12-bits Analog I/O Board (High Gain) for PCI
AIO-121602AH-PCI

This product is a PCI-bus compatible multifunction board equipped with analog input x 16ch, analog output x 2ch, digital input/output (unisolated TTL level x 4 each) and a counter (32-bit, TTL level x 1ch). It offers various input setting ranges, ensuring high precision measurement. This product can perform sampling at various different timings based on the multiple trigger condition, clock condition. This product accompanies Windows/Linux driver and full-fledged data logger software “C-LOGGER”. Possible to be used as a data recording device for MATLAB or LabVIEW, with dedicated libraries.

The product lineup consists of four different models, based on the availability of analog outputs: “High Gain” types (input ranges: ±10V, ±1V, ±0.1V, ±0.01V, 0 - +10V, 0 - +1V, 0 - +0.1V, 0 - +0.01V); and "Low Gain" types (input range: ±10V, ±5V, ±2.5V, ±1.25V, 0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V).

AI-1216AH-PCI
AIO-121602AL-PCI
AI-1216AL-PCI

Features

Multifunction board allows you to build a complex system for even a PC with very few expansion slots.
Equipped with analog input(12bits, 16ch), analog output (12 bits, 2ch), digital input / output (4 each, TTL level), counter (32 bits TTL level 1ch).

High-precision measurement can be performed by multiple input range setup.
Detailed measurement can be performed by multiple range setup in accordance with measuring object Bipolar / unipolar range setup can be performed by software.
Input range High Gain type :
Bipolar ±10V, ±1V, ±0.1V, ±0.01V,
Unipolar 0 - +10V, 0 - +1V, 0 - +0.1V, 0 - +0.01V

Equipped with buffer memory (1K data) which can be used in either FIFO or ring format
This product has buffer memory (1K data each for analog input and output) which can be used in either FIFO or ring format. You can also perform analog input and output in the background, independent of software and the current status of the PC.

Data logger software, Windows/Linux compatible driver libraries are attached
Supporting the data logger software [C-LOGGER] that enables the graph display, zoom observation of recorded signal data, file saving, and dynamic transfer to the spreadsheet software program “Excel” without program. And also, the driver library API-PAC(W32) which makes it possible to create applications of Windows/Linux and a diagnostic program by which the operations of hardware can be checked is equipped.

Digital filter function to prevent wrong recognition of external signal chattering is provided.
This product has analog input / output control signal, digital input signal and digital filter function to prevent it from chattering in counter input signal. (excluding external clock input signal, counter gate signal)

Software-based calibration
Setting and calibrating the analog input and output can be performed completely by software. You can also set your own calibration data in place of the default data set at the factory and use different calibration data depending on the operating conditions

MATLAB/LabVIEW is supported by a plug-in of dedicated library.
Using the dedicated library makes it possible to create each application for MATLAB/LabVIEW.

Packing List

Board [AIO-121602AH-PCI] …1
First step guide … 1
Disk *1 [API-PAC(W32)] …1
Synchronization control cable (10cm) …1
Serial number label … 1
Product Registration Card & Warranty Certificate … 1

