PCI Express-compliant
Bus master transfer, Multi-function Analog I/O

AIO-163202F-PE

Drive Library [API-PAC]: Included

AIO-163202F-PE is a multi-function, PCI Express bus-compliant interface board that contains high-precision 16-bit analog inputs (32ch), high-precision 16-bit analog outputs (2ch), digital inputs/outputs (LVTTL each 8ch), and a counter (32-bit, 2ch) function.
This board includes an event controller for integrated management of control signals by hardware and a bus master data transfer function for transferring large volumes of data at high speed. These features provide you with a high-performance PC-based measurement and control system.
Users can use the driver library (API-PAC(W32)) included with the board to write Windows application programs in any programming language (such as Visual Basic, Visual C++, etc.) that supports the calling of Win32 API functions.
Users can also collect data easily without programming when using the data logger software [C-LOGGER] stored on the attached CD-ROM. With plug-ins for the dedicated libraries, the board also supports MATLAB and LabVIEW.

Features

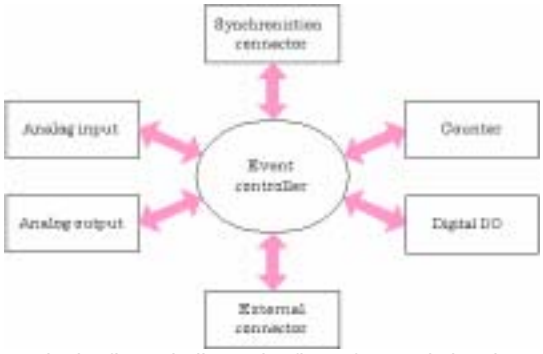
Multi-function

The PC Card contains analog inputs (16-bit, 32ch), analog outputs (16-bit, 2ch), digital inputs (8ch), digital outputs (8ch), and counters (32-bit binary, 1ch). Combining all these features on one PC Card allows complex systems to be implemented even on PCs with few spare expansion slots.

The event controller for different sampling control schemes

The PC Card incorporates an event controller for integrated hardware control. The event controller can use the external control signals and the events generated by the PC Card functions to start and stop analog input operation and perform clock control. This enables high-precision synchronization of the various PC Card functions without requiring software. Also, each function can be operated separately.

- Overview of event controller -



The arrows in the figure indicate the flow of control signals.
The main control signals included clock signals and the operation start and stop signals.

Example 1: Synchronize the timing of analog input and analog output based on an external clock signal.

Example 2: Start analog input operation each time the counter reaches a preset value.

Bus master transfer function and combined data I/O function

Bus master data transfer can be used for the analog inputs and outputs either separately or at the same time. This can be used to transfer large volumes of data between the PC Card and PC without placing a load on the CPU.
When using bus master data transfer for analog input data, you can also transfer the analog output, digital input, digital output, and counter data at the same time synchronized with the analog input clock signal. This function ensures reliable data synchronization in the systems you implement.

Buffer memory available for background processing independent of software

The analog inputs and outputs each have their own buffer memory which can be used when not using bus master transfer.
You can also perform analog input and output in the background, independent of software and the current status of the PC.

Software-based calibration

Setting and calibrating the analog input and output ranges can be performed completely by software.
No tricky jumper settings are required. 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.

Synchronous control connector

This board is equipped with a synchronous control connector capable of synchronizing control of multiple boards, enabling channel through increase of the number of boards. This synchronous operation is easily configured.

Filter function for easy connection of external signals

The digital input signals, counter input signals, and the external control signals for analog I/O incorporate a digital filter to prevent problems such as chattering.

The same systems can be implemented on either desktop or Laptop PCs

The "Analog F Series" (ADA16-32/2(PCI)F and ADA16-32/2(CB)F) have equivalent functionality.
Systems developed on a desktop PC can be ported directly to a notebook PC with minimal changes.

Data logger software C-LOGGER support

This board support C-LOGGER, the data logger software provides the capability of graph, file saving and transferring to Excel.

