

12-bits Analog I/O Board (Low Gain) for PCI

AIO-121602AL-PCI



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

This product is a PCI-bus compatible multifunction board equipped with analog input x 16ch, analog output x 2ch, digital input/output (non-isolated 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: $\pm 10V$, $\pm 1V$, $\pm 0.1V$, $\pm 0.01V$, $0 - +10V$, $0 - +1V$, $0 - +0.1V$, $0 - +0.01V$); and "Low Gain" types (input range: $\pm 10V$, $\pm 5V$, $\pm 2.5V$, $\pm 1.25V$, $0 - +10V$, $0 - +5V$, $0 - +2.5V$, $0 - +1.25V$).

AIO-121602AH-PCI
AI-1216AH-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(12 bits, 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 of Low Gain type :
Bipolar $\pm 10V$, $\pm 5V$, $\pm 2.5V$, $\pm 1.25V$,
Unipolar $0 - +10V$, $0 - +5V$, $0 - +2.5V$, $0 - +1.25V$

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.

Sampling can be started and stopped by software or input data comparison or by an external trigger.

Sampling can be started and stopped by software or input data comparison or by an external trigger (timing controlled by an externally input control signal). The sampling period can be controlled by the internal clock (high-precision timer included on the board) or by an external clock (externally input control signal).

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-121602AL-PCI] ...1
First step guide ... 1
CD-ROM *1 [API-PAC(W32)] ...1
Synchronization control cable (10cm) ...1

*1 The CD-ROM contains the driver software and User's Guide.

Specification

Encoder Input Section

Item	Specification
Analog input	
Isolated specification	Un-Isolated
Input type	Single-Ended Input
Number of input channels	16ch
Input range	Bipolar $\pm 10V$, $\pm 5V$, $\pm 2.5V$, $\pm 1.25V$ or Unipolar 0 - 10V, 0 - 5V, 0 - 2.5V, 0 - 1.25V
Absolute max. input voltage	$\pm 20V$
Input impedance	M Ω or more
Resolution	12bit
Non-Linearity error *1*2*4	$\pm 2LSB$ (When using the input range $\pm 10V$, $\pm 5V$, 0 - 10V, 0 - 5V) $\pm 3LSB$ (When using the input range $\pm 2.5V$, 0 - 2.5V) $\pm 5LSB$ (When using the input range $\pm 1.25V$, 0 - 1.25V)
Conversion speed	10 μ sec/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 μ sec can be selected by software)
External stop signal	TTL level (Rising or falling edge can be selected by software) Digital filter (1 μ sec can be selected by software)
External clock signal	TTL level (Rising or falling edge can be selected by software)
Analog output	
Isolated specification	Un-Isolated
Number of output channels	2ch
Output range	Bipolar $\pm 10V$
Absolute max. input current	$\pm 3mA$
Output impedance	1 Ω or less
Resolution	12bit
Non-Linearity error *1	$\pm 1LSB$
Conversion speed	10 μ sec
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 μ sec can be selected by software)
External stop signal	TTL level (Rising or falling edge can be selected by software) Digital filter (1 μ sec can be selected by software)
External clock signal	TTL level (Rising or falling edge can be selected by software)
Digital I/O	
Number of input channels	4 TTL levels (positive logic)
Number of output channels	4 TTL levels (positive logic)
Counter	
Number of channels	1ch
Counting system	Up count
Max. count	FFFFFFFFh (Binary data, 32bit)
Number of external inputs	2 TTL levels (Gate/Up)/ch Gate (High level), Up (Rising edge)
Number of external outputs	TTL Count match output (positive logic, pulse output)
Response frequency	10MHz (Max.)
Common section	
I/O address	64 ports
Interruption level	Errors and various factors, One interrupt request line as INTA
Connector	CN1 37 pin D-SUB connector [F (female) type] DCLC-J37SAF-20L9E [mfd by JAE] or equivalent to it
	CN2 30-pin Pin-header PS-30PE-D4TIPNI [mfd. 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 105.68 (H)
Weight	150g

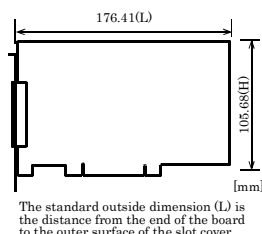
*1 The non-linearity error means an error of approximately 0.1% occurs over the maximum range at 0°C and 50°C ambient temperature.

*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.

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.

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Data Logger Software C-LOGGER (Supplied: Stored on the API-PAC(W32) CD-ROM)

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.

