

## 1-MHz, 16-Bit USB Data Acquisition Modules



### OMB-DAQ-3000 Series

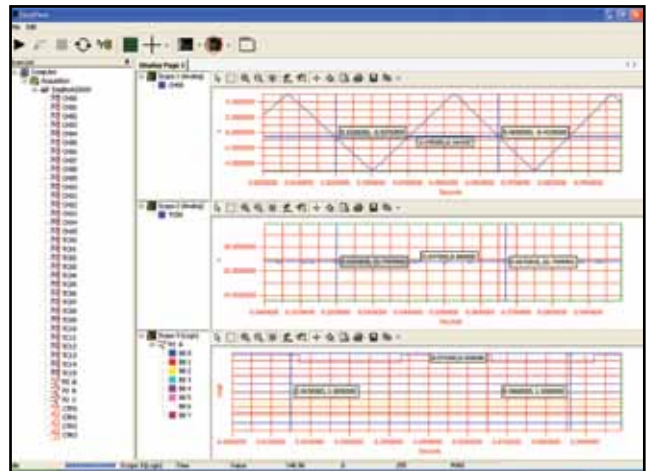


- ✓ 1-MHz, 16-Bit Multifunction USB Modules
- ✓ Synchronous Analog Input, Analog Output, Digital I/O, and Counter/Timer I/O
- ✓ 8 Differential or 16 Single-Ended Analog Inputs (Software-Selectable per Channel)
- ✓ Thermocouple or Voltage Input on Any Analog Channel
- ✓ User-Expandable up to 64SE/32DE Analog Inputs, Including Thermocouple Measurements
- ✓ Up to four 16-Bit, 1-MHz Analog Outputs
- ✓ 24 High-Speed Digital I/O Lines
- ✓ Four 32-Bit Counter Input Channels with Quadrature Encoder Capability
- ✓ Low-Latency Control Output Capability (as Low as 2  $\mu$ s Latency)

#### Software

- ✓ Includes DaqView Software for Instant Set-Up, Real-Time Viewing, Data Logging and Frequency Domain Analysis, Compatible with Windows XP/Vista/7 (32-Bit and 64-Bit)
- ✓ Support for Visual Studio and Visual Studio .NET, including examples for Visual C++, Visual C#, Visual Basic and Visual Basic .NET

DAQVIEW software included with the OMB-DAQ-3000 Series.



- ✓ Comprehensive Drivers for DASyLab and LabVIEW
- ✓ DaqCal Software Application for Easy User Calibration

The OMB-DAQ-3000 Series offers high-speed, multifunction data acquisition in a low-cost, portable package. The module offers synchronous and concurrent voltage input, temperature input, waveform output, counter input, quadrature encoder input, timer output and digital I/O. Everything needed to begin acquiring, viewing and storing data is included with the OMB-DAQ-3000 Series, including comprehensive software support.

The OMB-DAQ-3000 features a 16-bit/1-MHz A/D converter, 16 analog input channels user-expandable to 64, up to four 16-bit/1-MHz analog outputs, 24 high-speed digital I/O, 2 timer outputs and four 32-bit counters. All analog I/O, digital I/O, and counter/timer I/O can operate

synchronously and simultaneously, guaranteeing deterministic I/O among all signal types.

Unique to the OMB-DAQ-3000 is a low-latency, highly deterministic control output mode that operates independent of the PC. In this mode, digital, analog and timer outputs can respond to analog, digital and counter inputs, as fast as 2  $\mu$ s, at least 1000 times faster than other products that rely on the PC for decision making.

#### Software

Included with the OMB-DAQ-3000 is new DaqView software, a comprehensive application that enables set-up, data logging and real-time data viewing without requiring any programming skills.

The DaqView software also includes additional features such as direct-to-Excel enhancements (compatible with 32-bit operating systems only), FFT analysis, and statistics.

OMB-DAQ-3000 with  
OMB-PDQ30 shown  
smaller than actual size.



Also included with the OMB-DAQ-3000 is a complete set of drivers and detailed sample programs for the most popular programming languages and software packages. Driver support includes Visual Basic, C/C++, LabVIEW and DASyLab. DaqCOM provides Windows-based ActiveX/COM-based programming tools for Microsoft Visual Studio and Visual Studio.NET.

