



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

Features

# Integrates the analog signal I/O and digital signal I/O features into one board.

With this one board, following features can be added: analog inputs (10µsec [100KSPS]/ch, 12bit, 16channels), analog outputs (10µsec [100KSPS], 12bit, 1channel), counter (32bit, TTL level 2channels), and digital I/Os (8channels for TTL level). A feature-rich system is possible even with a PC that has relatively fewer expansion slot(s).

#### Supports the SC series signal conditioners.

The SC series signal conditioner that provides various signal conversion features are supported. Using this product with the SC series, by unifying I/O ranges through conversion for each channel, it can support diverse testing applications that require different I/O specifications for testing purposes.

# Analog I/O features that supports numerous sampling modes.

Buffer memory (256K data) can be used as FIFO or RING for analog input or output, supporting several start/stop condition settings. Many types of sampling operation are possible with matching the counters, internal timer and/or external clock. Trimmer-less design that enables calibration of conversion accuracy via software.

# Counter features that supports both of the single-phase and two-phase modes.

Single-phase mode (up count) and two-phase (up-down count) mode are supported. Various applications such as pulse-signal adder, rotary encoder, linear-scale position detection can be supported. A digital filter feature that suppresses malfunction caused by a noise.

# Synchronized operation of multiple interface boards is supported.

On-board synchronization control connector. Enables synchronized operation with the other boards that have synchronization connectors (Max. 16 boards).

### Supports data logger software C-LOGGER

Without requiring any programming, supports C-LOGGER, our data logger software that enables graphical view of the measurement data, observation with zooming, file save and dynamic transmission to Excel (a spreadsheet software) (Stored on the bundled CD-ROM).

This product is a PCI bus-compliant interface board that integrates the analog I/O and digital I/O features into one board. It has 12bit analog inputs (16channels), 12bit analog outputs (1channel), 8 digital I/Os, and 2 channels of counter that supports encoder inputs (2-phase signals). Using it with a signal conditioner (separately available) that converts and integrates relevant I/Os that may differ according to what to be measured and/or controlled, it can support diverse testing applications that require complex and various I/O features. As a support for application development environments, a lot of driver software and middleware is provided such as Windows / Linux APIs and MATLAB / LabVIEW libraries.

**Supports various application development environments.** A lot of driver software and middleware is provided for application development environments.

API functions for Windows / Linux programming languages "API-TOOL" (Stored on the bundled CD-ROM)

ActiveX component (OCX) "ACX-PAC(W32)" (Option).

Library for MATLAB "ML-DAQ" (download from the CONTEC's Web site (free of charge)).

Library for LabVIEW "VI-DAQ" (download from the CONTEC's Web site (free of charge)).

## Specification

#### < 1 / 2 >

Item	Specification			
Analog input				
Isolated specification	Non-isolated			
Input type	Single-Ended Input			
Number of input	16channels			
channels .				
Input range	Bipolar ±10V			
Absolute max. input	±15V			
voltage				
Input impedance	1MΩ or more			
Resolution	12bit			
Non-Linearity error *1	±2LSB			
Conversion speed	10µsec [100KSPS]/ch (Max.)			
Buffer memory	256K data FIFO or 256K data RING			
Conversion start	Software, conversion data compare, external trigger, count			
trigger	compare match for counter, count clear, carry / borrow, timer			
Conversion stop	Settings include data save complete, conversion data compare,			
trigger	external trigger, software, count compare match for counter, count			
Esternal start sing al	clear, digital filter error, abnormal input error, carry / borrow, timer			
External start signal	TTL (Rising or failing edge can be selected by software)			
External stop signal	TTL (Rising or falling edge can be selected by software)			
External clock signal	I I L (Rising or falling edge can be selected by software)			
External status output	Z TTL Compliant clock output			
	Sampling clock output			
	Non isolated			
Number of output	Non-isolated			
channels	1channel			
	Binolar +10V			
Absolute max input	±5m∆			
currency	10/17			
Output impedance	1MΩ or less			
Resolution	12bit			
Non-Linearity error *1	±1LSB			
Conversion speed	10µsec [100KSPS] (Max.)			
Buffer memory	256K data FIFO or 256K data RING			
Conversion start	Software, external trigger, count compare match for counter, count			
trigger	clear, carry / borrow, timer			
Conversion stop	Settings include data save complete, external trigger, software,			
trigger	count compare match for counter, count clear, carry / borrow, timer			
External start signal	TTL (Rising or falling edge can be selected by software)			
External stop signal	TTL (Rising or falling edge can be selected by software)			
External clock signal	TTL (Rising or falling edge can be selected by software)			
External status output	2 TTL			
signal	Sampling clock output			

