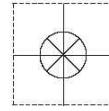


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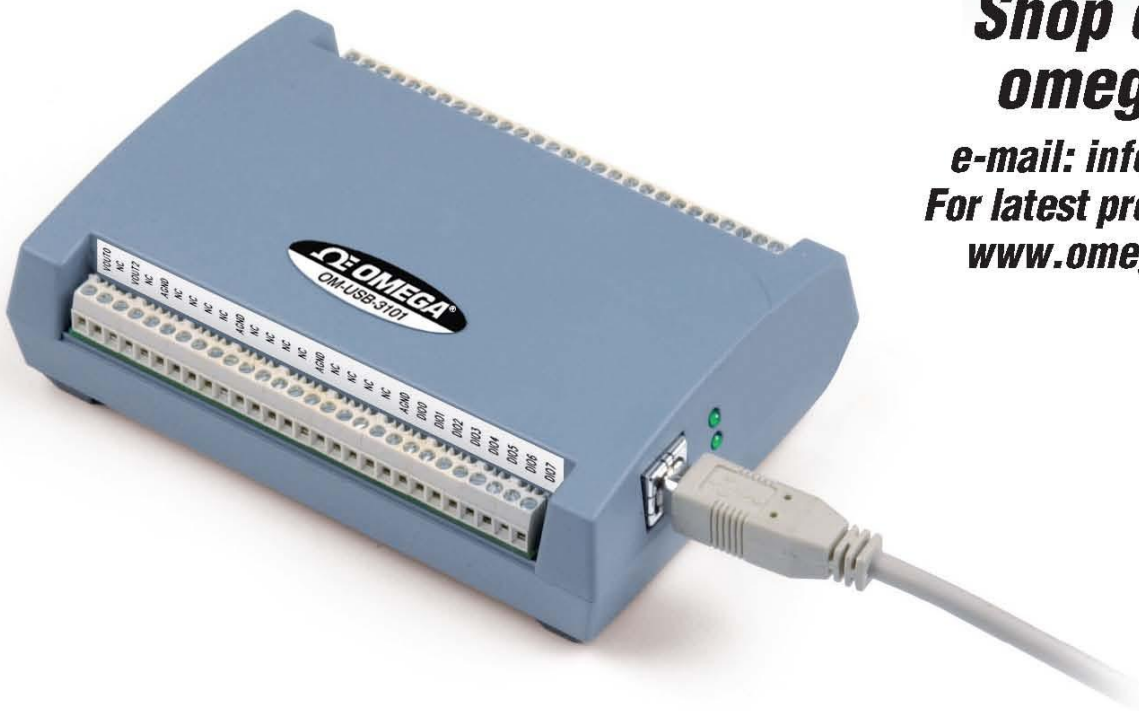
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OM-USB-3101 **4-Channel Analog Output** **USB Data Acquisition Module**



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About this User's Guide

What you will learn from this user's guide

This user's guide describes the Omega Engineering OM-USB-3101 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 OM-USB-3101 hardware is available on our website at www.omega.com. You can also contact Omega Engineering by phone, fax, or email with specific questions.

- Phone: (203) 359-1660
- Fax: (203) 359-7700
- Email: das@omega.com

Introducing the OM-USB-3101

The OM-USB-3101 is a USB 2.0 full-speed device that is supported under popular Microsoft® Windows® operating systems. The OM-USB-3101 is fully compatible with both USB 1.1 and USB 2.0 ports.

The OM-USB-3101 provides four channels of analog voltage output, eight digital I/O connections, and one 32-bit event counter.

The OM-USB-3101 has a quad (4-channel) 16-bit digital-to-analog converter (DAC). You set the voltage output range of each DAC channel independently with software for either bipolar or unipolar. The bipolar range is ± 10 V, and the unipolar range is 0 to 10 V. The analog outputs may be updated individually or simultaneously. A bidirectional synchronization connection allows you to simultaneously update the DAC outputs on multiple devices.

The OM-USB-3101 features eight bidirectional digital I/O connections. You can configure the DIO lines as input or output in one 8-bit port. All digital pins are floating by default. A screw terminal connection is provided for pull-up (+5 V) or pull-down (0 volts) configuration.

The 32-bit counter can count TTL pulses.

The OM-USB-3101 is powered by the +5 volt USB supply from your computer. No external power is required. All I/O connections are made to screw terminals.