< Operating environment >

OS Windows Vista, XP, Server 2003, 2000

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)

- 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 (5pieces)
: CN5-D37M

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

Accessories

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

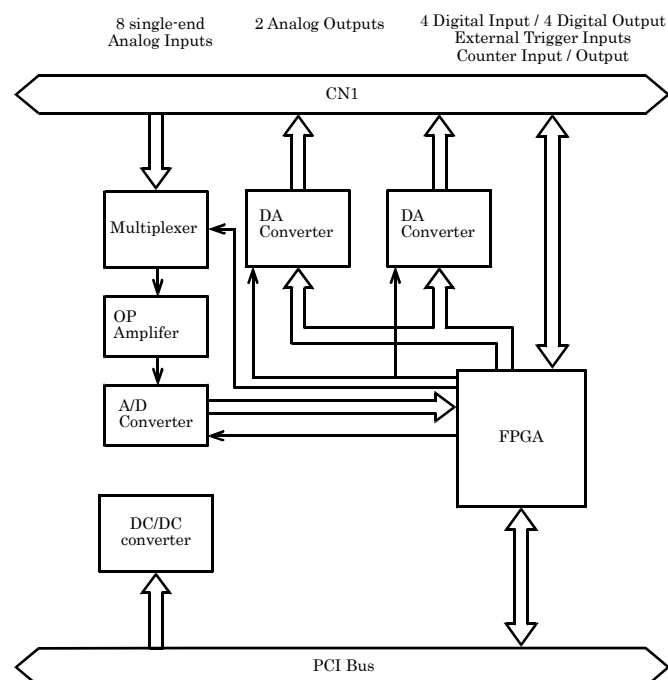
*1 PCB37P or PCB37PS optional cable is required separately.

*2 "Spring-up" type terminal is used to prevent terminal screws from falling off.

*3 A DT/E2 and PCB37P or PCB37PS optional cable is required separately.

* Check the CONTEC's Web site for more information on these options.

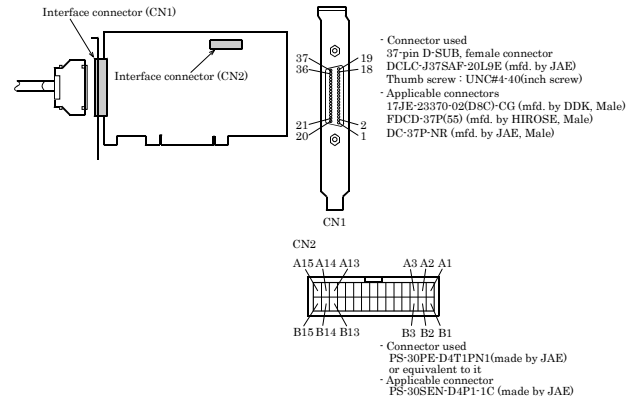
Block Diagram



How to connect the connectors

Connector shape

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



* Please refer to page 3 for more information on the supported cable and accessories.

Connector Pin Assignment

Pin Assignments of Interface Connector

CN1	
Digital Ground	37
Analog Ground	36
Analog Ground	35
Analog Ground	34
Analog Ground	33
Analog Ground	32
Analog Ground	31
Analog Ground	30
Analog Ground	29
Analog Ground	28
Analog Ground	27
Analog Ground	26
Analog Ground	25
Analog Ground	24
Analog Ground	23
Analog Ground	22
Analog Ground	21
Analog Ground	20
19	+5V DC from PC
18	Analog Output 01
17	Analog Output 00
16	Analog Input 15
15	Analog Input 7
14	Analog Input 14
13	Analog Input 6
12	Analog Input 13
11	Analog Input 5
10	Analog Input 12
9	Analog Input 4
8	Analog Input 11
7	Analog Input 3
6	Analog Input 10
5	Analog Input 2
4	Analog Input 9
3	Analog Input 8
2	Analog Input 1
1	Analog Input 0

Analog Input 0 - Analog Input 15	Analog input signal. The numbers correspond to channel numbers.
Analog Output 0 - Analog Output 1	Analog grounds for identically numbered analog input signals.
Analog Ground	Common analog ground for analog I/O signals.
Digital Ground	Common digital ground for digital I/O signals, external trigger inputs, external sampling clock inputs, and counter I/O signals.
+5VDC	5V DC from PC

CAUTION

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.

Pin Assignments of Interface Connector CN2

CN2	
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Ground	DGND
Digital Output 03	DO 03
Digital Output 02	DO 02
Digital Output 01	DO 01
Digital Output 00	DO-00
B15 A15	AO START
B14 A14	AO STOP
B13 A13	AO EXCLK
B12 A12	AI START
B11 A11	AI STOP
B10 A10	AI EXCLK
B9 A9	CNT GATE
B8 A8	CNT UPCLK
B7 A7	CNT OUT
B6 A6	Vcc
B5 A5	DGND
B4 A4	DI 03
B3 A3	DI 02
B2 A2	DI 01
B1 A1	DI-00
AO External Start Trigger Input	AO External Start Trigger Input
AO External Stop Trigger Input	AO External Stop Trigger Input
AO External Sampling Clock Input	AO External Sampling Clock Input
AI External Start Trigger Input	AI External Start Trigger Input
AI External Stop Trigger Input	AI External Stop Trigger Input
AI External Sampling Clock Input	AI External Sampling Clock Input
CNT GATE Counter Gate Control Input	CNT GATE Counter Gate Control Input
Counter UP Clock Input	CNT UPCLK Counter Output
5V	Digital Ground
Digital Ground	Digital Input 03
Digital Input 03	Digital Input 02
Digital Input 02	Digital Input 01
Digital Input 01	Digital Input 00

AI External Start Trigger Input	External trigger input for starting analog input sampling.
AI External Stop Trigger Input	External trigger input for stopping analog input sampling.
AI External Sampling Clock Input	External sampling clock input for analog input.
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.
VCC	5V DC from PC
Reserved	Reserved pin.