Plug-in library for MATLAB and LabVIEW support

This board comply with the library “ML-DAQ” for The MathWorks’ MATLAB and “VI-DAQ” for LabVIEW. These libraries can be downloaded at CONTEC’s website.

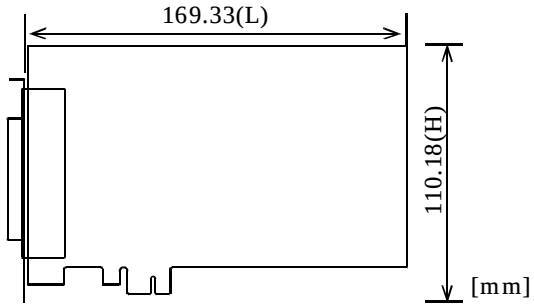
Specifications

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Input type	Single-Ended Input or Differential Input
	Number of input channels	32 channels (Single-Ended Input) 16 channels (Differential Input)
	Input range	Bipolar ±10V, ±5V, ±2.5V or Unipolar 0 - +10V, 0 - +5V, 0 - +2.5V
	Absolute max. input voltage	±15V
	Input impedance	1MΩ or more
	Resolution	16bit
	Non-Linearity error *1	±5LSB
	Conversion speed	2μsec/ch (Max.)
	Buffer memory	64k Word FIFO or 64k Word RING
	Conversion start trigger	Software, conversion data compare, external trigger, and event controller output.
	Conversion stop trigger	Settings include data save complete, conversion data compare, external trigger, event controller output, and software.
	External start signal	LVTTL level (Rising or falling edge can be selected by software)
	External stop signal	LVTTL level (Rising or falling edge can be selected by software)
	External clock signal	LVTTL level (Rising or falling edge can be selected by software)
	External status output signal	2 LVTTL levels Sampling clock output
Analog output		
	Isolated specification	Un-Isolated
	Number of output channels	2ch
	Output range	Bipolar ±10V, ±5V, ±2.5V, ±1.25V or Unipolar 0 - +10V, 0 - +5V, 0 - +2.5V
	Output current ability	±5mA
	Output impedance	1Ω or less
	Resolution	16bit
	Non-Linearity error *1	±3LSB
	Conversion speed	10μsec (Max.)
	Buffer memory	64k Word FIFO or 64k Word RING
	Conversion start trigger	Software, external trigger, and event controller output.
	Conversion stop trigger	Settings include data save complete, external trigger, event controller output, and software.
	External start signal	LVTTL level (Rising or falling edge can be selected by software)
	External stop signal	LVTTL level (Rising or falling edge can be selected by software)
	External clock signal	LVTTL level (Rising or falling edge can be selected by software)
	External status output signal	2 LVTTL levels Sampling clock output
Digital I/O		
	Number of input channels	8 LVTTL levels (positive logic)
	Number of output channels	8 LVTTL levels (positive logic)
Counter		
	Number of channels	2ch
	Counting system	Up count
	Max. count	FFFFFFFFh (Binary data, 32bit)
	Number of external inputs	2 LVTTL levels (Gate/Up)/ch Gate (High level), Up (Rising edge)
	Number of external outputs	LVTTL level 1 output/ch Count match output (positive logic, pulse output)
	Frequency response	10MHz (Max.)
Bus master section		
	DMA channels	2 channels (one each for input and output)
	Transfer bus width	32bit
	Transfer data length	8 PCI Words length (Max.)
	FIFO	1K-Word/ch
	Scatter/Gather function	64M-Byte/ch

Synchronization bus section		
	Control output signal	Selection of output signal with the software when specifying a sync master board.
	Control input signal	Selection of sync factor with the software when specifying sync slave boards.
	Max. board count for connection	16 boards including the master board
	Used connector	PS-10PE-D4LI-B1(JAE) or equivalent x 2
Common section		
	I/O address	64 ports x 1, 256 ports x 1 region
	Interruption level	Errors and various factors, One interrupt request line as INTA
	Connector	96-pin half pitch connector [F (female) type] PCR-96LMD [HONDA TSUSHIN KOGYO CO., LTD.] or equivalent
	Power consumption (Max.)	3.3VDC 500mA 12VDC 300mA
	Operating condition	0 - 50°C, 10 - 90%RH (No condensation)
	Bus specification	PCI Express Base Specification Rev. 1.0a x 1
	Dimension (mm)	169.33(L) x 110.18(H)
	Weight	130g