Functional block diagram

OM-USB-3101 functions are illustrated in the block diagram shown here.

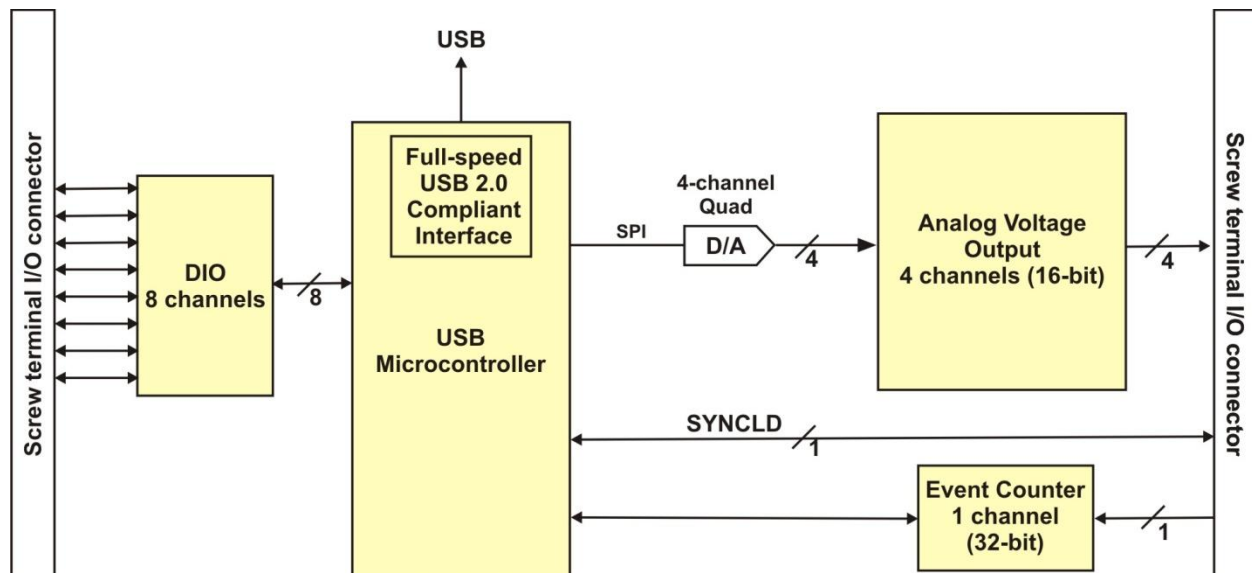


Figure 1. OM-USB-3101 block diagram

Installing the OM-USB-3101

What comes with your shipment?

The following items are shipped with the OM-USB-3101:

Hardware

- OM-USB-3101
- USB cable

Software

- Software for OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Modules CD

Documentation

In addition to this hardware user's guide, you should also receive the *OMB-DAQ-2400*, *OM-USB*, *OM-WEB*, and *OM-WLS Series Data Acquisition Software User's Guide*. This booklet provides an overview of the software you received with the device, and includes information about installing the software.

Unpacking

As with any electronic device, take care while handling to avoid damage from static electricity. Before removing the device 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 any components are missing or damaged, notify Omega Engineering immediately by phone, fax, or e-mail.

- Phone: (203) 359-1660
- Fax: (203) 359-7700
- Email: das@omega.com

Installing the software

Refer to the *Software User's Guide* for instructions on installing the software. This booklet ships with the hardware, and is available in PDF at <http://www.omega.com/manuals/manualpdf/M4803.pdf>.

Installing the hardware

Install the software before you install your device

The driver needed to run the OM-USB-3101 is installed when you install the software. Therefore, you need to install the software before you install the hardware.

To connect the OM-USB-3101 to your system, connect the USB cable to an available USB port on the computer or to an external USB hub connected to the computer. Connect the other end of the USB cable to the 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. The LED on the OM-USB-3101 turns on after the device is successfully installed.

If the power LED turns off

If the power LED is illuminated but then turns off, the computer has lost communication with the OM-USB-3101. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the power LED should turn back *on*.