## Analog Input

The OMB-DAQ-3000 has a 16-bit, 1-MHz A/D coupled with 16 single-ended inputs, 8 differential analog inputs, or 8 differential thermocouple inputs.

Seven software-programmable ranges provide inputs from 10V to  $\pm 100$  mV full scale. Each channel can be software-configured for a different range, as well as for single-ended or differential bipolar input, or thermocouple input. The hybrid PGIA on the OMB-DAQ-3000 is guaranteed to settle to the specified accuracy while operating at the full 1 M sample/s rate.

Every analog input on the OMB-DAQ-3000 or on the OMB-PDQ30 expansion option can accept a thermocouple (TC) input. Built-in cold-junction sensors are provided for each of the removable screw-terminal connectors, and any TC type can be attached to any channel. When measuring TCs, the OMB-DAQ-3000 operates in an over-sample mode, where multiple readings taken on each

TC channel, digitally filtered, cold-junction compensated and converted to temperature. As a result, channels with TCs attached are measured at a rate 50 Hz to 10 kHz, depending on how much over-sampling is selected. In line-cycle rejection mode, over-sampling occurs during one cycle of either 50 Hz or 60 Hz, providing a high level of 50 Hz or 60 Hz rejection.

## Analog Channel Expansion

Adding additional analog input channels for the OMB-DAQ-3000 is easy using the optional OMB-PDQ30 expansion module. The OMB-PDQ30 connects to the OMB-DAQ-3000 by either plugging directly into the expansion connector or via a cable (OMB-CA-96A) if distance is required between the two units.

The OMB-PDQ30 provides an additional 48SE/24DE analog inputs or 24 differential thermocouple inputs, software-configured on a per-channel basis. The total channel capacity with a OMB-PDQ30 attached is 64 single-ended or 32 differential inputs.

## Synchronous I/O

The OMB-DAQ-3000 can make analog measurements and read digital and counter inputs, while synchronously generating up to four analog outputs as well as digital pattern outputs. Digital and counter inputs do not affect the overall A/D rate because they use no time slot in the scanning sequencer.

## Input Scanning

The OMB-DAQ-3000 has several scanning modes to address a wide variety of applications. A 512-location scan buffer can be loaded by the user with any combination of analog input channels. All analog input channels in the scan buffer are measured sequentially at 1  $\mu$ s per channel.

The user can also specify that the sequence repeat immediately or repeat after a programmable delay, from 0 to 19 hours, with 20.83 ns resolution.

## Output Timing

The digital and analog outputs on the OMB-DAQ-3000 can be updated asynchronously or synchronously in several modes.

In asynchronous mode, digital and analog outputs can be updated before, during or after an analog input sequence. The maximum update rate in this mode is non-deterministic and is entirely dependent on the PC processor speed, the operating system and programming environment.

In synchronous output modes, outputs can be updated continuously from the PC or in response to an input from an analog channel, digital channel or counter channel.

When updated from the PC, the user can specify the rate at which the output is updated in 20.83 ns intervals. Outputs are updated synchronously at a maximum rate of 1  $\mu$ s.

OMB-DAQ-3000 Series Selection Chart					
Model Number	Analog Inputs	Input Ranges	Digital I/O	Analog Outputs	Counter/Timers
OMB-DAQ-3005	16SE/8DE	7	24	0	4/2
OMB-DAQ-3000	16SE/8DE	7	24	2	4/2
OMB-DAQ-3001	16SE/8DE	7	24	4	4/2
OMB-DAQ-3005 & OMB-PDQ30	64SE/32DE	7	24	0	4/2
OMB-DAQ-3000 & OMB-PDQ30	64SE/32DE	7	24	2	4/2
OMB-DAQ-3001 & OMB-PDQ30	64SE/32DE	7	24	4	4/2

## Low-Latency Setpoint Control Mode

The other synchronous method of output is where either a digital, analog, or timer output is associated with any analog, digital or counter. The state or level of the output is determined by the level or state of an associated input.

## Triggering

The OMB-DAQ-3000 supports a full complement of trigger modes to accommodate any measurement application.

## Calibration

Every range on the OMB-DAQ-3000 is calibrated from the factory using a digital NIST traceable calibration method. This method works by storing a correction factor for each range on the unit at the time of calibration.

Included with each OMB-DAQ-3000 is DaqCal software, an easy-to-operate software package that allows the users to calibrate their OMB-DAQ-3000.

## Analog Output (OMB-DAQ-3000 and 3001 Only)

Two or four 16-bit, 1-MHz analog output channels are built into the OMB-DAQ-3000 with an output range from -10 to +10V. The maximum rate at which analog outputs can be updated depends on several factors, including the speed of the USB port. Typically, with the A/D operating at full 1 M reading/s rates, one analog output can be updated continuously from PC memory at 1 MHz, or two analog outputs at 500 kHz or four analog outputs at 250 kHz. If waveform output throughput is critical to your application, contact OMEGA for the most recent update on multi-channel DAC output rates.

In addition, a program can asynchronously output a value to any of the D/As for non-waveform applications, presuming that the D/A is not already being used in the waveform output mode. Lastly, each of the analog outputs can be used in a control mode, where the output level is dependent on whether an associated analog, digital or counter input is above or below a user-specified limit condition. When used to generate waveforms, the D/As can be clocked in several different modes. Each D/A can be separately selected to be clocked from one of the following sources.

## Asynchronous Internal Clock

The on-board programmable clock can generate updates ranging from once every 19 hours to 1 MHz, independent of any acquisition rate.

## Synchronous Internal Clock

The rate of analog output update can be synchronized to the acquisition rate derived from 1 MHz to once every 19 hours.

## Asynchronous External Clock

A user-supplied external input clock can be used to pace the D/A, entirely independent of analog inputs.

## Synchronous External Clock

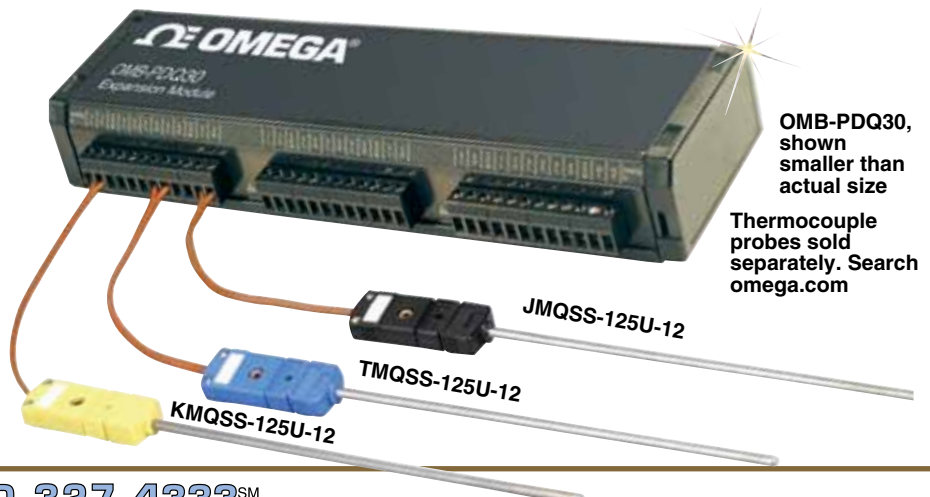
A user-supplied external input clock can pace both the D/A and the analog input.

## Digital I/O

Twenty-four TTL-level digital I/O lines are included in the OMB-DAQ-3000. Digital I/O can be programmed in 8-bit groups as either inputs or outputs and they can be scanned in several modes (see Input Scanning). Ports programmed as inputs can be part of the scan group and scanned along with analog input channels, or they can be asynchronously accessed via the PC at any time, including when a scanned acquisition is occurring. Two synchronous modes are supported when scanned along with analog inputs. In one of these modes, digital inputs are scanned at the start of each scan sequence, which means the rate at which they are scanned is dependent on the number of analog input channels and the delay period.

## Pattern Generation

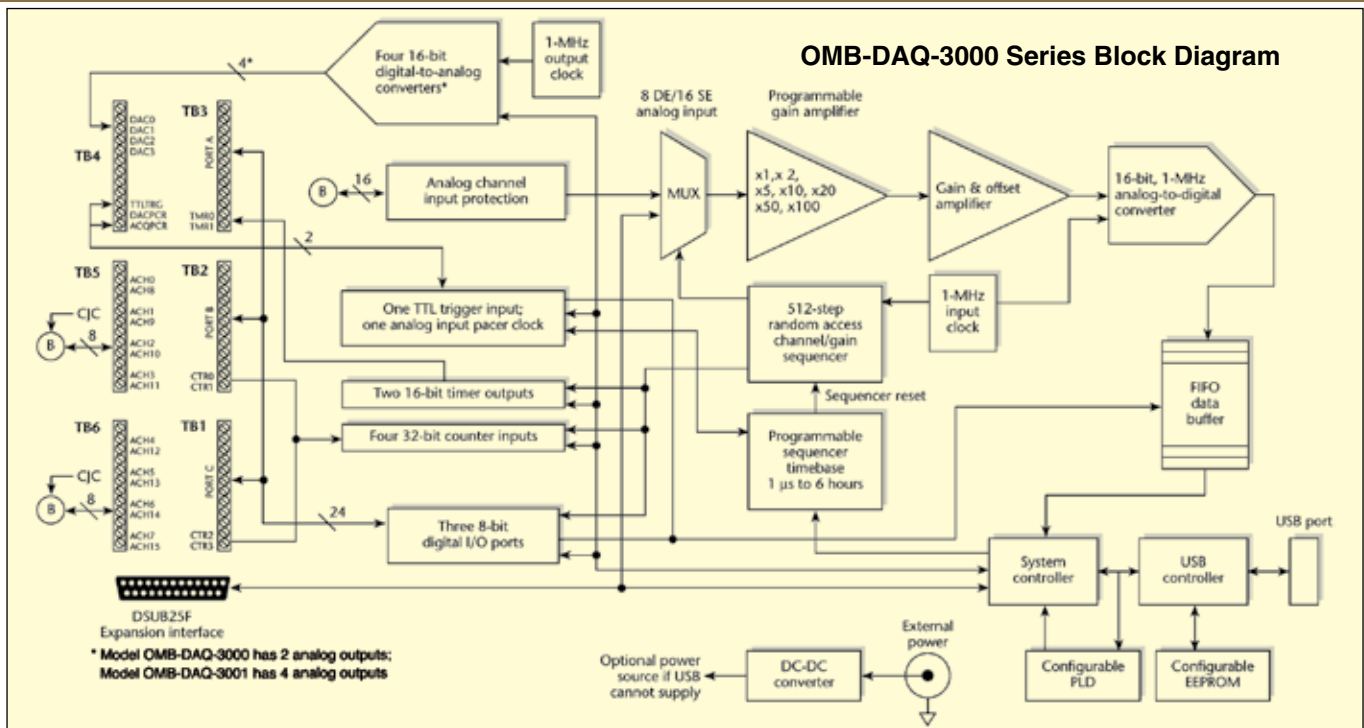
Two of the 8-bit ports can be used to generate a 16-bit digital pattern at up to 1 MHz. The digital pattern can be read from PC RAM or a file on the hard disk. Digital pattern generation is clocked in the same four modes as was described with analog output.



OMB-PDQ30, shown smaller than actual size

Thermocouple probes sold separately. Search omega.com

# USB DATA ACQUISITION



## Counter Inputs

Four 32-bit counters are built into the OMB-DAQ-3000. Each will accept frequency inputs of up to 20 MHz, and each counter channel can be configured in a variety of modes, including counter, period, pulse width, time between edges, or multi-axis-quadrature encoder. The counters can concurrently monitor time periods, frequencies, pulses, and other event-driven incremental occurrences from encoders, pulse generators, limit switches, proximity switches, and magnetic pick ups. As with all other inputs to the OMB-DAQ-3000, the counter inputs can be read asynchronously under program control, or synchronously as part of an analog and digital scan group based either on an internal programmable timer or on an external clock source.

The OMB-DAQ-3000 supports quadrature encoders with up to 2 billion pulses per revolution, 20 MHz input frequencies, and x1, x2, x4 count modes. Encoder input signals must be within -15 to 15V and the switching threshold is TTL (1.3V).

## Timer Outputs

Two 16-bit timer outputs are built into the OMB-DAQ-3000, each capable of generating different square waves with a programmable frequency range from 16 Hz to 1 MHz.

## General Specifications

### Environment:

**Operating Temperature:**

-30 to 70°C (-54 to 158°F)

**Storage Temperature:**

-40 to 80°C (-40 to 176°F)

**Relative Humidity:**

0 to 95% non-condensing

**Communications:** USB 2.0

high-speed mode (480 Mbps), if available, otherwise USB1.1 full-speed mode (12 Mbps)

**Acquisition Data Buffer:** 1 MSample

**Vibration:** MIL STD 810E category 1 and 10

**Signal I/O Connector:** 6 banks of removable screw-terminal blocks

**External Power:**

**Connector:** Switchcraft# RAPC-712

**Power Range:** 6 to 16 Vdc (used when USB port supplies insufficient power, or when an independent power supply is desired)

**Over Voltage:** 20V for 10 seconds, maximum

**Expansion Connector:** 25-pin DSUB, female

**Dimensions:** 269 W x 92 D x 45 mm H (10.6 x 3.6 x 1.6")

**Weight:** 431 g (0.95 lb)

## ANALOG INPUTS

**Channels:** 16 single-ended or 8 differential, programmable on a per-channel basis as single-ended or differential

**Expansion:** An additional 48 analog inputs per board via optional OMB-PDQ30 module; expansion channels have identical features as the main board channels

**Expansion Connector:** 25-pin, DSUB, female

**Over-Voltage Protection:** ±30 V without damage

**Voltage Measurement Speed:** 1 µs per channel

**Temperature Measurement Speed:** Programmable from 100 µs to 20 ms per channel

**Ranges:** Software or sequencer selectable on a per-channel basis, ±10V, ±5V, ±2V, ±1V, ±0.5V, ±0.2V, ±0.1V

### Power Consumption<sup>1</sup>

Model Number	Power Consumption Typical <sup>2</sup>
OMB-DAQ-3000	2500 mW
OMB-DAQ-3001	3000 mW
OMB-DAQ-3005	2000 mW
OMB-DAQ-3000 and OMB-PDQ30	2900 mW
OMB-DAQ-3001 and OMB-PDQ30	3400 mW
OMB-DAQ-3005 and OMB-PDQ30	2400 mW

1. The power consumption listed is for a single OMB-DAQBOARD-3000 Series device, or for a single device connected to a OMB-PDQ30 expansion module  
2. An optional power adapter (OMB-TR-2U) will be required if the USB port cannot supply adequate power. USB2 ports are by USB2 standards, required to supply 2500 mW (nominal at 5V, 500 mA).



OMB-DAQ-3000 shown smaller than actual size

**Input Impedance:** 10M $\Omega$  single-ended; 20 M $\Omega$  differential

**Total Harmonic Distortion:** -80 dB typical for  $\pm 10V$  range, 1 kHz fundamental

**Signal-to-Noise and Distortion:** 72 dB typ for  $\pm 10V$  range, 1 kHz fundamental

**Bias Current:** 40 pA typical (0 to 35 $^{\circ}C$ )

**Crosstalk:** -75 dB typical DC to 60 Hz; -65 dB typical @ 10 kHz

**Common Mode Rejection:** -70 dB typical DC to 1 kHz

## A/D SPECIFICATIONS

**Type:** Successive approximation

**Resolution:** 16-bit

**Maximum Sample Rate:** 1 MHz

**Nonlinearity (Integral):**  $\pm 2$  LSB maximum

**Nonlinearity (Differential):**  $\pm 1$  LSB maximum

## INPUT SEQUENCER

Analog, digital and frequency inputs can be scanned synchronously, based on either internal programmable timer or an external clock source. Analog and digital outputs can be synchronized to either of these clocks.

**Programmable Parameters per Scan:** Channel (random order), gain

**Depth:** 512 locations

**On-Board Channel-to-Channel Scan Rate:**

**Analog:** 1 MHz maximum

**Digital:** 4 MHz if no analog channels are enabled, 1 MHz with analog channels enabled

## EXTERNAL ACQUISITION

### SCAN CLOCK INPUT

**Maximum Rate:** 1.0 MHz

**Clock Signal Range:** Logical zero 0 to 0.8V; logical one 2.4 to 5.0V

**Minimum Pulse Width:** 50 ns high, 50 ns low

## TRIGGERING

**Trigger Sources:** 6, individually selectable for starting and stopping an acquisition. Stop acquisition can occur on a different channel than start acquisition; stop acquisition can be triggered via modes 2, 4, 5 or 6 described below.

### 1. Single-Channel Analog Hardware Trigger

Any analog input channel can be software programmed as the analog trigger channel, including any of the analog expansion channels.

### 2. Single-Channel Analog Software Trigger

Any analog input channel, including any of the analog expansion channels, can be selected as the software trigger channel.

### 3. Single-Channel Digital Trigger

A separate digital input is provided for digital triggering.

### 4. Digital Pattern Triggering

8- or 16-bit pattern triggering on any of the digital input ports. Programmable for trigger on equal, above, below or within/outside of a window. Individual bits can be masked for "don't care" condition.

### 5. Counter/Totalizer Triggering

Counter/totalizer inputs can trigger an acquisition. User can select to trigger on a frequency or on total counts that are equal, above, below or within/outside of a window.

## THERMOCOUPLE TYPES AND ACCURACY <sup>1</sup>

Thermocouple	Temperature Range $^{\circ}C$	Accuracy ( $\pm^{\circ}C$ )	Noise ( $\pm^{\circ}C$ )
J	-200 to 760	1.7	0.2
K	-200 to 1200	1.8	0.2
T	-200 to 400	1.8	0.2
E	-270 to 650	1.7	0.2
R	-50 to 1768	4.8	1.5
S	-50 to 1768	4.7	1.5
B	300 to 1400	3.0	1.0
N	-270 to 1300	2.7	0.3

<sup>1</sup> Assumes 16384 over sampling applied, CMV=0.0V, 60 minute warm-up, still environment and 25 $^{\circ}C$  ambient temperature. Excludes thermocouple error; TC<sub>0</sub> = 0 $^{\circ}C$ , for all types except B (1000 $^{\circ}C$ ), OMB-TR-2 for external power

## 6. Software Triggering

Trigger can be initiated under program control.

## 7. Multi-Channel Triggering

Up to 16 channels can be used to generate a trigger condition for any combination of analog inputs, digital inputs or counter inputs.

## ANALOG OUTPUTS

(OMB-DAQ-3000 and 3001 only)

Analog output channels are updated synchronously relative to scanned inputs, and clocked from either an internal on-board clock or an external clock source. Analog outputs can also be updated asynchronously, independent of any other scanning in the system. Streaming from disk or memory is supported, allowing continuous, nearly infinite-length waveform outputs (limited only by available PC system resources).

**Channels:** OMB-DAQ-3000, 2; OMB-DAQ-3001, 4

**Resolution:** 16-bits

**Data Buffer:** PC-based memory

**Output Voltage Range:**  $\pm 10V$

**Output Current:**  $\pm 1$  mA; sourcing more current (1 mA to 10 mA) may require OMB-TR-2 power adaptor)

**Offset Error:**  $\pm 0.0045V$  max

**Digital Feedthrough:** <10 mV when updated

**DAC Analog Glitch:** <12 mV typical at major carry

**Gain Error:**  $\pm 0.01\%$

**Update Rate:** 1 MHz max, 19 hrs min (no minimum with external clock), resolution 20.83 ns, 250 kHz if all 4 DACs enabled

**Settling Time:** 2  $\mu s$  to rated accuracy

**Clock Sources:** 4, programmable

1. On-board D/A clock, independent of scanning input clock
2. Onboard scanning input clock
3. External D/A input clock, independent of external scanning input clock
4. External scanning input clock

# USB DATA ACQUISITION

Voltage Range*	Accuracy ± (% of reading + % Range) 23°C ± 10°C, 1 year	Temperature Coefficient ± (ppm of reading + ppm Range) /°C -30°C to 13°C and 33°C to 70°C	Noise** (cts RMS)
-10 to 10V	0.031% + 0.008%	14 + 8	2.0
-5 to 5V	0.031% + 0.009%	14 + 9	3.0
-2 to 2V	0.031% + 0.010%	14 + 10	2.0
-1 to 1V	0.031% + 0.02%	14 + 12	3.5
-500 mV to 500 mV	0.031% + 0.04%	14 + 18	5.5
-200 mV to 200 mV	0.036% + 0.05%	14 + 12	8.0
-100 mV to 100 mV	0.042% + 0.10%	14 + 18	14.0

\* Specifications assume differential input single channel scan, 1-MHz scan rate, unfiltered, CMV=0.0V, 30 minutes warm-up, exclusive of noise, range -FS to +FS \*\* Noise reflects 10,000 samples at 1-MHz, typical, differential short

## DIGITAL I/O

**Channels:** 24

**Ports:** 3 x 8 bit, each port is programmable as input or output

**Input Scanning Modes:**

2 programmable

1. Asynchronous, under program control at any time relative to input scanning
2. Synchronous with input scanning Input Characteristics: 10KΩ pull up to 5V, 20 pF to common

