

## 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 (LVTTTL level 3 channels), digital I/O (each 4 channels for LVTTTL level), counter (32-bit, LVTTTL 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.

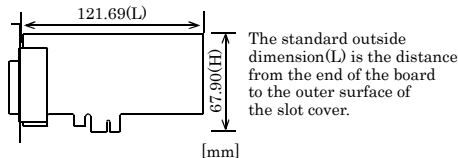
Using the dedicated library MATLAB and VI-DAQ makes it possible to make a LabVIEW application.

## 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        | LVTTL-level (Rising or falling edge can be selected by software)<br>Digital filter (1μ sec can be selected by software) |
| External stop signal         | LVTTL-level (Rising or falling edge can be selected by software)<br>Digital filter (1μ sec can be selected by software) |
| External clock signal        | LVTTL-level (Rising or falling edge can be selected by software)                                                        |
| <b>Digital I/O</b>           |                                                                                                                         |
| Number of input channels     | Unisolated input 4ch (LVTTL-level positive logic)                                                                       |
| Number of output channels    | Unisolated output 4ch (LVTTL-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 LVTTL-level (Gate/Up)/ch<br>Gate (High level), Up (Rising edge)                                                       |
| Number of external outputs   | LVTTL-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 280mA 12VDC 380mA                                                                                                |
| 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                                                                                                                     |

\*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) [Stored on the bundled CD-ROM driver library API-PAC(W32)]

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 useful for checking operation is provided.

#### < Operating environment >

OS Windows Vista, XP, Server 2003, 2000  
Adaptation language Visual Basic, Visual C++, Visual C#, Delphi, C++ Builder

You can download the updated version from the CONTEC's Web site (<http://www.contec.com/apipac/>). 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) [Stored on the bundled CD-ROM driver library API-PAC(W32)]

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.

#### < Operating environment >

OS RedHatLinux, TurboLinux  
(For details on supported distributions, refer to Help available after installation.)

Adaptation language gcc

You can download the updated version from the CONTEC's Web site (<http://www.contec.com/apipac/>). 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 (Available for downloading (free of charge) from the CONTEC web site.)

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.

See <http://www.contec.com/mldaq/> for details and download of ML-DAQ.

### Data acquisition VI library for LabVIEW VI-DAQ (Available for downloading (free of charge) from the CONTEC web site.)

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.

See <http://www.contec.com/vidaq/> for details and download of VI-DAQ.

## 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

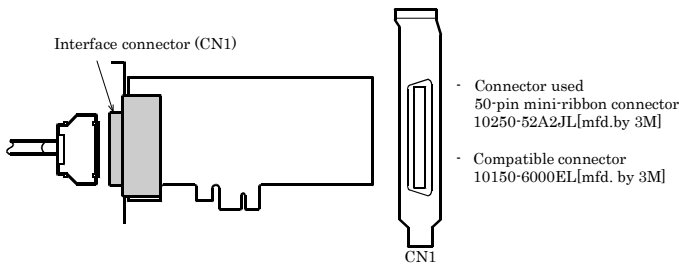
Board [AO-1616L-LPE] ...1  
First step guide ... 1  
CD-ROM \*1 [API-PAC(W32)] ...1  
Standard-sized bracket...1

\*1 The CD-ROM contains the 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.

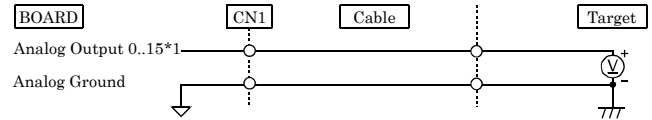
If analog and digital ground are shorted together, noise on the digital signals may affect the analog signals. Accordingly, analog and digital ground should be separated.

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

## Analog Output Signal Connection

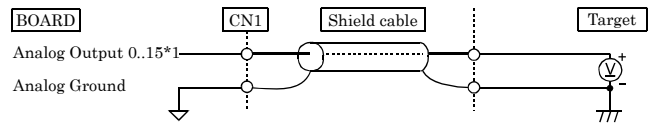
This section shows how to connect the analog output signal by using a flat cable or a shielded cable. The following figure shows an example of flat cable connection. Connect the signal source and ground to the CN1 analog output.

#### 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.

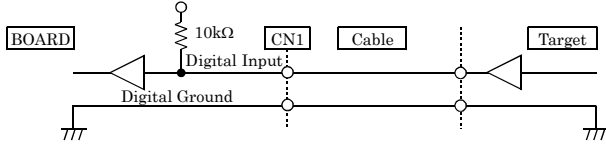
Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage the board.

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.

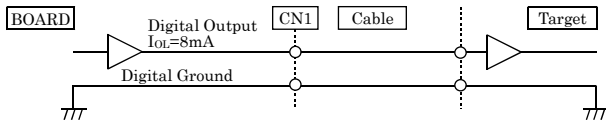
## Digital I/O signals, Counter signals and Control signals Connection

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 TTL level signals.

### Digital Input Connection



### Digital Output Connection



### About the counter input signal control

Counter Gate Control Input (see page 3, Connector Pin Assignment<sup>\*)</sup>) 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

