Isolated high-functional Analog Input Board for PCI
AI-1216I2-PCI

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

This product is PCI-compliant interface boards that convert analog input signals to digital equivalents (performing analog-to-digital conversion).

This product can perform A-D conversion at a conversion speed of 20μsec per channel and a resolution of 12bit.

Windows/Linux device driver is supported with this product.

* The contents in this document are subject to change without notice.
* Visit the CONTEC website to check the latest details in the document.
* The information in the data sheets is as of July, 2024.

Features

- **Bus-isolation by optocoupler and digital isolator**
PC and external I/O circuit is isolated from each other by optocoupler and digital isolator, offering good noise immunity.

- **Sixteen single-ended channels and eight differential channels**
Either board allows the single-ended or differential input mode to be selected with on-board jumpers.   The order of channels subject to signal conversion can be preset in the dedicated register.

- **On-board buffer memory**
The board has buffer memory available as a FIFO or ring buffer to hold 256 kilobytes of data.   This enables sampling to be executed in the background independently of the processing power of the PC.

- **Assorted sampling control functions**
The board can control the starting and stopping of sampling not only with software commands but also by detecting analog signal strength or digital signals.   The board offers a choice of sampling clocks selectable to determine the sampling speed: the internal sampling clock using the on-board clock generator and the external sampling clock using the digital signal input from an external device.

- **Digital input/output function**
The board has optocoupler isolation open-collector output (sink type) digital output 4 channels, optocoupler isolation input (corresponding to sink output) digital input 4 channels and can monitor, control the external device.

- **Abundant optional units**
Optional units are available for enhancements.   Using optional units enhances board functions and facilitates connections.

- **Windows/Linux support device driver**
Using the device driver API-TOOL makes it possible to create applications of Windows/Linux. In addition, a diagnostic program by which the operations of hardware can be checked is provided.

Included Items

Product ...1
Please read the following...1

Specifications

Function specification

Item		Description
Analog input		
	Isolated specification	Bus-isolated
	Input type	Single-Ended Input or Differential Input (Jumper setup)
	Number of input channels	16ch (Single-Ended Input) 8ch (Differential Input)
	Input range	Bipolar ±10V, ±5V, ±2.5V, ±1.25V or Unipolar 0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V 4 - 20mA (Set the input range using both jumpers and software setting.)
	Absolute max. input voltage	±20V Input range : ±10V, ±5V, ±2.5V, ±1.25V, 0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V
	Absolute max. input current	25mA Input range : 4 - 20mA
	Input impedance	1MΩ or more Input range : ±10V, ±5V, ±2.5V, ±1.25V, 0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V
	Resolution	12bit
	Non-Linearity error *1*2	±2LSB(±10V, ±5V, 0 - +10V, 0 - +5V) ±4LSB(±2.5V, ±1.25V, 0 - +2.5V, 0 - +1.25V) ±3LSB(4 - 20mA)
	Conversion speed	20μsec/ch (Max.)
	Buffer memory	256K Word FIFO or 256K Word RING (Software setup)
	Conversion start trigger	Software, Conversion data compare and External trigger
	Conversion stop trigger	Data save complete, Conversion data compare, External trigger and Software.
Digital I/O section		
	Number of input channels	Opto-Isolated Input (for current sinking output) 4ch Response time : within 1msec
	Number of output channels	Opto-Isolated Open Collector Output (current sinking type) 4ch Response time : within 1msec
Common section		
	I/O address	16 ports boundary
	Interruption level	Errors and various factors, One interrupt request line as INTA (Interrupts can be enabled or disabled.)
	Power consumption	+5VDC 700mA (Max.)
	Bus specification	PCI(32bit, 33MHz, Universal key shapes supported *3)
	Dimension (mm)	176.41(L) x 106.68(H)
	Weight	150g

*1   A linearity error approximately 0.1% of full-range may occur when operated at 0°C or 50°C ambient temperature.
*2   When using a signal source with a built-in high-speed operational amp.
*3   This board requires +5V power supply from expansion slots (it does not operate in the environment of only +3.3V power supply).

