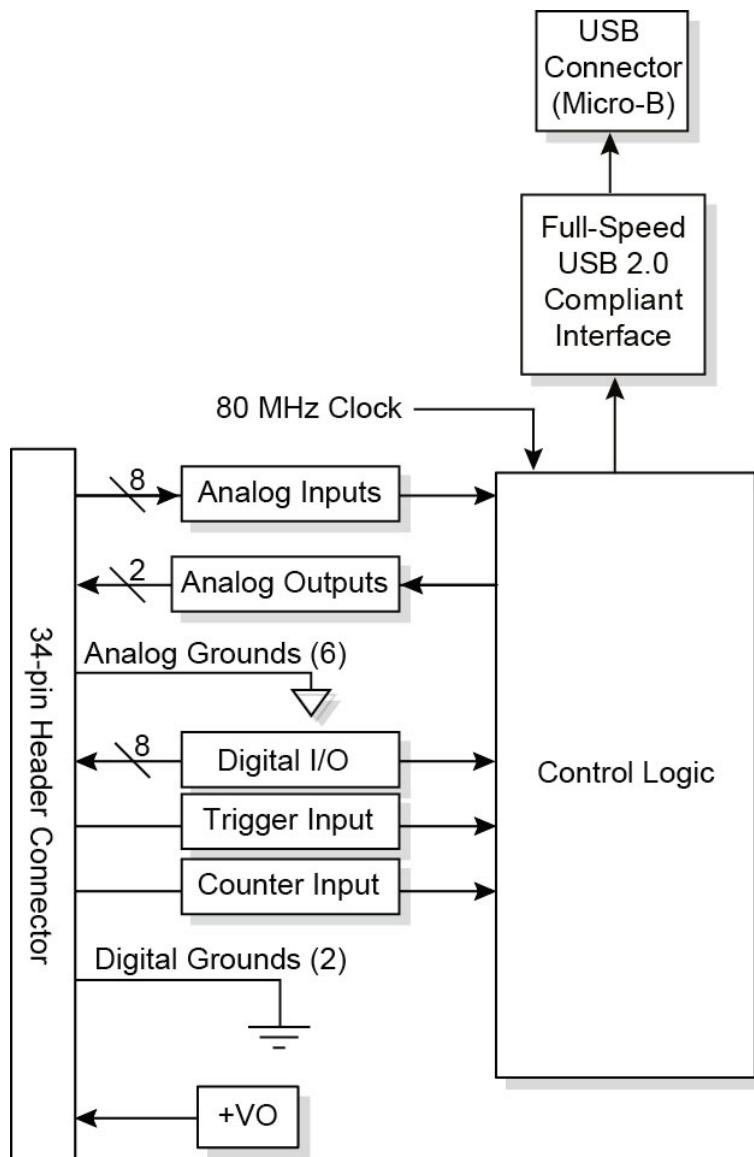
Figure 1. USB-231-OEM functional block diagram

Installing the USB-231-OEM

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the board 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.

Installing the software

Refer to the USB-231-OEM product page on the Measurement Computing website for information about how to install the supported software.

> **Install the software before you install the hardware**
> The driver needed to run the device is installed when you install the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Installing the hardware

Installing on a Windows platform

Connect the USB-231-OEM to a to an available USB port on the computer running Windows. Connect the other end of the cable to the micro-USB connector on the device. No external power is required.

When connected for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. When the dialog closes, the installation is complete.

Installing on an Android platform

Many Android devices include a standard A-type USB port to connect to the USB-231-OEM. If your device does not have a USB port, you may need a USB OTG cable for your Android device to host a USB device. Refer to your Android device documentation for more information.

Calibrating the hardware

The Measurement Computing Manufacturing Test department performs the initial factory calibration. Contact Measurement Computing for details about how to return your device and have it calibrated to the factory specifications.

Field calibration is not supported.

Functional Details

Analog input acquisition modes

The USB-231-OEM can acquire analog input data in two different modes – software paced and hardware paced.

Software paced mode

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

The maximum throughput sample rate in software paced mode is system-dependent.

Hardware paced mode

You can acquire data from up to eight channels in hardware paced mode. The analog data is continuously acquired and converted to digital values until you stop the scan. Data is transferred in blocks of samples from the device to the memory buffer on your computer. The block size varies depending on the sample rate.

The maximum continuous scan rate is an aggregate rate. The total acquisition rate for all channels cannot exceed 50 kS/s. The following table lists the scan rate when scanning from one to eight channels.

Maximum continuous scan rate

# channels scanned	Sample rate (kS/s)
1	50
2	25
3	16.67
4	12.5
5	10
6	8.33
7	7.14
8	6.25

You can start a hardware paced continuous scan with either a software command or with an external hardware trigger event.

Board components

Board components are shown in Figure 2.
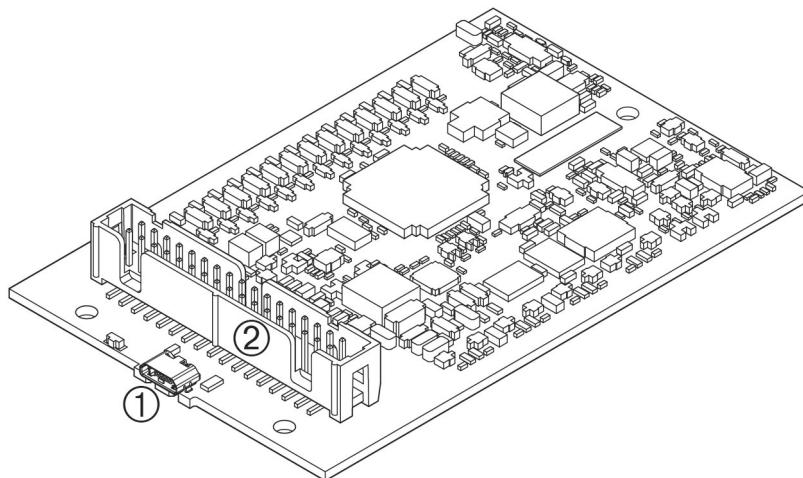
| 1 | Micro-USB connector | 2 | 34-pin header connector (J2) |

Figure 2. Board components

USB connector

The Micro-USB connector provides +5 V power and communication. No external power supply is required.

