Check Your Package

Thank you for purchasing the CONTEC product. The product consists of the items listed below. Check, with the following list, that your package is complete. If you discover damaged or missing items, contact your retailer.

Product Configuration List
- Unit [AIO-163202FX-USB] …1
- AC adapter …1
- AC Cable (for 125VAC) …1
- USB cable (1.8m) …1
- USB cable attachment on the main unit’s side (For Mini B connector side) …1
- Clamps for prevention of cable on the main unit’s side …1
- CD-ROM *1 [API-USBP(WDM)] …1
- First step guide … 1
- Power connector MC1,5/3-ST-3,5 …1
- Ferrite core …1

*1 The CD-ROM contains the driver software and User’s Guide (this guide)
Copyright

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1. Before Using the Product

This chapter provides information you should know before using the product.

About the Unit

This product is a USB2.0-compliant analog I/O unit that extends the analog I/O function of USB port of PCs. This product features high-precision 16bit analog inputs (32channels), high-precision 16bit analog outputs (2channels), digital I/O (LVTTL level each 8channels), and a counter (32bit binary, LVTTL level 2channels) function. This product includes an event controller for integrated management of control signals by hardware and buffer memory (128K data). Together, these features provide all you need to build a high-performance PC-based measurement and control system.

As there is compatible with PCI bus-compatible board ADA16-32/2(PCI)F and PCI Express bus-compatible board AIO-163202F-PE in terms of connector shape and pin assignments, it is easy to migrate from the existing system.

Using the bundled API function library package [API-USBP(WDM)], you can create Windows application software for this board in your favorite programming language supporting Win32 API functions, such as Visual Basic or Visual C/C++.

It can also collect data easily without a program when the data logger software [C-LOGGER] stored on the attached CD-ROM is used. With plug-ins for the dedicated libraries, this product also supports MATLAB and LabVIEW.

Features

- Multi-function
  The unit contains analog inputs (16bit, 32channels), analog outputs (16bit, 2channels), digital inputs (LVTTL level 8channels), digital outputs (LVTTL level 8channels), and counters (32bit binary, LVTTL level 2channels). Combining all these features on one unit allows complex systems to be implemented even on PCs with USB port only.

- Compatible to USB1.1/USB2.0
  Compatible to USB1.1/USB2.0 and capable to achieve high speed transfer at HighSpeed (480 Mbps).

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

Overview of event controller

Each I/O function can be synchronized by the operation starting/stopping signal and the clock signal etc. of each I/O function.

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 value reaches a constant one.
1. Before Using the Product

- USB HUB function, the CONTEC’s USB supported products (Max. 4) can be used.
This product has the USB HUB function. Max. 4 AIO-163202FX-USB can be used in 1 USB port of
PC.*5 When you use 4 or more AIO-163202FX-USB, you can do by connecting AIO-163202FX-USB
to the another USB port of PC side.
Also, you can connect the CONTEC’s USB supported products other than AIO-163202FX-USB to the
USB port of AIO-163202FX-USB. *1*2

- Buffer memory for 128K of data available for background processing
The analog inputs and outputs each have their own buffer memory (128K data) which can be used.
The buffer memory can be used as FIFO or RING form.
You can also perform analog input and output in the background, independent of software and the
current status of the PC.

- Software-based calibration function
Calibration of analog input/output can be all performed by software. Apart from the adjustment
information prepared before shipment, additional adjustment information can be stored according to the
use environment.

- 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.

- Compatible with PCI / PCI Express bus board and Card Bus PC card in it’s design. Common
connector shape and pin assignment with PCI / PCI Express bus board and Card Bus PC card.
This product has the common connector shape and pin assignment with PCI bus board
ADA16-32/2(PCI)F, PCI Express bus board AIO-163202F-PE and Card Bus PC card
ADA16-32/2(CB)F *3 so you can use the common cables and accessories, it is easy to migrate from the
existing system *4.

⚠️ CAUTION
AIO-163202FX-USB has neither the bus master transfer function nor a synchronous control connectors that exist
in the PCI bus-compatible board ADA16-32/2(PCI)F and the PCI Express bus-compatible board AIO-163202F-PE.
In the system that uses the bus master transfer function and the synchronous control connector, it is not likely to
be able to shift.
1. Before Using the Product

- Data logger software, Windows compatible driver libraries are attached.

The attached data logger software [C-LOGGER] enables the graph display of recorded signal data and file saving without a program. Also, driver library API-USBP(WDM) that makes it possible to create applications of Windows is attached.

- Plug-ins for the dedicated libraries, this product also supports MATLAB and LabVIEW.

We offer a dedicated library [ML-DAQ], which allows you to use this product on MATLAB by The MathWorks as well as another dedicated library [VI-DAQ], which allows you to use the product on LabVIEW by National Instruments.

These dedicated libraries are available, free of charge (downloadable), on our web site.

*1 Do not connect the device other than that of CONTEC’s USB to the USB port included on the AIO-163202FX-USB. Otherwise, this may cause a failure or malfunction.

*2 When connecting multiple units with USB HUB function and set up them, do one at a time and complete setup for the previous unit before starting to do the next unit.

*3 When using the optional connector conversion cable ADC-68M/96F.

*4 There are some differences of the specifications between this product and AIO-163202F-PE, ADA16-32/2(PCI)F and ADA16-32/2(CB)F. For more details on this, refer to “Chapter7, Difference from AIO-163202F-PE, ADA16-32/2(PCI)F and ADA16-32/2(CB)F”

*5 This product cannot be stacked up for installation.
1. Before Using the Product

Support Software

You should use CONTEC support software according to your purpose and development environment.

Windows version of analog I/O driver **API-AIO(WDM)**
[Stored on the bundled CD-ROM driver library API-USBP(WDM)]

The API-AIO(WDM) is the Windows version driver library software that provides products in the form of Win32 API functions (DLL). Various sample programs such as Visual Basic and Visual C++, etc and diagnostic program useful for checking operation is provided.

**< Operating environment >**
OS Windows 7, 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/apiusbp/).

Data Logger Software **C-LOGGER**
[Stored on the bundled CD-ROM driver library API-USBP(WDM)]

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 7, Vista, XP, Server 2003, 2000

Data Acquisition library for MATLAB **ML-DAQ**
(Available for downloading (free of charge) from the CONTEC web site.)

This is the library software which allows you to use our analog I/O device products on MATLAB by the MathWorks. Each function is offered in accordance with the interface which is integrated in MATLAB’s Data Acquisition Toolbox. See http://www.contec.com/mldaq/ for details and download of ML-DAQ.

Data acquisition VI library for LabVIEW **VI-DAQ** *1
(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.

*1 In / out range function of analog input or event controller function is not supported.
1. Before Using the Product

**Cable & Connector  (Option)**

- Shield Cable with 96-Pin Half-Pitch Connectors at One End: PCA96PS-0.5P (0.5m)  
  : PCA96PS-1.5P (1.5m)
- Shield Cable with 96-Pin Half-Pitch Connectors at Both Ends: PCA96PS-0.5P (0.5m)  
  : PCA96PS-1.5P (1.5m)
- Flat Cable with 96-Pin Half-Pitch Connectors at One End: PCA96P-1.5 (1.5m)
- Flat Cable with 96-Pin Half-Pitch Connectors at Both Ends: PCB96P-1.5 (1.5m)
- Half Pitch 96P Female Connector Set (5 Pieces): CN5-H96F

**Accessories  (Option)**

- Buffer Amplifier Box for Analog Input Boards (32ch type): ATBA-32F *1*2*7
- Buffer Amplifier Box for Analog Input Boards (8ch type): ATBA-8F *1*2*3*7
- Terminal Unit for Cables (M3 x 96P): DTP-64A *1
- Screw Terminal Unit (M3.5 x 96P): EPD-96 *1
- Screw Terminal Unit (M3 x 96P): EPD-96A*1 *5
- BNC Terminal Unit (for analog input 32ch): ATP-32F *1
- BNC Terminal Unit (for analog input 8ch): ATP-8 *1*3*4
- USB I/O Unit Bracket for X Series: BRK-USB-X
- AC-DC power supply unit (input: 85 - 132VAC, output: 5VDC 3.0A): POW-AC13GY
- DC-DC power supply unit (input: 10 - 30VDC, output: 5VDC 3.0A): POW-DD10GY
- DC-DC power supply unit (input: 30 - 50VDC, output: 5VDC 3.0A): POW-DD43GY

*1 PCB96PS-* optional cable is required separately (0.5mm is recommended).
*2 An external power supply is necessary (optional AC adapter POA200-20-2 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.
*5 “Spring-up” type terminal is used to prevent terminal screws from falling off.
*6 It is the same as the one appended to the product. Please buy it necessary for maintenance.
*7 When a buffer amp is connected, the pin assignments are different from those for the connector of this product. For the pin assignment, refer to the buffer amp's product manual.

* Check the CONTEC’s Web site for more information on these options.
1. Before Using the Product

Customer Support

CONTEC provides the following support services for you to use CONTEC products more efficiently and comfortably.

**Web Site**

Japanese http://www.contec.co.jp/
English http://www.contec.com/
Chinese http://www.contec.com.cn/

Latest product information

CONTEC provides up-to-date information on products.
CONTEC also provides product manuals and various technical documents in the PDF.

Free download

You can download updated driver software and differential files as well as sample programs available in several languages.

Note!  For product information
Contact your retailer if you have any technical question about a CONTEC product or need its price, delivery time, or estimate information.

**Limited One-Year Warranty**

CONTEC products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to one year from the date of purchase by the original purchaser.

Repair will be free of charge only when this device is returned freight prepaid with a copy of the original invoice and a Return Merchandise Authorization to the distributor or the CONTEC group office, from which it was purchased.

This warranty is not applicable for scratches or normal wear, but only for the electronic circuitry and original products.  The warranty is not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect, or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy.

**How to Obtain Service**

For replacement or repair, return the device freight prepaid, with a copy of the original invoice.  Please obtain a Return Merchandise Authorization number (RMA) from the CONTEC group office where you purchased before returning any product.

* No product will be accepted by CONTEC group without the RMA number.

**Liability**

The obligation of the warrantor is solely to repair or replace the product.  In no event will the warrantor be liable for any incidental or consequential damages due to such defect or consequences that arise from inexperienced usage, misuse, or malfunction of this device.
Safety Precautions

Understand the following definitions and precautions to use the product safely.

Safety Information

This document provides safety information using the following symbols to prevent accidents resulting in injury or death and the destruction of equipment and resources. Understand the meanings of these labels to operate the equipment safely.

<table>
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<th>Description</th>
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<td>🔴 DANGER</td>
<td>DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
<tr>
<td>🔴 WARNING</td>
<td>WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td>🔴 CAUTION</td>
<td>CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.</td>
</tr>
</tbody>
</table>

Handling Precautions

⚠️ DANGER

Do not use the product where it is exposed to flammable or corrosive gas. Doing so may result in an explosion, fire, electric shock, or failure.

⚠️ CAUTION

- Do not strike or bend this product. Otherwise, this may malfunction, overheat, cause a failure or breakage.
- Do not touch this product's terminals (edge connector) with your hands. Otherwise, this may malfunction, overheat, or cause a failure. If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- Do not close the ventilation hole(s) of this product by, for example, placing an object. This may cause overheating, malfunction, and/or failure of the product.
- Make sure that your PC can supply ample power to all this product installed. Insufficiently energized products could malfunction, overheat, or cause a failure.
- Do not connect the device other than that of CONTEC’s USB to the USB port included on the AIO-163202FX-USB. Otherwise, this may cause a failure or malfunction.
- When connecting multiple units and set up them, do one at a time and complete setup for the previous unit before starting to do the next unit.
- The specifications of this product are subject to change without notice for enhancement and quality improvement. Even when using this product continuously, be sure to read the manual and understand the contents.
- Do not modify this product. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this product.
- Regardless of the foregoing statements, CONTEC is not liable for any damages whatsoever (including damages for loss of business profits) arising out of the use or inability to use this CONTEC product or the information contained herein.
1. Before Using the Product

- If you use this product in a noisy environment, attach the bundled ferrite core to stabilize the operation.
  When attaching a ferrite core to the USB cable, coil it around once near the connector while leaving it open, and then close it.
Environment

Use this product in the following environment. If used in an unauthorized environment, the product may overheat, malfunction, or cause a failure.