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

Physical Dimension



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

Supported Software

Driver Software Package API-PAC(W32) (Included)
API-PAC(W32) is the library software that provides the commands for CONTEC hardware products in the form of Windows standard Win32 API functions (DLL). It makes it easy to create high-speed application software taking advantage of the CONTEC hardware using various programming languages that support Win32 API functions, such as Visual Basic and Visual C++.
It can also be used by the installed diagnosis program to check hardware operations. CONTEC provides download services (at http://www.contec.com/apipac/) to supply the updated drivers and differential files.
For details, read Help on the bundled CD-ROM or visit the CONTEC Web site.
< Operating environment >
OS: Windows XP, Server 2003, 2000, Me, 98, etc..
Language: Visual C++ .NET, Visual C# .NET, Visual Basic .NET, Visual Basic

Linux version of analog I/O driver API-AIO (LNX)
(Supplied: Stored on the API-PAC(W32) CD-ROM)
This driver is used to control CONTEC analog I/O boards (cards) from within Linux. Users can control CONTEC I/O boards easily using the shared library called from the user application, the device driver (module) for kernel version, and the board (card) configuration program(config). CONTEC provides download services (at http://www.contec.com/apipac/) to supply the updated drivers and differential files.
For details, read Help on the bundled CD-ROM or visit the CONTEC's Web site.
< Operating environment >
OS: RedHatLinux, TurboLinux, etc..
(For details on supported distributions, refer to Help available after installation.)
Adaptation language: gcc, etc..

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.co.jp/clogger) to supply the updated drivers.
For details, refer to the C-LOGGER Users Guide or our website.
< Operating Environment >
OS: Windows XP, Server 2003, 2000

Data Acquisition library for MATLAB ML-DAQ
-Available at 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 at 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.
*1: The bus master transmission (analog input and output), the analog input in-range and out-range function and the event controller function of analog F series are not supported. It is impossible to synchronize
the AIO-163202F-PE with another board only when the synchronous connector was used.

Packing List

- Board [AIO-163202F-PE] …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

Accessories

Buffer Amplifier Box for Analog Input Boards: ATBA-32F *1*2

Buffer Amplifier Box for Analog Input Boards: ATBA-8F *1*2

Screw Terminal:DTP-64(PC) *1

Terminal Unit:EPD-96 *1

Termination Panel with BNC connectors for Analog I/O Boards
:ATP-32F *1

Termination Panel with BNC connectors for Analog I/O Boards
:ATP-8 *1*3*4

1 PCB96PS - optional cable is required separately.
*2 An external power supply is necessary (optional AC adaptor POA200-20 prepared.)
*3 The analog input could have 8 channels to be used.
*4 The digital input can be used up to four points, the digital output up to four points and the counter I/O up to 1 channel.
*Check the CONTEC's Web site for more information on these options.

Optional Cable & Connector

Shielded Cable with One 96-Pin Half-Pitch Connector
PCA96PS-0.5P (0.5m)
PCA96PS-1.5P (1.5m)

Shielded Cable with 96-Pin Half-Pitch Connectors at Both Ends:
PCB96PS-0.5P (0.5m)
PCB96PS-1.5P (1.5m)

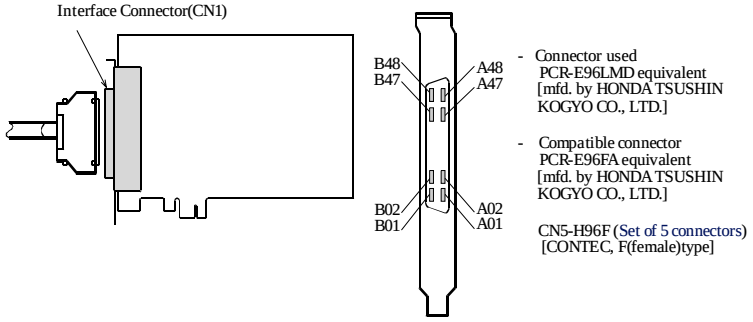
Flat Cable with One 96-Pin Half-Pitch Connector:
PCA96P-1.5 (1.5m)

Flat Cable with 96-Pin Half-Pitch Connectors at Both Ends:
PCB96P-1.5 (1.5m)

Half Pitch 96-Pin Female Connector Set (5Pieces):
CN5-H96F

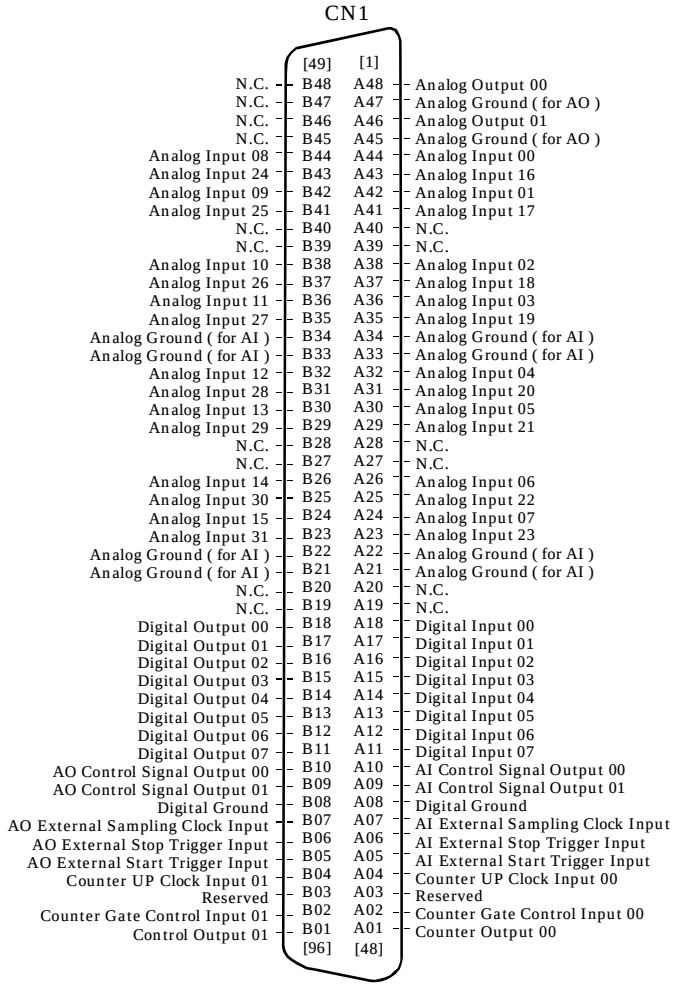
Connector Wiring

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



Connector Pin Assignment

Pin Assignments of Interface Connector (CN1) < Single-Ended Input >



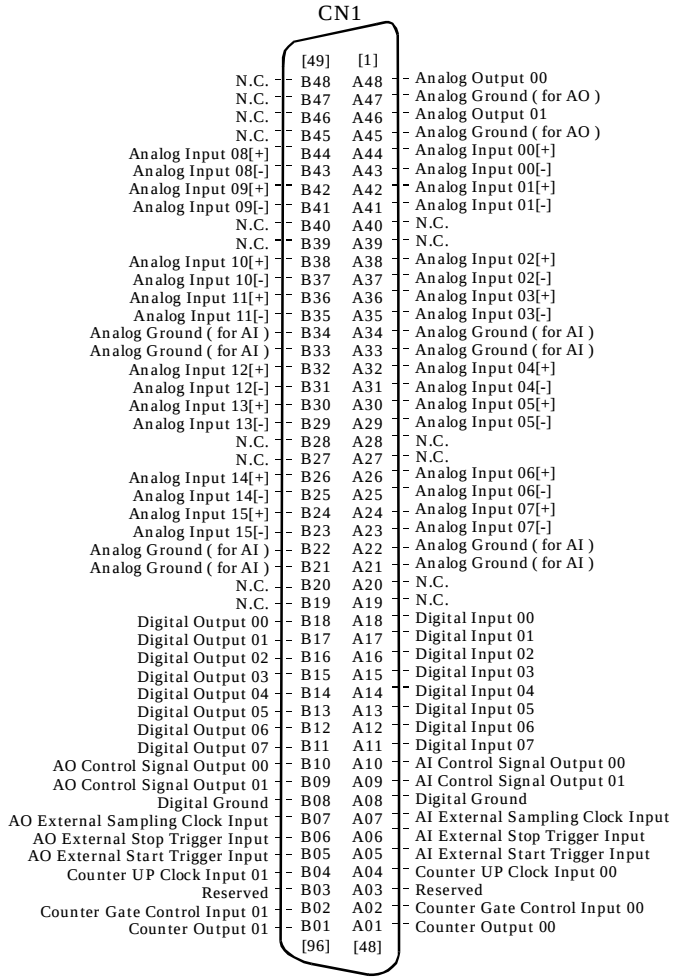
*The numbers in square brackets [ ] are pin numbers designated by HONDA TSUSHIN KOGYO CO., LTD.

Analog Input00 - Analog Input31	Analog input signal. The numbers correspond to channel numbers.
Analog Output00 - Analog Output01	Analog output signal. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog I/O signals.
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.
AI Control Signal Output 00	External sampling clock output signal for analog input.
AI Control Signal Output 01	External output signal for analog input status. Not currently connected.
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.
AO Control Signal Output 00	External sampling clock output signal for analog output.
AO Control Signal Output 01	External output signal for analog output status. Not currently connected.
Digital Input00 - Digital Input07	Digital input signal.
Digital Output00 - Digital Output07	Digital output signal.
Counter Gate Control Input00 - Counter Gate Control Input01	Gate control input signal for counter.
Counter Up Clock Input00 - Counter Up Clock Input01	Count-up clock input signal for counter.
Counter Output00 - Counter Output01	Count match output signal for counter.
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. Do not connect outputs to each other.
-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 (CN1) < Differential Input >



*The numbers in square brackets [ ] are pin numbers designated by HONDA TSUSHIN KOGYO CO., LTD.

Analog Input00 - Analog Input15	Analog input signal. The numbers correspond to channel numbers.
Analog Output00 - Analog Output01	Analog output signal. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog I/O signals.
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.
AI Control Signal Output 00	External sampling clock output signal for analog input.
AI Control Signal Output 01	External output signal for analog input status. Not currently connected.
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.
AO Control Signal Output 00	External sampling clock output signal for analog output.
AO Control Signal Output 01	External output signal for analog output status. Not currently connected.
Digital Input00 - Digital Input07	Digital input signal.
Digital Output00 - Digital Output07	Digital output signal.
Counter Gate Control Input00 - Counter Gate Control Input01	Gate control input signal for counter.
Counter Up Clock Input00 - Counter Up Clock Input01	Count-up clock input signal for counter.
Counter Output00 - Counter Output01	Count match output signal for counter.
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

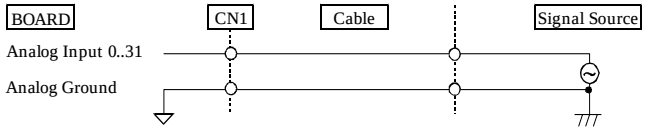
-Do not connect any of the outputs and power outputs to the analog or digital ground. Do not connect outputs to each other.
-If analog and digital ground are shorted together, noise on the digital signals may affect the analog signals. Accordingly, analog and digital ground should be separated.
-Leave "Reserved" pins unconnected. Connecting these pins may cause a fault in the board.

Analog Input Signal Connection

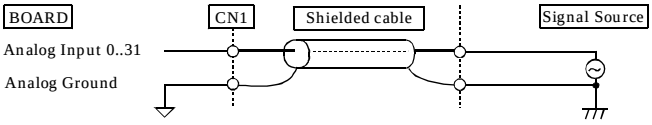
The procedure for connecting analog signals depends on whether the analog input signals are single-ended or differential. The sections below describe how to connect the signals using flat cable and shielded cable.

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.



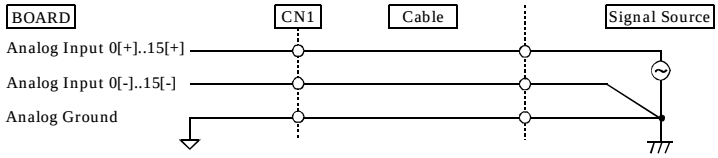
The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise. For each analog input channel on CN1, connect the core wire to the signal line and connect the shielding to ground.



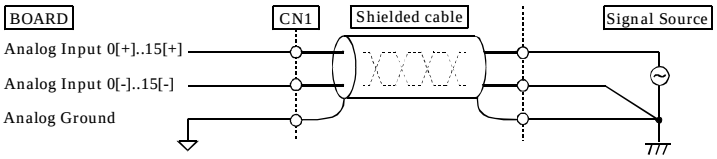
⚠ CAUTION
-If the signal source contains over 1MHz signals, the signal may effect the cross-talk noise between channels.
-If the board and the signal source receive noise or the distance between the board and the signal source is too long, data may not be input properly.
-An input analog signal should 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.

Differential Input

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.



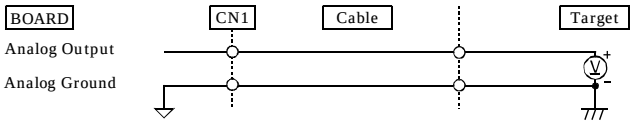
The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise. For each analog input channel on CN1, connect the "+" input to the signal and connect the "-" input to the signal source ground. Also connect the analog ground on the board and the signal source ground to the shielding.



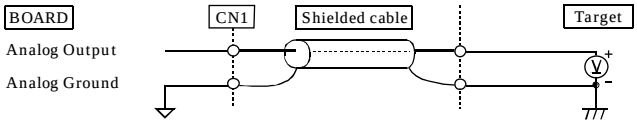
⚠ CAUTION
-If the signal source contains over 1MHz signals, the signal may effect the cross-talk noise between channels.
-When the analog ground is not connected, the conversion data is not determined.
-If the board and the signal source receive noise or the distance between the board and the signal 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.

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.



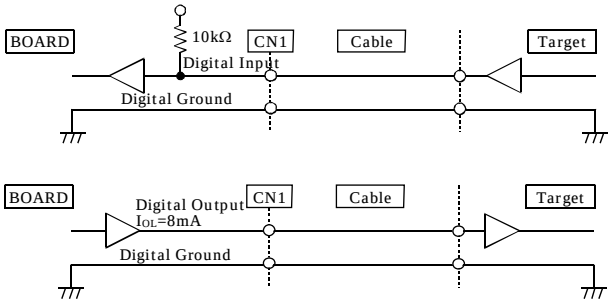
The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise. For the CN1 analog output, connect the core wire to the signal line and connect the shielding to ground.



⚠ CAUTION
-When a frequency of 1MHz or higher is contained in the source signal, the cross talk between channels may occur.
-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 ±5mA (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.
-The signal connected to an input terminal may shake after a multiplexer change. In this case, a shake can be lessened by shortening the cable between the source signal and an analog input board, or inserting high-speed buffer amplifier between the source signal and an analog input board.

Digital I/O, Counter and Control Signal 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 LVTTL level signals.



⚠ CAUTION
Do not short the output signals to analog ground, digital ground, and/or power line. If doing so, this board may be damaged.

Synchronization Control Signals

SC Connectors

Controlling simultaneous operations between boards or controlling in sync with events is in part dependent on software performance. In order to enhance the reliability of the entire system and to solve these problems, the board is equipped with SC (Synchronization Control) connectors.

Connecting the SC connectors allows boards of the same or different models to operate in sync with one another.

From the boards connected with the SC cable, select one master board and use others as slaves. On the master board, set the signal to be supplied to the slave boards with the software. On the slave boards, the signal from the master board can be set to either the pacer clock operation start or stop factor.

