12-bits Analog Input Board (High Gain) for PCI

AI-1216AH-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, 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: ±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).

　AIO-121602AH-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(12 bits, 16ch), 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.

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 [AI-1216AH-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
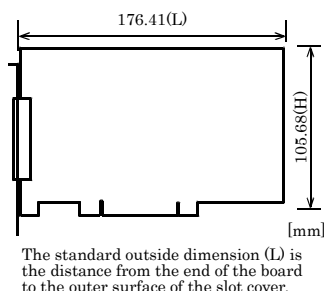*1   The Disk contains the driver software and User's Guide.

Specification

Encoder Input Section

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Input type	Single-Ended Input
	Number of input channels	16ch
	Input range	Bipolar ±10V, ±1V, ±0.1V, ±0.01V or Unipolar 0 - 10V, 0 - 1V, 0 - 0.1V, 0 - 0.01V
	Absolute max. input voltage	±20V
	Input impedance	1MΩ or more
	Resolution	12bit
	Non-Linearity error *1*2*4	±2LSB (When using the input range ±10V, ±1V, 0 - 10V, 0 - 1V) ±5LSB (When using the input range ±0.1V, 0 - 0.1V) ±10LSB (When using the input range ±0.01V, 0 - 0.01V)
	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 (1μsec can be selected by software)
	External stop signal	TTL level (Rising or falling edge can be selected by software) Digital filter (1μsec 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 450mA (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	135g
	Certification	RoHS,VCCI

*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

176.41(L)
105.68(H)
[mm]

The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

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.

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 (5pieses)
: CN5-D37M

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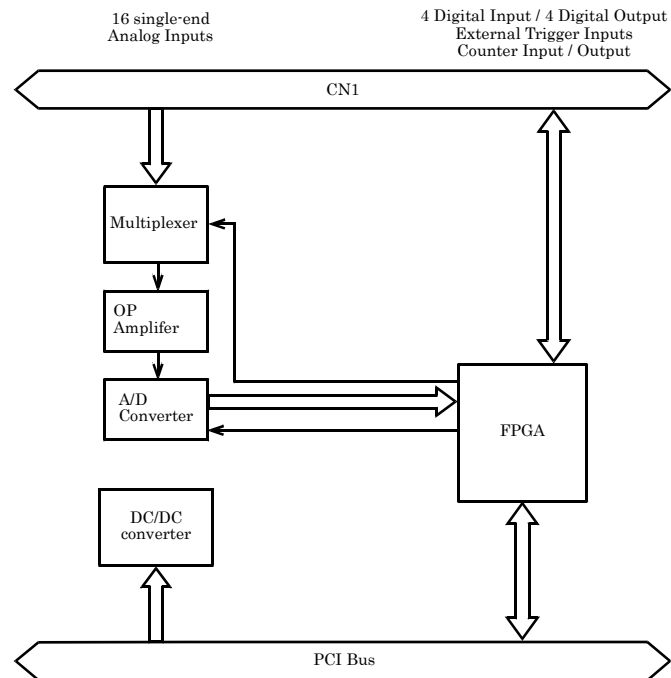
Accessories

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.

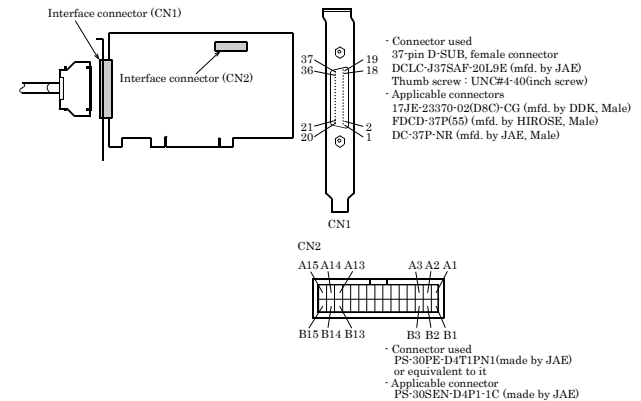*   Check the CONTEC's Web site for more information on these options.

Block Diagram

16 single-end
Analog Inputs

4 Digital Input / 4 Digital Output
External Trigger Inputs
Counter Input / Output

CN1

Multiplexer

OP Amplifer

A/D Converter

DC/DC converter

FPGA

PCI Bus

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.