Operating temperature
0 - 50°C

Operating humidity
10 - 90%RH (No condensation)

Corrosive gases
None

Floating dust particles
Not to be excessive

Inspection

Inspect the product periodically as follows to use it safely.

- Check that the connector has no dust or foreign matter adhering.

Storage

When storing this product, keep it in its original packing form.

(1) Put this product in the storage bag.
(2) Wrap it in the packing material and then put it in the box.
(3) Store the package at room temperature at a place free from direct sunlight, moisture, shock, vibration, magnetism, and static electricity.

Disposal

When disposing of the product, follow the disposal procedures stipulated under the relevant laws and municipal ordinances.
2. Setup

This chapter explains how to set up the product.

What is Setup?

Setup means a series of steps to take before the product can be used. This section enables you to prepare the software and hardware by operating in accordance with each step in this chapter using the bundled CD-ROM. Taking the following steps sets up the software and hardware. You can use the diagnosis program later to check whether the software and hardware function normally.

   Step 1 Setting the Hardware
   Step 2 Installing the Software
   Step 3 Installing the Hardware
   Step 4 Checking Operations with the Diagnosis Program

Uninstall the driver and then set it up again if it cannot be set up properly.

The following shows the basic flow for installing product.
Step 1 Setting the Hardware

This section describes how to set up the product and how to connect it to a PC.

When using the AIO-163202FX-USB, you do not have to set with SW. Connect it to the USB interface connector of PC that you use.

Name of each parts

LED indicator

The above figure has already attached the USB cable attachment.

Figure 2.1. Name of each parts (Front side)
Step 2 Installing the Software

Install software.
The following description assumes the operating system as Windows XP. Although some user interfaces are different depending on the OS used, the basic procedure is the same.

Points
- If you are using Windows XP or Windows 2000, please log on as Administrator (authorized account) before proceeding to the following steps.

Illustration of Menu Screen

Points
- Please set up the supplied CD-ROM if it has not been set up. The menu starts automatically.
- If the menu do not start, launch X:AUTORUN.EXE(X:CD-ROM drive) from [Run…] in Start menu.
- The screen design may be different.
Installation of API-USBP(WDM) Development Environment

Installation of development environment is namely installing supplied online help and sample program in all language in order to use API function.

1. Clicking on “Install Development or Execution Environment”.
   [API-USBP(WDM) Installer] dialog box displays.

2. Selecting “Advanced Digital I/O driver”.

3. Clicking on “Install” button.
   Please perform installation following the directions on the screen. And thus the installation is completed.

* The screen design may be different.
Installing C-LOGGER

Install the data collection software.

(1) Clicking on “C-LOGER”.
   [Choose Setup Language] dialog box displays.

(2) Selecting “English”.

(3) Clicking on “OK” Button.
    Please perform installation following the directions on the screen. And thus the installation is completed.

* The screen design may be different.
Step 3 Installing the Hardware

Under Windows, information about the converter needs to be detected by the OS. This is called hardware installation.

To use more than one of USB product with HUB function, make sure to install them one by one, setting each unit after completing the previous one.

Connection with 5VDC Power Supply for Self-power

This product must be connected with 5VDC power supply (in a self-powered state).

Connect with 5VDC power supply by using +5VDC input pin.

**Figure 2.2. +5 VDC Input Terminal Pinouts**

When using the attached AC adapter [POA200-20-2], please connect directly to the input terminals.

When the accompanying power connector (MC1,5/3-ST-3,5, suitable cable: AWG28 - 16) is used to supply power to this unit, strip the end of the suitable cable and insert it to the power connector before firmly securing it using a screw.

**Figure 2.3. Connecting the AC Adapter POA200-20-2**

Beside the AC adapter, a power supply for installation on a DIN rail is also available (as an option).

Use the appropriate power supply depending on the operating environment and application. When a power supply for installation on a DIN rail is used, connect the unit using the accompanying power connector MC1,5/-ST-3,5.

⚠️ CAUTION

- Connect 5VDC power supply to the main unit. Next, connect the USB cable to the PC. Do not turn it on or off when using. If you remove, USB cable is first and then 5VDC power supply.
- When the USB module is not used, leave the AC adapter unplugged.
- Continuously using the AC adapter heated affects its life.
- Use the AC adapter not in a closed place but in a well-ventilated place not to be heated.
- Do not remove the power connector [MC1,5/3-ST-3,5] attached to the AC adapter.
Connecting the Product

(1) Turn on the power to the PC before connecting this product.

(2) When the PC has been up and running, plug the USB interface connector to a USB port in the PC. The converter can also be connected to the PC via a USB hub of this product.

(3) USB cable can be attached firmly to the main unit by using a USB cable attachment.

- The USB cable attachment cannot be used excluding an attached cable.
- When the USB cable attachment is being used, do not perform removing and connecting the USB cable on the unit side repeatedly. This may damage the USB cable attachment or yourself.
(4) When connecting the USB cable through the USB hub of this product, it can be made easily not to come off by using clamps for prevention of cable on the main unit's side (Appended goods).

![Usage of clamps for prevention of cable on the main unit's side](image)

**Figure 2.6.** Usage of clamps for prevention of cable on the main unit's side
Setting with the Found New Hardware Wizard

(1) The “Found New Hardware Wizard” will be started.
*In Windows Vista, Because the driver's installation is completed by "Installing the Software", it is not necessary to operate it about the Hardware Wizard.

(2) Select “Install from a list or specific location”, then click on the [Next] button.
Detect setup information from supplied CD automatically for installing USB driver.

Point
Please specify the path for supplied CD as follows in the case of failure in detecting automatically.
X:\INF\WDM\AIO  (X: CD-ROM drive)

(3) Click on [Finish] button to complete the installation of USB driver.
Setting Properties Using Device Manager

After connecting product with a PC and completing driver installation, open Device Manager and set properties.

(1) Starting Device Manager.

From [Start] menu, click on [Settings]-[Control Panel]-[System] and then click on [Device Manager] button in [Hardware] tab.

* The name of the connected product will be displayed.
AIO-163202FX-USB

- In the case of Windows 98

Right-click on [My Computer] and select [Properties] to start device manager.
(2) Setting the Device Name.
   Right-clicking on the product name and selecting [Properties] displays [Product Properties].
   Open [Common Settings] tab and enter arbitrary name in the editing box for device name.
   (Default name also can be used.)

   ![Image of Properties dialog]
   * The name of the connected product will be displayed. AIO-163202FX-USB

   * The product-specific number will be displayed as the serial number.

   **CAUTION**
   USB driver can not be used without settings. Settings must be performed.

(3) Clicking on [OK] button.
   Device name is set by clicking [OK] button.
Step 4 Checking Operations with the Diagnosis Program

Use the diagnosis program to check that the product and driver software work normally, thereby you can confirm that they have been set up correctly.

What is the Diagnosis Program?

The diagnosis program diagnoses the states of the product and driver software. It can also be used as a simple checker when an external device is actually connected. Using the “Diagnosis Report” feature reports the driver settings, the presence or absence of the product, I/O status, and interrupt status.

Check Method

To check the analog I/O data, use the loopback connection on the board to directly connect the analog output (channel 0) to an analog input, or connect to an external signal source. No external connection is required if using loopback to check the I/O.

The figure below shows an example of checking by connecting to an external signal. The example is for channel 0 on the AIO-163202FX-USB.

Connection diagram

< Analog Input >
- Single-Ended Input

- Differential Input

Interface connector

AI00
AGND

Signal source (e.g. Battery etc.)

AI00+
AI00-
AGND

CAUTION

Input data remains indeterminate when no input pin is connected. The input pin for the channel not connected to the signal source must be connected to the analog ground. For details, see “Chapter 3 External Connection”.

< Analog Output >

Interface connector

AO00
AGND

e.g. Tester

© CONTEC

AIO-163202FX-USB
Using the Diagnosis Program

Starting the Diagnosis Program

Click [Diagnosis] on the Properties page to start the diagnosis program.

* The name of the connected product will be displayed. AIO-163202FX-USB
2. Setup

Analog input
Select the input channel and input type from the lists. Input data is plotted on a graph.

Analog output
You can select the desired output channel from the lists. You can select the DC (constant voltage), sine wave, or square wave as the output data.

Digital I/O
The upper row of circular lamps indicates the digital input states. Red indicates the bit is ON and brown indicates OFF. Clicking the lower row of switches turns the digital output bits ON or OFF.

Counter input
Selecting a counter channel displays the count value and state of that counter channel. Clicking the zero clear button resets the count to zero.
Diagnosis Report

(1) The diagnosis report saves detailed data, including the device settings and settings for each channel, to a text file and displays the file for you to view.

Clicking [Diagnosis Report] prompts you to specify where to save the report text file.

(2) The diagnosis report contains the following data.
- Version of OS
- Device Information
- File Information
- Initialization, interrupts, I/O state for each channel

Execution time measurement

Clicking [Execution Time Measurement] runs the program to measure API function execution speed. The operation of this program is explained in "API function Execution Speed Measurement Program" in Chapter 4.
Setup Troubleshooting

Symptoms and Actions

Data input or output does not operate correctly
- Run the diagnosis program to check that the device is registered and whether any initialization errors have occurred.
- Is there a problem with the device settings, wiring, or similar? Check the I/O range setting. Also, the input data will be undefined if the wiring terminals are not connected. Ensure that the channels you are using are correctly connected. Connect unused channels to analog ground.
- For voltage input, check by connecting a battery or similar if you do not have any other suitable signal source. Also check that connecting to analog ground reads correctly as 0V.

The diagnostic program works correctly but the application program does not.
The diagnostic program uses the API-TOOL functions. If the diagnostic program works correctly, other applications should work correctly also. If you have a problem, recheck your program taking note of the following points.
- Check the return values of the API functions.
- Refer to the source code for the sample programs.

The OS does not boot correctly or does not detect the device correctly.
Refer to the "Troubleshooting" section of API-AIO(WDM) HELP.

If your problem cannot be resolved
Contact your retailer.
3. External Connection

This chapter describes the interface connectors on the product.
Check the information available here when connecting an external device.

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) of unit shown below.

- Connector used
  PCR-E96LMD+ [mfd. by HONDA TSUSHIN KOGYO CO., LTD.] or equivalence to it
- Compatible connectors
  PCR-E96FA+ [mfd. by HONDA TSUSHIN KOGYO CO., LTD.] or equivalence to it

* Please refer to chapter 1 for more information on the supported cable and accessories.