All board operations can also be stopped with a stop request from the master in case of an error, for example, or when requested from a slave board. A maximum of 16 boards can be connected including the master.

For more information on the setup procedure, see the driver software online help. When the SC is not connected, use the board with stand-alone settings.

Example 1: When clock start and stop requirements are set the same for multiple boards

In order to synchronize master clock start and stop with slave boards you can build a synchronous system which does not depend on software processing capabilities.

If the board model is the same, data remains synchronized among boards even when channels are expanded. When board models are different, data still remains compatible since operating clock start and stop are dependent on the master.

(1) Connect the SC cable.
(2) Designate master/slave with the software.
(3) Assign to the connectors the clock start and stop signals to be output from the master.
(4) Set up slave boards so they can utilize all signals.
(5) Start in order of slave to master boards.

⚠ CAUTION

-When clock signals are assigned to the synchronization control connector, the maximum clock frequency is restricted to 5MHz.

-When signals are assigned to the synchronization control connector, a delay of approximately 100ns occurs at the slave board.

Example 2: When controlling slave operations with master's internal events

By outputting an internal event (interrupt) occurring on the master board, the slaves can start operating in sync with that signal.

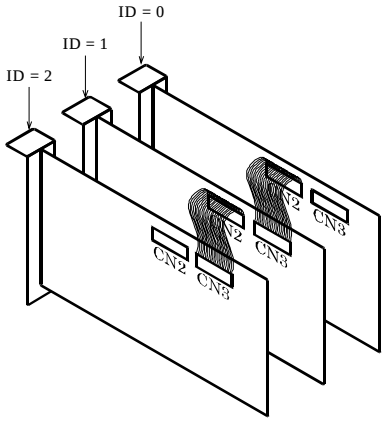
(1) Connect the SC cable.
(2) Designate master/slave with the software.
(3) Assign to the connector the event signal to be output from the master.
(4) Set signals from the master to the start requirements on the slave boards.
(5) Start in order of slave to master boards.

Connecting the SC Connectors (CN2 and CN3)

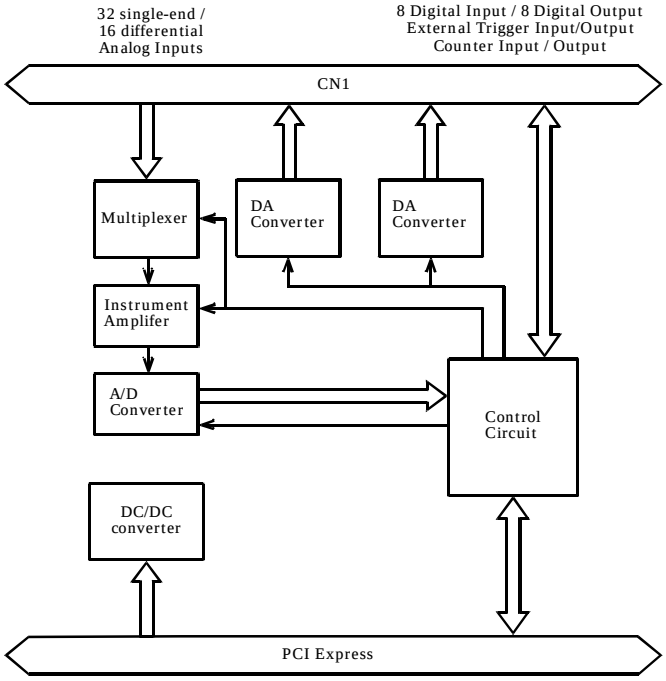
This board is equipped with sync signal control connectors (CN2 and CN3) for connecting a sync signal cable. When the cable is connected, multiple boards can operate in sync with one another.

- Connection Procedure -

Connect the sync signal cable when two or more boards need to operate in sync with one another. Connect CN2 with a smaller ID number to CN3 with a greater ID number with the cable. You should only use the cable that came with the board.



Block Diagram



*Price, specification, color and design of the products may be changed without notice.