Calibrating the OM-USB-3101

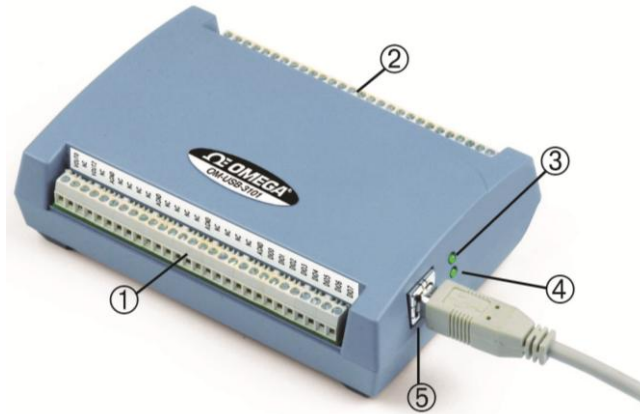
The OM-USB-3101 is shipped fully calibrated. Calibration coefficients are stored in the device FLASH memory. Return the device to Omega Engineering when calibration is required. The normal calibration interval is once per year.

Functional Details

External components

The OM-USB-3101 has the following external components, as shown in Figure 2.

- Screw terminals
- LED indicators
- USB connector



- | | | | |
|---|------------------------------|---|---------------|
| 1 | Screw terminal pins 1 to 28 | 4 | Power LED |
| 2 | Screw terminal pins 29 to 56 | 5 | USB connector |
| 3 | Status LED | | |

Figure 2. OM-USB-3101 external components

USB connector

The USB connector provides power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than 5 V. No external power supply is required.

LED indicators

The OM-USB-3101 has two LED indicators – **Status** and **Power**.

- The **Status** LED indicates the communication status of the OM-USB-3101. It blinks when data is being transferred, and is off when the OM-USB-3101 is not communicating. This LED uses up to 10 mA of current and cannot be disabled.
- The **Power** LED turns on when the device is connected to a USB port on a computer or an external USB hub connected to a computer.

Screw terminals

The screw terminals on the bottom edge of the OM-USB-3101 provide the following connections:

- Four analog voltage outputs (**VOUT0**, **VOUT1**, **VOUT2**, **VOUT3**)
- Eight digital I/O (**DIO0** to **DIO7**)
- One digital I/O pull-down resistor connection (**DIO CTL**)
- One SYNC I/O terminal for external clocking and multi-unit synchronization (**SYNCLD**)
- One counter input (**CTR**)
- One power output (**+5 V**)
- Analog ground (**AGND**) and digital ground (**DGND**) connections

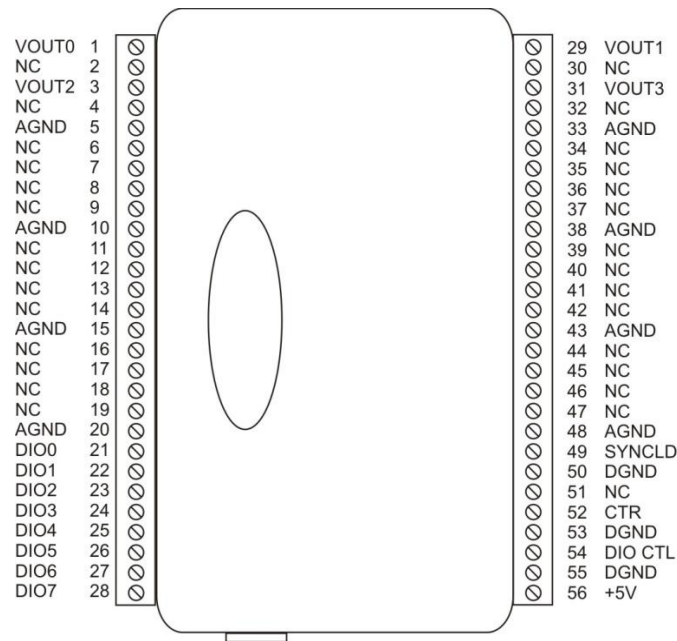


Figure 3. OM-USB-3101 signal pinout

Use 16 AWG to 30 AWG wire gauge when making screw terminal connections.

Signal connections

Analog voltage outputs

The screw terminal pins labeled **VOUT0** to **VOUT3** are voltage output terminals. The voltage output range for each channel is software-programmable for either bipolar or unipolar. The bipolar range is ± 10 V, and the unipolar range is 0 to 10 V. The channel outputs may be updated individually or simultaneously.

Digital I/O

You can connect up to eight digital I/O lines to **DIO0** through **DIO7**. Each digital channel is individually configurable for input or output. The digital I/O terminals can detect the state of any TTL-level input. Refer to the schematic shown in Figure 4.