Figure 3.1. Interface Connectors and Mating Connectors
## Connector Pin Assignment

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

![Connector PIN Diagram](image)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Meaning</th>
<th>Pin No.</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>B48</td>
<td>N.C.</td>
<td>A48</td>
<td>Analog Output 00</td>
</tr>
<tr>
<td>B47</td>
<td>N.C.</td>
<td>A47</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B46</td>
<td>N.C.</td>
<td>A46</td>
<td>Analog Output 01</td>
</tr>
<tr>
<td>B45</td>
<td>N.C.</td>
<td>A45</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B44</td>
<td>Analog Input 08</td>
<td>A44</td>
<td>Analog Input 00</td>
</tr>
<tr>
<td>B43</td>
<td>Analog Input 24</td>
<td>A43</td>
<td>Analog Input 16</td>
</tr>
<tr>
<td>B42</td>
<td>Analog Input 09</td>
<td>A42</td>
<td>Analog Input 01</td>
</tr>
<tr>
<td>B41</td>
<td>Analog Input 25</td>
<td>A41</td>
<td>Analog Input 17</td>
</tr>
<tr>
<td>B40</td>
<td>Analog Ground (for AD)</td>
<td>A40</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B39</td>
<td>Analog Ground (for AD)</td>
<td>A39</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B38</td>
<td>Analog Input 10</td>
<td>A38</td>
<td>Analog Input 02</td>
</tr>
<tr>
<td>B37</td>
<td>Analog Input 26</td>
<td>A37</td>
<td>Analog Input 18</td>
</tr>
<tr>
<td>B36</td>
<td>Analog Input 11</td>
<td>A36</td>
<td>Analog Input 03</td>
</tr>
<tr>
<td>B35</td>
<td>Analog Input 27</td>
<td>A35</td>
<td>Analog Input 19</td>
</tr>
<tr>
<td>B34</td>
<td>Analog Ground (for AD)</td>
<td>A34</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B33</td>
<td>Analog Ground (for AD)</td>
<td>A33</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B32</td>
<td>Analog Input 12</td>
<td>A32</td>
<td>Analog Input 04</td>
</tr>
<tr>
<td>B31</td>
<td>Analog Input 28</td>
<td>A31</td>
<td>Analog Input 20</td>
</tr>
<tr>
<td>B30</td>
<td>Analog Input 13</td>
<td>A30</td>
<td>Analog Input 05</td>
</tr>
<tr>
<td>B29</td>
<td>Analog Input 29</td>
<td>A29</td>
<td>Analog Input 21</td>
</tr>
<tr>
<td>B28</td>
<td>Analog Ground (for AD)</td>
<td>A28</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B27</td>
<td>Analog Ground (for AD)</td>
<td>A27</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B26</td>
<td>Analog Input 14</td>
<td>A26</td>
<td>Analog Input 06</td>
</tr>
<tr>
<td>B25</td>
<td>Analog Input 30</td>
<td>A25</td>
<td>Analog Input 22</td>
</tr>
<tr>
<td>B24</td>
<td>Analog Input 15</td>
<td>A24</td>
<td>Analog Input 07</td>
</tr>
<tr>
<td>B23</td>
<td>Analog Input 31</td>
<td>A23</td>
<td>Analog Input 23</td>
</tr>
<tr>
<td>B22</td>
<td>Analog Ground (for AD)</td>
<td>A22</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B21</td>
<td>Analog Ground (for AD)</td>
<td>A21</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B20</td>
<td>Digital Ground</td>
<td>A20</td>
<td>Digital Ground</td>
</tr>
<tr>
<td>B19</td>
<td>N.C.</td>
<td>A19</td>
<td>N.C.</td>
</tr>
<tr>
<td>B18</td>
<td>Digital Output 00</td>
<td>A18</td>
<td>Digital Input 00</td>
</tr>
<tr>
<td>B17</td>
<td>Digital Output 01</td>
<td>A17</td>
<td>Digital Input 01</td>
</tr>
<tr>
<td>B16</td>
<td>Digital Output 02</td>
<td>A16</td>
<td>Digital Input 02</td>
</tr>
<tr>
<td>B15</td>
<td>Digital Output 03</td>
<td>A15</td>
<td>Digital Input 03</td>
</tr>
<tr>
<td>B14</td>
<td>Digital Output 04</td>
<td>A14</td>
<td>Digital Input 04</td>
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<td>B13</td>
<td>Digital Output 05</td>
<td>A13</td>
<td>Digital Input 05</td>
</tr>
<tr>
<td>B12</td>
<td>Digital Output 06</td>
<td>A12</td>
<td>Digital Input 06</td>
</tr>
<tr>
<td>B11</td>
<td>Digital Output 07</td>
<td>A11</td>
<td>Digital Input 07</td>
</tr>
<tr>
<td>B10</td>
<td>AO Control Signal Output 00</td>
<td>A10</td>
<td>AI Control Signal Output 00</td>
</tr>
<tr>
<td>B09</td>
<td>AO Control Signal Output 01</td>
<td>A09</td>
<td>AI Control Signal Output 01</td>
</tr>
<tr>
<td>B08</td>
<td>Digital Ground</td>
<td>A08</td>
<td>Digital Ground</td>
</tr>
<tr>
<td>B07</td>
<td>AO External Sampling Clock Input</td>
<td>A07</td>
<td>AI External Sampling Clock Input</td>
</tr>
<tr>
<td>B06</td>
<td>AO External Stop Trigger Input</td>
<td>A06</td>
<td>AI External Stop Trigger Input</td>
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<tr>
<td>B05</td>
<td>AO External Start Trigger Input</td>
<td>A05</td>
<td>AI External Start Trigger Input</td>
</tr>
<tr>
<td>B04</td>
<td>Counter UP Clock Input 01</td>
<td>A04</td>
<td>Counter UP Clock Input 00</td>
</tr>
<tr>
<td>B03</td>
<td>Reserved</td>
<td>A03</td>
<td>Reserved</td>
</tr>
<tr>
<td>B02</td>
<td>Counter Gate Control Input 01</td>
<td>A02</td>
<td>Counter Gate Control Input 00</td>
</tr>
<tr>
<td>B01</td>
<td>Control Output 01</td>
<td>A01</td>
<td>Control Output 00</td>
</tr>
</tbody>
</table>

* [ ] shows pin numbers specified by HONDA TSUSHIN KOGYO CO., LTD.*
### Figure 3.2. Pin Assignments of Interface Connector (CN1)  < Single-Ended Input >

⚠️ **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 product.

- When the Buffer Amplifier Box is used, pin assignments are different. Refer to the pin assignments for the connector on the Buffer Amplifier Box.
## Pin Assignments of Interface Connector (CN1) < Differential Input >

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Meaning</th>
<th>Pin No.</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>B48</td>
<td>N.C.</td>
<td>A48</td>
<td>Analog Output 00</td>
</tr>
<tr>
<td>B47</td>
<td>N.C.</td>
<td>A47</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B46</td>
<td>N.C.</td>
<td>A46</td>
<td>Analog Output 01</td>
</tr>
<tr>
<td>B45</td>
<td>N.C.</td>
<td>A45</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B44</td>
<td>Analog Input 08[+]</td>
<td>A44</td>
<td>Analog Input 00[+]</td>
</tr>
<tr>
<td>B43</td>
<td>Analog Input 08[-]</td>
<td>A43</td>
<td>Analog Input 00[-]</td>
</tr>
<tr>
<td>B42</td>
<td>Analog Input 09[+]</td>
<td>A42</td>
<td>Analog Input 01[+]</td>
</tr>
<tr>
<td>B41</td>
<td>Analog Input 09[-]</td>
<td>A41</td>
<td>Analog Input 01[-]</td>
</tr>
<tr>
<td>B40</td>
<td>Analog Ground</td>
<td>A40</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B39</td>
<td>Analog Ground</td>
<td>A39</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B38</td>
<td>Analog Input 10[+]</td>
<td>A38</td>
<td>Analog Input 02[+]</td>
</tr>
<tr>
<td>B37</td>
<td>Analog Input 10[-]</td>
<td>A37</td>
<td>Analog Input 02[-]</td>
</tr>
<tr>
<td>B36</td>
<td>Analog Input 11[+]</td>
<td>A36</td>
<td>Analog Input 03[+]</td>
</tr>
<tr>
<td>B35</td>
<td>Analog Input 11[-]</td>
<td>A35</td>
<td>Analog Input 03[-]</td>
</tr>
<tr>
<td>B34</td>
<td>Analog Ground</td>
<td>A34</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B33</td>
<td>Analog Ground</td>
<td>A33</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B32</td>
<td>Analog Input 12[+]</td>
<td>A32</td>
<td>Analog Input 04[+]</td>
</tr>
<tr>
<td>B31</td>
<td>Analog Input 12[-]</td>
<td>A31</td>
<td>Analog Input 04[-]</td>
</tr>
<tr>
<td>B30</td>
<td>Analog Input 13[+]</td>
<td>A30</td>
<td>Analog Input 05[+]</td>
</tr>
<tr>
<td>B29</td>
<td>Analog Input 13[-]</td>
<td>A29</td>
<td>Analog Input 05[-]</td>
</tr>
<tr>
<td>B28</td>
<td>Analog Ground</td>
<td>A28</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B27</td>
<td>Analog Ground</td>
<td>A27</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B26</td>
<td>Analog Input 14[+]</td>
<td>A26</td>
<td>Analog Input 06[+]</td>
</tr>
<tr>
<td>B25</td>
<td>Analog Input 14[-]</td>
<td>A25</td>
<td>Analog Input 06[-]</td>
</tr>
<tr>
<td>B24</td>
<td>Analog Input 15[+]</td>
<td>A24</td>
<td>Analog Input 07[+]</td>
</tr>
<tr>
<td>B23</td>
<td>Analog Input 15[-]</td>
<td>A23</td>
<td>Analog Input 07[-]</td>
</tr>
<tr>
<td>B22</td>
<td>Analog Ground</td>
<td>A22</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B21</td>
<td>Analog Ground</td>
<td>A21</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>B20</td>
<td>Digital Ground</td>
<td>A20</td>
<td>Digital Ground</td>
</tr>
<tr>
<td>B19</td>
<td>N.C.</td>
<td>A19</td>
<td>N.C.</td>
</tr>
<tr>
<td>B18</td>
<td>Digital Output 00</td>
<td>A18</td>
<td>Digital Input 00</td>
</tr>
<tr>
<td>B17</td>
<td>Digital Output 01</td>
<td>A17</td>
<td>Digital Input 01</td>
</tr>
<tr>
<td>B16</td>
<td>Digital Output 02</td>
<td>A16</td>
<td>Digital Input 02</td>
</tr>
<tr>
<td>B15</td>
<td>Digital Output 03</td>
<td>A15</td>
<td>Digital Input 03</td>
</tr>
<tr>
<td>B14</td>
<td>Digital Output 04</td>
<td>A14</td>
<td>Digital Input 04</td>
</tr>
<tr>
<td>B13</td>
<td>Digital Output 05</td>
<td>A13</td>
<td>Digital Input 05</td>
</tr>
<tr>
<td>B12</td>
<td>Digital Output 06</td>
<td>A12</td>
<td>Digital Input 06</td>
</tr>
<tr>
<td>B11</td>
<td>Digital Output 07</td>
<td>A11</td>
<td>Digital Input 07</td>
</tr>
<tr>
<td>B10</td>
<td>AO Control Signal Output 00</td>
<td>A10</td>
<td>AO Control Signal Output 00</td>
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<td>B99</td>
<td>AO Control Signal Output 01</td>
<td>A09</td>
<td>AO Control Signal Output 01</td>
</tr>
<tr>
<td>B98</td>
<td>Digital Ground</td>
<td>A08</td>
<td>Digital Ground</td>
</tr>
<tr>
<td>B97</td>
<td>AO External Sampling Clock</td>
<td>A07</td>
<td>AO External Sampling Clock</td>
</tr>
<tr>
<td>B96</td>
<td>AO External Stop Trigger Input</td>
<td>A06</td>
<td>AO External Stop Trigger Input</td>
</tr>
<tr>
<td>B95</td>
<td>AO External Start Trigger Input</td>
<td>A05</td>
<td>AO External Start Trigger Input</td>
</tr>
<tr>
<td>B94</td>
<td>Counter UP Clock Input 01</td>
<td>A04</td>
<td>Counter UP Clock Input 00</td>
</tr>
<tr>
<td>B93</td>
<td>Reserved</td>
<td>A03</td>
<td>Reserved</td>
</tr>
<tr>
<td>B92</td>
<td>Counter Gate Control Input 01</td>
<td>A02</td>
<td>Counter Gate Control Input 00</td>
</tr>
<tr>
<td>B91</td>
<td>Counter Output 01</td>
<td>A01</td>
<td>Counter Output 00</td>
</tr>
</tbody>
</table>

* [] shows pin numbers specified by HONDA TSUSHIN KOGYO CO., LTD.*
### 3. External Connection