Interface connector (CN1)

Interface connector (CN2)

- Connector used
  37-pin D-SUB, female connector
  DCLC-J37SAF-20L9E (mfd. by JAE)
  Thumb screw : UNC#4-40(inch screw)
- Applicable connectors
  17JE-23370-02(DSC)-CG (mfd. by DDK, Male)
  FDCD-37P(55) (mfd. by HIROSE, Male)
  DC-37P-NR (mfd. by JAE, Male)

CN1

CN2

A15 A14 A13 ... A3 A2 A1

B15 B14 B13 ... B3 B2 B1

- Connector used
  PS-30PE-D4T1PN1(made by JAE)
  or equivalent to it
- Applicable connector
  PS-30SEN-D4P1-1C (made by JAE)

Connector Pin Assignment
Pin Assignments of Interface Connector

CN1

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

Analog Input 0 - Analog Input 15	Analog input signal. The numbers correspond to channel numbers.
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. The current capacity that can be output is as follows. AIO-121602AH-PCI, AIO-121602AL-PCI: The total of "5+ V DC from PC [CN1]" and "VCC [CN2]" is 0.9A. AI-1216AH-PCI, AI-1216AL-PCI: The total of "5+ V DC from PC [CN1]" and "VCC [CN2]" is 1.0A.
N.C.	No connection to this pin.

⚠ 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	B15 A15	N.C.	Not Connect
Digital Ground	DGND	B14 A14	N.C.	Not Connect
Digital Ground	DGND	B13 A13	N.C.	Not Connect
Digital Ground	DGND	B12 A12	AI START	AI External Start Trigger Input
Digital Ground	DGND	B11 A11	AI STOP	AI External Stot Trigger Input
Digital Ground	DGND	B10 A10	AI EXCLK	AI External Sampling Clock Input
Ground	Reserved	B9 A9	CNT GATE	CNT GATE Counter Gate Control Input
Digital Ground	DGND	B8 A8	CNT UPCLK	Counter UP Clock Input CNT UPCLK
Digital Ground	DGND	B7 A7	CNT OUT	Counter Output
Digital Ground	DGND	B6 A6	Vcc	5V
Digital Ground	DGND	B5 A5	DGND	Digital Ground
Digital Output 03	DO 03	B4 A4	DI 03	Digital Input 03
Digital Output 02	DO 02	B3 A3	DI 02	Digital Input 02
Digital Output 01	DO 01	B2 A2	DI 01	Digital Input 01
Digital Output 00	DO-00	B1 A1	DI-00	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.
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 The current capacity that can be output is as follows. AIO-121602AH-PCI, AIO-121602AL-PCI: The total of "5+ V DC from PC [CN1]" and "VCC [CN2]" is 0.9A. AI-1216AH-PCI, AI-1216AL-PCI: The total of "5+ V DC from PC [CN1]" and "VCC [CN2]" is 1.0A.
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.

Optional Cable DT/B2

30 pin connector
(Connect to the CN2)

37 pin D-SUB connector
(Connect to the external device)
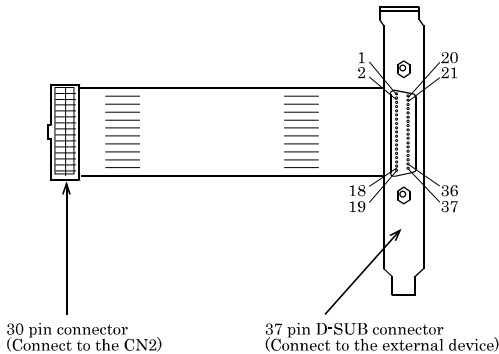
Pin Assignments of an optional cable 37-Pin D-SUB

|					
Ground	Reserved	1	20	N.C.	Not Connect
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	N.C.	Not Connect
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	N.C.	Not Connect
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)
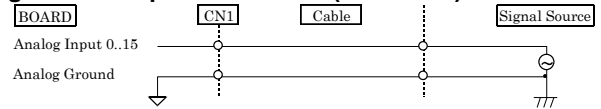
The following figure shows an example of shield cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise.   For each analog input channel on CN1, connect the core wire to the signal line and connect the shielding to ground.

Single-ended Input Connection (Shield Cable)
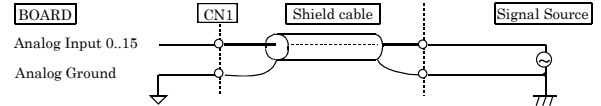
⚠ CAUTION

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.

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
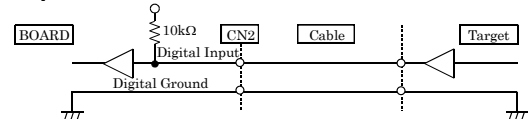
Digital Output Connection
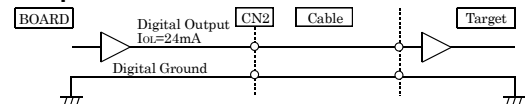
⚠ CAUTION

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.