Installation Environment Requirements

Item	Description
Operating ambient temperature	0 - 50℃
Operating ambient humidity	10 - 90%RH (No condensation)
Floating dust particles	Not to be excessive
Corrosive gases	None
Standard	VCCI Class A, CE Marking (EMC Directive Class A, RoHS Directive), UKCA

Physical Dimensions

176.41(L)
106.68(H)
[mm]
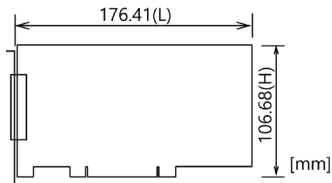
The standard outside dimension (L) is the distance from the end of the card to the outer surface of the slot cover.

Support Software

Name	Contents	How to get
Windows version High-efficiency Analog I/O Driver API-AIO(WDM)	The API-AIO(WDM) is the Windows version driver 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.	Download from the CONTEC website *1
Analog I/O Driver for Linux API-AIO(LNX)	This is the Linux version driver software provided in API function formats. The software includes various sample programs such as gcc (C, C++) and Python programs.	Download from the CONTEC website *1
Software Development Tool Kits (SDK) and Support Software	In addition to the device drivers, we offer many software programs for using CONTEC devices in an easier manner.	Download from the CONTEC website *2

*1 Download the files from the following URL.

   https://www.contec.com/download/

*2 For supported software, search the CONTEC website for this product and view the product page.

   https://www.contec.com/

Optional Products

Product Name	Model type	Description
Shield Cable with two 37-pin D-type connectors	PCB37PS-0.5P	0.5m
	PCB37PS-1.5P	1.5m
Flat Cable with 37-Pin D-type Connectors on 2Ends	PCB37P-1.5	1.5m
Shield Cable with One 37pin D-type Connector	PCA37PS-0.5P	0.5m
	PCA37PS-1.5P	1.5m
Flat Cable with a 37Pin D-type Connectors	PCA37P-1.5	1.5m
Conversion Cable (16-Pin to 15-Pin) with Bracket	DT-E3	
Shielded Cable with Connector on both sides for 15-pin D-Type Connector	PCB15P-1.5P	1.5m *1*2
Coaxial Cable for Single-ended Inputs	PCC16PS-1.5	1.5m
	PCC16PS-3	3m
2 Wires Shielded Cable for Differential Inputs	PCD8PS-1.5	1.5m
	PCD8PS-3	3m
Screw Terminal (M3 * 37P)	EPD-37A	*3*4
Screw Terminal (M3.5 * 37)	EPD-37	*4
M3 screw terminal board	FTP-15	*5
General Purpose Terminal	DTP-3C	*4
Screw Terminal	DTP-4C	*4
Termination Panel with BNC connectors for Analog I/O Boards	ATP-16E	*4
Isolated Expansion Accessory for Analog Input	ATII-8C	*4*6
Low Pass Filter Accessory for Analog Input	ATLF-8A	*4*6
Buffer Amplifier Box for Analog Input Boards	ATBA-16E	*4

*1   A DT-E3 optional cable is required separately.

*2   For FTP-15 only

*3   "Screw upright terminal panel" is used to prevent terminal screws from falling off.
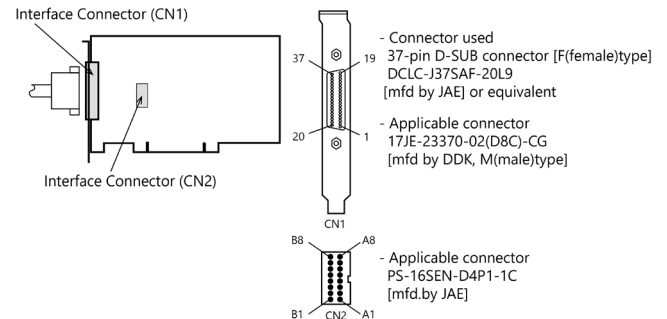
*4   A PCB37P or PCB37PS optional cable is required separately.