<table>
<thead>
<tr>
<th>Pin Assignment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input00 - Analog Input15</td>
<td>Analog input signal. The numbers correspond to channel numbers.</td>
</tr>
<tr>
<td>Analog Output00 - Analog Output01</td>
<td>Analog output signal. The numbers correspond to channel numbers.</td>
</tr>
<tr>
<td>Analog Ground</td>
<td>Common analog ground for analog I/O signals.</td>
</tr>
<tr>
<td>AI External Start Trigger Input</td>
<td>External trigger input for starting analog input sampling.</td>
</tr>
<tr>
<td>AI External Stop Trigger Input</td>
<td>External trigger input for stopping analog input sampling.</td>
</tr>
<tr>
<td>AI External Sampling Clock Input</td>
<td>External sampling clock input for analog input.</td>
</tr>
<tr>
<td>AI Control Signal Output 00</td>
<td>External sampling clock output signal for analog input.</td>
</tr>
<tr>
<td>AI Control Signal Output 01</td>
<td>External output signal for analog input status. Not currently connected.</td>
</tr>
<tr>
<td>AO External Start Trigger Input</td>
<td>External trigger input for starting analog output sampling.</td>
</tr>
<tr>
<td>AO External Stop Trigger Input</td>
<td>External trigger input for stopping analog output sampling.</td>
</tr>
<tr>
<td>AO External Sampling Clock Input</td>
<td>External sampling clock input for analog output.</td>
</tr>
<tr>
<td>AO Control Signal Output 00</td>
<td>External sampling clock output signal for analog output.</td>
</tr>
<tr>
<td>AO Control Signal Output 01</td>
<td>External output signal for analog output status. Not currently connected.</td>
</tr>
<tr>
<td>Digital Input00 - Digital Input07</td>
<td>Digital input signal.</td>
</tr>
<tr>
<td>Digital Output00 - Digital Output07</td>
<td>Digital output signal.</td>
</tr>
<tr>
<td>Counter Gate Control Input00 - Counter Gate Control Input01</td>
<td>Gate control input signal for counter.</td>
</tr>
<tr>
<td>Counter Up Clock Input00 - Counter Up Clock Input01</td>
<td>Count-up clock input signal for counter.</td>
</tr>
<tr>
<td>Counter Output00 - Counter Output01</td>
<td>Count match output signal for counter.</td>
</tr>
<tr>
<td>Digital Ground</td>
<td>Common digital ground for digital I/O signals, external trigger inputs,</td>
</tr>
<tr>
<td></td>
<td>external sampling clock inputs, and counter I/O signals.</td>
</tr>
<tr>
<td>Reserved</td>
<td>Reserved pin</td>
</tr>
<tr>
<td>N.C.</td>
<td>No connection to this pin</td>
</tr>
</tbody>
</table>

**Figure 3.3. Pin Assignments of Interface Connector (CN1)  < Differential Input >**

⚠️ **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 product.
- When the Buffer Amplifier Box is used, pin assignments are different. Refer to the pin assignments for the connector on the Buffer Amplifier Box.
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 unit 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 unit and the signal source receive noise or the distance between the unit 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 unit 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.
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 unit to the signal source ground.

![Differential Input Connection (Flat Cable)](image)

Figure 3.6. Differential Input Connection (Flat Cable)

The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the signal source and unit 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 unit and the signal source ground to the shielding.

![Differential Input Connection (Shielded Cable)](image)

Figure 3.7. Differential Input Connection (Shielded Cable)

⚠️ 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 unit and the signal source receive noise or the distance between the unit 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 unit analog ground). If it exceeds the maximum voltage, the unit 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 shield cable.

The following figure shows an example of flat cable connection.

Connect the signal source and ground to the CN1 analog output.

![Figure 3.8. Analog Output Connection (Flat Cable)]

The following figure shows an example of shield cable connection. Use shield cable if the distance between the signal source and this 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.

![Figure 3.9. Analog Output Connection (Shielded Cable)]

⚠️ **CAUTION**

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

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

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

- Analog output signal outputs hundreds of μ voltages when USB cable is inserted.
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 LVTTL level signals.

---

**Figure 3.10. Digital Input Connection**

**Figure 3.11. Digital Output Connection**

About the counter input control signal
Counter Gate Control Input (refer to the chapter 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 this product 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 damage the product.
- If connected to each output, a pull-up resistor must be about 10kΩ to pull up with a 3.3V power source.
- Each input accepts 5V TTL signals.

Reference

For the operation timings for control signal input, see “Control Signal Timings” in Chapter 6 “Hardware”.

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4. Application Development

Please reference to online help and sample program when developing applications.

Reference to Online Help

Click on [Programs]-[CONTEC API-USBP(WDM)]-[API-USBP(WDM) Help] from [Start] menu. The information for application development, such as function reference is provided in [API-USBP(WDM) Help].

Detailed introduction to search method for help should be found from [How to navigate Help] in the help.

For basic usage, please reference to “Tutorial” for help.

Printing Function Reference

Clicking on Print button from online help prints the page being displayed. It can be printed entirely as follows in the case of referencing to printing function.

As figure shown on the right, selecting 📑 mark and clicking on Print button prints all the topics under the mark selected at a time.
4. Application Development

Sample Program

Sample programs are copied in installation path. (The default path is Program Files\CONTEC~)

Sample programs in all language are provided here. To run a sample program, click on [Programs]- [CONTEC API-USBP(WDM)]-[AIO]-[Sample Name] from [Start] menu.

Distributing Developed Application

Please distribute the developed application with USB driver in supplied CD-ROM. Created application (including driver) can be freely distributed.
Use of utility program

Program for Measuring the Executive Speed of Function

Program for measuring the executive speed of function is a program that can measure the executive time of some main functions.

To use the program for measuring the executive speed of function, please click the button "Measure tool..." from CONTEC DIAGNOSIS PROGRAM.

Step to use

1. Select the device to be measured from the device list.
2. Measure the executive speed of a function by clicking the button with the function name.
   - Select the number of channels for conversion from the list for AioMultiAi and AioMultiA0.
   - Input the size of data to be transferred for AioGetAiSamplingData and AioSetAoSamplingData.
   - Set the transfer data in "kByte".
3. Terminate the application by clicking the button "Exit".

* The name of the connected product will be displayed. AIO-163202FX-USB
Measuring Analog Input tool

This is a utility that measuring Analog input with FIFO memory infinitely. Retrieves the data from memory as the event is occurred because the number of conversion data has arrived at the maximum. The data of FIFO memory is more visual displayed.

Setting Channels, Internal/External Clock, Conversion speed, Sampling Number that it makes event occurring. After the sampling clock error event is occurred, setting all of conversion condition.

Step to use

1. The device used is selected from the list of the device, and a set button is clicked.
2. Setting the conversion condition on the form of [Setting Analog Input].

Retrieves the data from memory as the event is occurred because the number of conversion data has arrived at the specified number. Return to original form, after clicked the button of [OK].
(3) The measuring is begun after clicked the button of [Start], the conversion’s information is displayed.

The sampling number within FIFO:

That is the conversion data is stored at memory. That is more visual displayed in [Memory Image].

The sampling number when event:

The event is occurred when the input sampling number within FIFO reach this number.

Total Input Sampling Number:

The total sampling number is stored at memory for this application.

The Measuring will stop when this error as follows.

Sampling clock error:

When the application is measuring with internal clock, sampling clock is too fast to process.
When the application is measuring with External clock, clock cycle is too fast. Moreover, noise is being considered.

Buffer overflow:

The memory has overflowed because the conversion speed is too fast compared with the speed at which data is taken.

(4) The measuring is stopping after clicked the button of [Stop].

Measuring Analog Output tool

This is an analog output and measurement utility able to sample indefinitely using the FIFO memory. An event is triggered when the remaining conversion data in memory reaches a specified level and this causes the new output data to be loaded. The utility also shows a visual representation of the data in the FIFO memory.

The number of channels, whether to use an internal or external clock, conversion speed, number of times to sample before generating an event, and number of samples to load at each event can be specified. As an event is also generated if a sampling clock error occurs, you can use the utility to test the conversion operation under a range of different conditions.
Step to use

(1) Use the combo box at the top left of the window to select the device name of the device to use, then click the [Set] button.

(2) Specify the conversion conditions in the analog input setup window.
An event is triggered and the next block of data is loaded after the number of samples specified in the settings have been output. Clicking the OK button saves the settings and returns to the previous window.

(3) The measuring is begun after clicked the button of [Start], the conversion's information is displayed.
The sampling number within FIFO:
This specifies the number of conversion data values remaining in memory (that have not yet been output). This is shown visually in the "Memory Image".
Sampling count for triggering event:
An event is triggered when the number of samples remaining in the FIFO reaches the specified value.
Number of samples to load:
The number of output data values (samples) to load at each event.

The Measuring will stop when this error as follows.
Sampling clock error:
When the application is measuring with internal clock, sampling clock is too fast to process.
When the application is measuring with External clock, clock cycle is too fast. Moreover, noise is being considered.

(4) The measuring is stopping after clicked the button of [Stop].
Returning to Initial State

This is the method of returning to initial state. It is suggested that you should return to initial state and perform installation again when the operation is losing stabilization.

1. Deleting Device form Device Manager.

2. Drawing 5VDC power supply (the attached AC adapter) from unit

3. Drawing USB cable from a PC

4. Uninstalling Driver
   Select [CONTEC API-AIO(WDM) driver] from [My Computer]-[Control Panel]-[Add/Remove Programs].

5. Restarting
5. About C-LOGGER

Outline of C-LOGGER

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.

The program is stored on the attached CD-ROM [Driver Library API-USBP (WDM)].

C-LOGGER offers the following functions.

- Sampling and displaying data with high-speed
- Supporting plural windows
- Sending to excel with high-speed
- Supporting 2 data (binary and csv) forms
- Setting acquirement conditions easily with wizard
- Operating intuitively with file viewer and property viewer
- Saving to file automatically for long-time and mass-data acquirement
- Displaying Graph in 2 Screens: Whole and Zoom
- Abundant Function for Customization

For details, refer to the C-LOGGER Users Guide.
6. Functions

This chapter describes the different functions that can be implemented using the hardware and driver together. Unless stated otherwise, the driver is assumed to be API-AIO(WDM).

* When data logger software (C-LOGGER) is used, a part of it's function can not be used.

Analog Input Function

This product converts analog signals to digital data according to the resolution and stores it in memory. You can set a variety of conditions for analog input, including the input channel, sampling period, and sampling start/stop conditions.

Analog input processes are classified as follows:

1. Setting the Conversion Conditions

   - Resolution
   - Input Mode
   - Channel
   - Channel conversion order
   - Range
   - Data transfer method
   - Memory Mode
   - Repeat

2. Starting / stopping operation

   - Start
   - Stop

3. Monitoring the Status and Acquiring Data

   - Status
   - Sampling
   - Transfer
   - Repeat
   - Data acquisition
   - Conversion data

4. Reset

   - Status
   - Memory
1. Setting the Conversion Conditions

First, set the conditions for executing analog input.

Resolution

“Resolution” signifies the number of bits used by an analog input device to represent analog signals. The higher the resolution, the more finely the voltage range is segmented, allowing the device to convert analog values to digital equivalents more precisely.

A device with a resolution of 12bit divides the range width into 4096 segments. When the device covers the range of 0 - 10V, the minimum unit of converted voltages is \( \frac{10}{4096} \approx 2.44\text{mV} \).

If the device has a resolution of 16bit, it is \( \frac{10}{65536} \approx 0.153\text{mV} \) instead.

AIO-163202FX-USB : The resolution is 16bit.

Input Mode

"Input Mode" indicates the method of connecting analog input signals. The input modes available are single-ended input and differential input.

The single-ended input mode is suitable for the environment in which the potential difference between the signal source and ground and noise components can be ignored. For the environment in which they cannot be ignored, the differential input mode is suitable.