When using the USB connector to connect to the USB host, leave the D+ and D- signals and VBUS on the 34-pin connector disconnected.

Header connector J2

The 34-pin header connector provides the connections listed in the following pinout tables.

Caution!   To ensure the specified EMC performance, the length of any wire or cable connected to the header connector must be no longer than 0.5 m (20 in.).

Differential mode pinout

Do not connect to connector pins labeled *NC*.

J2 differential pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	AOUT0	Analog output 0	2	AOUT1	Analog output 1
3	AGND	Analog ground	4	AGND	Analog ground
5	CH3H	Analog input 3 HI	6	CH3L	Analog input 3 LO
7	CH2H	Analog input 2 HI	8	CH2L	Analog input 2 LO
9	CH1H	Analog input 1 HI	10	CH1L	Analog input 1 LO
11	CH0H	Analog input 0 HI	12	CH0L	Analog input 0 LO
13	AGND	Analog ground	14	AGND	Analog ground
15	D–	USB differential data signals	16	VBUS	USB power
17	D+	USB differential data signals	18	LED	Status LED driver
19	GND	Digital ground	20	DIO0	DIO bit 0
21	DIO1	DIO bit 1	22	DIO2	DIO bit 2
23	DIO3	DIO bit 3	24	DIO4	DIO bit 4
25	DIO5	DIO bit 5	26	DIO6	DIO bit 6
27	DIO7	DIO bit 7	28	NC	No connection
29	TRIG	Digital trigger input	30	NC	No connection
31	NC	No connection	32	GND	Digital ground
33	CTR	Counter input	34	+VO	User voltage output

Single-ended mode pinout

Do not connect to connector pins labeled *NC*.

J2 single-ended pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	AOUT0	Analog output 0	2	AOUT1	Analog output 1
3	AGND	Analog ground	4	AGND	Analog ground
5	CH3H	Analog input 3	6	CH3L	Analog input 7
7	CH2H	Analog input 2	8	CH2L	Analog input 6
9	CH1H	Analog input 1	10	CH1L	Analog input 5
11	CH0H	Analog input 0	12	CH0L	Analog input 4
13	AGND	Analog ground	14	AGND	Analog ground
15	D–	USB differential data signals	16	VBUS	USB power
17	D+	USB differential data signals	18	LED	Status LED driver
19	GND	Digital ground	20	DIO0	DIO bit 0
21	DIO1	DIO bit 1	22	DIO2	DIO bit 2
23	DIO3	DIO bit 3	24	DIO4	DIO bit 4
25	DIO5	DIO bit 5	26	DIO6	DIO bit 6
27	DIO7	DIO bit 7	28	NC	No connection
29	TRIG	Digital trigger input	30	NC	No connection
31	NC	No connection	32	GND	Digital ground
33	CTR	Counter input	34	+VO	User voltage output

Signal connections

Analog input

You can connect up to eight single-ended inputs or up to four differential inputs to connectors **CH0H/CH0L** through **CH3H/CH3L**. The input voltage range is ±10 V. Figure 3 shows the USB-231-OEM analog input circuitry.
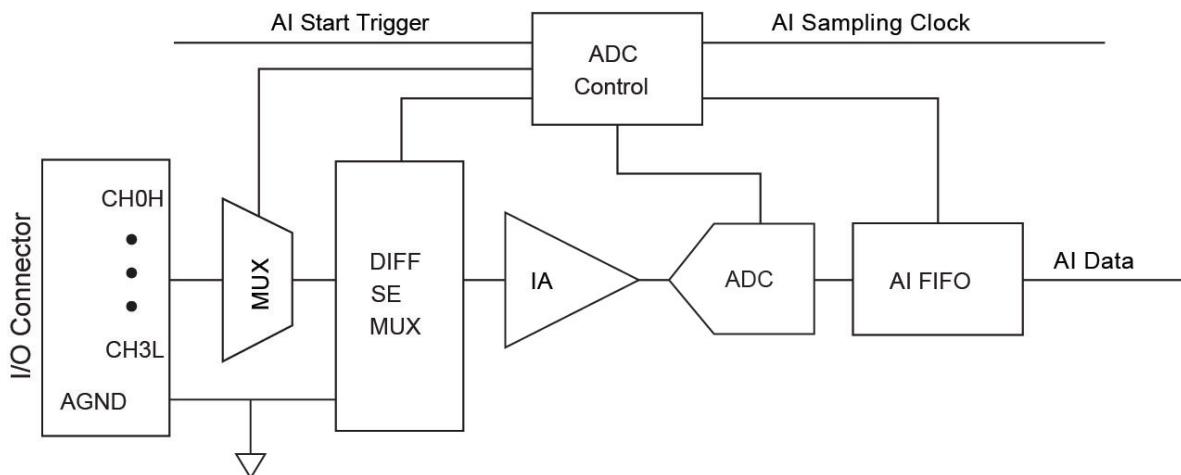
Figure 3. USB-231-OEM analog input circuitry

The main analog input circuitry blocks are as follows:

- **MUX**—The multiplexer (MUX) routes one AI channel at a time to the mode selector multiplexer (DIFF/SE MUX).
- **DIFF/SE MUX**—The mode selector MUX selects between DIFF mode and SE measurement mode.
- **IA**— The instrumentation amplifier (IA) removes the common mode signal and buffers the analog input signal before it is sampled by the analog-to-digital converter (ADC).
- **ADC**—The ADC digitizes the AI signal by converting the analog voltage into digital code.