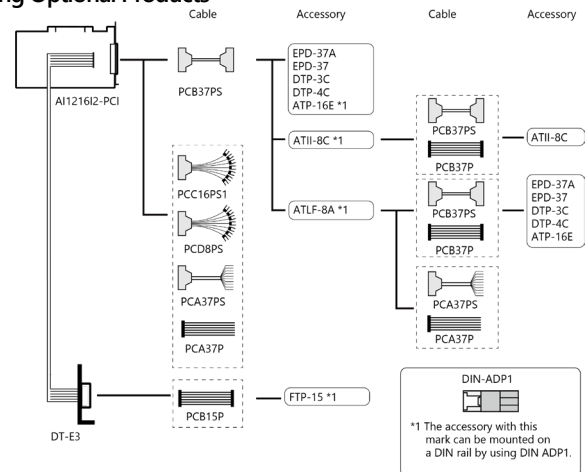*5   A DT-E3 or PCB15P optional cable is required separately.

*6   External Power supply is required separately.

Visit the CONTEC website for the latest optional products.

Connecting an Interface Connector

Interface Connector (CN1)
Interface Connector (CN2)

37 19
20 1
CN1

- Connector used
  37-pin D-SUB connector [F(female)type]
  DCLC-J37SAF-20L9
  [mfd by JAE] or equivalent
- Applicable connector
  17JE-23370-02(D8C)-CG
  [mfd by DDK, M(male)type]

B8 A8
B1 CN2 A1

- Applicable connector
  PS-16SEN-D4P1-1C
  [mfd.by JAE]

Adding Optional Products

| | Cable | Accessory | Cable | Accessory |

AI1216I2-PCI
PCB37PS
EPD-37A EPD-37 DTP-3C DTP-4C ATP-16E *1
ATII-8C *1
PCB37PS
PCB37P
ATII-8C
PCC16PS1
ATLF-8A *1
PCB37PS
PCB37P
EPD-37A EPD-37 DTP-3C DTP-4C ATP-16E
PCD8PS
PCA37PS
PCA37P
PCA37PS
PCA37P
PCB15P
FTP-15 *1
DIN-ADP1
DT-E3
*1 The accessory with this mark can be mounted on a DIN rail by using DIN ADP1.

*1   The optional products with this mark can be mounted on a DIN rail by using [DIN-ADP1] accessary.

Layout on the Interface Connector(CN1)
Single-Ended Input

Signal	Pin			Pin	Signal
N.C.	37			19	N.C.
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

Signal name	Description
Analog Input 0 - Analog Input 15	Analog input signal with single-ended input. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog input signals.
N.C.	No connection to this pin.

Differential Input

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

Signal name	Description
Analog Input 0[+] - Analog Input 7[+]	Analog input signal with differential input. The numbers correspond to channel numbers.
Analog Input 0[-] - Analog Input 7[-]	Analog input signal with differential input. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog input signals.
N.C.	No connection to this pin.

Signal Layout on the Interface Connector (CN2)

N.C.	B8		A8	+Common In
+Common Out	B7		A7	Sampling Clock Output
External Sampling Clock Input	B6		A6	External Stop Trigger Input
External Start Trigger Input	B5		A5	Digital Input 3 / INT Trigger
Digital Input 2	B4		A4	Digital Input 1
Digital Input 0	B3		A3	-Common Out
Digital Output 3	B2		A2	Digital Output 2
Digital Output 1	B1		A1	Digital Output 0

| Signal name	Description
Digital Input 0 - Digital Input 2	Digital Input signal. The numbers correspond to input bits.
Digital Input 3 / INT Trigger	Digital Input signal. The numbers correspond to input bits. Common for interrupt trigger input signal.
Digital Output 0 - Digital Output 3	Digital output signal. The numbers correspond to output bits.
External Start Trigger Input	External trigger input for starting sampling.
External Stop Trigger Input	External trigger input for stopping sampling.
External Sampling Clock Input	External sampling clock input signal.
Sampling Clock Output	Sampling clock output signal.
+Common In	Connect the plus side of external power supply. Common for each digital input signal.
+Common Out	Connect the plus side of external power supply. Common for each digital output signal.
-Common Out	Connect the minus side of external power supply. Common for each digital output signal.
N.C.	No connection to this pin.

⚠ **CAUTION**

Do not short any of the digital outputs to digital ground.
Neither connect outputs to each other. Doing either can result in a fault.