The number of channels available in differential input mode is half that in single-ended input mode. This product uses on-product jumpers to set the input mode.

Channel

"Channel" represents each point of analog input.

For individual channel numbers, see “How to connect the connectors” to “Connector Pin Assignment” in Chapter 3 "External Connection".

You can specify an arbitrary number of points of analog input by setting the channels by means of software.
Channel conversion order
Normally, when performing conversion for more than one channel at each sampling, conversion is performed consecutively starting from channel 0.

If you wish, you can specify a different channel conversion order.
If the successive approximation input method is used, input is performed as specified by the channel conversion order setting.

Range
"Range" means the range of voltages at which analog input can be performed.

AIO-163202FX-USB: The input range for the device is set by software.
Data transfer method
It is the device buffer mode, which uses memory for conversion data storage either on the device or in the driver.

When conversion starts, data is saved in the device buffer (memory on the device itself or in the driver).
The device buffer can operate as FIFO or ring memory.
The application calls an API function at an appropriate timing and fetches the conversion data from the device buffer.
Device buffer mode handles conversion data by sampling count and API functions are provided to retrieve conversion data directly as voltage values.
Memory format
The memory format can be specified by software.

**Device buffer mode**
- **FIFO format**
  In the FIFO (First In First Out) format, input data items are read from memory in the same order in which they were written to the memory. Input data items are fed out of the memory sequentially, where the oldest one is always read from the memory. The status monitor and application notification functions are provided, which check and report the state in which the memory has stored a fixed amount of data or in which the memory has become full. The FIFO memory is used to obtain all input data from analog input in a short or infinite period of time.

- **Ring format**
  In the ring format, the memory contains storage areas arranged in a ring. Input data items are written to the memory sequentially. When it stores data exceeding the limit, it overwrites the area storing the previous item of input data. The status monitor and application notification functions are provided, which check and report the state in which data has been written to certain areas of memory. The ring memory is used to obtain data where conversion has stopped due to some event, usually without obtaining data in the normal state.
Repeat

"Repeat" indicates the number of repetitions of sampling to be executed, from when the sampling start condition is satisfied until the end of sampling, including delayed sampling. The number of repetitions is set by means of software, for which conversion is repeated. You can set an infinite number of repetitions, in which case the conversion is terminated by the software abort command.

Input data items are stored to the memory sequentially. The repetition state can be subject to status monitoring and application notification.

Clock

The sampling clock controls the sampling frequency. You can select either the internal sampling clock, external sampling clock, or the output of the event controller.

The sampling clock is selected by means of software.

- **Internal sampling clock**
  
  The clock signal from the on-product clock generator is used.

- **External sampling clock**

  The edge of the digital signal input from an external device is used for the sampling clock.

- **Event controller output**

  A specified output of the event controller is used as the sampling clock.
  
  Refer to the explanation of the event controller functions or to the driver help for details about the event controller.
Start Condition

The condition for controlling the start of sampling can be selected from among software, input data comparison, an external trigger and an event controller. The conditions for controlling the start and stop of sampling are completely independent of each other; they can be set separately.

- Software
  This product starts sampling and storing input data to memory immediately after the operation start command is issued.

- Input data comparison
  When the operation start command is issued, the product compares the analog signal input through a specified channel to the value of the preset comparison level. If the analog signal satisfies the condition, the product starts storing input data.
  Level comparison conditions are set as two conditions: level and direction.

The above sketch shows that the level comparison condition is satisfied in the rising direction. The start condition is satisfied when the analog signal at the specified channel passes the comparison level in the rising direction. Input data items are stored to memory, starting with those at solid dots.

The above sketch shows that the level comparison condition is satisfied in the falling direction. The start condition is satisfied when the analog signal at the specified channel passes the comparison level in the falling direction. Input data items are stored to memory, starting with those at solid dots.

If you set the level comparison directions to both directions, the start condition is satisfied when the analog signal passes the level both in the rising and falling directions.
- Conversion data in-range comparison
  The in-range compare start condition is established when the level on the specified analog channel enters the range specified by level 1 and level 2. Saving of conversion data to memory is performed for the sample points indicated by the black dots.
  If the analog signal already exist within the in-range, the convention starts immediately.

  ![Analog signal diagram](image)

  Start condition: \[ \text{Level 2} \leq \text{Analog signal} \leq \text{Level 1} \]

- Conversion data out-of-range comparison
  The out-of-range compare start condition is established when the level on the specified analog channel is outside the range specified by level 1 and level 2. Saving of conversion data to memory is performed for the sample points indicated by the black dots.
  If the analog signal already exist within the out-range, the convention starts immediately.

  ![Analog signal diagram](image)

  Start condition: \[ \text{Analog signal} \leq \text{Level 2 or Level 1} \leq \text{Analog signal} \]

- External trigger
  This product starts waiting for an external control signal as soon as the operation start command is output.
  Sampling and data transfer to memory start when the specified edge (rising edge or falling edge) is input from the external control signal.

- Event controller output
  This product starts waiting for an external control signal as soon as the operation start command is output.
  Sampling and data transfer to memory start when the specified event controller output is received.
  Refer to the explanation of the event controller functions or to the driver help for details about the event controller.
Stop Condition

The condition for controlling the stop of sampling can be selected from among the last sampling count, input data comparison, an external trigger, and software abort.

This product stops sampling whenever an error occurs irrespective of the stop condition setting.

- Last sampling count
  This product stops sampling after storing input data to memory for the specified number of times of sampling.

- Input data comparison
  Once the product has started sampling, it compares the analog signal input through a specified channel to the value of the preset comparison level. If the analog signal satisfies the condition, the product stops sampling.

Level comparison conditions are set as two conditions: level and direction.

The above sketch shows that the level comparison condition is satisfied in the rising direction. The stop condition is satisfied when the analog signal at the specified channel passes the comparison level in the rising direction. Input data items are stored to memory, ending until those at solid dots.

The above sketch shows that the level comparison condition is satisfied in the falling direction. The stop condition is satisfied when the analog signal at the specified channel passes the comparison level in the falling direction. Input data items are stored to memory, ending until those at solid dots.

If you set the level comparison directions to both directions, the start condition is satisfied when the analog signal passes the level both in the rising and falling directions.
- Conversion data in-range comparison
  The in-range compare stop condition is established when the level on the specified analog channel enters the range specified by level 1 and level 2. Saving of conversion data to memory is performed for the sample points indicated by the black dots. If the analog signal already exist within the in-range, the convention starts immediately.

- Conversion data out-of-range comparison
  The out-of-range compare stop condition is established when the level on the specified analog channel is outside the range specified by level 1 and level 2. Saving of conversion data to memory is performed for the sample points indicated by the black dots.

- External trigger
  The product starts waiting for an external control signal after the specified number of samples have been performed. Sampling stops when the specified edge (rising edge or falling edge) is input from the external control signal.

- Software
  Sampling continues indefinitely in this mode. Sampling only stops in response to a software command or an error.

- Event controller output
  Sampling stops when the specified event controller output is received. Refer to the explanation of the event controller functions or to the driver help for details about the event controller.
Delay

Delayed sampling is performed after the sampling stop condition is satisfied. When a sampling stop condition other than the software abort command is satisfied, the product performs sampling for the specified number of times of delayed sampling to store input data to memory. If you set the number of times of delayed sampling to 0, the product stops sampling the moment the sampling stop condition is satisfied.

Event

"Event" works as a function for reporting the occurrence of a certain product state to the application. The following events can be used in combination depending on the purpose of usage.

- "AD conversion start condition satisfied" event
  This event occurs when the AD conversion start condition is satisfied. The event is nullified when the conversion start condition is "software".

- "Repeat end" event
  This event occurs whenever a repetition is completed.

- "End of device operation" event
  This event occurs when the entire operation including repetitions is completed.

- "Stored specified sampling times" event
  This event occurs when sampling has been performed for the number of times set by software.

- Overflow event
  This event occurs at an attempt to store input data with the memory full.

- Sampling clock error event
  This event occurs when conversion stops as an error occurs due to a sampling clock period that is too short.

- AD conversion error event
  This event occurs when conversion stops due to an AD conversion error.
2. Starting/Stopping Operation

Sampling is started by the software command. Once started, sampling can be stopped by the software command at any timing.

3. Monitoring the Status and Acquiring Data

Software commands are used to monitor the operation status of the device and to acquire input data from memory. Status monitoring and data acquisition can be performed even during sampling.

Status

The current state of the device can be checked by obtaining the device status. The following types of device status are available:

- Device operating
  The “device operating” status remains ON, after the execution of the sampling start command until the product completes conversion, aborts operation due to an error, or stops sampling in response to the command.

- Waiting for start trigger
  This status remains ON, after the product starts sampling until the start trigger is input, if the conversion start condition is an external trigger or level comparison. The status is set to OFF when the input trigger is input to start conversion. The status is set to ON whenever the product enters the conversion start wait status even when repeated operation has been set.

- Specified sampling data stored
  This status is set to ON when input data stored in memory has reached the amount corresponding to the preset number of times of sampling.
  If the memory format is FIFO, the status is set to OFF when the amount of input data in the memory falls below the value corresponding to the preset number of times of sampling as data is acquired.
  Once the status is set to ON when the memory format is ring, it remains ON until it is reset.

- Overflow
  An overflow error occurs when an attempt is made to store input data to memory while it has been full of input data.
  When the memory format is FIFO, the product stops conversion.
  When the memory format is ring, the product continues conversion while overwriting existing data with new one.

- Sampling clock error
  This error occurs when the sampling clock period is too short.

- AD conversion error
  If the “device operating” status remains ON (without terminating conversion) for an extended period of time, the driver regards that state as an operation error and sets this status to ON. This error stops sampling.

Sampling

The number of sampled items of input data stored in memory can be obtained by the software command.
Repeat
The current repeat count can be obtained by the software command.

Data acquisition
When using the device buffer, the conversion data stored in memory can be retrieved using a software command.
The figure below shows the correspondence between the sampling count and the conversion channel for the conversion data stored in memory.

Input data is acquired differently depending on the memory format used.

- Data acquisition in FIFO format
  When FIFO memory is used, the oldest data is always read first.
The following sketch shows an image of data acquisition in FIFO format.
When data is acquired from the memory, the free memory space increases by that data size. When data is acquired next, the oldest one of the existing data items is taken from the memory in the same way.
The FIFO memory deletes data once that data is acquired.
6. Functions

- Data acquisition in ring format
  When ring memory is used, data is read always with respect to the current input data write position. The following sketch shows an image of data acquisition in ring format.
  The sampling count obtained is always the number of times of sampling for up to the latest data (shaded portion below).
  The larger the number of samples taken, the older the data item acquired first.
  As the ring memory retains data even after that data is acquired, you can fetch the same data any number of times.

![Conversion data write position]

Conversion data

The following equation represents the relationship between input data and voltage.

Voltage = Input data x (Max. range value – Min. range value) / Resolution + Min. range value

The value of resolution for the 12bit device is 4096; that for the 16bit device is 65536.