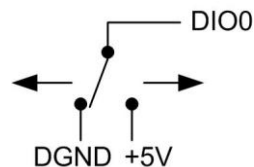


Figure 4. Schematic showing switch detection by digital channel DIO0

If you set the switch to the +5 V input, DIO0 reads *TRUE* (1). If you move the switch to DGND, DIO0 reads *FALSE* (0).

For more information about digital signal connections

For general information about digital signal connections and digital I/O techniques, refer to the *OMB-DAQ-2400*, *OM-USB*, *OM-WEB*, and *OM-WLS Series General Guide to Signal Connections* (available on our web site at www.omega.com/manuals/manualpdf/M4830.pdf).

DIO control terminal (DIO CTL) for pull-up/down configuration

All digital pins are floating by default. When inputs are floating, the state of unwired inputs are undefined (they may read high or low). You can configure the inputs to read a high or low value when they aren't wired. Use the

DIO CTL pin to configure the digital pins for pull-up (inputs read high when unwired) or pull-down (inputs read low when not wired).

- To pull up the digital pins to +5V, wire the **DIO CTL** terminal pin to the **+5V** pin.
- To pull down the digital pins to ground (0 volts), wire the **DIO CTL** terminal pin to a **DGND** pin.

Synchronous DAC load

The synchronous DAC load terminal (**SYNCLD**) is a bidirectional I/O signal that allows you to simultaneously update the DAC outputs on multiple devices. You can use this pin for two purposes:

- Configure as an input (slave mode) to receive the D/A LOAD signal from an external source.
When the SYNCLD pin receives the trigger signal, the analog outputs are updated simultaneously.

SYNCLD must be logic low in slave mode for immediate update of DAC outputs

When the SYNCLD pin is in slave mode, the analog outputs can be updated immediately or when a positive edge is seen on the SYNCLD pin (this is under software control.)

The SYNCLD pin must be at a low logic level for DAC outputs to update immediately. If the external source supplying the D/A LOAD signal is pulling the SYNCLD pin high, no update will occur.

Refer to the "USB-3100 Series" section in the *Universal Library User's Guide* for information on how to update DAC outputs immediately.

- Configure as an output (master mode) to send the internal D/A LOAD signal to the SYNCLD pin.
You can use the SYNCLD pin to synchronize with a second OM-USB-3101 and simultaneously update the DAC outputs on each device. Refer to [Synchronizing multiple units](#) section below.

Use InstaCal to configure the SYNCLD mode as master or slave. On power up and reset the SYNCLD pin is set to slave mode (input). Refer to the "USB-3100 Series" section in the *Universal Library User's Guide* for information on how to configure the OM-USB-3101 with the Universal Library.

Synchronizing multiple units

You can connect the **SYNCLD** terminal pin (pin 49) of two OM-USB-3101 units together in a master/slave configuration and simultaneously update the DAC outputs of both devices. Perform the following procedure:

1. Connect SYNCLD on the master OM-USB-3101 to the SYNCLD pin on the slave OM-USB-3101.
2. Configure SYNCLD on the slave device for input to receive the D/A LOAD signal from the master device. Use InstaCal to set the direction of the SYNCLD pin.
3. Configure SYNCLD on the master device for output to generate an output pulse on the SYNCLD pin.

Set the Universal Library `SIMULTANEOUS` option for each device. Refer to the *Universal Library User's Guide* for information on how to configure the OM-USB-3101 with the Universal Library. When the SYNCLD pin on the slave device receives the signal, the analog output channels on each device are updated simultaneously.

Counter input

The **CTR** terminal is a 32-bit event counter that can accept frequency inputs up to 1 MHz. The internal counter increments when the TTL levels transition from low to high.

Power output

The **+5V** terminal can output up to 10 mA maximum. You can use this terminal to supply power to external devices or circuitry.

Caution! The **+5V** terminal is an output. Do not connect to an external power supply or you may damage the device and possibly the computer.

Ground

The analog ground (**AGND**) terminals provide a common ground for all analog voltage output channels.

The digital ground (**GND**) terminals provide a common ground for the digital, counter, and sync terminal and the power terminal.

Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Analog voltage output

Table 1. Analog voltage output specifications

Parameter	Conditions	Specifications
Digital to Analog converter		DAC8554
Number of channels		4
Resolution		16 bits
Output ranges	Calibrated	± 10 V, 0 to 10 V Software configurable
	Un-calibrated	± 10.2 V, -0.04 to 10.08 V Software configurable
Output transient	± 10 V to (0 to 10 V) or (0 to 10 V) to ± 10 V range selection. (Note 1)	Duration: 5 μ S typ. Amplitude: 5V p-p typ.
	Host PC is reset, powered on, suspended or a reset command is issued to device. (Note 2)	Duration: 2 S typ. Amplitude: 2V p-p typ.
	Initial power on	Duration: 50 mS typ. Amplitude: 5V peak typ.
Differential non-linearity (Note 3)	Calibrated	± 1.25 LSB typ. -2 LSB to +1 LSB max.
	Un-calibrated	± 0.25 LSB typ. ± 1 LSB max.
Output current	VOUTx pins	± 3.5 mA typ.
Output short-circuit protection	VOUTx connected to AGND	Indefinite
Output coupling		DC
Power on and reset state		DACs cleared to zero-scale: 0 V, ± 50 mV typ.
		Output range: 0-10V
Output noise	0 to 10 V range	14.95 μ Vrms typ.
	± 10 V range	31.67 μ Vrms typ.
Settling time	<i>to 1 LSB accuracy</i>	<i>25 μS typ.</i>
Slew rate	0 to 10 V range	1.20 V/ μ S typ.
	± 10 V range	1.20 V/ μ S typ.
Throughput	Single-channel	100 Hz max., system dependent
	Multi-channel	100 Hz/#ch max., system dependent

Note 1: The OM-USB-3101 output voltage level defaults to 0V whenever the output voltage range is reconfigured.

The OM-USB-3101 output voltage level will also default to 0V:

- 1) Whenever the host PC is reset, shut down or suspended.
- 2) If a reset command is issued to the device.

Note 2: The duration of this particular output transient is highly dependent on the enumeration process of the host PC. Typically the output of the USB-3101 is stable after 2 seconds

Note 3: The maximum differential non-linearity specification applies to the entire 0 to 70 °C temperature range of the OM-USB-3101. This specification also accounts for the maximum errors due to the software calibration algorithm (in Calibrated mode only) and the DAC8554 digital to analog converter non-linearities.

Table 2. Absolute accuracy specifications – calibrated output

Range	Accuracy (\pm LSB)
\pm 10 V	14.0
0 to 10 V	22.0

Table 3. Absolute accuracy components specifications – calibrated output

Range	% of reading	Offset (\pm mV)	Temp drift (%/°C)	Absolute accuracy at FS (\pm mV)
\pm 10 V	\pm 0.0183	1.831	0.00055	3.661
0 to 10 V	\pm 0.0183	0.915	0.00055	2.746

Table 4. Relative accuracy specifications

Range	Relative accuracy (\pm LSB)	
\pm 10 V , 0 to 10 V	4.0 typ.	12.0 max.

Analog output calibration

Table 5. Analog output calibration specifications

Parameter	Conditions	Specifications
Recommended warm-up time		15 minutes min.
On-board precision reference		DC level: 5.000 V \pm 1 mV max.
		Tempco: \pm 10 ppm/°C max.
		Long term stability: \pm 10 ppm/SQRT(1000 hrs)
Calibration method		Software calibration
Calibration interval		1 year

Digital input/output

Table 6. Digital I/O specifications

Digital logic type	CMOS
Number of I/O	8
Configuration	Independently configured for input or output
Pull-up/pull-down configuration (Note 4)	User configurable All pins floating (default)
Digital I/O input loading	TTL (default)
	47K ohms (pull-up/pull down configurations)
Digital I/O transfer rate (system paced)	System dependent, 33 to 1000 port reads/writes or single bit reads/writes per second.
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

Note 4: Pull up and pull down configuration area available using the DIO CTL terminal block pin 54. The pull down configuration requires the DIO CTL pin (pin 54) to be connected to a DGND pin (pin 50, 53 or 55). For a pull up configuration, the DIO CTL pin should be connected to the +5V terminal pin (pin 56).