- **AI FIFO**—The DAQ device can perform both single and multiple analog-to-digital conversions of a fixed or infinite number of samples. A first-in-first-out (FIFO) buffer holds data during AI acquisitions to ensure no data is lost.
- **ADC Control**—The ADC control circuitry sets the conversion rate of the ADC, sets the input configuration, drives the scanning sequence, and starts acquisitions synchronous with the TRIG or CTR signal

Single-ended configuration

When configured for SE input mode, the input signal is referenced to analog ground (**AGND**) and delivered through two wires:

- Connect the wire carrying the signal to be measured (**CHxH** or **CHxL**).
- Connect the second wire to **AGND**.

The input range for single-ended mode is ±10 V. The single-ended mode pinout is shown in the Single-ended mode pinout section on page 11.

Differential configuration

When configured for differential input mode, the input signal is measured with respect to the low input and delivered through three wires:

- Connect the wire carrying the signal to be measured to **CHxH**
- Connect the wire carrying the reference signal to **CHxL**
- Connect the third wire to **AGND**.

The differential mode pinout is shown in the Differential mode pinout section on page 10.

Note: To perform a single-ended measurement using differential channels, connect the signal to **CHxH** and ground the associated **CHxL** input.

Input range

The USB-231-OEM has an input range of ±10 V. For DIFF mode, each AI should stay within ±10 V with respect to AGND, and the voltage between positive and negative inputs should be lower or equal to ±10 V. For SE mode, signals of ±10 V at any analog input connector with respect to AGND are accurately measured.

Beyond ±10 V, the input signal begins clipping as shown in Figure 4. Typically, this clipping begins at ±10.5 V.
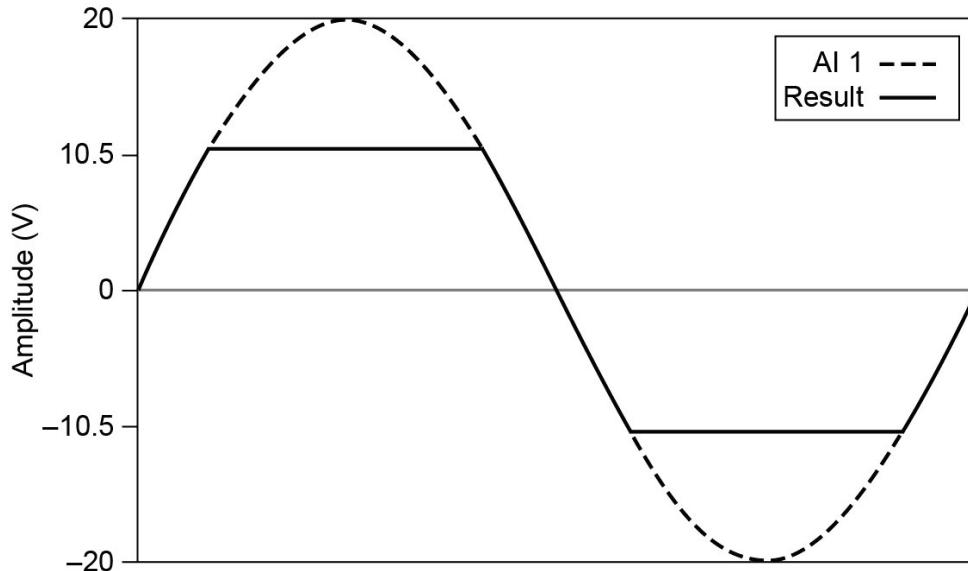
Figure 4. Analog input exceeding ±10 V returning clipped results

Multichannel scanning

The USB-231-OEM can scan multiple channels at high rates and digitize the signals accurately. However, you should consider several issues when designing your measurement system to ensure the high accuracy of your measurements:

- **Use low impedance sources –** To ensure fast settling times, your signal sources should have an impedance of <1 kΩ. Large source impedances increase the settling time of the DAQ device and decrease the accuracy at fast scanning rates.
- **Use short high-quality cabling –** Using short high-quality cables can minimize several effects that degrade accuracy including crosstalk, transmission line effects, and noise. The capacitance of the cable also can increase the settling time.

  To ensure the specified EMC performance, operate this product only with shielded cables and accessories. The length of any wire or cable connected to the connector must be no longer than 0.5 m (20 in.).
- **Avoid scanning faster than necessary –** Design your system to scan at slower speeds to give the DAQ device more time to settle to a more accurate level when switching between channels.

Analog output

Figure 5 shows the USB-231-OEM analog output circuitry.
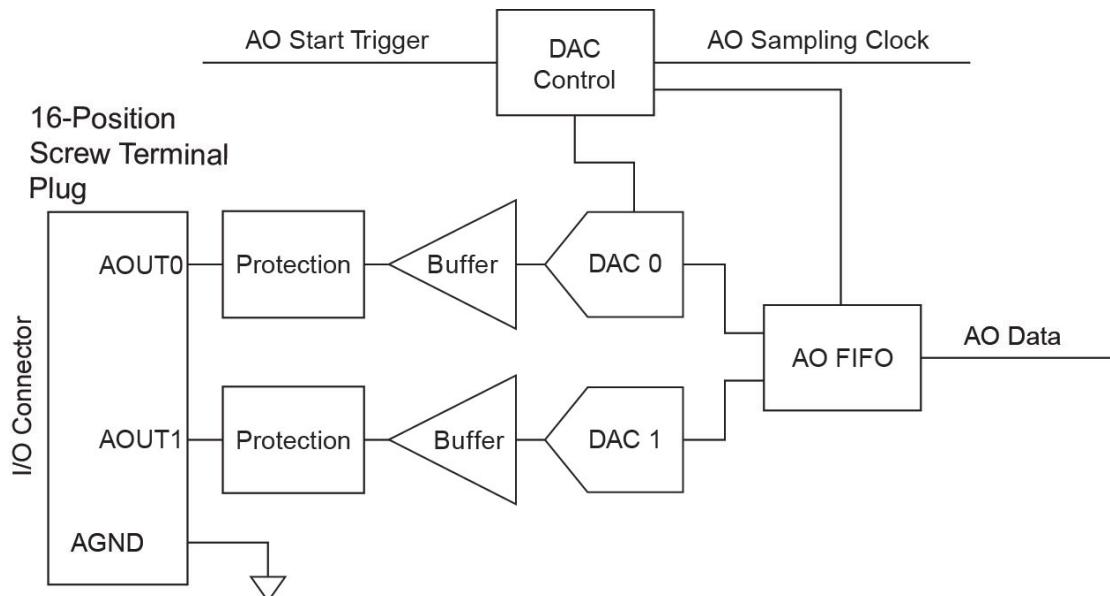
Figure 5. USB-231-OEM analog output circuitry