< ± 10V range >

The following table shows the relation between AD conversion data and voltage.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Conversion data (12bit)</th>
<th>Voltage</th>
<th>Conversion data (16bit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+9.995V</td>
<td>4095</td>
<td>+9.99970V</td>
<td>65535</td>
</tr>
<tr>
<td>0.005V</td>
<td>2049</td>
<td>0.00030V</td>
<td>32769</td>
</tr>
<tr>
<td>0V</td>
<td>2048</td>
<td>0V</td>
<td>32768</td>
</tr>
<tr>
<td>-0.005V</td>
<td>2047</td>
<td>-0.00030V</td>
<td>32767</td>
</tr>
<tr>
<td>-10.000V</td>
<td>0</td>
<td>-10.000V</td>
<td>0</td>
</tr>
</tbody>
</table>

Ex.: When conversion data 49152 is input at a resolution of 16bit in the ± 10V range
   Voltage = 49152 x (10 - (-10)) ÷ 65536 + (-10)
   = 5.0
The following table shows the relation between AD conversion data and voltage.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Conversion data (12bit)</th>
<th>Voltage</th>
<th>Conversion data (16bit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+9.998V</td>
<td>4095</td>
<td>9.99985V</td>
<td>65535</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.00015V</td>
<td>32769</td>
</tr>
<tr>
<td>5V</td>
<td>2048</td>
<td>5V</td>
<td>32768</td>
</tr>
<tr>
<td>4.998V</td>
<td>2047</td>
<td>4.99985V</td>
<td>32767</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0V</td>
<td>0</td>
</tr>
</tbody>
</table>

Ex.: When AD conversion data 49152 is input at a resolution of 16bit in the 0 - 10V range

\[
\text{Voltage} = \frac{49152 \times (10 - 0)}{65536} + 0 = 7.5
\]

4. Reset

Various states can be reset by executing the following reset commands:

**Status**

This command resets the sampling clock error status and AD conversion error status.

**Memory**

This can only be used when the transfer mode is set to device buffer mode.

This command resets the following memory related states.

- Resets the conversion data in memory.
- Resets the repeat count to 0.
- Resets the sampling count to 0 when a stop trigger is input.
- Resets the buffer overflow status.
- Resets the status information for the specified data save count.
Analog Output Function

This product converts digital data to analog signals according to the resolution. You can set a variety of conditions for analog output, including the output channel, sampling period, and sampling start/stop conditions. Analog output processes are classified as follows:

1. Setting the Conversion Conditions
   - Resolution
   - Channel
   - Range
   - Output data
   - Data transfer method
   - Memory Mode
   - Repeat
   - Start Condition
   - Stop Condition
   - Event

2. Starting / stopping operation
   - Clock
   - Start
   - Stop

3. Monitoring the Status and Acquiring Data
   - Status
   - Sampling
   - Transfer
   - Repeat

4. Reset
   - Status
   - Memory
1. Setting the Conversion Conditions

First, set the conditions for executing analog input.

Resolution

"Resolution" signifies the number of bits used by an analog output device to represent analog signals. The higher the resolution, the more finely the voltage range is segmented, allowing the device to convert digital values to analog equivalents more precisely.

A device with a resolution of 12bit divides the range width into 4096 segments. When the device covers the range of 0 - 10V, the minimum unit of converted voltages is \( \frac{10}{4096} \approx 2.44\text{mV} \).

If the device has a resolution of 16bit, it is \( \frac{10}{65536} \approx 0.153\text{mV} \) instead.

Channel

"Channel" represents each point of analog output. For individual channel numbers, see "How to connect the connectors" to "Connector Pin Assignment" in Chapter 3 "External Connection". You can specify an arbitrary number of points of analog output by setting the channels by means of software.

Range

"Range" means the range of voltages at which analog output can be performed.

AIO-163202FX-USB : The resolution is 16bit.

AIO-163202FX-USB : The output range of the device is set by software.
Output data

Output data = ((Voltage – Min. range value) x Resolution) / (Max. range value – Min. range value)

The value of resolution for the 12bit device is 4096; that for the 16bit device is 65536.
The table below shows the relationship between output data and voltage in the ±10V range.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Output data (12bit)</th>
<th>Voltage</th>
<th>Output data (16bit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+9.995V</td>
<td>4095</td>
<td>+9.99970V</td>
<td>65535</td>
</tr>
<tr>
<td></td>
<td>:</td>
<td></td>
<td>:</td>
</tr>
<tr>
<td>0.005V</td>
<td>2049</td>
<td>0.00030V</td>
<td>32769</td>
</tr>
<tr>
<td>0V</td>
<td>2048</td>
<td>0V</td>
<td>32768</td>
</tr>
<tr>
<td>-0.005V</td>
<td>2047</td>
<td>-0.00030V</td>
<td>32767</td>
</tr>
<tr>
<td></td>
<td>:</td>
<td></td>
<td>:</td>
</tr>
<tr>
<td>-10.000V</td>
<td>0</td>
<td>-10.000V</td>
<td>0</td>
</tr>
</tbody>
</table>

Ex.: When 3V is output at a resolution of 16bit in the ±10V range

Output data = (3 - (-10)) x 65536 ÷ (10 - (-10))

= 42598.4 *

* The value that can be set as output data at this time is an integer. Select "42598" or "42599" as the output data.
The analog signal corresponding to the output data contains an error as follows:
- Output data "42598" converted to: 2.9998 V
- Output data "42599" converted to: 3.0001 V
This error is a consequential error occurring when output data is obtained from an expected analog value.
Data transfer method
It is the device buffer mode, which uses memory for conversion data storage either on the device or in the driver.

The application output data is first stored in the device buffer (memory on the device itself or in the driver).
When conversion starts, the device starts outputting the output data.
The device buffer can operate as FIFO or RING memory.
Device buffer mode handles conversion data by sampling count and API functions are provided to retrieve conversion data directly as voltage values.
Memory format

The memory format can be specified by software.

- **FIFO (First In First Out) format**
  - Use FIFO format if you wish to output a continuous arbitrary analog output like that shown below.

![FIFO format diagram](image1)

When using FIFO format, writing of conversion data to memory is always performed from after the most recent data and DA conversion is performed on the oldest data in memory. You can write to memory during analog output operation. An error occurs if the volume of data exceeds the memory size. However, this error does not stop analog output if it is in progress.

- **Ring format**
  - Use ring format if you wish to output a repeated pattern like that shown below.

![Ring format diagram](image2)
When using ring format, write the data for one complete cycle of the output waveform before starting operation.
You cannot write to the memory during its operation of analog output.
DA conversion data is output continuously in the sequence in which the ring format data is stored.

* Although the figure shows a single analog output channel, output from multiple channels is also possible.

Repeat
You can specify a repeat count to perform sampling for a specified number of times.

Memory must be set to ring format if a number of repetitions is to be specified.
(The number of repetitions cannot be specified for FIFO memory format.)
The number of repetitions is set by software and sampling is repeated for the specified number of times.
You can also specify that operation continue indefinitely. If set to repeat indefinitely, analog output operation is stopped by outputting a analog output stop command by software.
Setting data

Use a software command to save the data in memory.
The figure below shows the relationship between the conversion data stored in memory and the sampling count and conversion channels.

The procedure for setting the conversion data is different depending on the memory format being used.

- Procedure for FIFO format
  When using FIFO format, setting data to memory is always performed from the most recent data. New data can be added during conversion.

- Procedure for RING format
  When using ring format, a ring memory area large enough for the data to be set is reserved. Data cannot be modified during DA conversion.
Clock

The sampling clock controls the sampling frequency. You can select from among the internal sampling clock, or the external sampling clock, or the event controller. The sampling clock is selected by means of software.

- **Internal sampling clock**
  The clock signal from the on-product clock generator is used.

- **External sampling clock**
  The edge of the digital signal input from an external device is used for the sampling clock.

- **Event controller output**
  A specified output of the event controller is used as the sampling clock.
  Refer to the explanation of the event controller functions or to the driver help for details about the event controller.

Start Condition

The condition for controlling the stop of sampling can be selected from among the last sampling count, an external trigger, software, or the event controller output abort.

The product stops sampling whenever an error occurs irrespective of the stop condition setting.

- **Software**
  The product starts sampling and storing input data to memory immediately after the operation start command is issued.

- **External trigger**
  The product starts waiting for an external control signal as soon as the operation start command is output.
  Sampling and data transfer from memory start when the specified edge (rising edge or falling edge) is input from the external control signal.

- **Event controller output**
  The product starts waiting for an external control signal as soon as the operation start command is output.
  Sampling and data transfer from memory start when the specified event controller output is received.
  Refer to the explanation of the event controller functions or to the driver help for details about the event controller.

Stop Condition

The condition for controlling the stop of sampling can be selected from among the last sampling count, an external trigger, software, or the event controller output abort.

The product stops sampling whenever an error occurs irrespective of the stop condition setting.

- **Last sampling count**
  The product stops sampling after storing input data to memory for the specified number of times of sampling.

- **External trigger**
  The product starts waiting for an external control signal after the specified number of samples have been performed.
  Sampling stops when the specified edge (rising edge or falling edge) is input from the external control signal.
6. Functions

- Software
  Sampling continues indefinitely in this mode. Sampling only stops in response to a software command or an error.

- Event controller output
  Sampling stops when the specified event controller output is received. Refer to the explanation of the event controller functions or to the driver help for details about the event controller.

Event

"Event" works as a function for reporting the occurrence of a certain product state to the application. The following events can be used in combination depending on the specifications and purpose of the application.

- "DA conversion start condition satisfied" event
  This event occurs when the DA conversion start condition is satisfied. The event is nullified when the conversion start condition is “software”.

- "Repeat end" event
  This event occurs whenever a repetition is completed.

- "End of device operation" event
  This event occurs when the entire operation including repetitions is completed.

- "Specified number of output samples complete" event
  This event occurs when the number of output samples specified by software have been completed.

- Sampling clock error event
  This event occurs when conversion stops as an error occurs due to a sampling clock period that is too short.

- DA conversion error event
  This event occurs when conversion stops due to a DA conversion error.

2. Starting/Stopping Operation

Analog output operation is started by a software command (the analog output start command). Similarly, you can stop analog output at any time using a software command (the analog output stop command).
3. Monitoring the Status and Acquiring Data

You can use a software command to check the status of analog output operation and of the output data stored in memory.

Status

The current state of the device can be checked by obtaining the device status.

The following types of device status are available:

- Device operating
  The “device operating” status remains ON, after the execution of the sampling start command until the product completes conversion, aborts operation due to an error, or stops sampling in response to the command.

- Waiting for start trigger
  This status remains ON, after the product starts sampling until the start trigger is input, if the conversion start condition is an external trigger or an event controller output. The status is set to OFF when the input trigger is input to start conversion.
  The status is set to ON whenever the product enters the conversion start wait status even when repeated operation has been set.

- Specified number of data outputs
  This status turns ON when the output data set in memory has reached a predefined number of samples.

- Sampling clock error
  This error occurs when the sampling clock period is too short.

- DA conversion error
  If the “device operating” status remains ON (without terminating conversion) for an extended period of time, the driver regards that state as an operation error and sets this status to ON. This error stops sampling.

Sampling

The number of sampled items of output data transferred from in memory can be obtained by the software command.

This command can only be used in device buffer mode.

Repeat

The current repeat count can be obtained by the software command.

This command can only be used in device buffer mode.
4. Reset

Various states can be reset by executing the following reset commands:

Status
This command resets the sampling clock error status and AD conversion error status.

Memory
This can only be used when the transfer mode is set to device buffer mode.

This command resets the following memory related states:
- Resets the conversion data in memory.
- Resets the repeat count to 0.
- Resets the sampling count to 0 when a stop trigger is input.
- Resets the status information for the specified data save count.
Counter Function

1. Setting the Operating Conditions

This specifies the conditions for counter operation.

Operating conditions

The basic operation of the counter is to count an external input signal. The counter includes a function to detect a count match and perform a specified operation when the current count value reaches a preset count value.

Compare count values

The compare count load function automatically loads the next compare count value when a count match occurs.

<table>
<thead>
<tr>
<th>Time of count compare match</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>\ldots</th>
<th>nth</th>
</tr>
</thead>
</table>

The figure above shows an example of using the compare count load function.

After the counter starts, the first count match occurs when the count reaches 1000.

When the count reaches 1000, the counter value at which the second compare count match is to occur (2000) is set.

This continues with the next value from the array being set each time a count match occurs.

After the final value from the array is loaded, operation can start again from the beginning of the array. Alternatively, loading can be halted (in which case, the compare count value remains at 2000).
6. Functions

Preset value
This function loads the next preset value automatically each time a compare count match occurs.