*1 The Disk contains the driver software and User’s Guide.
**Specification**

### Encoder Input Section

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog input</td>
<td>Isolated</td>
</tr>
<tr>
<td>Isolated specification</td>
<td>Unisolated</td>
</tr>
<tr>
<td>Input type</td>
<td>Single-Ended Input</td>
</tr>
<tr>
<td>Number of input channels</td>
<td>16ch</td>
</tr>
<tr>
<td>Input range</td>
<td>Bipolar ±10V, ±1V, ±0.1V, ±0.01V or Unipolar 0 - 10V, 0 - 0.1V, 0 - 0.01V</td>
</tr>
<tr>
<td>Absolute max. input voltage</td>
<td>±20V</td>
</tr>
<tr>
<td>Input impedance</td>
<td>±1MΩ or more</td>
</tr>
<tr>
<td>Resolution</td>
<td>12bit</td>
</tr>
</tbody>
</table>
| Non-Linearity error | *1) ±2LSB (When using the input range ±10V, ±1V, 0 - 10V, 0 - 1V)  
*2) ±4LSB (When using the input range ±0.1V, ±0.01V)  
±10LSB (When using the input range ±0.01V, ±0.001V) |
| Conversion speed | 150μsec/ch |
| Buffer memory | 1K data |
| Conversion start trigger | Software / external trigger |
| Conversion stop trigger | Number of sampling times / external trigger/software |
| External start signal | TTL level (Rising or falling edge can be selected by software)  
Digital filter (1 μsec can be selected by software) |
| External stop signal | TTL level (Rising or falling edge can be selected by software)  
Digital filter (1 μsec can be selected by software) |
| External clock signal | TTL level (Rising or falling edge can be selected by software) |

### Analog output

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated specification</td>
<td>Unisolated</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>2ch</td>
</tr>
<tr>
<td>Output range</td>
<td>Bipolar ±10V</td>
</tr>
<tr>
<td>Absolute max. input current</td>
<td>±3mA</td>
</tr>
<tr>
<td>Output impedance</td>
<td>11 or less</td>
</tr>
<tr>
<td>Resolution</td>
<td>12bit</td>
</tr>
<tr>
<td>Non-Linearity error</td>
<td>*1) ±2LSB</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>1μsec</td>
</tr>
<tr>
<td>Buffer memory</td>
<td>1K data</td>
</tr>
<tr>
<td>Conversion start trigger</td>
<td>Software / external trigger</td>
</tr>
<tr>
<td>Conversion stop trigger</td>
<td>Number of sampling times / external trigger/software</td>
</tr>
</tbody>
</table>
| External start signal | TTL level (Rising or falling edge can be selected by software)  
Digital filter (1 μsec can be selected by software) |
| External stop signal | TTL level (Rising or falling edge can be selected by software)  
Digital filter (1 μsec can be selected by software) |
| External clock signal | TTL level (Rising or falling edge can be selected by software) |

### Digital I/O

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of input channels</td>
<td>4 TTL levels (positive logic)</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>4 TTL levels (positive logic)</td>
</tr>
</tbody>
</table>

### Counter

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>1ch</td>
</tr>
<tr>
<td>Counting system</td>
<td>Up count</td>
</tr>
<tr>
<td>Max. count</td>
<td>32767FFFEh (Binary data,32bit)</td>
</tr>
</tbody>
</table>
| Number of external inputs | 2 TTL levels (Gate Up/Up)  
Gate (High level), Up ( Rising edge) |
| Number of external outputs | TTL Count match output (positive logic, pulse output) |
| Response frequency | 16MHz (Max.) |

### Common section

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O address</td>
<td>64 ports</td>
</tr>
<tr>
<td>Interconnection level</td>
<td>Errors and various factors. One interrupt request line as INTA</td>
</tr>
</tbody>
</table>
| Connector CN1 | 37 pin D-SUB connector (F [female] type)  
DCC-LJ37SAF-203E Intd by JAE or equivalent to it |
| Connector CN2 | 30 pin Pin-header  
FG-30PE-D4T3PN [Intd. by JAE] or equivalent to it |
| Power consumption | 5VDC 600mA (Max.) |
| Operating condition | 0 - 50°C, 10 - 90%RH (No condensation) |
| Bus specification | PCI(32bit, 33MHz, Universal key shapes supported -3) |
| Dimension (mm) | 176.41(L) x 30.00(W) x 68.00(H) |
| Weight | 155g |
| Certification | H05SVV, V0 |

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.
2) At the time of the source use of a signal which built in the high-speed operational amplifier.
3) This board requires power supply at +5V from an expansion slot (it does not work on a machine with a +3.3V power supply alone).
4) This accuracy is tested in bipolar mode. The accuracy in unipolar mode is double.