#### < 2 / 2 >

_	item	Specification			
C	Counter				
	Counter input				
1	Number of	2 channels			
	channels				
		Up/down counting			
	Counting system	(2-phase/Single-phase/Single-phase Input with Gate Control			
		Attached)			
	Max. count	FFFFFFFh(binary data, 32bit)			
	Counter input	Unisolated TTL level input			
	mode				
	Counter input	Phase-A/UP 1 x 2 channels			
	signal	Phase-B/DOWN 1 x 2 channels			
	_	Phase-Z/CLR 1 x 2 channels			
	Response	10MHz			
	frequency Disital filter				
	Digital filter	U.1µsec - 1.6384Msec of not used			
	Timer				
	Timer Counter start	Inisec - 6000msec Inisec unit			
1	trigger	Sonware/External start input			
1	Counter stop	Software/External stop input			
1	trigger	Soltware/External Stop Input			
1	Control input				
1	Control input signal	Inisolated TTL level input			
1	type	onisolateu i i Elievel lilput			
1	Control input	1 x 2 channels *3			
	channel				
	Control input signal	- Preset/Select Rise or Fall)			
	o onti on input orginal	- Zero-clear(Select Rise or Fall)			
		- Counter start/stop(Select Rise or Fall)			
		- General-purpose input(positive logic)			
		Software-selected from among the above four options			
	Response time	100nsec (Max.)			
	Control output				
	Control output	Unisolated TTL level output			
	signal type				
	Control output	1 x 2 channels			
	channel				
	Control output	<ul> <li>Count match 0 output(one-shot pulse output)</li> </ul>			
	signal	<ul> <li>Count match 1 output(one-shot pulse output)</li> </ul>			
		<ul> <li>Digital filter error output(one-shot pulse output)</li> </ul>			
		- Abnormal input error output(one-shot pulse output)			
1		- General-purpose output(Level output)			
1		Soliware-selected from among the above five options			
1	One abot output	(r usinverneyative logic is selected with the soltware.)			
1	circle shot output	Cap be set for each chapped, within provision + 1,000			
1	Boopopoo	toan be set to reach channel, within precision + Tµsec)			
1	frequency	100fisec (wlax.)			
1	Rated output	$I_{or} = 24 \text{mA} (M_{or})$ $I_{or} = -15 \text{mA} (M_{or})$			
1	current	10L=24 mra (max.) $10H=10$ mra (max.)			
H	Digital I/O				
11	Number of input	I Inisolated input Schappels (TTL level positive logic)			
1	channels	onisolated input ochannels (TTE level positive logic)			
1	Number of output	I Inisolated output 8channels (TTL level positive logic)			
1	channels	טוויטימנטי טעונטע טטומווויטיש (דדב ובעבו גטטונועב וטעוט)			
Н	Common section				
ľì	I/O address	64 ports x 1, 256 ports x 1 region			
1		Errors and various factors. One interrunt request line as INTA			
	Connector	96-nin half nitch connector [M/male)type]			
1	Comilectur	PCR-E96I MD+ IHONDA TSUSHIN KOGYO CO I TD 1			
1	Power consumption	5\/DC 680m4 (May )			
1		$0 = 50^{\circ}$ C $10 = 90\%$ RH (No condensation)			
1	PCI bue				
1	r of pus	32bit 33MHz Universal key shapes supported *2			
1	Dimension (mm)	176 41(L) x 105 68(H)			
	Weight	120a			
1	weight	Taug			

\*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 This board requires +5V power supply from expansion slots (it does not operate in the

- \*2 This board requires +5V power supply from expansion slots (it does not operate in the environment of only +3.3V power supply).
   \*3: You can select either the control input signal (CNT0, CNT1 Control Input) or 2 channels of
- \*3: You can select either the control input signal (CNT0, CNT1 Control Input) or 2 channels of digital input signals (Digital Input 00, 01) by using software.