The main analog output circuitry blocks are as follows:

- **Protection –** The protection circuit prevents damage of the buffers in case of a short circuit or an overvoltage condition.
- **Buffer –** The buffer amplifies the analog signal to the ±10 V range and ensures the driving capability for the external load.
- **DAC 0 and DAC 1 –** The digital-to-analog converters (DAC) convert the digital signals into low-level analog signals.
- **AO FIFO –** The AO FIFO (first-in-first out) ensures that data is transferred to the DACs in a timely manner without being affected by USB latencies.
- **DAC Control –** The DAC control sets the DAC data rate and the startup condition, which could be triggered by the **TRIG** signal.

Analog output signals are referenced to AGND. Connect the loads between AOUT0 or AOUT1 and AGND as shown in Figure 6 on page 14.
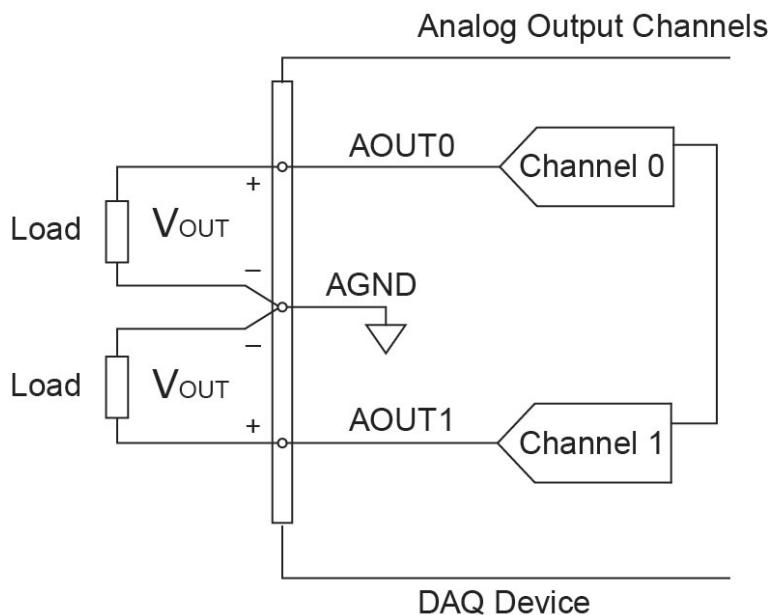
Figure 6. USB-231-OEM analog output connection diagram

Power-on state

The AO circuitry exhibits a short glitch when the device is powered on and when the DAQ device exits suspend mode. After power-up, the AO circuitry is reset to 0 V.

AO range

The AO range is ± 10 V.

Minimizing glitches on the output signal

When using a DAC to generate a waveform, you may observe glitches on the output signal. These glitches are normal; when a DAC switches from one voltage to another, it produces glitches due to released charges. The largest glitches occur when the most significant bit of the DAC code changes. You can build a low-pass deglitching filter to remove some of these glitches, depending on the frequency and nature of the output signal.

Generating analog output data

The USB-231-OEM can generate analog output data in two different modes – software paced and hardware paced.

- **Software paced** – Software controls the rate at which data is generated. Software sends a separate command to the hardware to initiate each DAQ conversion. Software-paced generations are also referred to as immediate or static operations. They are typically used for writing a single value out, such as a constant DC voltage.
- **Hardware paced** – A digital hardware signal controls the generation rate. This signal is generated internally on your device. Hardware-paced generations have advantages over software-timed acquisitions, such as the time between samples can be much shorter, and the timing between samples can be *deterministic* (data is sampled at regular intervals).

Hardware-timed operations are buffered. During hardware-paced AO generation, data is moved from a PC buffer to the onboard FIFO on the DAQ device using USB signal streams before it is written to the DACs one sample at a time. Buffered generations allow for fast transfer rates because data is moved in large blocks rather than one point at a time.

The sample mode can be either finite or continuous in a buffered I/O operation:

- In finite sample mode, a specified number of samples are generated, and then the generation stops.
- In continuous mode, an unspecified number of samples are generated until you stop the generation.

Digital I/O

You can connect up to eight digital I/O lines to **DIO0** through **DIO7**. **GND** is the ground-reference signal for digital I/O. Each digital I/O line is bit-configurable as input or output. Digital input voltage ranges from 0 V to 5 V are permitted, with thresholds of 0.8 V (low) and 2.3 V (high). Each DIO channel can sink up to 4 mA for direct drive applications when used as an output. All digital I/O updates and samples are software-paced.