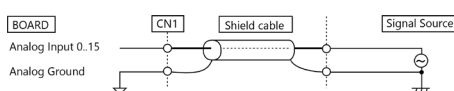## Connecting Analog Input Signal

Single-ended Input
Single-ended Input Connection (Flat Cable)
The following figure shows an example of flat cable connection. Each signal source is connected to one analog input channel and the signal common to analog ground pin of CN1.
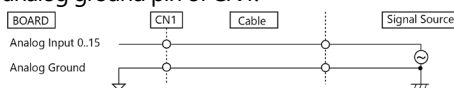
Single-ended Input Connection (Shielded Cable)
The following figure shows an example of shielded cable connection. When the distance between the signal source and the product is long or you want to increase the noise tolerance, a shield cable is suggested.

Connect the signal by the core wire and common signal by the shield braids.
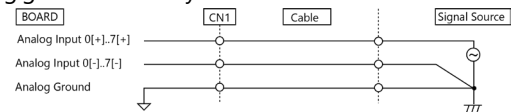

⚠ **CAUTION**

- When a frequency of 1MHz or higher is contained in the source signal, the cross talk between channels may occur.
- If the product and the signal source receive noise or the distance between the product 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 product analog ground). If it exceeds the maximum voltage, the product may be damaged.
- Connect all the unused analog input channels to analog ground.

Differential Input
Differential Input Connection (Flat Cable)
The following figure shows an example of flat cable connection.

Each signal source is connected to a [+] pin of analog input channel and the signal common of this source to the [-] pin of this input channel of CN1. In addition, the signal common must be connected to the pin of the analog ground of CN1 by a third wire.

Differential Input Connection (Shielded Cable)
The following figure shows an example of shielded cable connection. When the distance between the signal source and the product is long or you want to increase the noise tolerance, a shield cable connection is preferred. Each signal source is connected to a [+] pin of analog input channel and the signal common of this source to the [-] pin of this input channel of CN1. In addition, the signal common must be connected to the pin of the analog ground of CN1 by the shielded braids.
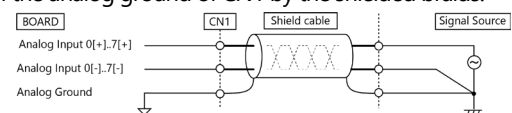

⚠ **CAUTION**

- When a frequency of 1MHz or higher is contained in the source signal, the cross talk between channels may occur.
- The input data would be uncertain if the analog ground is not connected.
- If the product and the signal source receive noise or the distance between the product and the signal source is too long, data may not be input properly.
- The input voltage from the [+] input or [-] input should not exceed the maximum input voltage (based on the product analog ground). If it exceeds the maximum voltage, the product may be damaged.
- Because the input data will be uncertain if the [+] pin or the [-] pin of CN1 is not connected, all the unused input pins of CN1 should be connected to the analog ground, AGND.
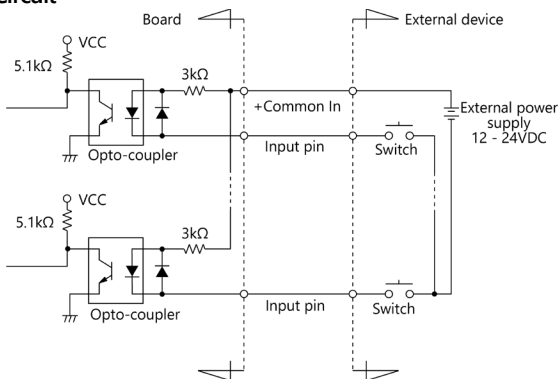
Current Input
Current Input Connection (Flat Cable)
The following figure shows an example of flat cable connection. For each analog input channel on CN1, connect the "+" input to the signal and connect the "-" input to the signal source ground. Also connect the analog ground on the board to the signal source ground.
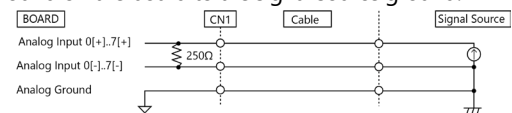
Differential Input Connection (Shielded Cable)
The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise. For each analog input channel on CN1, connect the "+" input to the signal and connect the "-" input to the signal source ground. Also connect the analog ground on the board and the signal source ground to the shielding.
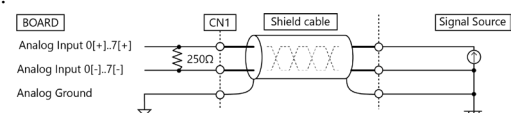
CAUTION

- If the signal source contains over 1MHz signals, the signal may affect the cross-talk noise between channels.
- When the analog ground is not connected, input data comes to be undetermined.
- 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.
- Voltage of an input analog signal to both [+] and [-] input should not exceed the 1-5V (relate to the board analog ground).   If it exceeds the maximum voltage, Even within the range scope, correct data input may not be possible.
- An input analog signal to both [+] and [-] input 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 [+] and [-] input channels to analog ground.

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

The following sections show examples of how to connect digital I/O signals. Connect CN2 to an external device using a 15-pin D-SUB connector with bracket.
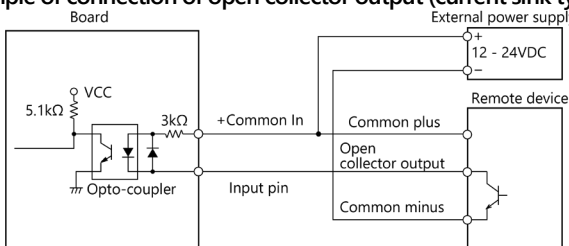
Connecting the input signal

To the digital input signal and control signal (External Start Trigger Input, External Stop Trigger Input, External Sampling Clock Input) pins, connect current driven devices such as a switch and a transistor output device. Input circuit is as follows.   +Common In is common to individual input signals.   An external power supply is required to drive the input circuit. The power capacity required at this time is about 8 mA per input channel at 24 VDC (or about 4 mA at 12 VDC).
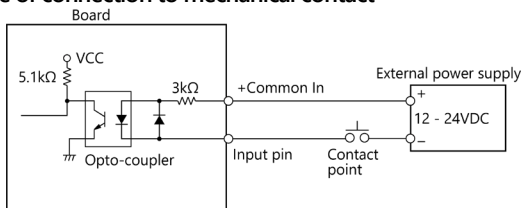
Input Circuit

Example of connection of open collector output (current sink type)

Example of connection to mechanical contact

### Relationships between input signal and data (internal logic) on the PC

Internal logic	Contact point	Input pin voltage level
0	OFF	High
1	ON	Low

Connecting the output signal

To the digital output signal and control signal (Sampling Clock Output) pins, connect a relay controller or a current driven control device such as a LED.   Output circuit is as follows.   +Common Out / -Common Out is common to individual output signals.   Output current rating is 100 mA (Max.) per 1 point and 2 A per 1 common.

The output transistor is not associated with a surge voltage protection circuit.   When the output signal is used to drive the inductive load to a relay or lamp, apply surge protection to the load side.
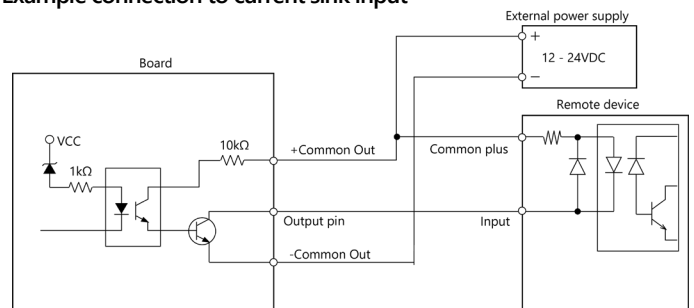
Output Circuit
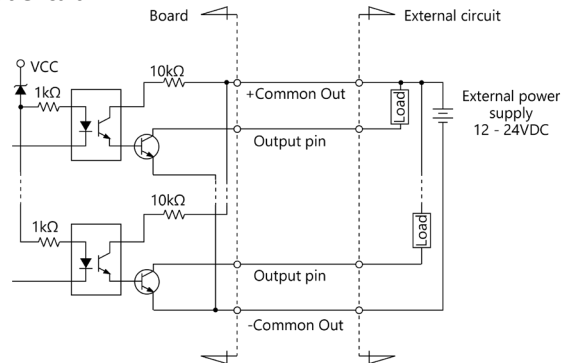
Internal logic and output signal