**Board Dimensions** 



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 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 Wind

Windows Vista, XP, Server 2003, 2000

Adaptation language Visual Basic, Visual C++, Visual C#, Delphi, C++ Builder

For more details on the supported OS, applicable language and how to download the updated version, please visit the CONTEC's Web site (http://www.contec.com/apipac/).

#### 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

For more details on the supported OS, applicable language and how to download the updated version, please visit the CONTEC's Web site (http://www.contec.com/apipac/).

### Data Logger Software C-LOGGER

[Stored on the bundled CD-ROM driver library API-PAC(W32)]

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 \* C-LOGGER supports analog features only.

#### 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.

ML-DAQ supports analog / digital features only.

# 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/vidag/ for details and download of

VI-DAQ.

VI-DAQ supports analog / digital / counter features only

# Cable & Connector

### Cable (Option)

Shield Cable with 96-Pin	
D-SUB Connector at One End	: PCA96PS-0.5P (0.5m)
	: PCA96PS-1.5P (1.5m)
Shield Cable with 96-Pin	
Half-Pitch Connectors at Both Ends	: PCB96PS-0.5P (0.5m)
	: PCB96PS-1.5P (1.5m)
Flat Cable with 96-Pin	
Half-Pitch Connectors at One End	: PCA96P-1.5 (1.5m) *1
Flat Cable with 96-Pin	
Half-Pitch Connectors at Both Ends	: PCB96P-1.5 (1.5m) *1

# **Connector (Option)**

Half Pitch 96P Female Connector Set (5 Pieces)

: PCB96P-1.5 (1.5m) \*1 Flat cable is not VCCI ClassA compliant. For VCCI ClassA compliance, use the shield cable(PCA96PS/PCB96PS). \*1

Accessories

# Accessories (Option)

Screw Terminal Unit (M3 x 96P) : EPD-96A \*1 \*3 Screw Terminal Unit (M3.5 x 96P) : EPD-96 \*1 Signal conversion board for analog I/O : SC-AIO1604G \*1 \*2 Box for signal conversion board (4-Slots) : ESC-4

- PCB96PS-\* optional cable is required separately (0.5mm is recommended).
- Optional ESC-4 is required separately. "Spring-up" type terminal is used to prevent terminal screws from falling off. \*2 \*3
- Check the CONTEC's Web site for more information on these options

# Packing List

Board [AIO-121601M-PCI] ...1 First step quide ...1 CD-ROM \*1 [API-PAC(W32)] ...1 SC Cable (10cm) ...1

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

# Block Diagram



# How to connect the connectors

#### **Connector shape**

To connect an external device to this product, plug the cable from the device into the interface connector (CN1) shown below.



Please refer to page 2 for more information on the supported cable and accessories.

#### **Connector Pin Assignment**

To connect an external device to this product, plug the cable from the device into the interface connector (CN1) shown below

#### **Pin Assignment of CN1**



CNT0/CNT1 Control Input*	External control signal for counter input.	
Digital Output 00 - Digital Output 07	Digital output signal. The numbers correspond to channel numbers.	
Digital Ground	Common digital ground for digital I/O signals, external trigger inputs, external sampling clock inputs, and counter I/O signals.	
AI External Sampling Clock Input	External sampling clock input for analog input.	
AI External Stop Trigger Input	External trigger input for stopping analog input sampling.	
AI External Start Trigger Input	External trigger input for starting analog input sampling.	
AO External Sampling Clock Input	External sampling clock input for analog output.	
AO External Stop Trigger Input	External trigger input for stopping analog output sampling.	
AO External Start Trigger Input	External trigger input for starting analog output sampling.	
CNT Input A0 - CNT Input A1	Phase-A input signal of counter. The numbers correspond to channel numbers.	
CNT Input B0 - CNT Input B1	Phase-B input signal of counter. The numbers correspond to channel numbers.	
CNT Input Z0 - CNT Input Z1	Phase-Z input signal of counter. The numbers correspond to channel numbers.	
CNT Output 0 - CNT Output 1	Output signal of counter. The numbers correspond to	

Channel numbers. The Digital Input 00/01 or CNT0/CNT1 Control Input is selected by software.