Figure 7 below shows **DIO0** through **DIO7**connected to signals configured as digital inputs and digital outputs.
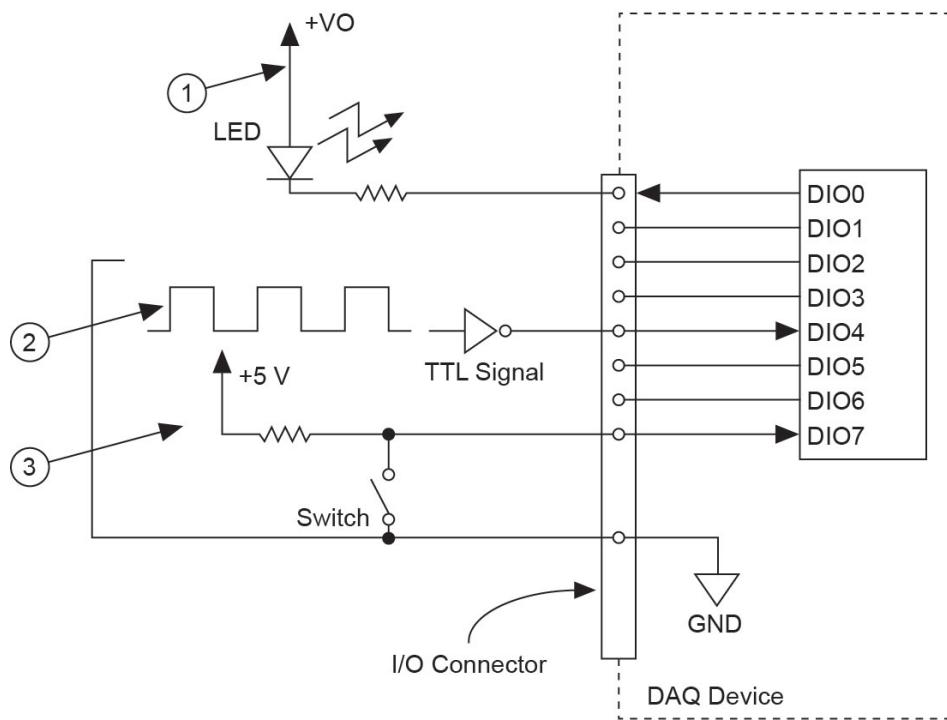
1   DIO0 configured as an open drain digital output driving a LED
2   DIO4 configured as a digital input receiving a TTL signal from a gated inverter
3   DIO7 configured as an digital input receiving a 0 V or 5 V signal from a switch

Figure 7. Example of connecting a load

Caution!   Exceeding the maximum input voltage ratings or maximum output ratings – listed in the Specifications chapter – can damage the device and the computer. Measurement Computing is not liable for any damage resulting from such signal connections.

Power-on states

At system startup and reset, the USB-231-OEM sets all DIO lines to high-impedance inputs. The device does not drive the signal high or low. Each line has a weak pull-down resistor connected to it.

DIO protection

To protect the DAQ device against overvoltage, undervoltage, and overcurrent conditions, as well as ESD events, avoid these fault conditions by using the following guidelines:

- If you configure a DIO line as an output, do *not* connect it to any external signal source, ground signal, or power supply.
- If you configure a DIO line as an output, understand the current requirements of the load connected to these signals. Do *not* exceed the specified current output limits of the DAQ device. Measurement Computing has several signal conditioning solutions for digital applications requiring high-current drive.
- If you configure a DIO line as an input, do *not* drive the line with voltages outside of its normal operating range. The DIO lines have a smaller operating range than the AI signals.
- Treat the DAQ device as you would treat any static-sensitive device. Always properly ground yourself and the equipment when handling the DAQ device or connecting to it.

Trigger input

The **TRIG** connector is an external digital trigger input. The trigger mode is software-selectable for rising edge- or falling edge detection.

Counter input

The **CTR** connector is a 32-bit counter that can count rising edges. Edges can only be counted up from 0.

Counting down is not supported – you cannot set the initial count to 100 and count down to 99, 98, 97.

USB signals, power (D–, D+, VBUS)

When using a USB connector on your motherboard to connect the USB-231-OEM to the USB host through the 34-pin connector, do not connect to the USB connector.

Status LED driver (LED)

The LED signal indicates the device status as shown in the following table:

LED State	Device Status
Off	Device is not connected or is in suspend mode.
On, not blinking	Device is connected and functioning normally.
Blinking	Device has encountered an error.

An open collector output drives the LED signal. For applications that use the LED signal, connect an external pull-up resistor from the LED signal to an external voltage.

LED electrical characteristics are listed in the Specifications chapter.

To drive a status LED, refer to the circuit in Figure 8.
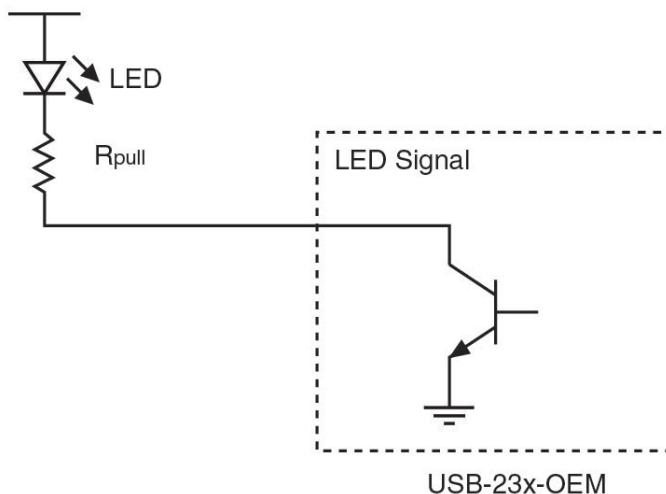