Synchronous DAC Load

Table 7. SYNCLD I/O specifications

Parameter	Conditions	Specification
Pin name		SYNCLD (terminal block pin 49)
Power on and reset state		Input
Pin type		Bidirectional
Termination		Internal 100K ohms pull-down
Software selectable direction	Output	Outputs internal D/A LOAD signal.
	Input	Receives D/A LOAD signal from external source.
Input clock rate		100 Hz max
Clock pulse width	Input	1 μ s min
	Output	5 μ s min
<i>Input leakage current</i>		$\pm 1.0 \mu$ A <i>typ.</i>
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 (Note 5)	IOH = -2.5 mA	3.3 V min
	No load	3.8 V min
Output low voltage (Note 6)	IOL = 2.5 mA	1.1 V max
	No load	0.6 V max

Note 5: SYNCLD is a Schmitt trigger input and is over-current protected with a 200 Ohm series resistor.

Note 6: When SYNCLD is in input mode, the analog outputs may either be updated immediately or when a positive edge is seen on the SYNCLD pin (this is under software control.) However, the pin must be at a low logic level in order for the DAC outputs to be updated immediately. If an external source is pulling the pin high, no update will occur.

Counter

Table 8. CTR I/O specifications

Parameter	Conditions	Specification
Pin name		CTR
Number of channels		1
Resolution		32-bits
Counter type		Event counter
Input type		TTL, rising edge triggered
Counter read/writes rates (software paced)	Counter read	System dependent, 33 to 1000 reads per second.
	Counter write	System dependent, 33 to 1000 reads per second.
Schmidt trigger hysteresis		20 mV to 100 mV
<i>Input leakage current</i>		$\pm 1.0 \mu$ A <i>typ.</i>
Input frequency		1 MHz max.
<i>High pulse width</i>		500 ns <i>min.</i>
<i>Low pulse width</i>		500 ns <i>min.</i>
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

Table 9. Memory specifications

EEPROM	256 bytes		
EEPROM configuration	Address range	Access	Description
	0x000-0x0FF	Read/write	256 bytes user data

Microcontroller

Table 10. Microcontroller specifications

<i>Type</i>	<i>High performance 8-bit RISC microcontroller</i>
<i>Program memory</i>	<i>16,384 words</i>
<i>Data memory</i>	<i>2,048 bytes</i>

Power

Table 11. Power specifications

Parameter	Conditions	Specification
Supply current	USB enumeration	< 100 mA
Supply current (Note 7)	Quiescent current	140 mA typ.
+5V user output voltage range (Note 8)	Available at terminal block pin 56	4.5 V min, 5.25 V max.
+5V user output current (Note 9)	Available at terminal block pin 56	10 mA max.

Note 7: This is the total quiescent current requirement for the OM-USB-3101 which includes up to 10 mA for the status LED. This does not include any potential loading of the digital I/O bits, +5V user terminal, or the VOUTx outputs.

Note 8: Output voltage range assumes USB power supply is within specified limits.

Note 9: This refers to the total amount of current that can be sourced from the +5V user terminal (pin 56) for general use. This specification also includes any additional contribution due to DIO loading.

USB specifications

Table 12. USB specifications

USB device type	USB 2.0 (full-speed)
USB device compatibility	USB 1.1, 2.0
USB cable length	3 meters max.
<i>USB cable type</i>	<i>A-B cable, UL type AWM 2527 or equivalent (min 24 AWG VBUS/GND, min 28 AWG D+/D-).</i>

Environmental

Table 13. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 85 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 14. Mechanical specifications

Dimensions	127 mm (L) x 88.9 mm (W) x 35.56 (H)
------------	--------------------------------------

Main connector and pinout

Table 15. Main connector specifications

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Pin	Signal Name	Pin	Signal Name
1	VOUT0	29	VOUT1
2	NC	30	NC
3	VOUT2	31	VOUT3
4	NC	32	NC
5	AGND	33	AGND
6	NC	34	NC
7	NC	35	NC
8	NC	36	NC
9	NC	37	NC
10	AGND	38	AGND
11	NC	39	NC
12	NC	40	NC
13	NC	41	NC
14	NC	42	NC
15	AGND	43	AGND
16	NC	44	NC
17	NC	45	NC
18	NC	46	NC
19	NC	47	NC
20	AGND	48	AGND
21	DIO0	49	SYNCLD
22	DIO1	50	DGND
23	DIO2	51	NC
24	DIO3	52	CTR
25	DIO4	53	DGND
26	DIO5	54	DIO CTL
27	DIO6	55	DGND
28	DIO7	56	+5V

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Data Logging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments