

## 100KSPS 16-bit 16ch Analog Output Board for PCI Express(Low Profile)

### AO-1616L-LPE



\* Specifications, color and design of the products are subject to change without notice.

This product is a Low Profile PCI Express bus-compliant interface board used to provide an analog signal output function on a PC.

This product is multifunction type with 16-bit analog output 16 channels, digital I/O and counter function.

This product carries buffer memory for 1K of data, allowing sampling to be performed in a variety of trigger / clock conditions.

Windows/Linux driver is bundled with this product.

Possible to be used as a data recording device for MATLAB and LabVIEW, with dedicated libraries.

## Features

### High precision analog output 16 channels, each 4 channels for digital I/O, counter 1 channel

This product has analog output (10 $\mu$ sec, 16-bit, 16 channels), analog output control signal (LVTTL level 3 channels), digital I/O (each 4 channels for LVTTL level), counter (32-bit, LVTTL level 1 channel).

### The start/end of sampling can be controlled by software, an external trigger, etc.

You can select from software, an external trigger to control the start of sampling. You can select from completion of sampling for a specified number of sessions, an external trigger or software to control forcibly the end of sampling. The sampling cycle can be selected from the internal clock or an external clock.

### Safety design to adjust output voltage to 0V when power supply is turned on

To prevent the unstable voltage and the connected device of D/A converter from fault and malfunctions when the power supply is turned on, the circuit is designed to adjust output voltage of the analog output to 0V.

### Equipped with buffer memory (1K data) that can be used in the FIFO or RING format

The block contains buffer memory (1K data) that can be used in the FIFO or RING format. This allows for background analog output that does not depend on the operation status of the software or PC.

### Digital filter function included to prevent misdetection due to chattering on external signals

A digital filter is included to prevent misdetection due to chattering on the control signal (external trigger input signal, sampling clock input signal, etc.), digital input signal and counter input signal.

(Except from external clock input signal and counter gate signal)

### Functions and connectors are compatible with PCI compatible board DA16-16(LPCI)L

The functions same with PCI compatible board DA16-16(LPCI)L are provided.

In addition, as there is compatibility in terms of connector shape and pin assignments, it is easy to migrate from the existing system.

### Support for both of low-profile and standard PCI slots (interchangeable with a bundled bracket)

This product has each bracket for both low-profile size slot and standard size slot. If you wish to mount this product in a standard size slot, replace this with the standard size bracket.

### Software-based calibration function

Calibration of analog output can be all performed by software. Apart from the adjustment information prepared before shipment, additional adjustment information can be stored according to the use environment.

### Windows/Linux compatible driver libraries are attached.

Using the attached driver library API-PAC(W32) makes it possible to create applications of Window/Linux. In addition, a diagnostic program by which the operations of hardware can be checked is provided.

### MATLAB and LabVIEW is supported by a plug-in of dedicated library VI-DAQ.

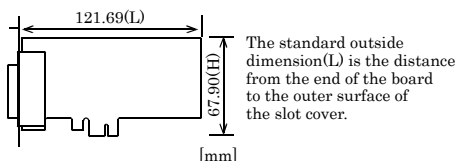
Using the dedicated library MATLAB and VI-DAQ makes it possible to make a LabVIEW application.

## Specification

Item	Specification
<b>Analog output</b>	
Isolated specification	Unisolated
Number of output channels	16ch
Output range	Bipolar ±10V
Absolute max. output current	±3mA
Output impedance	1Ω or less
Resolution	16bit
Non-Linearity error *1	±5LSB
Conversion speed	10μ sec
Buffer memory	1k Word
Conversion start trigger	Software / external trigger
Conversion stop trigger	Number of sampling times / external trigger/software
External start signal	LVTTTL-level (Rising or falling edge can be selected by software) Digital filter (1μ sec can be selected by software)
External stop signal	LVTTTL-level (Rising or falling edge can be selected by software) Digital filter (1μ sec can be selected by software)
External clock signal	LVTTTL-level (Rising or falling edge can be selected by software)
<b>Digital I/O</b>	
Number of input channels	Unisolated input 4ch (LVTTTL-level positive logic)
Number of output channels	Unisolated output 4ch (LVTTTL-level positive logic)
<b>Counter</b>	
Number of channels	1ch
Counting system	Up count
Max. count	FFFFFFFFh (Binary data,32bit)
Number of external inputs	2 LVTTTL-level (Gate/Up)/ch Gate (High level), Up (Rising edge)
Number of external outputs	LVTTTL-level Count match output (positive logic, pulse output)
Response frequency	10MHz (Max.)
<b>Common section</b>	
I/O address	64 ports
Interruption level	Errors and various factors, One interrupt request line as INTA
Connector	10250-52A2JL[3M]
Power consumption (Max.)	3.3VDC 310mA 12VDC 430mA
Operating condition	0 - 50°C, 10 - 90%RH (No condensation)
Bus specification	PCI Express Base Specification Rev. 1.0a x1
Dimension (mm)	121.69 (L) x 67.90 (H)
Weight	70g
Certification	VCCI Class A, CE Marking (EMC Directive Class A, RoHS Directive), UKCA

\*1 The non-linearity error means an error of approximately 0.1% occurs over the maximum range at 0°C and 50°C ambient temperature.

### Board Dimensions



## Support Software

### Windows version of analog I/O driver API-AIO(WDM)

The API-AIO(WDM) is the Windows version driver library software that provides products in the form of Win32 API functions (DLL). Various sample programs such as Visual Basic and Visual C++, etc and diagnostic program \*1 useful for checking operation is provided. For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

### Linux version of analog I/O driver API-AIO(LNX)

The API-AIO(LNX) is the Linux version driver software which provides device drivers (modules) by shared library and kernel version. Various sample programs of gcc are provided.

For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

### Data Acquisition library for MATLAB ML-DAQ

This is the library software which allows you to use our analog I/O device products on MATLAB by The MathWorks. Each function is offered in accordance with the interface which is integrated in MATLAB's Data Acquisition Toolbox.

For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

### Data acquisition VI library for LabVIEW VI-DAQ

This is a VI library to use in National Instruments LabVIEW.

VI-DAQ is created with a function form similar to that of LabVIEW's Data Acquisition VI, allowing you to use various devices without complicated settings.

For more details on the library and download of VI-DAQ, please visit the CONTEC's Web site.

## Cable & Connector

### Cable(Optional)

Shield Cable with 50-Pin Mini-Ribbon Connectors at either Ends  
 : PCB50PS-0.5P (0.5m)  
 : PCB50PS-1.5P (1.5m)

Shield Cable with 50-Pin Mini-Ribbon Connector at one End  
 : PCA50PS-0.5P (0.5m)  
 : PCA50PS-1.5P (1.5m)

## Accessories

### Accessories (Option)

Screw Terminal Unit (M3 x 50P) : EPD-50A \*1\*2

- \*1 PCB50PS-0.5P or PCB50PS-1.5P optional cable is required separately.
- \*2 "Spring-up" type terminal is used to prevent terminal screws from falling off.
- \* Check the CONTEC's Web site for more information on these options.

## Packing List

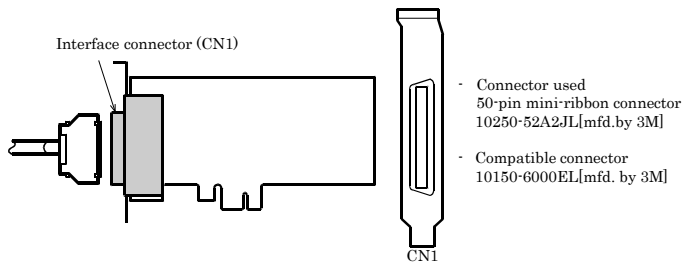
Board [AO-1616L-LPE] ...1  
 First step guide ... 1  
 Disk \*1 [API-PAC(W32)] ...1  
 Standard-sized bracket...1  
 Warranty Certificate...1  
 Serial software and User's Guide...1  
 Serial number label...1

\*1 Driver software and User's Guide.

## How to connect the connectors

### Connector shape

To connect an external device to this board, plug the cable from the device into the interface connector (CN1) shown below.



\* Please refer to page 2 for more information on the supported cable and accessories.

### Connector Pin Assignment

#### Pin Assignments of Interface Connector(CN1)

Analog Output 02	AO 02	50	25	AO 00	Analog Output 00
Analog Ground ( for AO )	AGND	49	24	AGND	Analog Ground ( for AO )
Analog Output 03	AO 03	48	23	AO 01	Analog Output 01
Analog Ground ( for AO )	AGND	47	22	AGND	Analog Ground ( for AO )
Analog Output 06	AO 06	46	21	AO 04	Analog Output 04
Analog Ground ( for AO )	AGND	45	20	AGND	Analog Ground ( for AO )
Analog Output 07	AO 07	44	19	AO 05	Analog Output 05
Analog Ground ( for AO )	AGND	43	18	AGND	Analog Ground ( for AO )
Analog Output 10	AO 10	42	17	AO 08	Analog Output 08
Analog Ground ( for AO )	AGND	41	16	AGND	Analog Ground ( for AO )
Analog Output 11	AO 11	40	15	AO 09	Analog Output 09
Analog Ground ( for AO )	AGND	39	14	AGND	Analog Ground ( for AO )
Analog Output 14	AO 14	38	13	AO 12	Analog Output 12
Analog Ground ( for AO )	AGND	37	12	AGND	Analog Ground ( for AO )
Analog Output 15	AO 15	36	11	AO 13	Analog Output 13
Analog Ground ( for AO )	AGND	35	10	AGND	Analog Ground ( for AO )
Output Control External Sampling Stop Trigger Input	OCESSPI	34	9	OCESSTI	Output Control External Sampling Start Trigger Input
Output Control External Sampling Clock Input	OCESSCKI	33	8	DGND	Digital Ground
Digital Output 00	DO 00	32	7	DI 00	Digital Input 00
Digital Output 01	DO 01	31	6	DI 01	Digital Input 01
Digital Output 02	DO 02	30	5	DI 02	Digital Input 02
Digital Output 03	DO 03	29	4	DI 03	Digital Input 03
Digital Ground	DGND	28	3	DGND	Digital Ground
Counter Clock Input	CNT CKI	27	2	CNT GCI	Counter Gate Control Input
Reserved ( Counter Input )	Reserved	26	1	CNT CPO	Counter Count-up Pulse Output

Analog Output00 - Analog Output15	Analog output signal. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog I/O signals.
AO External Start Trigger Input	External trigger input for starting analog output sampling.
AO External Stop Trigger Input	External trigger input for stopping analog output sampling.
AO External Sampling Clock Input	External sampling clock input for analog output.
Digital Input00 - Digital Input03	Digital input signal.
Digital Output00 - Digital Output03	Digital output signal.
Counter Gate Control Input	Gate control input signal for counter.
Counter Up Clock Input	Count-up clock input signal for counter.
Counter Output	Counter output signal.
Digital Ground	Common digital ground for digital I/O signals, external trigger inputs, external sampling clock inputs, and counter I/O signals.
Reserved	Reserved pin.
N.C.	No connection to this pin.

#### CAUTION

Do not connect any of the outputs and power outputs to the analog or digital ground. Neither connect outputs to each

other. Doing either can result in a fault.

If analog and digital ground are shorted together, noise on the digital signals may affect the analog signals. Accordingly, analog and digital ground should be separated.

Leave "Reserved" pins unconnected. Connecting these pins may cause a fault in the board.