<table>
<thead>
<tr>
<th>Time of count compare match</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>...</th>
<th>nth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cnt[n] Preset value</td>
<td>Cnt[0] = 0</td>
<td>Cnt[1] = 500</td>
<td>Cnt[2] = 1000</td>
<td>...</td>
<td>Cnt[n-1] = 1500</td>
</tr>
</tbody>
</table>

The figure above shows an example of using the preset value load function. In this example, the compare match value is set constant at 2000.

When the counter starts, zero is loaded as the initial preset count.
A compare count match occurs when the count reaches 2000. At this time, 500 is loaded as the next preset value and the count value jumps to 500. This continues with the next value from the array being set each time a count match occurs.

After the final value from the array is loaded, operation can start again from the beginning of the array. Alternatively, loading can be halted (in which case, the preset value remains at 1500).

Input signal
The external clock or event controller output can be selected as the counter input signal.

Digital filter
A digital filter can be used on external input bits.
The filter time can be set to "don't use", 1μs, 128μs, or 16ms by software.

Event
The event function notifies the application when something occurs on the device.
The following events can be used as required.
- Compare count match event
  This event is triggered when a compare match occurs on the counter.
- Count overrun event
  This event is triggered when a counter overrun occurs.
- Counter operation error
  This event is triggered when a counter operation error causes the counter to stop.
2. Starting/Stopping Operation/Preset
Starting and stopping the counter and setting the preset values are performed using software commands. Once the counter has started, it can be stopped at any time by a software command. The function for setting the preset values can also be called at any time regardless of whether the counter is running or not.

3. Monitoring the Status and Acquiring Data
Software commands can be used to monitor the device operating status and read counter data. Status monitoring and data acquisition can both be performed while the counter is running.

Status
The current state of the device can be checked by obtaining the device status. The following types of device status are available:
- Counter operating
  The device operating status is ON from the time the operation start command is executed until operation stops due to a stop command or error.
- Compare count match
  The compare count match status turns ON when a count match occurs after the counter is started. The status is turned OFF by the status reset command.
- Overrun
  The overrun status turns ON if another count match occurs when the compare count match status is already ON. The status is turned OFF by the status reset command. Even if the overrun status turns ON, this does not stop the counter.
- Counter operation error
  Execution of driver processing may not be able to keep up if multiple count match events occur within a short time period. In this case, the counter operation error status turns ON and counter operation stops.

Data acquisition
The current count value can be read using a software command.

4. Reset
Various states can be reset by executing the following reset commands:

Counter reset
Resets the counter. This restores the counter to its state after power on.

Status
Resets the compare count match status and overrun status.
Digital Input Function

Input bit
Individual digital input points are called input bits.
When the number of input points of a device is 8, the bits are determined as bit 0 - bit 7.

<table>
<thead>
<tr>
<th>Bit7</th>
<th>Bit6</th>
<th>Bit5</th>
<th>Bit4</th>
<th>Bit3</th>
<th>Bit2</th>
<th>Bit1</th>
<th>Bit0</th>
</tr>
</thead>
</table>

Input in Bits
The state 1 (ON) or 0 (OFF) of each input bit can be obtained by specifying the bit.

Input in Bytes
Individual input bits can be input in byte units.
When the number of input points of the device is 4, the individual input bits are arranged as shown below and the byte data to be input is a value between 0 and 15 depending on the states of the bits.

EX. Input of bit 7 (OFF), bit 6 (ON), bit 5 (OFF), bit 4 (ON), bit 3 (OFF), bit 2 (ON),
    bit 1 (OFF), bit 0 (ON)
    Byte data = 85(55H)

<table>
<thead>
<tr>
<th>Bit7</th>
<th>Bit6</th>
<th>Bit5</th>
<th>Bit4</th>
<th>Bit3</th>
<th>Bit2</th>
<th>Bit1</th>
<th>Bit0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0(OFF)</td>
<td>1(ON)</td>
<td>0(OFF)</td>
<td>1(ON)</td>
<td>0(OFF)</td>
<td>1(ON)</td>
<td>0(OFF)</td>
<td>1(ON)</td>
</tr>
</tbody>
</table>

Digital filter
A digital filter can be used on the input bits.
The filter time can be set to "don't use", 1μs, 128μs, 16ms by software.
Digital Output Function

Output bit
Individual digital output points are called output bits. When the number of output points of a device is 8, the bits are determined as bit 0 - bit 7.

Output in Bits
The state of each output bit can be changed to ON or OFF by specifying the bit and setting it to 1 or 0.

Output in Bytes
Individual output bits can be output in byte units. When the number of output points of the device is 4, the individual output bits are arranged as shown below and byte data to be output is a value between 0 and 15.

Ex. Output of bit 7 (ON), bit 6 (OFF), bit 5 (ON), bit 4 (OFF), bit 3 (ON), bit 2 (OFF), bit 1 (ON) and bit 0 (OFF)
Byte data = 170 (AAH)

<table>
<thead>
<tr>
<th>Bit7</th>
<th>Bit6</th>
<th>Bit5</th>
<th>Bit4</th>
<th>Bit3</th>
<th>Bit2</th>
<th>Bit1</th>
<th>Bit0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Event Controller Function

Overview of the event controller
The event controller is used to determine how the control signals between the various functions are interlinked.
Customizing the way in which the control signals are used allows more advanced operations to be implemented by synchronizing the different functions within a single device and by synchronizing operation between multiple devices.

The arrows in the figure show the flow of control signals.
The main control signals include the operation start signals, operation stop signals, and clock signals.
Example of using the event controller (1)

The following example shows how to configure the event controller to perform analog output synchronized with analog input.

![Diagram of Analog Input and Output with Signal Source and Destination]

First, the conversion start signal for analog input can be configured to be used as the start signal for analog output so that analog input and output start simultaneously.

1. Set the analog input start condition
   This example specifies software activation.

2. Set the analog output start condition
   As the control signal from analog input is used as the start condition, set this as an event controller output.

3. Setting up the event controller
   Setup the event controller.
   The signal destination is the conversion start signal for analog output and the signal source is the analog input software start signal.

⚠️ CAUTION
If the start condition for analog input is set to something other than software activation, the signal source for the event controller must also be specified.

Next, to perform both analog input and output with the same interval, configure so that the clock signal for analog input is used as the clock signal for analog output.

4. Set the clock to use for analog input
   This example specifies the internal clock.

5. Set the clock to use for analog output
   As the control signal from analog input will be used as the clock, set this as an event controller output.

6. Setting up the event controller
   Setup the event controller.
   The signal destination is the sampling clock for analog output and the signal source is the internal clock signal for analog input.
   In this example, conversion is started first for the analog output. Actual analog output does not start until analog input conversion starts.

7. Start conversion
   Start conversion.
Example of using the event controller (2)

The following example shows how to configure the event controller to start analog input when a count match occurs on the counter.

Connect the count match signal from the counter to the conversion start signal for analog input.

1. Set the analog input start condition
   As the control signal from the counter is used as the start condition, set this as an output from the event controller.

2. Setting up the event controller
   Setup the event controller.
   The signal destination is the conversion start signal for analog input and the signal source is the count match signal from the counter.

3. Start operation
   In this example, conversion is first started for analog input. Actual conversion does not start until a count match occurs on the counter.
Example of using the event controller (3)

The following example shows how to count the analog output clock and output the counter count match signal externally each time a specified number of clocks have been input.

1. Set the counter input signal
   As this example uses the analog input clock signal, setup the event controller accordingly.

2. Setting up the event controller
   Setup the event controller.
   The signal destination is the count-up clock signal and the signal source is the internal clock signal for analog output.

3. Start conversion
   Start the counter first, then start analog output.
7. About Hardware

Hardware specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analog input</strong></td>
<td></td>
</tr>
<tr>
<td>Isolated specification</td>
<td>Non-isolated</td>
</tr>
<tr>
<td>Input type</td>
<td>Single-Ended Input or Differential Input</td>
</tr>
<tr>
<td>Number of input channels</td>
<td>32 channels (Single-Ended Input) 16 channels (Differential Input)</td>
</tr>
<tr>
<td>Input range</td>
<td>Bipolar ±10V, ±5V, ±2.5V or Unipolar 0 · +10V, 0 · +5V, 0 · +2.5V</td>
</tr>
<tr>
<td>Absolute max. input voltage</td>
<td>±15V</td>
</tr>
<tr>
<td>Input impedance</td>
<td>1MΩ or more</td>
</tr>
<tr>
<td>Resolution</td>
<td>16bit</td>
</tr>
<tr>
<td>Non-Linearity error</td>
<td>±5LSB</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>2μsec/ch (Max.) *3 [500KSPS]*4</td>
</tr>
<tr>
<td>Buffer memory</td>
<td>128K data FIFO or 128K data RING</td>
</tr>
<tr>
<td>Conversion start trigger</td>
<td>Software, conversion data compare, external trigger, and event controller output etc.,</td>
</tr>
<tr>
<td>Conversion stop trigger</td>
<td>Settings include data save complete, conversion data compare, external trigger, event controller output, and software etc.,</td>
</tr>
<tr>
<td>External start signal</td>
<td>LV TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External stop signal</td>
<td>LV TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External clock signal</td>
<td>LV TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External status output signal</td>
<td>LV TTL level : 2 Sampling clock output</td>
</tr>
<tr>
<td><strong>Analog output</strong></td>
<td></td>
</tr>
<tr>
<td>Isolated specification</td>
<td>Non-isolated</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>2 channels</td>
</tr>
<tr>
<td>Output range</td>
<td>Bipolar ±10V, ±5V, ±2.5V, ±1.25V or Unipolar 0 · +10V, 0 · +5V, 0 · +2.5V</td>
</tr>
<tr>
<td>Absolute max. output current</td>
<td>±5mA</td>
</tr>
<tr>
<td>Output impedance</td>
<td>1Ω or less</td>
</tr>
<tr>
<td>Resolution</td>
<td>16bit</td>
</tr>
<tr>
<td>Non-Linearity error</td>
<td>±3LSB</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>10μsec (Max.) [100KSPS]*4</td>
</tr>
<tr>
<td>Buffer memory</td>
<td>128K data FIFO or 128K data RING</td>
</tr>
<tr>
<td>Conversion start trigger</td>
<td>Software, external trigger, and event controller output etc.,</td>
</tr>
<tr>
<td>Conversion stop trigger</td>
<td>Settings include data save complete, external trigger, event controller output, and software etc.,</td>
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</tr>
<tr>
<td>External stop signal</td>
<td>LV TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External clock signal</td>
<td>LV TTL level (Rising or falling edge can be selected by software)</td>
</tr>
<tr>
<td>External status output signal</td>
<td>LV TTL level : 2 Sampling clock output</td>
</tr>
</tbody>
</table>
Table 7.1. Specification

Item | Specification
---|---
**Digital I/O**
Number of input channels | Non-isolated input 8 channels (LVTTL level positive logic)
Number of output channels | Non-isolated output 8 channels (LVTTL level positive logic)

**Counter**
Number of channels | 2 channels
Counting system | Up count
Max. count | FFFFFFFFh (Binary data, 32 bit)
Number of external inputs | LVTTL level : 2 (Gate/Up) per channel, Gate (High level), Up (Rising edge)
Number of external outputs | LVTTL level : 1 per channel, Count match output (positive logic, pulse output)
Frequency response | 10 MHz (Max.)

**USB**
Bus specification | USB Specification 2.0/1.1 standard
USB transfer rate | 12 Mbps (Full-speed), 480 Mbps (High-speed) \*5
Power supply | Self power \*6
Attached AC adapter (POA200-20-2) | 90 - 264 VAC, 5.0 VDC ±5%, 2.0 A (Max.)
 | Cable length : about 1.5 m, AC Cable length : about 1.5 m

**Common section**
Connector | 96-pin half pitch connector [M (male) type] PCR-96LMD+ [HONDA TSUSHIN KOGYO CO., LTD.] or equivalence to it
Number of terminals used at the same time | 127 terminals (Max.) \*7
Power consumption (Max.) | 5 VDC 1300 mA
Operating condition \*8 | 0 - 50°C, 10 - 90% RH (No condensation)
 | * When using the attached AC adapter POA200-20-2, it is 0 - 40°C
Physical dimensions (mm) | 180(L) x 140(D) x 34(H) (No protrusions)
Weight | 300 g
Attached cable length | USB Cable 1.8 m

\*1: A linearity error approximately 0.1% of full range may occur when operated at 0°C or 50°C ambient temperature.