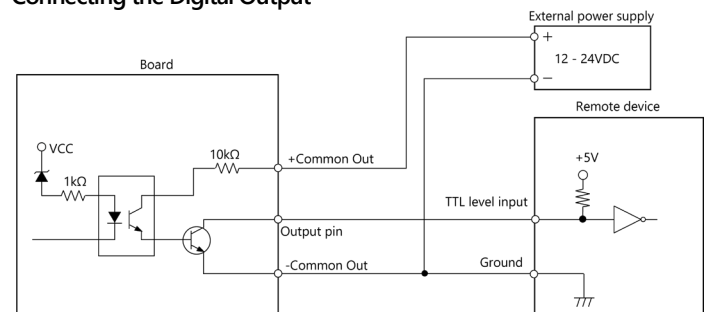| Internal logic	Output transistor	Output signal
0	OFF	High
1	ON	Low

CAUTION

For using the sampling clock output signal, set the sampling clock to at least 4 milliseconds, or normal output may not be obtained.
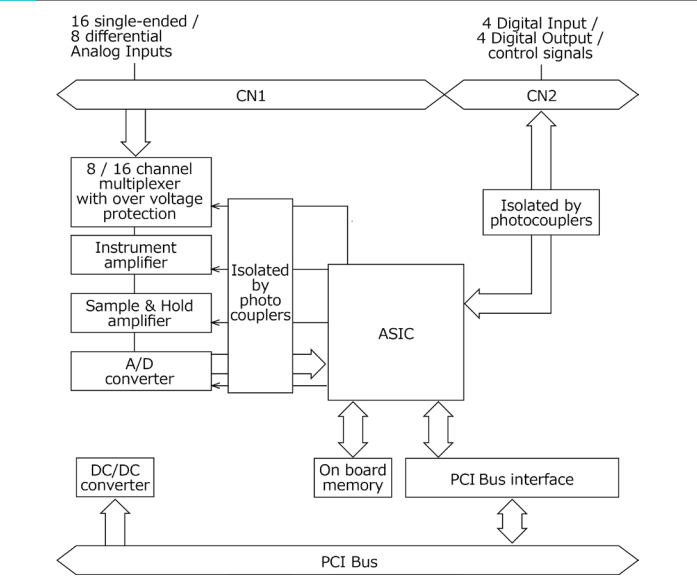
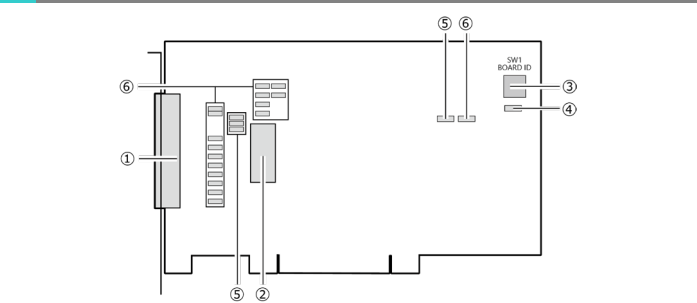### Example connection to current sink input

Connecting the Digital Output

Circuit Block Diagram

Component Name

No.	Name	No.	Name
1	Interface Connector(For Analog Input)	4	Jumper for setting interrupt signal resource
2	Interface Connector (For Digital I/O)	5	Jumper for input method setting
3	Board ID Setting Switch	6	Jumper for input range setting

Differences from Conventional Products

This product supersedes the ADI12-16(PCI) but it can be used basically in the same way as the existing product.

The differences in the specifications are listed below.

	AI-1216I2-PCI	ADI12-16(PCI)
About the board name to be displayed	ADI12-16(PCI) *1	ADI12-16(PCI)
Supportive environment	RoHS Directive compliant product	Lead reduced product
Current consumption.	5V 700mA	5V 1200mA
Board body weight	150g	160g

*1   The board name "ADI12-16(PCI)" will be displayed even after installing this product. The product runs without problems even with the displayed board name "ADI12-16(PCI)".