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**Support Software**

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

[Stored on the bundled Disk 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. 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 Disk 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. 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 Logger Software C-LOGGER (Supplied: Stored on the API-PAC(W32) Disk)**

C-LOGGER is a data logger software program compatible with our analog I/O products. This program enables the graph display of recorded signal data, zoom observation, file saving, and dynamic transfer to the spreadsheet software “Excel”. No troublesome programming is required. CONTEC provides download services (at http://www.contec.com/clogger) to supply the updated drivers. For details, refer to the C-LOGGER Users Guide or our website.

**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.

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**Board Dimensions**

![Board Dimensions Diagram](image-url)
Cable & Connector

Cable (Option)
Flat Cable with Two 37-pin D-SUB Connectors
: PCB37P-1.5 (1.5m)
Shielded Cable with Two 37-pin D-SUB Connectors
: PCB37PS-0.5P (0.5m) : PCB37PS-1.5P (1.5m)
Flat Cable with One 37-pin D- SUB Connector
: PCA37P-1.5 (1.5m)
Shielded Cable with One 37-pin D- SUB Connector
: PCA37PS-0.5P (0.5m) : PCA37PS-1.5P (1.5m)
30-pin Pinhead Connector to 37-pin D-SUB Connector
: DT/B2 (0.5m) *1

Connector (Option)
D-SUB37P Male Connector Set (Spieses)
: CN5-D37M

* It is necessary for the connection of the digital I/O signal, the counter signal, and the control signal.

Accessories (Option)
Screw Terminal (M3 x 37P)
: EPD-37A *1*2*3
Screw Terminal (M3.5 x 37P)
: EPD-37 *1*3
General Purpose Terminal
: DTP-3A *1*3
Screw Terminal
: DTP-4A *1*3

* PCB37P or PCB37PS optional cable is required separately.
* "Spring-up" type terminal is used to prevent terminal screws from falling off.
* A DT/E2 and PCB37P or PCB37PS optional cable is required separately.
* Check the CONTEC’s Web site for more information on these options.

Block Diagram

Connector shape
The on-board interface connector (CN1 and CN2) is used when connecting this product and the external devices.

Connector Pin Assignment
Pin Assignments of Interface Connector

AIO-121602AH-PCI

Ver.1.04
A. 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.

Optional Cable DT/B2

Analog Signal Connection

Analog signal input types are divided into single-ended input and differential input. This board uses single-ended input fixed. The following examples show how to connect analog input signals using a flat cable and a shielded cable.

Single-ended Input

The following figure shows an example of flat cable connection. Connect separate signal and ground wires for each analog input channel on CN1.

Single-ended Input 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.

Single-ended Input Connection (Shield Cable)

A. CAUTION
If the signal source contains too fast signals, the signal may effect the cross-talk noise between channels. If the board and the signal source receive noise or the distance between the board and the signal source is too long, data may not be input properly.

An input analog signal should not exceed the maximum input voltage (relate to the board analog ground). If it exceeds the maximum voltage, the board may be damaged.

Connect all the unused analog input channels to analog ground.

The signal connected to an input channel may fluctuate after switching of the multiplexer. If this occurs, shorten the cable between the signal source and the analog input board or insert a high-speed amplifier as a buffer between the two to reduce the fluctuation.

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 AIO-121602AH-PCI has two analog output channels.
### CAUTION
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 ±3mA (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 Input Connection Diagram](image)

#### Digital Output Connection

![Digital Output Connection Diagram](image)

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

### About the counter input control signal

Counter Gate Control Input (refer to the page 3 Connector Pin Assignment) acts as an input that validate or invalidate the input of an external clock for the counter. This function enables the control of an external clock input for the counter. The external clock for the counter is effective when input is "High", and invalid when input is "Low". If unconnected, it is a pull-up in the board (card) and remains "High". Therefore the external clock for the counter is effective when the counter gate control input is not connected.

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