\*2: At the time of the source use of a signal which built in the high-speed operational amplifier.

\*3: The required time is indicated in the analog to digital translation of one channel. When AD of two or more channels is converted, time of the a few minutes of the channel is necessary.

Conversion time = Number of conversion channels x 2μsec

\*4: SPS = Samplings Per Second. The number of data that can be converted in one second is shown.

\*5: The USB transfer speed depends on the host PC environment used (OS and USB host controller).

\*6: The supplied current is insufficient in the bus power. Please use the attached AC adaptor (POA200-20-2).

\*7: As a USB hub is also counted as one device, you cannot just connect 127 USB terminals.

\*8: To suppress the heating, ensure that there are spaces for ventilation (about 5cm) around this product.
### Table 7.2.  AC adapter environmental condition (environmental specification)

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>90 - 264VAC</td>
</tr>
<tr>
<td>Rated input current</td>
<td>300mA</td>
</tr>
<tr>
<td>Number of frequency</td>
<td>50 - 60Hz</td>
</tr>
<tr>
<td>Rated output voltage</td>
<td>5.0VDC</td>
</tr>
<tr>
<td>Rated output current</td>
<td>2.0A (Max.)</td>
</tr>
<tr>
<td>Dimension (mm)</td>
<td>47.5(W) x 75(D) x 27.3(H) (No protrusions)</td>
</tr>
<tr>
<td>Weight</td>
<td>175g</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>0 - 40 ºC</td>
</tr>
<tr>
<td>Operating humidity</td>
<td>20 - 80%RH (No condensation)</td>
</tr>
<tr>
<td>Life expectancy</td>
<td>4 years at the ambient temperature 40 ºC</td>
</tr>
<tr>
<td></td>
<td>(When 100VAC is input and 1.3A is output)</td>
</tr>
<tr>
<td>Allowable time of short interruption</td>
<td>15ms (Max.) (When 100VAC is input and 1.3A is output) *1</td>
</tr>
<tr>
<td>Floating dust particles</td>
<td>Not to be excessive</td>
</tr>
<tr>
<td>Corrosive gases</td>
<td>None</td>
</tr>
<tr>
<td>Voltage corresponding to the attached AC cable</td>
<td>125VAC 7A</td>
</tr>
</tbody>
</table>

*1 When the short interruption occurs and the defective operation of the equipment is generated, please insert the power supply of the equipment after pulling out it.
Physical dimensions

Figure 7.1. Physical dimensions

Figure 7.2. Physical dimensions of attached AC adapter (POA200-20-2)
Block Diagram

Figure 7.3 is a circuit block diagram of this product.

![Block Diagram](image)

Figure 7.3. Block Diagram
Control Signal Timings

Control Signal Timings for Analog Input

Figures 7.4, 7.5, 7.6, and Table 7.3 show the control signal timings for the analog input function.

External Smapling Clock Input

Conversion start

$t_{DEC}$

Figure 7.4. Timing Chart of External Sampling Clock

External Smapling Start Trigger Input

$t_{SRS}$ \(\rightarrow\) \(t_{HRS}\)

$t_{SFS}$ \(\rightarrow\) \(t_{HFS}\)

Figure 7.5. Timing Chart of Sampling Start Control Signal

External Smapling Stop Trigger Input

$t_{SRP}$ \(\rightarrow\) \(t_{HRP}\)

$t_{SFP}$ \(\rightarrow\) \(t_{HFP}\)

Figure 7.6. Timing Chart of Sampling Stop Control Signal

Table 7.3. Control Signal Timings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Time</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay time from external sampling clock to first A/D start pulse</td>
<td>(t_{DEC})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling start (Rising edge)</td>
<td>(t_{SRS})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling start (Rising edge)</td>
<td>(t_{HRS})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling start (Falling edge)</td>
<td>(t_{SFS})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling start (Falling edge)</td>
<td>(t_{HFS})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling stop (Rising edge)</td>
<td>(t_{SRP})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling stop (Rising edge)</td>
<td>(t_{HRP})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling stop (Falling edge)</td>
<td>(t_{SFP})</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling stop (Falling edge)</td>
<td>(t_{HFP})</td>
<td>100</td>
<td>nsec</td>
</tr>
</tbody>
</table>

⚠️ CAUTION

The times listed in Table 7.3 are for standard operating conditions.
Control Signal Timings for Analog Output

Figures 7.7, 7.8, 7.9 and Table 7.4 show the control signal timings for the analog input function.

![Timing Chart of External Sampling Clock (Analog output)](image1)

**Figure 7.7. Timing Chart of External Sampling Clock (Analog output)**

![Timing Chart of Sampling Start Control Signal](image2)

**Figure 7.8. Timing Chart of Sampling Start Control Signal**

![Timing Chart of Sampling Stop Control Signal](image3)

**Figure 7.9. Timing Chart of Sampling Stop Control Signal**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Time</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay from external sampling clock to actual start</td>
<td>tDEC</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Settling time</td>
<td>tWS</td>
<td>10000</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling start (Rising edge)</td>
<td>tSRS</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling start (Rising edge)</td>
<td>tHRS</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling start (Falling edge)</td>
<td>tSFS</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling start (Falling edge)</td>
<td>tHFS</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling stop (Rising edge)</td>
<td>tSRP</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling stop (Rising edge)</td>
<td>tHSP</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Set up time of sampling stop (Falling edge)</td>
<td>tSFP</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of sampling stop (Falling edge)</td>
<td>tHFP</td>
<td>100</td>
<td>nsec</td>
</tr>
</tbody>
</table>

⚠️ CAUTION

The times listed in Table 7.4 are for standard operating conditions.
Control Signal Timings for Counter

Figures 7.10, 7.11, and Table 7.5 show the control signal timings for the analog input function.

![Timing Chart of Counter Input Signal](image1)

Figure 7.10. Timing Chart of Counter Input Signal

![Timing Chart of Counter Output Signal](image2)

Figure 7.11. Timing Chart of Counter Output Signal (Pulse output)

### Table 7.5. Control Signal Timings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Time</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up time of counter input (Rising edge)</td>
<td>t_{SRC}</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Hold time of counter input (Rising edge)</td>
<td>t_{HRC}</td>
<td>100</td>
<td>nsec</td>
</tr>
<tr>
<td>Pulse width of counter output signal</td>
<td>t_{PSC}</td>
<td>1000</td>
<td>nsec</td>
</tr>
</tbody>
</table>

⚠️ **CAUTION**

The times listed in Table 7.5 are for standard operating conditions.
About Calibration

Although this product is calibrated before shipping, you can use the calibration program to calibrate analog input and output yourself.

Starting the calibration program

Click the [Calibration] button on the property page for the device to start the calibration program.

Proced with connecting the calibration equipment and performing the calibration in accordance with the instructions displayed by the calibration program.

Analog input calibration

Analog input calibration requires a reference voltage generator.
As the analog input has 16bit resolution, use a reference voltage generator with a precision of at least 5 digits after the decimal point.
Calibrate one channel only for each range that you use.

Analog output calibration

Analog output calibration requires a digital multimeter.
As the analog output has 16bit resolution, use a multimeter with a precision of at least 5 digits after the decimal point.
Calibrate each channel separately for each range that you use.

Factory setting

You can use the calibration program to restore the factory calibration settings.

If for some reason you are unable to achieve the rated accuracy, please contact the CONTEC information center.
### Difference from AIO-163202F-PE, ADA16-32/2(PCI)F and ADA16-32/2(CB)F

#### Table 7.6.  Difference from AIO-163202F-PE, ADA16-32/2(PCI)F and ADA16-32/2(CB)F

<table>
<thead>
<tr>
<th>Item</th>
<th>AIO-163202FX-USB</th>
<th>AIO-163202F-PE</th>
<th>ADA16-32/2(CB)F</th>
<th>ADA16-32/2(PCI)F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analog input</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffer memory</td>
<td>128K data FIFO or 128K data RING</td>
<td>64K data FIFO or 64K data RING</td>
<td>64K data FIFO or 64K data RING</td>
<td></td>
</tr>
<tr>
<td>External start</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>TTL level</td>
</tr>
<tr>
<td>signal,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>signal,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External clock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>signal</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>TTL level</td>
</tr>
<tr>
<td><strong>Analog output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffer memory</td>
<td>128K data FIFO or 128K data RING</td>
<td>64K data FIFO or 64K data RING</td>
<td>64K data FIFO or 64K data RING</td>
<td></td>
</tr>
<tr>
<td>External start</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>TTL level</td>
</tr>
<tr>
<td>signal,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>signal,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External clock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>signal</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>LVTTL level</td>
<td>TTL level</td>
</tr>
<tr>
<td><strong>Digital I/O</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of input</td>
<td>Non-isolated input 8 channels (LVTTL level positive logic)</td>
<td>Non-isolated input 4 channels (LVTTL level positive logic)</td>
<td>Non-isolated input 8 channels (TT level positive logic)</td>
<td></td>
</tr>
<tr>
<td>channels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of output</td>
<td>Non-isolated output 8 channels (LVTTL level positive logic)</td>
<td>Non-isolated output 4 channels (LVTTL level positive logic)</td>
<td>Non-isolated output 8 channels (TTL level positive logic)</td>
<td></td>
</tr>
<tr>
<td>channels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Counter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of channels</td>
<td>2 channels</td>
<td>1 channel</td>
<td>2 channels</td>
<td></td>
</tr>
<tr>
<td>Number of external inputs</td>
<td>LVTTL level</td>
<td></td>
<td>TTL level</td>
<td></td>
</tr>
<tr>
<td>Number of external outputs</td>
<td>LVTTL level</td>
<td></td>
<td>TTL level</td>
<td></td>
</tr>
<tr>
<td><strong>Bus master</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>transfer function</td>
<td>None</td>
<td>Have</td>
<td>None</td>
<td>Have</td>
</tr>
<tr>
<td><strong>Sync signal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>None</td>
<td>Have</td>
<td>None</td>
<td>Have</td>
</tr>
<tr>
<td>connectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Connector</strong></td>
<td>96-pin half pitch connector [M (male) type]</td>
<td>68-pin 0.6mm-pitch connector [F (female) type] *1</td>
<td>96-pin half pitch connector [M (male) type]</td>
<td></td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Max.)</td>
<td>5VDC 1300mA</td>
<td>3.3VDC 500mA, 12VDC 300mA</td>
<td>3.3VDC 600mA</td>
<td>5VDC 1100mA</td>
</tr>
<tr>
<td><strong>Bus specification</strong></td>
<td>USB Specification 2.0/1.1 standard</td>
<td>PCI Express Base Specification Rev. 1.0a x1</td>
<td>PC Card Standard Card Bus</td>
<td>PCIE(32bit, 33MHz, Universal key shapes supported)</td>
</tr>
<tr>
<td><strong>Physical dimensions (mm)</strong></td>
<td>180(L) x 140(D) x 34(H) (No protrusions)</td>
<td>169.33(L) x 110.18(H)</td>
<td>85.6(W) x 54.9(D) x 5.0(H) TYPE II</td>
<td>176.41(L) x 105.68(H) TYPE II</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>300g</td>
<td>140g</td>
<td>80g</td>
<td>130g</td>
</tr>
</tbody>
</table>

*1: When you use the optional connector conversion cable ADC-68M/96F, connector is 96-pin half pitch connector [M (male) type].