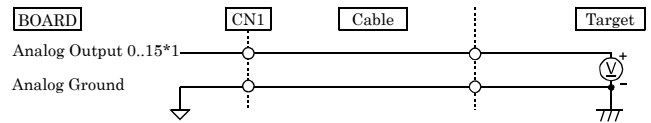
### Analog Output Signal Connection

This section shows how to connect the analog output signal by using a flat cable or a shielded cable.

The following figure shows an example of flat cable connection.

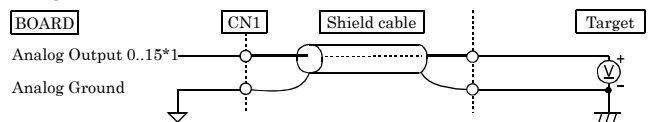
Connect the signal source and ground to the CN1 analog output.

#### Analog Output Connection (Flat Cable)



The following figure shows an example of shield cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise. For each analog input channel on CN1, connect the core wire to the signal line and connect the shielding to ground.

#### Analog Output Connection (Shield Cable)



\*1 The number of channels depends on each board. The AO-1616L-LPE has 16 channels.

#### CAUTION

When the power supply is turned on, the output voltage of all channels becomes 0 V.

If the board or the connected wire receives noise, or the distance between the board and the target is long, data may not be outputted properly.

For analog output signal, the current capacity is  $\pm 3\text{mA}$  (Max.). Check the specification of the connected device before connecting the board.

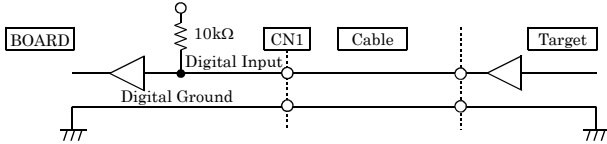
Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage the board.

Do not connect an analog output signal to any other analog output, either on the board or on an external device, as this may cause a fault on the board.

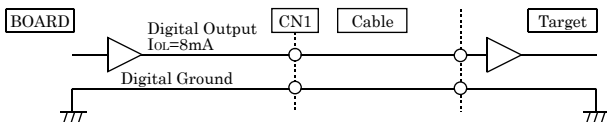
### Digital I/O signals, Counter signals and Control signals Connection

The following sections show examples of how to connect digital I/O signals, counter I/O signals, and other control I/O signals (external trigger input signals, sampling clock input signals, etc.). All the digital I/O signals and control signals are LVTTTL level signals.

#### Digital Input Connection



#### Digital Output Connection



#### About the counter input signal control

Counter Gate Control Input (see page 3, Connector Pin Assignment”) allows the input of the external clock for the counter to be enabled and disabled. This function can be used to control the input of the external clock for the counter. When the input level is “High”, the input of the external clock for the counter is enabled. It is, on the other hand, disabled, when the input level is “Low”. Note that when it is not connected, the input level is set to “High” as the board (card) pins are pulled up. Therefore, the input of the external clock for the counter is enabled when it is not connected.

#### ⚠ CAUTION

Do not short the output signals to analog ground, digital ground, and/or power line. Doing so may damage the board.

### Difference from DA16-16(LPCI)L

The functions same with conventional product of DA16-16(LPCI)L are provided with the this product. In addition, as there is compatibility in terms of connector shape and pin assignments, it is easy to migrate from the existing system. So you can use the same operating procedures as DA16-16(LPCI)L.

There are some differences in specifications as shown below.

	AO-1616-LPE	DA16-16(LPCI)L
Power consumption	+3.3VDC 280 mA (Max.)	+5VDC 1100 mA (Max.)
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI (32-bit, 33MHz, Universal key shapes supported)
External start signal	LVTTTL-level	TTL-level
External stop signal	LVTTTL-level	TTL-level
External clock signal	LVTTTL-level	TTL-level
Digital Input/Output	LVTTTL-level positive logic	TTL-level positive logic
External Counter Input/Output	LVTTTL-level	TTL-level
Dimension (mm)	121.69(L) x 67.90(H)	121.69(L) x 63.41(H)
Weight	70g	60g

### Block Diagram