Figure 8. Circuit to drive a status LED

To use the LED signal to monitor the device state, refer to the circuit in Figure 9.
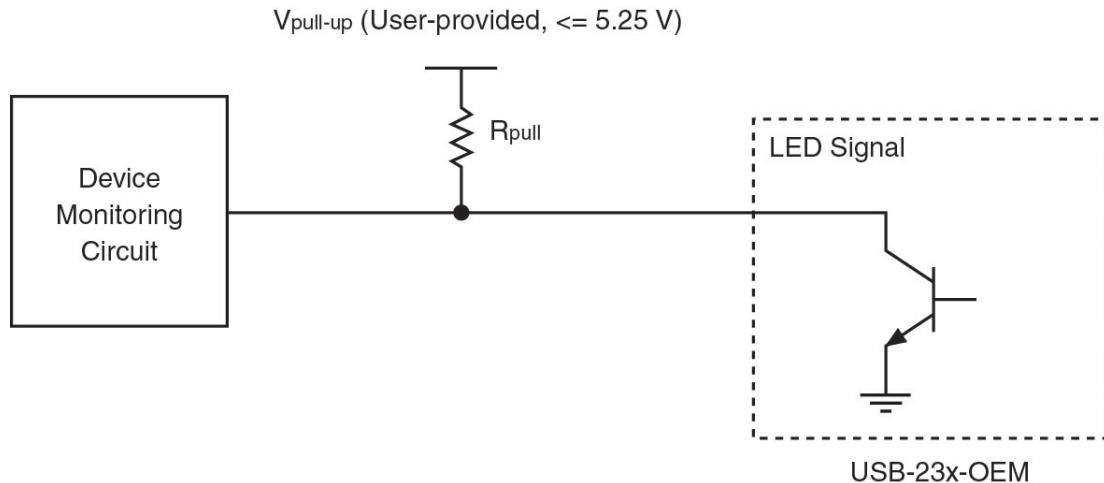

Figure 9. Circuit to monitor device state with LED signal

+VO power source

Figure 10 shows the **+VO** power source circuitry of the USB-231-OEM.
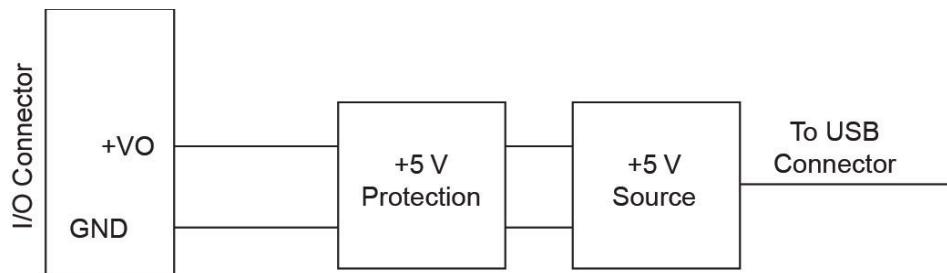
Figure 10. +VO power source circuitry

The main blocks featured in the **+VO** power source circuitry are as follows:

- **+5 V Source**—Regulated 5 V supply.
- **+5 V Protection**—Circuit for overvoltage, over current, and short circuit protection.

The +5 V source is limited at 200 mA typically. In case of hard short circuit to ground, this limit is further reduced to avoid excessive power dissipation.

Connecting the load

The return connector for the +5 V source is the **GND** connector. The +5 V load should be connected between the **+VO** connector and **GND**. The current delivered by the USB-231-OEM at the **+VO** connector is sourced from the USB connector. To meet the USB specifications, a maximum of 150 mA can be used from the **+VO** connector.
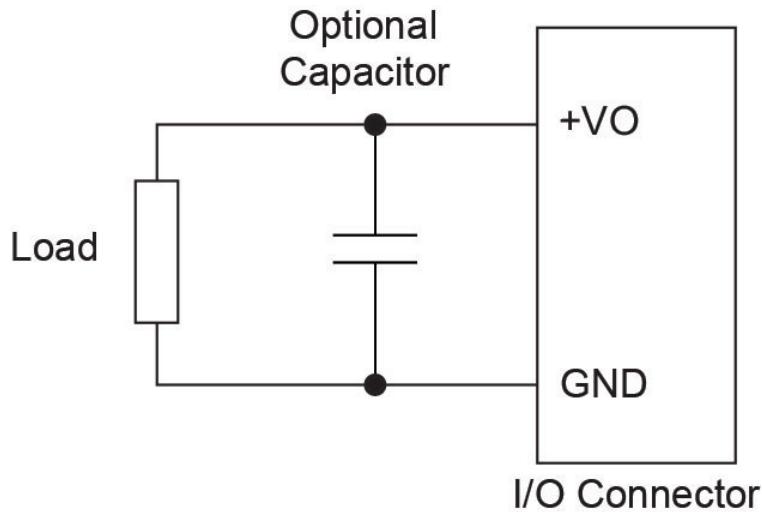
Figure 11. Connecting the +VO power source load

The + 5 V power is always enabled and the voltage is present at the **+VO** connector when the device is in active mode. The +5 V power source is not available for about one second after the device is first connected to the USB connector or when the device is in suspend mode.

Ground

The analog ground (**AGND**) connectors provide a common ground for all analog channels. The digital ground (**GND**) connectors provide a common ground for the digital, counter, and power connector.

For more information about signal connections

For more information about analog and digital signal connections, refer to the *Guide to DAQ Signal Connections* on our website at www.mccdaq.com/support/DAQ-Signal-Connections.aspx.