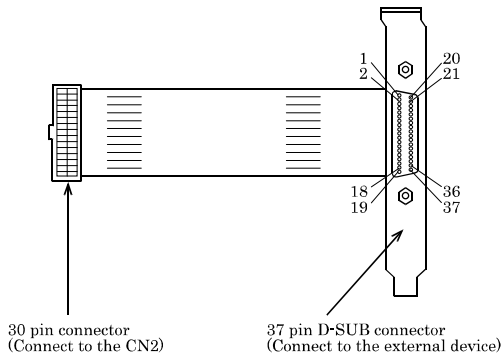
CAUTION

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.

Optional Cable DT/B2



Pin Assignments of an optional cable 37-Pin D-SUB

Ground	Reserved	1	20	AO START	AO External Start Trigger Input
Digital Ground	DGND	2	21	DGND	Digital Ground
Digital Ground	DGND	3	22	N.C.	Not Connect
Digital Ground	DGND	4	23	N.C.	Not Connect
Digital Ground	DGND	5	24	N.C.	Not Connect
Digital Output 03	DO 03	6	25	N.C.	Not Connect
Digital Output 02	DO 02	7	26	N.C.	Not Connect
Digital Output 01	DO 01	8	27	N.C.	Not Connect
Digital Output 00	DO 00	9	28	AO STOP	AO External Stop Trigger Input
CNT GATE Counter Gate Control Input	CNT GATE	10	29	DGND	Digital Ground
Counter UP Clock Input CNT UPCLK	CNT UPCLK	11	30	DGND	Digital Ground
Counter Output	CNT OUT	12	31	DGND	Digital Ground
5V	Vcc	13	32	DGND	Digital Ground
Digital Ground	DGND	14	33	DGND	Digital Ground
Digital Input 03	DI 03	15	34	AO EXCLK	AO External Sampling Clock Input
Digital Input 02	DI 02	16	35	AI START	AI External Start Trigger Input
Digital Input 01	DI 01	17	36	AI STOP	AI External Stop Trigger Input
Digital Input 00	DI 00	18	37	AI EXCLK	AI External Sampling Clock Input
Not Connect	N.C.	19			

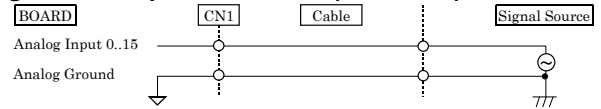
Analog Signal Connection

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

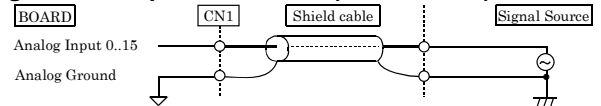
The following figure shows an example of flat cable connection. Connect separate signal and ground wires for each analog input channel on CN1.

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)



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.

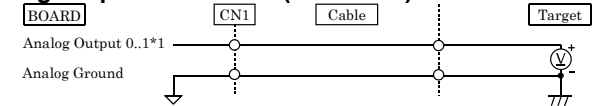
The signal connected to an input channel may fluctuate after switching of the multiplexer. If this occurs, shorten the cable between the signal source and the analog input board or insert a high-speed amplifier as a buffer between the two to reduce the fluctuation.

Analog Output Signal Connection

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

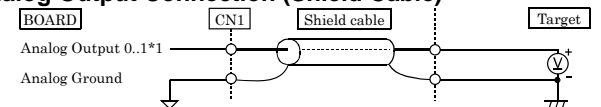
The following figure shows an example of flat cable connection. Connect the signal source and ground to the CN1 analog output.

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-PC have 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 $\pm 3\text{mA}$ (Max.). Check the specification of the connected device before connecting the board.

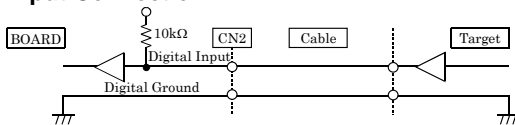
Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage the board.

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.

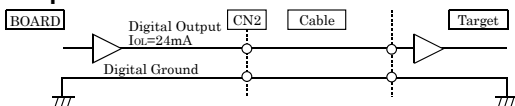
Digital I/O signals, Counter signals and Control signals Connection

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



⚠ 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.