#### A CAUTION

Do not connect any of the outputs and power outputs to the analog or digital ground.

Neither connect outputs to each other. Doing either can result in a fault.

If analog and digital ground are shorted together, noise on the digital signals may affect the analog signals. Accordingly, analog and digital ground should be separated.

# Analog Input Signal Connection

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.

# 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 product is long or if you want to provide better protection from noise. For each analog input channel on CN1, connect the core wire to the signal line and connect the shielding to ground.

# Single-ended Input Connection (Shield Cable)



# A CAUTION

If the signal source contains over 1MHz signals, the signal may effect the cross-talk noise between channels.

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.

In the channel switching, the multiplexer does the electrical charge and discharge on the internal capacitor according to the signal voltage. Therefore, the voltage from the previous switching state may go into the next channel. It might cause the error of the signal source action. If this occurs, insert a high-speed amplifier as a buffer between the signal source and the analog input pin to reduce the fluctuation.

An input pin may fail to obtain input data normally when the signal source connected to the pin has high impedance. If this is the case, change the signal source to one with lower output impedance or insert a high-speed amplifier buffer between the signal source and the analog input pin to reduce the effect.

# 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 shielded cable connection. Use shielded cable if the distance between the signal source and product 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.

### Analog Output Connection (Shield Cable)



#### **A** CAUTION

If the product or the connected wire receives noise, or the distance between the product 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 product.

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

Do not connect an analog output signal to any other analog output, either on the product or on an external device, as this may cause a fault on the product.

# Control Signal of Analog I/O

# External sampling clock signal

# (AI External Sampling Clock Input, AO External Sampling Clock Input)

Pin used to input the external pacer clock. The maximum frequency is 10MHz.

If the external clock input is selected as the sampling clock, sampling occurs on the falling edge of the signal.



# Other control input signals

### (Al External Start Trigger Input, Al External Stop Trigger Input, AO External Start Trigger Input, AO External Stop Trigger Input)

These signals are TTL-level compatible and the trigger edge is software-programmable at either the rising or falling edge. High- and low-level hold times of at least 50 nsec are required to detect an edge of the signal.



# **Digital I/O signals Connection**

The following sections show examples of how to connect digital I/O signals.

All the digital I/O signals are TTL level signals.

#### **Digital Input Connection**





### A CAUTION

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

### Connection of the Counter Input Signal

You can connect to a rotary encoder or linear scale with a TTL level output circuit, or to an open-collector output circuit. The signal must be a TTL level input and can be up to 10MHz. For a two-phase input, connect both phase A and phase B. For a single phase input, connect to either phase A or phase B. If not using the Z phase, this does not need to be connected.

# Example Connection for Counter Input Circuit Digital Output Connection

#### Connection with counter input circuit (counter input)



#### Input signal





# ▲ CAUTION

The connection cable length should be within 1.5 m.

To prevent noise from causing a malfunction, arrange the connection cable as away from any other signal conductor or noise source as possible.

# Example Connection with a Rotary Encoder



# **Example Connection with a Linear Scale**



# Connection of Control Signal for the Counter

# Connection of a control input

The control input signals consist of one pin per channel that can be selected as the channel's counter start/stop or preset. The signals are TTL-level inputs.

As pull-up resistors (10k $\Omega$ ) are provided on the product

# Control input circuit and its sample connection



#### **A** CAUTION

The connection cable length should be within 1.5 m.

To prevent noise from causing a malfunction, arrange the connection cable as away from any other signal conductor or noise source as possible.

# Connection of a control output

This outputs a general-purpose output signal (level output) or a one-shot pulse output to indicate a hardware event such as a count match. The signal is a TTL level output and can be set to positive or negative logic by software.

### Control output circuit and its sample connection