Mechanical drawings
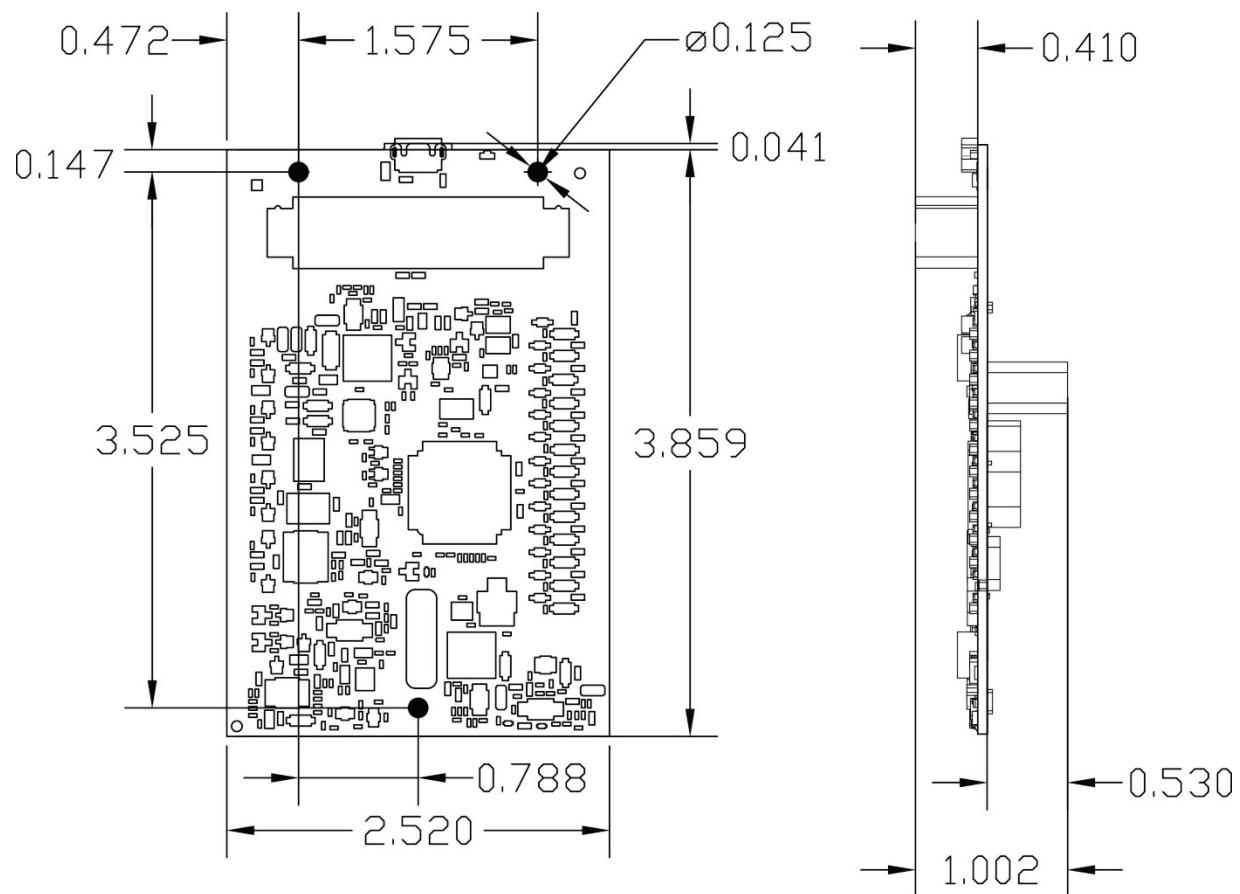
Figure 12. Circuit board dimensions

Specifications

All specifications are subject to change without notice.
Typical for 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		Successive approximation
ADC resolution		16 bits
Sampling rate	Maximum aggregate	50 kS/s
Number of channels		8 single-ended or 4 differential; software-selectable
Input voltage range		±10 V
Working voltage		±10 V
Overvoltage protection	Power on	±30 V max
	Power off	±20 V max
Input impedance		>1 GΩ
Input bias current		±200 pA, typ
INL		±1.8 LSB
DNL		16 bits no missing codes
CMRR		56 dB (DC to 5 kHz)
Input bandwidth		300 kHz
Trigger sources		Software, TRIG

Absolute accuracy (analog input DC voltage measurement accuracy)

Table 2. Absolute accuracy (no load)

Range	At full scale (typical at 25 °C)	At full scale (maximum over temperature)	System noise
±10 V	6 mV	26 mV	0.4 mV$_{rms}$

Analog output

Table 3. Analog output specifications

Parameter	Condition	Specification
Resolution		16 bits, 1 in 65,536
Output range		±10 V
Number of channels		2
Update rate	Hardware paced	5 kS/s simultaneous per channel max, hardware-paced
Trigger sources		Software, TRIG
Output current drive		±5 mA
Short circuit current		±11 mA
Slew rate		3 V/μs
Output impedance		0.2 Ω
Absolute accuracy (no load)	Typical at full scale	8.6 mV
	Maximum over temperature, full scale	32 mV
INL		±4 LSB
DNL		16 bits no missing codes
Power-on state		0 V
Startup glitch		–7 V for 10 μs

Timebase

The following specifications apply to hardware-paced analog input and analog output sampling accuracy.

Parameter	Specification
Timebase frequency	80 MHz
Timebase accuracy	±100 ppm
Timing resolution	12.5 ns

Digital input/output

Table 4. Digital I/O specifications

Parameter	Specification
Compatibility	LVTTL, 3.3 V LVCMOS
Number of channels	8 (DIO0 through DIO7)
Configuration	Each bit can be configured as input (power on default) or output
Pull-down resistor	47.5 kΩ to digital ground (GND).
Absolute maximum voltage range	–0.3 V to 5 V with respect to digital ground (GND)

Digital input

Table 5. Digital input specifications

Parameter	Condition	Specification
Input voltage range	Power on	0 V to 5 V
	Power off	0 V to 3.3 V (Note 1)
Input voltage protection		$\pm$20 V on two lines per port (maximum of five lines for all ports) for up to 24 hours
Input high voltage		2.3 V min
Input low voltage		0.8 V max
Input leakage current	At 3.3 V	0.8 mA max
	At 5 V	4.5 mA max

Note 1:   Do not leave a voltage above 3.3 V connected on the DIO line when the device is not powered. This can cause long-term reliability issues.