**Input Characteristics:**

220Ω series resistor, 20 pF to common

**Input Protection:** ±15 kV ESD clamp diodes

**Input Levels:**

**Low:** 0 to 0.8V

**High:** 2.0 to 5.0V

**Output Levels:**

**Low:** <0.8V

**High:** >2.0V

**Output Characteristics:**

Output 1.0 mA per pin

**Sampling/Update Rate:**

4 MHz max

## PATTERN GENERATION

### OUTPUT

Two of the 8-bit ports can be configured for 16-bit pattern generation. The pattern can also be updated synchronously with an acquisition at up to 1 MHz.

## COUNTER

Each of the four high-speed, 32-bit counter channels can be configured for counter, period, pulse width, time between edges or multi-axis quadrature encoder modes.

Counter inputs can be scanned synchronously along with analog and digital scanned inputs, based on an internal programmable timer or an external clock source.

**Channels:** 4 x 32 bit

**Input Frequency:** 20 MHz max

**Input Signal Range:** -15 to 15V

**Input Characteristics:**

10K pull up, ±15 kV

ESD protection

**Trigger Level:** TTL

**Minimum Pulse Width:**

25 ns high, 25 ns low

**Debounce Times:**

16 selections from

500 ns to 25.5 ms;

positive or negative

edge sensitive;

glitch detect mode

or debounce mode

**Time Base**

**Accuracy:** 50 ppm

(0 to 50°C)

**Five Programmable**

**Modes:** counter,

period, pulsewidth,

timing, Encoder

## FREQUENCY/PULSE

### GENERATORS

**Channels:** 2 x 16-bit

**Output Waveform:** Square wave

**Output Rate:** 1 MHz base

rate divided by 1 to 65,535

(programmable)

**High-Level Output Voltage:**

2.0V min @ -1.0 mA; 2.9V min

@ -400 μA

**Low-Level Output Voltage:**

0.4V max @ 400 μA

**OMB-PDQ30 Expansion Module**

See the OMB-PDQ30 data sheet

for complete specifications

### Maximum Usable Input Voltage + Common Mode Voltage

Ranges	Maximum (CMV + Vin)
0.5, 1, 2, 5, 10V	10.5V
0.1, 0.2V	2.1V

## Accessories and Cables

Model Number	Description
<b>OMB-CA-96A</b>	OMB-DAQ-3000 Series to OMB-PDQ30 Cable, 0.6 m (2')
<b>OMB-CA-179-1</b>	USB cable, 1 m (3')
<b>OMB-CA-179-3</b>	USB cable, 3 m (10')
<b>OMB-CA-179-5</b>	USB cable, 5 m (16')
<b>OMB-CN-153-12</b>	Spare terminal block
<b>OMB-TR-2U</b>	External power supply
<b>OMB-PDQ10</b>	DIN rail mounting adaptor for OMB-DAQ-3000

## To Order Visit [omega.com/omb-daq-3000](http://omega.com/omb-daq-3000) for Pricing and Details

Model Number	Description
<b>OMB-DAQ-3005</b>	16-bit, 1-MHz USB data acquisition module with 16 analog inputs, 24 digital I/O, four counters, and two timers; includes DaqView software, support for Visual Studio and Visual Studio .NET, with examples for Visual C++, Visual C#, Visual Basic and Visual Basic .NET; drivers for DASyLab and LabVIEW; DaqCal software application.
<b>OMB-DAQ-3000</b>	Same as OMB-DAQ-3005 but with two 16-bit, 1-MHz analog outputs
<b>OMB-DAQ-3001</b>	Same as OMB-DAQ-3005 but with four 16-bit, 1-MHz analog outputs
<b>OMB-PDQ30</b>	Analog input expansion module, adds 48SE/24DE channels to OMB-DAQ-3000 Series

Comes complete with with DaqView software, software drivers and operator's manual on CD ROM. USB cable required (ordered separately).

**Ordering Example:** OMB-DAQ-3000 Personal DAQ USB data acquisition module and OCW-1 OMEGACARE<sup>SM</sup> extends standard 1-year warranty for a total of 2 years, with OMB-PDQ30 expansion module and OCW-1 OMEGACARE<sup>SM</sup> extends standard 1-year warranty for a total of 2 years, and OMB-CA-179-1 USB cable.