Digital output

Table 6. Digital output specifications

Parameter	Condition	Specification
Output low voltage	4 mA	0.7 V max
	1 mA	0.2 V max
Output high voltage	4 mA	2.1 V min
	1 mA	2.8 V min
		3.6 V max
Maximum output current per line		$\pm$4 mA

External digital trigger

Table 6. External digital trigger specifications

Parameter	Specification
Trigger source	TRIG input
Trigger mode	Software configurable for rising or falling edge. Power on default is rising edge.
Input high voltage	2.3 V min
Input low voltage	0.8 V max

Counter

Table 7. Counter specifications

Parameter	Specification
Pin name	CTR
Number of counters	1
Resolution	32 bits
Counter type	Edge counter (rising)
Counter direction	Count up
Counter source	CTR
Input frequency	5 MHz max
High pulse width	100 ns min
Low pulse width	100 ns min

LED electrical characteristics

Table 8. LED electrical specifications

Parameter	Condition	Specification
Output Low Voltage	I_{OL} = 8 mA	0.4 V max
	I_{OL} = 18 mA	1.2 V typ
External pull-up voltage		5.25 V max
Maximum sinking current		18 mA max

Memory

Table 9 Memory specifications

Parameter	Specification
Data FIFO	2,047 samples (4096 bytes)
Non-volatile memory	▪ Up to 256 kB microcontroller integrated Flash ▪ 2 kB microcontroller integrated EEPROM)

Power requirements

Table 10. Power specifications

Parameter	Specification
From USB	4.50 to 5.25 VDC (Note 2)
Idle USB current	165 mA
Maximum load USB current	<500 mA (Note 3)

Note 2: A typical bus-powered hub provides 100 mA on its USB lines. The USB-231-OEM does not work on a bus-powered hub.

Note 3: The maximum power draw from all output terminals should be kept under 0.9 W to avoid overloading the USB port

Power output

Table 11. External voltage specifications

Parameter	Specification
Output voltage	5 V, $\pm 3\%$
Maximum current	150 mA
Overcurrent protection	200 mA
Short circuit current	50 mA
Overvoltage protection	± 20 V

USB specifications

Table 12. USB specifications

Parameter	Specification
Device type	USB 2.0 full speed (12 Mb/s)
Device compatibility	USB 1.1, USB 2.0
Connector type	USB micro-B receptacle
USB cable type	A-micro-B cable, UL type AWM 2725 or equivalent (28 AWG × 2C + 28 AWG × 2C + AB)
USB cable length	3 m (9.84 ft) max

Environmental

Table 13. Environmental specifications (Indoor use only)

Parameter	Specification
Operating temperature range	0 °C to 45 C
Storage temperature range	–40 °C to 85 °C
Operating humidity range	5% to 95% RH, non-condensing
Storage humidity range	5% to 90% RH, non-condensing
Pollution degree (IEC 60664)	2
Maximum altitude	2,000 m

Mechanical

Table 14. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	98 mm × 64 mm × 12 mm (3.90 in. × 2.50 in. × 0.50 in.)
Weight	31 g (1.10 oz)

Header connectors

Table 15. Header connector specifications

Parameter	Specification
Connector type	One 2 × 17 0.1 in. pitch headers labeled J2

Differential mode pinout

Do not connect to connector pins labeled *NC*.

Table 16. J2 differential pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	AOUT0	Analog output 0	2	AOUT1	Analog output 1
3	AGND	Analog ground	4	AGND	Analog ground
5	CH3H	Analog input 3 HI	6	CH3L	Analog input 3 LO
7	CH2H	Analog input 2 HI	8	CH2L	Analog input 2 LO
9	CH1H	Analog input 1 HI	10	CH1L	Analog input 1 LO
11	CH0H	Analog input 0 HI	12	CH0L	Analog input 0 LO
13	AGND	Analog ground	14	AGND	Analog ground
15	D–	USB differential data signals	16	VBUS	USB power
17	D+	USB differential data signals	18	LED	Status LED driver
19	GND	Digital ground	20	DIO0	DIO bit 0
21	DIO1	DIO bit 1	22	DIO2	DIO bit 2
23	DIO3	DIO bit 3	24	DIO4	DIO bit 4
25	DIO5	DIO bit 5	26	DIO6	DIO bit 6
27	DIO7	DIO bit 7	28	NC	No connection
29	TRIG	Digital trigger input	30	NC	No connection
31	NC	No connection	32	GND	Digital ground
33	CTR	Counter input	34	+VO	User voltage output

Single-ended mode pinout

Do not connect to connector pins labeled *NC*.

Table 17. J2 single-ended pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	AOUT0	Analog output 0	2	AOUT1	Analog output 1
3	AGND	Analog ground	4	AGND	Analog ground
5	CH3H	Analog input 3	6	CH3L	Analog input 7
7	CH2H	Analog input 2	8	CH2L	Analog input 6
9	CH1H	Analog input 1	10	CH1L	Analog input 5
11	CH0H	Analog input 0	12	CH0L	Analog input 4
13	AGND	Analog ground	14	AGND	Analog ground
15	D–	USB differential data signals	16	VBUS	USB power
17	D+	USB differential data signals	18	LED	Status LED driver
19	GND	Digital ground	20	DIO0	DIO bit 0
21	DIO1	DIO bit 1	22	DIO2	DIO bit 2
23	DIO3	DIO bit 3	24	DIO4	DIO bit 4
25	DIO5	DIO bit 5	26	DIO6	DIO bit 6
27	DIO7	DIO bit 7	28	NC	No connection
29	TRIG	Digital trigger input	30	NC	No connection
31	NC	No connection	32	GND	Digital ground
33	CTR	Counter input	34	+VO	User voltage output